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PROCEEDINGS OF THE AMERICAN BURN ASSOCIATION



44th Annual Meeting
Tuesday **through** Friday
April 24-27, 2012

Washington State Convention Center
Seattle, Washington

BRING THIS PROGRAM BOOK TO THE MEETING



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Nicole S. Gibran, MD, FACS

Proceedings of the American Burn Association

44th Annual Meeting

Tuesday through Friday

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Seattle, Washington**

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To be presented before the Presidential Address on Wednesday, April 25th

Harvey Stuart Allen
Distinguished Service Award

in memory of

Gary F. Purdue, MD, FACS
Dallas, TX

Curtis P. Artz
Distinguished Service Award

presented to

Patricia W. Gillespie, RN, BSN, MS
Longmont, CO

Burn Prevention Award

presented to

Judith S. Okulitch, MS
Portland, OR

General Information

The annual meeting is exciting and fulfilling, however, it can be overwhelming for those unaccustomed to navigating the multitude of education offerings. Here are a few helpful hints to make the meeting a more meaningful experience.

This Program Book is the printed proceedings of the annual meeting. It is mailed to all ABA members about one month prior to the meeting, providing attendees with the opportunity to familiarize themselves with the event information.

The white pages banded with red contain the names and locations of various elected and appointed officers and committee members, a summary of the program, and more detailed information about some of the highlights of the program, including date, time, topic and site of the various presentations. Included in the summary are the Correlative Sessions, complete with the abstracts to be presented, the moderators and their respective locations. For easy reference, a program time grid of the various sessions can be found on the back cover of this volume.

The staggered, gray-banded sections delineate the abstracts presented on Wednesday, Thursday, and Friday, respectively. The actual abstracts accepted for publication are reproduced, two to a page, in these gray sections. The last gray section is devoted to abstracts describing the posters.

The final section of this book contains the author index, a listing of names of the exhibitors and reproduced floor plans of this meeting facility.

The ABA is a multi-disciplinary association and the program content is designed to provide all members with activities within their scope of practice, knowledge level and interest.

The **Educational Symposium** is presented on the day preceding the first correlative sessions. The Symposium topics are rotated through a cycle of several years and are designed to provide basic information for the novice burn care provider. There is an additional fee for participation and you must register to attend.

The **Sunrise Symposia** are offered on Wednesday and Thursday mornings and the Luncheon Symposia are offered on Friday. A variety of topics are presented within small groups. Moderators guide the discussion following a short introduction to the topic. Your active participation in the discussion is expected. A light meal will be provided and you must register to attend. Be aware that these sessions are very popular and pre-registration may be difficult. However, there are frequently no-shows so space may be available at the door. **New this year, the three most popular Sunrise Symposia on Wednesday and Thursday will be repeated on Friday morning.**

The **Post Graduate Courses** will offer three topics this year. These four-hour courses of advanced instruction are given in two-hour sessions on Wednesday and Thursday afternoons. These courses are designed to provide advanced knowledge to experienced burn care professionals. There is no additional fee for participation in the courses, but pre-registration is required.

Additional educational opportunities will be provided on Friday afternoon, which include: Recap of the Burn Quality Consensus Conference; Improved Care Through Research; International Outreach in Burn Care; and Laser Technology in Treatment of Burns.

Correlative Sessions present new information in the form of short presentations of the abstracts reproduced in this book. Abstract categories run in two-hour increments on Wednesday, Thursday and Friday mornings. Abstracts are loosely grouped into topics, but “room hopping” is expected. The abstracts are generally presented at the quarter hour, so plan the “hops” accordingly. There will be six correlative sessions being presented simultaneously.

Plenary Sessions are where all attendees come together to hear a particular speaker or topic presented. The plenaries are the vehicle used to impart information on topics of broad importance, applicability, and interest.

CME Accreditation and Credit

The American Burn Association is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians. The American Burn Association takes responsibility for the content, quality, and scientific integrity of this CME activity.

The American Burn Association designates this educational activity for a maximum of 31.5 *AMA PRA Category 1 Credit(s)*[™]. Physicians should only claim credit commensurate with the extent of their participation in the activity.

AACN Credit

This program will offer accreditation for nurses. Information will be available at a later date.

CDR Credit

The American Burn Association has applied for approved credit for up to a maximum of 28 CPE Category II and III contact hour through the Commission on Dietetic Registration, depending on attendance at the various educational sessions offered.

Further information and CEU statements are available at the Registration Desk.

Speaker Ready Room

The Speaker Ready Room is located in Room 601. As in previous years, all presenters must use LCDs. Please remember to check into the Speaker Ready Room the day before your presentation.

Your presentation will be entered onto a “common” disc by the technician. Please make sure your presentation is in its final form as once “burned” onto the common disc, no changes can be made. Also, please note that you do not need to bring your computer into your session.

The Speaker Ready Room will be open during the following hours and staffed with a technician to assist with any questions.

Monday	April 23	12:00 pm - 4:00 pm
Tuesday	April 24	8:00 am - 5:00 pm
Wednesday	April 25	7:00 am - 5:00 pm
Thursday	April 26	7:00 am - 5:00 pm
Friday	April 27	7:00 am - 2:00 pm

Publication of your manuscript in the *Journal of Burn Care & Research*, the official publication of the American Burn Association, is expected. Manuscripts should be prepared according to the format specified by the *Journal*, and must be submitted online through the *Journal's* website at <https://www.editorialmanager.com/jbcr/>. **All manuscripts submitted from the meeting will receive priority review and early publication in the *Journal*.**

Registration Information for future meetings can be obtained from the ABA's Central Office:

American Burn Association
311 S. Wacker Dr., Suite 4150
Chicago, IL 60606
(312) 642-9260
(312) 642-9130 FAX
www.ameriburn.org
info@ameriburn.org

Future ABA Meetings

April 23 – 26, 2013	Palm Springs, California
March 25 – 28, 2014	Boston, Massachusetts
April 21 – 24, 2015	Chicago, Illinois
May 3 – 6, 2016	Las Vegas, Nevada
March 21 – 24, 2017	Boston, Massachusetts
April 10 – 13, 2018	Chicago, Illinois
April 9 – 12, 2019	Las Vegas, Nevada

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Jeffrey C. Schneider, MD	2014
Melinda Shetler, OT	2014

Research Committee

Bruce A. Cairns, MD, FACS, Chair	2014
Toni C. Butler, MD	2012
Iris H. Faraklas, CCRN	2012
Celeste C. Finnerty, PhD	2012
Shari Honari, RN, BSN	2012
Carl I. Schulman, MD	2012
Martin G. Schwacha, PhD	2012
Jeffrey W. Shupp, MD	2012
Chenicheri Balakrishnan, MD	2014
Mashkoor A. Choudhry, PhD	2014
Vincent A. Gabriel, MD, MSc, FRCPC	2014
Aziz Ghahary, PhD	2014
Abraham P. Hounq, MD	2014
Elizabeth J. Kovacs, PhD	2014
Gordon K. Lindberg, MD, PhD	2014
Claire Murphy, PharmD	2014
Oscar E. Suman, PhD	2014
Lan Van-Buendia, MS, OTR/L	2014
Rhonda L. Williams, RN, CCRN	2014
Yong Ming Yu, MD, PhD	2014

Verification Committee

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Nicole S. Gibran, MD, FACS, Vice Chair	2012
Michael D. Peck, MD, ScD, FACS	2012
Reginald L. Richard, PT, MS	2012
Wendy L. Wahl, MD, FACS	2012
Richard J. Kagan, MD, FACS	2013
Rajiv Sood, MD, FACS	2013
David M. Heimbach, MD, FACS	2015
Steven E. Wolf, MD, FACS	2015
Charles J. Yowler, MD, FACS	2015
David G. Greenhalgh, MD, FACS	2017
Linwood R. Haith, MD, FACS	2017
Kathy G. Supple, MSN, ACNP, CCRN	2017
Alan R. Dimick, MD, FACS, <i>Senior Member</i>	
John A. Griswold Jr., MD, FACS, <i>Senior Member</i>	

Institutional Advisory Council

Michael D. Peck, MD, ScD, FACS, Chair	2012
Kathleen A. Doherty, RN, BS	2012
Richard J. Kagan, MD, FACS	2012
Ann M. Williamson, RN, PhD	2012
Robert M. Dembicki, RN, MS	2013
Armin A. Rahmadian, MHA	2013
Betty J. Bartleson, RN, BSN, MSN	2014
Ronald Hitzler, BS, MBA	2014

2011-2012 Ad Hoc Committees

Ad Hoc Coding Committee

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David H. Ahrenholz, MD, FACS
Donna J. Cartwright, MPS, RHIA
William L. Hickerson, MD, FACS
James H. Holmes IV, MD, FACS
Pamela A. Howard, MD, FACS
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James Kraatz, MD
Claudette A. Mansour, RN, MPH
Michael D. Peck, MD, ScD, FACS
Lynne C. Yurko, RN, BSN, ME-BC
Karen Zupko, <i>Consultant</i>
Maureen T. Kiley, <i>Staff Liaison</i>
John A. Krichbaum, <i>Staff Liaison</i>

Ad Hoc CME Evaluation Committee

Tina L. Palmieri, MD, FACS, FCCM, Chair
Kathleen A. Hollowed, RN
Robert L. Sheridan, MD, FACS
Kathy G. Supple, MSN, ACNP, CCRN

Ad Hoc Critical Care Burn Fellowship Committee

Nicole S. Gibran, MD, FACS, Chair
David G. Greenhalgh, MD, FACS
G. Patrick Kealey, MD, FACS
Robert L. Sheridan, MD, FACS

Ad Hoc Conflict of Interest Committee

Nicole S. Gibran, MD, FACS, Chair
Steven T. Boyce, PhD
William G. Cioffi Jr., MD, FACS
Kathy G. Supple, MSN, ACNP, CCRN
Ronald G. Tompkins, MD, FACS
Susan M. Browning, MPH, <i>Ex Officio</i>
John A. Krichbaum, JD, <i>Ex Officio</i>

2012 Special Interest Groups

Advanced Practice Registered Nurse/Physician Assistant (formerly Mid Level Providers)

Tuesday, April 24

3:30 pm - 5:30 pm

Room 309

The program will feature guest speaker John Bishop, PA and will discuss APRN/PA coding and billing updates.

Anesthesiology/Respiratory

Tuesday April 24

9:00 am - 12:00 pm

Room 304

This SIG provides a forum for anesthesia providers to share information regarding peri-operative care of burn patients including pain management, critical care and respiratory issues.

Bioengineering/Biophysics

Tuesday, April 24

1:00 pm - 3:00 pm

Room 618

This SIG is a forum for exchange between clinicians and scientists interested in the application of basic physical and engineering science to understanding burn path physiology, development of molecular repair therapeutics and tissue engineering science. The speaker will be Buddy D. Ratner, PhD from University of Washington Engineered Biomaterials (UWEB).

Burn Camp

Monday, April 23

3:00 pm - 7:00 pm

Room 203

Provides a forum on how to foster a partnership with your local burn center to optimize outreach and camper recruitment.

Burn Centers Disaster

Tuesday, April 24

12:30 pm - 2:30 pm

Room 309

This SIG provides a forum for those involved with emergency preparedness to come together and collaborate on various disaster-related issues. Our 2012 agenda features an HSS Regional Emergency Coordinator who will offer ideas about how to improve integrative planning efforts between ABA burn centers and local, regional and federal agencies.

Burn Center Physicians

Tuesday, April 24

3:30 pm - 5:30 pm

Room 620

This session is an informal meeting for physicians and others interested in discussing issues such as burn unit management, physician's role, responsibilities, and reimbursement.

Burn Epidemiology (New)

Monday, April 23

3:00 pm - 5:00 pm

Room 614

The Epidemiology SIG of the ABA provides a forum for exchange between public health and safety professionals, clinicians, and statisticians who are interested in developing a common understanding of the epidemiology of burn and fire injury.

Burn Prevention/Federation of Burn Foundations/IAFFBF

Tuesday, April 24

7:30 am - 11:00 am

Room 607

The Federation of Burn Foundations, ABA Burn Prevention Committee, IAFF Burn Foundation and SafeKids will offer a shared program with keynote speaker Mary Marchone from the National Fire Academy. Other topics will include: "Child Abuse in the Burn Community"; an update on the National FEMA JFS evaluation tool from Dr. Ken Fineman; and "Prevention Potpourri" covering updates on a wide variety of topics.

Burn Registry Users

Tuesday, April 24

8:00 am - 9:00 am

Room 308

Provides an opportunity for all users of the Burn Registry to network with other registry users and ABA leadership of the National Burn Repository. Provides a format for updates of N-TRAC burn module and provides a forum for the exchange of information, problem sharing, and problem solving.

Burn Survivor and Reintegration

Tuesday, April 24

8:00 am - 10:30 am

Room 602

The program will address topics of intimacy, sexuality and the burn survivor with tools available for professionals and survivors.

Canadian

Monday, April 23

7:00 pm - 12:00 am

Metropolitan Room (Sheraton)

The agenda for this year will include guest speakers Dr. Sarvesh Logsetty of International Burn Care presenting "How to Take Modern Burn Care to Developing Countries" and Dr. Redouane Bouali presenting "Interburns: Creating a low income country teaching model". The agenda includes 2 guest speakers and 6 selected papers. The meeting provides an opportunity for attendees to meet and discuss issues that are relevant to burn care in Canada.

Chaplains/Pastoral Caregivers

Monday, April 23

10:30 am - 12:00 pm

Room 306

The discussion will focus on the importance of pastoral care on your burn team and participating in research.

Firefighters

Monday, April 23

9:00 am - 12:00 pm

Room 602

Sacramento Fire Department Assistant Chief Chris Costamagna will give a speech on Liaison Response Teams.

Nursing

Tuesday, April 24

1:00 pm - 4:00 pm

Room 611

This year's program includes guest speaker Dr. Lawrence Gottlieb from the University of Chicago Burn Center. The topic is "What Nurses Need To Know About Reconstruction". Following the main speaker, we will have opportunity for break out sessions by areas of interest such as Nurse Managers, Staff Nurses, Educators, etc.

Nutrition

Tuesday, April 24

1:30 pm - 4:30 pm

Room 614

This SIG fosters interaction among professionals through the exchange of nutrition and metabolism information. Team members include clinical dietitians/nutritionist, nutrition support practitioners, dietetic technicians, researchers, and others with an interest in nutrition support and metabolism.

Occupational Therapy/Physical Therapy (OT/PT)

Tuesday, April 24

8:00 am - 1:00 pm

Room 3A

The OT/PT SIG will focus on the burn rehabilitation of the shoulder complex. Professors from the University of Washington will provide lectures on anatomy, kinesiology and current evidence. Thereafter, breakout groups will facilitate further exploration by providing hands-on learning, problem solving and discussion. Lab attire recommended

Pediatric

Tuesday, April 24

1:00 pm - 3:00 pm

Room 2B

This SIG's multidisciplinary team will address the devastating consequences of pediatric burn injury. Goals include: facilitating communication and cooperation among individuals and centers of excellence in pediatric burn care; establishing sub-committees to review the world's medical literature and practices of care; publishing pediatric-based guidelines and protocols; establishing philanthropic funding and support global initiatives.

Pharmacy

Tuesday, April 24

3:00 pm - 5:00 pm

Room 613

This SIG provides the opportunity for interactions among professionals interested in the pharmaceutical care of the burn patient. This forum allows for open discussion among colleagues on medical management, pharmacokinetics in burn patients, and research opportunities. Additionally, the program will focus on micronutrients in burn injury.

Psychosocial

Tuesday, April 24

12:00 pm - 3:00 pm

Room 602

The Psychosocial SIG is proud to present our keynote speaker Chuck Bombardier, PhD, ABPP from the University of Washington who will be discussing motivational interviewing.

Reconstructive

Tuesday, April 24

10:00 am - 12:00 pm

Room 618

A forum for those interested in surgical care for the burn survivor. The meeting consists of case presentations and discussion by attendees. All are encouraged to submit cases for the PowerPoint presentation to Robert.spence@medstar.net. Advanced submission of cases for presentation is recommended to allow scheduling.

Research

Tuesday, April 24

2:00 pm - 5:00 pm

Room 604

Guest speaker Dr. Lance Price, Director of the Center for Microbiomics and Human Health at the Translational Genomics Research Institute, will be speaking about his grant-funded translational genomic research assessing cutting edge molecular/metagenomic technologies to address the complexities of human infections, both in burn and chronic wound states. Poster presentations will follow Dr. Price's lecture. These presentations were selected from abstracts submitted to the Research SIG for consideration and include all areas of patient care.

Forty-Fourth Annual Meeting Program Summary

Unless noted, all meetings will be held at the Washington State Convention Center

Monday, April 23

6:30 am - 5:00 pm	Registration East Lobby - 6th Floor
7:30 am - 5:00 pm	ABLS Provider Course Redwood Room (Sheraton)
8:00 am - 9:30 am	Burn Registry Committee Room 3B
8:00 am - 3:30 pm	Membership Advisory Committee Room 2A
9:00 am - 12:00 pm	FireFighters SIG Room 602
9:00 am - 5:00 pm	Burn Prevention Committee Room 604
9:30 am - 10:30 am	Ad Hoc Coding Committee Room 308
10:00 am - 11:00 am	Education Committee Room 614
10:00 am - 11:30 am	NBR Committee Room 3B
10:30 am - 12:00 pm	Chaplains/Pastoral Caregivers SIG Room 306
11:30 am - 1:00 pm	MAC/SIG Chair Luncheon Room 607
11:30 am - 1:30 pm	ABLS Provider Luncheon Jefferson (Sheraton)
12:00 pm - 1:30 pm	IAC/Government Affairs Luncheon Room 606
12:00 pm - 2:30 pm	Aftercare Reintegration Committee Room 612
12:00 pm - 4:00 pm	Speaker Ready Room Room 601
12:00 pm - 5:00 pm	ABLS Course Breakouts See Page S18
1:30 pm - 2:30 pm	Bylaws Committee Room 306
2:00 pm - 3:30 pm	Coding Workshop Room 2B
2:30 pm - 4:00 pm	Burn Science Advisory Panel Room 305
3:00 pm - 5:00 pm	Burn Epidemiology SIG Room 614
3:00 pm - 7:00 pm	Burn Camp SIG Room 203
3:30 pm - 5:00 pm	ABLS Advisory Committee Room 309
4:00 pm - 5:30 pm	Verification Committee Room 304
5:00 pm - 8:00 pm	IAFF Business Meeting Room 3B
5:30 pm - 6:30 pm	Ad Hoc Conflict of Interest Committee Room 306
7:00 pm - 12:00 am	Canadian SIG Metropolitan Room (Sheraton)

Tuesday, April 24

7:00 am - 7:00 pm	Registration East Lobby - 6th Floor
7:30 am - 9:30 am	ABLS Instructor Course Lecture Redwood Room (Sheraton)
7:30 am - 11:00 am	Burn Prevention and Federation of Burn Foundations SIG Room 607
8:00 am - 5:00 pm	Speaker Ready Room Room 601
8:00 am - 9:00 am	Burn Registry Users SIG Room 308
8:00 am - 10:30 am	Burn Survivor and Reintegration SIG Room 602
8:00 am - 11:00 am	Organization and Delivery of Burn Care Committee Room 201
8:00 am - 11:00 am	Research Committee Room 617
8:00 am - 1:00 pm	Occupational Therapy/Physical Therapy SIG Room 3A
8:00 am - 4:00 pm	Educational Symposium Room 608
8:00 am - 3:00 pm	Board of Trustees Meeting Room 208
9:00 am - 12:00 pm	Anesthesiology/Respiratory SIG Room 304
9:00 am - 3:00 pm	Poster Set-Up Exhibit Hall - 6th Floor
9:00 am - 5:00 pm	TRACS Workshop Room 303
9:30 am - 11:00 am	International Outreach Committee Room 616
10:00 am - 12:00 pm	Reconstructive SIG Room 618
10:00 am - 1:00 pm	ABLS Course Breakouts See Page S18
11:30 am - 2:00 pm	Board of Trustees/Committee Chair Luncheon Room 2A
12:00 pm - 3:00 pm	Psychosocial SIG Room 602
12:30 pm - 2:30 pm	Burn Center Disaster SIG Room 309
1:00 pm - 3:00 pm	Bioengineering/Biophysics SIG Room 618
1:00 pm - 3:00 pm	Pediatric Burns SIG Room 2B
1:00 pm - 4:00 pm	Burn Prevention Workshop Room 615

Tuesday, April 24 (continued)

1:00 pm - 4:00 pm	Nursing SIG Room 611
1:00 pm - 4:00 pm	SOAR Coordinator Course Room 617
1:30 pm - 3:30 pm	ABLS Coordinator Course Redwood Room (Sheraton)
1:30 pm - 4:30 pm	Nutrition SIG Room 614
2:00 pm - 3:00 pm	Rehabilitation Committee Room 616
2:00 pm - 5:00 pm	Research SIG Room 604
2:30 pm - 3:30 pm	Southern Regional Meeting Room 202
3:00 pm - 4:00 pm	Archives Committee Room 619
3:00 pm - 5:00 pm	Ethical Issues Committee Room 201
3:00 pm - 5:00 pm	Pharmacy SIG Room 613
3:00 pm - 7:00 pm	Exhibits Open/Poster Viewing Exhibit Hall - 6th Floor
3:30 pm - 5:30 pm	Advanced Practice Registered Nurse/Physician Assistant SIG Room 309
3:30 pm - 5:30 pm	Burn Center Physicians SIG Room 620
3:30 pm - 5:30 pm	Rehabilitation Workshop Room 606
5:00 pm - 7:00 pm	Opening Reception Exhibit Hall - 6th Floor

Wednesday, April 25

6:30 am - 6:30 pm	Registration East Lobby - 6th Floor
6:30 am - 6:30 pm	Poster Viewing Exhibit Hall - 6th Floor
6:30 am - 7:45 am	Sunrise Symposia 1-13 See Page S21
7:00 am - 7:45 am	New Member Welcome Breakfast Room 613
7:00 am - 5:00 pm	Speaker Ready Room Room 601
8:00 am - 9:30 am	Opening Ceremony, Awards & Presidential Address 4th Floor
9:30 am - 10:00 am	Coffee with Exhibitors Exhibit Hall - 6th Floor
9:30 am - 1:45 pm	Exhibits Open Exhibit Hall 6th Floor
10:00 am - 12:00 pm	FF I: Wind Driven Fire Room 3A
10:00 am - 12:00 pm	Corr I: Public Health Room 603
10:00 am - 12:00 pm	Corr II: Wounds - Tissue Eng Room 607
10:00 am - 12:00 pm	Corr III: Pain and Comfort Mgmt Room 608
10:00 am - 12:00 pm	Corr IV: Rehabilitation Room 612
10:00 am - 12:00 pm	Corr V: CC - Inhalation Room 615
10:00 am - 12:00 pm	Corr VI: Nutrition/Metab Room 620
12:15 pm - 1:45 pm	Lunch with Exhibitors Exhibit Hall - 6th Floor
12:30 pm - 1:30 pm	Poster Rounds with Professors & Authors Exhibit Hall - 6th Floor
2:00 pm - 4:00 pm	PG A: Re-Integration Room 603
2:00 pm - 4:00 pm	PG B: Difficult Cases Room 607
2:00 pm - 4:00 pm	PG C: Developing Technology Room 608
4:00 pm - 6:30 pm	Exhibits Open Exhibit Hall - 6th Floor
4:15 pm - 5:00 pm	Midwest Regional Meeting Room 304
4:15 pm - 5:45 pm	MCTG Town Hall Meeting Room 612
5:00 pm - 6:30 pm	Wine & Cheese Reception - Posters with Authors Exhibit Hall - 6th Floor

Thursday, April 26

6:30 am - 5:00 pm	Registration East Lobby - 6th Floor
6:30 am - 7:45 am	Sunrise Symposia 14-26 See Page S33
6:30 am - 1:45 pm	Poster Viewing Exhibit Hall - 6th Floor
7:00 am - 5:00 pm	Speaker Ready Room Room 601
8:00 am - 9:30 am	Presidential Plenary 4th Floor
9:30 am - 10:00 am	Coffee with Exhibitors Exhibit Hall - 6th Floor
9:30 am - 1:45 pm	Exhibits Open Exhibit Hall 6th Floor
10:00 am - 12:00 pm	FF II: Injury Awareness Room 3A
10:00 am - 12:00 pm	Corr VII: Epidemiology/Prev Room 620
10:00 am - 12:00 pm	Corr VIII: Wounds - Basic Science Room 612
10:00 am - 12:00 pm	Corr IX: Wounds - Clinical Room 607
10:00 am - 12:00 pm	Corr X: CC - Infection Room 608
10:00 am - 12:00 pm	Corr XI: Psychosocial Room 615
10:00 am - 12:00 pm	Corr XII: Reconstruction Room 603
12:15 pm - 1:45 pm	Lunch with Exhibitors Exhibit Hall - 6th Floor
12:15 pm - 1:45 pm	JBCR Editors Lunch Room 303
12:30 pm - 1:30 pm	Poster Rounds with Professors & Authors Exhibit Hall - 6th Floor
2:00 pm - 4:00 pm	PG A: Re-Integration Room 603
2:00 pm - 4:00 pm	PG B: Difficult Cases Room 607
2:00 pm - 4:00 pm	PG C: Developing Technology Room 608
4:15 pm - 5:30 pm	Changing Places Room 2B
4:15 pm - 5:30 pm	The Year in Review: The Top Journal Publications in 2011 Room 612
4:15 pm - 5:45 pm	Local Burn Tour Harborview Burn Unit

Friday, April 27

6:30 am - 7:45 am	Repeat of Three Most Popular Sunrise Symposia Room 204, 205, 206
6:30 am - 7:45 am	Best in Category Poster Presentations Room 605
7:00 am - 4:30 pm	Registration East Lobby - 6th Floor
7:00 am - 2:00 pm	Speaker Ready Room Room 601
8:00 am - 9:30 am	Plenary I: Disaster Management Ballroom 6C
8:00 am - 9:30 am	Plenary II: Return to Work Ballroom 6A
9:30 am - 10:00 am	Coffee Break Exhibit Hall - 6th Floor
10:00 am - 12:00 pm	FF III: Sprinklers Room 3A
10:00 am - 12:00 pm	Corr XIII: CC - Resuscitation Room 607
10:00 am - 12:00 pm	Corr XIV: Immunology Room 603
10:00 am - 12:00 pm	Corr XV: Psychosocial Room 620
10:00 am - 12:00 pm	Corr XVI: Wounds - Clinical Room 608
10:00 am - 12:00 pm	Corr XVII: Rehabilitation Room 615
10:00 am - 12:00 pm	Corr XVIII: QI Room 612
12:15 pm - 1:45 pm	Luncheon Symposia 27-36 See Page S46
12:15 pm - 1:45 pm	Ethics Case Presentation Room 6A
2:00 pm - 4:00 pm	Consensus Conference Room 612
2:00 pm - 4:00 pm	Improved Care Through Research Room 607
2:00 pm - 4:00 pm	International Burn Care Room 608
2:00 pm - 4:00 pm	Laser Technology Room 603
4:15 pm - 5:15 pm	Business Meeting Room 605
7:45 pm - 12:30 am	Annual Banquet 6th Floor

Saturday, April 28

9:00 am - 11:30 am	Board of Trustees Meeting Room 208
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Special Workshop and Forums

ABLS Provider Course (Sheraton Hotel)

Monday, April 23

7:30 am - 5:00 pm

Redwood Room (Sheraton)

The Provider Course provides guidelines in the assessment and management of the burn patient during the first 24 hours.

ABLS Instructor/Coordinator Course (Sheraton Hotel)

Tuesday, April 24

7:30 am - 3:30 pm

Redwood Room (Sheraton)

The Instructor Course is designed to introduce participants to general concepts of teaching and learning and to prepare participants as instructors of the Provider Course.

ABLS Breakouts (All Rooms in the Sheraton Hotel): Ballard Room, Boren Room, Capitol Hill Room, Columbia Room, Greenwood Room, Kirkland Room, Leschi Room, Medina Room, Ravenna Rooms

Coding Workshop

Monday, April 23

2:00 pm - 3:30 pm

Room 2B

This fast-paced and information packed session will help you code and document to optimize revenue and minimize your risk for an audit. We will discuss proper use of the new skin replacement and substitute CPT codes implemented in 2012, burn wound debridement codes, review Evaluation and Management coding as well as when to bill an E&M code and a procedure on the same day. Additionally, a brief overview of ICD-10-CM will be presented demonstrating common burn diagnosis codes using the new code set.

TRACS Workshop

Tuesday, April 24

9:00 am - 5:00 pm

Room 303

The TRACS training workshop will offer a brief Beginner Refresher in the morning, with the remainder of the workshop focusing on the Report Writer feature. Report Writer topics will include the administrative module, navigation and understanding of various types of data elements in the burn registry, analyzing data requests, accessing the Report Writer, using standard reports, creating data table reports, and basic queries.

Burn Prevention Workshop

Tuesday, April 24

1:00 pm - 4:00 pm

Room 615

This workshop will feature an update on the National Scald Prevention Campaign and National Juvenile Firesetter Database. The day will end with an opportunity for attendees to share their success stories.

Rehabilitation Workshop

Etiology and Diagnosis of Common Localized Neuropathies

Tuesday, April 24

3:30 pm - 5:30 pm

Room 606

This workshop is designed to refresh an individual's knowledge of diagnosing particular nerves compromised during the treatment of the burned patient. It shall cover nerve anatomy, muscles innervated, sensory loss, muscle testing, treatment, etiology and prevention. Individuals will participate in groups rotating to assigned faculty demonstrators.

New Member Welcome Breakfast

Wednesday, April 25

7:00 am - 7:45 am

Room 613

If you're a new ABA member attending the Annual Meeting for the first time, please join your colleagues and ABA leadership for breakfast at this informal networking session.

Educational Symposium

Outpatient Care of the Burn Survivor

8:00 am - 4:00 pm

Room 608

Course Description: The Educational Symposium is designed to develop the knowledge base of the new (less than 3 years) burn care provider. The number of patient contacts in the outpatient setting is probably ten times the number of contacts in the inpatient setting on an annual basis. There is a lack of knowledge for all members of the burn team, in particular the new practitioner, regarding issues related to outpatient burn care and transition from inpatient to outpatient.

As a result of attending this session, the learner should be able to: (1) Recognize common challenges faced by patients and families in the outpatient burn care setting and use case management to facilitate the outpatient transition process; (2) Educate patients and families in preparation for discharge from inpatient to outpatient; (3) Describe unique features and options for wound care in outpatient burns; (4) Employ best strategies for the management of pain and itch; (5) Recommend appropriate uses of telemedicine in outpatient burn care; (6) Recognize common challenges in burn therapy of the outpatient; and (7) Understand the needs of burn survivors (both adult and child) for reintegration.

8:00 am - 8:15 am

Welcome and Introduction

Anjay K. Khandelwal, MD
Caran Graves, RD, MS

8:15 am - 8:45 am

Who Can/Should Be Seen in the Outpatient Setting?

Robert C. Cartotto, MD, FRCSC
Stacey M. Loen, RN, BSN, MA, ACNP-BC

8:45 am - 9:30 am

Wound Care in the Outpatient Setting

Hamed Amani, MD
Barbara R. Birmingham, CRNP

9:30 am - 10:00 am

Medication Management in the Outpatient Setting: How Is It Different?

Kendrea M. Muldrew-Jones, PharmD

10:00 am - 10:15 am

Break

10:15 am - 11:10 am

Physical and Occupational Therapy for the Outpatient

Keith Jacobs, PT
Dana Y. Nakamura, OTR/L, CLT, CLMC

11:10 am - 11:30 am

Realistic Nutrition Goals for the Outpatient

Jennifer R. Carter, RD, LD, CNSC

11:30 am - 1:00 pm

Break

1:00 pm - 1:30 pm

Psychosocial Aspects of Outpatient Care

Ruth B. Rimmer, PhD, CLCP

1:30 pm - 2:15 pm

School Re-entry and Vocational Rehabilitation

Sabina Brych, BA
Lisa K. Rindal, MS, OTR/L

2:15 pm - 2:45 pm

Burn Survivors - Life after the Burn Unit

Larissa Hertz

2:45 pm - 3:15 pm

Discharge Planning

Lezli Matthews, RN, BSN

3:15 pm - 4:00 pm

Questions and Answers

Anjay K. Khandelwal, MD

SOAR Coordinator Course

1:00 pm - 4:00 pm Room 617

Speaker: Pam Peterson, RN, BSN

Course Description: Survivors Offering Assistance in Recovery (SOAR) was designed by a national advisory team of health care professionals and burn survivors to provide a structured volunteer peer support program. The program also enables the medical centers to create a pool of motivated and trained peer supporters with a minimum expenditure of staff resources.

As a result of attending this activity, the learner should be able to: (1) Describe the framework for successful program implementation; (2) Identify requirements of the SOAR program; (3) Utilize the resources and materials of the SOAR program; (4) Understand the basic elements of giving feedback and managing conflict; and (5) Understand the role of the national organization.

1:00 pm - 1:15 pm	Introduction
1:15 pm - 2:30 pm	Implementing a Successful Program: Overview and Startup
2:30 pm - 2:45 pm	Break
2:45 pm - 3:05 pm	What Does It Take to Offer a SOAR Program?
3:05 pm - 3:25 pm	What Resources and Materials Are Available?
3:25 pm - 3:45 pm	Effective Communications for Coordinators
3:45 pm - 4:00 pm	Program Evaluation and Forms

Sunrise Symposia

6:30 am - 7:45 am

1. **New Treatments for Scald Burns**
Room 2A
Moderators: Joel S. Fish, MD, MSc, FRCS(C) and Paul Silverstein, MD, FACS
2. **Team Building/Critical Communication Training in the Burn Unit**
Room 2B
Moderators: David T. Harrington, MD and Lezli Matthews, RN, BSN
3. **Quality Improvement for Nursing**
Room 201
Moderators: Carolyn B. Blayney, RN, BSN and Cynthia L. Reigart, RN, BSN
4. **Pain Management for Outpatients**
Room 203
Moderators: Bridget A. Gill, RN, BSN and Kathy G. Supple, MSN, ACNP, CCRN
5. **Novel Approaches to Enteral Nutrition in Burn Patients**
Room 305
Moderators: Maggie L. Dylewski, PhD, RD and Theresa M. Mayes, RD
6. **Rehab Management of Pediatric Hand Burns**
Room 205
Moderators: Karen J. Kowalske, MD and Patricia A. Tufaro, OTR/L
7. **Body Image**
Room 206
Moderators: Barbara Kammerer-Quayle, MA and Jill L. Sproul, RN, MS
8. **Sleep Deprivation in the Burn Patient**
Room 3A
Moderators: James A. Fauerbach, PhD and Philip E. Fidler, MD
9. **Management of Central Lines in Burn Patients**
Room 3B
Moderators: Michael J. Mosier, MD and Joan M. Weber, RN, BSN, CIC
10. **Management of Hypertrophic Scars**
Room 303
Moderators: Raphael C. Lee, MD, FACS, ScD, PhD and Edward E. Tredget, MD, MSc, FRCSC
11. **Assessment and Treatment of Facial Burns**
Room 304
Moderators: Matthias B. Donelan, MD, FACS and Colleen E. Macner, PT, DPT
12. **New Nursing Initiatives**
Room 211
Moderators: Maria L. Serio-Melvin, RN and Sandra J. Yovino, RN
13. **Top Ten List: A Discussion of Ideas or Interventions That Have Made Our Life Easier**
Room 204
Moderators: Christopher W. Lentz, MD, FACS, FCCM and Dixie Reid, PA-C

Wednesday, April 25

Opening Ceremony, Awards Presentation and Presidential Address

8:00 am - 9:30 am

4th Floor

Our Third Leg: We Have Seen It All Before

Presented by

Nicole S. Gibran, MD, FACS

Director, UW Regional Burn Center

Professor, UW Department of Surgery

Harborview Medical Center

Seattle, Washington

As a result of attending this activity, the learner should be able to: (1) Evaluate clinical and scientific conceptions that are the basis for burn heritage; (2) Demonstrate that our scientific discoveries depend on elementary clinical observations at the bedside and on common sense; and (3) Illustrate that our future success depends on synergism and that our joint efforts will be greater than the sum of individual contributions.



Wednesday Correlative Sessions

Correlative Session I: Public Health

10:00 am - 12:00 pm Room 603

Moderators: James C. Jeng, MD, FACS and Peggy S. Simpson, RN

1. Improving Fire and Burn Prevention through Enhanced Community Promotion
2. Too Hot for Tots! Early Childhood Burn and Scald Prevention Program: A Tool for Community Educators
3. Longitudinal Function and Participation Outcomes are Predicted by Satisfaction with Appearance and Perceived Social Exclusion
4. Internet Informational Needs Survey: Burn Injury Population
5. Anatomy of the National Burn Repository
6. Using Monte Carlo Simulation for Modeling Surge Capacity in the ABA Southern Region
7. Burn Center Unit-Specific Disaster Preparedness Plan
8. The Balance Sheet: Understanding Burn Center Finances

Wednesday, April 25

Correlative Session II: Wounds - Tissue Engineering

10:00 am - 12:00 pm Room 607

Moderators: Steven T. Boyce, PhD and John E. Greenwood, MD, FRACS, BSc

9. Functionality of IDO Expressing Allogenic Engineering Skin Composite in a Fibrotic Animal Model
10. Distinct Phenotypes of Deep vs. Superficial Keloid Fibroblasts in Keloid Skin Substitutes Transplanted to Mice
11. A Bilayer Hydrogel with Stem Cells Derived from Debrided Human Burn Tissue for Improved Skin Regeneration
12. Hydrogel Incorporation within a Collagen:GAG Matrix Results in an In Situ Gelling Scaffold with Improved Functionality for the Burn Patient
13. Use of Human Placenta Derived Amniotic Membranes in the Treatment of Partial and Deep Partial Thickness Burns
14. Application of an Acellular Fetal Bovine Dermis for Partial and Full Thickness Burns
15. Is Artificial Dermis an Effective Tool in the Treatment of Tendon-Exposed Wounds?
16. Suprathel® Versus Autologous Split-Thickness Skin in Deep Partial-Thickness Burns: First Long-Term Results

Correlative Session III: Pain and Comfort Management

10:00 am - 12:00 pm Room 608

Moderators: Palmer Q. Bessey, MD, FACS and Shelley A. Wiechman, PhD

17. Pruritus in Adult Burn Survivors: Incidence, Characteristics and Risk Factors
18. Effectiveness of Sedation with Nitrous Oxide versus General Anesthesia for Pediatric Patients Undergoing Cosmetic Laser Therapy
19. Longitudinal Mediation of Pain and PTSD Symptom Clusters
20. The Effects of Virtual Reality Pain Distraction on Voluntary Range of Motion in Adult Burn Patients
21. Combined-Volatile-IV Anesthesia (CVIVA): Effects of a Balanced Anesthetic Infusion in Burn Center Patients
22. Hypnosis Delivered through Immersive Virtual Reality for Wound Care: A Randomized, Controlled Study
23. The Use of Methylnaltrexone in Burn Patients
24. Effectiveness of Emu Oil on Burn Scar

Correlative Session IV: Rehabilitation

10:00 am - 12:00 pm Room 612

Moderators: Debra Reilly Culver, MD, FACS and Phala A. Helm, MD

25. Assessment of Cardiopulmonary Function During Exercise in Severely Burned Pediatric Patients
26. Temperature Regulation Is Impaired in Well-Healed Adult Skin Graft Patients Exercising in the Heat
27. Effects of Early Exercise on the Number of Joint Release Interventions in Children with Severe Burns
28. Study on the Effect of a Well-Planned Rehabilitation on the Outcome of Severe Burn Patients in China
29. Fatigue in Electrical Injury Patients
30. Roles of Positive Coping and Positive Personality Traits in Long Term Physical and Emotional Recovery after Burn Injury
31. A Scoring System for Risk Stratification of Acute Transfers from Inpatient Rehabilitation in the Burn Population
32. Severe Burn and Disuse Effects on Bone Structure and Strength in Rats Over Time

Correlative Session V: Critical Care - Inhalation

10:00 am - 12:00 pm Room 615

Moderators: Stephen E. Morris, MD, FACS and Tam N. Pham, MD

33. Effects of Leukotriene Antagonist Treatment on Pulmonary Function in Ovine Smoke Inhalation Injury
34. Nebulization with Gamma-Tocopherol Ameliorates Acute Lung Injury after Burn and Smoke Inhalation in the Ovine Model
35. Airway Pressure Release Ventilation (APRV) Successfully and Safely Treats Smoke Inhalation Injury
36. A Comparison of Injury Scoring Systems in Predicting Burn Mortality
37. Standardized Bronchoscopy Form for Classification/Progress of Burn Inhalation Injury
38. Is Early Bronchoscopy Helpful in Diagnosing Inhalation Injury?
39. Effects of Pneumonia on Clinical Outcomes in Burned Children with Inhalation Injury
40. Effects of Mechanical Ventilation on Cardiopulmonary Function in Burned Patients with Inhalation Injury

Correlative Session VI: Nutrition/Metabolism

10:00 am - 12:00 pm Room 620

Moderators: Carmelle A. Cooper, BSc, RD and Steven E. Wolf, MD, FACS

41. Essential Roles for ACVR2B and its Ligands in Burn Injury Survival and Muscle Wasting
42. Long Term Characterization of Muscle Protein Synthesis in Pediatric Burns
43. Evaluation of Glucagon-Like Polypeptide-1 (GLP-1) Effect in Burn Injury by Intragastric Glucose Tolerance Test (IGGTT)
44. Measures of Total Energy Expenditure and Its Components Using the Doubly Labeled Water Method in Rehabilitating Burn Children
45. Oral Administration of Propranolol Diminishes Extremity Blood Flow in Pediatric Burned Patients
46. Long-Term Followup Fracture Incidence in Children Receiving Vitamin D Supplementation During the Acute Phase Postburn
47. The Impact of Chronic Hyperglycemia on Glycemic Control and Clinical Outcomes Post-Burn Injury
48. The Utility of Hemoglobin A1c in Glycemic Management of Burn Patients

Firefighter Course I

Modern Fire Environment and the Impact of Horizontal Ventilation

10:00 am - 12:00 pm Room 3A

Moderator: Ron Schreiber, FF

Course Description: Discussion will be on how current in home products impact the fuel load and establish the modern day fire firefighters encounter during operations. In addition there will be discussion on how traditional ventilation practices impact the fire environment and if traditional tactics need to be addressed and/or revised.

Speakers: Lt. John Ceriello, FF and Battalion Fire Chief George Healy, FF



Postgraduate Course A: Improving Social Re-Integration Outcomes through Empowerment of the Burn Survivor

Wednesday, April 25 and Thursday, April 26

2:00 pm - 4:00 pm Room 603

Course Directors: Amy R. Acton, RN, BSN and Jill L. Sproul, RN, MS

Course Description: Burn care professionals do not regularly address issues such as improving body image, developing social skills and providing peer support with patients. By addressing these issues, the burn survivor is empowered with recovery tools and necessary support to assist with the re-integration process.

As a result of attending this activity, the learner should be able to: (1) Identify, discuss, and apply psychosocial interventions that promote social skill development and social comfort in community re-integration for burn survivors; (2) Define and describe the role of peer support in burn care as an adjunct to the burn team and its use to address body image and social skill development in burn survivor recovery; and (3) Identify resources and action steps to assist with the delivery of compassionate burn care through continued learning and integration of body image, social skills development, and peer support.

Wednesday, April 25

2:00 pm - 2:10 pm	Compassionate Care & Psychosocial Considerations Karen L. Badger, PhD, MSW
2:10 pm - 2:25 pm	Addressing Body Image: Clinical Implications Shelley A. Wiechman, PhD
2:25 pm - 2:35 pm	The Burn Survivor's Perspective Kimberly Calman-Holt, BA
2:35 pm - 2:50 pm	The Role of Image Enhancement in Post-Burn Recovery Rebekah R. Allely, OTR Barbara Kammerer-Quayle, MA
2:50 pm - 3:10 pm	Reconstructive Surgery for Body Image Enhancement Robert J. Spence, MD, FACS
3:10 pm - 3:40 pm	Responding to Appearance Expectations of Burn Survivors and Family James A. Bosch, MA Bernadette D. Martinez-Wright, MSW, LCSW
3:40 pm - 3:50 pm	Addressing and Integrating Body Image into Burn Care Jill L. Sproul, RN, MS
3:50 pm - 4:00 pm	Questions and Answers

Wednesday, April 25

Thursday, April 26

2:00 pm - 2:10 pm	Enhancing Social Skills to Improve Re-Integration Radha K. Holavanahalli, PhD
2:10 pm - 2:20 pm	Burn Survivors' Experience Phoenix Video
2:20 pm - 2:30 pm	Psychosocial Interventions: Beyond Surviving... Tools for Thriving after a Burn Injury Radha K. Holavanahalli, PhD
2:30 pm - 2:40 pm	Psychosocial Interventions: Web-Based Intervention and Pilot Social Skill Development Modules Amy R. Acton, RN, BSN
2:40 pm - 2:50 pm	Psychosocial Interventions: Group & Peer Forums Elizabeth Dideon Hess, LCSW
2:50 pm - 3:00 pm	Healthcare Professional's Perspective: Role of Social Skill Development in Burn Care Stacy Burke, ACNP-BC, CCRN
3:00 pm - 3:10 pm	Overview of Peer Support Karen L. Badger, PhD, MSW
3:10 pm - 3:25 pm	The Burn Survivor's Perspective Phillip J. Tammaro, FF Anthony S. Gonzalez
3:25 pm - 3:40 pm	Establishing Peer Support Programs: Survivors Offering Assistance in Recovery (SOAR) Pam Peterson, RN, BSN
3:40 pm - 3:50 pm	Role of Peer Support in Burn Care Jill L. Sproul, RN, MS
3:50 pm - 4:00 pm	Questions and Answers

Postgraduate Course B: Difficult Cases, Difficult Decisions Managing Conflicting Priorities on a Multidisciplinary Burn Team

Wednesday April 25 and Thursday April 26

2:00 pm - 4:00 pm Room 607

Course Directors: Leopoldo C. Cancio, MD and Heather A. Shankowsky, RN, CCRP

Course Description: The number of patients with large complicated burn injuries seen at any institution are limited. Because of the complexity of the injuries, these patients require critical care, surgery and rehabilitative care from many members of the multidisciplinary burn team. As a result, burn team members may have difficulty in prioritizing acute and rehabilitation care plans. Additionally, because of the limited amount of evidence-based medicine in this area, expert opinions and experience are used to guide treatment plans.

As a result of attending this activity, the learner will be able to: (1) Understand the potential outcome for the specific type of patient with difficult and complicated injuries and understand the need for specialized centers with dedicated multidisciplinary members.

Wednesday, April 25:

Difficult Resuscitation of 10-Year-Old Girl with Burn (70% TBSA) and Inhalation Injury from a House Fire of Suspicious Origin

2:00 pm - 2:10 pm	Introduction and Case Presentation Leopoldo C. Cancio, MD
2:10 pm - 2:20 pm	Critical Care: What Should We Do When the Patient is Failing Resuscitation? Bruce C. Friedman Sr., MD, FCCP, CNSP, FCCM
2:20 pm - 2:30 pm	Rehabilitation: Do We Begin Therapy Soon Enough? Ingrid S. Parry, MS, PT
2:30 pm - 2:40 pm	Surgery: How Fast and How Soon Should We Excise? Robert L. Sheridan, MD, FACS
2:40 pm - 2:50 pm	Metabolic Support: Are We Doing All We Can? Steven E. Wolf, MD, FACS
2:50 pm - 3:00 pm	Respiratory Therapy: What's the Best Way to Get Patients Off the Ventilator? Ronald P. Mlcat, PhD, RRT
3:00 pm - 3:10 pm	Airway Emergency: How Should We Manage a Lost Airway in the ICU? Christopher V. Maani, MD
3:10 pm - 3:20 pm	Nursing: How Well Do We Do at Managing Potentially Conflicting Priorities on the Burn Team? Paula C. Fillari, BSN, RN, CCRN
3:20 pm - 4:00 pm	Questions and Answers

Thursday, April 26:

Large Electrical Burn of a 28-Year-Old Male with Involvement of the Skull and Bilateral Lower Limbs

2:00 pm - 2:10 pm	Introduction and Case Presentation Edward E. Tredget, MD, MSc, FRCSC
2:10 pm - 2:30 pm	Fluids/ICU Care and Management: Renal Replacement Therapy Robert C. McDermid, MD
2:30 pm - 2:50 pm	Pathophysiology of Electrical Injury Raphael C. Lee, MD, PhD, ScD, FACS
2:50 pm - 3:10 pm	Reconstruction: Lower Limbs Lawrence J. Gottlieb, MD, FACS
3:10 pm - 3:30 pm	Reconstruction: Head and Neck Daniel N. Driscoll, MD, FACS
3:30 pm - 3:50 pm	Neuropsychological Complications and Management Neil H. Pliskin, PhD
3:50 pm - 4:00 pm	Questions and Answers

Postgraduate Course C: Developing Technology

Wednesday April 25 and Thursday April 26

2:00 pm - 4:00 pm Room 608

Course Directors: Tammy L. Coffee, MSN, RN, ACNP and Michael A. Serghiou, OTR, MBA

Course Description: Due to the geographic location of burn centers across North America and overseas, access to burn care may be delayed or unavailable. There is a need to decrease the financial cost associated with outpatient follow-up visits, patient transfer to burn centers for acute care and improved communication among health care providers regarding medical care of burn patients.

As a result of attending this activity, the learner will be able to: (1) Use technological advancements to improve patient outcome; (2) Use technological advancements to collaborate with burn centers to improve patient outcomes; (3) Become familiar with different systems available; and (4) Become familiar with federal and state regulations pertaining to telemedicine.

Wednesday, April 25

2:00 pm - 2:20 pm	Telemedicine- Can You See Me Now? Jeffrey R. Saffle, MD, FACS
2:20 pm - 2:40 pm	Telemedicine Rules, Regulation and Reimbursement Luanna Theurer
2:40 pm - 3:00 pm	Implementing Telemedicine Katrina Brunsman, RN Petra Warner, MD
3:00 pm - 3:30 pm	Use of Telemedicine: Live Demonstration Pablo Rodriguez Sr., MD Michael A. Serghiou, OTR, MBA
3:30 pm - 3:45 pm	Telemedicine: Where Do We Go From Here? Jeffrey R. Saffle, MD, FACS
3:45 pm - 4:00 pm	Questions and Answers

Thursday, April 26

2:00 pm - 2:20 pm	Nanotechnology Anne Hockin, PhD
2:20 pm - 2:40 pm	Computerized Lund Browder Diagram James C. Jeng, MD, FACS
2:40 pm - 3:00 pm	Use of Laser Doppler Imaging in Determining Burn Depth James C. Jeng, MD, FACS
3:00 pm - 3:20 pm	The Use of Computerized Decision Support Software in the Management of Burn Patients Elizabeth A. Mann, RN, PhD
3:20 pm - 3:40 pm	Current Technology for High Thermoplastic Face Mask Fabrication Beth A. Costa, OT
3:40 pm - 4:00 pm	Questions and Answers

Wednesday, April 25

Multi-Center Trials Group Town Hall Meeting

4:15 pm - 5:45 pm

Room 612

4:15 pm - 4:20 pm

Welcome

Jeffrey R. Saffle, MD, FACS

4:20 pm - 4:50 pm

Review of Funded Projects/Progress to Date; Recruiting Subjects - Why You Should Participate

Jeffrey R. Saffle, MD, FACS

Tina L. Palmieri, MD, FACS, FCCM

Susan M. Browning, MPH

4:50 pm - 5:00 pm

Status of Future Projects

Jeffrey R. Saffle, MD, FACS

Susan M. Browning, MPH

5:00 pm - 5:20 pm

New Business

5:20 pm - 5:45 pm

Nominations for Burn Science Advisory Panel

Jeffrey R. Saffle, MD, FACS

Sunrise Symposia

6:30 am - 7:45 am

14. **Assessing Burn Depth with Instruments**
Room 2A
Moderators: Jeffrey S. Guy, MD and James C. Jeng, MD, FACS
15. **Resistant Organisms**
Room 2B
Moderators: Dustin Crumby, RN, BSN and Paula C. Fillari, CCRN
16. **Pain Management: Alternatives to Medication**
Room 201
Moderators: David H. Ahrenholz, MD, FACS and Walter J. Meyer III, MD
17. **Economic Challenges Facing Burn Units**
Room 203
Moderators: Marion H. Jordan, MD, FACS and Richard J. Kagan, MD, FACS
18. **Nutritional Management of the Diabetic Burn Patient**
Room 305
Moderators: Caran Graves, RD, MS and Elizabeth A. Mann, RN, PhD
19. **Prevention of Injuries in the Older Adult**
Room 211
Moderator: Kathleen A. Hollowed, RN and Victor C. Joe, MD
20. **Pain Management in Pediatric Patients**
Room 206
Moderators: Soman S. Sen, MD and Sam R. Sharar, MD
21. **Dealing with Addictions in Burn Patients**
Room 3A
Moderators: Annette F. Matherly, RN, CCRN and Alan W. Young, DO, PM&R
22. **What's Available to Stop the Itch**
Room 3B
Moderators: Gretchen J. Carrougher, RN, MN and Louis R. Pizano, MD, MBA
23. **Management of Amputees**
Room 304
Moderators: Peter C. Esselman, MD, MPT and Michael A. Serghiou, OTR, MBA
24. **Verification**
Room 303
Moderators: Richard L. Gamelli, MD, FACS and David G. Greenhalgh, MD, FACS
25. **Management of 4th Degree Hand Burns**
Room 204
Moderators: Beth A. Costa, OT and Colleen M. Ryan, MD, FACS
26. **Treatment/Wound Care of Diabetic Burn Patients**
Room 205
Moderators: Tammy L. Coffee, MSN, RN, ACNP and Marc G. Jeschke, MD, PhD

Presidential Plenary

International Global Health

8:00 am - 9:30 am 4th Floor

Moderator: Nicole S. Gibran, MD, FACS

Course Description: There is an ongoing need to increase awareness of burns as a global burden of disease and to identify varying NGO models of delivery of care.

As a result of attending this activity, the learner should be able to: (1) Understand the role of burns as part of the global burden of disease; (2) Examine the benefits of reaching out to the International Community to improve the design of burn care in underserved countries; and (3) Analyze the significance of burn injuries as a cause of disability in a developing country.

8:00 am - 8:15 am	Overview/Introduction Nicole S. Gibran, MD, FACS David P. Mackie, MD
8:15 am - 8:35 am	Global Burden of Disease Charlie Mock, MD, PhD, MPH
8:35 am - 8:55 am	Operation Smile Randy Sherman, MD, FACS
8:55 am - 9:15 am	ABA International Outreach Nathan A. Kemalyan, MD, FACS
9:15 am - 9:30 am	Questions and Answers

Thursday, April 26

Thursday Correlative Sessions

Correlative Session VII: Burn Epidemiology/Prevention

10:00 am - 12:00 pm Room 620

Moderators: Janet Cusick-Jost, RN, MS and Ernest J. Grant, RN, BSN, MSN

49. Child Abuse by Burning: Highly Predictive Model for Detection
50. Incidence of Intimate Partner and Family Violence in Adult Burn Victims
51. High-Risk But Not Always Lethal: The Effect of Cirrhosis on Mortality in Thermally Injured Adults
52. A Bilingual Anti-Scald, Fire & Burn Prevention Campaign for Head Start Results in Reduced Pediatric Admissions to a Busy Regional Burn Center
53. Repeated Dissemination of Burn Prevention Information to Students Increases Knowledge Retention
54. Multi-Center Testing of a Burn Prevention Teaching Tool for Amish Children
55. 4,442 Battlefield Burn Injuries: The Magnitude of the Challenge
56. Burn Knowledge Assessment in Zambia

Correlative Session VIII: Wounds - Basic Science

10:00 am - 12:00 pm Room 612

Moderators: Dorothy M. Supp, PhD and Edward E. Tredget, MD, MSc, FRCSC

57. Red Blood Cells Associated 14-3-3 Proteins Function as Anti-Scarring Factors
58. Simvastatin Protects Burn-Injured Hepatocyte from Apoptosis by Suppressing the TNF-alpha/Caspase-3 Signal Pathway
59. Utilization of Molecular Sequencing Methods to Characterize the Microflora of Burn Wounds During Initial Hospital Admission
60. Alternative Erythropoietin Signaling Prevents Sub-Acute Deep Dermal Micro Vascular Thrombosis, Thus Reducing Progressive Ischemia and Necrosis in a Mouse Burn Model
61. The Effects of Rat Mesenchymal Stem Cells on Injury Progression in a Rat Comb Burn Model
62. Quantifying Extent of Thermal Protein Denaturation by MR Imaging
63. Infra-Red Contrast Imaging to Non-Invasively Monitor Burn Injuries in a Porcine Burn Model
64. Molecular and Non-Invasive Imaging Assessment of Donor Site Healing Dynamics

Correlative Session IX: Wounds - Clinical

10:00 am - 12:00 pm Room 607

Moderators: Warren L. Garner, MD, FACS and Colleen M. Ryan, MD, FACS

65. Development of a Novel Smartphone-Based Application for Photographic Burn Wound Monitoring
66. Experience of Using an Electronic Wound Mapping System in a Burn Center
67. Heal or Die: Burn Wound Healing Trajectories and Their Impact on Survival
68. Comparison of Devices for Pressure Ulcer Prophylaxis
69. A Simple Cost Saving Measure: 2.5% Mafenide Acetate Solution
70. Herpes Simplex Virus Type 1 Infection in Burn Patients
71. Improved Wound Management with Minimally Invasive Debridement: Experiences of Four European Burn Centres in Adults and Children with an Enzymatic Debriding Agent
72. Long Term Scarring and Quality of Life in Bromelain Based Enzymatically Debrided Patients: A Controlled Study

Correlative Session X: Critical Care - Infection

10:00 am - 12:00 pm Room 608

Moderators: Amalia Cochran, MD, FACS and Michael A. West, MD, PhD, FACS

73. Pseudomonas aeruginosa Modulates Pulmonary Host-Response and Dissemination through the Transactivator OxyR after a Burn Injury
74. Bacterial Superantigen Virulence Factors Are Detectable in Burn Patients
75. Empiric Gram Negative Antimicrobial Therapy in National and International Pediatric Burn Patients
76. Novel Clinical Parameters to Predict Burn Sepsis Are Superior to American Burn Association Consensus Criteria
77. Parameters for Ordering Blood Culture in Major Burn Injury Patients: Hyperthermia Alone Is Not Adequate
78. Strategies to Eliminate Central Line Associated Bloodstream Infections (CLABSI)
79. Strategies to Eliminate Ventilator Associated Pneumonia (VAP's)
80. Lincosamide Antibiotic Treatment Inhibits Virulence Factor Production in MRSA-Infected Burn Wounds

Correlative Session XI: Psychosocial

10:00 am - 12:00 pm Room 615

Moderators: David R. Patterson, PhD and Ruth B. Rimmer, PhD, CLCP

81. Beyond Burn Camp: Building An Adult-Centered After-Care Program with SOAR (Survivors Offering Assistance in Recovery) Certified Peer Counselors as Mentors
82. "Celebration of Life": A Review of Adult Burn Survivor Annual Reunions
83. Social Exclusion and Appearance Dissatisfaction Effect Psychological and Social Recovery
84. Social Exclusion and Pain Among Severe Burn Survivors
85. Reasons for Distress Among Burn Survivors at Discharge, 6, 12, and 24 Months Post-Discharge
86. Burn-Injured Adolescents Report Gaining Multiple Developmental Benefits and Improved Life Skills as a Result of Burn Camp Attendance
87. Remember Me Program: Bridging the Gap between the Hospital and School
88. The SOAR Program's Impact in a Burn Center

Correlative Session XII: Reconstruction

10:00 am - 12:00 pm Room 603

Moderators: Duncan Nickerson, MD, FRCSC and Robert J. Spence, MD, FACS

89. How Soon is Now? A Systematic Review of Laser and Light-Based Therapies for Hypertrophic Burn Scars and the Need for Robust Clinical Trials to Determine Best Practices
90. Beginning to See the Light: Efficacy of and Patient Satisfaction with Intense Pulsed Light in the Treatment of Burn Scar Dyschromia
91. Assessment of Hair Density and Sub-Epidermal Tissue in Burn Scars Using High Frequency Ultrasound
92. Under Pressure: Elective Peripheral Nerve Decompression after Burn Injury and Comparison of Patients with Electrical Versus Non-Electrical Etiologies
93. Clinical Analysis on Recurrent Marjolin's Ulcer
94. To Release Severe Postburn Contracture of the First Web Space with Reverse Posterior Interosseous Flaps
95. Burn Neck Contracture in Children: The Incidence, Management and the Results
96. Face Transplantation after High Voltage Burns: Functional Recovery at 2.5 Years

Firefighter Course II

Burn Injury Awareness for Fighters

10:00 am - 12:00 pm Room 3A

Moderator: Gerry Adams, FF

Course Description: The course will discuss the associated risks of fire fighting and the design, limitations, and use of protective equipment. There will also be a review of past case studies to determine what has been learned. The importance of receiving proper care for burn injuries will be stressed.

Speakers: Oscar Barrera, FF; Lionel Crowther, FF; Kathleen A. Hollowed, RN; and Jason Woods, FF

Postgraduate Courses

2:00 pm - 4:00 pm

See pages S27-31 for complete outlines of the courses.

Postgraduate Course A: Improving Social Re-Integration Outcomes through Empowerment of the Burn Survivor

Room 603

Postgraduate Course B: Difficult Cases, Difficult Decisions - Managing Conflicting Priorities on a Multidisciplinary Burn Team

Room 607

Postgraduate Course C: Developing Technologies

Room 608

Changing Places

4:15 pm - 5:30 pm

Room 2B

Each and every day, thousands of career and volunteer firefighters place themselves in harm's way in the performance of duty. In spite of advances in firefighter training, personal protective equipment, and tactics, firefighting is still an inherently dangerous profession. Each year, the U.S. averages 100 firefighter fatalities, and around 80,000 firefighters are injured in the line of duty. While we still continue to burn firefighters at an alarming rate, the members of the fire service are seeing a spike in the number of heart and cancer-related illnesses and deaths.

In this year's Changing Places session, we will discuss the occupational hazards that are associated with the fire service. Large-scale fires with flashover or building collapse result in burns or other traumatic injuries that make the evening news. Meanwhile, there are thousands of firefighters each year that suffer from cancer or cardiac-related injuries that go unmentioned or covered by the local or national news media. Please join us as members of the Seattle Firefighter's Local 27 discuss case studies that have affected the men and women of the Seattle Fire Department.

The Year in Review: The Top Burn Journal Publications in 2011

4:15 pm - 5:30 pm

Room 612

Course Description: The editors or key representatives for the *Journal of Burn Care and Research*, *Burns*, the *Journal of the International Society for Burn Injuries and Wound Repair and Regeneration* and *Journal of Trauma* will discuss the top publications in their journals over the past year.

As a result of attending this activity, the learner should be able to: (1) Examine top publications in the *Journal of Burn Care & Research*, *Burns*, *Journal of the International Society for Burn Injuries and Wound Repair and Regeneration*, and *Journal of Trauma*; and (2) Review major advances in published burn research.

4:15 pm - 4:20 pm

Introduction

Tina L. Palmieri, MD, FACS, FCCM

4:20 pm - 4:35 pm

Journal of Burn Care and Research

Richard L. Gamelli, MD, FACS

4:35 pm - 4:50 pm

Burns

Steven E. Wolf, MD, FACS

4:50 pm - 5:05 pm

Journal of the International Society for Burn Injuries and Wound Repair and Regeneration

David G. Greenhalgh, MD, FACS

5:05 pm - 5:20 pm

Journal of Trauma

David T. Harrington, MD

5:20 pm - 5:30 pm

Questions and Answers

Thursday, April 26

Three Most Popular Sunrise Symposia

6:30 am - 7:45 am

New Treatment for Scald Burns

Room 204

Moderators: Joel S. Fish, MD, MSc, FRCS(c) and Paul Silverstein, MD, FACS

Management of 4th Degree Hand Burns

Room 205

Moderators: Beth A. Costa, OT and Colleen M. Ryan, MD, FACS

Pain Management

Room 206

Moderators: Walter J. Meyer III, MD and Soman S. Sen, MD

Best in Category Poster Presentations with Authors

6:30 am - 7:45 am Room 605

Moderator: Tammy L. Coffee, MSN, RN, ACNP

Posters will be judged by the ABA President, Program Committee Chair, Research Committee Chair and Membership Advisory Committee Chair. One poster from each of the 13 categories will be awarded Best in Category. These 13 posters will be presented by the authors in a brief, oral summary. At the conclusion of the session, the judges will award the three top posters of the meeting. These top three posters will be displayed in the registration area for the remainder of the meeting.

Friday Morning Plenary Sessions

Plenary I: Disaster Management

8:00 am - 9:30 am *Ballroom 6C*

Moderator: Sidney F. Miller, MD, FACS

Course Description: There remains a gap in meshing the burn care community and the federal government's response to a mass casualty. Closing this gap will deliver the most positive outcome possible. In this session, a natural disaster scenario affecting Seattle and the Pacific Northwest will be presented and a panel of burn care community leaders and leaders from the federal government will present response scenarios.

As a result of attending this activity, the learner should be able to: (1) Examine the importance of a workable plan to care for burn injuries in a mass casualty event and (2) Understand and interpret an effective hospital, local, state, or nationwide response to mass casualties.

This Session will present existing governmental and private capabilities to respond to mass casualties and what expanded synergies can better prepare all involved for future disasters. Discussion will include transportation of the wounded, surge capacity and regional response.

8:00 am - 9:00 am

Federal Response

RADM Ann R. Knebel, RN, DNSc, FAAN

Burn Care Community Response/Surge Capacity

James C. Jeng, MD, FACS

Regional Washington State Response

Eileen M. Bulger, MD, FACS

Western States Regional Response

Jeffrey R. Saffle, MD, FACS

9:00 am - 9:30 am

Discussion

Plenary II: Return to Work

8:00 am - 9:30 am *Ballroom 6A*

Moderator: Peter C. Esselman, MD, MPT

Course Description: Return to work is an important goal of any rehabilitation program for an individual with a burn injury. There is increasing knowledge regarding barriers to return to work after burn injuries and increased recognition of this issue in the burn community. Despite this increased understanding of the need for vocational services, there are only a few burn centers that provide vocational rehabilitation services. This educational session will review the barriers to return to work and present best practices for vocational rehabilitation services in burn injuries and other diagnostic groups. This educational session will provide information to providers and directors of burn centers regarding vocational rehabilitation services.

As a result of attending this activity, the learner should be able to: (1) Understand the barriers to return to work after burn injury, promote and support return to work activities in their patients; and (2) Understand the role of vocational rehabilitation and what services are available to assist with return to work after a burn injury.

8:00 am - 8:20 am

Barriers to Return to Work after Burn Injuries

Peter C. Esselman, MD, MPT

8:20 am - 8:40 am

Vocational Rehabilitation Systems and Disability Law

Kurt L. Johnson, PhD

8:40 am - 9:00 am

In the Trenches: Getting People Back to Work

Catherine T. Calvert, PhD, CRC

9:00 am - 9:30 am

Burn Survivor Perspective: Panel Discussion

Friday Correlative Sessions

Correlative Session XIII: Critical Care - Resuscitation

10:00 am - 12:00 pm Room 607

Moderators: Matthias Majetschak, PhD and Jeffrey R. Saffle, MD, FACS

- 97. Albumin Rescue: It Just Takes Time
- 98. Albumin Mitigates Renal Injury During the Initial Resuscitation of Large Burns
- 99. Albumin Supplementation Following Burns: Is It Necessary?
- 100. Peri-Operative Hypothermia: An Indicator of Outcomes in Burn Patients
- 101. The Effect of Propranolol on Cardiovascular Parameters Measured by Transpulmonary Thermodilution in Severely Burned Children
- 102. Parecoxib Reduces Systemic Inflammation and Acute Lung Injury in Burned Animals with Delayed Fluid Resuscitation
- 103. Differences in Resuscitation in Morbidly Obese Burn Patients May Contribute to Mortality in this High-Risk Group
- 104. Predicting Outcomes in Severely Burned Children: More Than Body Surface Area Alone

Correlative Session XIV: Immunology

10:00 am - 12:00 pm Room 603

Moderators: Mashkoor A. Choudhry, PhD and Celeste C. Finnerty, PhD

- 105. Immuno-Protective Role of CD4+CD25- Converted to Regulatory T Cells in Allogenic Skin Graft
- 106. Myeloid Suppressor Cells Invade the Burn Wound Site Early after Injury
- 107. Superantigen Virulence Factors in Wound Biopsies and in Kidney Tissue of Animals with Staphylococcus Aureus-Infected Burn Wounds
- 108. Peripheral Blood Mononucleocyte-Derived Erythroid Progenitors and Erythroblasts are Decreased in Burn Patients
- 109. The Impairment of Neutrophil Chemotaxis after Burn in Rats
- 110. Radiation Combined with Thermal Injury: A Role for Myeloid-Derived Suppressor Cells in Chronic Immunosuppression
- 111. Relative Adrenal Insufficiency in Burn Patients
- 112. Use of Recombinant Factor VIIa (rVIIa) in Burn Patient Surgeries

Correlative Session XV: Psychosocial

10:00 am - 12:00 pm Room 620

Moderators: Walter J. Meyer III, MD and Ann G. Cook, MSW, BS, LCSW

113. Comparison of Sleep Parameters Obtained from Actigraphy and Polysomnography during the Rehabilitative Phase Postburn
114. Sleep Disorder: Are Sleep Problems Adding to the Complications of Childhood Burn Injury Survival?
115. Impact of a Nursing-Driven Sleep Hygiene Protocol on Sleep Quality
116. Retrospective Examination of the Effectiveness of Zolpidem for Sleep in Pediatric Burn Patients with a Known History of Attention Deficit/Hyperactivity Disorder
117. Impact of Obesity on Body Image Dissatisfaction and Social Integration Difficulty Among Adolescent and Young Adult Burn Injury Survivors
118. Measuring Depression in Adults and Children with Burn Injuries
119. Does Propranolol Prevent Symptoms of Posttraumatic Stress Disorder (PTSD) in Children with Large Burns?
120. Experiencing the Pediatric Burn Injury from the Parental Point of View

Correlative Session XVI: Wounds - Clinical

10:00 am - 12:00 pm Room 608

Moderators: James H. Holmes IV, MD, FACS and Soman S. Sen, MD

121. Propranolol Reduces Vascularity and Inflammation in Post-Burn Hypertrophic Scars
122. Propranolol Reduces Endoplasmic Reticulum Stress Markers in Skeletal Muscle from Severely Burned Children
123. Evaluation of a Sedation/Analgesia Protocol for Burn Wound Dressing Changes in Pediatric Patients
124. A Model to Investigate Using Adult Human Skin Precursors to Improve Outcomes in Split Thickness Skin Grafts
125. The Vacuum Assisted Closure Device as a Split Thickness Skin Graft Bolster in the Burn Population
126. The Novel Application of a Spatial Frequency Domain Imaging System to Determine Signature Spectral Differences Between Infected and Non-Infected Burn Wounds
127. Prospective Characterization of the Burn Wound Microbiome
128. Cutaneous Barrier Disruption Extends Beyond the Burn

Friday, April 27

Correlative Session XVII: Rehabilitation

10:00 am - 12:00 pm Room 615

Moderators: Peter C. Esselman, MD, MPT and Dana Y. Nakamura, OTR/L, CLT, CLMC

- 129. Acute Burns of the Palm: Is Early Splinting Necessary?
- 130. Burn Splint Prescription and Patient Wear
- 131. Technique for Positioning Foot and Ankle Burns
- 132. Determining the Standards for Treatment of Shoulder/Axillary Burns
- 133. Scar Management of the Face: Does Early Versus Late Intervention Impact Outcome?
- 134. Natural Skin and Burn Scar Biomechanic Investigation
- 135. The Use of a Fibrin Sealant for Securing Skin Grafts to the Hand and Upper Extremity and Its Impact on Outpatient Occupational Therapy
- 136. Effectiveness of the “Road to Recovery” Program Among Outpatients with Burns or Complex Trauma

Correlative Session XVIII: Quality Improvement

10:00 am - 12:00 pm Room 612

Moderators: Nicole S. Gibran, MD, FACS and Marilyn L. Moore, PT

- 137. The Young Adult Outcome Questionnaire
- 138. Improving Patient Satisfaction through the Delivery of Burn Telemedicine Clinics
- 139. A Performance Improvement Initiative to Determine the Impact of Increasing the Time Interval Between Changing Centrally Placed Intravascular Catheters
- 140. Web-Based Burn Rounds: A Quality Care Initiative
- 141. Telemedicine: The Operational Logistics of Developing and Implementing a State-Wide Program
- 142. The Financial Impact of Outpatient Burn Services
- 143. Journal Club Promotes Clinical Research, Continuing Education and Evidence-Based Practice
- 144. Improving Employee Satisfaction: One Burn Center’s Experience

Firefighter Course III

Fire Sprinklers: An Important Life Safety Initiative You Need to Know About

10:00 am - 12:00 pm Room 3A

Moderator: Michael D. Peck, MD, ScD, FACS

Course Description: This course will assist burn care professionals in their efforts to advocate for and speak clearly about the national, state and local efforts to adopt building codes requiring residential fire sprinklers for newly constructed homes. The content will provide information and resources covering: incidence of home fires, science of fire in new construction and how this impacts life safety, myths about fire sprinklers and the role you can play in the state and national efforts now underway.

As a result of attending this session, the learner should be able to: (1) Understand why residential fire sprinklers are a key tool in the reduction of fire loss in our country; (2) List the ways and means by which the learner can become an effective advocate for fire sprinklers in his or her community; and (3) Clearly state the facts about fire sprinklers to counter the myths that opponents use to remove this life safety code from building codes in our communities.

10:00 am - 10:15 am	Personal Stories: The Transformation of Burn Survivors into Sprinkler Advocates Amy R. Acton, RN, BSN
10:15 am - 10:35 am	The Cost of Residential Fires in America Gary Keith
10:35 am - 11:15 am	Science of Fire in Modern Homes and the Impact on Firefighter and the Public's Safety Sean DeCrane, Battalion Chief Ronald J. Siarnicki, FF
11:15 am - 11:30 am	Dispelling the Myths Related to Fire Sprinklers Peg Paul
11:30 am - 11:50 am	Panel Discussion of Fire Sprinkler Activists: Your Role in Fire Sprinkler Advocacy
11:50 am - 12:00 pm	Call to Action Michael D. Peck, MD, ScD, FACS

Friday, April 27

Luncheon Symposia

12:15 pm - 1:45 pm

27. **Electronic Health Record**
Room 2A
Moderators: Leopoldo C. Cancio, MD and Stephen E. Morris, MD, FACS
28. **Global Outreach**
Room 2B
Moderators: Nathan A. Kemalyan, MD, FACS and Barbara A. Latenser, MD, FACS
29. **Getting the Most Out of Rehabilitation**
Room 203
Moderators: Peter C. Esselman, MD, MPT and Karen J. Kowalske, MD
30. **Staffing Ratios and Issues**
Room 204
Moderators: Mary Jo Baryza, PT, MS, PCS and Robert M. Dembicki, RN, MS
31. **Hospital Acquired Infections and Infection Control in the Burn Unit**
Room 205
Moderators: Michael J. Mosier, MD and Grace L. Schmits, RN, MSN
32. **Initiating Tube Feedings in the Critically Ill Burn Patient**
Room 206
Moderators: Amalia Cochran, MD, FACS and Caran Graves, RD, MS
33. **Burn Camp**
Room 211
Moderators: J. Bradley Wiggins, RN, BSN and Jason Woods, FF
34. **Support Groups: Establishing and Maintaining**
Room 201
Moderators: Karen B. Levinson, MSW and Pamela Peterson, RN, BSN
35. **Prevention of Boutonniere Deformities**
Room 303
Moderators: Trudy J. Boulter, OTR, BS, CHT and William L. Hickerson, MD, FACS
36. **Pharmacists in the Burn Unit**
Room 304
Moderators: Karen Lee Brown, PharmD and Claire Murphy, PharmD, BCPS

Ethics Case Presentation: Facial Transplantation - Our Experiences As We Journey Forward

12:15 pm - 1:45 pm Room 6A

Course Description: The understanding of facial transplantation is a new frontier and less than three patients have received this procedure in the United States.

As a result of attending this activity, the learner should be able to: Understand the challenges and lessons learned from initial efforts in facial transplantation - now in its infancy, but with great promise for burn survivors.

Speakers: Jeffrey E. Janis, MD and Bohdan Pomahac, MD

Recap of the Burn Quality Consensus Conference

2:00 pm - 4:00 pm Room 612

Moderator: Nicole S. Gibran, MD, FACS

Course Description: Not all attendees attended the Consensus Conference on February 7, 2012 in Washington, DC. This session will provide an overview of the results of the Consensus Conference. The Consensus Conference defined metrics that can be used to quantify the quality of the care that is delivered and success of interventions. Practitioners have never been able to define quality outcome measures for the following clinical problems: wound healing; nutrition; resuscitation; psychological outcomes; functional outcomes.

As a result of attending this activity, the learner should be able to: (1) Establish best practice for quality metrics; (2) Define quality and patient safety benchmarks; (3) Determine what other organizations are doing to benchmark patient safety; (4) Determine how quality metrics can guide clinical trial outcomes; (5) Determine how quality metrics can be used in ABA/ACS verification process; and (6) Determine how these metrics would influence differential reimbursement.

2:00 pm - 2:30 pm	Introduction/Overview Nicole S. Gibran, MD, FACS
2:30 pm - 2:45 pm	Wound Healing Steven T. Boyce, PhD Adam J. Singer, MD
2:45 pm - 3:00 pm	Nutrition Maggie L. Dylewski, PhD, RD Lucy Wibbenmeyer, MD
3:00 pm - 3:15 pm	Resuscitation Leopoldo C. Cancio, MD Michael J. Mosier, MD
3:15 pm - 3:30 pm	Psychological Outcomes Walter J. Meyer III, MD Shelley A. Wiechman, PhD
3:30 pm - 3:45 pm	Functional Outcomes Matthias B. Donelan, MD, FACS Bernadette Nedelec, PhD, BSc, OT
3:45 pm - 4:00 pm	Questions and Answers

Friday, April 27

Improved Care through Research: Translational (Not Just Laboratory) Research

2:00 pm - 4:00 pm

Room 607

Course Description: The goal of this year's Research Symposium, jointly sponsored by the Research Committee and Research SIG, is to discuss the fundamentals of burn translational research, with a focus on the interface between clinical and basic science research.

As a result of attending this session, the learner should be able to: (1) Understand the fundamental principles of translational research; (2) Understand how the ABA MCTG develops and conducts burn translational research; (3) Become informed about what basic science experts are doing in burn translational research; and (4) Participate in a brainstorming panel discussion on translational research.

2:00 pm - 2:15 pm

Introduction to Translational Research: What Is It and How Is It Different?

Bruce A. Cairns, MD, FACS

Iris H. Faraklas, RN, BS

2:15 pm - 2:30 pm

Translational Research and the ABA Multi-Center Trials Group

Tina L. Palmieri, MD, FACS, FCCM

2:30 pm - 2:45 pm

Translational Science Study Design: Planning, Consent, Implementation

Mary Beth Lawless, MSN, RN

2:45 pm - 3:15 pm

Burn Translational Research and the Basic Science

B. Lynn Allen-Hoffman, PhD

Elizabeth J. Kovacs, PhD

Steven E. Wolf, MD, FACS

3:15 pm - 3:30 pm

Inflammation and the Host Response to Injury Glue Grant: Update and Vision

Bruce A. Cairns, MD, FACS

Celeste C. Finnerty, PhD

3:30 pm - 4:00 pm

Panel Discussion and Brainstorming Session - Ideas and Plans for the Future

Friday, April 27

International Outreach in Burn Care: Focus on our Partners - A User's Guide to North American Organizations Active in Burn Care around the World

2:00 pm - 4:00 pm **Room 608**

Moderator: Nathan A. Kemalyan, MD, FACS

Course Description: North American burn care teams have made remarkable strides in providing burn care that optimizes survival and functional recovery after burn injury. These benefits have not been widely disseminated in the second and third worlds, in spite of the fact that many advances in burn care are accessible to resource-restricted environments. A great opportunity exists to improve burn care world-wide by forming alliances for dissemination of modern burn care practices throughout the world. The American Burn Association is in a unique position to coordinate and carry out international outreach to disseminate modern burn care practices to other countries where basic health care infrastructure exists, but burn care expertise is lacking.

As a result of attending this session, the learner should be able to: (1) Identify one or more upcoming international outreach opportunities in which they may participate in the coming year and (2) Identify the changes that have occurred in burn care due to previous volunteer burn teaching/care trips.

2:00 pm - 2:20 pm	A Brief History of Medical Missions Caran Graves, RD, MS
2:20 pm - 2:40 pm	Burn Care in the Developing World: A Collaborative Approach Mary M. Kwasniewski
2:40 pm - 3:00 pm	Partnering with the American Burn Association: Development of Burn Care Capacity in Developing Countries Carol W. Horvitz
3:00 pm - 3:20 pm	Reflections on Burn Care in Resource-Poor Settings Robert L. Sheridan, MD, FACS
3:20 pm - 3:40 pm	Burn Care in the Developing World: The Leaders Live There (Not in the US, nor Europe, nor ...) Scott Corlew MD, MPH, FACS
3:40 pm - 4:00pm	Essential Burn Management Sarvesh Logsetty, MD

Friday, April 27

Laser Technology in Treatment of Burns

2:00 pm - 4:00 pm

Room 603

Moderator: Matthias B. Donelan, MD, FACS

Course Description: New laser technology is now available for the treatment and rehabilitation of burn scars. Providers need to be aware of available products, use and validity of tools

As a result of attending this session, the learner should be able to: (1) Identify different types of lasers; (2) Understand the application of laser technology; and (3) Accurately assess the technology and allocate resources.

2:00 pm - 2:20 pm

Laser-Tissue Interactions

E. Victor Ross, MD, CAPT MC, USN (ret.)

2:20 pm - 2:40 pm

Pulsed Dye Laser Therapy for Burn Scars: A General Surgeon Can Make It Work

J. Kevin Bailey, MD

2:40 pm - 3:00 pm

Prospective Clinical Application of Laser Light on Hypertrophic Burn Scars: Comparing Different Lasers

Sigrid A. Blome-Eberwein, MD

3:00 pm - 3:20 pm

Carbon Dioxide Fractional and Erbium Fractional Laser Therapy of Burn Scars

Robert J. Spence, MD, FACS

3:20 pm - 3:40 pm

Burn Scar Rehabilitation with Pulsed Dye Laser Therapy and Tension Relief

Matthias B. Donelan, MD, FACS

3:40 pm - 4:00 pm

Questions and Answers

Business Meeting

4:15 pm - 5:15 pm

Room 605

All ABA active members are encouraged to attend the Annual Business Meeting. This meeting provides members an opportunity to be updated on all ABA activities, including committee reports, and to welcome in the new ABA president.

President Nicole S. Gibran, MD, FACS

*cordially invites the attendees of the
2012 Annual Meeting
to an evening celebrating the*

*44th Anniversary of the
American Burn Association
Annual Banquet*

Friday, April 27, 2012

Cocktail Reception

7:00 pm

Dinner

8:00 pm

6th Floor

Washington State Convention Center

Friday, April 27

Poster Sessions

Exhibit Hall - 6th Floor
Abstracts 145-293

Poster Set-Up *Tuesday, April 24* *9:00 am - 3:00 pm*

Poster Viewing *Tuesday, April 24* *3:00 pm - 7:00 pm*

Wednesday, April 25 *6:30 am - 6:30 pm*

Thursday, April 26 *6:30 am - 1:45 pm*

Rounds with Professors and Authors

Wednesday, April 25 *12:30 pm - 1:30 pm*

Reconstruction, Wounds - Clinical, Prevention, Critical Care -
Infection, Rehabilitation, Pain and Comfort Management,
and Quality Improvement

Thursday, April 26 *12:30 pm - 1:30 pm*

Wounds - Basic Science, Public Health, Psychosocial,
Nutrition/Metabolism, Epidemiology, Critical Care -
Inhalation and Resuscitation

Wine & Cheese Reception with Authors

Wednesday, April 25 *5:00 pm - 6:30 pm*

Poster Dismantle

Thursday, April 26 *2:00 pm - 5:00 pm*

Topic: Reconstruction

Moderators: Matthias B. Donelan, MD, FACS and Lawrence J. Gottlieb, MD, FACS

- 145. The Effect of CO2 Fractional Laser (Pixel®) on Hypertrophic Burn Scars
- 146. Combination of Fractional Photothermolysis Laser (Er:Glass) and Fractional CO2 Laser for Burned Face
- 147. Aesthetic Improvement of Burn Scar By Dermabrasion with Dermal Overgraft and Additional Laser Therapy
- 148. Review of Epinephrine Solution Use in 408 Consecutive Cases of Burn Reconstruction
- 149. Reconstruction of Post Burn Ala Defect Using Adiposocutaneous Graft
- 150. Upper Eyelid Ptosis Following Early Repeated Release of Burned Eyelids
- 151. The Use of Transpositional Fasciocutaneous Flap Alias 3/4 FC Z-plasty Technique in Burn Contracture Release
- 152. Salvaging the Knee: The Use of Local, Pedicled, and Free Flaps for Limb Length Preservation

Topic: Wounds - Clinical

Moderators: Sarvesh S. Logsetty, MD and John T. Schulz III, MD, FACS, PhD

153. Characterization of Skin Allograft Use in Thermal Injury
154. Intermediate-Level Disinfection with Accelerated Hydrogen Peroxide Prevents Accumulation of Bacteria during Repeated Daily Debridement of Infected Pork Hock with Versajet
155. Pediatric Toxic Epidermal Necrolysis: Institutional Review and Guideline Development
156. A Case of Argyria and Acute Leukopenia Associated with the Use of an Antimicrobial Soft Silicone Foam Dressing
157. Does Appropriate Preoperative Surgical Antimicrobial Prophylaxis Affect Post Operative Surgical Site Infections in Burn Patients
158. Experience with the Crane Flap for Hand Burn Reconstruction
159. Management of Purpura Fulminans in a Burn Treatment Center
160. Preliminary Report: Chronic Ulcerations and the Incidence of Squamous Cell Carcinoma in Burn Patients
161. Pyoderma Gangrenosum: A Difficult Diagnosis Best Managed in a Burn Treatment Center
162. The Use of a Dermal Regeneration Template in the Reconstruction of Traumatic Soft Tissue Injuries
163. Toxic Epidermal Necrolysis: A 13-Year Retrospective Review
164. Novel Surgical Approach for Axillary Hidradenitis Suppurativa Utilizing a Bilayer Skin Regeneration Template and Thin Split Thickness Skin Grafts: A Retrospective Case Series
165. The Dermis Graft: Another Autologous Option for Acute Burn Wound Coverage
166. Amish Burn Wound (ABW) Ointment and Burdock Leaf Dressings: Assessments of Antimicrobial and Cytotoxic Activities
167. The Use of Microskin Grafts in the Treatment of Massive Burn Patients
168. Triple Drug Therapy: A Novel Alternative in the Management of Burn Wounds of Indeterminate Depth
169. Early Surgery for ALL Pediatric Scalds: Developing a Dermal Preserving Surgical Algorithm for the Benefit of Patients and Health Care Providers
170. Evaluation of Enzymatic Debridement of Deeply Burned Hand: A Prospective Randomized, Controlled Study
171. The Severity of Post-Burn Hypertrophic Scars is Dependent on the Burn Mechanism

Topic: Prevention

Moderators: Annemarie O'Connor, MSN, FNP-BC and Michael D. Peck, MD, ScD, FACS

- 172. Too Hot to Handle: An Examination of Hot Water Temperature and Water Heaters in a Sample of Urban Homes
- 173. Burn Prevention Education for Community Based Family Services Providers: A Pilot Initiative
- 174. Burn Prevention Education for Parents of Low-Income Pre-Schoolers: Results of a Local Initiative
- 175. Full Thickness Burn Injury after Gel/Fuel Firepot Explosion: A Need for Public Awareness
- 176. Instant Noodles: A Significant Cause of Scald Burn Morbidity in All Populations
- 177. Juvenile Firesetters: Are We Contributing to the Problem?
- 178. Napalm for Sale in the Garden Aisle?
- 179. Safe Signals: A Burn Education and Prevention Program for High Functioning Young Adults with ASD

Topic: Critical Care - Infection

Moderators: G. Patrick Kealey, MD, FACS and Joan M. Weber, RN, BSN, CIC

- 180. A Standard, Institution-Wide Approach to Central Lines Facilitates a Low Burn CLBSI Rate
- 181. Trimethoprim-Induced Hyperkalemia (HK) in Burn Admissions Treated with Intravenous or Oral Trimethoprim Sulfamethoxazole (T/S) for Infections - Nature or Nurture?
- 182. Diagnosing Ventilator-Associated Pneumonia in Burn Patients: Endotracheal Aspirates Versus Bronchoalveolar Lavage
- 183. The Impact of Reusable Isolation Gowns on Infection Rates in a Burn Unit: Clean or Contraindicated?
- 184. Impact of Multiple Drug Resistant (MDR) *Acinetobacter baumannii* (AB) on Changes in Antibiotic Susceptibility of *Pseudomonas aeruginosa* (PA) in a Burn Treatment Center
- 185. Decreasing Infection Rates: Is it Ever Enough?
- 186. Case Study: A Rare Fungal Infection in Tornado Victims
- 187. Eradication of *Acinetobacter baumannii* Outbreak at a Burn Centre

Topic: Rehabilitation

Moderators: Bernadette Nedelec, PhD, BSc, OT and Ingrid S. Parry, MS, PT

- 188. Effect of Burn Bandages on Hand Goniometry Measurements
 - 189. Collaborative Approach in the Development and Implementation of Educational Programs on Positioning and Splinting for Patient Optimal Functional Outcomes
 - 190. A Novel Gaming System for Children with Upper Extremity Burn
 - 191. A Comparison of Three 7th Generation Video Game Platforms During Burn Rehabilitation
 - 192. The Use of Low-Load, Prolonged Stretch, Dynamic Splinting To Improve Functional Elbow Range of Motion after Deep Thermal Injury: A Case Report
-

Topic: Pain and Comfort Management

Moderators: Leopoldo C. Cancio, MD and Judy Fabbri, RN

- 193. A Randomized, Multisite Study on Virtual Reality Pain Distraction in Pediatric Burn Patients during Physical Therapy
- 194. Smokers Experience Increased Pain and Itch after Major Thermal Burn Injury
- 195. Improved Donor Site Pain Control after Skin Graft Harvesting Using Ultrasound Guided LFCN (Lateral Femoral Cutaneous Nerve) Block
- 196. Pain Assessment Measures: Review of the Literature with Recommendations for Clinical Use in a Burn Center
- 197. Midazolam as Adjunctive Therapy in the Management of Procedural Pain Associated with Burn Injuries
- 198. Clinical Pathways for Pain, Anxiety, and Delirium in Burns
- 199. Neuropathic Mechanisms in the Pathophysiology of Burns Pruritus: Redefining Directions for Therapy and Research

Topic: Quality Improvement

Moderators: Tammy L. Coffee, MSN, RN, ACNP and Joseph A. Molnar, MD, PhD

- 200. Discharge Phone Calls: Do They Make a Difference?
- 201. Intravenous Warming Catheter Helps Burn Patients Maintain Core Body Temperature During Surgery
- 202. Cellulitis Following Thermal Injury: A Retrospective Review for Quality Improvement
- 203. Application of Lean Six Sigma Techniques to Enhance Burn Center Cost Savings
- 204. The Successful Use of a Bridle: A New Way to Wrangle a Pediatric Nasal Feeding Tube
- 205. Spontaneous Breathing Trial Protocol Experience in Pediatric Burn Patients
- 206. Quality Improvement in Donor Site Management with Mepilex Ag
- 207. Are Cultured Epidermal Autografts Worth the Cost?
- 208. The Positive Effect of Therapy Interventions on the Burn Patient Population
- 209. The Impact of a Warmed Operating Theatre on the Thermal Status of Surgical Personnel
- 210. Simulation in Advanced Burn Life Support: The Way of the Future
- 211. The Accurate Estimation of the Burn Surface Area by Japanese EMTs
- 212. Walking the Walk: Team Steps
- 213. Improving Patient Throughput in the Burn Center: Results of a Pilot Experience
- 214. From Door to Floor (ED to BICU): Timing is Everything...
- 215. Out Patient in a Bed: A Novel Approach to Comprehensive Acute Burn Care Delivery
- 216. A Retrospective Analysis: Perceptions after 56 ABLS Classes (In Four Years)
- 217. Development of an Electronic Acute Kidney Injury Smart Alert System
- 218. Achieving Burn Pediatric Specialty Clinic Designation in a Non Pediatric Hospital
- 219. A Dedicated Student Nurse Extern Program: Effective for Burn Nurse Retention

Topic: Wounds - Basic Science

Moderators: Alexis Armour, MD and David G. Greenhalgh, MD, FACS

- 220. Healing Efficacy of Sea Buckthorn (*Hippophae rhamnoides* L.) Seed Oil on Burn Wounds in Sheep
- 221. Debridement of Burn Eschar Using Bromelain Preparation (DGD)
- 222. Efficacy of Pirfenidone in Post-Dermal Burns Hypertrophic Scars: A Multicenter Experience
- 223. Selectivity of a Bromelain Based Enzymatic Debridement Agent: A Porcine Study
- 224. The Effect of Controlled Mild Hypothermia on Survival in a Resuscitated Rat Model of Large Scald Burns
- 225. Chronological Histological Findings of Cultured Epidermal Autograft over Artificial Dermis Focusing on Basement Membrane Proteins
- 226. Wounds Healing of Partial Thickness Burns with Biological Dressing of Cultured Human Keratinocytes Live (EPIFAST)
- 227. Wound Closure over Integrated Polymer Neo-Dermes Using Cultured Epithelial Autograft and Composite Cultured 'Skin Equivalents'

Topic: Public Health

Moderators: Kathe M. Conlon, RN, BSN, CEM and Barbara A. Latenser, MD, FACS

- 228. Burns Occurring to Rural Older Adults: The Implications of Geography and Access to Care
- 229. The Correlation Between Burn Mortality Rates and Economic Status of Countries
- 230. Feasibility and Accuracy of Photographic Assessment of Thermal Injury: Innovative Approach to Evaluation of Burn Wounds in a Resource-Poor Setting
- 231. Guidelines for the Treatment of Burns on Volunteer Missions
- 232. An Emergency Healthcare Coalition-Based Approach to Burn Mass Casualty Planning
- 233. Outcomes of Burn Patients Transferred by Aircraft
- 234. Survey of Burn Care and Proposal for Burn Center in East Africa: An International Academic Burn Center Exchange

Topic: Psychosocial

Moderators: James A. Fauerbach, PhD and Richard J. Kagan, MD, FACS

- 235. The Effectiveness of Propranolol in Controlling Symptoms of General Anxiety and Depression in Pediatric Burn Survivors
- 236. Effect of Propranolol on Social Anxiety in Youth with Large Burns
- 237. The Utility of Virtual Reality in Minimizing Procedural Distress with Pediatric Burn Patients
- 238. Are Pain and Itching Causing Sleep Disruption in Pediatric Burn Patients?
- 239. Effect of Social Environment on Brain Metabolism after Burn Injury in Rats
- 240. A Novel Initiative to Support Pediatric Burn Survivor Recovery
- 241. Examining Experiences of Support: Making Meaning in a Burn Survivor Support Group
- 242. Self-Silencing Following Burn Injury: Psychological Care Implications
- 243. Self Inflicted Burns: A Systematic Review of the Literature
- 244. The Challenges of Starting a Burn Support Group in a Rural Area
- 245. Stress and Coping in Burn and ICU Nurses
- 246. The Effect of Healing Touch on Sleep Patterns of Pediatric Burn Patients
- 247. The Role of a Dedicated Psychiatrist as Part of the Burn Team

Topic: Nutrition/Metabolism

Moderators: Palmer Q. Bessey, MD, FACS and Michele M. Gottschlich, PhD, RD

- 248. Proteasome Activity in Skeletal and Cardiac Muscle during Burn Induced Hypermetabolism
- 249. The Effects of Metformin and Fenofibrate on Post-Burn Rat Liver
- 250. Effect of Atorvastatin on Metabolic Effects of Thermal Injury
- 251. Body Mass Index and Burn Injury: What Happens after Discharge?
- 252. Initiation of Nutrition within 24 Hours of Admission to Burn Intensive Care Unit
- 253. NPO Times in Pediatric Population Undergoing Anesthesia Procedure: Are We at Best Practice?
- 254. Assessment of Serum Zinc Levels in Critically Ill Burn Patients
- 255. The Predictive Value of Nutritional and Inflammatory Indices in Pressure Ulcer Development in Pediatric Burns
- 256. Impact of Constipation on Critically Ill Burned Adults
- 257. The Impact of Oxandrolone on Length of Stay Following Major Burn Injury: A Clinical Practice Evaluation
- 258. Nutritional Demands in Patients with Toxic Epidermal Necrolysis
- 259. The Safety and Efficacy of Parenteral Nutrition among Pediatric Patients with Burn Injuries
- 260. *Pseudomonas aeruginosa* Infection Following Burn Injury Induces a Systemic Anti-Inflammatory Response
- 261. The Role of Estradiol in Immunomodulation Following Burn Injury

Topic: Epidemiology

Moderators: Kirsten Balding, RN, BSN and B. Daniel Dillard

- 262. Statewide Ban on Recreational Fires Resulted in a Significant Decrease in Campfire Related Summer Burn Center Admissions
- 263. Sustaining Burns from Household Heating Pads: Who Is At Risk?
- 264. Kids At Risk Every Second (KARES): A Review Process of Pediatric Burns to Assess Likelihood of Intentional Injury
- 265. Are Flame and Scald Burns Different in Children?
- 266. Pediatric Burn Survivors from Mexico are Different than Comparable U.S. Survivors
- 267. Impact of Children with Special Needs on Differences in Fire Safety Priorities and Preferred Method for Parent Education
- 268. Nursing Related Articles in the Burn Literature
- 269. A Descriptive Study of Oilfield Burns
- 270. Do Patterns of Grease Burns Differ with Hand Dominance?
- 271. Burn Patients Treated at a Combat Support Hospital in Afghanistan
- 272. Adolescents: Large Children or Small Adults?
- 273. The Hot 100: An Analysis of the Highest Impact Burn Papers in the Last 55 Years
- 274. Incidence and Frequency of Burn Injury in the American Civil War as Compared to Modern Day Conflicts
- 275. Combined Trauma and Burn Injury
- 276. Revisiting Serum Lactate and Base Deficit as Markers for Burn Mortality: Beyond Age, TBSA and Inhalation Injury
- 277. Do Local Burn Center Populations Reflect the Demographic Characteristics of the National Burn Repository?
- 278. Comparison of Scald and Flame Burns: A 17-Year Study
- 279. Comorbidities or Significant Medical History in Firefighters Increases Likelihood of Larger Burn Injuries
- 280. A Longitudinal Burn Outcome Database: Updates on a Multicenter Study
- 281. Ethnicity and Etiology in Burn Trauma

Topic: Critical Care - Inhalation & Resuscitation

Moderators: Robert C. Cartotto, MD, FRCSC and Tina L. Palmieri, MD, FACS, FCCM

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1. Improving Fire and Burn Prevention through Enhanced Community Promotion

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Introduction: Reducing fire deaths has been a goal for the US, as documented in Healthy People 2010 and 2020. Fire department (FD) home visiting programs have had mixed results. The use of community health workers (CHW) to bridge the cultural divide that contributes to disparities in health outcomes has demonstrated success for many diseases; but not fully explored by safety advocates. This presentation examines the effect of community promotion on a smoke alarm distribution program by comparing FD entry rates, program acceptance by residents, and level of complete smoke alarm coverage between study areas.

Methods: Using data from the US Census Bureau and FD, 49 census tracts were assessed on: 1) housing vacancy rates, 2) number of previous FD visits attempted and completed, 3) residential fire rates, 4) percent of dwellings built after 1984, and 5) percent of owner-occupied dwellings. Various combinations of census tracts were considered. Ultimately, 12 (6 Intervention (I) and 6 Control (C)) were selected that had the best match on the above indicators. Between July-December 2009, a survey was conducted in the study area on knowledge, attitudes and practices related to fire & burn safety; data collectors also tested smoke alarms to confirm their status. Between April 2010-2011, the FD visited homes to educate about risks and to install lithium battery alarms in the home. The FD was accompanied by study staff who monitored FD activity. FD visits in the I area were preceded by promotion activities, such as door-to-door canvassing by CHW.

Results: Baseline survey results revealed that study areas were comparable on sociodemographic characteristics, housing factors, and self-reported safety behaviors. I and C homes were also comparable in terms of the proportion who were home (40.2 vs 39.2, $X^2=0.81$, $p\text{-value} < 0.37$) at the time of the FD visit. When residents were home, the FD was more likely to gain entrance into I vs C homes (75% vs. 62%, $X^2=58.84$, $p\text{-value} < 0.0001$). Finally, I vs C homes (83.2 vs 78.6, $X^2=7.41$, $p\text{-value} < 0.0067$) were more likely to be fully protected by lithium battery alarms as a result of the FD visit.

Conclusions: The use of CHW and pre-promotion activities appear to contribute to improvements to a FD's home visiting program. Compared to control homes, Intervention homes were more likely to participate in the program and be fully covered by lithium battery smoke alarms. The extent to which these enhancements can be attributed to the CHW versus the advanced notice will be teased out in future analyses.

Applicability of Research to Practice: Our research results suggest that FD home visiting programs can be enhanced through the use of CHW and pre-promotion activities.

2. Too Hot for Tots! Early Childhood Burn and Scald Prevention Program: A Tool for Community Educators

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Introduction: Approximately 130 children under the age of 5 will be admitted to our Emergency Department this year due to a thermal injury.

The consequences of a childhood burn injury are not only significant physically, but socially and emotionally over both the short and long term.

These injuries often happen because the parent is unaware of the burn hazards in their home and do not take the necessary precautions to modify the home environment, or they incorrectly estimated their child's abilities.

Pediatric thermal injury patterns are predictable and thus preventable. A targeted approach was designed to heighten the public's awareness about this common mechanism of injury.

Methods: The Too Hot for Tots program is an educational resource designed to shift the knowledge, attitudes and practices of parents and caregivers regarding burn injuries to young children in the home.

The target audience for this resource is parents of children under the age of 5 years. This resource includes the following: 1) A professionally produced, evidence based 16 minute video, 2) Take-home brochure and hot tap water temperature testing card with link to view the Too Hot for Tots video on-line 3) Set of 4 posters with the key messages 4) Educator tutorial CD for community nurses.

Results: An Impact Evaluation of this program was conducted with 269 new parents attending post partum groups at community health units to determine if: (1) Viewing the Too Hot for Tots DVD AND receiving the Too Hot for Tots brochure with attached hot tap water temperature testing card and link to view the Too Hot for Tots video on-line, effectively promotes change in parental knowledge, attitudes and practices regarding burn prevention in the home; and (2) To determine if the Too Hot for Tots brochure ALONE with attached hot tap water temperature testing cards and link to view the Too Hot for Tots video on-line is equally effective in promoting change in parental knowledge, attitudes and practices.

Conclusions: The Impact Evaluation has been very positive but due to the scope and externally mandated timelines of this project, results are still being analyzed. Study results will be presented fully at the conference.

Applicability of Research to Practice: Educational initiatives that aim to change behaviour and reduce injury rates need to be evaluated in order to determine: 1) if the education motivated the end user to adopt the prevention strategies recommended and 2) to determine if that behaviour change was sustained over a period of time and resulted in decreased rates for injury admission. Results and challenges will be presented.

3. Longitudinal Function and Participation Outcomes are Predicted by Satisfaction with Appearance and Perceived Social Exclusion

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Introduction: Burns alter appearance, and sometimes patients are dissatisfied. Appearance changes may also decrease comfort in social settings and believe others are uncomfortable with them. As humans, it hurts to be dissatisfied with one's appearance and to feel vulnerable and distanced from others. If others seem uncomfortable, the social pain worsens. We examine whether higher appearance dissatisfaction and perceived social exclusion longitudinally predict poorer function and participation outcomes.

Methods: Participants (n= 623) were adults admitted to regional burn centers with major burn injuries and consented to 2 year outcome study. The mean age was 44 years (SD=16), 73% were male (n=460), the mean %TBSA = 19.5% (SD=17). The Satisfaction With Appearance Scale (SWAP: appearance dissatisfaction, perceived social exclusion). Predictor models used mixed model procedure with continuous variables measuring function (SF-12 Physical Composite Score: PCS; SF-12 Mental Composite Score: MCS), and participation (Community Integration Scale CIQ) outcomes and life satisfaction (Satisfaction With Life: SWL). Binary outcome models (Return To Work: RTW) were determined using the genmod procedure. All analyses were run in SAS 9.2. Covariates were: age, gender, and %TBSA burned.

Results: Item-level changes over time: Over the 2-year study period, there was significantly more agreement that: 1) changes in appearance increased discomfort around friends and strangers, 2) discomfort interfered with relationships, and 3) believing the burn is unattractive to others. They became less satisfied with their overall appearance and their face, neck, and arms.

Results of the mixed models: Parameter estimates and p-values are shown in parentheses for the SWAP models predicting physical composite scores (-0.022, p<0.001), SF-12 mental composite scores (-0.3, p<0.001), community integration questionnaire (-0.2, p<0.001), satisfaction with life (-0.04, p<0.001), and return to work (-0.01, p<0.008).

Higher SWAP scores indicate greater dissatisfaction with appearance and perceived exclusion. Higher SF-12 PCS and MCS scores mean greater health. For both PCS and MCS a decrease in SWAP indicated an increase in PCS and MCS score. Also a decrease in SWAP indicated a higher score for CIQ, and a decrease in SWAP indicated a higher score for SWL. A decrease in SWAP made RTW more likely.

Conclusions: A decrease in appearance dissatisfaction and social exclusion increased physical and psychosocial function, community participation, and likelihood of returning to work.

Applicability of Research to Practice: Early assessment and monitoring of body image and social adjustment may be indicated.

4. Internet Informational Needs Survey: Burn Injury Population

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Introduction: Burn survivors often have complex long-term medical, social, financial and vocational needs that develop after surgical concerns have been addressed. While research exists on general health information needs and information seeking practices, minimal research addresses the unique experience of the burn-injured population. We conducted a survey of Internet use practices in order to better understand how the Internet might provide burn survivors, their friends and family with vital and useful information.

Methods: We developed an anonymous survey that was approved by knowledge translation experts and the University Institutional Review Board. Participation was voluntary and open to all adult burn survivors; parents of burn survivors, and adult friends or relatives who were seen in our regional clinic over a 3-month period.

Results: Three hundred fifty (350) anonymous surveys were received and respondents are characterized in the table. Over 300 respondents (87%) have access to a computer with Internet connection. About half (51.4%; n=180) have looked up burn-related information on the Internet. The most common 'searched fields' were: burn injuries (73%), first aid for burns (52%), photographs of burns (51%), and depth of burn (50%). Of these individuals, 94% found the information always or sometimes helpful. Seventy-one percent found the information always or sometimes frightening or scary. Issues identified as needing more information (regardless of Internet access; n=350) were: burn scars (31%), burn itch (30%), burn pain (28%), moisturizing creams (27%), and burn injuries/depth of burn/first aid for burns/massage for burn scars (all 26%). Neither 'age range' or 'time since injury' had a significant impact on the use of the Internet to gain burn-related information.

Conclusions: Our findings suggest that burn survivors and their families - regardless of age and time since injury - use the Internet to obtain lay information concerning burn injury and treatment. Current information is generally helpful but is perceived as somewhat frightening; additional web-based content on the complications of injury and treatment are needed.

Applicability of Research to Practice: The informational needs identified provide a foundation for further Internet web-site development and education efforts.

Respondent Characteristics

Gender	Male	163 (46.6%)
Age range	18-20	27 (7.7%)
	21-35	159 (45.4%)
	36-50	93 (26.6%)
	Greater than 50	53 (15.1%)
Respondent descriptor	Burn survivor	178 (50.9%)
	Parent of survivor	138 (39.4%)
	Other	21 (6%)
Time since injury	0-7 days	84 (24%)
	8-14 days	90 (25.7%)
	15-28 days	30 (8.6%)
	1-6 months	70 (20%)
	7-12 months	16 (4.6%)
	1-5 years	30 (8.6%)
	Greater than 5 years	18 (5.1%)

5. Anatomy of the National Burn Repository

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Introduction: The National Burn Repository (NBR), with more than 300,000 records supplied by >90 different facilities from 35 different states, has the potential to supply valuable clinical outcomes data to guide future burn therapy. Prior to using the NBR to describe outcomes, it is essential to understand database characteristics and data content. The purpose of this study was to delineate the database characteristics and data content issues that arise in NBR analysis and identify opportunities for improvement of this important resource.

Methods: A deidentified (no institution or patient identifiers) copy of the NBR database (April 27, 2011) was obtained from the American Burn Association as part of a national grant. Database characteristic domains were assessed using the Minimum Mandatory Columns from "Guidelines for the Operation of Burn Centers", 2007. Data content analysis was limited to records entered after the year 2000 with four variables: burn size, gender, age, and survival. Data were analyzed for the following: burn size related fields, admission and discharge year, mortality, and hospital/ventilator length of stay.

Results: A total of 286,293 records with burn-specific data were included in the Main Table data set. The data field types (total of 123 fields) included: 49 numeric fields, 34 character (free text only), 27 character (fixed list choice), 8 date/time, and 5 alphanumeric. Of these, 55,787 had no gender, age, TBSA, or survival data; 89,031 were before 2000; and 2025 had no clear indication of injury, leaving 139,450 for analysis. The most frequent missing variables were description of the event (70%) and the E-code (56%). Analysis of data field content revealed that 7573 records had no burn area identified, 3548 had difference between the entered and calculated partial thickness burn size, 1755 had a difference between entered and calculated full thickness burn, and 9 had burn size >100. A total of 602 records indicate that the patient was discharged alive and dead. Other issues were ventilator and ICU days exceeding hospital days, and year of discharge before year of admission.

Conclusions: The NBR is a potential wealth of information regarding burn injury. However, accurate analysis of the database requires resolution of issues raised by the large number of free text fields, inaccurate/incomplete data entry/conversion, conflicts between different tables in the database, and unclear empty fields. Resolution of these issues can be accomplished by minimizing free text fields, data range checks during data entry, not allowing empty fields, and changing to a web-based, patient data entry format.

Applicability of Research to Practice: Identify limitations in burn database.

6. Using Monte Carlo Simulation for Modeling Surge Capacity in the ABA Southern Region

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Introduction: Medical disasters with significant numbers of burn patients create incredible challenges for medical disaster planners everywhere. Our state has a similar ratio of resources (comparing staffed beds with the state population) as states with similar demographics. States across the our ABA region have worked together to develop a plan should an individual burn center require additional capacity in response to a disaster. This study examined the application of Conventional, Contingency and Crisis Surge Capacity disaster planning thresholds as they relate to actual burn disasters based on historical accounts as well as theoretical patient numbers.

Methods: This work quantified capacity within the state and at the regional level. A stochastic model was developed using Monte Carlo Simulation to quantify the regional capacity. Secondary data from the ABA National Burn Repository are critical to understanding this problem. We used the surge capacity of the burn centers, and the static capacity for the intrastate trauma centers, to manage the initial surge of patients. For contingency surge capacity we examined regional capacities using our model. Patient numbers included five actual burn disasters occurring in the past 20 years and five theoretical patient numbers to better understand where the model could break down.

Results: There are 12 trauma centers with two being co-located with verified burn centers in our state. There are 21 self-identified burn centers less than 900 miles from our state who are included in our ABA region. Using the distribution curve for daily capacity/availability in our state and applying this curve over the data for randomized center capacity/availability gave us a more clear view of the probability of reaching the break points for conventional, contingency and crisis surge capacity in our state and in our region.

Conclusions: Our model confirmed that our state is capable of managing the medical disaster where burn patient numbers are similar to historical burn disasters. Theoretical numbers stressed the system well beyond conventional and contingency surge capacity and gave us as well as our colleagues across the nation a more finite understanding where the breaking point is for burn disaster planning in the US.

Applicability of Research to Practice: The science of medical disaster planning requires that we understand conventional, contingency and crisis surge capacities for burn care resources. Quantitative results give medical disaster planners trigger points for planning to absorb patients, when to transfer patients, and at what point standards of care may not be consistently applied for all patients.

7. Burn Center Unit-Specific Disaster Preparedness Plan

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Introduction: Catastrophic events over the past decade, both man-made and natural disasters, have challenged hospitals to improve their disaster preparedness programs. Burn centers across the country have been confronted with the reality that bed availability for critical burn patients during a disaster is significantly limited. The key to success in caring for large numbers of burn patients in a disaster is dependent on an organization's preparation for such an event. A plan is necessary to assess needs, determine resources, identify strengths, and outline effective communication. Without such preparation, there would likely be increased morbidity and mortality in this burn population.

Methods: A multidisciplinary team collaborated on a plan for unit-specific operations during a burn surge disaster. Utilizing both our State Burn Surge Disaster plan and hospital-specific disaster plan as guides, a clearly defined, burn center unit-specific disaster preparedness plan was designed and tested. This disaster plan will streamline processes by improving communication within the unit and with the hospital's command center. Efficiency of workflow is maximized by more rapid assessment and timely interventions during an influx of critically injured burn patients. Each team member's recognition of their role and tasks in the disaster will also improve communication flow among the team.

Results: Multiple disaster drills to test this plan have demonstrated a continued increase in organization, efficiency and efficacy of work flow, as well as improved communications among the burn team. Debriefing of each drill by this team provided opportunity for revision of the plan to increase its effectiveness in a disaster scenario. Team member recognition of their roles and tasks in a disaster was critical in the success of each drill.

Conclusions: A burn center unit-specific disaster preparedness plan provides instructions for improved patient care during a crisis. The template to be presented offers a complete tool for successful planning and preparation. It provides more effective organization and is readily available for all team members to reference in a disaster situation.

Applicability of Research to Practice: The threat of burn surge disaster is always present. Most health care organizations are prepared for disaster at the system level, but may need assistance at the unit-specific level. The design and implementation of a unit-specific disaster preparedness plan will improve practice in the event of a burn surge disaster. The plan would benefit burn centers nationally and internationally.

8. The Balance Sheet: Understanding Burn Center Finances

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Introduction: Given the number of burn center closures over the past 15 years, it is important that the remaining centers remain financially viable to prevent the loss of more burn beds. With the uncertainty of the future of US health care funding and the potential for significant cuts in disproportionate share funding burn centers must remain vigilant about the impact of our service on hospital revenue. We explored our financial data to understand patient and injury characteristics that impact cost of care and reimbursement.

Methods: We merged patient characteristics from our registry with a hospital financial database based on hospital discharges from July 2006 through June 2010; these data do not include the physician pro fees. We correlated age, burn size (TBSA) and presence of inhalation injury with cost and reimbursement.

Results: We reviewed data on 2684 patients for whom complete data was available in both databases. Patient characteristics are summarized in Table 1. As expected, total cost corresponded significantly with increasing burn size ($p < 0.001$). Multivariate analysis indicates that age, TBSA and inhalation injury were all significantly associated with total costs. However, increasing burn size was inversely correlated with payment ($p < 0.01$). Payor status (Table 2) was associated with different reimbursement rates; interestingly Medicare was not associated with an unfavorable reimbursement rate.

Conclusions: Identifying the factors that contribute to hospital costs and reimbursement is imperative for identifying how burn centers can be proactive about cost containment and resource utilization. An indirect correlation between burn size and reimbursement suggests that decreasing numbers of patients with large burns may also be good for business.

Applicability of Research to Practice: Resource utilization, hospital finances and cost containment are essential elements of understanding health care policy.

Table 1

	Mean or % (sd)
Age	30.4 (22.5)
% male	69.1%
% inhalation Injury	6.25%
TBSA	8.2 (12)
LOS	8.4d (14.2)
ICU LOS	2.6d (9.9)
Total Costs	\$23,777 (\$61,097)
Total payments	\$23,336 (\$66,698)

Table 2

Payor	# patients (% Total)	% Cost Reimbursed
Commercial	1004 (37%)	73%
Medicaid	683 (26%)	48%
Medicare	300 (11%)	92%
Workman's comp	239 (9%)	63%
Self Pay	411 (15%)	5%
Unknown	47 (2%)	30%
Total	2684 (100%)	

9 . Functionality of IDO Expressing Allogenic Engineering Skin Composite in a Fibrotic Animal Model

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Introduction: The healing of burn injury is a dynamic biological process and there must be a set of factors that gradually slow down and/or terminate the dynamic healing process at the late stage of this process. We have previously demonstrated that stratifin which is mainly released by differentiated keratinocytes has a potent MMP-1, 3, -8 and 24 stimulatory effect for fibroblasts. In another study, we also showed that allogenic Indoleamine 2,3-Dioxygenase (IDO) expressing skin substitute can be immuno protected and used a wound coverage. In this study, we have used a combination of these studies to explore whether engraftment of IDO expressing engineered skin substitute can be immune protected and if so, whether it has any anti- hypertrophic scarring effect in a rabbit ear fibrotic model.

Methods: Human keratinocytes and fibroblasts were established in cultures and used to engineered an allogenic skin substitute made of epidermal layer of keratinocytes and dermal layer of fibroblasts expressing IDO gene. Upon evaluation of IDO enzyme activity, the composite was employed as a coverage in fibrotic rabbit ear wounds. The healing quality was determined by evaluating the scar elevation index, epidermal thickness and matrix accumulation.

Results: The findings revealed a significant improvement in scarring outcome as a result of an increase in MMP-1 expression, a significant reduction in both the scar elevation index as well as the epidermal thickness. Further, the result of human HLA staining revealed that xenogeneic human skin composite has not been rejected by rabbit immune system

Conclusions: Here, we showed that IDO expressing engineering skin composite not only would serve as a wound coverage, but also function as a new strategy in reducing hypertrophic scarring in fibrotic model.

Applicability of Research to Practice: The findings of this study show that a shelf ready IDO expressing engineered skin composite can be developed to serve not only as a wound coverage, but also, as way of reducing hypertrophic scar formation in burn patients.

10 . Distinct Phenotypes of Deep vs. Superficial Keloid Fibroblasts in Keloid Skin Substitutes Transplanted to Mice

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Introduction: Keloid scars result from an abnormal fibroproliferative process following burns or other skin injuries. Keloids are refractory to treatment and are unique to humans. The lack of animal models for keloid scarring has hindered efforts to understand the mechanisms involved in keloid formation and slowed development of effective therapies. Hypothetically, keloid skin substitutes grafted to mice could serve as an in vivo model of keloid formation. To investigate the utility of this model, skin substitutes prepared with deep or superficial keloid fibroblasts were grafted to mice.

Methods: Primary keratinocytes, deep fibroblasts and superficial fibroblasts were isolated with IRB approval and informed consent from a thick, facial keloid excised from a pediatric burn survivor; normal cells were isolated from human breast skin. Skin substitutes were prepared using 6 combinations of cells: 1, normal keratinocytes (NK) and normal fibroblasts (NF); 2, NK and deep keloid fibroblasts (DKF); 3, NK and superficial keloid fibroblasts (SKF); 4, keloid keratinocytes (KK) and NF; 5, KK and DKF; and 6, KK and SKF. Skin substitutes were grafted to excisional wounds in athymic mice (N=8 per group), and were evaluated 12 wks after surgery. Quantitative RT-PCR was used to analyze expression of selected genes in fibroblasts and skin substitutes. Planimetry of wound tracings was used to quantify graft area, and image analysis of histological sections was performed for determination of dermal and epidermal thickness.

Results: DKF displayed elevated expression of type 1 collagen alpha 1 chain (COL1A1), TGF- β 1, periostin, plasminogen activator inhibitor 2, and inhibin beta A compared to SKF and NF. After grafting to mice, keloid skin substitutes in group 5, prepared with KK and KDF, were significantly thicker to controls (group 1) and had increased COL1A1 expression. In contrast, keloid skin substitutes in group 6, prepared with KK and SDF, had significantly greater area. Histological analysis revealed abnormal collagen organization in keloid skin substitutes containing KDF or SDF.

Conclusions: The data suggest that keloid skin substitutes grafted to mice represent a novel in vivo model of keloid scarring. Some aspects of the phenotypes observed in skin substitutes prepared with keloid keratinocytes and either deep or superficial keloid fibroblasts mimic the thickening and spreading seen in human keloids. Because this model contains both fibroblasts and keratinocytes, and can be stably transplanted to mice, it permits evaluation of both cell-cell and cell-matrix interactions in vitro and in vivo.

Applicability of Research to Practice: Keloid skin substitutes are a valuable new tool for the study of keloid scarring that can be used for evaluation of novel therapeutic interventions.

11 . **A Bilayer Hydrogel with Stem Cells Derived from Debrided Human Burn Tissue for Improved Skin Regeneration**

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Introduction: Burn wounds constitute 5-10% of military casualties, typically involve 40-60% of total body surface area (TBSA) and require extensive reconstruction. Burn wound debridement often involves the removal of subcutaneous skin layers including portions of intact hypodermal adipose tissue. We hypothesize that the intact adipose associated with the debrided skin tissue could be a potential source of viable autologous stem cells and could be used with FDA approved biomaterials for the development of tissue engineered skin substitutes.

Methods: Discarded tissue samples were collected from severely burned patients undergoing wound debridement. Debrided subcutaneous adipose-derived stem cells (dsASCs) were isolated and their immunophenotype characterized using FACS and immunofluorescence. To develop tissue engineered treatments, dsASCs were embedded in a bilayered collagen, polyethylene glycol (PEG)-fibrin gel and analyzed for up to 12 days in vitro. The engraftment of the bilayer-dsASC construct within a wound bed was assessed using an excision wound model in athymic rats.

Results: The dsASCs were found to express a panel of stem cell-specific surface markers by FACS (CD54+, CD71+, CD90+, STRO-1+) and immunofluorescence (CD105+) analysis. Within the bilayer gel dsASCs proliferated and differentiated, showing a fibroblast spindle-shaped morphology in the collagen layer and a tubular microvascular network in the PEG-fibrin layer. When the construct was applied onto an excision wound bed in athymic rats, there was an influx of polymorphonuclear cells with minor matrix remodeling at the gel-host interface at day 4. The majority of the hydrogel had been replaced with host extracellular matrix by day 8, and the wound beds had an increased blood vessel density at day 16 compared to control gels.

Conclusions: Intact adipose associated with discarded skin tissue can be a potential source of autologous stem cells. When dsASCs are incorporated within a collagen, PEG-fibrin based bilayer hydrogel they develop stromal and vascular phenotypes through matrix-directed differentiation without the use of growth factors. Preliminary studies indicate that dsASCs can express VEGF-A in vitro and may account for the enhanced vascular network in vivo. The bilayer applied to a full thickness excision wound shows positive engraftment and improved vascularization.

Applicability of Research to Practice: This study provides evidence that stem cells in the hypodermis of discarded burn tissue are preserved after severe thermal injury and can be isolated in quantities that could be useful clinically for skin repair and regeneration. The dsASCs and hydrogel scaffolds may provide a system for development of a vascularized dermal equivalent that overcome the limitations of current skin equivalents.

12 . **Hydrogel Incorporation within a Collagen:GAG Matrix Results in an In Situ Gelling Scaffold with Improved Functionality for the Burn Patient**

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Introduction: Each year over 500,000 patients seek medical attention for burn injuries in North America. These treatments are costly and challenging for healthcare professionals. For those patients with severe burns requiring autologous grafts, donor sites may be limited if not available. In this scenario skin substitutes and acellular scaffolds may be used as alternative coverage. Although these strategies have dramatically improved healing outcome in burn patients they are limited by the length of time it takes to integrate with surrounding tissue, become vascularized, as well as populated by cells. In previous publications, we have proposed the idea of a 'patient-ready' skin substitute. Moving toward a skin substitute that is readily available for the patient we developed an in-situ gelling scaffold that would permit integration with surrounding tissue. Furthermore it was our goal to create a system that could resist cell mediated contracture and provides an ideal environment for tissue regeneration. Our hypothesis that a composite matrix using both a collagen:GAG network and a crosslinked PVA-hydrogel would provide an environment that would gel rapidly at 37°C, increase the matrix strength while mitigating hyperproliferation of fibroblasts.

Methods: Briefly, three scaffolds were prepared and compared (1) collagen:GAG, (2) collagen:GAG crosslinked with 0.02%w/w glutaraldehyde, (3) collagen:GAG crosslinked with 0.02% glutaraldehyde and containing a crosslinked PVA hydrogel. Gelling rates, toxicity, contracture, cell proliferation, topography, tensile strength and cellular architecture by creating a skin model were all evaluated. In order to evaluate integration with the wound bed, gels were applied to full thickness wounds in Sprague Dawley Rats.

Results: Our results demonstrate that hydrogel collagen composites exhibit faster fibril formation, reduced contracture, reduced cell proliferation, linear cellular organization and unique architecture ($p < 0.05$). Mechanical strength is significantly improved ($p < 0.05$), yet elasticity is decreased. Gels integrated with the wound bed and promote improved healing; encouraging polarized cellular arrangement and angiogenesis.

Conclusions: Our findings suggest that the addition of PVA hydrogels to the crosslinked collagen based systems, enhances both mechanical and gelling properties, in addition to providing an integrative environment that mitigates gel contracture by fibroblasts.

Applicability of Research to Practice: Ultimately our novel in-situ gelling composite may improve the strategies used to create and apply skin substitutes and acellular matrix to the burn patient.

13. **Use of Human Placenta Derived Amniotic Membranes in the Treatment of Partial and Deep Partial Thickness Burns**

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Introduction: There are a multitude of treatment modalities to choose from when treating partial thickness burn injuries. Our goals in the treatment of partial thickness burns are to: speed the healing process, decrease pain, & return the patient to as close to their pre-injury state as possible functionally and cosmetically. With the above in mind, we have begun to use human placenta derived amniotic membrane (AM) on partial & deep partial thickness burn injuries. The amniotic membrane contains mesenchymal stem cells (MSCs), collagen & growth factors. In our recent experience we have found that the use of AM has promoted timely burn wound closure, reduced pain, & minimized hypertrophic scarring.

Methods: We placed AM on a total of 12 patients with partial & deep partial thickness burns. The TBSA burned ranged from 1-18 %. 9 of the 12 patients underwent 2 stage debridement & grafting of their injuries. The remaining 3 patients underwent 1 stage procedures. All procedures took place in the operating room. The operative technique used with AM placement is as follows: All burn wounds are debrided using high speed dermabrasion technique. The AM is then carefully transferred from its original carrier to a sterile piece of Adaptic. The AM was then applied to the area(s) of partial thickness burn. Gentamicin ointment was then applied to the Adaptic followed by a dry dressing. The operative dressings were removed down to the Adaptic on post operative day 3. Any area of lifting Adaptic was then carefully trimmed. Areas with adherent Adaptic were left undisturbed & redressed with gentamicin ointment & a dry dressing daily until the wound had completely re-epithelialized.

Results: At this time 11 of the 12 patients treated with AM continue to be followed after complete wound closure for a mean follow up period of 5 months. All patients showed improvement in their level of pain control acutely after application of AM. Complete wound closure time from the date of application of AM ranged from 7 to 12 days with a mean of 9 days. None of the patients have developed hypertrophic burn scars or significant textural changes in the area(s) of AM application as of this time. All patients have developed varying degrees of pigment alteration in the treated area(s).

Conclusions: We feel that use of AM for the treatment of partial thickness burns is a promising treatment modality. We realize that this preliminary evaluation is extremely limited. We feel that further evaluation of AM for treatment of partial thickness burns in the form of a randomized, multi-center trial comparing it with other products used to treat partial thickness burns would be beneficial.

Applicability of Research to Practice: The use of AM in the treatment of partial thickness burns improves: healing time, pain control & cosmetic outcome.

14. **Application of an Acellular Fetal Bovine Dermis for Partial and Full Thickness Burns**

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Introduction: Biological and nonbiological treatments have been used to improve wound healing of partial or small full thickness burn wounds instead of undergoing daily wound care or autografting. The goal is to decrease pain, provide a less traumatic treatment, decrease length of hospital stay, and improve cosmesis. In our practice, we have documented use of a novel acellular matrix derived from fetal bovine dermis, rich in type 1 and type 3 collagen. This closed wound environment optimizes wound healing by stimulating cell repopulation, revascularization, and native collagen production. The product is marketed for partial thickness burns, however we have successfully used it in both partial and full thickness burns.

Methods: Ten patients, 8 children and 2 adults, with partial and full thickness burn wounds ranging between 1-12% TBSA were used in this study. Patients were taken to the operating room for debridement of the burn wound. The dermal matrix was soaked in normal saline for 1 minute and then placed on the burn area, covered with gentamicin ointment, adaptic, and a dry dressing. The patient was discharged from the hospital and the dressings were removed 3 days postoperatively in the clinic. The dermal matrix remained adherent, any loose area was trimmed, and a new gentamicin/adaptic dressing was applied. This dressing was repeated every 3 days, until the dermal matrix lifted off and the area was healed.

Results: Mean healing time from placement of the dermal matrix to completely healed was 11.2 days with a range of 6 to 20 days. In the 3 patients (4 areas) with only deep partial thickness burns, healing time was an average of 7 days. In the patients with partial and full thickness burns the average healing time was 13.7 days. All patients, except one which had a 40% TBSA burn, were discharged either post-op day 0 or 1. One patient developed hypertrophic scarring in the area of the full thickness burn.

Conclusions: Overall, the dermal matrix was a beneficial treatment modality for large partial thickness burns and mixed partial and full thickness burns. The patients did not require daily dressings nor a donor site of an autograft, which significantly improved pain, trauma, and length of stay. We believe the overall healing time was decreased, though we do not have controls to compare to. Scarring appears to be improved compared to autografting or dressing changes, as we had minimal discoloration and minimal hypertrophic scarring. The difficulty with this dermal matrix was the thickness and hardness of the product once dry, causing difficulty with trimming and removal of the product, and in some cases, causing pressure points.

Applicability of Research to Practice: By utilizing novel therapeutic interventions to provide a closed wound environment which optimizes wound healing, we can minimize pain, hospital stay, and scarring.

15 . **Is Artificial Dermis an Effective Tool in the Treatment of Tendon-Exposed Wounds?**

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Introduction: As flap surgery remains the main technique to close wounds with tendon exposure, the application of artificial dermis in these complex soft tissue wounds is seldom reported. The purpose of this paper is to review our experiences in the treatment of tendon exposed wounds with artificial dermis.

Methods: This retrospective study included 23 patients with 33 tendon-exposed wounds treated with artificial dermis from 2004 to 2009. Data including patient demographics, wound type, duration from artificial dermis implantation to split thickness skin grafting, surgical complications, and clinical outcome were obtained by chart review. Successful treatment was defined as the formation of golden-yellow neodermis followed by successful split thickness skin grafting.

Results: Among the 33 tendon-exposed wounds, 11 were secondary to chronic ulcers, 16 to acute wounds and 6 to surgical wounds after hypertrophic scar excision. The mean patient age was 48 years. The overall success rate with the artificial dermis technique was 82% including 63% in the chronic ulcer group, 88% in the acute wounds, and 100% in the surgical wounds. In the success group, 11% of the wounds required repeated artificial dermis implantations. Within the failure group, 2 wounds were closed by below knee amputation, 2 by local flap surgery, and 2 were allowed spontaneous healing as a result of graft failure.

Conclusions: We have demonstrated an overall success rate of 82% for tendon-exposed wound closure by using artificial dermis. The surgical outcome was better in surgical and acute wounds than in chronic wounds.

Applicability of Research to Practice: We demonstrated the success rate of use of artificial dermis for tendon-exposed wound closure and thought it might be an possible alternative to flap surgery in some cases not suitable for it.

16 . **Suprathel® Versus Autologous Split-Thickness Skin in Deep Partial-Thickness Burns: First Long-Term Results**

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Introduction: While autologous skin grafting has been the standard for coverage of full-thickness areas, several options for deep-partial-thickness defects exist. With regard to economize donor sites, we have compared a copolymer based on DL-lactid acid (Suprathel®) as temporary wound dressing with autologous skin, and analyzed time to healing and scar quality in matched areas of deep-partial- thickness burn wounds.

Methods: We have recruited 18 patients with a median age of 45 years (range: 25-83 years) for this prospective, non-blinded controlled noninferiority trial suffering from deep partial-thickness burns from November 2009 to July 2010. After early tangential excision, matched deep partial-thickness areas were covered with 1:1.5 meshed autologous skin grafts and the copolymer for direct intra-individual comparison. Scars were evaluated by means of the Vancouver Scar Scale (VSS), the Patient and Observer Scar Assessment Scale (POSAS), and suction cu-tometry (MPA 580, Courage and Khazaka) on days 180 and 360 postoperatively.

Results: Fifteen days after surgery, complete wound closure was present in 44.4% (8/18) and 88.9% (16/18) of areas covered with the copolymer and autologous skin grafts, respectively. Subjective and objective scar evaluation detected similar results in areas covered with copolymer compared to autologous skin on days 180 and 360 after surgery. Hypertrophic scar formation occurred in only one male study patient in both study areas.

Conclusions: Deep partial-thickness burns covered with the copolymer exhibited a prolonged time to healing as compared to autologous skin grafts, while the scar quality revealed comparable results. Within a treatment concept of large-scale burn injuries, the coverage of deep partial-thickness burns with Suprathel® may be able to help minimize skin donor sites and restrict autologous skin for full-thickness burned areas. Notwithstanding, more clinical studies with larger number of patients are needed that verify our promising results.

Applicability of Research to Practice: The copolymer (Suprathel®) may serve as a valuable option for coverage of deep partial-thickness wounds and can especially in large burns help to reserve split-thickness donor sites for full-thickness defects.

17 . **Pruritus in Adult Burn Survivors: Incidence, Characteristics and Risk Factors**

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Introduction: Burn pruritus is a common and distressing complaint after injury; reported in as many as 87% of burn survivors. Itching adversely affects sleep, activities of daily living and psychosocial well-being. The purpose of this study was to investigate self-reported postburn pruritus in a multi-center study of adult burn survivors over time.

Methods: Data were drawn from a longitudinal database. Injury characteristics, demographics and multiple self-reported measures were examined using descriptive statistics, linear regression and mixed models.

Results: Two cohorts of adult burn survivors were studied. Group 1 participants were injured from 2006-2010 and were followed prospectively for up to 2 years (n=637). The average age at time of injury was 43 years (SD,15.7), 73% were male, 64% Caucasian, average burn size was 19% (SD,17) TBSA, and 62% of injuries were due to flame. Incidence and severity of pruritus were compared to multiple variables over time at discharge, 6, 12, and 24-months postburn (table). In Group 1, we found a significant difference between males and females, with females having higher itch scores (0-10 VAS; zero - no itch and 10 - unbearable itch) at both discharge (females 6.21 vs males 5.47; p=0.0094) and 6-months (females 5.64 vs. males 4.57; p=0.0053) postburn; the significance disappears at later time-points. Regression results determined that for every 1% increase in TBSA burn, there is a 0.031 increase in itch VAS and for every 1% increase in TBSA grafted, there is a 0.022 increase in itch VAS. Group 2 participants were injured 4-10 years (mean,7.1) prior to an assessment using the validated 5-D Itch Scale (n=336). For these individuals, 44% report itch in the area of the burn, graft or donor site. In this cohort, itching exists for less than 6 hrs/day (76%) and is considered mild (52%) or moderate (29%). With regard to sleep disruption, itch impacts sleeping for 59% of respondents who suffer from pruritus.

Conclusions: As with previous reports, we find that the incidence of pruritus is high, initially affecting over 90% of burn survivors. Incidence tapers over time but retains clinical importance with significant itch-related distress and intensity. Being female was a significant predictor of itch in the early postburn period. The size and depth of injury are also related to itch with larger and deeper injuries causing greater itch intensity.

Applicability of Research to Practice: This study contributes to a better understanding of pruritus in burn patients and provides information concerning risk factors.

	Discharge	6-months	12-months	24-months
Itch incidence	93%	86%*	83%*	73%*
Mean itch (0-10 VAS)	5.68(3.07)	4.85(3.37)*	4.06(3.3)*	3.24(3.1)*
Mean distress (0-10 VAS)	4.98(3.23)	4.74(3.44)	4.03(3.37)*	3.28(3.24)*

* p<0.0001 when compared to Discharge ratings

18 . **Effectiveness of Sedation with Nitrous Oxide versus General Anesthesia for Pediatric Patients Undergoing Cosmetic Laser Therapy**

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Introduction: General anesthesia via mask is commonly used in pediatric patients for brief painful procedures because it is rapid and effective. Inhalation anesthesia can cause breath holding, bronchospasm, laryngospasm, airway obstruction, emesis and post procedural issues such as nausea and emergence delirium. Nitrous oxide is a strong analgesic agent with essentially no anesthetic properties and has been used as a sole agent outside the operating room for sedation for dental procedures and emergency department procedures. We evaluated the effectiveness of sedation using nitrous oxide (50-70%) in oxygen combined with topical 4% lidocaine cream compared to general anesthesia for pediatric patients undergoing laser therapy for port wine stains, hypertrophic scars, and hair removal post skin grafting.

Methods: We conducted a retrospective chart review for all children over the age of six receiving general anesthesia or sedation with nitrous oxide (50-70%) for laser therapy during a six year period. Patients receiving nitrous oxide sedation had 4 % topical lidocaine cream applied to the affected areas for at least 20 minutes prior to the start of the procedure. Patient age, number of laser pulses, onset time for sedation, PACU recovery times, and complications of general anesthesia and nitrous oxide sedation were recorded.

Results: Results are summarized in the table below.

Anesthetic	General Anesthesia	Nitrous oxide + Topical Lidocaine
Total number of procedures	177	77
Patient Age		
Age 6-10	93	20
Age 11+	84	57
Average Number of Laser Pulses (range)	172 (9-924)	225 (15-1138)
Minutes to adequate sedation (range)	9 (1-25)	5 (1-10)
Total time minutes in PACU (range)	36 (10-145)	13 (1-30)
COMPLICATIONS	N (%)	N (%)
Nausea	26 (15%)	3 (3%)
Vomiting	9 (5%)	3 (3%)
Delirium	22 (12%)	1 (1%)
Airway Obstruction	13 (7%)	0
Hypoxia	0	0
Inadequate Sedation	0	1 (1%)
Total Complications	70 (40%)	8 (10%)

Conclusions: Sedation with nitrous oxide (50-70%) combined with topical lidocaine is as effective as general anesthesia via mask for pediatric patients undergoing cosmetic laser therapy. Nitrous oxide has a lower incidence of complications such as nausea, vomiting, and delirium. Unlike general anesthesia, there was no airway obstruction in the nitrous oxide cohort and the recovery times were significantly shorter.

Applicability of Research to Practice: Nitrous oxide sedation can be used effectively as an alternative to general anesthesia for brief painful procedures such as laser therapy and it has a lower complication rate. Nitrous oxide sedation is well tolerated, has minimal side effects, and is associated with shorter recovery times in pediatric patients.

19 . **Longitudinal Mediation of Pain and PTSD Symptom Clusters**

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Introduction: Among burn survivors, post-injury pain and post-traumatic stress disorder (PTSD) are major clinical concerns. Trauma memories may be linked with sensory and affective pain experiences that perpetuate PTSD cluster symptoms over the first year post-injury. Reciprocating effects between pain and PTSD symptoms have been documented, but few studies have identified mediating relations between specific PTSD symptom clusters and pain after traumatic injury, and none after burn injury.

Methods: Participants were adult patients (72% male; 64% Caucasian) admitted to a regional Burn Center that met ABA criteria for a major burn injury. PTSD symptoms and pain severity were assessed at baseline (T1; N=245), 6 months (T2; N=140) and 12 months (T3; N=121) post-discharge. The McGill Pain Questionnaire, Short Form, measured pain severity. PTSD symptoms were assessed using the Davidson Trauma Scale. Longitudinal autoregressive models were specified to explore mediated relations between PTSD clusters and pain. All models controlled for TBSA burned, history of mental health treatment, and gender.

Results: PTSD symptoms predicting pain: Avoidance at discharge predicted T2 pain, but no PTSD symptom cluster at T2 predicted T3 pain. Pain predicting PTSD symptoms: Pain at T1 predicted avoidance symptoms at T2, and pain at T2 predicted all 3 PTSD symptom clusters at T3. Mediated effects: Pain severity partially mediated the effects of avoidance symptoms at baseline on 12-month avoidance ($ab = .078$, $SE = .036$, $p < .05$), reexperiencing ($ab = .072$, $SE = .036$, $p < .05$), and hyperarousal symptoms ($ab = .067$, $SE = .037$, $p < .05$). Pain also partially mediated the influence of T1 re-experiencing symptoms on avoidance ($ab = .008$, $SE = .034$, $p < .05$), reexperiencing ($ab = .072$, $SE = .036$, $p < .05$), and hyperarousal symptoms ($ab = .034$, $SE = .034$, $p < .05$) at 1 year.

Conclusions: We found evidence for pain as a partial mediator of PTSD reexperiencing and avoidance symptom sub-clusters over the first year post-burn injury. Although PTSD symptoms one month post-discharge predicted pain at T2, no PTSD symptom cluster mediated pain over the 12-month post-discharge period. Results of the study lend support to the notion that post-injury pain and PTSD symptoms are cyclical in nature amongst burn survivors.

Applicability of Research to Practice: Pain may be a key mechanism in the perpetuation of PTSD symptoms and avoidance may be the most salient PTSD cluster relevant to pain. Clinical practice should address pain and post-traumatic stress sequelae in a unified manner, as to reduce the impact of pain symptomatology on PTSD avoidance related behaviors and vice versa.

20 . **The Effects of Virtual Reality Pain Distraction on Voluntary Range of Motion in Adult Burn Patients**

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Introduction: The pain from aggressive burn injury physical therapy is a constant hindrance to effective patient recovery and non-pharmacological options to facilitate patient comfort and response to therapy are becoming increasingly desirable. Immersive virtual reality, possibly the most extreme of distraction therapies is attractive but there are a number of basic theoretical questions with its use. The current study tested the hypothesis that patients given control over their range of motion during physical therapy during immersive virtual reality distraction would show greater range and less pain.

Methods: Twenty-four patients admitted to a major regional burn center served as the sample for the study (mean TBSA = 13.85, range = 1% to 45%). All patients were in a within-subjects design in which they received both the experimental manipulation (immersive virtual reality distraction) and the control group (standard ranging without distraction) in a randomized presentation. In both the experimental and control phases, patients were instructed to range their burned joint to the extent they felt comfortable. Therapist goniometer measurements were taken after each range extension/flexion to determine the ROM achieved (dependent variable). Ratings of the patients' subjective pain were also taken on a graphic rating scale after each ROM, under each condition.

Results: Paired t-tests showed that compared to how far they actively stretched without distraction (control condition, mean ROM = 103.48 degrees, SD = 194.05) patients stretched their burned joints further during VR (mean ROM during VR = 107.33, SD = 193.11). The difference was statistically significant $t(23) = 2.61$, $p = .016$. Similarly, on a zero to 100 worst pain rating scale, compared to active ranging without distraction (control mean = 53.04, SD = 26.70), patients rated their pain lower during VR (41.30, SD = 27.31), and the difference was statistically significant, $t(22) = 2.274$, $p < .05$.

Conclusions: Patients who were allowed to control their own range of motion showed significantly greater extension of joint range as well as less pain during immersive virtual reality than during no distraction. The findings provide early information about how much high levels of distraction might affect active, as opposed to passive stretching ROM exercises.

Applicability of Research to Practice: A new non-pharmacologic technique that increased active range of motion at the same time it reduced acute pain would be of great clinical value.

21. Combined-Volatile-IV Anesthesia (CVIVA): Effects of a Balanced Anesthetic Infusion in Burn Center Patients

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Introduction: Patients with burns and other soft tissue injuries often require multiple operations for debridement and skin grafting. The use of a combination of volatile and intravenous medications has the potential to decrease opioid use and improve postoperative pain control in patients undergoing serial operations. Dexmedetomidine is a newer alpha-2 agonist that has been used perioperatively to provide adequate pain control while decreasing opioid use. Ketamine, an NMDA receptor antagonist, offers pain control while providing stimulation to both respiratory and cardiac systems. We utilized a mixture of these agents to attenuate intraoperative opioid use, and recorded post-operative effects on pain control.

Methods: After IRB approval and in accordance with the approved protocol, the records of 17 patients receiving the specified infusion were analyzed in a retrospective, case-controlled manner. Five patients did not require a second operation; therefore our analysis included 12 patients. The CVIVA infusion admixture consisted of dexmedetomidine (4 mcg/ml), ketamine (1-4 mcg/ml), and fentanyl (2-4 mcg/ml). The standard group received volatile gas anesthesia (VGA) with bolus analgesic. Patients with postoperative ventilation or regional anesthesia were not evaluated.

Results: The results demonstrated a significant decrease in the VGA requirement in the CVIVA group compared to the standard group (MAC%, 0.68% vs. 0.94%, $p=0.03$). There was a 69% increase in time spent in the post-anesthesia care unit (PACU) for CVIVA patients compared to our standard practice, which was statistically significant (2.02 hours vs. 1.2, $p=0.002$). There was a 32% decrease in intraoperative opioid requirement for the CVIVA group compared to the standard group (expressed in oral morphine equivalents per hour, 29.13 vs. 42.04), however this difference was not statistically significant ($p=0.35$).

Conclusions: We observed a statistically significant reduction in VGA requirement and increased time in PACU in this retrospective review of 12 patients who received CVIVA technique. The ability to make generalized conclusions is limited by the small and retrospective nature of this study. Future randomized, prospective, appropriately powered trials are necessary to further clarify the findings of this study and the impact on patient care.

Applicability of Research to Practice: The reduction of VGA is relevant for practice, in that it diminishes the negative effect of high concentrations of gas, such as tachycardia, hypotension and neurotoxic effects at the neurocellular level. The increase in PACU time for CVIVA technique may be attributable to deeper patient sedation relative to standard anesthesia practices. This increase in recovery time has a negative impact on staffing requirements.

22. Hypnosis Delivered through Immersive Virtual Reality for Wound Care: A Randomized, Controlled Study

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Introduction: Pain during wound care is one of the greatest challenges in burn care. Although pharmacologic approaches remain the standard of care, approaches with less side effects, or that may work when drugs do not, are of interest to the burn community. Hypnosis has been found to reduce procedural burn pain in a number of studies. This study sought to test hypnosis delivered through a 3-dimensional immersive virtual reality (VR) system to patients undergoing ongoing burn wound cleaning.

Methods: Fifty-five patients hospitalized for burn injuries (mean TBSA of 13.5%; range = 2% to 65%) were randomly assigned to one of three treatment groups. All patients received no treatment on baseline day. On treatment Day 1, patients in Group 1 looked into VR goggles and had the illusion of passively floating down a 3D canyon, passing numbers 1-10 while listening to synchronized hypnotic suggestions via earphones. At the bottom of the canyon, they saw a vivid blue lake surrounded by lush green hills. While floating over the water, they received post-hypnotic suggestions for relaxation and comfort during wound cleaning sessions. They then ascended back up out of the canyon while listening to suggestions they would become more and more awake. Group 2 listened to the same audio suggestions with their eyes closed (audio only, no VR). Group 3 (the plausible control group) did not receive any hypnotic suggestions. Instead, Group 3 played a video game in VR at a time other than in wound care, to provide a control for both attention and exposure to technology.

Results: Table 1 shows mean pain intensity ratings during baseline compared to mean pain intensity ratings after one day of treatment; standard deviations are shown in parentheses. Patients showed approximately equivalent reductions in pain intensity in all three groups. When comparing pain during wound care at baseline to that after one treatment, there was no significant between-groups difference in how much pain dropped after treatment, $F(2,52) = 1.50$, $p = .23$, NS.

Conclusions: Although no between-groups differences were found, since this was the first controlled study of VR hypnosis for burn pain, and the software was in an early phase of development, future research is needed. New ways of making hypnosis treatments more effective, and/or to enhancing patients' ability to become hypnotized should be explored.

Applicability of Research to Practice: Development of a new non-pharmacologic technique that effectively reduced persistent pain would be of great clinical value.

Table 1

	Baseline (no treatment)	Post-treatment (after 1 day)
Group 1, (n = 23)	M = 70.65, (31.13)	67.39 (27.83)
Group 2, (n = 17)	M = 79.12, (28.63)	58.83 (38.06)
Group 3, (n = 15)	M = 87.00, (12.79)	76.00 (20.28)

23 . The Use of Methylnaltrexone in Burn Patients

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Introduction: High-dose narcotics are commonly required for pain control in patients with large burns and soft-tissue surgical infections (NSTIs), resulting in constipation which can be difficult to treat and sometimes dangerous. Methylnaltrexone (MLTX), a μ -opioid antagonist which reverses narcotic effects on the bowel without affecting analgesia, has been effective in treating opioid-induced constipation in oncology patients. We reviewed our experience with use of MLTX in our burn center.

Methods: Our burn center has developed an organized bowel protocol that includes the administration of stimulant laxatives and stool softeners with supplementation by osmotic agents if needed. MLTX is added if patients have not had bowel function after four days or if they have previously responded to MLTX administration. With IRB approval, we reviewed all patients who received MLTX from May 2009 through November 2010. The primary outcome examined was time to laxation from drug administration.

Results: Forty-eight patients received a total of 112 doses of MLTX. Six patients had NSTIs; the remainder had burns with a median size of 17% total body surface area (IQR: 10 - 27% TBSA). Median patient age was 42 (IQR: 26 - 56); 75% were male. These patients received a median of 171 morphine equivalents of narcotics daily prior to MLTX administration (IQR: 120 - 334 equivalents). Each episode of MLTX administration was given a median of 53 hours after admission or the previous recorded bowel movement (IQR: 20-120 hours); on 9 occasions more than one dose of MLTX was required to achieve laxation. Administration produced laxation within 4 hours in 32% of patients, and within 10 hours in 50% of patients. Seventeen patients received multiple doses of MLTX (range 2 - 12 doses) for refractory constipation.

Conclusions: We have found Melthylntalrexone to be an effective adjunct to induce laxation in patients who require large doses of narcotics, and who have failed to respond to more conventional laxatives.

Applicability of Research to Practice: This study expands the potential indications for the use of methylnaltrexone to include its use in the treatment of opioid-induced constipation in patients with burns and soft tissue injuries.

24 . Effectiveness of Emu Oil on Burn Scar

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Introduction: Burned patients are usually suffered from itching sensation, pigmentation and pain after wound healing. Emu oil®(Almeca, Netherland) is a type of oil, which contains various unsaturated fatty acid including Omega 4,6, and 9. It is extracted from chest of Emu which is a kind of Ostrich. Being used for relieving arthritis and myalgia by aborigines in Australia, Emu oil became widely used for easing burned, itching, and dry skin. Authors suggest usefulness of Emu oil® by comparing differences of physical properties of scars between before and after applying Emu oil® on burn scars of patients..

Methods: We did studies on 60 patients (30 for experimental groups and 30 for control groups) with burn scars from February 2010 to Jun 2011. We investigated sex, age, site, duration of illness, condition of scars, and complications. Conditions of scars are evaluated with quantitative estimation. Thickness of scar is checked by ultrasonography, pigmentation, erythema, trans-epidermal water loss by CK-MPA-Multi-Probe Adapter Version 1.5.1.4(CK electronic, Germany), and elasticity by Win-Cutometer MPA Version 2.14.4.1(CK electronic, Germany)

Results: Among 60 patients, sex ratio was 34;26(male:female). Age of patients ranged from 15 to 62 with an average of 34. Average follow up period was 12 months. Site of scar is in the following; 9 cases in head and neck, 7 cases in trunk, 9 cases in upper limbs, and 5 cases in lower limbs. Duration of illness ranges from 2 months to 20 years with an average of 3 years. elasticity of 0.361 ± 0.292 (before applying) $\sim 0.544 \pm 0.028$ (after applying), pigmentation of 173.071 ± 132.642 (before applying) $\sim 120.195 \pm 100.698$ (after applying), erythema of 514.500 ± 78.921 (before applying) $\sim 457.500 \pm 96.372$ (after applying), and trans-epidermal water loss of 32.768 ± 12.817 (before applying) $\sim 19.207 \pm 10.025$ (after applying) ($p < 0.05$) showed an improved result with use of Emucare Oil, while sebum of 63.773 ± 79.550 (before applying) $\sim 61.286 \pm 94.898$ (after applying) and thickness of scar of 0.292 ± 0.246 (before applying) $\sim 0.305 \pm 0.249$ (after applying) ($p > 0.05$) did not show significant effects. There was no case for any side effect detected throughout the study.

Conclusions: Emu oil® improve elasticity, decrease pigmentation, erythema and trans-epidermal water loss. There was no effect in sebum and thickness of scar. This is due to high skin penetration, anti-inflammation, skin regeneration, and emulsification characteristics of Emu oil®, helping skin regeneration so that symptoms due to burn scars can be eased. And clinically it also has effect on atopy patients to relieve their symptoms. Emu oil® is highly suggested to be an appropriate treatment for management of burn scar. However, further researches in molecular biology, histology are required to prove mechanism of actions.

Applicability of Research to Practice: Burn scar management.

25 . **Assessment of Cardiopulmonary Function During Exercise in Severely Burned Pediatric Patients**

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Introduction: Severe burn injury leads to extensive physical and functional limitations resulting in delayed recovery and delayed patient reintegration into activities of daily living. It is known that burned children have decreased cardiopulmonary function that lasts many years. Post traumatic response to burn leads to prolonged skeletal muscle catabolism and weakness, which persist despite standard rehabilitation therapy. While peak oxygen uptake (VO₂peak) has been previously described, cardiopulmonary parameters related to the aerobic status of the burned patients have not yet been reported. Here we evaluated additional cardio-respiratory responses during exercise in burned children.

Methods: Ninety one children, ages 7-17, were enrolled in the study. Fifty burned children (B) with burns ≥30% of total body surface area (TBSA) and 41 age-matched non-burned (NB) controls underwent a standardized treadmill exercise test, using the modified Bruce protocol, and pulmonary function tests (PFT) using a Medgraphics PF/DX Pulmonary Function System. Assessments in the B group were obtained at 9-12 months post-burn and compared to NB controls. Data are reported as mean ± SD. Significance was set at p<0.05

Results: Our results indicate a significant difference in VO₂ peak between the groups, B 30.2 ± 7.0 ml/kg/min compared to the NB 35.5 ± 8.4 ml/kg/min (p<0.01). Oxygen consumption at the anaerobic threshold in the B group was 17.1 ± 5.8 ml/kg/min compared to 21.6 ± 7 ml/kg/min in the NB group (p<0.01); Oxygen Pulse in the B group was 8.7± 3.6 ml/beat compared to a 11.9 ± 4.1 ml/beat for the NB (p<0.001). Forced expiratory volume in one-second was 2.3 ± 0.9 L for the B group and 2.7 ± 1.0 L (p<0.01) for the NB. Peak VE was 52.3 ± 22.3 for the B and 72.9 ± 27.0 for the NB (p<0.001). However, both groups reached anaerobic threshold near the same percentage of VO₂ (56.8% B and 61.4% NB).

Conclusions: Our results indicate the difference in burned and non-burned cardiopulmonary function is the result of cardiopulmonary deconditioning confounded by the reduced muscle mass rather than abnormal oxygen muscle usage. Prolonged endurance exercise training should be considered for improving cardiopulmonary capacity and faster recovery.

Applicability of Research to Practice: This study reiterates the need for long term physical rehabilitation therapy including exercise training to improve functional capacity.

26 . **Temperature Regulation Is Impaired in Well-Healed Adult Skin Graft Patients Exercising in the Heat**

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Introduction: Prior studies investigating the effects of skin grafts on temperature regulation report mixed findings. This is likely related to subjects performing exercise at differing levels of oxygen uptake and thus differing levels of heat generation. This study tested the hypothesis that temperature regulation is impaired in individuals with skin grafts when performing exercise at the same level of heat generation in a high ambient temperature.

Methods: Twenty burn survivors (age range: 22-54 years; 16±14 years post-injury) with well-healed split thickness grafts were stratified into two groups: 20-40% body surface area (BSA) grafted (N=13) and 45-75% BSA grafted (N=7). Six similarly aged healthy non-injured subjects served as control. Subjects exercised for 45 min at a fixed level of heat generation, equivalent to 1 l/min oxygen uptake, in an environmental chamber (40° C, 30% relative humidity). Core body temperature was measured from gastrointestinal temperature via an ingestible telemetric thermometer pill.

Results: Oxygen uptake and metabolic heat generation were not different between groups during exercise (see table). However, the elevation in core body temperature was significantly greater in the 45-75% BSA group relative to both the 20-40% BSA and control groups, while there were no differences in core temperature elevations between the 20-40% BSA and control groups.

Conclusions: Temperature regulatory capacity is profoundly impaired in individuals with grafts covering 45-75% of their BSA, but not those with 20-40% BSA of grafted skin.

Applicability of Research to Practice: Individuals with ≥45% of their BSA grafted are at a greater risk for a heat related injury when exercising at a relatively low intensity in the heat. These data have important implications towards the safety of skin graft patients as well as “return to duty” in burned military personnel.

	Control	20-40% BSA	45-75% BSA
Oxygen uptake (l/min)	1.03±0.07	1.09±0.21	1.03±0.15
Metabolic heat generation (watts)	298±45	311±52	321±72
Increase in core temperature during exercise (°C)	0.62±0.32	0.81±0.23	1.14±0.34*¥
Data are mean±SD. * Different from control group (P<0.01). ¥ Different from 20-40% BSA group (P=0.054).			

27 . **Effects of Early Exercise on the Number of Joint Release Interventions in Children with Severe Burns**

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Introduction: Studies in burned children have demonstrated an increase in lean body mass (LBM) and muscle strength as a result of exercise implemented at 6 months postburn. We hypothesized that earlier exercise (at 3 months postburn) would provide similar benefits and decrease the number of surgeries joint contractures. We investigated a group of patients involved in a supervised, hospital-based exercise program, in combination to physical and occupational therapy (PTEX group), and a group receiving home-prescribed physical and occupational exercises (H group) alone.

Methods: At admission, patients with $\geq 40\%$ total body surface area burns were randomized to a PTEX (n=13) or to a H group (n=10). We assessed changes in leg muscle strength and LBM before and after the 3-months training program with isokinetic dynamometry and with dual-energy X-ray absorptiometry, respectively. Additionally, we blindly examined both groups at 6 months post completion of exercise, to determine the number of surgical interventions in lower extremity joints. Differences within and between groups were evaluated by paired and unpaired t-tests, and nonparametric tests when appropriate. Statistical significance was set at <0.05 .

Results: We found a significant improvement in muscle strength of 82% in the PTEX group versus 62% in the H group, as well as a 6% improvement in LBM in the PTEX group versus relatively no change in the H group. After the exercise program, the percentage of patients requiring surgical release in lower extremity joints was less in the PTEX group (8%) than in the H group (40%).

Conclusions: A supervised exercise and physiotherapy program as soon after discharged from the burn unit appears to decrease the severity of major joint contractures resulting in a lesser need to intervene surgically to improve function.

Applicability of Research to Practice: Post-burn scarring is a serious clinical problem in severely burned patients; the use of exercise to reduce contractures is a low-cost, practical approach.

28 . **Study on the Effect of a Well-Planned Rehabilitation on the Outcome of Severe Burn Patients in China**

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Introduction: The incidence of burns in the low and middle-income countries remains much higher, compared with the high income countries. Especially, severe burn injuries (such as more than 50% TBSA) have been prevalent in China, as a result of rapid industrialization. These severe burns patients require a long-term rehabilitation program in order to restore their main functional independence and ability after survival. However, many severe burns victims in China suffer from serious disabilities because of the lack of a complete and well-planned rehabilitation treatment regime. This study would like to study the final outcome of those severe burn patients in China and investigate the maximal potential for a well-planned rehabilitation program on these severe burns cases.

Methods: 10 pair of burns patients with a TBSA more than 50% was recruited in the study in regional hospitals in China. The patients were paired up according to their age, gender, depth of burns, time required for wound healing up so as to promise a comparable matching. One patient was selected in each pair to follow the routine procedure that patients were discharge after surgeries when their wound healed up; while the other one in each pair was given a well-defined rehabilitation program. All patients were followed up for six months and the outcome of each subject was assessed by the blinded assessor in terms of their scar condition, functional ability and ADL as well as quality of life.

Results: Most regularly treated patients without any instruction on post-burn rehabilitation showed quite negative response for the follow-up and they felt quite disappointed at their functional abilities of their limbs and could not and had little tendency to try to regain their living independence. Results showed differences in the outcome of patients of each pair being different treated after their injury. Those subjects with an early and well-planned rehabilitation program generally reported a higher satisfaction of their scar conditions, functional activities and ADL, compared with those regularly treated patients.

Conclusions: The severe burns injuries can cause unexpected serious disabilities in those burn victims without a sense of the well-planned and timely rehabilitation regime. The recovery potential for these severe cases in China would be maximized if a prophylactic and complete rehabilitation could be implemented in regional hospitals which deserve the attention of Chinese physicians, health care professionals and the governmental ministry of health.

Applicability of Research to Practice: This clinical study looks at the outcome of severe burn cases that are common in China and explores the rehabilitation role in improving the general outcome of them, which can arouse the interest and attention for this compressing problem.

29 . Fatigue in Electrical Injury Patients

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Introduction: Fatigue is a common long-term sequelae of electrical injury (EI). Experiential fatigue with EI has been reported in literature but minimal investigations have been performed to explain the cause of this fatigue. The purpose of this study was to investigate central and peripheral fatigue in EI patients.

Methods: EI patients complaining of fatigue and age and sex-matched healthy volunteers were recruited. All subjects completed a peer-reviewed fatigue severity scale questionnaire. Central and peripheral conduction times were recorded. Motor evoked potentials (MEP) and M-waves were measured using surface electromyogram of right abductor digiti minimi (ADM) using transcranial magnetic stimulation (TMS) and ulnar nerve stimulation at wrist (UNS). Stimulation was performed while at rest and during maximal voluntary contraction (MVC). Fatigue was induced using 2 minutes of MVC and subjects were followed for 15 minutes of recovery. The experiment was repeated with the use of an inflated blood pressure cuff during the first 75 seconds of recovery to maintain muscle ischemia.

Results: Eight EI patients and eight healthy volunteers were examined (all male, 46 ± 7.8 years vs. 45.5 ± 7.3 years). Fatigue severity scale questionnaire confirmed significant differences in experiential fatigue reported by EI patients compared to healthy volunteers ($p=0.043$). Baseline measures showed no difference in central and peripheral conduction times. Cortical silent period was prolonged in patients compared to volunteers (177ms vs. 145ms, $p=0.0433$). Maximal force produced and drop in force with fatigue were similar in both groups. Drop in MEP amplitude with consecutive TMS at rest (5 pulses at 0.3Hz) was observed immediately after exercise but was present only for EI patients with BP cuff after 2 minutes of recovery ($p<0.05$). M-wave area with contraction was significantly higher for EI patients compared to healthy volunteers at the beginning of the recovery phase ($p=0.0071$).

Conclusions: Prolonged cortical silent period in EI patients suggests that GABA-B receptor-mediated cortical inhibition may be increased with EI. BP-induced delay in recovery from drops in amplitude of consecutive MEP's demonstrates greater peripheral fatigue in EI patients after exercise. Higher increase in M-wave area post-exercise suggests greater decrease in conduction velocity of muscle action potential with exercise in EI patients. Overall, experiential fatigue reported by EI patients is shown to have both central and peripheral components.

Applicability of Research to Practice: Physiological causes behind experiential fatigue in EI patients have been demonstrated. Evidence of both central and peripheral fatigue leads way to the development of diagnostic tools and improved treatment options for EI patients suffering from fatigue.

30 . Roles of Positive Coping and Positive Personality Traits in Long Term Physical and Emotional Recovery after Burn Injury

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Introduction: Recovery of physical, psychological, and social functioning are of chief concern following a major burn injury. Personality and enduring patterns of thought, emotions, and behavior individuals use to deal with stress (i.e., coping), have been shown to predict health and function in other fields. The impact of personality characteristics and coping styles on the physical, psychological, and social functioning is not well known. This study examined the prospective impact of in-hospital positive coping and personality traits on long term physical, psychological, and social functioning.

Methods: Prior to discharge, participants completed the Brief COPE, a measure of a variety of coping behaviors and the NEO Five-Factor Inventory (NEO-FFI), a measure of characteristics that uniquely influence individual's thought processes, motivation, and behavior. In the current study three coping behaviors were utilized included Avoidance, Active, and Acceptance as well as two personality factors: Neuroticism (N) and Extraversion (E). The SF-12 Role Physical (RP - physical function) and Role Emotional (RE - emotional adjustment) Scores was evaluated at discharge, 6 (n=219), and 12 (n= 198) months post-discharge. In separate analyses, in-hospital Brief COPE and NEO-FFI scores were used to predict RP and RE at 6 and 12 months post-discharge. Covariates in all models included: gender, age, TBSA grafted, and RP and PE pre-injury.

Results: The 6 and 12 month samples (respectively, in parentheses) were similar: sex (male: 72%; 71%); mean age (41years; 41years), mean TBSA (14%, 13%). 6 Months: Results of the multiple regression analyses showed that greater negative coping (Avoidance) and personality (N) traits at discharge significantly predicted lower RP and RE at 6 months post burn injury: RP [Avoidance (R2 change =.046); N (R2 change =.037)]; PE [Avoidance (R2 change =.050); N (R2 change =.056)]. 12 Months: Higher E (positive personality characteristic) served as the strongest predictor of better RP at 12 months following the burn injury: R2 change = .025. Higher positive coping (Acceptance) and personality (E), and lower negative personality (N) traits served as predictors of better RE at 12 months: Acceptance (R2 change = .026); E (R2 change= .050); N (R2 change=.062).

Conclusions: These findings provide evidence that positive coping and personality styles observed in hospitalized burn patients positively impact long term physical, psychological, and social functioning. Negative coping and personality characteristics appear to play a more primary role in the earlier stages of recovery.

Applicability of Research to Practice: Early assessment of coping styles and personality can help focus rehabilitation efforts and may improve both physical and psychosocial outcomes.

31 . **A Scoring System for Risk Stratification of Acute Transfers from Inpatient Rehabilitation in the Burn Population**

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Introduction: Acute care hospital readmissions are increasingly being regarded as a marker of quality of care. Burn patients requiring inpatient rehabilitation tend to have significant medical complexity placing them at risk for early acute care readmissions, but no data has been published to help clinicians identify those at highest risk of readmission.

Methods: We did a retrospective database analysis of the Uniform Data System for Medical Rehabilitation (UDSMR) functional outcome data from 2002 to 2010. Logistic regression was used to determine significant predictor variables ($p \leq 0.05$) of transfers back to an acute care facility within 3 days of admission to an inpatient rehabilitation facility (IRF). Variables tested included demographic, functional data, total body surface area (TBSA) burned, and comorbid diagnoses. A scoring system based on significant predictors was developed to help stratify patients for risk of acute hospital readmission.

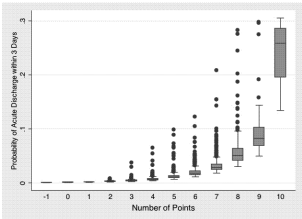
Results: From the UDSMR database 4572 patients had a primary diagnosis of burn injury and met inclusion criteria. Significant risk factors for acute transfer included age, admission FIM instrument ("FIM") motor score, and whether or not this was the patient's first IRF admission. A regression model based on these variables had a c-statistic of 0.77. Lower admission FIM motor score and anything but an initial admission to an IRF were associated with an increased risk of acute transfer. Older age was also associated with increased acute transfer risk. A 12-point scoring system from -1 to 10 was developed based on these variables to stratify patients' acute transfer risk.

Conclusions: Easily measured variables including age, functional level, and rehabilitation admission status can be used to identify the risk of an acute hospital readmission within three days from an IRF. Notably TBSA and medical comorbidities were not significant predictors of acute transfers.

Applicability of Research to Practice: This study provides a simple and practical scoring system, which clinicians can use to identify burn rehabilitation patients who are at a high risk of an early readmission to an acute care hospital from an inpatient rehabilitation facility.

Acute Transfer Scoring System

Age	Points	Admission Class	Points	Admission FIM Motor	Points
18-29	0	First IRF Admission	0	13-19	7
30-49	-1			20-29	6
				30-39	5
50-69	0			40-49	4
				50-59	3
70-79	1	Other Admission Class	3	60-69	2
≥80	2			70-79	1
				80-91	0



32 . **Severe Burn and Disuse Effects on Bone Structure and Strength in Rats Over Time**

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Introduction: Challenges resulting from severe burn injury and disuse can be substantial from the time of injury and lasts for years following discharge. Burn and disuse result in endocrine responses that are associated with bone loss, leading to an increase risk of fracture and osteopenia. Bone structure responds independently to burn injury and disuse as a result of bed rest and has become an unassuming issue. The purpose of this study was to determine how bone structure and mechanical strength are affected by severe burn and disuse after 14 days.

Methods: Four groups of male, Sprague-Dawley rats (~ 300g): Sham Ambulatory (SA; N=10), Burn Ambulatory (BA; N=9), Sham/Hindlimb Unloading (SH; N=10) and Burn/Hindlimb unloaded (BH; N=10) were used. Burn groups received a 40% total body surface area full-thickness scald burn. Disuse by HLU was initiated immediately following injury. At the conclusion of the study, femurs were removed, cleaned, wrapped in saline-soaked gauze and stored at -20°C. Micro-CT images were collected at 25-µm and the 3 regions of interest (full bone, cortical and trabeculae) were analyzed and femur biomechanical parameters were measured by three-point bending testing of femurs biomechanical strength.

Results: Bone microstructure, bone mineral content (BMC) and Tissue Mineral Content (TMC) were decreased ($p < 0.001$) in BH compared to SA, BA, and SH. Cortical area and cortical thickness of the femoral midshaft was decreased in the burn groups ($p < 0.03$). Total volume of the distal trabeculae was increased independently of burn and disuse and in combination of burn and disuse ($p < 0.04$). Bone volume percentage and trabecular thickness were increased as a result of disuse and not affected by burn injury ($p < 0.005$). Bone surface to bone volume ratio was decreased by disuse ($p < 0.02$) but not affected by burn independently or in combination. Bending failure, a direct measure of bone strength, showed a 25% reduction in burn and disuse independently and a 51% decrease in combination. There was a significant positive association between both BMC and TMC and bending failure ($r^2 = 0.562$; $p < 0.0004$) as well as trabecular thickness and bending failure ($r^2 = 0.37$, $p < 0.02$). Bone strength was not affected by changes in the cortical bone.

Conclusions: Burn injury, accompanied by disuse cause complex bone strength and mechanical changes. Bone microstructure is affected differently by burn injury and compromising bone strength. Trabecular strength decreases as a result of disuse, which may lead to secondary injuries, such as fractures, while cortical bone has an underlying response related to the burn injury itself.

Applicability of Research to Practice: Disuse can offer detrimental issues on the burn patient and exacerbates over time. These data illustrate patients need for rehabilitation to be started as soon as possible.

33. **Effects of Leukotriene Antagonist Treatment on Pulmonary Function in Ovine Smoke Inhalation Injury**

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Introduction: The aims of this study were to investigate the effects of treatment with the leukotriene receptor antagonist Montelukast (MON) in our established model of acute lung injury (ALI) resulting from smoke inhalation injury (SII).

Methods: Eleven female sheep (30-40 kg) were operatively prepared for chronic study and were allocated randomly either to uninjured sham (n=3), injured vehicle control (n=3) or injured MON treatment (n=5) group. After tracheostomy, SII (48 breath of cotton smoke) was induced under deep general anesthesia. The sheep were mechanically ventilated and resuscitated for 24h in awake state. Treatment group received MON (70mg/sheep/day) as a continuous iv infusion and Control animals iv Ringers solution. Measurements were taken at baseline (BL) and every 3 to 6 h. Statistical analysis was accomplished with two-way ANOVA and Bonferroni post hoc comparisons. Data are expressed as mean \pm SEM. Significance was set as $p < 0.05$.

Results: The vehicle-treated group showed a significant decrease in PaO₂/FiO₂ ratio compared to MON treated animals (24h: 239 \pm 64 vs 468 \pm 9) and demonstrated also significant higher ventilatory pressures compared to MON (24h: 30.2 \pm 3 vs 17.8 \pm 1). Histopathologic analysis for bronchial obstruction scores expressed a significant difference between the control (24.9 \pm 1.4) and both other groups, the sham (2.9 \pm 1) and MON treatment (13.7 \pm 5).

Conclusions: Improvement of pulmonary function in SII sheep treated with MON demonstrates a significant role of arachidonic acid metabolites in the acute pathology of SII. The improvement in pulmonary function under MON treatment may be related to both, inhibition of smooth muscle constriction and reduction of smoke inhalation associated production of bronchiolar cast. Further studies to examine a minimum effective dose and extended benefits are needed.

Applicability of Research to Practice: MON is safely used in patients with chronic obstructive pulmonary disease. Demonstration of beneficial effects in combating the acute pathology of inhalation injury allows further studies to assess the impact of the treatment in burn victims with inhalation injury.

34. **Nebulization with Gamma-Tocopherol Ameliorates Acute Lung Injury after Burn and Smoke Inhalation in the Ovine Model**

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Introduction: We hypothesize that the nebulization of gamma-tocopherol (g-T) in the airway of our ovine model of acute respiratory distress syndrome (ARDS) will effectively improve pulmonary function following burn and smoke inhalation after 96 hours.

Methods: Adult ewes (n=14) were subjected to 40% total body surface area burn and were insufflated with 48 breaths of cotton smoke under deep anesthesia, in a double-blind comparative study. A customized aerosolization device continuously delivered g-T in ethanol with each breath from 3 to 48 hours after the injury (g-T group, n=6), while the control group (n=5) was nebulized with only ethanol. Animals were weaned from the ventilator when possible. All animals were sacrificed after 96 hours, with the exception of one untreated animal that was euthanized after 64 hours.

Results: Lung g-T concentration significantly increased after g-T nebulization compared to the control group (38.5 \pm 16.8 nmol/g vs. 0.39 \pm 0.46, $p < 0.01$). The PaO₂/FiO₂ ratio was significantly higher after treatment with g-T compared to the control group (310 \pm 152 vs 150 \pm 27.0, $p < 0.05$). The following clinical parameters were improved with g-T treatment: pulmonary shunt fraction, peak and pause pressures, lung bloodless wet-to-dry weight ratios (2.9 \pm 0.87 vs 4.6 \pm 1.4, $p < 0.05$), and bronchiolar obstruction (2.0 \pm 1.1% vs 4.6 \pm 1.7%, $p < 0.05$). Nebulization of g-T, carried by ethanol, improved pulmonary oxygenation and markedly reduced the time necessary for assisted ventilation in burn and smoke injured sheep.

Conclusions: In conclusion, we report that burn and smoke inhalation injury significantly reduces lung alpha- and gamma-tocopherol concentrations and increases markers of pulmonary pathophysiology such as deteriorated pulmonary gas exchange, increased peak and pause pressures, massive airway obstruction, and increased pulmonary edema, while nebulization with gamma-tocopherol attenuated the injury, improved pulmonary oxygenation, and markedly reduced ventilator time.

Applicability of Research to Practice: Delivery of g-T into the lungs may be a safe, novel, and efficient approach for management of ALI patients who have sustained oxidative damage to the airway.

35 . **Airway Pressure Release Ventilation (APRV) Successfully and Safely Treats Smoke Inhalation Injury**

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Introduction: Airway-pressure release ventilation (APRV) has been utilized in burn patients with inhalation injury for nearly four years at a regional burn center. A group of patients with inhalation injury treated with APRV was compared to a similar group of patients treated with high-frequency percussive ventilation. Clinical variables studied included those related to pulmonary function, complications of therapy, and global outcomes.

Methods: The charts of all burn patients with inhalation injury who were ventilated using the APRV mode were retrospectively reviewed. Inhalation injury was diagnosed based on history, physical examination, laboratory data, and bronchoscopy findings. Data collected included demographic data, burn and inhalation injury data, and outcome data. Outcome data included mortality, ventilator days, ICU days, incidence of ventilator-associated pneumonia (VAP), FIO₂, PAO₂: FIO₂ ratios (P/F ratio), mean and peak airway pressures, the need for interventions such as repeat bronchoscopy or thoracostomy tubes, and respiratory complications. This group of patients was compared with a historic cohort of 20 patients treated with high-frequency percussive ventilation.

Results: There were 112 patients identified with inhalation injury who were ventilated with APRV. Mean total body surface area burned was 19%. Average ventilator time was 7 days. Twelve patients died for a mortality of 11%. The vast majority of patients were ventilated with 0.40 FIO₂ throughout ventilator management. Likewise, P/F ratios remained in the 250 to 300 range. Peak airway pressures (Phigh) rarely exceeded 30 mm Hg. Most patients requiring ventilation greater than two weeks developed VAP. There were no significant complications resulting from APRV mode of ventilation. When compared to this group, the group of patients treated with high-frequency percussive ventilation demonstrated decreased P/F ratios and the number of therapeutic bronchoscopies. Other outcome measures such as ventilator days, ICU days, length of stay, and incidence of pneumonia did not differ between the two groups.

Conclusions: APRV has proven to be a safe and efficacious mode of ventilation for burn patients with inhalation injury. When compared to a historic cohort of patients treated with high-frequency ventilation, APRV demonstrates better P/F ratios and the need for fewer repeat bronchoscopies. APRV has become our preferred mode of ventilation in patients with inhalation injury.

Applicability of Research to Practice: Airway pressure release ventilation (APRV) is a safe and effective mode of ventilation in burn patients with inhalation injury.

36 . **A Comparison of Injury Scoring Systems in Predicting Burn Mortality**

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Introduction: Scoring systems are implemented in hospitals and burn centers to assess a patient's predicted morbidity and mortality. Previous research suggests that age, inhalation injury, total body surface area burn (TBSA), full-thickness burn size, and other factors are potential outcome predictors in burn patients. The objective of this project was to determine which of eight commonly used burn scoring systems best predicts mortality among burn patients TBSA burn $\geq 20\%$.

Methods: A retrospective review was conducted for all patients admitted into a regional burn center with a $\geq 20\%$ TBSA burn over an 18 month period of time. Univariate analyses were conducted to determine the relationship between each variable and mortality. For each of the eight scoring systems evaluated, a receiver operating characteristic (ROC) curve was calculated to determine the overall accuracy of each system in predicting mortality, as evidenced by the area under the curve (AUC).

Results: Data from a total of 117 patients were analyzed. The average age was 33 year, 72% were male, and average percent TBSA was 39.15 with an overall mortality of 17% (n=20). Mortality rates were statistically significantly associated with age, Injury Severity Score (ISS), Revised Trauma Score (RTS), APACHE II score, percent of full-thickness burn, total body surface area burned, and the number of risk factors. Of those scoring systems evaluated, the Trauma Injury Severity Score Method (AUC=0.8378) and the Age and Total Body Surface Area Burned equation (AUC=0.8003) demonstrated the highest predictive value.

Conclusions: Age, ISS, TBSA, full thickness burns, RTS, APACHE II score, and number of risk factors are potentially influential factors related to burn mortality. The TISS scoring system provided the highest mortality predictive quality.

Applicability of Research to Practice: The results could be useful for clinical and medical practices of burn injuries treatment.

37. **Standardized Bronchoscopy Form for Classification/Progress of Burn Inhalation Injury**

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Introduction: Many patients sustaining life-threatening burns simultaneously suffer smoke inhalation, causing acute lung injuries. Usually, the inhalation injury is confirmed on admission to the burn center using fiber optic bronchoscopy; however, there is no standardized approach to scoring bronchoscopies throughout burn centers. The purpose of this study is to develop a scoring system based on initial bronchoscopic findings that assist in predicting severity of inhalation injury.

Methods: Beginning in February of 2008, intubated patients with suspicion of inhalation injury underwent an initial fiber optic bronchoscopy within 24 hours of admission and were entered into the study. Extensive information regarding the history of the burn, physical examination, laboratory and radiographic data and the bronchoscopy exam itself were collected. Bronchoscopic findings included carbon staining, mucosal damage, edema and secretions were recorded in order to classify the injury (as mild, moderate, or severe). Outcome measures included patient disposition, number of vent days, length of intensive care unit (ICU) and hospital stay, P/F ratios, and development of ventilator associated pneumonia.

Results: Those patients whom expired during the course of their stay were not included in analysis, leaving 64 evaluable subjects. The majority of subjects were male (73%) with an average age of 44.5 years (SD 17.6), average total body surface area burn of 21% (SD 20.45), and an average bronchoscopy score of 4.3 (SD 2.5; scoring system range 0 - 16). Based on the initial documentation of burn injury severity, this study confirms that severity correlates with the length of intubation period/ventilatory support ($p=0.0035$), the length of ICU stay ($p=0.0068$) and length of hospital stay ($p=0.0395$).

Conclusions: Using the bronchoscopy scoring system as an initial assessment tool is an effective way of classifying the extent of an inhalation injury. More importantly, using the scoring system is useful in predicting patients' healing pattern and respiratory/ventilatory therapy needs. A standardized bronchoscopy system for classification and progression of burn inhalation injury is necessary in today's rapidly advancing surgical technology. Such a system may be used to direct patient respiratory management, especially extubation.

Applicability of Research to Practice: An accurate inhalation scoring system can be used to predict outcome and direct clinical care in burn patients with inhalation injury.

38. **Is Early Bronchoscopy Helpful in Diagnosing Inhalation Injury?**

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Introduction: Diagnosing inhalation injury still relies on the triad: Burn in an enclosed space, COHB level elevation and soot in the airway.

Other modalities to diagnose inhalation injury have been employed in the past (Xenon scan, laryngoscopy, CT, etc.). None of these modalities are clinically established or available in all institutions. Previous studies attempted to stage inhalation injury with and without bronchoscopy, but clinical parameters were not a strong predictor of complications and mortality. This study evaluated the predictive value of location of soot deposition above or below the main carina during initial bronchoscopy.

Methods: Retrospectively included were all patients admitted to the Burn Center with suspected inhalation injury, undergoing bronchoscopy by the burn surgeons (within 24 h) between 1- 2002 and 12- 2008 . Excluded were patients dead on arrival. Data collection included: Patient age, sex, history and mechanism of burn, past medical history, Total Body Surface Area Burn (TBSA), facial burns, dysphonia, findings on auscultation, time between burn and burn unit admission, bronchoscopy findings, adverse effects of bronchoscopy (bleeding), burn unit length of stay, number of days on ventilator, pneumonia/ infection rate, fluid resuscitation amount, ABG, COHb level, initial chest x-ray findings and mortality. A mixed models ANOVA and covariate analysis were conducted. IRB approval was obtained.

Results: Of 3087 patients, 340 underwent an initial bronchoscopy because of suspected inhalation injury (facial burns/singed facial hair etc.). 60% of patients had soot deposits below the level of the carina, 32% had abnormal findings on initial chest x-ray and only 2% had an abnormal initial auscultation. There were less than 1% adverse events related to bronchoscopy. The presence of soot below the level of the main carina independently predicted mortality ($p=0.015$), infection ($p=0.004$), ICU stay ($p=0.03$) and prolonged ventilator treatment ($p=0.000$). Chest x-ray independently only predicted ICU stay and number of ventilator days. None of the other respiratory parameters, including the initial COHb level, had any independent influence on mortality, vent days, infection or ICU stay. Results also consider the impact of non-respiratory covariates on our outcomes.

Conclusions: The specific finding of soot deposition beyond the level of the main carina independently predicted mortality, ventilator days and pneumonia rate in patients with suspected inhalation injury. Bronchoscopy within 24 hours post injury should therefore be recommended as a standard diagnostic tool for smoke inhalation injury. Known clinical covariates like TBSA, age and total fluid resuscitation had the expected impact on our outcome measures, confirming previous studies results.

39 . Effects of Pneumonia on Clinical Outcomes in Burned Children with Inhalation Injury

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Introduction: Inhalation injury continues to represent a major source of morbidity and mortality. Inhalation injury predisposes the burn patient to pneumonia. Pneumonia has been shown to increase mortality by 40-60%. The aim of the present study was to evaluate the incidence, morbidity, and mortality of pneumonia among a large group of pediatric burn patients with inhalation injury.

Methods: Seven hundred sixty nine pediatric burn patients with inhalation injury were retrospectively studied. Patients were randomized into two groups; pneumonia (n=150) vs. no-pneumonia (n=619). Outcome variables included demographics, length of stay (LOS), length of ventilation (LOV), incidence of acute respiratory distress syndrome (ARDS), and mortality. Data are reported as mean \pm SD. Significance was accepted at $p < 0.05$.

Results: The overall incidence of pneumonia was 19.5%. Age was similar in both groups. The % TBSA burn in the pneumonia group was 62 ± 23 vs. 48 ± 25 in patients without ($p < 0.05$). The LOS for patients with pneumonia was 39 ± 37 days vs. 31 ± 29 days for those without ($p < 0.05$). The average length of ventilation in patients with pneumonia was 14 ± 18 days vs. 5 ± 11 days for those without ($p < 0.05$). The ARDS rate for patients with pneumonia was 38% vs. 4% for those without ($p < 0.05$). The mortality rate for patients with pneumonia was 43% vs. 7% for those without ($p < 0.05$).

Conclusions: The presence of pneumonia in pediatric burn patients with inhalation injury significantly increases the LOS, LOV, incidence of ARDS and mortality. Therapeutic priorities should be aimed at prevention, early detection and aggressive treatment.

Applicability of Research to Practice: This study underscores the need for increased focus on the prevention and treatment of pneumonia following inhalation injury.

40 . Effects of Mechanical Ventilation on Cardiopulmonary Function in Burned Patients with Inhalation Injury

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Introduction: Inhalation injury remains a significant source of morbidity and mortality in patients with thermal injury. Thus, the management of inhalation injury often requires the use of mechanical ventilation. Survivors of inhalation injury have decreased lung function and reduced exercise capacity that persist for years after the burn injury. Advances in clinical care have positively impacted outcomes in this patient population. The effects of new respiratory care strategies on long term morbidity remain uncertain. The aim of this study, therefore, was to assess the effects of mechanical ventilation on peak cardiopulmonary function (VO₂ peak) at 6 to 9 months post burn..

Methods: Ninety two pediatric burn patients >6 years of age with burns $\geq 30\%$ of TBSA burned were evaluated and allocated into two groups: mechanical ventilated (MV: n= 47) vs. no mechanical ventilation (NMV: n=45). All patients underwent a standardized treadmill exercise test (the modified Bruce protocol) using Medgraphics CardioO₂ (St. Paul, MN) for cardiopulmonary assessment. Outcome variables included demographics, length of hospital stay, length of mechanical ventilation, and incidence of pneumonia and VO₂ peak.

Results: Patients included in the MV group were more severely burned (%TBSA: $65 \pm 16\%$ vs. $57 \pm 14\%$, $p < 0.05$; %TBSA - 3rd degree burns: $53 \pm 24\%$ vs. $43 \pm 23\%$, $p < 0.05$). Length of hospital stay was also significantly greater in the MV group (46.06 ± 26.42 vs. 28.67 ± 23.23 days, $p < 0.01$). Length of mechanical ventilation was 8.02 ± 9.20 days. VO₂ peak was not different between groups (MV: 29.21 ± 6.65 , NMV: 31.28 ± 7.20 ml/kg/min). No correlation between VO₂ peak and length of hospital stay or time on the ventilator was found. Seven patients from the MV group had diagnosed pneumonia. Further analyses excluding these patients showed no significant changes between the NMV and MV groups.

Conclusions: The use of mechanical ventilation in the acute care of pediatric patients with inhalation injury did not adversely affect VO₂ peak when assessed 6-9 months post burn. We conclude that proper, kind gentle ventilation modality significantly preserves cardiopulmonary function during exercise. Low VO₂ peak values are most likely due to prolonged inactivity.

Applicability of Research to Practice: This study underscores the benefits of kind gentle ventilation modality in preserving the cardiopulmonary function of severely burned patients.

41 . Essential Roles for ACVR2B and its Ligands in Burn Injury Survival and Muscle Wasting

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Introduction: Burn injury is characterized by chronic inflammation, hypermetabolism and hypercatabolism. This results in significant skeletal muscle loss, although the mechanisms responsible are largely unknown. The myostatin family of ligands signal through Activin type IIA/B receptors (ACVR2A/B), resulting in SMAD2/3 phosphorylation and skeletal muscle atrophy. We recently reported that a soluble form of the murine ACVR2B receptor (ACVR2B/Fc) potently inhibits skeletal muscle wasting in cancer cachexia in mice. Here we sought to investigate the role of the myostatin/ACVR2B/SMAD2 pathway in severe burn injury.

Methods: C57BL/6 wild-type mice or mice with skeletal muscle specific expression of a dominant negative ACVR2B (MLC-dnACVR2B) were subjected to 20% body surface area burn injury. ACVR2B/Fc (10mg/kg) was administered by intraperitoneal injection on days 1, 5 and 8. Mice were killed at 14 days. Body mass, muscle mass and carcass composition were determined. Western blotting analysis for phospho(p)-SMAD2 in quadriceps was performed.

Results: Burned wild-type mice showed reduced final body (-4.5%, NS), carcass (-5.1%, NS), quadriceps (-12.6%, $P<0.01$), and gastrocnemius weights (-8.1%, $P<0.05$) versus unburned mice. Burned mice treated with ACVR2B/Fc exhibited increased final body (+10.7%, $P<0.001$), carcass (+14.2%, $P<0.001$), quadriceps (+15.9%, $P<0.01$), gastrocnemius (+13.6%, $P<0.001$), and tibialis weights (+13.1%, NS), versus carrier-treated burned mice. Survival at 14 days was 75% for carrier treated mice and 100% for ACVR2B/Fc treated mice. Burned wild-type mice exhibited increased skeletal muscle pSMAD2 at 6hrs, 12hrs and 14 days. Conversely, no pSMAD2 was detected in burned MLC-dnACVR2B mice at 6hrs and 12hrs. All MLC-dnACVR2B mice died within 48hrs of burn injury.

Conclusions: Activation of pSMAD2 in skeletal muscle after burn was mediated through myostatin family ligand signaling. Inhibition of those ligands, using soluble ACVR2B/Fc, improved survival and rescued muscle wasting after burn injury. Thus, myostatin family signaling through ACVR2B is responsible in part for muscle wasting and late mortality after burn injury. Paradoxically, the observed 100% early mortality of MLC-dnACVR2B mice also indicates that intact skeletal muscle ACVR2B is required for acute survival after burn injury. Given its conserved function in humans, modulation of myostatin family signaling is an important clinical target for burn therapy.

Applicability of Research to Practice: The modulation of myostatin family ligand signaling in severe burn injury reduces muscle wasting and improves survival, making this is an important clinical target for burn therapy.

42 . Long Term Characterization of Muscle Protein Synthesis in Pediatric Burns

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Introduction: The hypermetabolic and hyper-inflammatory responses following severe burn injury persists for up to 36 months. Poor nutrition and dietary deficiencies existing prior to the injury, and ten-fold elevations of catecholamines immediately post-burn lead to alterations in muscle physiology. Characterization of the time course of post-burn muscle protein synthesis, breakdown, and turnover, however, has not been reported. Here we report the post burn time course of fractional synthetic rate (FSR) alterations over the first 18 months post injury.

Methods: 179 Pediatric patients with $\geq 30\%$ Total Body Surface Area (TBSA) burns from October 2002 to August 2008 participated in this study. These patients were participants of prospective randomized control trials and consented to protein kinetic studies by means of well-established stable isotope infusion methodology. Stable isotope tracer infusion studies and muscle biopsies were performed at time points (10d, 20d, 30d, 3mo, 6mo, 9mo, 12mo, and 18mo). Patients were 6 ± 5 years of age, 74% male, with $59\pm 16\%$ TBSA burned, 74% sustaining flame injuries, and 40% had inhalation injury. Statistical analysis was performed using paired t-test. Significance level was accepted at $p<0.05$.

Results: Baseline FSR was measured 10d post burn and was calculated at $0.094\pm 0.01\%$; FSR was significantly increased at all subsequent time points ($P<0.01$). The peak FSR occurred 30d post burn ($0.159\pm 0.02\%$, compared to baseline, $P<0.01$).

Conclusions: After the baseline measurements, the post-burn muscle FSR reached steady levels which lasted for at least 18 months post-injury. These data correlated with our additional findings that even 36 months post burn, elevated levels of cytokines, impaired insulin sensitivity and decreased levels of growth hormone and IGF-1 persist. As cytokines, insulin sensitivity, and IGF-1 signaling are all implicated in protein metabolism, future studies will focus on determining the causal relationships between these sequelae and post burn muscle wasting.

Applicability of Research to Practice: Immune suppression and muscle weakness accompany loss of lean body mass. Further research to determine the role of genomic and proteomic responses on muscle protein kinetics is warranted in the chronic phase of burn injury to decrease the catabolic response.

43. **Evaluation of Glucagon-Like Polypeptide-1 (GLP-1) Effect in Burn Injury by Intragastric Glucose Tolerance Test (IGGTT)**

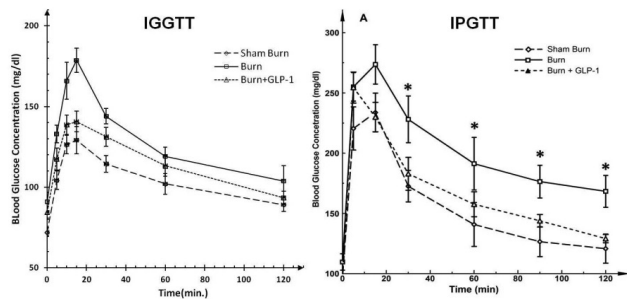
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Introduction: One of the major clinical manifestations of burn injury (BI) induced insulin resistance (IR), the extent of which is associated with mortality and morbidity in severely burned patients. Glycemic control using insulin is now an integral part in the care of burn patients. Studies have demonstrated the potential benefit of using the gut hormone GLP-1 in correcting the hyperglycemia of ICU patients without the risk of hypoglycemia which may occur with insulin treatment. Our previous animal experiments showed the efficiency of GLP-1 for glycemic control in burned animals by intraperitoneal glucose tolerance test (IPGTT). Since most critically ill burn patients are receiving enteral feeding (EN), the present study was designed to evaluate the effect of GLP-1 by IGGTT and comparing the results with IPGTT.

Methods: Male CD rats (n=21) were divided into three groups. Sham Burn (SB), Burn (B) and Burn + Chronic GLP-1 infusion (B+GLP) with implanted osmotic pumps. B groups had 40% full thickness BI. IGGTT was performed on post burn day 6 by a bolus injection of glucose (2 mg/kg) via an intragastric tube. The results of IGGTT were compared with IPGTT results from our previous study.

Results: Blood glucose (BG) curves for IGGTT and IPGTT are shown in the Figure. The two sets of curves show a similar pattern, further confirming the efficiency of GLP-1 in reducing BI induced hyperglycemia. Furthermore the IGGTT study demonstrated a significant lower level of maximal BG compared with the IPGTT study (178.7 ± 7.5 vs. 264.8 ± 13.3 mg/dl; $p < 0.001$). This was accompanied by a much higher peak insulin level (5.60 ± 1.91 vs. 2.10 ± 0.29 ng/ml; $p < 0.001$) in both SB and B groups. Hence, IG glucose more efficiently stimulated insulin production compared to IP glucose.

Conclusions: 1) Both IPGTT and IGGTT tests confirmed the efficacy of GLP-1 in reducing hyperglycemia and improving IR status in BI. 2) Enteral glucose administration more efficiently stimulates insulin production which is associated with reduced fluctuations of BG.



44. **Measures of Total Energy Expenditure and Its Components Using the Doubly Labeled Water Method in Rehabilitating Burn Children**

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Introduction: A persistent hypermetabolic state is proposed as the cause for delayed anabolism and lack of growth in burned children. However our own clinical experience has been that resting energy expenditure (REE) is not increased significantly during the rehabilitative phase, suggesting that other energy variables may be involved. We measured total energy expenditure (TEE) and its major components in rehabilitating pediatric burn patients to better understand this phenomenon.

Methods: Children admitted with initial burns 20% or greater of their total body surface area (TBSA) were enrolled into this study at the time of wound closure. TEE was measured using the combined stable isotope ^{18}O and 2H water method. Following a baseline urine sample, a weight based oral dose of the stable isotope tracers was given. TEE was calculated based on urinary isotopic abundance on days 0, 1, 5, and 7. On at least 2 days of that 7-day period, REE was measured in each patient, upon awakening, following an overnight fast, by indirect calorimetry. Activity energy expenditure (AEE) was assessed using a physical activity monitoring device worn on the wrist or ankle for a 24-hour period. TEE and REE were compared to gender-specific, age and weight matched predicted norms using the Dietary Reference Intakes (DRI) standards. The relative contribution of REE and AEE to TEE was determined.

Results: Ten children with an average burn size of 53.7 ± 20 (range: 27-82) %TBSA completed this study. Their mean age (years) and weight (kg) were 10.4 ± 5.5 and 35.8 ± 16.4 respectively. Daily TEE averaged 66 kcal/kg, and was 1.08% of the reference DRI, however the range was large, with 50% of patients having TEE values that were above normal. Mean REE was slightly below predicted REE, and represented 55.8% of TEE, while AEE accounted for 36.2% of TEE (Table 1).

Conclusions: REE is not uniformly raised in recovered burn children. TEE and REE were comparatively normal in this population, however there was high variability both in relationship to norms and in the contribution of REE and AEE to TEE among the individual children. Convenient methods to assess TEE and its components during rehabilitation are needed.

Applicability of Research to Practice: Understanding total energy expenditure in rehabilitating burn patients and the relative contribution of its components enable the practitioner to respond appropriately to negative energy balance.

Table 1 Measures of Total, Resting, and Activity Energy Expenditure in Rehabilitating Burn Children

	TEE (kcal/day)	REE (kcal/day)	AEE (kcal/day)	REE/ TEE (%)	AEE/ TEE (%)	REE/ DRI- REE (%)	TEE/ DRI- TEE (%)
Mean (SD)	2000.6 (633.6)	1109.3 (403.2)	733.5 (688.3)	55.8 (14.5)	36.2 (30.1)	92.0 (24.9)	1.08 (0.45)
Range	1127- 3044	401- 1819	39- 1995	30.1- 76.0	2.2- 86.0	40.1- 120.7	46.6- 215.2

45 . Oral Administration of Propranolol Diminishes Extremity Blood Flow in Pediatric Burned Patients

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Introduction: In burns, the 'flow' phase lasts up to 12 months, characteristically presenting hyperdynamic peripheral circulation. A previous study showed that a brief two-hour infusion of IV propranolol in burned adults decreased their elevations in heart rate (HR), mean arterial pressure (MAP) and leg blood flow (LBF). We hypothesized that oral administration of propranolol in pediatric burn patients would lead to a sustainable decrease in LBF and cardiac parameters.

Methods: Analysis was performed in patients enrolled in a prospective-randomized control trial of oral propranolol. The first measurement of LBF using an infusion of Indocyanine Green to the femoral artery was conducted 9±1 days postburn. Propranolol was started 11±2 days post-burn and continued for 20±2 days until discharge. While on propranolol, a second LBF measurement was obtained 21±2 days postburn. Hypothesis testing involved T-test. Statistical significance was set at a p value of <0.05. Results are shown as mean ± SEM.

Results: Twenty-one children with 59±3% total body surface area (TBSA) burn received propranolol at 2-4 mg/kg/day, while thirty-eight demographically-comparable controls did not. Before initiating propranolol, both groups were extremely hyperdynamic. Propranolol lowered the HR by 20% (p<0.001), MAP by 10% (p<0.05), and effectively decreased LBF (14.7±1.4 vs. 10.2±1.1 ml.min⁻¹.100 ml leg⁻¹, p=0.001). Neither of these effects was observed in controls.

Conclusions: During the acute period of severe burns, propranolol diminishes peripheral blood flow and blunts the post-burn hyperdynamic response.

Applicability of Research to Practice: Propranolol is recommended to further assess the effect of diminished peripheral blood flow in wound healing.

46 . Long-Term Followup Fracture Incidence in Children Receiving Vitamin D Supplementation During the Acute Phase Postburn

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Introduction: Effect of supplemental vitamin D on fracture incidence is unclear. The objective of this study was to evaluate the post-intervention incidence of fractures in children during the rehabilitative phase postburn.

Methods: Fifty patients were randomized to acutely receive 100 IU/kg/day of D2, D3 or placebo (03/21/03 - 01/07/09). Serum D25, D1,25, D2 and D3 were obtained on postburn (PB) day 7, midpoint, discharge and 1- year PB; DEXA was performed at discharge and 1- year PB. Parents were contacted by phone from 01/11 - 08/11 for long term follow-up consisting of a query of fracture occurrence since discharge. Fracture outcome was differentiated between supplementation groups. Demographics, vitamin D nutriture and DEXA parameters were compared between the positive and negative fracture groups.

Results: Fracture history was available in 39 of 50 patients (78% return). Long-bone fractures were reported in 6 of 39 patients (15.4% incidence). Fractures ensued w/i one month to 2 yrs following discharge. Four fractures occurred in the placebo group; two fractures were observed in the D2 group; and none occurred in the D3 group. Serum vitamin D was similar between the positive and negative fracture groups throughout the study timeline. The fracture group had a higher TBSAB (83.8 ± 4.9% vs 53.0 ± 2.9%, p<0.0001); full thickness (69.7 ± 9.4% vs 39.4 ± 4.1%, p<0.02); and increased incidence of inhalation injury (33% vs 6%, p<0.04) in comparison to those without fracture. DEXA z-score indicated decreased bone density in the placebo fracture group at discharge.

Conclusions: Fracture was associated with placebo or D2 treatment and decreased z- score at discharge. There was no evidence of relationship between serum vitamin D and fracture. Although we were unable to prove cause/effect relationship of vitamin D intake to fractures due to possible confounding variables (burn size, depth, inhalation injury), the results reaffirm the negative impact of burns on bone health. Given no fractures occurred in the D3 supplemented group, it is speculated that acute vitamin D3 provision PB may offer a protective benefit against fractures in children; however the small sample size makes this impossible to demonstrate statistically.

Applicability of Research to Practice: A gap in knowledge regarding best practice methods for fracture prevention exists. Additional research is needed to further delineate D3 requirements postburn and to differentiate the mechanism(s) involved in bone demineralization.

Comparison of Parameters Between Groups at Discharge

	Fracture		No Fracture			
	Placebo (n=4)	D2 (n=2)	Placebo (n=9)	D2 (n=11)	D3 (n=13)	p value
D25	53.5 (23.0,55.7)	32.8 (32.8,32.8)	47.2 (38.3,55.1)	42.0 (34.0,53.0)	37.8 (31.3,58.3)	0.65
D1,25	25.9 (19.0,104.0)	37.0 (37.0, 37.0)	23.7 (19.2,84.0)	40.1 (20.0,79.0)	36.0 (18.0,70.0)	0.93
D2	0.71 (0.71, 0.71)	11.5 (11.5, 11.5)	1.2 (0.71,2.5)	19.0 (14.0,21.0)	0.71 (0.71,0.71)	0.73
D3	52.5 (22.3,55.0)	21.3 (21.3, 21.3)	46.0 (35.0,54.0)	23.5 (18.0,26.0)	34.0 (30.6,55.0)	0.94
Z score	-2.05 + 0.46*	-1.10 + 0.10	-0.54 + 0.42*	-0.35 + 0.05	-0.66 + 0.31	0.07
p value represents interaction of fracture and group						
*different at p<0.05 adjusting for multiple testing						
Vitamin D values reported as median (25th,75th percentile)						
Z score reported as mean + SEM						

47. The Impact of Chronic Hyperglycemia on Glycemic Control and Clinical Outcomes Post-Burn Injury

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Introduction: Eighteen percent of patients > 65 years have a diagnosis of diabetes, while 85% of patients > 65 years with burn injury have diabetes. Poor outcomes in diabetic burn patients are thought to be due to complications of acute and chronic hyperglycemia. While hyperglycemia during critical illness has typically been associated with poor outcomes, patients with higher hemoglobin A1c (HbA1c) measurements have been shown to tolerate higher glucose levels during hospitalization. However, this relationship has not been evaluated in the burn population. The objective of this study was to examine the impact of chronic glucose control on glycemic parameters and outcomes in the acute post-burn period.

Methods: This was a retrospective analysis comparing patients with chronic hyperglycemia (HbA1c > 6.5) to patients with euglycemia (HbA1c < 6.5). Patients aged 18-89 years admitted for initial burn care between January 2009 and June 2010 with a HbA1c on admission were included. The primary endpoint was unplanned readmissions, with secondary endpoints of length of stay (LOS) and mortality. Patients admitted for > 7 days were further evaluated for time-weighted glucose (GluTW), glucose variability (Gv), and infection rates. The standard glucose target was 110-150 mg/dl.

Results: Two hundred fifty eight patients were included (32 chronic hyperglycemia and 226 euglycemia). Burn severity was similar between the groups. Patients with chronic hyperglycemia were significantly older, and were more likely to have diabetes, respiratory disease and hypertension. While survival rates were similar, the chronic hyperglycemia group had significantly increased LOS and a higher rate of unplanned readmission. Among the 87 patients admitted for > 7 days, chronic hyperglycemia patients had higher GluTW (163.3 + 27.8 vs. 131.6 + 23.1 mg/dl, p<0.001) and Gv (53.3 + 19.2 vs. 24.7 + 15.1, p<0.001). Despite these differences, infection rates were similar (31.3 chronic hyperglycemia vs. 38% euglycemia, p=0.612).

Conclusions: Chronic hyperglycemia prior to burn injury was associated different glucose trends during hospitalization despite a standard glucose target as well as worse outcomes. Further research is needed to identify whether chronic hyperglycemia necessitates a different approach to glycemic management acutely post-burn.

Applicability of Research to Practice: Based on these results, patients with chronic hyperglycemia may benefit from different strategies for glucose management.

Table 1 Characteristics and Outcomes of Chronic Hyperglycemia and Euglycemia Patients

	Chronic Hyperglycemia (n=32)	Euglycemia (n=226)	p-value
Baseline Characteristics			
Male gender, n(%)	26 (81.3)	173 (76.5)	0.553
Age, years (mean + SD)	54.7 + 14.4	44.3 + 16.1	0.001
Total body surface area, % (median [IQR])	3 [1-7]	3 [1.5-7]	0.441
Diabetes mellitus, n(%)	29 (90.6)	17 (7.5)	<0.001
Hypertension, n(%)	19 (59.4)	59 (26.1)	<0.001
Respiratory disease, n(%)	10 (31.3)	37 (16.4)	0.041
Admission HbA1c (mean + SD)	8.00 + 1.52	5.42 + 0.42	<0.001
Admission Glucose, mg/dl (median [IQR])	162 [129-201.75]	106 [95-126]	<0.001
Clinical Outcomes			
ICU admission, n(%)	13 (40.6)	57 (25.3)	0.069
Hospital length of stay, days (median [IQR])	13 [8-38]	9 [3-33]	0.038
Survival, n(%)	32 (100)	220 (97.3)	>0.99
Unplanned readmission, n(%)	5 (15.6)	3 (1.3)	0.001

48. The Utility of Hemoglobin A1c in Glycemic Management of Burn Patients

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Introduction: Hyperglycemia and diabetes mellitus (DM) are common ICU problems increasing morbidity and mortality. Hemoglobin A1c level (A1c) is used for the diagnosis of DM but there is little data about whether either DM or A1c levels affect actual glucose control measures in the ICU. We performed this IRB approved retrospective study to assess the relationship of pre-burn diagnosis of DM, admission A1c and ICU glucose control measures in burn patients and utility of these factors in patient care.

Methods: Charts of acute burn patients >25 years of age with A1c measured on admission to the Burn ICU from January 2008 to April 2010 were reviewed. We examined patient demographics, admission diagnosis, history of DM, A1c, use of sliding scale insulin (SSI), continuous insulin infusion (CII) or oral hypoglycemic medications (oral agents), and outcomes.

Results: Eighty-five patients (76% male) had admission A1c obtained. Average age was 51 with 13% incidence of pre-burn DM. Median A1c for all patients was 5.4 (normal <6.0%). Patients with pre-burn DM had a higher percentage of elevated (>6.5%) A1c than those without (58% vs. 3%, p<0.001). Those with DM were more likely to receive SSI (92% vs. 56%, p, 0.017) and oral agents (75% vs. 32%, p=0.006) but not significantly more likely to require CII (33% vs. 18%, p=0.191). There were no significant differences in mortality, but LOS per %TBSA was greater in those with DM. Patients with a history of DM were more likely to be discharged with oral agents (83% vs. 11%, p<0.001). Results were not statistically different when A1c was used as a marker for DM.

Conclusions: Patients with either a stated history of DM or elevated admission hemoglobin A1c levels were more likely to require SSI or oral agents but not significantly more likely to require CII after a burn. Hemoglobin A1c levels correlated with patient history but increased cost without improving care.

Applicability of Research to Practice: Glycemic control should be managed clinically; A1c offers no additional benefit beyond a proper admission history.

	Total	No history DM	History DM	p-value***
Number of burn patients	85	73	12	
Male % (n)	76% (65)	80% (59)	50% (6)	0.030
Age*	51.1 ± 15.1	48.9 ± 14.6	64.3 ± 10.5	<0.001
TBSA**	10.5 (5.3-22.3)	11.3 (5.8-22.8)	4.5 (1.5-10)	0.014
HgbA1c	5.4 (5.1-5.7)	5.3 (5.1-5.6)	6.6 (5.6-10.5)	<0.001
BMI**	28.6 (24.5-32.3)	28.3 (24.3-32.1)	30.3 (25.5-33.6)	0.283
Sliding Scale Insulin	61% (52)	56% (41)	92% (11)	0.017
Continuous Insulin Infusion	20% (17)	18% (13)	33% (4)	0.191
LOS/TBSA**days	1.5 (0.7-2.7)	1.3 (0.7-2.6)	2.8 (1.9-6.0)	0.010

*mean ± STD, **median (IQR), *** Wilcoxon rank sum test is used for continuous variables; Chi Square is used for categorical variables.

49 . **Child Abuse by Burning: Highly Predictive Model for Detection**

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Introduction: Child abuse by burning is suspected in 1-25% of all children admitted to burn centers. Reporting injuries is often difficult secondary to the lack of objective data. As missed injuries can lead to further intentional injuries, we sought to determine a model incorporating objective data to guide the determination of the likelihood of the presence of intentional injury.

Methods: Prospectively we enrolled 68 children < 14 years of age who were admitted to our burn center 4/2008 to 10/2009. Parents filled out an injury questionnaire. Charts were abstracted for additional information. Statistical analysis included multifactor logistic regression, student T test, Pearson chi squared and Fisher's exact tests where indicated. We constructed a composite risk score from identified risk factors and receiver operating characteristic (ROC) analysis was employed to assess its value.

Results: Our study sample was predominantly boys (70%) with an average age of 61.2±49.7 months. Their average burn size was 6.5±6.7% and they stayed an average of 5.7±7.2 days. The health care team suspected abuse in 15 children, with 10 of these children having confirmed abuse by Department of Health and Human Services ($p < 0.001$). The outcome of four children could not be determined. Factors significantly associated with abusive injury included: parental age, time to medical assistance, scald etiology, feet burn, immersion lines, parental relationship and type of first aid given after the injury. Four variables strongly predicted the presence of child abuse and constituted our "ABC'S" model. These included: age < 24 months (A), tap water burn etiology (B), no parent present at time of injury (C) and delay in seeking medical treatment (S). This model has exceptional predictive value of the burn being inflicted by abuse with area under ROC curve 98% (95% CI 96-100%). The presence of two of these variables predicted intentional injury with a sensitivity of 100% and specificity of 94% in our prospective sample.

Conclusions: In conclusion, health care team members are adept at determining the presence of abusive injury through evaluation of injury circumstances and burn patterns. The "ABC'S" model helps to provide additional objective evidence to guide uniform evaluation of childhood injuries.

Applicability of Research to Practice: Objective data can help practitioners better detect abusive burn injuries.

50 . **Incidence of Intimate Partner and Family Violence in Adult Burn Victims**

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Introduction: Much has been written about the incidence of inflicted burn injuries in children but not of adult victims, particularly males who have been thermally injured by intimate partners and family members.

Methods: We conducted a retrospective chart review of all adults over age 18 admitted in a 30 month period with burn injuries and identified those who at any point in their hospitalization reported the injury as the result of assault. We further delineated those patients whose injury was caused by an intimate partner or family member versus those injured by an unknown assailant. We analyzed the percent total body surface area (%TBSA), length of stay and number of surgical interventions needed for wound closure.

Results: A total of 1,114 adult patients were admitted to the burn center with thermal burn injuries in the time period; thirty-one were identified as victims of assault (2.8%). Of these assault victims, twenty-one were burned by intimate partners or family members (67.7%). The average %TBSA was 12.7%. Patients assaulted by partners, family members and intimate acquaintances on average spent 15.6 days in the burn center. Ten of the twenty-one patients (47.6%) required surgical intervention for wound closure. Males constituted the majority, 15/21 (71.4%).

Conclusions: Domestic violence against men, particularly burn assault, is an unrecognized problem. Current societal attitudes continue to blame men as "bringing it on themselves" and downplay the seriousness of the injury. However, men who are scalded by their intimate partners are often hospitalized for a significant amount of time, frequently require tangential excision and skin grafting and suffer emotionally and physically. Few resources exist in either government or private sectors which address the issue of intimate partner violence directed at men, particularly those who have been burned by their partners. Burn injuries inflicted on men as revenge for perceived wrongdoing is often treated in the media with humor and contempt for the victim. Examples of this attitude have been noted in movies as well as in tabloids. Our burn center has identified a population who are in need of counseling, support and legal assistance. A public awareness and education campaign would also bring to light the seriousness of this type of injury to those in the community who view scalding as an acceptable means of revenge or misunderstand the seriousness and implications of a burn injury.

Applicability of Research to Practice: Directly applicable to practice and outreach education.

51 . **High-Risk But Not Always Lethal: The Effect of Cirrhosis on Mortality in Thermally Injured Adults**

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Introduction: Of those patients who undergo emergency surgery, the presence of cirrhosis greatly increases the risk of death. Little has been reported on cirrhosis as a co-morbidity in burn patients. We sought to determine the effect of pre-existing cirrhosis on mortality in thermally injured patients.

Methods: We conducted a retrospective review of patients with acute thermal burns admitted to our burn center during the period 2003-2010. The diagnosis of cirrhosis was established from hospital records and/or autopsy reports for 24 patients. Multivariate logistic regression on mortality was performed with age, total body surface area (TBSA) burned, inhalation injury, and cirrhosis as the candidate predictors. Data are presented as means±standard deviation.

Results: Of 808 charts that were reviewed, data were analyzed on 24 cirrhotic and 784 non-cirrhotic patients. The mortality rate for the cirrhotic (C) patients was 50%, and for the non-cirrhotic (NC) patients the mortality rate was 14.8%. These 2 patient groups were similar in TBSA (C 17.1±17.0%, NC 22.6±22.2%, $p = 0.23$) and full thickness burn size (C 8.0±16.1%, NC 12.7±19.4%, $p = 0.24$), but differed in age (C 58.3±13.6 yrs, NC 41.7 ±18.7 yrs, $p < .0001$) and inhalation injury (C 29.2%, NC 13.7%, $p = 0.03$). By logistic regression, the independent predictors of mortality were age (OR 1.08, C.I. 1.06-1.10), TBSA (OR 1.08, C.I. 1.06-1.10), inhalation injury (OR 3.17, C.I. 1.61-6.25), and cirrhosis (OR 8.78, C.I. 2.97-25.98).

Conclusions: Among patients with severe burns, cirrhosis increases the risk of death by almost 9-fold. Cirrhosis in this patient population is not uniformly fatal, but new strategies would be needed to improve outcomes.

Applicability of Research to Practice: A patient admitted with burns and clinical stigmata of cirrhosis warrants further investigation to uncover the presence of liver dysfunction or failure.

52 . **A Bilingual Anti-Scald, Fire & Burn Prevention Campaign for Head Start Results in Reduced Pediatric Admissions to a Busy Regional Burn Center**

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Introduction: In a major review of burn center admissions in the United States, children younger than 5 years (< 50%) accounted for the age group with the highest incidence of burn center hospitalizations. A review of the burn registry over a two-year period revealed that 90% of pediatric patients sustained scald or fire/flame related injuries and that 65% of patients were Hispanic. Considering the magnitude of scald and fire/flame related injuries, largely impacting a specific ethnicity, an anti-scald and fire/flame burn prevention program was designed for Head Start teachers, parents and children, in zip codes previously designated as high risk for pediatric burn admissions.

Methods: In an effort to reach the targeted zip codes with an educational, family-oriented, anti-scald and fire safety program, storybooks, alphabet safety cards and a fire safety coloring book in English and Spanish with curriculum were provided. Lessons addressed scald prevention, the importance of escape plans, smoke detectors and fire prevention and included parent education. Parent and teacher trainings were conducted in conjunction with printed materials. Pre and post tests regarding burn prevention knowledge were given to parents and teachers and a pre-and post program review of the burn registry documenting pediatric patient admissions (0-5 years) residing in the training program zip codes was undertaken.

Results: Parents showed a significant improvement in understanding the danger of burns and prevention techniques ($n=196$) pre-test mean score of 45% and a post-test mean score of 86% ($p<0.0001$). Teachers ($n=114$) also showed improvement pre-test mean of 79% to a post-test mean of 99% ($p<0.0001$). Prior to the initiation of the program there were 25 pediatric admissions from targeted zip codes. After the program had been in effect for 1.5 years, there were only 11 admits, a 66% reduction. Scald admissions were reduced by 71%, from 17 to 5 patients and the number of Hispanic children decreased by 66% from 16 to 6 patients.

Conclusions: This burn prevention program designed for and delivered through Head Start was found to be effective in increasing burn prevention knowledge in parents and teachers and appears to have impacted behaviors which resulted in a measureable decrease in burn admissions from the targeted areas.

Applicability of Research to Practice: Burn centers should consider partnering with their local Head Start program in order to promote burn prevention education and reduce the incidence of serious burn injury in children 0-5.

53 . Repeated Dissemination of Burn Prevention Information to Students Increases Knowledge Retention

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Introduction: Burn prevention presentations to grade school students play an important role in the effort to reduce fire injuries and promote fire safety. This study's burn prevention program, started in 2002 and implemented in conjunction with firefighters and the school district, teaches an established 30-minute curriculum each year to an average of 9,000 grade school students with information for the parents in their primary language. The goal of this program is to reach each child each year in their schools to teach them vital skills on fire safety and burn prevention. This study was to determine the knowledge retention of children getting regular presentations each year versus knowledge retention of children who have only received the presentation one time.

Methods: A five-question multiple choice pre- and post-test was developed for the program for students to complete right before the presentation and within the day following the presentation. There are three different age-appropriate versions of the same test (kindergarten, first through third grades, fourth and fifth graders) that cover the main topics of the curriculum. They are completed in the classroom and administered by their teachers.

Results: We received a total of 1,283 matched pre- and post-tests from 13 schools in 2010. For kindergarteners (n=321), we observed an overall knowledge increase of 15.6% from the pre-test to the post-test, for first through third graders (n=623), an increase of 15% and of 23% for fourth and fifth graders (n=339).

We broke down the data to look at scores of the students at schools receiving a presentation for the first time, and students in the schools that have received at least two previous presentations in previous grades. We found two schools in each of those categories. Fourth and fifth grade students receiving their first presentation (n=107) scored an average of 63% on their pre-test, and students who had received the presentation at least two times in earlier grades (n=127) scored an average of 81% on their pre-test. Their post-test results were similar with an average score of 90% and 93% respectively.

Conclusions: We conclude that students at schools that received the presentation at multiple grade levels annually over two years performed better on pre-tests than students who had no previous presentation. While students had definite increases in knowledge on fire safety and burn prevention topics after one presentation, the best retention of knowledge occurred when they have received the information multiple times.

Applicability of Research to Practice: This research underscores the need to create prevention programming that builds in a system for reaching the same children more than once over time to ensure the retention of life-saving information on fire safety and burn prevention.

54 . Multi-Center Testing of a Burn Prevention Teaching Tool for Amish Children

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Introduction: Burn prevention is not taught in Amish schools although there are inherent risks and resultant injuries associated with the Amish lifestyle. Specific educational opportunities for burn prevention are related to scalds, ignition of clothing, and ignition of highly flammable materials. A culturally sensitive burn prevention teaching tool, depicting children in their normal home environment, was developed with community support from an Old Order Amish church district. Pilot testing in one private Amish school (JBCR 2012) demonstrated a highly significant improvement in test scores. The goal of this study was to perform a multicenter evaluation of a burn prevention teaching tool for Amish children.

Methods: Following IRB approval, private schools were recruited via invitation in Amish newsletters. A teaching tool (magnetic story board, burn safety curriculum and test questions) was provided to each school. Teachers obtained parental permission and informed assent for the children to participate. Teaching involved magnetic pieces arranged to tell stories, involving burn hazards. The children were challenged to rearrange the pieces for a safer situation. Pre- and post-tests were used to capture baseline knowledge and measure improvement. Scores were expressed as a percentage of the 25 questions answered correctly. Teachers provided recommendations and a written evaluation of the tool's utility.

Results: Students (n=295) from 15 private Amish schools in 8 states participated in this study during the 2010-2011 school term. Statistical analysis using paired t-tests demonstrated a highly significant improvement in percent correct test scores for 290 students who completed both tests. The overall difference between the pre- and post- tests, without regard to gender or grade, was 21.1 points (p<0.0001). In addition, the difference between genders was also statistically significant (t=2.01, p=.0456) with a mean difference of 22.8 points for females and 19.4 points for males. Interestingly, the difference in scores between the upper and the lower grade students was not statistically significant. The gender difference was statistically significant. Evaluations of the burn prevention teaching tool by the teachers were all favorable.

Conclusions: Results from this multi-center study of the burn prevention teaching tool further corroborate findings from our previous pilot study. This tool is highly effective for improving burn prevention knowledge among Amish children.

Applicability of Research to Practice: These results coupled with community acceptance support continued burn prevention education for Amish children using this burn prevention teaching tool.

55 . **4,442 Battlefield Burn Injuries: The Magnitude of the Challenge**

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Introduction: Historically, 5-10% of wartime injuries involve burns, yet few health care providers have significant burn experience. The first time providers encounter burn patients may be in an austere environment with limited resources. To date, the proportion of burns among all trauma admissions during current combat operations has not been reported. We determined the incidence and severity of burn injuries over the last decade of war.

Methods: A retrospective review of the U.S. Joint Theater Trauma Registry was performed. Data queried included: date of injury, theater of injury (Iraq or Afghanistan), age, patient category, mechanism of injury, total body surface area burned (TBSA), injury severity score (ISS), inhalation injury, mortality, and in-theater length of stay.

Results: Between 2002 and 2010, 41846 patients were treated in military hospitals in Iraq or Afghanistan for traumatic injuries; burn injury was reported for 4442 of these patients (10.6%). Of this total, 13% (n=595) were children and 86% (n=3847) adults. Additionally, 70% (n=3166) of the injuries were battle-related while 29% (n=1338) were non-battle injuries. ISS was >12 in 42% (n=1919) of the patients. The mean TBSA was significantly different between adult (11% TBSA +20.4) and pediatric patients (15% +17.0; $p < .0001$). Adults used 14270 hospital days (5.7 days/patient ± 18.7), and children used 5765 days (9.7 days/patient ± 15.1 ; $p = .0001$).

Conclusions: The incidence of battlefield burn injuries over the last decade is consistent with reports from past conflicts. The increased length of stay and TBSA of children demonstrate a need for deployed hospitals and providers to prepare to care for this unique population. Because local national patients are not evacuated from theater, this need includes the definitive-care period beyond the initial resuscitation encompassed by the Advanced Burn Life Support course. It is important that future pre-deployment training, clinical practice guidelines, and resource allocation reflect these facts.

Applicability of Research to Practice: Proper burn training can improve battlefield care by refining the postburn resuscitation process, reducing the risk of infection, and increasing the patients' potential for future independence.

56 . **Burn Knowledge Assessment in Zambia**

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Introduction: Fire related injuries are one of the leading causes of morbidity and mortality globally, and are responsible for more than 300,000 deaths globally per year. The distribution of burn injury is disproportionate, with those residing in low and middle income countries facing the largest burns burden. Even within the countries with the largest burn burden, injuries are disproportionate with children being the hardest hit. In one rural Zambian hospital 44% of the admitted burns were in children younger than five.

Methods: Zambian school-aged children and adults completed separate surveys about their level of burn prevention knowledge. Each survey was available in both English and Nyanja, the dialect of Chewa spoken in the Katete, Zambia area. Burn prevention knowledge was then provided to these children in the form of a translated burn prevention story and coloring book. Some common burn prevention techniques were also demonstrated to the students after the surveys were complete.

Results: Students in two primary schools aged 9-19 (n=550) completed the student burn prevention survey; adults in the surrounding community ages 21-67 (n=39) completed an adult survey. Half of the students surveyed did not believe that hot food or water could cause a burn (50.5%). Only 406 (73.8%) students thought adults are the only ones who should light a fire. Not all students agreed (93.3%) that playing/running by the fire was dangerous. When queried about actions to take if their clothes catch fire, 55.4% of students provided a correct response such as pouring water on themselves or removing their clothing. Unfortunately, only 6.7% of students responded with some variation of Stop, Drop, and Roll, the technique taught to children in high income countries. Although the adults surveyed fared better than the children in their burn knowledge base, early first aid knowledge was limited.

Conclusions: Due to the lack of adequate burn care in many low and middle income countries, burn prevention programs will be necessary to reduce the global burn burden. Using the results of this data, burn prevention programs can be specifically developed for Zambia and applied to other Sub-Saharan nations. Future research about retention of this knowledge, and impacts on the number of burn injuries seen in nearby hospitals will be needed to determine the overall success of this program.

Applicability of Research to Practice: All evidence points to a clear need to reduce burn injury and mortality globally, and the best and most effective way of accomplishing this is through combined efforts of teaching burn care and burn prevention to those underserved.

57 . **Red Blood Cells Associated 14-3-3 Proteins Function as Anti-Scarring Factors**

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Introduction: During the inflammatory phase of any types of wound healing including burn wounding, a blood clot functions as a temporary extracellular matrix (ECM) for cell migration & proliferation. Although, the role of cytokines and growth factors released from immune cells in healing process are well known, it is not clear whether any factors associated with red blood cells (RBC) has any role in the healing process. We have previously demonstrated that some members of 14-3-3 protein family including stratifin, which is mainly released by differentiated keratinocytes, have a potent MMP-1, 3, -8 and 24 stimulatory effect for fibroblasts. This finding sets the stage for this current study through which the presence of 14-3-3 isoforms in human RBC and their anti-fibrogenic effect have been evaluated.

Methods: To demonstrate the anti-fibrogenic effect of RBC, we evaluated the level of MMP-1 fibroblasts treated with RBC lysate for 24 hrs using western blot analysis. Further the presence of different isoforms of 14-3-3 proteins in human RBC was also determined by western blotting using specific antibody for each of the 7 isoform of 14-3-3 proteins.

Results: The findings revealed the presence of all seven isoforms of 14-3-3 (eta,gamma,epsilon,sigma,beta,zeta and theta) in RBC lysate though with different levels of expression. Interestingly, the levels of some of these proteins were higher in RBC from new born babies compared to those of adults. We also found that RBC lysate significantly increased the expression of MMP-1 in different strains of fibroblasts and this increase at least, in part, seems to be due to MMP-1 stimulatory effect of 14-3-3 proteins.

Conclusions: we concluded that certain isoforms of 14-3-3 proteins are associated with RBC cells and as such they may function as ECM modulating factor for fibroblasts.

Applicability of Research to Practice: The findings of this study revealed that Due to MMP-1 stimulating effect of RBC lysate, it might be used as an anti-fibrogenic factor for treatment of some fibroproliferative conditions such as hypertrophic scarring in burn patients.

58 . **Simvastatin Protects Burn-Injured Hepatocyte from Apoptosis by Suppressing the TNF- α /Caspase-3 Signal Pathway**

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Introduction: Statin treatment has been shown to decrease mortality in patients with burn injury. This decrease is at least partially attributable to the reduction of hepatic complications, in which hepatic apoptosis may play a role. However, the mechanism(s) of liver damage after peripheral burn injury remains poorly understood. We hypothesized that statin treatment may modulate apoptosis-related gene expression and thereby protect hepatocytes.

Methods: Mice were subjected to 30% full-thickness burn injury and then treated either with or without simvastatin. The livers were harvested for histological assessment and determinations of gene expression. Tumor necrosis factor alpha (TNF- α) and caspase-3 knockout (KO) mice were also used to evaluate the effects of simvastatin on post-burn liver injury. The effects of simvastatin on TNF- α and caspase-3 expressions were further evaluated in cultured mouse hepatocytes.

Results: Burn injury induced significant liver damage which was indicated by striking levels of apoptosis. Simvastatin reduced the apoptotic index in the livers of burned mice and this effect could be partially blocked by TNF- α or caspase-3 inhibitors. Simvastatin decreased burn-induced TNF- α and caspase-3 expression in the liver. TNF- α and caspase-3 KO mice demonstrated lower levels of apoptotic hepatocytes in response to burn and simvastatin did not significantly decrease hepatocyte apoptosis in either strain of KO mice. An in-vitro study demonstrated that simvastatin suppresses TNF- α and caspase-3 expression in primary cultures of mouse hepatocytes.

Conclusions: Simvastatin reduces mouse hepatocyte apoptosis, at least partially, by suppressing expression of the TNF- α /caspase-3 pathway.

Applicability of Research to Practice: Overall, this study demonstrated that peripheral thermal injury leads to remote hepatocyte apoptosis and that simvastatin treatment can significantly attenuate this process by decreasing activity of the TNF- α /caspase-3 signaling pathway. These novel findings provide a mechanistic platform for understand how statin treatment reduces morbidity and mortality in burn patients and suggest that the TNF- α /caspase-3 pathway may represent a new target for the development of more effective treatment regimes for patients with burn injury.

59 . **Utilization of Molecular Sequencing Methods to Characterize the Microflora of Burn Wounds During Initial Hospital Admission**

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Introduction: Infection remains a leading source of mortality and morbidity in burn injuries, with an increasing proportion of multidrug resistant organisms reported from burn units worldwide. While routine surveillance for bacterial pathogens is performed in some burn centers, others only culture wounds with clinical signs of infection or graft loss, with some utilizing invasive quantitative tissue cultures rather than swabs. There is debate about the utility of each of these methods, with studies showing a poor correlation between the results of cultures and clinically significant infections.

Methods: 5 mm punch biopsies were collected from patients with >20% total body surface burns on day of admission and every other day, up to 10 days post-admission. We utilized bacterial tag-encoded FLX-titanium amplicon pyrosequencing (bTEFAP) to evaluate the polymicrobial assemblages in burns. The goal of this study was to establish the efficacy of these techniques in providing detailed microbiologic descriptions of burn wound flora, and to compare these results with traditional swab and culture methods.

Results: Of the top 20 bacterial genera identified using bTEFAP over half were anaerobes or highly fastidious bacteria that are not easily cultured using standard clinical microbiology techniques. *Staphylococcus* and *Pseudomonas* were two of the most ubiquitous bacterial genera. These organisms were commonly identified by culture methods, yet within the assemblages only 2 of the burn wound samples had these genera as dominant populations (one with 53% *Staphylococcus*, and one with 51% *Pseudomonas*). *Prevotella*, *Granulicatella*, *Clostridium*, and *Anaerococcus* were other dominant and ubiquitous genera which are not normally or easily diagnosed with routine clinical culture techniques. Each of these genera have also been associated with sepsis and bacteremia. Anaerobes accounted for approximately 35% of all bacteria averaged among all samples, facultative anaerobes were 33%, and aerobes were 32%.

Conclusions: Molecular detection with bTEFAP proved significantly more sensitive than standard lab cultures and was much more successful in detecting anaerobes. However further investigations need to be done to determine how this early and sensitive detection can influence the course of treatment.

Applicability of Research to Practice: Standard culture techniques using broth and agar tend to select for organisms that are easily cultured, while other organisms such as anaerobes may be under-represented. This bias may lead to inappropriate and ineffective use of antibiotic therapy.

60 . **Alternative Erythropoietin Signaling Prevents Sub-Acute Deep Dermal Micro Vascular Thrombosis, Thus Reducing Progressive Ischemia and Necrosis in a Mouse Burn Model**

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Introduction: Clinically relevant burn wounds are characterized by a progressive transition from a predominately necrotic coagulation zone, to an ischemic and inflammatory zone, and finally to a hyperemic but otherwise healthy zone. The ischemic and inflammatory zone is subject to secondary, expanding tissue necrosis both in area and depth. This delay is a potential window of opportunity to introduce non-surgical treatment approaches which may be effective in reducing the extent of tissue damage. In this study, we investigated the effect of a small peptide derived from erythropoietin, termed ARA290, which is specifically designed to stimulate the cellular protective and non-erythropoietic functions of erythropoietin mediated by the CD131/erythropoietin hetero-receptor.

Methods: Two burn models were used to create a full-thickness burn. To evaluate the effect of ARA290, different methods were used to study differences in wound healing over time such as: (a) secondary wound expansion and scar surface area; (b) immunohistology; (c) measure of relative vascular area of wound beds; (d) qPCR; (e) a myeloperoxidase assay; (f) a model of neutrophilic depletion by Gr-1 anti-mouse antibody; (g) cell culture studies.

Results: Burn wounds exhibited clinically relevant progressive tissue damage and necrosis within 48 hours post burn. Morphological evidence suggests that areas of progressive damage underwent thrombosis of the deep dermal vascular network (DDVN) up to 48 hours post burn and necrosis of other cellular components within 72 hours. Systemic administration of ARA290 starting up to 4 hours post burn prevented much of the thrombosis. As a result, tissue perfusion throughout the deep dermal layers was maintained and there was a correspondingly reduced extent of secondary tissue damage. ARA290 was also found to profoundly decrease markers of oxidative stress and suppress a TNF-alpha driven inflammatory response.

Conclusions: A erythropoietin-derived peptide that specifically stimulates the cellular protective pathway via alternate erythropoietin signaling significantly decreases the expansion of tissue damage in skin burn wound models. The mechanism of action involves maintenance of vascular patency in the affected areas, and likely a reduction in oxidative stress and TNF-alpha-mediated inflammatory responses.

Applicability of Research to Practice: We show compelling evidence that stimulation of the alternative signaling pathway of erythropoietin could be used as a therapy to minimize secondary tissue damage, and in turn surgical debridement and plastic-reconstructive measures in severely burned patients.

61 . The Effects of Rat Mesenchymal Stem Cells on Injury Progression in a Rat Comb Burn Model

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Introduction: Burns are common injuries that can result in significant scarring leading to poor function and disfigurement. Unlike mechanical injuries, burns often progress both in depth and size over the first few days after injury, possibly due to inflammation and oxidative stress. A major gap in the field of burns is the lack of an effective therapy that reduces burn injury progression. Since mesenchymal stem cells (MSC) have been shown to improve healing in several injury models, we hypothesized that species-specific MSC would reduce injury progression in a rat comb burn model.

Methods: Using a 150 gm brass comb preheated to 100 degrees Celsius, we created 4 rectangular burns, separated by 3 unburned interspaces on both sides of the backs of male Sprague-Dawley rats (300g). The interspaces represented the ischemic zones surrounding the central necrotic core. Left untreated, most of these interspaces become necrotic. In an attempt to reduce burn injury progression, 20 rats were randomized to tail vein injections of 1 ml rat specific MSC 106 cells/ml (n=10) or normal saline (n=10) 60 minutes after injury. Tracking of the stem cells was attempted by injecting several rats with Quantum dot labeled MSC.

Results: By four days post-injury, all of the interspaces in the control rats (54/54 [100%]) became necrotic while in the experimental group, 29/48 (60%) of the interspaces became necrotic (Fisher's exact test; $P < 0.001$). A 7 days, the percentage of the unburned interspaces that became necrotic in the MSC treated group was significantly less than in the control group (80% vs. 100%, $p < 0.0001$). We were unable to identify any Quantum dot labeled MSC in the injured skin. No adverse reactions or wound infections were noted in rats injected with MSC.

Conclusions: Intravenous injection of rat MSC reduced burn injury progression in a rat comb burn model.

Applicability of Research to Practice: In the future human mesenchymal stem cells may prove beneficial in reducing burn injury progression in patients with partial thickness and mixed burns.

62 . Quantifying Extent of Thermal Protein Denaturation by MR Imaging

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Introduction: Protein denaturation involves conformational unfolding which increases the exposure of protein hydrophobic residues leading to a modification of the number and kinetics of water molecules in contact with the protein surface. Therefore, it is quite likely that MRI can be used to quantify the extent of protein denaturation. The biomedical importance of such an observation consists in the possibility to detect denatured proteins in injured tissues by using magnetic resonance imaging (MRI).

Methods: To test this concept, we adapted the Zimmerman-Brittin equations for water proton relaxation kinetics in the three different water pools in tissue. The T2 spin relaxation rate in each water pool was obtained from Bryant, R.G. (1996) *Annu. Rev. Biophys. Biomol. Struct.* 25:29, 1996. The relative size of the pools depends on both interstitial fluid volume and the extent of protein denaturation. To determine the value of the relaxation kinetics we measure the T2 relaxation time for normal and heat denatured (95 degrees C for 30 minutes) 10% bovine serum albumen (BSA) over a range of concentrations in 1 ml of phosphate buffered saline in polypropylene microtubes. T2 measurements were obtained with a Siemens 3 Tesla MRI. Each measurement was repeated 3 times to achieve statistical confidence.

Results: We were able to readily distinguish dilution ($R > 0.9997$) from protein denaturation ($R > 0.998$). With an added correction factor for water behavior at the polypropylene surface, our model fit experimental data for both dilution of native BSA and heat denatured BSA with high accuracy.

Conclusions: Our basic model accurately predicts the T2 relaxation time change due to protein denaturation in the presence of edema.

Applicability of Research to Practice: The ability to anatomically image the extent of protein denaturation in burn trauma would have great value in advancing indications for burn wound management and resuscitation.

63 . Infra-Red Contrast Imaging to Non-Invasively Monitor Burn Injuries in a Porcine Burn Model

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Introduction: Accurate determination of burn depth is vital to burn wound management. Clinical diagnosis is only 50-70% accurate, while even Laser Doppler only becomes accurate after approximately 3 days. Infra-Red Contrast Imaging (IRCI) is a non-invasive method, operating in the far-infra red region that instantaneously measures IR (infra-red) emission from tissue, the result of which is a contrast image based on a temperature scale. We evaluated IRCI in a validated porcine burn model to determine its ability to distinguish between superficial and deep-dermal burns.

Methods: A prospective animal experiment was performed using 4 anesthetized female Yorkshire pigs. Twenty 2.5 x 2.5 cm burns of varying depth were created with an aluminum bar pre-heated to 70 or 80 degrees Celsius and applied to the animals' backs for 30 seconds. IR images were obtained at 24, 48, and 72 hours and correlated with depth of burns.

Results: Qualitatively, the IR images show zones within burns, much like the Jackson model of burn injury. Significantly, more than three zones were observed with differences in temperature between burns and within burns. The superficial burns (70 °C applied for 30 seconds) were characterized by a warmer center corresponding to the original dimensions of the burns surrounded by a warm periphery. In contrast, the deep burns (80 °C applied for 30 seconds) were characterized by a colder center and periphery (approximately 2 degrees Celsius lower than shallow burns). Wounds with a higher temperature core and periphery (as seen by IR) indicate less tissue damage while those with lower temperature of core and periphery indicate greater tissue damage. Also, the diameter of a deep burn at lower temperatures is larger than shallow burn areas by about 30%. These differences were evident between superficial (70/30) and deep (80/30) burns as early as 24 hours and were consistent at later time points also.

Conclusions: Preliminary data suggests that IRCI can be used to distinguish between superficial and deep-dermal burns.

Applicability of Research to Practice: Further studies will evaluate the accuracy of IRCI in predicting and monitoring the progression of human burns.

64 . Molecular and Non-Invasive Imaging Assessment of Donor Site Healing Dynamics

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Introduction: Better understanding the physiology of donor site healing may lead to advances in how these wounds are treated, and may ultimately allow more frequent autografting and more efficient care of the burn-injured patient. Unfortunately, a paucity of data exists in regards to perfusion metrics over the course of wound healing. Furthermore, there are no studies that interrelate indices of perfusion with the molecular and cellular processes of donor site healing.

Methods: Male Duroc pigs were anesthetized and donor site wounds were created on the flanks using a Zimmer dermatome at 0.030in depth and measuring 3in x 3in. Wounds were covered with a standard anti-microbial dressing and held in place with a neoprene vest. Laser Doppler Images (LDI), whole blood, plasma, and punch biopsies were obtained pre- and post-excision and on days 2, 4, 7, 9, 11, 14, and 16 until wounds were healed. RNA isolation and rt-PCR were performed using porcine primers for Ki-67 and vascular endothelial growth factor (VEGF).

Results: All wounds were re-epithelialized by post-procedure day 16. A significant increase in mean perfusion units (PU) was observed at days 2, 4, and 7, with mean PUs returning to baseline by day 9 (p 0.05). Fold-change expression of Ki-67 and VEGF remained at or below baseline until day 9, at which time the levels increased.

Conclusions: These findings demonstrate that mRNA expression of proliferative markers (Ki-67 and VEGF) did not increase immediately after wounding but rather occurred after wound perfusion returned to normal levels. This increase in gene expression parallels regeneration of epidermal cells in the healing wound.

Further studies are underway to fully understand the physiology of donor site healing, including a more complete analysis of gene expression dynamics using microarrays and data analysis aimed at elucidating potential correlations between perfusion assessments, gene expression, and protein dynamics. This analysis may lead to therapeutic targets for increasing healing rates and developing guidelines using these parameters for identifying re-harvest time points.

Applicability of Research to Practice: Understanding the metrics of donor site healing will help to better define treatment options and timing of therapy.

65. Development of a Novel Smartphone-Based Application for Photographic Burn Wound Monitoring

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Introduction: Approximately 500,000 burn injuries require medical treatment each year. Serial photography monitors wound healing and aids clinical-decision making. Digital cameras are commonly used for routine burn wound monitoring. Inter-image consistency improves clinical assessment of burn wound and graft progression. Existing digital cameras lack features to facilitate consistent day-to-day and user-to-user wound photography. We report the use of a Smart Device-based wound imaging application in the burn patient population.

Methods: We conducted a clinical needs assessment survey to define specifications for a burn-specific wound image application. Twenty burn critical care nurses and 4 burn surgeons were surveyed. The Apple iOS 4.0 Software Development Kit (Cupertino, CA) was used to create the new application. Prototype software was trialed at the Burn Center using simulated burn wounds. Clinical validation of the device was conducted in 10 prospectively recruited adult (ages ≥ 18 years) patients of any burn size to compare the performance of the iOS application versus the existing burn unit digital camera (Kodak C913). Image J (National Institutes of Health, Bethesda, MD) software analyzed color, brightness, and angle regularity between the two methods.

Results: Survey results specified the need for a cost-effective, user-friendly, and robust image system to facilitate consistent serial photography and informatics features including clinician notes storage, wound location, and secure wireless connectivity. The new application, "BurnBookApp", was developed based these needs assessment findings and installed on a iPhone 3GS and iPad 2 (Apple, Cupertino, CA). We modified the phone to improve resistance against accidental drops and hospital cleaning solutions. Photographs taken by the application were successfully transmitted wirelessly with simulated patient information via secure hospital networks. Clinicians found the new iOS application to be significantly easier to use ($N = 20$, $P < 0.01$) than the burn unit digital camera. Image analysis suggested iOS images were less variable (color, angle, and brightness) than those from the burn unit camera ($N = 20$, $P < 0.01$).

Conclusions: Photographs using our novel iOS-based imaging application exhibited improved color, consistency between images, and user-friendliness compared to the current digital camera used by our burn center. The application also provided clinicians with the ability to record pertinent patient information and the option to transmit images using existing hospital secure wireless intranet.

Applicability of Research to Practice: The application provides a low-cost, connected, and clinically effective imaging solution for burn centers and outlying hospitals.

66. Experience of Using an Electronic Wound Mapping System in a Burn Center

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Introduction: We developed an electronic wound mapping system (Wound Flow) to display the pattern of burn injury and the results of surgical intervention; it graphically displays progression of healing over time. Wound Flow has been used daily at the bedside by the interdisciplinary burn care team to include physicians, physician assistants, nurses, dieticians, physical therapists, wound care coordinators, and clinical nurse specialists. Wound Flow allows for incorporation of wound photographs and animation of wound progression. The purpose of this performance improvement project was to describe use of Wound Flow and the effects of burn wound mapping in our burn center.

Methods: A retrospective review of the Wound Flow database was performed for patients with $\geq 10\%$ total body surface area (TBSA) burns admitted from August 2010 to July 2011 to the burn intensive care and progressive care units. Burn wound mapping was expected on admission, after surgery, and weekly during the hospital course. The Utilization Rate (defined as mapping completed at least every 8 days until $< 10\%$ open wounds) was calculated. Clinical impact of the Wound Flow system was evaluated.

Results: A total of 113 patients meeting criteria were admitted to the burn center; Wound Flow was used for admission wound mapping in 103 patients (91%). Mean TBSA for males ($n = 87$) was $24 \pm 16\%$ (range 10-90%) vs $39 \pm 27\%$ (range 10-83%) for females ($n = 16$). Mean length of stay (LOS) was 25 ± 24 days (range 1-131 days). The Utilization Rate was 52% (65% for $\geq 40\%$ TBSA and 49% for $< 40\%$ TBSA); 66% of patients had photographs added to the database. The use of Wound Flow during interdisciplinary rounds resulted in improved communication within the team regarding wound assessment and healing, triggering earlier recognition of setbacks initiating aggressive efforts towards resolution.

Conclusions: Utilization of Wound Flow mapping is greater for larger TBSA injury; ongoing efforts are being made to improve use with the smaller burns understanding the considerable resource commitment for such a project. Portability of the system, streamlining the updating process, training additional users, and inclusion of user feedback are interventions underway to increase utilization.

Applicability of

Research to Prac-

tice: Daily reference to each patient's wound status using a computer display may improve interdisciplinary team communication and attention to wound management.



67. Heal or Die: Burn Wound Healing Trajectories and Their Impact on Survival

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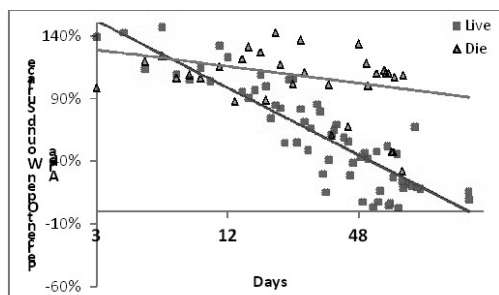
Introduction: Timely closure is essential to survival in severely burned patients, but the rate of wound healing, and its effect on survival, has not been well described. The purpose of this study was to determine the time course of burn wound closure in thermally injured patients.

Methods: As part of a performance improvement project, we used software (Wound Flow) to depict burn wounds, surgical results, and healing progression at multiple timepoints after burn center admission. We reviewed these data for all patients admitted to the ICU with > 20% total body surface area (TBSA) burned. We determined the days from injury until reduction to an open burn wound size < 10% (DAYS). The ratio DAYS/TBSA, and the rate of burn wound closure (healing rate) were calculated. For demographic data, the median and interquartile ranges (IQR) were calculated.

Results: There were 79 patients available for analysis in the database. The median age was 48 yrs (IQR 31-58) and TBSA 34% (28-54); 34% had inhalation injury; the mortality rate was 35%. Repeated measures analysis of covariance showed a significant difference between survivors and non-survivors on open wound size as a function of time ($p < 0.001$, figure 1). A subset of 24 patients in the database had documentation of successful wound closure. In this subset, median DAYS was 41 (28-54); median DAYS/TBSA was 1.3 (1.0-1.86). There was only 1 death in this group. Survivors had a 0.62% drop in open wound size/day, or 4.3%/week. After day 20 there was a difference in mortality between patients with a positive healing rate (2%/day, 100% survival) and those with a negative healing rate (-2%/day, 100% mortality, $p < 0.001$).

Conclusions: Adult patients with thermal injury who successfully heal their wounds have a median time to wound closure of 1.3 days/TBSA. Patients who die often fail to heal their wounds and can be identified by their healing rate after day 20. This serves as a pilot study which will allow us to assess factors that impact burn wound healing and burn wound failure.

Applicability of Research to Practice: Quantifying the progress of burn wound healing, or lack thereof, will allow us to implement therapies to achieve timelier wound closure.



68. Comparison of Devices for Pressure Ulcer Prophylaxis

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Introduction: Despite preventative efforts, pressure ulcers are problematic in the ICU. Patients develop ulcers when the pressure between the skin and the supporting surface exceeds the capillary hydrostatic pressure (approximately 25-30mmHg). This study investigated various commercially available and homemade devices to determine which most effectively alleviated heel pressure in adults.

Methods: Interface pressure between various surfaces and the right heel of 2 supine adult subjects was recorded with the FSA Prime Seat Evaluation System (SoftFlex Mat with universal base and FSA 4D Software; Blue Chip Medical; Suffern, NY). Two adult males, one 74" tall and 250 lb, one 66" tall and 160 lb were measured. Pressure was tested with the right foot in both a vertical and an externally rotated position (2 recordings per position). Tests were completed with the foot directly on a Stryker Foam (SF) Mattress (Stryker Medical; Kalamazoo, MI), Roho Dry Flotation Mattress Overlay (ROHO, Inc; Belleville, IL), standard issue hospital pillows between foot and SF mattress, an air-filled donut shaped balloon under heel, and with a water-filled nitrile glove under heel. Comparisons were made with repeated measures ANOVA and Mann-Whitney Test.

Results: For the 250 lb adult, heel pressure reached 124 mmHg on SF, 44 mmHg with pillows, 82 mmHg with a water-filled glove, 109 mmHg on the air-filled balloon, and 25 mmHg with the Roho Mattress Overlay (RMO). For the 160 lb adult, heel pressure reached 120 mmHg on SF, 17mmHg with pillows, 44mmHg with water-filled glove, 41 mmHg on air-filled balloon, and 12 mmHg with the RMO. Pressure was significantly lower in the smaller male (40 ± 31 vs 72 ± 36 mmHg, $p = 0.004$) and when the foot was externally rotated compared to when it was vertical in both subjects (41 ± 30 vs 70 ± 40 mmHg) across all surfaces. Pillows significantly reduced the pressure interface when added to the SF mattress (97 ± 38 vs 27 ± 13 mmHg, $p < 0.001$) and so did the water-filled glove (97 ± 38 vs 46 ± 22 mmHg, $p < 0.05$).

Conclusions: The RMO was the only device that kept pressure interface below capillary hydrostatic pressure in both adults. The water-filled glove significantly reduced pressures compared to the mattress alone, but the air-filled balloon did not. Both still created pressures theoretically high enough to result in decubitus ulcers. Use of pillows over the SF mattress significantly decreased interface pressure to a mean below capillary hydrostatic pressure although the larger adult still had maximum pressures that exceeded capillary hydrostatic pressure. The most effective devices from the current study should be further investigated to evaluate clinical outcomes and cost-benefit analysis resulting from their use.

Applicability of Research to Practice: Comparison of devices for pressure ulcer prophylaxis can aid the clinician in device selection.

69 . A Simple Cost Saving Measure: 2.5% Mafenide Acetate Solution

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Introduction: Despite the fact that the optimum concentration of mafenide acetate solution is unknown, the 5% solution is traditionally used, and has been the highest costing drug on formulary. To ensure cost-effective use of mafenide acetate solution, a new policy was instituted that restricted the 5% solution to targeted indications only, as agreed upon by the Medical Staff; otherwise, a 2.5% mafenide acetate solution was utilized. We systematically reviewed cost and patient outcomes associated with this approach.

Methods: A retrospective review of all patients receiving mafenide acetate solution at a single pediatric burn hospital was performed before and after the initiation of a new policy on the use of 5% versus 2.5% solution. Five percent Sulfamylon was deemed the restricted concentration used for treating patients with one or more of the following indications per the Attending Surgeon approval: (1) eschar + sepsis, (2) eschar + multidrug resistant organisms (MDROs), (3) eschar + foreign patient admission + unknown wound culture data, (4) sepsis + MDROs + suspected/probable silver nitrate failure, and/or (5) confirmed or suspected skin or skin structure infection with MDROs + suspected/probable silver nitrate failure. Duration of therapy, adverse events, cost, incidence of wound infection and bacteremia were recorded.

Results: In 2009, 69 patients were treated with 5% mafenide acetate solution for a total cost of \$125,000 (\$1811 / patient). In 2010, following the initiation of the policy, 48 patients were treated: 19 received 5% mafenide acetate solution with appropriate indication, while the remaining 29 received 2.5% Sulfamylon for a total cost of \$38,632 (\$804 / patient). There were no significant changes in the incidence of bacteremia or wound infection when comparing 2010 to 2009. No side effects of therapy, either 2.5% or 5%, were noted.

Conclusions: Under certain conditions, a 2.5% mafenide acetate solution is appropriate, and is not associated with increased bacteremia or wound infection. The restriction of the 5% solution and use of the 2.5% solution provided significant cost savings.

Applicability of Research to Practice: Although 5% mafenide acetate solution has become the standard concentration in practice, data suggests that lower concentrations may be equally efficacious and significantly less costly. Burn centers should consider this simple strategy to decrease pharmacy expenditures.

70 . Herpes Simplex Virus Type 1 Infection in Burn Patients

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Introduction: Herpes simplex virus type 1 (HSV-1) is common, with reports that up to 85% of US adults have serologic evidence of exposure. Burn injuries may increase the risk for reactivation of latent HSV-1. The purpose of this study is to characterize the risk factors, treatments, and outcomes of patients that developed HSV-1 infection following burn injury to aid in the development of an algorithm that identifies patients who should be treated with antiviral prophylaxis.

Methods: A retrospective study was performed of all patients treated for burns between 2005-2010. Patients with HSV-1 outbreaks were identified and data collection included demographics, type of burn, TBSA percentage involved, HSV-1 presentation, diagnosis, treatment, outcome, complications, length of hospitalization, and mortality.

Results: Between 2005-2010, 134 adult intubated burn patients (103 males & 31 females, average age 48) were admitted to Memorial Medical Center Regional Burn Unit. Twenty-three adult burn patients developed HSV-1 infection. 19 of 23 patients had positive HSV-1 viral culture, while 4 patients had negative culture but were treated based on clinical diagnosis. All 23 patients had been intubated within 24 hours of injury, and the mean burn size was 29% total body surface area (range 5-65%). The mean time to presentation of the viral exanthem was 13 days post burn (range 6-27.) Herpetic facial rashes presented an average of 13 days after burn (range 9-27 days). Bronchial lavage viral culture was positive in 5 patients, and presented significantly earlier than facial lesions (average day 8 vs 13, $p=0.028$). Average length of hospitalization for intubated adult burn patients was 17 days, while length of hospitalization for patients with HSV-1 infection was 31 days (range 9-52 days). Complications of HSV-1 infection included discomfort, prolonged wound healing, increased scarring, ophthalmic involvement, and disseminated herpetic rash.

Conclusions: Herpetic burn wound infections were found in 17% of intubated adult burn patients during the 5 year period of this retrospective study. Successful treatment of HSV-1 infection included intravenous and oral antivirals, wound care, and meticulous efforts to prevent nosocomial spread. Early detection may decrease patient discomfort and improve patient care. To date, this is the largest review of HSV-1 burn wound infections in the English literature. Based on this data, we have designed a prospective study of seropositive patients at risk for reactivation. With this we aim to develop an algorithm to determine which patients may benefit from antiviral prophylaxis to decrease morbidity in burn patients.

Applicability of Research to Practice: Describe the incidence, risk factors, treatments and outcomes of burn patients that develop HSV-1 infections.

71 . **Improved Wound Management with Minimally Invasive Debridement: Experiences of Four European Burn Centres in Adults and Children with an Enzymatic Debriding Agent**

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Introduction: Preservation of skin tissue for spontaneous healing is important especially in paediatric burn care. Early and accurate diagnosis of burn depth however can be challenging. Overgrafting due to early excision or wound infection and hypertrophic scarring due to delayed excision are common risks. We present preliminary results of selective debridement of deep and mid-dermal (II°&III°) burn necrosis in adults and children with a novel agent Debriding Gel Dressing (DGD) in a minimally invasive enzymatic approach.

Methods: In our burn centers DGD was used during a prospective randomized multi-center phase III-study. Patients aged 4 to 55 years with acute deep (II°&III°) burns of 5% to 30% TBSA were included. Lyophilized enzymes were mixed in hydrating gel to form DGD and applied immediately onto the wound under occlusive dressing for 4 hours. After debridement, patients were treated by the center's standards of care (SOC) - surgical and/or topical wound care. The control group was treated by the center's SOC. Data on debridement efficacy, need and extent of surgery, hospital stay and long-term outcomes were collected.

Results: Altogether 57 patients, 12 children and 43 adults were randomized by central online randomization system, enrolling 27 DGD and 30 SOC patients. The eschar debridement with DGD was selective and well tolerated in all patients. The DGD debrided wound could be easily diagnosed visually for burn depth and extension. Full thickness burns underwent skin grafting, whereas the partial thickness areas of the wound epithelialized spontaneously. Graft take was similar in both groups. SOC needed considerably more surgical debridements and grafting under general anaesthesia, while DGD enzymatic debridement could be well tolerated when performed under analgosedation on the ward. Side effects during the DGD application (fever and pain) could be well controlled by soaking, analgesics and antipyretics. Hospital stay was shorter in the DGD-group with similar long-term scarring outcome so far.

Conclusions: Our initial results indicate that enzymatic debridement with DGD removes the eschar selectively and promptly. It enables diagnosis and wound treatment of burns. DGD fast non-surgical debridement may improve burn care, particularly in difficult areas as hands and in paediatric scald burns.

Applicability of Research to Practice: If approved, DGD could be used as a first line treatment for early wound debridement in adults and children with minimal surgical intervention.

72 . **Long Term Scarring and Quality of Life in Bromelain Based Enzymatically Debrided Patients: A Controlled Study**

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Introduction: Multiple prior studies have demonstrated the ability of an investigational bromelain based debriding gel dressing (DGD) to completely remove the burn eschar after a 4-hour topical application and to prevent or release elevated interstitial compartment pressures. The resulting raw, debrided wound bed can be accurately diagnosed, grafted or allowed to spontaneously epithelialize. DGD treated patients had a significant decrease in the percentage of burns requiring excision, the total burn area requiring surgical excision, the area of skin grafting and blood loss. In the current study we determined the impact of the shift from a surgically based wound care strategy to a minimally invasive modality based on enzymatic debridement on long term cosmesis and function (quality of life [QOL]).

Methods: Burn patients enrolled in a multicenter, randomized, controlled, two-arm (DGD vs. Standard of Care [SOC]) phase III study (n=181) were evaluated for their long term (>2 years post injury) results. Their scars were evaluated by an independent observer blinded to treatment assignment using the Modified Vancouver Scar Scale (MVSS), and their QOL was assessed with the Short Form 36 (SF-36) assessment tool for adults, and the Burn Outcomes Questionnaire (BOQ) for pediatric and adolescent patients.

Results: Patients in the two study groups were similar in baseline characteristics. DGD treated patients had significantly better scores on the MVSS, SF-36, and BOQ compared with patients assigned to the SOC. Despite slightly delayed wound closure in some DGD treated patients, the improved cosmetic and functional results appear to be correlated with a reduction in the number and size of wounds requiring surgical excision and grafting.

Conclusions: The long term scarring, functionality and quality of life results indicate that a minimally invasive modality of burn wound care that is based on early non surgical effective, fast and selective eschar removal and spontaneous epithelialization of the preserved dermis is at least as good as the long term results seen in patients receiving standard of care.

Applicability of Research to Practice: These results suggest that once approved, DGD will play an important role as a first line debriding method in burn care. The clinical relevance of the improved long term outcomes remains to be determined.

73. **Pseudomonas aeruginosa Modulates Pulmonary Host-Response and Dissemination through the Transactivator OxyR after a Burn Injury**

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Introduction: Pulmonary infections with *Pseudomonas aeruginosa* (PA) are a major cause of difficult to treat bacterial infections in burn patients. Although antibiotic treatment remains the main choice, rapid emergence of multidrug resistant strains of PA and the weakened immune system of burn patients force us to rethink our strategies to find more suitable solutions. Much of our sepsis research has focused on host immune response without considering the direct relationship between expression of specific bacterial genes and their capacity to modify host immune response. Here we test the hypothesis that oxidant stress negating transactivator OxyR expression modulates the pulmonary host immune response using a wild-type (PAO1) and an OxyR deletion mutant (Δ OxyR) to infect the pulmonary bed in a burn model.

Methods: C57Blk/6J mice under anesthesia were subjected to a combined 15% scald burn and intra-tracheal infection with either PAO1 or Δ OxyR (13K CFU each). Sham and burn (B) alone served as controls. The lungs and spleens were harvested 48 h after the injury and their bacterial burden estimated. The lung tissues were frozen and gene expression profiles were determined by microarray analysis using GST Microarrays (Affymetrix). Bioinformatic analysis of data was performed using both Ingenuity Pathway analysis and Biocarta to document the differential gene expression profile in B vs. PAO1 vs. Δ OxyR groups ($p < 0.001$).

Results: PAO1 and Δ OxyR infections resulted in a similar bacterial growth in the lungs 48 h post-injury (PAO1 - $1.1 \times 10^7 \pm 7.57 \times 10^6$ and Δ OxyR - $3.15 \times 10^6 \pm 2.9 \times 10^5$ CFU/g, $p = 0.2$, $n = 7/\text{group}$). PAO1 infection also resulted in bacterial dissemination to the spleen ($3.5 \times 10^6 \pm 6.7 \times 10^5$ CFU/g). In contrast, Δ OxyR infected mice showed no systemic dissemination. Gene expression analysis showed that several immune pathways were downregulated in Δ OxyR infected lung when compared to PAO1 including oxidative stress, B lymphocyte signaling, IL-10 signaling, CCR5 signaling, T cell activation, inhibition of matrix metalloproteinases, and PMN signaling. Inflammatory cytokines such as IL-6, TNF- α and IL-1 α were upregulated by 570%, 264% and 234% respectively in PAO1 compared to Δ OxyR. In contrast, SMAD-7 and KLF-2 were upregulated in Δ OxyR-infected lungs compared to PAO1. All of these pathways profoundly affect the inflammatory status of the host.

Conclusions: Taken together, the results of this study lead us to conclude that OXYR expression in PA markedly influences pulmonary host-immune response and is essential for the systemic dissemination of PA.

Applicability of Research to Practice: Detailed understanding of the molecular mechanisms of pathogen host response is crucial to the development of targeted antimicrobial therapy in the future.

74. **Bacterial Superantigen Virulence Factors Are Detectable in Burn Patients**

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Introduction: Burn patients are at risk for complications due to bacterial infection, with one of the primary organisms of concern being virulence factor-producing staph species. Limited references exist regarding detection of virulence factors, including toxins such as Toxic Shock Syndrome Toxin (TSST-1) and the Staphylococcal Enterotoxins (SE) in hospitalized burn patients. While little is known about the involvement of superantigens and virulence factors in the clinical outcome and immune status of burn patients, there is reasonable data to suggest that their presence in burn patients can alter the dynamics or development of burn shock and sepsis. To better understand the contribution that these molecules make in systemic and local disease a confirmation of their presence in the burn patient population is important.

Methods: One hundred seventy-five burn patients were included in this study. Discarded serum samples were acquired from the clinical laboratory, catalogued, decanted into aliquots, and frozen for subsequent analysis. In total > 1,200 samples were acquired and analyzed for SEA, SEB, or TSST-1 by using a modified sandwich capture ELISA. Additionally, each sample was assayed for α -hemolysin. Pertinent patient demographic and clinical course and laboratory data were retrieved to match each serum sample.

Results: Sixty percent of patients (105/175) tested positive for SEA, SEB, or TSST-1 at some point during their hospital stay. The average age of patients was 44 years, and the mean burn size was 9.3%. A correlation was observed between toxin positivity and larger burn extent. Patients with longer lengths of stay were more likely to be positive for toxin presence ($p < 0.008$). When comparing all patients that had a *Staphylococci* sp. infection, those who were MRSA-positive were more likely to be positive for toxin ($p < 0.05$). There was no correlation between toxin presence and mortality in this study.

Conclusions: The contributions of superantigens to burn wound pathophysiology are very likely under-appreciated. This report is the first large series that proves the presence of these molecules in burn patients. Of particular note, patients with MRSA are more likely to have these toxins in their blood. Future work will be aimed at understanding the impacts that these virulence factors have on wound healing and overall patient clinical outcome.

Applicability of Research to Practice: Novel detection of bacterial virulence factors in burn patient. These may play a role in wound healing and immune response.

75. **Empiric Gram Negative Antimicrobial Therapy in National and International Pediatric Burn Patients**

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Introduction: Antimicrobial resistance patterns differ based on geographic location and this variance impacts selection of empiric antimicrobial therapy. Over the past 5 years, burn-injured children transferred from non-U.S. locations appeared to have a greater number of multi-drug resistant (MDR) organisms compared with those patients from the U.S. We therefore reviewed our institution's data to better understand the differences between foreign and U.S. patients in terms of MDR organisms and also to determine whether colistin would be an appropriate antibiotic for empiric gram-negative coverage for international patients with suspected infections.

Methods: We conducted a retrospective analysis of all burn patients admitted to our hospital from 2006-2010 that had sustained burns >10% TBSA. All patients were admitted to our acute care unit and routine surveillance cultures were obtained. Admission data was collected including: demographic and burn data, as well as additional cultures as indicated. Length of stay in the hospital and ICU, ventilator days, central line days, OR days, mortality, organisms grown and their resistance were also obtained.

Results: A total of 385 patients were admitted, 133(34.5%) of which came from outside the U.S. International patients had significantly larger burns (39.73% vs. 22.80% TBSA, $p < 0.001$) and more inhalational injuries (27.1% vs. 16.3%, $p < 0.03$). They also had significantly longer lengths of stay in the hospital and ICU, more ventilator and central line days, and more operations than children from the U.S. ($p < 0.001$). International patients presented with a higher overall incidence of infection (66.9% vs. 2% $p < 0.001$), had more MDR bacterial infections on admission (51.2% vs. 1%, $p < 0.001$), as well as higher numbers of pan-MDR infection on admission (13.5% vs 1.1%, $p < 0.001$).

Conclusions: At our pediatric burn center, non-U.S. patients present with significantly higher rates of infection, the majority of which are due to multi-drug resistant bacteria. The high incidence of infection with MDR bacteria in this patient population supports the use of colistin as part of empiric therapy for gram negative infections.

Applicability of Research to Practice: This paper highlights the challenges in gram negative antimicrobial therapy while treating international burn patients and supports the use of Colistin as part of empiric therapy for gram negative infections.

76. **Novel Clinical Parameters to Predict Burn Sepsis Are Superior to American Burn Association Consensus Criteria**

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Introduction: Sepsis is a significant cause for morbidity and death in the burn patient. Criteria for detection of sepsis developed by the American Burn Association (ABA) have not been formally evaluated. The purpose of this study was twofold: 1) determine the ability of the ABA criteria to predict sepsis in the burn patient; and 2) develop a model representing the best combination of clinical predictors associated with sepsis in the same population.

Methods: A retrospective, case-controlled, within-patient comparison of burn patients admitted to a single intensive care unit (ICU) was conducted for the period January 2005 to September 2010. Blood culture results were paired with clinical condition to define three groups: "positive-septic"; "negative-septic", and "negative-not septic". Data for 13 predictors were collected for the 72 hours prior to obtaining each culture; ABA criteria: heart rate (HR), respiratory rate (RR), temperature (T), platelet count, insulin requirement, serum glucose, enteral feeding residual, and stool output; and clinical parameters: mean blood pressure (MAP), urinary output, base deficit (BD), white blood cell count, and requirement for vasoactive medication. Descriptive statistics, ANOVA and ROC curves were used to identify the most significant dichotomized predictor variables for model development; then selected variables were evaluated using logistic regression, generalized estimating equations and ROC area under the curve (AUC) analyses to assess model predictive ability.

Results: Fifty-nine subjects were included in the study, representing 177 culture periods. Subjects were 40 ± 19 years of age, 88% male, with 81 ± 64 ICU days, 49 ± 20 total burn size, and 49% hospital mortality. ABA sepsis criteria were significantly different among culture type only on the day prior to culture ($p = .004$). Novel variables identified for the model included: HR > 130 bpm, MAP < 60 mmHg, BD < -6 mEq/L, T 150 mg/dl. The model was significant in predicting "positive culture-septic" and general sepsis state (positive and negative culture with sepsis), with AUC of 0.775 ($p < 0.001$) and 0.714 ($p < .001$), respectively; comparatively the ABA criteria AUC was 0.619 ($p = 0.028$) and 0.597 ($p = .035$), respectively. The combination of the best 6 predictors performed better than when analyzed individually (AUC 0.775 versus 0.576-0.669).

Conclusions: The ABA criteria performed reasonably well, but only for the day prior to positive blood culture results. A combination of 6 novel predictors is superior to the ABA criteria yet algorithms or computer support will be necessary for the clinician to find such models useful.

Applicability of Research to Practice: Markers of sepsis specific to the burn patient are unique and clear definition is necessary for early identification and treatment.

77. Parameters for Ordering Blood Culture in Major Burn Injury Patients: Hyperthermia Alone Is Not Adequate

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Introduction: The current standard for obtaining blood cultures in burn patients is arbitrary and most often the same as for non-burn patients even though they have a higher baseline body temperature. Currently, pyrexia higher than 38.4 and leukocytosis are routinely used parameters for ordering blood culture at our burn center. We hoped to find parameters useful for discerning bacterial infections in burn patients in order to improve specificity and reduce excessive cost.

Methods: A retrospective review of medical records was performed for all burn patients with TBSA larger than 20% over a period of January 2009 to June 2011. All blood cultures data points (up to 10 per patient) were collected with corresponding temperature, heart rate, WBC counts, differential WBC count and lactate. Culture positive rates were compared for ranges of temperature, lactate, and WBC count. We also reviewed combinations of elevated lactate and hyperthermia, leukocytosis and hyperthermia as well as leukopenia and hyperthermia. The statistical analysis was done using Chi-square test.

Results: We collected data for 360 blood cultures that could be included in this study. The positive culture rate was 6.0%, 3.9%, 4.9%, and 13.1% respectively for temp <38 C, 38 - 38.4 C, 38.5 - 38.9 C, and > 38.9 C. Cultures taken when temp was above 38.9 C were significantly more positive (p=0.03) than when temperature was between 38 and 38.9 C. The rate of positive cultures was 15.8%, 5.8%, 5.7%, and 5.3% for WBC count <4.5, 4.5 - 9.9, 10.0 - 14.9, and >15.0 respectively. There were significantly more positive cultures (p=0.04) when the WBC count was less than 4.5 compared to the WBC count were above 4.5 and even above 15.0. Cultures were positive at 5.0%, 15.4%, and 20.0% when the lactate levels were <2.5, 2.5 - 4.9, and >4.9 respectively. Blood cultures tended to be significantly more positive when the lactate level was above 2.5 compared to when it was below 2.5 (p=0.02). Combination of temperature above 38.4 and WBC count below 4.4 did not show statistically significant difference. Finally, a temperature >38.4°C and a lactate >2.4 corresponded to a 27.3% positive cultures compared to a 4.9% ratio for all other situations (p=0.001). The detailed data is presented in table 1.

Conclusions: Our results show that temperature greater than 38.9°C, WBC count below 4.5, and lactate level above 2.5 are more specific parameters for ordering blood culture in burn patients.

Applicability of Research to Practice: Reduce cost of care for major burn injury patients.

Table 1.				
Patient temperature and Blood culture				
Temperature range	Negative	Positive	Total	Statistical analysis
<38 C	63	4	67	p<0.05 for Chi-Square test; compared between temp >38.9 C and 38-38.9 C
38 – 38.4 C	75	3	78	
38.5 – 38.9 C	137	7	144	
>38.9 C	53	8	61	
WBC count and Blood culture				
WBC count range	Negative	Positive	Total	
0-4.4	16	3	19	P<0.05 for Chi-Square test; compared between WBC count <4.5 and WBC count >10.0
4.5-9.9	97	6	103	
10.0-14.9	115	7	122	
15.0 and above	107	6	113	
Lactate level and Blood culture				
Serum lactate	Negative	Positive	Total	
<2.5	287	15	302	P<0.01 Chi-Square test; Compared between Lactate level <2.5 and >2.5
2.5 – 3.9	22	4	26	
>3.9	8	2	10	
Leukopenia and pyrexia				
	Negative	Positive	Total	
Temp>38.4 and WBC count<4.5	15	2	17	p>0.05 Chi-Square test
Others	323	20	296	
Pyrexia and Lactate levels				
	Negative	Positive	Total	
Temp>38.4 and Lactate>2.4	16	6	22	P<0.001 Chi-square test
Others	322	16	338	

78. Strategies to Eliminate Central Line Associated Bloodstream Infections (CLABSI)

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Introduction: Over 1.7 million healthcare-associated infections occur each year with 92,000 being central line associated bloodstream infections (CLABSI). In patients with significant burn injuries central venous access is requirement and extended use of venous access increases these patients risk of infection and mortality.

Objective is to develop and implement a multidisciplinary process that is unit specific to decrease the rates of CLABSI in our burn patients.

Methods: Our institution identified an interdisciplinary team to develop a number of written tools to assist with decreasing the rates of CLABSI including: a daily central venous (CV) access evaluation form, a CV line insertion check list, and an evaluation form for the occurrence of CLABSI. Educational inservices and training were completed from June-July 2009. After completion of the nursing education, the forms were installed into the daily work flow of the burn ICU nurses. Additionally, these forms were reviewed daily and weekly at the multidisciplinary burn meeting. In patients that meet criteria for a CLABSI as defined by the Center for Disease Control, an evaluation of the patient and risk factors for the infection were reviewed with the patient care team. Relevant data collected included the following: date of CV insertion, site of insertion, compliance with preventative check lists, and rates of infection. Descriptive analysis and Student T-test was utilized for data analysis, p values <0.05 were considered significant.

Results: Compliance with completing the various forms ranged from 90% to 95% with increasing compliance as time progressed. The rates of CLABSI in our BICU decreased from 10.1 + 9.3% in 2009 to 1.9 + 3.5% in 2010 (p=0.03). The mean number of days for vascular access increased from 113.8 + 41.1 in 2009 to 125.3 + 21.6 days in 2010 (p=0.422). Although, there was a decrease in the number of infections the use of peripherally inserted central catheters increased in 2010 as compared to 2009.

Conclusions: The implementation of written check sheets, daily and weekly discussions regarding the necessity of central lines and care team reviews of patients that developed CLABSI decreased the rates of blood stream infections in our burn unit.

Applicability of Research to Practice: Implications for practice are numerous. HAI's impact length of stay and ultimately mortality. Incorporating a "No Tolerance" for BSI's has to be a priority. All members of the healthcare team are necessary for this process to be carried out.

79 . Strategies to Eliminate Ventilator Associated Pneumonia (VAPs)

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Introduction: Over 1.7 million healthcare-associated infections occur each year with 99,000 health care associated deaths. Patients with significant burn or inhalation injuries require extended periods of mechanical ventilation (MV). Prolonged MV increases the patient's risk of ventilator associated pneumonia (VAP), increases hospital duration, and increases morbidity and mortality.

Objective is to develop and implement a multidisciplinary process that is unit specific to decrease the rates of VAPs in our burn patients.

Methods: Our institution identified an interdisciplinary team to develop tools to assist with decreasing the rates of VAP including: a VAP bundle compliance sheet and The VAP bundle which consists of; head of bed >30 degrees, spontaneous breathing trial, sedation awakening trial, and peptic ulcer prophylaxis and oral care per protocol. Education was completed from May-June 2009. After completion of the education, forms were installed into the daily work flow of the unit to allow tracking of compliance of the VAP bundle. Additionally, these forms were reviewed daily and weekly at the multidisciplinary burn meeting. In patients that met criteria for VAP as defined by the Center for Disease Control, an evaluation of the patients' risk factors, duration of mechanical ventilation, and additional respiratory parameters were reviewed with the patient care team to identify ways to reduce the future occurrences of VAP. Relevant data collected included: date of intubation or tracheostomy, duration of MV, size of endotracheal tube, source of culture (sputum, tracheal aspirate, or bronchioalveolar lavage) and X-rays for verification of pneumonia. Descriptive analysis and Student T-test was utilized for data analysis, p values <0.05 were considered significant.

Results: Compliance with completing the various forms ranged from 90% to 95% with increasing compliance as time progressed. The rates of VAP decreased from 10.7% in 2009 to 1.0% in 2010 (p=0.008). Additionally, the number of days patient spent MV decreased from 83 + 24.5 days in 2009 to 68.5 + 30.7 days in 2010 (p=0.175). Although, there was no significant decrease in the duration of MV the number of confirmed pneumonias did significantly decrease. This decrease may be attributed to the daily sedation vacations and aggressive weaning trials post implementation of the protocols.

Conclusions: The implementation of written check sheets, daily and weekly discussions regarding the necessity of mechanical ventilation, and care team reviews of patients that developed VAP significantly decreased the overall rates of VAP in our burn unit patients.

Applicability of Research to Practice: Daily assessment and review of Ventilator Bundles significantly decrease the rate of VAPs.

80 . Lincosamide Antibiotic Treatment Inhibits Virulence Factor Production in MRSA-Infected Burn Wounds

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Introduction: The mortality rate of burn patients is greatly increased if they experience complications of infection. Frequently, the organisms associated with such infections are Staphylococci, which include species such as MRSA that can be difficult to treat since they are antibiotic resistant. Virulence factor production can further complicate treatment as localized toxin presence may induce derailing of the healing process and allow for a more invasive infection, while toxin that becomes systemically circulating can induce shock and cause systemic host immune disruption.

Methods: Nine Male Sprague-Dawley rats were subjected to burn injury. In this model two (2 cm x 2 cm) full-thickness wounds were created on the dorsum of each animal. On the first post-injury day, wounds were inoculated with 1 x 10⁸ CFU MRSA that produces Toxic Shock Syndrome Toxin-1 (TSST-1). Animals were then divided into three groups based on treatment: vancomycin, linezolid, or sham. For the remainder of the time course, animals received twice-daily intravenous treatment. Wound assessment, blood sampling and wound biopsies occurred daily for the 10-day time course.

Results: All animals had wound quantitative cultures that exceeded 1 x 10⁸ CFU/g one day following inoculation and plateaued at 1 x 10¹¹ CFU/g near the end of the time-course. Neither antibiotic significantly reduced the bacterial counts in the wounds. Positive controls and vancomycin-treated animals had toxin in their wounds by day 5 and this remained throughout the study (ranging from 20-80 ng/ml). Linezolid treated animals had significant reduction in toxin production (< 5 ng/ml), and in most cases toxins were undetectable. No animals became systemically infected with bacteria at any point during the study.

Conclusions: Superantigen production in burn wounds has morbid consequences in terms of long-term wound healing and graft take. A *S. aureus* burn wound infection model was created that allowed study of the effect of two standard-use antibiotics on local burn wound pathophysiology. Most noteworthy is that low-dose linezolid arrested toxin production in the wound. Since bacterial counts were not reduced, this appears to be due to protein synthesis inhibition and not an anti-proliferative effect.

Applicability of Research to Practice: This work provides information on treatment strategies to local bacteria virulence factor production.

81 . Beyond Burn Camp: Building An Adult-Centered After-Care Program with SOAR (Survivors Offering Assistance in Recovery) Certified Peer Counselors as Mentors

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Introduction: Recovery from the physical and emotional trauma of a burn injury continues beyond discharge. Verified burn centers are required to provide an after-care program to support patients as they continue their recovery and integrate back into their home communities. Staff recognized the need for adult-centered after-care programs because 70% of patients were adults at time of admission and survivors injured as children aged out of burn camp programs. There was inadequate staffing to sustain a high-quality, adult-centered, after-care program in addition to the children's program.

Methods: Staff searched for recognized, high-quality, non-profit community programs that welcomed trained peer-counselor mentors, encouraged group interaction and were open to adults of any age and with varying physical, intellectual, social and financial abilities. Like burn camp, the program needed to gather survivors for a common activity over an extended period of time. Burn center contracted with LEAP (Life Expanding Adventure Program) and Write Around. SOAR certified peer counselors participated in both programs as mentors.

Results: After-care support coordinator supervised community programs but did not actively participate. Over four consecutive years, Write Around led an annual 10-week writing workshop open to discharged patients and family members. Eighteen survivors completed one or more workshops and contributed to a public reading and a published anthology. SOAR peer counselors participated in each workshop and were recognized as mentors. Over 2 years, LEAP organized two four-day wilderness-rafting trips with a total of 18 burn survivors. SOAR peer counselors participated in planning and led evening group activities. A SOAR peer counselor initiated an active facebook page and monthly survivor meetings after participating in LEAP and Write Around programs. The \$14,500 annual cost for these programs was paid through local foundation funding and participants were not charged a fee to attend.

Conclusions: Burn center was able to provide an adult-centered, consistent, after-care program by contracting with recognized, high-quality, community programs. Group members engaged in common activities, which did not center on burn trauma but rather on achieving established goals. SOAR peer counselors, serving as mentors, were present in all groups to address burn-related issues as they occurred.

Applicability of Research to Practice: An increased role of SOAR certified peer-counselors in after care programs allowed verified burn center to increase programs for adult survivors without increasing paid staff hours.

82 . “Celebration of Life”: A Review of Adult Burn Survivor Annual Reunions

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Introduction: For nearly 20 years, our Adult Burn Survivor Annual Reunion has offered burn survivors, family members, burn center staff, firefighters, and other community members an opportunity to come together for a day filled with inspiration, support, and resources for those touched by the trauma of a burn injury. The reunion components include a featured burn survivor speaker, time to visit and share experiences, time for small support group discussion, entertainment, and food. The program also encourages participants to develop networking opportunities to take back to their local communities. The objective of the present study was to examine attendees' views of recent reunion activities.

Methods: Following each reunion, attendees are asked to evaluate the event by responding to an anonymous questionnaire involving Likert-type scales and open-ended questions to rate the quality or usefulness of the activities involved. Activities examined for the present review include a morning reception, featured burn survivor speakers, open-microphone opportunities for sharing stories, time to meet other survivors, and support groups for survivors and their extended families. Evaluations from four burn reunions over a 5-year period (2006-2010) were examined.

Results: Evaluations were returned by 226 attendees over the four years, including burn survivors (32%), family members (35%), friends (17%), staff (10%), and others from the community such as volunteers and firefighters (6%), with response rates increasing from 42% in 2006 to 86% in 2011. Results for the five variables examined (welcoming reception, featured burn survivor speaker, open-microphone, meeting other survivors, and support groups) were overwhelmingly positive across the participant groups that responded. Support groups offered at 3 of the 4 reunions were attended by 66% of the burn survivors, 65% of family members, and 63% of friends responding during those three years; 20% of the group participants rated them to be “Good” and 80% rated them as “Excellent.”

Conclusions: Results demonstrate that attendees highly value the reunion experience, especially activities that support emotional needs and promote well-being for burn survivors, their friends and families, and the extended burn community. High participation rates and evaluations of the support groups offered underscore the need for and importance of ongoing support following a life-altering burn injury for burn survivors and for the family members and friends who support them.

Applicability of Research to Practice: Aftercare activities, such as reunions, provide resources that are critical to the long term recovery needs of persons living with a burn injury and their extended families. They also promote continued contact with members of the health care team and other members of the burn community.

**83 . Social Exclusion and Appearance
Dissatisfaction Effect Psychological and Social
Recovery**

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Introduction: When struggling to accept sudden burn-related changes in one's own appearance, it may make some individuals concerned about being excluded by others. Sensitivity about exclusion (Overall, 2009), especially because of one's appearance (Rosser, 2010), biases perception to appraise rejection. In key interactions, like meeting someone for first time or needing someone's support, fear of exclusion often leads to avoidance (Overall, 2009).

Methods: Participants (N= 227) were burn patients from a regional burn center: mean age 40 years, mean %TBSA burned= 11%, 69% male, 62% Anglo-American, 46% flame injuries. Outcome assessed at discharge (n=227), and 6- (n=102) and 12- (n=96) months using SF-36 subscales: Social Functioning (SF) and Role Interference by Emotional Problems (RE: psychological disability). Satisfaction With Appearance Scale (SWAP) assessed perceived social exclusion and dissatisfaction with appearance. Linear mixed models tested in SPSS statistically controlled gender, %TBSA, and psychological treatment history.

Results: Both perceived social exclusion ($B = -.90, p < .01$) and dissatisfaction with appearance ($B = -.43, p = .02$) had significant longitudinal effects on RE. In a separate model, perceived social exclusion ($B = -.98, p < .001$), but not dissatisfaction with appearance ($B = -.08, p = .66$) had a significant longitudinal impact on SF.

Conclusions: Both social exclusion and appearance dissatisfaction were longitudinally associated with worsening role interference from emotional problems (RE). Social exclusion was longitudinally associated with worsening social functioning (SF). Dissatisfaction with appearance was not related to social functioning in longitudinal models. Importantly, brief interventions given to study participants before an experimental rejection manipulation increased socializing (Lucas, 2010).

Applicability of Research to Practice: There is increasing evidence that dissatisfaction with appearance is detrimental to post-burn adjustment. However, the information presented here on social exclusion and sensitivity to exclusion has undergone rigorous basic science work in social psychology laboratories but has not yet been tested in clinical populations. These data provide new targets for clinical research and, ultimately, it is hoped will improve intervention.

**84 . Social Exclusion and Pain Among Severe Burn
Survivors**

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Introduction: Individuals with acquired alterations in appearance can be at a disadvantage when returning to duty/work, home, and community. A new challenge, social exclusion, can cause social pain when "one is being excluded from desired relationships or ¼ groups" (MacDonald, 2005). This study examines relationship of social pain with physical pain, and, tests if avoidance or acceptance are moderators of that relationship.

Methods: Participants (n= 125) were consenting admissions to a regional burn center with major burns. The sample was predominantly male (70%), Caucasian (65%), mean age= 39 years. Most frequent mechanism of injury was fire (47%). Study measures were completed at discharge (N=130), 6- (N=87) and 12- months (N=81) post-discharge. Satisfaction with Appearance Scale (SWAP) provided social exclusion measures: Social Discomfort (SD), Perceived Social Impact (PSI). McGill Pain Questionnaire yielded sensory and affective pain scores. The Brief COPE avoidance and acceptance subscales were used. Linear mixed regression models tested prospective relation of social exclusion with pain. We examined cross-sectional links of social pain and physical pain to test whether acceptance or avoidance moderated their relationships. All analyses controlled for %TBSA and gender.

Results: Longitudinal effects: SD had significant longitudinal impact on sensory ($\gamma_01 = .20, p = .03$) and affective ($\gamma_01 = .10, p = .006$) pain. PSI had a significant longitudinal effect on sensory ($\gamma_01 = .43, p < .001$) and affective ($\gamma_01 = .15, p < .001$) pain. The relations of SD and PSI with affective and sensory pain remained stable over time.

Moderation analysis: At discharge, avoidance significantly moderated the effect of PSI ($B = .051, p = .008$) on affective pain. High PSI correlated more strongly with high affective pain among people who often avoid versus avoid less often. Acceptance significantly moderated the effect of SD on affective ($B = -.065, p = .029$) and sensory pain ($B = -.15, p = .045$). High SD correlated more strongly with affective and sensory pain among people low versus high on acceptance.

Conclusions: Social pain (Social Discomfort; Perceived Social Impact) significantly predicted physical pain (affective, sensory). Also, avoidance and acceptance moderated the relationship between social pain and physical pain. Specifically, higher avoidance and lower acceptance strengthened the relationship of social pain and physical pain - that is, they made the pain worse.

Applicability of Research to Practice: This evidence suggests the importance of social adjustment and yields new insight into the way that pain and coping can interfere with it.

85. Reasons for Distress Among Burn Survivors at Discharge, 6, 12, and 24 Months Post-Discharge

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Introduction: The purpose of this study was to identify the top reasons for distress among burn survivors at various points in their recovery.

Methods: Participants were asked to rate 10 reasons for distress using a 0-10 scale (0 = no distress and 10 = a lot of distress) at four time-points following a burn injury (discharge, 6-, 12- and 24-months). The SF-12 was also administered at each time-point to provide a standardized measure of the health-related quality of life. The SWAP was used to understand the impact on body image, and a measure of return to work was used to determine barriers to returning to employment.

Results: A total of 579 adults participated in the study. The mean age was 43.74 (s.d. = 15.63), mean TBSA = 19.6% (s.d. = 17.36) and 74% were male. Predictive models with continuous outcomes were determined using a mixed model analysis. Variables with binary outcomes were determined using the genmod procedure. Financial concerns and long recovery time were the top reasons for distress at discharge, and although the severity decreased over time, they remained the top rated reasons for distress two years later. While pain and decreased range of motion were scored high initially, they were the lowest scored reasons for distress two years later. Pain, decreased range of motion, sleep disturbance, decreased strength, and long recovery time all showed significant decreases across all four time-points, while itching showed a significant decrease at 12 and 24 months. Interestingly, temperature changes, dissatisfaction with appearance, uncomfortable scars and changes in skin color all showed no significant change over time. The predictive models on the various outcome measures across all time-points are in the table below.

Conclusions: Pain, sleep disturbance and decreased strength result in a lower likelihood that a person will return to work. Given that financial concerns remain one of the top reasons for distress throughout the two-year period, interventions that aim to get a person back to work faster by managing pain, improving sleep and increasing strength will have a significant impact on the quality of life. Finally, interventions need to be developed that address body image concerns, as evidenced by the data that dissatisfaction with appearance, scars and changes in skin color do not improve over the two year time period.

Applicability of Research to Practice: This information should be used to design treatment interventions for issues causing the greatest distress at each time-point in recovery.

Predictors of Outcome

	SF-12 (physical component scale)	SF-12 (mental component scale)	SWAP	Return to Work
Predictors	Pain (p=.0001)	Pain (p=.0001)	Sleep disturbance (p=.0001)	Pain (p=.008)
	Itch (p=.0017)	Sleep disturbance (p=.0001)	Dissatisfaction with appearance (p=.0001)	Sleep disturbance (p=.0132)
	Decreased strength (p=.0001)		Financial concerns (p=.0025)	Decreased strength (p=.0556)
			Changes in skin color (p=.0001)	

86. Burn-Injured Adolescents Report Gaining Multiple Developmental Benefits and Improved Life Skills as a Result of Burn Camp Attendance

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Introduction: Anecdotally, burn camp has been reported to be a positive developmental and rehabilitative experience for attendees. However, there is little empirical data to support this belief. This study sought to explore if burn camp either directly or indirectly elicits positive development outcomes in pediatric burn survivors and/or increases their psychosocial well-being and achievement.

Methods: The Youth Experience Survey (YES 2.0) is a 66-item self-report inventory designed to measure developmental experiences in an organized youth activity that was administered to children ages 11-18 attending summer burn camp.

Results: One hundred and ten burn-injured youth, 58 male and 52 female, reported that burn camp had positively impacted their lives through improved identity exploration, goal-setting and problem-solving abilities, increased physical, communication, emotional regulation and time management skills (p<.0001). Participants reported more positive experiences than the norm group and higher mean scores on 90% (48) of the 53 positive items. Attendance at burn camp for more than 5 years resulted in even greater improvement.

Conclusions: Study results support the burn camp experience as a far-reaching and positive developmental activity. Participants credited the camp experience with helping them with identity formation and reflection, improved social interactions, and increased initiative; all positive developmental outcomes for youth. Results suggest burn camp is not only helping burn-injured youth deal with their burns, but camp participation also assists them in the development of social and basic life skills. Ultimately, allowing them to navigate the transition from youth to adulthood, more effectively and successfully.

Applicability of Research to Practice: These findings emphasize the important benefits adolescents report gaining from burn camp attendance. The camp venue reportedly aided in the acquisition of enhanced social skills and therefore participation should help youth with improved community integration, an important goal for burn patients. Furthermore, these results support and encourage burn care staff to recommend that burn-injured youth, even those in their teenage years, seriously consider participating in burn camp.

87 . **Remember Me Program: Bridging the Gap between the Hospital and School**

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Introduction: A major burn injury during childhood interrupts normal school experiences and friendships. The recovery period is difficult for patients and classmates. Recognizing the important role of school-related social networking during convalescence, the 'Remember Me' program was initiated to keep the patients in touch with peers while hospitalized. The purpose of this study was to evaluate program effectiveness in patients (K-8) who sustained a total body surface area burn > 20%.

Methods: The program was introduced to patients meeting enrollment criteria. Following signed release by the legal guardian, the child's residential school was oriented. A 'Remember Me' tool kit (program instructions, a Teddy Bear and a large, postage paid return envelope) was forwarded to the school. In accordance with guidelines, the bear was positioned in the patient's seat at school for the duration of the child's hospitalization. Placed with the bear was an envelope to collect classmate's letters, cards, photos and other forms of communication which was forwarded to the patient. The process was completed by a survey that assessed patient/parent/school satisfaction to gauge the utility of the program.

Results: Thirty patients (mean age 8.4 + 0.6, range 5-15 years old) from 18 states in the US and Mexico participated in the 'Remember Me' program. Patients were hospitalized an average of 52.4 + 9.2 days (range 2-205 days). Survey response (57% return) from schools and parent feedback indicated that 100% judged the program to be useful.

Conclusions: This investigation provides evidence that the 'Remember Me' program was overwhelmingly popular. Results indicate that the program was useful and the patient appreciated the school's attention. In the future, a similar program will be designed to address needs of patients in grades 9-12.

Applicability of Research to Practice: Clinicians should be aware that "Out of sight, out of mind" may be applicable in the situation of a burned classmate: if the student is not sitting in the desk, it is easy to forget about him. The 'Remember Me' program effectively maintains communication between burned children and their classmates and teachers.

88 . **The SOAR Program's Impact in a Burn Center**

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Introduction: Burn survivors and their loved ones face unique emotional challenges including fear of isolation, the unknown, and disfigurement, while family members often worry about how the survivor will cope and how they, themselves, will manage caring for the burn survivor upon discharge from the hospital. Peer support is a catalyst in helping both patients and loved ones be connected to others who have traveled a similar path, demystify burn recovery, and provide ideas for coping. In July of 2009, we implemented Survivors Offering Assistance in Recovery (S.O.A.R.), a nationally recognized peer support program, developed by the Phoenix Society, in an effort to improve emotional outcomes for our burn survivors and their families. We prospectively gathered data in order to monitor the number of monthly visits made by our peer supporters and evaluate the effectiveness of our program, as perceived by patients, families, loved ones, and peer supporters. Peer support visits were offered and conducted during both inpatient and outpatient treatment.

Methods: A review of prospectively gathered data, from 07/01/2009 - 6/30/2011, was performed to obtain information on the number of peer support visits each month and perceptions of participants on 6 items, at each visit, regardless if participants received multiple visits. In evaluating these six items, we utilized a 7 Point-Likert scale survey that was completed immediately following the peer support visit. Three of the six items, specifically measured the impact of the visit. They included: usefulness of visit, increased hopefulness of recovery, and if they would recommend the program to others.

Results: The number of S.O.A.R. visits conducted at our burn center was above the national average at 97.5 annual visits compared to 38.8. The mean scores of the usefulness of the visit, increased hopefulness of recovery, and if they would recommend the program to others ranged from 6.1 to 6.5, suggesting that participants believe peer support visits are beneficial in their recovery. Additionally, more than half of the visits were with patients and loved ones who requested additional visits.

Conclusions: Both patients and loved ones find peer support visits to be an important aspect in recovery. We attribute the success of our S.O.A.R. Program to offering visits throughout the continuum of care, dedicated peer support volunteers (two who have consistent schedules and eleven others who are available upon request), provision of written literature upon admission and in the waiting areas, and a multidisciplinary approach to offering a visit to each patient. The importance of peer support in burn recovery is evident, in our burn program, as it provides burn survivors and their loved ones a holistic approach to recovery.

Applicability of Research to Practice: The importance of a structure for success of peer support program.

89 . How Soon is Now? A Systematic Review of Laser and Light-Based Therapies for Hypertrophic Burn Scars and the Need for Robust Clinical Trials to Determine Best Practices

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Introduction: Hypertrophic burn scars can produce significant morbidity, including severe pruritis, chronic pain, and contracture, and best practices for management continue to evolve. Laser therapies have been added to treatment algorithms, but indications and efficacy have not been fully defined. We conducted a systematic review of laser and light-based therapies for the treatment of hypertrophic burn scars.

Methods: Using the key words “burn,” “scar,” “hypertrophic,” “laser,” we searched several electronic databases (PubMed, Embase, Cochrane). Inclusion criteria were the following: population: patients undergoing treatment of hypertrophic burn scars; intervention: laser or light-based therapies; outcomes: change in burn scar height, vascularity, stiffness, appearance, pain, pruritis; study design: clinical trials; language: English.

Results: We located 329 potential articles, which were refined to 87 unique publications. After eliminating animal studies, letters, case reports, reviews, and clinical trials with an unknown or limited (<5) number of burn patients, we identified 12 articles that met our inclusion criteria: 1 cohort study, 5 before-after studies, 4 controlled clinical trials, and 2 randomized controlled trials, 10 of which were prospective. All 6 of the clinical trials used internal controls, in which patients’ burn scars were split into treatment versus no treatment areas. No publications used non-treated external controls, compared different types of laser therapies, or compared laser treatment to non-laser treatments, such as pressure garments or silicone sheeting. A total of 770 patients were treated with pulsed dye laser (5 articles), erbium laser (3 articles), low-level laser therapy (2 articles), and intense pulsed light (2 articles). Assessment of outcomes was blinded in 3 articles and utilized a validated grading system in 6 articles. 11 articles demonstrated mild to moderate improvement in hypertrophic burn scars, whereas 1 article showed no sustained improvement over internal controls. The most frequent benefits were improvements in erythema, height, and pliability, noted in 5 articles, although improvements in pain, pruritis, color, and texture were also observed. Complications were reported in 18 patients, or 2.3% of the total group.

Conclusions: Our systematic review supports the use of laser and light-based therapies as an efficacious option for the treatment of hypertrophic burn scars. However, more robust clinical trials are needed to help determine best practices and guide clinicians regarding the timing and type of therapy.

Applicability of Research to Practice: This systematic review provides evidence for the use of lasers to treat hypertrophic burn scars.

90 . Beginning to See the Light: Efficacy of and Patient Satisfaction with Intense Pulsed Light in the Treatment of Burn Scar Dyschromia

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Introduction: Although laser therapies can improve the functional problems of hypertrophic burn scars, no treatment algorithms have emerged to reliably treat burn scar dyschromias, which represent an unsolved cosmetic concern for burn patients. Intense pulsed light (IPL) has been used successfully to treat other hyperpigmentation disorders, such as melasma & solar elastosis, but this modality has not been studied extensively in the treatment of burn scar dyschromias. We investigated the clinical efficacy of and patient satisfaction with IPL in the treatment of burn scar dyschromias.

Methods: Patients with burn scar dyschromia were selected for treatment with IPL and excluded from this study if areas of hyperpigmentation had been treated previously with topical lightening agents, such as hydroquinone, or triamcinolone. With fluences ranging from 10-22 joules/cm² & filters ranging from 560-640 nm, we used the Lume 1 platform (Lumenis) to target pigmented lesions in the dermis. Patients were pre-treated with topical lidocaine only if they experienced discomfort. No prophylactic antibiotics were given. Patients were not charged for the procedure, but third party payers were charged for middle-tier clinic visits. Providers assessed subjective improvement in dyschromia. Patients were queried for satisfaction, subjective efficacy, and willingness to pay.

Results: During 2011, 20 patients (11 females, 9 males; mean age 35.3 years, median Fitzpatrick skin type 4) underwent 23 IPL sessions, 3.2 years after burn injury (flame 9, scald 5, contact 3, friction 1, ultrasound 1, electrical 1). Mean TBSA was 27.6%; mean treatment area was 90.1 cm². Mean fluence was 15.4 J/cm²; the most common filter used was 590 nm. Complications included 4 patients with significant pain and 2 patients with blistering. 16 patients had mild to moderate improvement in color, as rated by the providers. 4 patients had no response. Regarding patient perception, efficacy was rated at 4.5 (using a Likert scale, where 3 = no effect, 4 = mild improvement, and 5 = significant improvement). Patient satisfaction was rated at 4.0, with all patients recommending this to others and 87% of patients willing to have a repeat procedure. Patients reported that they would pay a mean of \$5571 to remove their burn scars and valued each session to be worth a mean of \$1664. Mean length of follow-up after each procedure was 2.2 months.

Conclusions: IPL is efficacious in the treatment of burn scar dyschromia, with a high level of patient satisfaction, but includes the potential for morbidity. Future prospective, validated trials will be necessary to generate guidelines for patient selection and treatment parameters.

Applicability of Research to Practice: We introduce IPL as a method to treat burn scar dyschromia.

91 . **Assessment of Hair Density and Sub-Epidermal Tissue in Burn Scars Using High Frequency Ultrasound**

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Introduction: Several aspects of scar physiology and even morphology are unknown and unstudied. The objective evaluation of scars is in its infancy. The only established tool is the so called "Vancouver scar scale (VSS)", which measures only Pliability, Pigmentation, Height and Vascularity. Depth of the actual scar tissue, which may be far thicker than "height", only referring to elevation of tissue over the surrounding skin plane, is not assessed. Neither are skin adnexae, sensation or ability to temperature regulate.

This prospective study was designed to look at hair follicle density and depth of subepidermal tissue in Burn scars with high resolution ultrasound. Hair follicles and other intradermal structures can be visualized non-invasively with this modality and with no risk to the study subject. The study was reviewed and approved by the IRB.

Methods: 19 Burn survivors >18 years, showing obvious scars from burn injuries at least 9 months after wound healing, were included. A total of 10 non-grafted scars and 11 grafted scars were examined with high-resolution ultrasound (3 scans for each scar) (Longport, Inc., Glen Mills, PA). Each scar was compared to an area of healthy skin of the same body area intraindividually. Informed consent was obtained. The number of hair follicles was counted, the thickness of sub-epidermal collagen deposit was measured in mm. Digital photographs were taken of all investigated sites. A mixed models ANOVA with repeated measures was conducted. The analytic model used restricted maximum likelihood estimation, an unstructured variance-covariance matrix, and modeled random intercept by subjects. To correctly model the non-independence among scars, scars were nested within patients.

Results: In 11 grafted scars the mean hair follicle (HF) amount was 1.51 versus healthy skin 7.73 HF ($p < 0.0001$). In 10 ungrafted scars the mean HF count was 4.2 vs 7.5 in healthy skin ($p = 0.009$) the difference between grafted and non-grafted scars was significant ($p = 0.04$). The thickness of sub-epidermal scar tissue was also significantly ($p = 0.001$) increased in both, grafted (2.51 mm) and ungrafted (1.87 mm) scars versus healthy skin (1.81 mm and 1.61 mm). The difference between grafted and ungrafted scars regarding thickness was not significant ($p = 0.17$).

Conclusions: The sub-epidermal thickness of tissue and the amount of hair follicles was objectively and reliably measured non-invasively by high resolution ultrasound in Burn scars. This study documents scientifically the empirically long known fact that skin adnexae and dermal tissue are altered in scars and that it is not necessarily true that non-grafted (and presumably 2nd degree) wounds heal without these changes. The technology should be used in future scientific scar evaluations.

92 . **Under Pressure: Elective Peripheral Nerve Decompression after Burn Injury and Comparison of Patients with Electrical Versus Non-Electrical Etiologies**

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Introduction: Although neuropathy after burn injury may be multi-factorial, some patients with nerve compression benefit from surgical release. Few studies have examined long-term outcomes of nerve decompression in this setting. No studies have compared outcomes, based upon type of injury. We present our experience with elective nerve decompression in burn patients & compare patients with electrical vs non-electrical etiologies.

Methods: From 2000-2010, we performed 236 elective nerve decompressions, at an accredited burn center, in 105 burn patients with peripheral neuropathy. We retrospectively reviewed data collected prospectively: demographics, mechanism, TBSA, NCV/EMG, timing/type of release. Outcome measures: complications, impairment rating, work status, length of follow-up. Using Student's T test & chi-square analysis, we compared burn patients with electrical injury to those whose etiology was not due to electrical injury. Statistical significance: p values < 0.05 .

Results: 105 patients (mean age 38.3 years, TBSA 18.4%) underwent 236 decompressions, a median of 382 days after thermal (72), electrical (26), chemical (7) injury. Tinel's sign occurred in 78/105 exams, with abnormal NCV/EMG in 62/68 studies. Site of decompression: carpal tunnel (93), digital sheath (41), Guyon's canal (45), cubital tunnel (34), proximal fibula (12), superficial radial nerve (5), antebrachial cutaneous nerve (5), and pronator tunnel (1). Complications: dehiscence (16), infection (10), hematoma (1), nerve injury (1), for complication rates of 19.0% (by patient) and 8.5% (by site). 73 patients (69.5%) had definite improvement, 18 (17.1%) had minimal improvement, 14 (13.3%) did not improve. Of 61 patients with workers' compensation, 33 returned to work (mean impairment rating: 41%). We found no significant differences between patients with electrical vs non-electrical mechanisms, in terms of TBSA, timing/type of decompression, improvement, complications, or persistent chronic pain. Patients with electrical injury were younger (32.3 vs 40.8 years) and mostly male (96% vs 73%), had a higher incidence of workers' compensation (80.8% vs 50.6%), had a higher fasciotomy rate (42.3% vs 15.2%), had longer follow-up (681 vs 419 days), had more psychiatric disability (26.9% vs 11.4%), all $p < 0.05$.

Conclusions: Peripheral nerve decompression, late after burn injury, is effective in treating nerve compression syndromes, even in patients with electrical injury. Given the low morbidity & high potential for improvement, nerve release should be strongly considered as a therapeutic option in carefully selected burn patients.

Applicability of Research to Practice: This paper supports peripheral nerve decompression in burn patients.

93. Clinical Analysis on Recurrent Marjolin's Ulcer

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Introduction: In cases of finding chronic ulcerative lesion from a old scar, you can be suspicious of the Marjolin's ulcer. However, there are many occasions in which lesions are overlooked or treated improperly when the lesion is noticed late. Additionally, its prognosis is poor compared to other skin cancers. We studied on the patients who have received surgeries after having Marjolin's ulcer for the last ten years.

Methods: From January 2001 to May 2011, 48 patients have undergone surgeries on the primary site of ulcer. We have conducted a retrospective analysis on the categories of sex, age, primary lesion and its duration, rate of metastasis on diagnosis, incidents of relapse, and death rates.

Results: There were 29 male patient subjects and 19 female patient subjects, and their mean of the ages was 50.6(± 14.51) years old. Among the primary wound sites, 27 cases were on the lower limbs marking about 56%, upper limbs were the next (12 cases), followed by the trunk (6 cases) and the scalp (3 cases). It has taken about 34.7(± 5.3) years by the time patients were diagnosed with Marjolin's ulcer from the early stage of the primary lesion. From 8 patients, metastasis to the lymph nodes was noticed but there was no development to distant organ metastasis. From 10 cases, local relapse was found, and amputation was performed on 4 cases and skin graft was done on 4 cases. Three patients have died from difficulty of breathing from metastasis and a shock from sepsis after relapses of 2, 4, and 11 months.

Conclusions: Like other malignant tumors, the pathogenesis of the Marjolin's ulcer is unclear. Due to its rareness, there are disputes and arguments regarding its clinical conditions and prognosis. According to our research, all local relapses have occurred less than a month after the surgery, and especially, in 3 cases of death, metastasis was found within 3 months after the surgery. Therefore, when treating patients with chronic scar, dangers of malignant change must be recognized, and close examinations for local lymph node metastasis and distant metastasis must occur. Additionally, it is critical to understand the importance of wide removal and amputation of the primary site, aggressive post treatment, and regular observation.

Applicability of Research to Practice: This study shows clinical analysis on recurrent Marjolin's ulcer.

94. To Release Severe Postburn Contracture of the First Web Space with Reverse Posterior Interosseous Flaps

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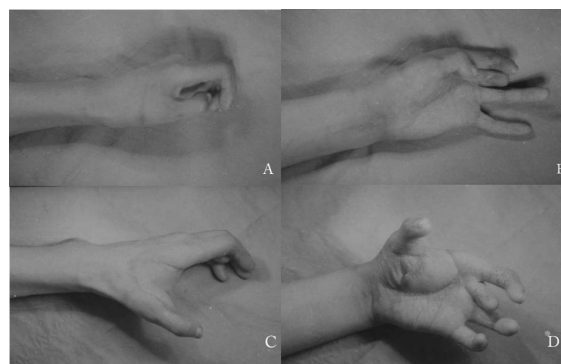
Introduction: Severe postburn contracture of the first web space is one of the most common deformities in hand. The contracture will significantly reduce the hands ability to grasp and similarly diminish the ability of the thumb to function appropriately. An adequate release of the first web is vital in optimizing hand function. As the merits of reverse posterior interosseous flap (RPIF), it has been widely used to recover the hand defects. But this flap has not well described to be used to release the contracture of the first web space.

Methods: From 2008 November to 2011 April, twelve consecutive patients (8 males and 4 females) with severe postburn contracture of first web space were enrolled in this study, their age ranged from 15 to 42 years (mean, 33 years), thumb index angle was 23 degrees (10-35 degrees). 17 RPIF were performed under general anesthesia, flap sizes ranged between 18 \times 8cm² and 10 \times 6cm², the average size was 113cm².

Results: The follow-up period ranged from 5 months to 26 months, with an average of 17 months. All flaps survived completely and were rapidly adapted to the recipient beds to achieve good color and texture harmonies. None early complications occurred, including venous congestion, arterial insufficiency, suture detachment, and infection. Fifteen donor sites were recovered by skin grafting, the remained two donor sites were healed with direct closure. No paralysis of the posterior interosseous nerve was observed in any of the cases. Measurement of first web angle in the last follow-up, thumb index angle was 78 degrees, increasing the web length of 260%. All patients were able to gain fundamental hand functions for daily routine activities.

Conclusions: Most of severe postburn contracture of the first web space are the indications need to be released with flaps. The RPIF have some considerable advantages involving thin and pliable structure, perfect color, and texture match to provide a fairly abundant tissue, wide arc of rotation, not to sacrifice a major artery in the hand, and not to interfere with lymphatic and venous drainages of the hand. While the drawbacks are its large donor defects requiring skin grafts and the dissection need be careful and skillful.

Applicability of Research to Practice: We suggest that the RPIF be used as reliable choice for releasing the severe postburn contracture of the first web space.



95 . Burn Neck Contracture in Children: The Incidence, Management and the Results

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Introduction: Contracture of the neck is a common consequence noted in individuals with burns of the head and neck. While the use of neck brace applied soon after the injuries is the regimen advocated, the efficacy in achieving contracture prevention is often curtailed because of pain and discomfort; i.e., poor patient compliancy. 179 children with neck contracture were managed between 2003 and 2007. The experience gained from managing this group of patients formed the basis of this report.

Methods: A total of 405 procedures was performed in this group of patients. The techniques used were (1) Scar excision; (2) Partial or full thickness skin grafting; (3) Local skin flaps; i.e., skin flap advancement, z-plasty, etc.; (4) An interpositional musculocutaneous flap alias 3/4 MC Z-plasty. The effectiveness of contractural relief was ascertained subjectively with complaints of recurrent or persistent tightness around the neck and the presence of contracting scar bands. Re-release of the neck contracture was carried out with the signs and symptoms described.

Results: Of 405 procedures, scar excision technique was used 32 times, Skin grafting was used in 64, local skin flap advancement or rotation techniques in 33 and 276 MC flaps were used for the rest. While partial loss of skin graft occurred in 6 and 4 partial flap necrosis was noted among those who had been treated with a MC flap technique, the incidence of re-release was noted to be the highest among the group treated with simple skin flap advancement following local tissue expansion technique and/or z-plasty. In contrast, a little over 12% of those who had undergone contractural release utilizing the modified musculocutaneous transpositional flap alias 3/4 MC Z-plasty required release.

Table 1

Techniques of Neck Release	# of Release	# of Re-release	
Scar excision	32	6	18.75%
Skin graft	64	13	20.31%
Local skin flap: z-plasty, TE, etc	33	14	42.42%
MC flap	276	34	12.32%
Total	405	67	

Conclusions: Although the conventional procedure of skin grafting remained effective in reconstructing neck contracture, the incidence of re-release was noted to be less if a MC flap can be fabricated and used to release the contracture.

96 . Face Transplantation after High Voltage Burns: Functional Recovery at 2.5 Years

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Introduction: In June of 2005, a 55-year-old male suffered severe facial burns treated with conventional reconstructive procedures. Due to the extent of injury, the patient was found eligible for face transplantation, which was performed in April, 2009. Facial form was immediately restored. Here we report on the patient's follow-up 2.5 years after transplantation.

Methods: In an effort to integrate facial allograft function, all major sensory and motor nerves were reconnected. Daily physical therapy began the first week post-transplant, and included electrical stimulation, sensory discrimination and mandibular range of motion exercises. Outpatient frequency decreased to 2-3 sessions per week until 6 months post-transplant. Patient was regularly examined for the 2.5 years after transplantation. Sensory recovery was tested using Semmes-Weinstein monofilaments (SWm) and 2-point discrimination examination. The Facial Disability Index (FDI) was used to measure physical function of the face, as well as social integration and wellbeing. The Sunnybrook Facial Grading Scale (SFGS) was used to evaluate the return of facial motor function; patient was also videotaped for visual comparison of facial movements.

Results: Return of sensory and motor function was observed at 3 and 6 months. At 2.5 years, SWm testing shows sensation at 4g of pressure in 100% of the allograft. The patient can correctly discriminate 2-point stimuli (5mm apart) in approximately 42% of the allograft surface area. The FDI shows scores of 70 for physical activity and 68 for social wellbeing. The SFGS was not given a full score. This functional recovery has improved the patient's speech, mastication, and social interaction, allowing him to smile symmetrically without synkinesis.

Conclusions: Targeted recovery of sensory and motor function after face transplantation appears to be related to the inclusion of major sensory nerves and individual motor branches in the donor allograft. Physical therapists play an integral role on the face transplant team and must be involved with the patient at the time of candidate selection for face transplantation. The SFGS is a validated instrument for return of function after facial paralysis, but the need to compare with a 'normal side' of the face prevents direct applicability in face transplant patients. A scale specific to face transplantation must be developed to objectively measure the recovery of motor function in this population.

Applicability of Research to Practice: Coaptation of motor and sensory nerves of the face can be performed using microsurgical techniques. A personalized plan of postoperative physical therapy should be devised and executed with the help and expertise of physical therapists. Sensorimotor testing can be performed in short outpatient visits at pre-determined time-points.

97. Albumin Rescue: It Just Takes Time

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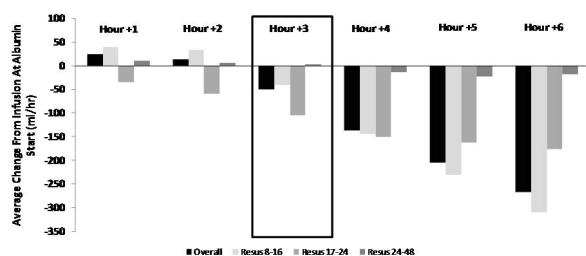
Introduction: Effective fluid resuscitation of burn patients is critical in improving mortality and reducing complications associated with fluid therapy during the initial 24 to 48 hours post burn. In addition, many providers include the use of colloids (i.e. albumin) during the initial fluid therapy. The objective of this study was to examine the effect of albumin use during active resuscitation of acute burn patients.

Methods: A retrospective review of patients admitted to our burn center from December 2007 to August 2011 that were actively resuscitated using a burn resuscitation computer decision support system (BRDSS) was performed. Infusion volume at each hour was guided by the BRDSS system with the addition of albumin as required by clinician guidance. Only patients who had at least 10 hours of active resuscitation on the BRDSS and received at least 6 hours of consecutive albumin therapy were included for analysis.

Results: A total of 80 patients met inclusion criteria for this study. Average age was 46 ± 18 years, weight was 82 ± 18 kg, and total burn size was $41 \pm 16\%$. Albumin was started on average 14 ± 5 hours post burn. Overall, average change in infusion as measured by the difference between crystalloid infusion rates at start of albumin (hour 0) and the six subsequent hours shows a significant decrease from a net positive fluid rate increase during the two subsequent hours (23 ± 161 ml/hr, 15 ± 248 ml/hr) to a net negative fluid rate decrease for hours 3 to 6 (-50 ± 293 ml/hr, -137 ± 295 ml/hr, -205 ± 328 ml/hr, -266 ± 349 ml/hr) ($p < 0.001$). A line fit for hours 0 to 2 shows an average positive slope of 7.35 ± 124 ml/hr and a negative slope of -72 ± 110 ml/hr for hours 3 to 6 ($p < 0.001$). Infusion rates also show a significant decrease at hour 3 for patients that started albumin therapy during the second 8 hours of resuscitation (hours 8-16) from 40 ± 179 ml/hr to -310 ± 380 ml/hr ($p < 0.001$).

Conclusions: Response to albumin therapy during active burn resuscitation appears to occur at least 3 hours post therapy initiation. On average, infusion rates will start to decrease on or after the third hour post albumin initiation with rates dramatically decreasing as albumin therapy continues. This effect is most pronounced during early albumin use at hours 8-16 post burn.

Applicability of Research to Practice: Determination of the effects of albumin during the first 48 hours post burn is necessary to develop optimal fluid management approaches for burn resuscitation.



98. Albumin Mitigates Renal Injury during the Initial Resuscitation of Large Burns

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Introduction: The debate over albumin administration has raged over decades. The theory behind administering colloids, e.g. albumin, is to ultimately decrease the amount of fluid required for administration, and thereby ameliorate "fluid creep". The complications of fluid creep are well described and include, airway swelling, soft tissue edema, abdominal compartment syndrome, and overall increased risk of death. Due to the controversy over albumin use in burn patients, a multi-center retrospective and prospective study was developed to identify how burn centers use albumin during the initial resuscitation of burn victims with large TBSA.

Methods: Surveys inquiring about past and current practices regarding the use of albumin, during the resuscitation phase of burn injuries, were sent to centers belonging to the Multicenter Trials Group of the ABA. Patients with burns greater than 20% TBSA were included in the survey. IRB approval was obtained for this study.

Results: Twelve regional burn centers in the USA and Canada participated in this study. 61.5% patients received albumin in the initial resuscitation phase (<24 hrs after admission). Patients who received albumin were more likely to be older, have greater TBSA, have inhalation injury, be sicker before burn injury, and have oliguria. The majority of patients received albumin because of oliguria (45.9%), to prevent the complications of excessive fluid administration (34.6%), hypotension (33.6%), and low albumin (24.4%). Administration of albumin resulted in a significant increase in urine output (UOP), however, when given for oliguria alone, there was no increase in UOP. Albumin administration was significantly associated with recovery from renal failure after 72 hours, regardless of when given.

Conclusions: The administration of albumin was associated with improved renal function, regardless of when albumin was administered during resuscitation. Although most sites felt that for the majority of patients who received albumin improved, there was no consensus amongst sites regarding selection criteria and protocol for administration of albumin.

Applicability of Research to Practice: "Fluid creep" is a well-described phenomenon during the initial burn resuscitation that can result in an overall increased risk of death. More effort needs to be focused on understanding how albumin decreases fluid creep and guidelines should be developed for administration of albumin in burn patients.

99 . Albumin Supplementation Following Burns: Is It Necessary?

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Introduction: Following fluid resuscitation, patients with major burns frequently develop prolonged hypoalbuminemia. It is not known if this should be corrected by albumin supplementation. Only one study has examined this question and found that albumin supplementation was not warranted in burned children¹. The purpose of this study was to determine if any benefits are associated with albumin supplementation to correct hypoalbuminemia in burned adults.

Methods: Retrospective comparison of patients with burns $\geq 20\%$ TBSA admitted to an adult regional ABA-verified burn center from May 1/ 09 to Sept 30/10 where we did not routinely supplement albumin (Control Group), and from Oct 1/10 to May 30/11 where we had instituted a protocol in which 5% albumin was provided to maintain serum albumin levels > 2 gm/dL (Albumin Group). Comparisons were made from post burn (PB) day 2 to 30 inclusive. All values are presented as the mean \pm SD.

Results: There were no significant differences between Control (n=26) and Albumin (n=17) in age (48 ± 15 vs 45 ± 21 yrs, $p=0.56$), burn size (33 ± 13 vs 34 ± 13 %TBSA, $p=0.831$), or full thickness burn size (19 ± 19 vs. 23 ± 19 %TBSA, $p=0.581$). The incidence of inhalation injury was greater in the Albumin group (71% vs 31%, $p=0.009$). The groups did not differ significantly in need for admission escharotomy, admission sequential organ failure and assessment (SOFA) score, number of surgical procedures/1st 30 days, or 24 and 48 hour fluid resuscitation volume requirements. The overall mean daily serum albumin level from PB day 2-30 in the albumin group (2.6 ± 0.1 gm/dL) was significantly greater than in controls (2.1 ± 0.7 , $p<0.001$). Serum albumin was significantly higher on every day in the albumin group between PB day 2-30 than in controls, except on PB day 23. Mean daily urine output between PB days 2-30 was significantly greater in the albumin group (30 ± 4 mL/kg/d vs 28 ± 4 mL/kg/d, $p=0.02$), but there were no significant differences between the groups in daily SOFA score/1st 30 days, peak SOFA score, delta SOFA, hospital length of stay, time to wound healing, duration of mechanical ventilation or 30 day and in-hospital mortality. The cost of routinely supplementing 5% albumin between PB day 2-30 in the albumin group was over four times that for the controls where we did not routinely provide albumin (\$70.30 per patient per day vs \$16.58 per patient per day).

Conclusions: Routine supplementation of 5% albumin to correct hypoalbuminemia is expensive and provides no obvious benefit. Possibly the hypoalbuminemia in the control group was not severe enough to create a difference in outcome. This question should be addressed with a randomized prospective study. 1. Greenhalgh et al J Trauma 1995;39:67.

Applicability of Research to Practice: The results of this study suggest that it is unnecessary to routinely correct hypoalbuminemia in burn patients.

100 . Peri-Operative Hypothermia: An Indicator of Outcomes in Burn Patients

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Introduction: The established risk factors for mortality in burn patients include age, TBSA, and inhalation injury. Recently hypothermia at the time of admission was shown to be associated with higher mortality and worse outcomes. In this study, we have evaluated mortality and outcomes in burn patients in relation to pre-operative hypothermia and intra-operative temperature change.

Methods: We performed chart review for all burn patients with TBSA $> 15\%$ admitted to our burn center between 2001 and 2005. Demographics, outcomes, complications, and peri-operative temperature logs were reviewed. Subjects were divided on three groups based on pre-operative temperature: <36 C, 36-38.5 C, >38.5 C. In a separate analysis, they were divided based on intra-operative temperature change: temperature change >1.5 C (either increase or decrease) and intra-operative temp change >1.5 C. The groups were compared for mortality, length of stay (LOS), length of ICU stay and days on ventilator. We used Chi-square analysis for mortality risk and ANOVA for outcomes comparison. The data was standardized for age and TBSA.

Results: Mortality rate for subjects with pre-operative temperature <36 C (n=30) 36-38.5 C (n=81) and >38.5 C (n=15) was 37%, 9% and 27% respectively. Subjects in groups <36 C and >38.5 had significantly higher mortality (Chi-Square- $p<0.001$, $p=0.044$). LOS, ICU days and vent days were significantly higher (ANOVA- $p<0.05$) in patients with pre-operative temp < 36 C or >38.5 C than subjects with temp 36-38.5 C. Mortality rate for subjects with intra-operative temp change >1.5 C (n=49) and temp change <1.5 C (n=86) was 26.5% and 10.5% respectively and the difference was statistically significant (Chi-square, $p=0.015$). Subjects with >1.5 C intra-operative temperature change had longer hospitalization (ANOVA, $p<0.01$) and spent more days on ventilator (ANOVA, $p<0.01$) when compared to patients with <1.5 C intra-operative temperature change.

Conclusions: Pre-operative hypothermia and rapid intra-operative temperature changes are associated with higher mortality. Further study with larger sample size may be required to assess if these are independent risk factors.

Applicability of Research to Practice: Peri-operative hypothermia can be an independent risk factor for outcomes in burn patients.

101 . The Effect of Propranolol on Cardiovascular Parameters Measured by Transpulmonary Thermodilution in Severely Burned Children

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Introduction: Severe burn injury causes a profound hypermetabolic response with physiologic derangements in circulating catecholamine levels, cardiac work, and overall energy expenditure. The β -adrenergic receptor (β -AR) antagonist, propranolol, decreases cardiac output and overall cardiac work in burned children. We examined the effect of propranolol on cardiovascular parameters derived from transpulmonary thermodilution measurements in severely burned children. Specifically, mean arterial pressure (MAP), heart rate (HR), cardiac index (CI), intrathoracic blood volume index (ITBVI), and extra vascular lung water (EVLW) were examined following propranolol treatment.

Methods: Pediatric patients with >40% TBSA burns from 12/05 to 03/08 were randomized into control (C: n=35) or propranolol (P: n=29) groups. Demographics were similar for both groups. The mean age, however, between the groups differed (P: 7.8 vs. C:11.1 yrs). Continuous cardiac monitoring and transpulmonary transthoracic measurements were performed. Cardiac Index, ITBVI, and EVLW were calculated using cooled saline injection. Systemic vascular resistance was calculated based on CO, MAP, and central venous pressure. Measurements of these parameters were compared over time between C and P treated patients.

Results: Baseline heart rate (HR) was not significantly different between the groups (C:153 \pm 29 vs. P: 150 \pm 32 BPM). However, a marked and sustained reduction in HR beginning by day 4 of treatment was observed in P compared to C (132 \pm 23 vs. 151 \pm 18 BPM, respectively, (p<.01)). Cardiac index (CI) was similar between groups at baseline (5.8 \pm 1.7 vs. 5.1 \pm 1.2), but decreased with P by day 3 (C: 6.3 \pm 0.8 vs. P: 5.4 \pm 1.0, p<.05). Propranolol was associated with a transient reduction in MAP at days 6-8; thereafter, MAP was similar. Other variables (SVRI, ITBVI and EVLW) were not affected by propranolol treatment.

Conclusions: Severe burn injury results in a hyperdynamic response, driven by the sustained increase in plasma catecholamine levels. Blocking this response with β -AR antagonists decreases cardiac work and overall energy expenditure. Specifically, propranolol treatment reduced HR and CI. The overall reduction in CI was due to fall in HR and not stroke volume. Propranolol did not alter MAP and was hemodynamically well tolerated. Volumetric indices (ITBV and EVLW) derived from transpulmonary thermodilution were similar, suggesting propranolol did not exacerbate cardiac function.

Applicability of Research to Practice: We show here preliminary data that supports the use of propranolol for reduction of cardiac work; expanding these findings to significantly older (and younger) patients will be the next step to demonstrate the safety and efficacy of propranolol.

102 . Parecoxib Reduces Systemic Inflammation and Acute Lung Injury in Burned Animals with Delayed Fluid Resuscitation

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Introduction: Burn injuries result in the release of proinflammatory mediators resulting in both local and systemic inflammation. Multiple organ dysfunction secondary to systemic inflammation after severe burn contributes significantly to the adverse outcome for burns victim, with the lungs frequently the main organ to fail. In this study, we evaluate the anti-inflammatory effects of Parecoxib, a parenteral COX-2 inhibitor, in a previously described delayed fluid resuscitation burned rat model.

Methods: Anaesthetized Sprague Dawley rats were inflicted with 45% TBSA full thickness scald burns, and subsequently subjected to delayed resuscitation with Hartmanns solution. Parecoxib (0.1, 1 and 10 mg/kg) were delivered intramuscularly 20 min post-injury followed by 12h interval and the rats were sacrificed at 6h, 24h and 48h. Burned induced Systemic Inflammatory Response Syndrome (SIRS) of the animals was determined by measuring various blood cytokine levels using ELISA and quantification of blood transaminases and urea creatinine levels. In addition, histological analysis and myeloperoxidase quantification of the lungs were conducted to assess the Acute Respiratory Distress Syndrome (ARDS) of the test animals. Statistical analysis was conducted using ANOVA, with P< 0.05 considered as significant.

Results: Burn rats developed SIRS and ARDS with significantly elevated blood cytokines, transaminase, creatinine and increased lung MPO levels. Burnt animals treated with 1mg/kg Parecoxib showed significantly reduced plasma level of CINC-1, IL-6, PGEM and lung MPO.

Conclusions: In this study, it is demonstrated that severe burn injury resulted in SIRS and ARDS. Treatment of 1 mg/kg Parecoxib is shown to mitigate systemic and lung inflammation without significantly affecting other organs in the burn rat model.

Applicability of Research to Practice: At present, no specific therapeutic agent is available to attenuate the systemic inflammatory response secondary to burn injury. The results suggest that Parecoxib may have the potential to be used both as an analgesic and ameliorate the effects of SIRS and ARDS after burn injury.

103 . Differences in Resuscitation in Morbidly Obese Burn Patients May Contribute to Mortality in this High-Risk Group

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Introduction: Outcomes data in the critically ill obese population are conflicting with little published in burn patients. Prior trauma studies suggest a prolonged time to reach end point goals of resuscitation in the obese compared to non-obese injured patients. We hypothesize that obese patients have worse outcomes after thermal injury and that differences in the response to resuscitation explain this disparity.

Methods: We retrospectively analyzed prospectively collected data from a multi-centered trial to compare resuscitation and outcomes in patients stratified by NIH/WHO BMI classification (BMI: normal weight 18.5-24.9, overweight 25-29.9, Obese 30-39.9, morbidly obese ≥ 40). Underweight patients (BMI < 18.5) were excluded. We analyzed patients by BMI class for fluids given and end points of resuscitation at 24 and 48 hours. Due to distribution of body habitus in the obese, the TBSA was recalculated for all patients using the method proposed by Neaman and compared to Lund-Browder estimates. Multivariate analysis was used to compare morbidity and mortality across BMI groups.

Results: We identified 296 adult patients with a mean TBSA of 41%. BMI groups were similar in patient and injury characteristics. Although resuscitation volumes exceeded the predicted formula in all BMI categories, higher BMI was associated with less fluid ($p=0.001$). Base deficit on admission was highest in the morbidly obese group and these patients did not correct their metabolic acidosis as well as lower BMI groups at 24 and 48 hours (p -values 0.04 and 0.03). There were no significant differences in TBSA calculations using Neaman vs. Lund Browder formulas. Complications and morbidities across BMI groups were similar, although examination of organ failure scores indicated more severe organ failure in the morbidly obese group. BMI was an independent risk factor for death only in morbidly obese patients (OR = 10.1; CI 1.94-52.5, p -value 0.006).

Conclusions: Morbidly obese patients with severe burns do not respond as well to fluid resuscitation and are at risk of developing more severe organ failure. These factors may contribute to higher mortality risk in the morbidly obese burn patient.

Applicability of Research to Practice: Findings may assist clinicians in resuscitation practices in the morbidly obese burn patient by alerting them to this high-risk group.

Resuscitation stratified by BMI.

	Normal Wt n=103	Over Wt n=91	Obese n=70	Morbidly Obese n=15	P-value
Fluids (obs/expected) 1	1.61 (1.75)	1.24 (0.48)	1.06 (0.47)	1.01 (0.41)	0.001
Initial Base Deficit 1	4.7 (4.5)	4.9 (4.0)	5.5 (4.3)	7.9 (8.3)	0.50
Unresolved base deficit 24 hours 2	10%	12%	6%	33%	0.04
Unresolved base deficit 48 hours 2	18%	13%	10%	45%	0.03

1 Data reported as mean (SD), 2 Percent of patients.

104 . Predicting Outcomes in Severely Burned Children: More Than Body Surface Area Alone

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Introduction: Traditionally, age and total body surface area (TBSA) have been used to predict outcomes after burn injury. Acid base status, including anion gap (AG) and base excess (BE), along with unmeasured anions expressed as strong ion gap (SIG) have utility as outcome measures in other diseases, but as of yet, have not been fully evaluated as mortality predictors in children, let alone children with burns. Physiologic scoring systems, such as the Pediatric Risk of Mortality (PRISM), may also aid in mortality stratification in critically ill burned children. Our objective was to determine if acid-base disturbances (unmeasured anion differences during and after acute burn resuscitation), and physiologic scoring systems (PRISM) were associated with patient outcomes after severe burn injury in children.

Methods: This study was a retrospective review of children admitted to a single burn center over a two year period with $\geq 20\%$ TBSA burns. Patient demographic and laboratory data were collected during each of the first four days of intensive care unit (ICU) admission, and outcomes were subsequently recorded. SIG, apparent strong ion difference (SIDa), and effective strong ion difference (SIDE) were calculated using the Stewart-Figge method of acid base analysis. BE and AG were recorded from arterial blood gas results. PRISM scores were calculated during each of the first four days of ICU admission. Patients with missing variables or those who did not survive the first four days of ICU admission were excluded from analysis. Categorical variables were evaluated with a chi square, continuous with students t-test.

Results: 69 patients, mean age 7.4 \pm 5.7 years, 50.8 \pm 19 % TBSA, with an overall mortality of 18.8%, were included in the study. Admission PRISM scores were significantly associated with survival (12.86 \pm 5.86 survivors vs. 23.31 \pm 9.74 non-survivors, $p=0.001$). Admission SIG, SIDE, and BE were associated with hospital length of stay ($p=0.02$, $p=0.04$, $p=0.02$), and number of operations performed ($p=0.05$, $p=0.03$, $p=0.04$). Admission SIG and BE were not associated with mortality. Admission SIDa and daily AG were associated with acute renal failure requiring dialysis (OR 0.74, $p=0.05$; Day 1- OR 1.49, $p=0.03$; Day 2- OR 1.99, $p=0.05$; Day 3- OR 2.32, $p=0.02$).

Conclusions: The PRISM score appears to be predictive of mortality in the pediatric burn population. Unmeasured anions, BE and AG may be useful in risk stratifying those patients who have higher metabolic dysfunction and will need more aggressive intervention to avoid complications such as renal failure.

Applicability of Research to Practice: Applying established injury assessment scores and markers of physiologic impairment may help to better prognosticate outcomes in pediatric burn patients.

105 . Immuno-Protective Role of CD4+CD25- Converted to Regulatory T Cells in Allogeneic Skin Graft

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Introduction: Autologous skin grafting is the gold standard for covering the burn wound; however large surface area burns present an obstacle with a limitation of donor sites. As such, non-rejectable allogeneic skin grafts would be ideal to serve as not only a wound coverage but also as a source of wound healing promoting factors. To achieve this, our research group are working on a novel principle of pre-sensitizing regulatory T cells (Treg) or CD4+CD25+ cells to allogeneic skin cells in an indoleamine 2, 3 dioxygenase (IDO) generated tryptophan deficient microenvironment, much like the environment in-utero that concludes with foetal tolerance in pregnancy. Importantly, isolation of large numbers of primary CD4+CD25+ cells is an obstacle as burn injuries in this population are extensive and these patients are very unwell. To increase our load of CD4+CD25+ cells, we hypothesize that dermal fibroblast/ IDO would generate a microenvironment in which the CD4+CD25- naïve T cells are transdifferentiated into functionally immunosuppressive CD4+CD25+ regulatory T cells (Treg). Additionally we will investigate whether these converted cells are antigen specific.

Methods: C57BL/6 fibroblasts were cultured to confluence, stimulated with IFN- γ and then co-cultured with BalbC CD4+CD25- cells for 96hrs. Flow cytometry was performed to detect CD4+CD25+Foxp3+ cells and q-PCR performed for Foxp3, TGF- β and IL-10. The Treg were then isolated with MACS and a CD8+ cell CFSE suppression assay using both C57BL/6 and NOD antigen presenting cells (APCs) was performed to determine functionality.

Results: A three-fold increase in the number of Treg cells was seen in the fibroblast/IDO (IDO) treatment group compared to fibroblast/ control (control) in addition to greater CTLA-4 expression after flow cytometry. Foxp3 fold increase was also greater in the IDO group but IL-10 expression was equivocal between control and IDO. Interestingly, TGF- β expression was higher in the monoculture and control groups. The antigen specific suppression assay showed greater suppression of CD8+ cells in the C57BL/6 APC but also evidence of suppression in the NOD APC group.

Conclusions: This is a novel, non-viral method to convert CD4+CD25- naïve T cells to functionally suppressive specific Treg immune cells. More research is needed to ensure antigen specificity and tolerance in vivo.

Applicability of Research to Practice: Cadaveric skin coverage of large surface area burns is widely used but with the admission that rejection is inevitable. We provide data on a new concept which can be used to generate tolerance to an allogeneic skin graft for burn patients.

106 . Myeloid Suppressor Cells Invade the Burn Wound Site Early after Injury

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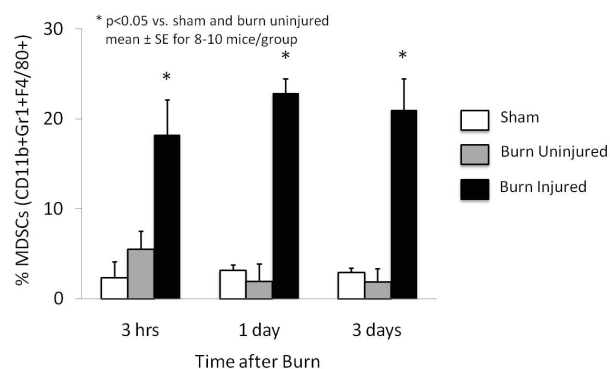
Introduction: Burn-related wound healing complications can in part be attributed to a dysfunctional immunoinflammatory response. Myeloid-derived suppressor cells (MDSCs), in part characterized by the co-expression of CD11b and Gr-1, have been implicated in a number of pathological conditions including cancer, autoimmunity, trauma, sepsis and burns. Nonetheless, their role in the burn wound immunoinflammatory response is unknown.

Methods: C57BL/6 male mice were subjected to a major burn (25% TBSA, 3rd degree) or sham treatment. Three hrs to 3 days thereafter, uninjured skin and burn wound skin samples were collected and subjected to dispase and trypsin digestion. Single cells were isolated and immune cell populations were analyzed by flow cytometry.

Results: Analysis of the myeloid cell population revealed that there was a massive influx of MDSCs (i.e., CD11b+Gr1+F4/80+) at 3 hrs post-injury that remained elevated at 1 and 3 days. (Figure). The MDSC influx at the wound site was paralleled by a strong inflammatory response as evidenced by elevated tissue levels of inflammatory cytokines (IL-1 β , IL-6) and chemokines (KC, MCP-1, MIP-1 α , MIP-1 β , RANTES) in the injured skin as compared with uninjured skin. In contrast, the influx of neutrophils and other myeloid cells did not occur till 1 and 3 days post-injury.

Conclusions: Myeloid-derived suppressor cells (CD11b+Gr1+F4/80+) invade the wound site as early as 3 hr after injury and are associated with a profound inflammatory response. These findings suggest a causative relationship between this unique immune cell population and burn wound healing complications of an inflammatory nature.

Applicability of Research to Practice: Therapeutic targets for decreased inflammatory complications.



107 . Superantigen Virulence Factors in Wound Biopsies and in Kidney Tissue of Animals with Staphylococcus Aureus-Infected Burn Wounds

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Introduction: Bacterial infection is known to be devastating, both systemically and locally in wounds. This is in part due to consequences of toxin and virulence factor production by some species. Superantigens are among these toxic virulence factors. Infection and multi-organ dysfunction are leading causes of hospital death for burn patients. Elucidating the dynamics of end organ damage from toxemia, especially in the kidney, may augment our understanding of the effects of these molecules.

Methods: Rats were subjected to full-thickness burns (2 x 2 cm) using a calibrated aluminum billet. On post-burn day #1, the wounds were inoculated with a toxin-producing strain of methicillin-resistant *S. aureus* (MRSA). Skin biopsies and serum were obtained on days two, five, seven and ten. On day ten, a necropsy was performed. An ELISA was utilized to quantify the amount of Toxic Shock Syndrome Toxin-1 (TSST-1) in the serum and skin biopsies. Renal tissues were embedded, sectioned, and stained for TSST-1 and Staphylococcal enterotoxin B (SEB). TUNEL assays were performed to analyze DNA fragmentation suggestive of apoptosis.

Results: The burn injuries and MRSA inoculations were non-lethal in all animals. Baseline skin and plasma levels of TSST-1 were not detectable. Skin biopsy TSST-1 levels were detected on all days in at least one animal and peaked at a mean value of 22.81 ng/ml on day seven. Two of the three animals became bacteremic after day five. Serum toxin levels of TSST-1 were only detected in one animal, on day two and ten. The highest recorded TSST-1 level in the serum was 4.793 ng/ml on day two. An ELISA of renal tissue from day five demonstrated a mean of 10.29 ng/ml for TSST-1, with a much smaller mean of 0.67 ng/ml for SEB. IHC of renal tissue demonstrated greater medullary staining than cortical staining for both SEB and TSST-1. Moreover, there was a larger cross-sectional area of staining for TSST-1 compared to SEB. TUNEL assays demonstrated more significant staining in the medulla, corresponding to the majority of TSST-1 detection.

Conclusions: MRSA is challenging to treat in the burn patient population, and the contribution of bacterial virulence factors are poorly defined in burn pathophysiology. While TSST-1 was rarely detected in the blood in this model, its sequestration in organs like the kidney and the induction of apoptosis demonstrate significant systemic effects. Further understanding the distribution and effects of molecules like SEB and TSST-1 may contribute to the treatment of infected wounds such as those seen in burn injury, and, moreover, may provide better insight into burn/septic shock.

Applicability of Research to Practice: This study outlines the systemic sequestration of a potent virulence factor that may have implications in burn pathophysiology.

108 . Peripheral Blood Mononucleocyte-Derived Erythroid Progenitors and Erythroblasts are Decreased in Burn Patients

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Introduction: Patients with large burns suffer from anemia of critical illness. Exogenous erythropoietin (EPO) administration has proven ineffective and transfusion has remained the only effective treatment, however, not without deleterious consequences. We have previously shown that erythroid precursors are significantly reduced 1 week after burn in an animal model. Therefore, we have utilized a 2-phase liquid culture system to quantify peripheral blood mononucleocyte (PBMC)-derived erythroid progenitors and to isolate the distinct populations of erythroblasts in burn patients.

Methods: IRB approval and informed consent were obtained. Blood samples were obtained at 10-14 days post burn from patients (B) admitted to our Burn ICU (n=5, 100% male, mean age 43, 20-63% TBSA burn, mean Hgb 8.05). Samples from healthy volunteers were used as controls (C). PBMCs were isolated using the Ficoll-Hypaque density-gradient technique and stored at -80 degrees until analysis. PBMCs were placed in Serum Free Expansion Medium (SFEM) containing cyclosporine A (1ng/ml), GM-CSF (20 ng/ml), SCF (30 ng/ml), IL-3 (5ng/ml) and incubated at 37°C with 5% CO₂ (Phase I). On day 6, non-adherent cells were washed and reseeded in SFEM containing human recombinant EPO (2µl/ml), holotransferrin (15µl/ml), SCF (1µl/ml) and incubated at 37°C with 5% CO₂ (Phase II). Aliquots from the phase II culture system on days 4, 6, 8, and 11 were incubated with mAbs to CD71, CD235a, and CD36. The total erythroid progenitors (CD71+ CD36+) and the erythroblast subpopulations (CFU-E, Pro-E, and Int-E) within this fraction were identified based on the differential expressions of CD71 and CD235a by flow cytometry and calculated per million expanded cells.

Results: On day 6 of the phase II culture system, the total erythroid progenitors (expanded from 1X10⁶ PBMCs through phase I) were significantly attenuated in burn patients compared to controls (C=6.8±0.4x10⁵, B=3.5±0.7x10⁵, p<0.01). Of the erythroblast subpopulations, in comparison to controls burn patients showed a significant reduction in Int-E while the CFU-E and Pro-E showed a trend towards reduction (CFU-E: C=5.8±1.1x10⁴, B=3.5±1.7x10⁴; Pro-E: C=1.8±0.08x10⁵, B=1.3±0.2x10⁵; Int-E: C=4.0±0.2x10⁵, B=1.5±0.3x10⁵, p<0.002).

Conclusions: Decreased erythropoiesis likely contributes to the anemia of burn. The unresponsiveness to exogenous EPO may be caused by an overall decrease in erythroid progenitors and Int-E subpopulation in particular.

Applicability of Research to Practice: An expanded knowledge of the molecular etiology of the anemia following burn injury may lead to new treatment options for burn patients.

109 . The Impairment of Neutrophil Chemotaxis after Burn in Rats

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Introduction: The immunocompromised status is an onerous problem for severely burned patients. Multiple studies have documented impairments in neutrophil function after burn, with potential implications for the development of sepsis in burn patients. We hypothesize that in rats, impairment of neutrophil chemotaxis occurs during the post-burn immunocompromised state. The present study aimed at measuring the impaired neutrophil migration speed after burn injury using a new microfluidic device.

Methods: Twelve Wistar male rats weighting 300-400 g were randomized into four groups (sham and 3, 6, 9 days after burn injury). The rats in the 3, 6, 9 days group received 30% TBSA scald burn. Each day, blood (10ml) was obtained by cardiac puncture and neutrophils were isolated by centrifugation with a two-step discontinuous gradient and purified with a negative selection kit for rat neutrophils. Microfluidic devices used to measure cell directional migration speed in response to chemoattractant gradients were prepared in our laboratory. These devices consist of a main channel and many small side channels where the neutrophil movement is tracked. Microscopy images of the individual neutrophils migrating through the small side channels were evaluated with image J software. Average velocities were calculated for first 10 minutes after each neutrophil entered into a side channel and statistical analysis was performed by ANOVA.

Results: The total numbers of neutrophils entering into the side channels was 206, 197, 113, 147 in sham burn and 3, 6 and 9 day post-burn groups and the mean velocities were 21.9, 19.3, 14.2, 13.5 $\mu\text{m}/\text{min}$ in the four groups. The average velocities of individual neutrophils were normally distributed around the mean, with standard deviation. The average velocities in the 6 and 9 days post-burn groups were significantly slower than that in the sham group ($p < 0.01$), suggesting progressive impairment in motility after the injury.

Conclusions: This study suggests that impairment of the mobility of rat neutrophils occurs after burn injury, similar to that previously measured in human neutrophils after severe burn injuries. In the future, the model developed in this study could be applicable for developing strategies for early detection and treatment of infection and sepsis.

Applicability of Research to Practice: Measuring neutrophil motility in a rat burn model could help evaluate therapeutic interventions to correct neutrophil deficiency, for potential applications in burn patients.

110 . Radiation Combined with Thermal Injury: A Role for Myeloid-Derived Suppressor Cells in Chronic Immunosuppression

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Introduction: The increasing sophistication of terrorist attacks and the recent nuclear crisis in Japan have amplified the interest in the immunobiology of radiation combined with burn injury (RCI). RCI is a poorly understood yet highly devastating injury that results in long-term immunosuppression. We hypothesize that RCI results in the progressive reduction of both adaptive and innate cell populations. We also hypothesize that serum cytokine profiles after RCI mimics burn injury early but is attenuated late after the insult due to depleted cell populations.

Methods: C57BL/6 female mice age 10-12 weeks underwent either a 20% (total body surface area) TBSA full thickness contact burn or sham procedure. One burn group and one sham group received a single whole body dose of 5 Gy radiation. The spleen and wound draining lymph nodes (DLN) were harvested 3 and 14 days after sham, burn, radiation or RCI. Splenocytes and DLN were analyzed by flow cytometry to identify adaptive and innate cells. Blood was obtained by cardiac puncture, and serum cytokines were analyzed by multiplex bead array. ANOVA and Tukey's test of multiple comparisons were used to compare absolute cell number and serum concentration (pg/ml) means within each group.

Results: Mice undergoing RCI resulted in 30% mortality while mice receiving 5 Gy irradiation alone all survived. At Day 3 and 14, CD4⁺ T cells, CD8⁺ T cells, and neutrophils were significantly decreased after irradiation and RCI when compared to sham and burn. At Day 14 after RCI, a population of cells identified as GR.1⁺ CD11b⁺, which we and others have defined as immunosuppressive myeloid derived suppressor cells (MDSC), became significantly elevated in the spleen and DLN compared to all other groups. Serum cytokines were also analyzed at both time points. Burn injury and RCI induced elevated concentrations of IL-6 early after injury as expected. However, the RCI mice additionally had significant elevation of IL-1 β at Day 3 and elevated MCP-1 and CXCL-10 at both Day 3 and 14.

Conclusions: RCI resulted in significant T lymphopenia and neutropenia early and late after injury. Late after injury, there was an expansion of MDSC cells within the secondary lymphoid organs. This corresponds to an early increase in IL-6 and IL-1 β and a sustained elevation of MCP-1 and CXCL-10. It appears burn injury mediates the increase in IL-6 and possibly MCP-1, whereas MDSCs secrete CXCL-10 and IL-1 β , which has been reported in other model systems. These data implicate MDSCs in the uniquely chronic immunosuppressive RCI phenotype. Future studies are needed to address the precise function of MDSCs as potential targets for immune countermeasures.

Applicability of Research to Practice: RCI is associated with high mortality and long-term immunosuppression.

111 . Relative Adrenal Insufficiency in Burn Patients

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Introduction: Relative adrenal insufficiency (RAI) is defined as inadequate production of cortisol in relation to increased demand in times of stress such as acute, severe burn injury. RAI is characterized by inappropriately low cortisol and/or inadequate response to exogenous adrenocorticotropin hormone (ACTH). RAI has been documented in a variety of critically ill and injured patient populations. RAI may be associated with increased morbidity and mortality in these populations. The purpose of this study was to assess the incidence of RAI in critically ill burn patients by routine assessment of cortisol levels and by stimulation with exogenous ACTH.

Methods: A prospective observational study of critically ill burn patients over a two year period was performed. Inclusion criteria included adult burn patients admitted to the burn ICU. Basic demographic data were recorded. Early morning cortisol levels were drawn Monday and Thursday on all patients while in the ICU. Cosyntropin stimulation tests were performed on patients based on cortisol levels and clinical status. Descriptive statistics were performed.

Results: Sixty patients were enrolled. Sixty-two percent were male, the mean total body surface area burned was 38%, and the mean age was 41 years. Mean biweekly cortisol level over the entire study period was 15.6. This did not vary significantly as a function of time, with a range of 12.3 to 20.2 over a maximum of 19 weeks. The number of patients with one or more cortisol levels below 30 was 60 (100%). The number of patients with one or more cortisol levels below 20 was 50 (83%). Twenty-one patients (35%) had cosyntropin stimulation tests. 15 patients (71%) failed to stimulate, with a rise in cortisol level of less than 9 at 15 or 30 minutes following stimulation.

Conclusions: Critically injured burn patients demonstrated relatively low cortisol levels throughout their ICU stay. Most of these patients subsequently failed cosyntropin stimulation testing. Relative adrenal insufficiency diagnosed by cortisol level and stimulation test is common in burn patients in the ICU. The clinical relevance of this finding remains unknown and further study is warranted.

Applicability of Research to Practice: Relative adrenal insufficiency is poorly defined in burn patients. This study further refines this diagnosis.

112 . Use of Recombinant Factor VIIa (rVIIa) in Burn Patient Surgeries

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Introduction: Severe hemorrhagic condition is common during the surgical procedures in burn patients. We empirically use recombinant factor VIIa (rVIIa) as a potential "universal haemostatic agent" for patients who bleed profusely. Pathological clot formation is one of the potential adverse events of rVIIa. This study investigated the possible adverse events of burn patients who empirically received rVIIa during surgical procedures without knowing their hemophilic status.

Methods: Our database was searched from January 2005 to March 2008. Patients who received rVIIa during the surgical procedures were identified. Their charts were reviewed and data of all thromboembolic adverse events were collected. Recombinant factor-related adverse events were also noted.

Results: Forty nine patients received rVIIa pre-operatively as an emergency haemostatic agent without knowing their hemophilic status. The mean age of the patients was 47 (range 16-84) yrs, 38 were male, 26 were African-American, and 21 Caucasian. The average total body surface area of burns was 52.7% (range 15-94), 44 of the patients had inhalation injury, and all patients required central lines. All patients received concomitant medication for clot prevention. The observed thromboembolic events were 18 events of deep venous thrombosis (DVT), 3 acute myocardial infarctions (AMI), 1 pulmonary embolism (PE), and 1 cerebrovascular accident (CVA). 11 patients developed DVT after they received rVIIa. The average days for developing DVT following rVIIa injections was 20 (range 3 - 75) and no DVT was observed within 72hrs of receiving rVIIa. The one observed event of PE developed in the patient before rVIIa therapy. There were 30 deaths, but no indication that the causes of death were from any thromboembolic event. 7 died within 48 hours of receiving rVIIa (average TBSA 59%, 6 with inhalation, 1 had DVT before rVIIa was given). Another 7 died within 7 days of receiving rVIIa (average TBSA 65%, 6 with inhalation, 2 had DVT before rVIIa was given). There was no significant change in PT and also in D-Dimer after receiving rVIIa. For recombinant factor-related adverse events, 33 patients had increased blood pressure, 8 had bleeding disorders, and 2 had fever. No patient experienced injection site pain.

Conclusions: The empirical use of rVIIa agent did not appear to increase the risk of thromboembolic event in burn patients. The relationship between the deaths and rVIIa use could not be analyzed due to the severity of the burn patients and also due to not having autopsy report.

Applicability of Research to Practice: This study warrants a randomized, prospective clinical trial to obtain further essential information.

113. **Comparison of Sleep Parameters Obtained from Actigraphy and Polysomnography during the Rehabilitative Phase Postburn**

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Introduction: Evidence of significant postburn sleep disturbance has been demonstrated to persist for many years postburn. Because bedside polysomnography (PSG) is often impractical, the ability to accurately assess sleep remains an unmet need. The purpose of this study was to validate actigraphy (ACG) as a portable, inexpensive and noninvasive means of evaluating sleep during the rehabilitative phase following burn injury.

Methods: Nocturnal recordings (2200-0600) of PSG and ACG were collected in 30 patients admitted for an elective reconstructive surgical procedure. Subjects had original burn injuries involving $50.3 \pm 4.4\%$ TBSA (range 17 to 95%), of which $39.4 \pm 6.5\%$ was full thickness. Their mean age at the time of burn was 3.8 ± 0.9 years (range 0.1 to 15.2 years) and they were 10.4 ± 0.9 years postburn at the time of the sleep studies. Two measures of ACG data were evaluated: proportional integration mode (PIM) and zero crossing mode (ZCM). ACG results were compared to PSG for prediction of total sleep time (TST), sleep onset latency and number of awakenings. Generalized mixed models were used for comparison of PIM and ZCM to PSG.

Results: The average overnight recording time was 438 minutes. Measurements of TST, sleep onset latency and awakenings are provided in the table below. The ZCM mode more accurately predicted TST and sleep latency than PIM; however neither ZCM nor PIM were precise in the estimation of number of awakenings ($p < 0.05$).

Conclusions: ACG appears to provide a reasonable estimate of TST and sleep onset latency in burn patients during the rehabilitative phase of care. Proper ACG mode selection is required to obtain clinically useful data and it appears that ZCM is preferable to PIM in our study sample. We speculate that differences in motion vigor and motion frequency mediate the variability observed between PIM and ZCM results.

Applicability of Research to Practice: Identifying and responding to the sleep needs of burn patients should be a goal of clinical care. An easy and inexpensive method of obtaining sleep data that does not sacrifice validity and reliability is desirable. ACG may represent a useful alternative to PSG to assess sleep during the rehabilitative phase postburn, but it does not replace PSG sleep stage diagnosis critical for those patients presenting with sleep disordered breathing or pronounced sleep disturbance. Future studies are needed to determine the utility of ACG during the acute phase of burn care.

Comparison of Sleep Parameters: PSG vs Actigraphy

Sleep Measures	PSG	PIM	ZCM
TST (min)	360 (322,401)A	249 (203,294)B	374 (320,406)A
Sleep onset latency (min)	27 (12,94)A	60 (38,122)B	30 (15,89)A
Awakenings (#)	22 (17,29)A	16 (12,20)B	9 (8,13)C
Data presented as median (25th,75th percentile)			
A different from B different from C ($p < 0.05$)			
TST, Total Sleep Time			

114. **Sleep Disorder: Are Sleep Problems Adding to the Complications of Childhood Burn Injury Survival?**

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Introduction: Relatively little is known about the sleep habits of burn-injured children and whether sleep patterns are altered as a result of burn injury and acute care hospitalization. A mounting body of evidence suggests that serious problems can arise from chronic sleep disruption and result in negative consequences for daytime behavior and academic function. This study examined the self-reported sleep habits of burn-injured children.

Methods: Children, ages 7-12, who attended burn camp, were asked to complete the 23 item Children's Sleep Habits Questionnaire, a reliable and valid child-appropriate, screening instrument which clusters sleep complaints into clinically meaningful categories. Parental permission was obtained and a psychologist administered the survey.

Results: The survey was completed by 107 burn-injured youth, mean age 10.6 years (SD ± 1.7). Reported etiology: Scald (51%) Fire/Flame (43 %) Other (7%), with an average 4.6 years from burn injury. 30% of participants qualified (summed score of ≥ 41) as having a sleep problem that warranted further evaluation. Children suffering a Fire /Flame burn were significantly more likely to have elevated scores ($p < .05$). Prevalence of sleep problems also differed significantly across race/ethnicity with African American children reporting sleep issues (59%) vs. Caucasian (28%) and Hispanic (38%) $p = .008$. Gender, age, age at burn, hidden vs. visible scarring did not show significant differences.

Conclusions: Nearly one-third of children reported an elevated level of sleep problems warranting further evaluation with a formal sleep study. Not surprising, Fire/Flame was more commonly associated with sleep problems due to the traumatic event. Minority children reported a higher incidence of problems, although other, potentially confounding factors such as lower socio-economic status, associated psychosocial stressors and different parenting styles may have contributed to the difference but were not evaluated.

Applicability of Research to Practice: A recent survey showed that pediatricians fail to screen for sleep problems, especially in middle childhood. This study suggests that sleep problems may be an important issue for burn providers to consider and screen for, as poor sleep habits can complicate other medical or mental health issues such as chronic illness, Attention Deficit Hyperactivity Disorder, Anxiety Disorders and Post Traumatic Stress disorder. The impact on social/academic function is of concern with implications for treatment.

115 . Impact of a Nursing-Driven Sleep Hygiene Protocol on Sleep Quality

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Introduction: Recent research has highlighted the importance of sleep deprivation in the development of ICU delirium. The purpose of this study was to evaluate the impact on sleep quality of a nursing-driven sleep hygiene protocol (SHP) instituted in a single Burn-Trauma ICU.

Methods: We evaluated all adult patients admitted to the Burn Service who were not delirious, able to respond verbally, and had not received general anesthesia in the prior 24 hours. Our SHP consists of interventions to minimize environmental stimuli and limit disruptions during the night (limiting vital signs, postponing lab draws, and discouraging housestaff from early pre-rounding). We measured subjective patient perception of sleep using the validated Richards-Campbell Sleep Questionnaire. Patients were surveyed pre implementation ("PRE"; May to December, 2010) and post implementation ("POST"; January to August, 2011). This analysis includes the initial survey response from each patient.

Results: There were 130 patients surveyed, 81 PRE and 49 POST; 60% (78) were burn admissions. There was no significant difference in responses between burn and non-burn patients either PRE or POST. Most patients in both groups were male. POST patients were significantly older and more frequently endorsed taking sleep medication at home (15% vs. 29%, $p=0.048$). The only significant difference between group responses was that POST patients reported falling asleep faster ($p=0.022$). Subgroup analysis of those patients who reported sleep difficulties prior to admission showed that POST patients reported a significantly higher pain score (6 vs. 3, $p=0.034$) but a significant improvement in falling asleep quickly (9 vs. 4, $p=0.002$) and being able to go back to sleep if awakened (8.5 vs. 5, $p=0.033$) than did PRE patients.

Frequency of complaints of sleep disruption was unchanged between PRE and POST. Common categories of complaints included ambient noise, clinician disruption, and pain. POST patients complained significantly less about clinician disruptions or ambient noise than PRE patients (22% vs. 6%, $p=0.012$).

Conclusions: This study failed to show a significant change in overall quality of sleep in all patients post SHP implementation. However, the decrease in clinician disruptions and ambient noise may impact patient sleep in a way not captured with this survey instrument.

Applicability of Research to Practice: The SHP allows patients to fall asleep quicker and return to sleep more easily. Pain continues to significantly impact sleep quality.

	Pre N=81	Post N=49	P-value**
% Male (n)	69% (56)	76% (37)	0.435
Age yrs*	41 (27-58)	49 (33-62)	0.027
Pain Score: No pain (0) to worst pain (10)*	5 (2-6)	5 (3-6)	0.645
Light sleep (1) to deep sleep (10)*	6 (3-8)	6 (4-9)	0.309
Never fall asleep (1) to asleep instantly (10)*	6 (3-8)	8 (5-9)	0.022
Awake all night (1) to never woke up (10)*	5 (3-8)	5 (3-7)	0.712
Couldn't go back to sleep (1) to back to sleep right away (10)*	6 (4-9)	8 (4-9)	0.140
Bad night's sleep (1) to good night of sleep (10)*	7 (4-8)	7 (3-9)	0.404
Patients with complaints affecting sleep % (n)	47% (38)	41% (20)	0.311

*Median (IQR), **Wilcoxon rank sum test is used for continuous variables; Chi Square is used for categorical variables.

116 . Retrospective Examination of the Effectiveness of Zolpidem for Sleep in Pediatric Burn Patients with a Known History of Attention Deficit/Hyperactivity Disorder

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Introduction: Existing research shows that pediatric burn patients are often sleep deprived. Studies have also demonstrated the importance of sleep for emotional and cognitive function as well as wound healing, immune and endocrine status. Evidence suggests patients with attention deficit/hyperactivity disorder (AD/HD) have difficulty with sleep, even when not hospitalized. The purpose of this study was to examine the effectiveness of zolpidem in pediatric burn patients with AD/HD by differentiating the responsiveness between patients with and without a pre-existing diagnosis of AD/HD.

Methods: A retrospective chart review was conducted on acute burn patients with AD/HD admitted between 2005 and 2011 who were initially placed on zolpidem for sleep disturbances. AD/HD subjects were matched for age, percent total body surface area burn (%TBSA), and ventilator status to patients without AD/HD. Length of time on zolpidem and any changes in sleep medication regimen were analyzed within and between the two groups to determine effectiveness. Effectiveness was defined based on the need for a change in the sleep medication or an increase in the zolpidem dose during the first 12 days of treatment.

Results: Twenty-three subjects with and 23 without AD/HD comprised the study sample. Paired t-tests demonstrated no differences in age and %TBSA, while McNemar's test failed to demonstrate any differences in ventilator status. Sixteen (69.6%) patients with and 13 (56.5%) patients without AD/HD required a sleep medication change ($p=0.541$). There was no difference in the effectiveness of zolpidem in both patient groups. Patients with AD/HD required a sleep medication change sooner than patients without AD/HD (median AD/HD = 5 days, median non-AD/HD = 9 days) ($p=0.06$).

Conclusions: This study confirms that sleep disorders are similar in pediatric burn patients with and without a concurrent diagnosis of AD/HD. Furthermore, it appears that zolpidem is not an effective drug for managing sleep in such children with or without AD/HD.

Applicability of Research to Practice: Treatment of altered sleep following burn injury remains a challenge. Zolpidem does not appear to promote sleep in the treatment of injured children with or without AD/HD. In the absence of evidence-based guidelines for sleep optimization, clinical assessment and monitoring of various pharmacologic and behavioral interventions is paramount to improve sleep and promote recovery.

117 . Impact of Obesity on Body Image Dissatisfaction and Social Integration Difficulty Among Adolescent and Young Adult Burn Injury Survivors

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Introduction: Burn injury deformities and obesity have been associated with social integration difficulty (SID) and body image dissatisfaction (BID). However, the combined effects of obesity and burn injury in SID and BID are not known. We conducted a cross sectional study to investigate whether obese adolescent and young adult burn injury survivors experience higher BID and SID compared to normal weight burn injury survivors.

Methods: The study sample was 51 adolescent (66.7% male, 92.2% Hispanics) and young adults (16 - 30 years old) burn injury survivors (total body surface area burn $52 \pm 16.2\%$, ≥ 5 years post-burn) and were categorized in normal weight and overweight /obese. Burn injury and current anthropometric information was obtained from patients' medical records. The main outcomes of interest and confounders were assessed with the Burn Specific Health Scale Brief, Short Form Health Survey version 2, and World Health Organization Disability Assessment Schedule II. Analysis of covariance and multiple linear regressions were performed to evaluate the objectives of this study.

Results: After controlling for confounders, obese / overweight burn injury survivors did not experience increased BID (12.7 ± 4.4 vs 11.9 ± 4.4 , $p = 0.64$) or SID (15.5 ± 5.7 vs 17.7 ± 7 , $p = 0.44$) compared to normal weight burn injury survivors. Multiple linear regression analysis revealed that weight status was not a significant predictor SID and BID ($p = 0.83$ and $p = 0.57$, respectively). However, mobility limitations predicted with greater SID ($p=0.002$) and BID ($p= 0.026$), while older age at burn was a predictor of increased BID ($p = 0.05$).

Conclusions: Contrary to our initial hypothesis, obese and overweight adolescents and young adults who sustained a major burn injury as children do not experience increased BID or SID compared to normal weight burn injury survivors. Mobility limitations, overall well-being and age at burn are more important factors affecting the long term BID and SID of pediatric burn injury survivors.

Applicability of Research to Practice: Periodical patient monitoring by multidisciplinary burn team may improve the psychosocial outcomes in long term burn injury survivors. Further larger longitudinal studies are needed to as the proposed as burn injury survivors may undergo changes during the adjustment period.

118 . Measuring Depression in Adults and Children with Burn Injuries

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Introduction: At the recent State of the Science of Burn Research conference co-sponsored by the American Burn Association (ABA) and the National Institute on Disability and Rehabilitation Research (NIDRR), the Department of Defense, Shriners Hospitals for Children and the National Institutes of Health, a need to better understand the various psychosocial aspects of burn recovery was identified. An accumulating body of research indicates that depression is one of the most common sources of distress that burn survivors face. Unfortunately, the incidence, duration, and long term impact of depression are poorly understood due to a wide variance in the methodology that is used to assess this disorder. The purpose of this study was to conduct a structured, systematic literature review of depression measures for adults and children with burn injuries so that we can determine the most reliable, valid and efficient means of identifying persons with depressive symptoms following a burn injury.

Methods: Standardized methods for conducting a systematic review (e.g., AAN, 2004) were followed. Searches were conducted in 6 databases and various search terms aimed at depression were targeted. We identified 255 articles on the topic of burn and depression. Four reviewers, including two external expert reviewers, reviewed methods and evidence tables for meeting study inclusion criteria. A total of 50 articles were included.

Results: The Beck Depression Inventory (BDI) was one of the most widely used measures in our review. Several articles showed that the measure has solid psychometric properties and can accurately assess severity of symptoms of depression in those patients with burn injuries. There is preliminary evidence to suggest that the Brief Symptom Inventory (BSI) and the Hospital Anxiety and Depression Scale (HADS) are also valid measures in this population. In children, the Diagnostic Interview for Children and Adolescents was found to be valid for assessment of depression. This review also revealed that several measures are being used inaccurately to diagnose depression.

Conclusions: Before we can determine if our field needs a measure of depression designed specifically for those with burn injuries, there is a need to determine if general measures of depression are valid in this population. This analysis showed that there are several measures that have strong validity in the burn population and should continue to be studied. We caution against the development of new depression measures for this population until a lack of support for existing measures is well established. Investigators need to report psychometric properties of the measures used in their studies so this goal can be accomplished.

Applicability of Research to Practice: This study provides direction for better identifying and treating depression in the burn population.

119 . Does Propranolol Prevent Symptoms of Posttraumatic Stress Disorder (PTSD) in Children with Large Burns?

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Introduction: Recent studies have investigated if propranolol prevents or reduces posttraumatic stress disorder (PTSD) in adults with burns, but its benefits have not been studied in children. This study examined if propranolol administered in the acute phase of recovery prevented subsequent development of PTSD in pediatric burn survivors. We hypothesized the rate of PTSD would be significantly less in the propranolol (prop) than no-propranolol (no-prop) group.

Methods: Long-term follow-up interviews were done of pediatric burn survivors who previously participated in a randomized-controlled trial in which propranolol was administered during their acute recovery. Participants were randomized to either the prop or no-prop group. They were evaluated for lifetime PTSD with a structured clinical interview, The Missouri Assessment of Genetics Interview for Children-MAGIC. They were matched on age, percent total body surface area burned (TBSA), and were at least 2 years post-burn.

Results: Preliminary data was obtained on 181 pediatric burn survivors (72 prop, 109 no-prop), 114(63%) males and 67 (37%) females. The majority of participants were Hispanic/Latino (94%). Mean TBSA burned was $56.3\% \pm 14.8$. Mean age at time of burn was $7.2y \pm 4.7$ (prop) and $7.5y \pm 4.5$ (no-prop), and mean age at assessment was $12.6y \pm 4.4$ and $13.6y \pm 4.4$ respectively. Diagnostic criteria for PTSD was met by 3 of 72 (4%) in the prop and 7 of 109 (6%) in the no-prop groups. When analysis included those meeting sub-threshold criteria, 12 of 72 (17%) in the prop group and 16 of 109 (15%) no-prop group experienced at least one PTSD symptom in each category: re-experiencing, avoidance, increased arousal. No significant differences were found between groups ($p < .05$).

Conclusions: Results did not show a difference in the rate of PTSD between groups. At this facility the prevalence of PTSD has been low. One can speculate this is because children receive intense pain and anxiety medication management with psychotherapy as part of the acute recovery process.

Applicability of Research to Practice: More research about the benefit of propranolol in pediatric burn care is indicated.

120 . Experiencing the Pediatric Burn Injury from the Parental Point of View

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Introduction: Experiencing the injury and hospitalization of a burn-injured child is a taxing and stressful parental task and has been labeled one of the most difficult and stressful experiences a parent can endure. The burn event is unanticipated and creates a crisis for both parents/caregiver and child. Beyond handling the physical challenges, along with the pain and uncertainty of outcome, parents must deal with the emotional needs of the burned child and sequelae on the rest of the family. This study sought to determine which issues parents/caregivers of burn-injured youth deemed most difficult.

Methods: Parents of children who attended burn camp were asked to complete a family information sheet with an eleven item likert scale survey. Parents were asked, on a scale from 1 (Not At All) to 5 (Very Hard) how difficult the issues surrounding their child's burn injury were to endure.

Results: The survey was completed by 75 parents/caregivers, 53% of respondents had a daughter and (47%) a son. Respondents included Caucasian (53%), African American (20%), Hispanic (17%) Native American (4%) and Other (7%) with 66% married. The highest mean score was 3.9 ($\pm .39$) for the item "The physical pain my child experienced." Items with a mean exceeding 3.0 included "My child's first hospital stay when he/she got burned" ($3.5 \pm .97$), "Time I had to spend away from my other children", (3.5 ± 1.6), "Loss of employment of a parent", ($3.5 \pm .1$), "My feeling of helplessness to fix everything for my child" (3.3 ± 1.3), and "Other adults/family members blaming me for the injury" (3.2 ± 1.8). The item "Difficulty getting to the doctor and therapy appointments" resulted in the lowest mean score (2.2 ± 1.3).

Conclusions: The top six parental responses for most challenging issues regarding their child's burn care experience were directly related to concerns which surfaced during or immediately after the child's initial burn hospitalization. This very difficult, disruptive and stressful time is challenging in a multitude of ways not only for the child but for the parent(s) as well.

Applicability of Research to Practice: Due to the high level of reported acute and post traumatic stress disorder in parents of burn-injured children, burn care professionals should be cognizant of the major issues facing parents. Consideration should be given, early upon admission, to initiating conversation regarding the aforementioned matters with them, offer potential solutions, and be especially aware of the importance of controlling the pain of pediatric patients.

121 . Propranolol Reduces Vascularity and Inflammation in Post-Burn Hypertrophic Scars

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Introduction: Hypertrophic scarring is a common complication in severely burned patients. These scars are characterized by inflammatory characteristics, are pruritic, and impair mobility and function. There are limited medical treatments for hypertrophic scars. Propranolol is a non selective β -blocker which has been shown to attenuate the hypermetabolic response post-burn. Our group has shown that propranolol treatment decreases post-burn hypertrophic scarring. Here we examined histological sections to determine whether there were differences between the scars from control or propranolol treated patients.

Methods: 20 patients were enrolled in the study. Ten patients received placebo and ten received 4 mg/Kg/day propranolol for one year post-burn. The demographics of the two groups were similar. Biopsies from representative scars were taken from these patients 18 months post-burn. Six observers who were blinded to treatment scored hematoxylin and eosin stained sections using a novel scoring system devised by our group. The criteria assessed included dermal inflammation, percent nodularity, vascularity, loss of rete ridges, collagen fiber size, collagen fiber orientation, blood vessel location, presence of cysts, and epidermal thickness, each scored from 0 (normal skin) to 4 (very abnormal). Scores for each group were tabulated and significance set at $p < 0.05$.

Results: Hypertrophic scars from patients treated with propranolol (P) had significant reductions ($P < 0.05$) in scar vascularity (P : 1.23 ± 0.07 , Control (C): 2.15 ± 0.04), perivascular inflammation (P : 1.1 ± 0.11 , C: 1.8 ± 0.11) and dermal inflammation (P : 0.94 ± 0.009 , C: 1.80 ± 0.11).

Conclusions: The mechanism by which propranolol may reduce post-burn hypertrophic scarring is unknown; these results indicate that angiogenesis and inflammation may be impacted by propranolol treatment. Future studies will focus on elucidating the impact of propranolol during wound healing.

Applicability of Research to Practice: Effective anti-scarring therapies are needed; this project begins to elucidate the mechanisms by which scarring reduction may be achieved.

122 . Propranolol Reduces Endoplasmic Reticulum Stress Markers in Skeletal Muscle from Severely Burned Children

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Introduction: Similarly to type-2 diabetes, severe burn injuries induce hyperglycemia, hyper-insulinemia, insulin resistance, and a hypermetabolic response. ER stress has recently been associated with insulin resistance in type-2 diabetes. We have previously shown that burn injury induces ER stress. We have further demonstrated that propranolol, given to reduce the heart rate by $\sim 20\%$ in severely burned children, improves insulin sensitivity. Here we determine whether propranolol, a non-specific $\beta 1$, $\beta 2$ -adrenergic receptor antagonist, has an effect on post-burn ER stress.

Methods: Eighteen pediatric burn patients and 4 non-burned children undergoing elective surgeries were enrolled. Nine burn patients were given placebo, while 9 were given 4mg/kg/day propranolol beginning 24-96 hours post injury. Skeletal muscle biopsies were obtained one and four weeks post burn. ER stress markers were measured by Western blot and semiquantitative RT-PCR methods.

Results: There were no significant differences in the demographics of the patient groups. The main markers of ER stress such phospho-IRE1 α , ATF6, PERK, XBP-1 and BiP were elevated in burn patients in comparison to non-burned subjects, $P < 0.05$, while Grp94, calreticulin and calnexin were not affected. Propranolol treatment had varying effects on expression of ER stress markers. Interestingly, the expression of the ER luminal glycoprotein chaperones Ero-1 α and Erp57 were increased by burn, and further elevations were seen in propranolol treated patients, $P < 0.05$.

Conclusions: Our results suggest that propranolol treatment elevates expression of ER luminal proteins that are required for proper protein folding and quality control of glycoproteins, both of which are important for tissue repair.

Applicability of Research to Practice: Our results suggest that propranolol treatment has beneficial effect on tissue repair by facilitating the synthesis and quality control of glycoproteins. Our results are in agreement with the experimental and clinical observation that propranolol administration improves protein synthesis after burn injury.

123 . Evaluation of a Sedation/Analgesia Protocol for Burn Wound Dressing Changes in Pediatric Patients

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Introduction: Children in burn centers undergo frequent wound dressing changes that exacerbate the intense, prolonged pain that burn injuries cause. Providing patient comfort through procedural sedation enhances proper wound care while minimizing anxiety and patient discomfort. Studies, however, report that even specialized burn units fail to treat procedural pain adequately. We evaluated effectiveness, safety, and patient acceptance of our regional burn center's procedural, conscious, sedation/analgesic protocol (a combination of fentanyl and midazolam) to reduce pain and facilitate pediatric burn dressing changes.

Methods: For this retrospective consecutive case review we ran a query of all burn patients age 16 years and under admitted to the burn unit from 2006 to 2010. From 339 patients identified, 164 were excluded because they did not undergo procedural sedation, leaving 175 patients suitable for evaluation. Patient and procedural-specific data were collected and entered into an Excel spreadsheet. Mean admission age was 5.6 years and 81.6% received an ASA rating of 2. We routinely monitor and record effectiveness and patient tolerability during a wound dressing change. Using the FLACC pain evaluation we record pain scores before and following sedation. A paired samples Student's t-test was used to verify statistical significance

Results: The analysis showed 149 (85.1%) patients received a sedative and/or analgesic dose within the protocol's normal range. Only 26 (14.9%) required additional doses. Of the total number of sedations, 91 necessitated fentanyl in combination with midazolam. The mean pre-procedure FLACC score of 2.05 decreased to a 0.70 post-sedation pain score, a 1.35-point reduction, shown to be significant ($p < 0.001$). Incidents of untoward events during sedation appeared in 5 patients. All sustained transient O₂ drops ranging from 75 to 89 percent. All responded immediately to brief administration of oxygen and manifested no further issues.

Conclusions: The retrospective analysis confirmed our clinical observations that the burn unit's procedural sedation protocol to ease anxiety and pain is appropriate for children and reduced FLACC pain scores significantly while resulting in few adverse events that were mild in nature and readily reversed.

Applicability of Research to Practice: Burn wound dressing changes are essential to reduce sepsis and promote healing. Our evidence demonstrated the reluctance to provide adequate procedural sedation, especially in pediatric patients, is unfounded. This evidence should encourage burn units to adopt procedural sedation to facilitate wound dressing changes in pediatric patients.

124 . A Model to Investigate Using Adult Human Skin Precursors to Improve Outcomes in Split Thickness Skin Grafts

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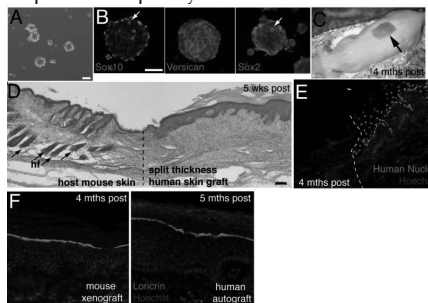
Introduction: A split thickness skin graft (STSG) is the standard for treatment of full thickness burns and other deep wounds. Excisional debridement and skin grafting are the two most common procedure codes reported in the 2011 NBR report. STSGs are sometimes life saving but the resulting grafted skin is devoid of dermal appendages. So, the skin is dry, hard and aesthetically different than normal skin. Adult human skin precursors (SKPs) may function as dermal stem cells. The purposes of these experiments were to isolate adult human skin precursors for transplantation into STSG and establish a mouse model of human STSG.

Methods: The Ethics Board approved the project. Informed consent was provided for biopsies. Additional tissue was collected from surgical waste and the regional tissue recovery program. Human STSG was sutured to a full thickness excision wound on the dorsum of 5-12 week old male CD-1 nude mice. The wounds were dressed with gauze and a silver containing dressing. Grafts were harvested at 5 weeks post transplant and monthly intervals after. SKPs were generated from 4mm punch biopsies of hair bearing skin from adults 18-75 years old. Only SKPs between 2-5 passages were used for transplantation and immunohistochemical analyses.

Results: A) SKPs (passage 2) generated from male human skin B) Self renewing human SKPs express characteristic markers of adult rodent SKPs (nuclei are shown in blue) C) Human STSG transplanted to a nude mouse 4 months post transplant with good graft take and no significant hypertrophic scarring D) H+E staining of human STSG (right) to a nude mouse (hf = hair follicle) E) immunohistochemical staining for human nuclei at transition (broken line) between human STSG (right) and mouse skin (left) F) Left: human split thickness xenograft on mouse staining for loricrin (red) Right: human autologous STSG biopsied 5 months post grafting also staining for loricrin (red). Not shown: SKPs could not be generated from samples of human split thickness skin. Human SKPs were transplanted in to the xenograft model and further results on outcomes are pending.

Conclusions: SKPs were absent in human STSG. SKPs can be generated from 4mm punch biopsies of human skin. A mouse model of STSG sustains human epidermis that has the structure and function of human autologous STSG. SKPs were transplanted to the STSG model and there is ongoing work to evaluate outcomes.

Applicability of Research to Practice: Adult SKPs collected from punch biopsies may be transplanted to STSG and could improve the quality of STSG.



125 . The Vacuum Assisted Closure Device as a Split Thickness Skin Graft Bolster in the Burn Population

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Introduction: The vacuum assisted closure device (VAC) is associated with improved wound healing outcomes. Its use as a bolster device to secure a split thickness skin graft (STSG) has been previously demonstrated, however, there is a paucity of evidence in the literature demonstrating the VACs benefits specifically in the burn population. Traditional bolstering methods are reported to result in average graft take of 87-89%. With use of the VAC becoming more commonplace, its effect on skin graft take and overall time to healing in burn patients deserves further investigation.

Methods: The authors retrospectively analyzed the burn registry database at a high volume level I trauma center and regional burn center to acquire patient data during a 16-month period. Patients were included who suffered a third degree burn injury requiring a STSG and received a VAC bolster to secure their STSG. Data points included age, sex, burn mechanism, burn location, grafted area in square centimeters, need for repeat STSG, percent graft take, and time to complete re-epithelialization measured in post operative days.

Results: Sixty-seven patients were included in the study. Some patients had multiple operative sites for a total of eighty-eight skin graft sites secured with a wound VAC. Age ranged from <1yr to 84 years (average 41 years). The average grafted area was 367±545 cm². The three most common sites for a VAC were the leg, thigh, and arm (28%, 15%, and 12%, respectively). Average percent graft take was 99.5±1.5%. Notably, no patients returned to the operating room for repeat STSG. The average time to complete re-epithelialization was 16±7 days.

Conclusions: The wound VAC is a highly reliable and easily reproducible method to bolster a STSG in the burn population. The observed rate of zero returns to the operating room for repeat STSG was especially encouraging. The VAC's ability to conform to contours of the body and cover large surface areas makes it especially useful in securing a STSG. No other study to date has looked at this large of a sample of burn patients exclusively treated with this skin graft bolstering modality. The unique needs and physiologic state of burn patients warrants special attention. Any method of post surgical burn care that improves outcomes and decreases the chance of returning to the operating room should be supported. Prospective randomized controlled trials comparing the VAC to traditional bolstering methods are necessary.

Applicability of Research to Practice: This research supports the use of the VAC in the burn population to secure and bolster STSG. This method of bolstering results in decreased repeat STSG and minimal graft loss, thus decreasing morbidity compared to conventional bolster dressings. The VAC is especially useful in anatomically difficult to bolster areas.

126 . The Novel Application of a Spatial Frequency Domain Imaging System to Determine Signature Spectral Differences Between Infected and Non-Infected Burn Wounds

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Introduction: Complications of infection are a major contributor to burn-related morbidity and mortality. Early detection of burn wound infection could lead to more precise and effective treatment, reducing systemic complications and the need for long-term, broad-spectrum intravenous antibiotics. Quantitative wound cultures from biopsies is the gold standard to determine invasive wound infection. However, this methodology is invasive and can take up to three days to yield results. This investigation focuses on the use of non-invasive imaging to determine the infection status of burn wounds in a controlled in-vivo model.

Methods: Full-thickness burn wounds (2 cm x 2 cm) were created on the dorsum of adult male Sprague-Dawley rats (n=6). Twenty-four hours after burn wound creation, wounds in the "Infected" group were inoculated with 200 µl of a vehicle containing 1 x 10⁸ CFU *Staphylococcus aureus*. "Control" group animals were inoculated with vehicle alone. Subsequently, the wounds were imaged daily for a total of 10 days and the differences of skin optical properties were assessed using a Spatial Frequency Domain Imaging (SFDI) at 11 different wavelengths from 500 nm to 700 nm. Regions of interest on the resulting images were selected and averaged at each time point.

Results: Statistically significant differences in average absorption and reduced scattering coefficients (μ_a and μ_s') at 620 and 700 nm were observed between the two groups (p<0.05). Differential optical properties were most evident by day 4 and persisted throughout the time course. A white area, which drastically scattered light, appeared on infected wounds at day 5.

Conclusions: Differential signature changes in optical properties are evident in infected burn wounds. This novel application of SFDI may prove to be a valuable adjunct to burn wound assessment. Further work will be aimed at determining dose-response relationships and prokaryotic species differences.

Applicability of Research to Practice: Novel imaging may be able to detect wound infection early and augment the course of treatment.

127 . Prospective Characterization of the Burn Wound Microbiome

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Introduction: Microbial colonization of burn wounds is a normal part of the healing process, but succession of microbial species may profoundly impact clinical outcomes. Most studies have used culture-based methods to describe longitudinal burn wound colonization; however, these methods are limited against fastidious organisms and complex bacterial communities.

Methods: Patients presenting with mid partial or full-thickness burns were screened, consented, and enrolled. From each participant, swab samples were collected daily for the first week post-injury, then weekly until grafting, infection, or wound closure. Each swab sample was immediately placed into storage media, frozen and stored at -80°C until analysis. During analysis, swab eluents underwent total cell lysis followed by DNA isolation. DNA was analyzed using 16S rRNA gene-based sequencing, resultant pyrosequences were processed and evaluated bioinformatically to generate a taxonomic data matrix, then analyzed using ecological methods.

Results: 46 samples from 8 male and 4 female participants from day 1 to day 23 post-injury were collected and analyzed. A total of $n = 83,875$ 16S rRNA gene sequences were obtained. Diverse bacterial types were detected among burn wound samples. Burn wound recolonization microbiomes were highly individual-dependent, with *Propionibacterium* spp., *Corynebacterium* spp., and *Staphylococcus* spp. the most prevalent bacteria types present in the first 24 - 48 hours after injury. However, depth of injury appeared to affect recolonization outcomes. Partial thickness superficial burns were more likely to be colonized with *Staphylococcus* spp. ($p = 0.026$), whereas anaerobic bacteria such as *Clostridium* spp. ($p = 0.038$) and *Actinomyces* spp. ($p = 0.044$) were more common in full-thickness burns.

Conclusions: Using culture-independent method, burn wound recolonization microbiome was characterized. Distinct trajectories in microbiome composition and changes over time among each individual were discovered highlighting the importance of the host immunologic response component in evaluating burn wound recolonization.

Applicability of Research to Practice: Prevalence of anaerobic bacterial types in burn wound recolonization was demonstrated. Due to the difficulty in detecting anaerobic bacteria, their role in burn wound healing remains unknown. Further investigation into culture-independent detection of anaerobic bacteria, for future studies or clinical use, is warranted.

128 . Cutaneous Barrier Disruption Extends Beyond the Burn

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Introduction: In burn patients, the skin's barrier function is critically altered beyond the wound, which may have implications for grafting. Antimicrobial peptides (AMPs), such as cathelicidin (CAMP/LL-37), beta-defensins (BD1, BD2), RNase7, and psoriasin (s100A7), function as a part of the innate immune system and are activated by epidermal proteases [i.e. kallikrein (KLK)-5, KLK7]. Lipids are also vital to the cutaneous barrier and rely on several lipid synthesis enzymes (i.e. fatty acid synthase=FAS, acetyl Co-A carboxylase=ACC, serine palmitoyl transferase=SPT, HMG-CoA reductase=HMGCR) to restore homeostasis following barrier disruption. Here, we sought to evaluate the global cutaneous changes in the burn and distally, where potential autografts may be harvested.

Methods: Human skin was collected from the burn, burn margin, and autograft during surgical excision and grafting. We evaluated 131 samples from 48 patients with a mean age of 47 years and mean burn size of 7.3% TBSA. Control skin was obtained from elective surgeries. AMPs, KLKs, and lipid synthesis enzymes were analyzed by qPCR, ELISA, and immunohistochemistry (IHC). HPLC fractionation was used to isolate AMP peptides. Fractions were subjected to a growth inhibition assay against *S. aureus* as a measure of AMP activity.

Results: The gene expression of ACC, FAS, HMGCR, and SPT lipid synthesis enzymes was substantially less in burn wounds and their margins ($p < 0.05$), and was reduced by $>75\%$ in autografts ($p < 0.05$). The AMP gene expression of CAMP, BD2, and s100A7 was elevated in burn wounds and margins, while BD1 was slightly decreased. In autografts, CAMP, BD2, RNase7, and s100A7 demonstrated downward trends. Similar changes in BD1 and BD2 protein were confirmed by ELISA ($p < 0.05$), while LL-37 protein levels were not significantly different. KLK5 gene expression was reduced in burn skin ($p < 0.05$), while KLK7 was slightly increased in autografts. Similar changes in KLK5 and KLK7 protein levels were confirmed by IHC, and revealed differences in KLK localization. Following HPLC fractionation, skin AMPs exhibited different functional capacities to inhibit bacterial growth. Specifically, a select fraction showed a 2- and 3-fold larger zone of inhibition in burn and burn margin, respectively (vs. controls, $p < 0.05$).

Conclusions: Burn injury results in a systemic cutaneous response that globally impairs skin function via changes in the chemical (i.e. AMPs) and physical (i.e. lipids) barriers.

Applicability of Research to Practice: Autografts are the standard for burn closure, but minimizing infection and graft loss remains challenging. Together, the skin's physical and chemical barriers directly limit infection and impact graft integrity. Thus, understanding how burn injury influences the global cutaneous barrier may help reduce the incidence of infection and graft loss.

129 . Acute Burns of the Palm: Is Early Splinting Necessary?

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Introduction: One of the goals of the burn therapist is to ensure that the patient has full range of motion (ROM) of any joints affected by a burn injury. The practice of splinting after skin grafting has been widely accepted by the burn care community as a necessary means to good patient outcomes; however, there is still uncertainty as to the need for splinting all acutely-injured areas. The purpose of this retrospective study was to assess the effectiveness of our pediatric burn center's current protocol for the management of acute burn injuries involving the palmar aspect of the hand.

Methods: Following IRB approval, the medical records of patients treated for hand burns between October 2008 and November 2010 were reviewed. Patients ranged in age from 12 to 40 months. Those patients who had circumferential burns involving the hand and/or required surgical intervention for the burn injury were excluded from the study. Data collected included the depth of burn, joint involvement, splint use, time to healing and resulting ROM. Comparisons were made between patients who used splints and those who did not, as well as between patients who achieved adequate ROM and those who did not. The data were analyzed by Student's t-test and χ^2 or Fisher's exact test, and statistical significance was defined as a p-value <0.05.

Results: Seventy-seven subjects were identified. Seventy percent (53) of the patients were male with a mean age of 20 months at the time of injury. The majority of patients (70%) presented with superficial partial thickness (SPT) burns and the average healing time was 12 days. Statistical analysis revealed significant differences in resulting ROM for both healing time ($t = -3.72$, $p = 0.0004$) and burn depth ($\chi^2 = 9.2293$, $p = 0.0024$). While 63% (34) of the patients with SPT burns had injuries which crossed at least one palmar hand joint, none of these patients received a splint and all of these patients had normal ROM at outcome. Only 4% (3) of patients were provided a splint, all of whom sustained a deep partial thickness burn and only one of these patients did not have normal ROM at outcome.

Conclusions: Based on the results, it does not appear necessary to routinely utilize hand splints when treating SPT burns involving the palmar aspect of the hand. ROM is typically maintained by daily activities and splints can be utilized if/when the patient demonstrates a decrease in ROM.

Applicability of Research to Practice: Health care providers need to remember that while practice guidelines and protocols help in the development of treatment plans, one's clinical judgement is also important in the delivery of cost-effective health care.

130 . Burn Splint Prescription and Patient Wear

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Introduction: Splint use to prevent scar contracture is a common burn rehabilitation intervention. Splint prescription includes type of splint, frequency and duration of wear. Few reports exist that document efficacy to support the use of burn splints thereby leaving current splint prescription based on anecdotal evidence and professional preference. As part of a prospective rehabilitation research initiative, splint prescription and patient wear was tracked for quality assurance (QA) purposes at our facility as approved by our Regulatory Compliance and Quality Assurance Office.

Methods: A pre-designed template to record burn splint wear on a 24-hour basis was used. Splint type and design was indicated on the form as well as time of splint application and removal to the nearest 15 minute interval. Patient electronic medical records were reviewed for splint wear orders related to time as prescribed by the burn therapist. Burn splint wear was collected daily. Actual time splints were worn was compared for conformity with total daily splint prescription time. Burn therapists received timely feedback as to splint wear compared to prescription. Splint wear conformity was categorized as either being worn as prescribed with a 10% time allowance or not worn as prescribed. The latter splint wear failures were further subdivided into either underutilized or over utilized categories.

Results: Thirty-six (36) consecutive patient records from September 2010 - July 2011 were reviewed for burn splint prescription coincident with the start of a prospective study. Thirteen (13) patients (36.1%) had splints prescribed. Six categories comprising 10 different splints were prescribed. Splint wear instances totaled 443. Of this number, 25.5% of splints were worn according to total amount of time prescribed while 74.5% were not. Of the splints not worn according to prescription, 81.2% were underutilized while 18.8% were over utilized or worn longer than prescribed. The majority of splint prescriptions (91.2%) were for block time intervals versus interrupted wear. No changes of the original splint wear schedule were noted. The results of this QA project were brought to the attention of the burn rehabilitation staff for ways to improve upon splint wear prescription and clinical practice.

Conclusions: This QA project revealed considerable departure from splint wear prescription than was thought to occur. The vast majority of patients wore their splints substantially less than the prescribed time. Based on these results involving block time splint wear prescription, a pre-set amount of desired splint wear time may need to be supplemented throughout a patient's day.

Applicability of Research to Practice: Heightened awareness on the part of the burn rehabilitation staff and care team as to splint wear may be necessary at all burn centers.

131 . Technique for Positioning Foot and Ankle Burns

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Introduction: Maintaining foot and ankle positioning while ensuring skin integrity is difficult, especially with large burns. In the past, burn units have used posterior foot splints or complicated multi-podus boots to immobilize and protect skin integrity of the foot post-grafting. We have developed a system which is user friendly, minimizes the difficulty level and decreases risk of skin breakdown in a cost effective way.

Methods: For the foot-plate: Splint material is cut out in a rectangular shape, 9"x12". Webbing material (2"-wide) is cut to lengths of 60" and 22". Hook and loop Velcro, 4" and 10" respectively, is sewn to each end of the longer strap. Parallel slits are cut at the top and bottom of the splint material to allow for both straps to slide through. Sew the shorter strap to the longer strap at ~45 degree angle. An additional "stirrup" strap (14" long) is riveted in place to support the heel. Application: A pressure-relieving boot and a prefabricated tri-panel knee immobilizer are applied to the patient. The foot-plate is then positioned on the plantar surface over the boot. The foot-plate straps are secured to the knee immobilizer. Velcro on the end of the foot-plate straps is used to adjust the tension, positioning ankle/foot in desired

Results: We have used this positioning system for 1 year on 6 patients. All patients were able to maintain neutral ankle position when positioned in foot-plate system, evidenced by goniometric measurements. There was no skin breakdown to the foot dorsum or heel. Patients had normal ankle range of motion when post-operative immobilization precautions were lifted. Additional benefits to this system are that it can provide some weight bearing and desensitization to the foot and lower leg. The foot-plate could also be adjusted to correct ankle inversion/eversion posturing. Both nursing staff and patients demonstrated good compliance and reported satisfaction using this technique. The foot-plate and straps cost <\$20 and are fabricated by the therapy aide.

Conclusions: Neutral ankle positioning in lower extremity burns is essential for successful and functional outcomes. The use of this foot-plate system is cost-effective, allowing for easy to obtain and consistent positioning of the ankle. Skin integrity is preserved and provides a comfortable alternative to other ankle positioning devices. Our facility will continue to use this foot-plate system.

Applicability of Research to Practice: These are essential considerations in the management of lower extremity burns and grafts.



132 . Determining the Standards for Treatment of Shoulder/Axillary Burns

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Introduction: Shoulder contracture following the acute phase of burn injury is thought to be due to inadequate physical exercise, lack of splinting and bracing. Significant scarring, deformity and loss of function are common. However, there is no gold standard for contracture prevention; splinting and range of motion are recommended in nonstandard variety of splint types and varying degrees of positions. The study examined burn therapists' attitudes and practice patterns toward the treatment of shoulder/axillary burns.

Methods: Burn therapists of North American burn centers completed an anonymous, internet survey. The survey included 13 questions about treatment of shoulder/axillary burns at their institute.

Results: Seventy nine therapists (60.8% OT, 36.7% PT) and other (2.5%) completed the survey. Majority were female (83.5%), mean age of 41.8 years and the majority had >10 years experience caring for burn patients. Daily assignment of patients with shoulder/axillary burns was noted by 45.6% of therapists to be <10% of their caseload, 27.8% with caseload of 11-25%, 13.9% of caseload of 26-50%, 7.6% with caseload of 51-75% and 5.1% with a caseload of 76-100%. To treat these burns, the majority of therapists (97.5%) used range of motion (ROM)/therapeutic exercises, 89.9% positioning devices, 78.5% splinting, 20.3% suspension of shoulder and 17.7% other modalities including scar management, pressure garments and inserts. Typical wearing schedule for devices varied with 24.1% responding at all times, 21.5% for 2 hours on/off, 1.3% daytime only, and 11.4% nighttime only. However, 41.8% stated "other" and wrote in case specific schedules. The majority (69.6%) did not suspend; however, of the 24 respondents who utilized suspension, 8.3% performed <1 hour, 1 hour (12.5%), 4 hours (16.7%), nighttime (21%), and other (42%) which again included case specific wearing schedules. When asked the best position of the shoulder in suspension, 4.3% stated shoulder flexion, 26% shoulder abduction, and 70% shoulder scaption.

Conclusions: Various treatment modalities are necessary to treat shoulder/axillary burns in order to optimize function. Use of ROM and splints/positioning devices appear to be standard therapy while shoulder suspension was less commonly utilized. With no standard of suspension time or positioning, further study is warranted.

Applicability of Research to Practice: Defining current therapy practices used to treat shoulder/axillary burns provides a foundation for evaluating the effect of treatment modalities on functional outcomes.

133 . Scar Management of the Face: Does Early Versus Late Intervention Impact Outcome?

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Introduction: Scarring of the face has long-term implications for appearance and quality of life. Nonsurgical methods of facial scar management include scar massage, facial exercises, compression and silicone. Traditional teaching is that early scar management minimizes scarring; however, little data exist to support this practice. This study was undertaken to determine if children who received early scar management of the face had better outcome than those who received later intervention.

Methods: In this IRB approved study, 71 patient records were retrospectively reviewed for timing of four different scar management interventions including scar massage, facial exercises, compression therapy (fabric or plastic face mask) and silicone application. Outcome measures used were Vancouver Scar Scale Rating (VSS), and need for facial reconstructive surgery. Nineteen subjects were excluded due to incomplete documentation.

Results: Average age of subjects was 6.6 (+5) years, TBSA 39.3(+25.3)%, and length of stay was 81.9(+89.2) days. Patients were classified as "good" outcome if they had a VSS of less than 6 (43%) or no reconstructive procedure to the face (48%) and 'poor' outcome if their VSS score was greater than 6(57%) or they required reconstruction to the face (52%). Significant correlation was found between TBSA and time to treatment ranging from fair to good: massage ($r=0.40$), facial exercise ($r=0.47$), compression ($r=0.53$) and silicone ($r=0.42$). Mann-Whitney U tests were conducted to determine if there was a difference in days to start treatment in regards to VSS and reconstructive outcome. Time to initiation of nonsurgical scar management was not associated with good or poor VSS or reconstructive outcomes (Table 1). Early initiation of pressure, however, approached significance for association with good VSS outcome and decreased need for reconstruction.

Conclusions: This preliminary study showed that early implementation of pressure therapy was associated with improved outcomes. Further investigation is needed comparing early and late pressure therapy and how it impacts scar outcome. Development of more objective and reliable facial and scar assessments will improve outcome measurement.

Applicability of Research to Practice: This study adds to the knowledge base regarding the timing and types of scar management treatment that may impact facial scar outcome.

Difference in timing of initiation of treatment in regard to VSS and reconstructive outcome.

Treatment	"Good" Outcome VSS ≤6	"Poor" Outcome VSS ≥6	P Value	"Good" Outcome (-) Recon.	"Poor" Outcome (+) Recon.	P Value
Massage	32.8 days ± 28.1	34.5 days ± 19.2	.609	31.4 days ± 20.2	34.2 days ± 22.2	.460
Exercise	29.7 days ± 13.2	32.4 days ± 23.1	.602	31.3 days ± 21.4	32.5 days ± 21.6	.776
Pressure	35.8 days ± 11.6	72.7 days ± 46.5	.030*	62.3 days ± 41.8	68.7 days ± 44.8	.069
Silicone	63.4 days ± 101.2	73.5 days ± 67.7	.719	69.5 days ± 64.5	99.9 days ± 131.0	.504

*approaching significance
 $\alpha = 0.0125$

134 . Natural Skin and Burn Scar Biomechanic Investigation

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Introduction: The ability to comparatively analyze natural skin and pathologic burn scar response relative to joint movement is an important feature to understanding optimal rehabilitation strategies following a burn injury. Previous research evaluating unburned skin excursion during joint range of motion (ROM) has demonstrated that skin excursion occurs throughout a defined area termed a cutaneous functional unit, with the majority of the excursion occurring nearest the joint of interest. The focus of this investigation was to evaluate how scar tissue may influence skin excursion during ROM.

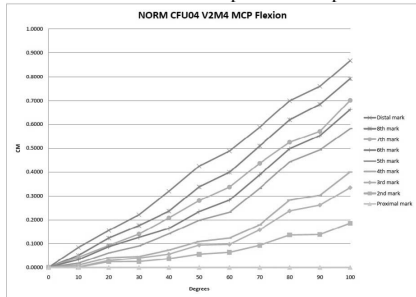
Methods: Two subgroups of subjects from a larger study population were selected to report preliminary findings about capturing dynamic tissue response to joint ROM using Dartfish video analysis software system. Skin tracking marks at one centimeter intervals were placed on the dorsum of the subjects' hands and a device was constructed to allow isolation of metacarpophalangeal (MCP) joint flexion during simultaneous video capture of mark movement in 10° increments. Subjects underwent four repeated assessments of MCP flexion and the fourth assessment was chosen to report as it represented preconditioned tissue. Five (5) subjects without burns (NB) to the dorsum of their hands and two (2) subjects with healed dorsal hand burns (HB) of 16 and 34 month duration are reported. All subjects had full MCP flexion. Regression analysis and Wilcoxon 2-sample were used for analysis.

Results: All subjects were aged matched within 5 years (23 - 28 years). Video capture skin movement findings are as follows:

- 1) Dorsal hand skin movement contribution to MCP flexion was measured to occur in a sequential and segmental manner (see Figure).
- 2) There was no statistically significant difference in slope of the plotted segment differences between NB and HB groups (NB: 0.1212 ± 0.1 ; HB: $0.0653 \pm .03$).
- 3) In 2 NB cases, the most distal segment (nearest MCP joint) demonstrated a variant elongation 'ceiling effect' versus continuous contribution to MCP joint flexion lending support for the anisotropic nature of skin.

Conclusions: These preliminary findings offer additional insights into the mechanical behavior of skin and burn scar. Although no difference was found between the groups, the lesser slope of the HB indicates that scar may contribute to joint motion as a unit versus segmentally.

Applicability of Research to Practice: The biomechanic understanding of skin and scar is fundamental to burn rehabilitation interventions and patient response to treatment.



135 . The Use of a Fibrin Sealant for Securing Skin Grafts to the Hand and Upper Extremity and Its Impact on Outpatient Occupational Therapy

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Introduction: The traditional approach to skin grafting of partial and full thickness burns to the hand and upper extremity consists of split thickness (STSG) secured mechanically with sutures or staples. Over the past year, our burn center has utilized Artiss™ (Baxter) on patients with appropriate wounds to secure STSG for coverage of their burn wounds. Our standard post-operative hand therapy protocol was modified to initiate early active range of motion on post-operative day (POD) 1 if the grafts were adherent and no significant hematoma was present. We evaluated outpatient occupational therapy (OOT) outcomes of patients following STSG secured with Artiss to their hands and wrist compared to patients whose STSG were secured with staples.

Methods: Thirteen patients whose STSGs were secured with Artiss from 2009-2010 (20 sites) were matched with thirteen patients whose STSGs were secured with staples from 2008-2009 (21 sites). Patients were matched by total body surface area treated with STSG and treatment sites. A review of prospectively gathered data was performed on both treatment groups to obtain QuickDASH outcome measurement scores, pain levels (0-10 scale), grip strength, return to full active range of motion and demographic information.

Results: The 20 Artiss treatment sites consisted of hands (n=18), hand/wrist (n=1), and wrist (n=1). The 24 staple treatment sites consisted of hands (n=18), hand/wrist (n=2), and wrist (n=1). As shown in Table 1, the Artiss treatment group required 12.3 weeks less OOT and achieved full AROM 64.45 days earlier than the staple treatment group. Both of these differences were considered very statistically significant. The Artiss group initiated OOT with a greater functional QuickDASH score than the staple group and rated their pain as being less than the staple group at their first OOT visit.

Conclusions: The use of Artiss™ represents a major advance for the fixation of hand and upper extremity grafts with immediate graft adherence. Early (POD 1) active and passive range of motion can be initiated without fear of graft shear or loss. This early range of motion greatly impacts a patient's functional outcome secondary to earlier return to full AROM, less loss of grip strength and lower pain rating at initial evaluation status post graft. The patient additionally benefits from less occupational therapy and earlier discharge.

Applicability of Research to Practice: Identified graft fixation method's impact on patient outcomes.

Table 1

	Weeks of outpatient OT	Day Achieved Full Range of Motion s/p surgery	Pre QuickDASH Score	Post QuickDASH Score	Initial Pain Rating (0-10)
Artiss Group	5.3	22.7	38.7	6.5	2.55
Staple Group	17.6	87.24	50.6	3.5	4.04
P Value	0.0010	0.0019	0.1099	0.3382	0.1428

136 . Effectiveness of the "Road to Recovery" Program Among Outpatients with Burns or Complex Trauma

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Introduction: The purpose of this study was to evaluate the effectiveness of the "Road to Recovery" program among outpatients with burns or complex trauma at a specialty rehabilitation hospital. This is a nine-week psycho-educational group intervention, which addresses psychological distress, promotes psycho-social functioning, assertiveness, functional coping styles, and encourages responsibility towards community reintegration.

Methods: A comparison of self-report outcome measures completed before and after five group interventions was performed (June 2008 - July 2010). The following outcomes were measured: health assertiveness skills (Health Assertiveness and Knowledge Questionnaire - HAKQ), coping styles (Coping with Health Injuries and Problems Scale - CHIP), depression, anxiety and stress (Depression Anxiety Stress Scale - DASS21), and stress (Perceived Stress Scale - PSS). Descriptive, paired t-test, repeated measures, and Pearson correlations were performed with a p<0.05 significance.

Results: The outcomes for 26 traumatically injured outpatients were investigated (burns=18, complex trauma=8). The majority were males (73%), mean age was 40.4±2.3 years; mean time from injury to assessment was 5.6±0.6 months. Overall, there was a significant increase in health assertiveness (13.1 vs. 11.8, p = 0.005) and a significant reduction in stress level (20.7 vs. 23.2, p = 0.027) post-intervention. There was a higher mean percentage change among outpatients with burns compared to complex trauma indicating greater reduction in depression (-24.07% vs. 2.08%), stress (-12.56% vs. -5.07%), and anxiety (-6.06% vs. 3.02%), respectively. For burn patients there was a significant positive correlation between emotional-preoccupation coping style and pre-intervention stress (r=0.78, p<0.001), depression (r=0.75, p=0.001), and anxiety (r=0.61, p=0.05). Lastly, both groups had a significant negative correlation between health assertiveness and pre-intervention emotional preoccupation coping style (r=-0.48, p<0.05), stress (r=-0.52, p<0.05), depression (r=-0.57, p<0.005), and anxiety (r=-0.65, p=0.001).

Conclusions: The "Road to Recovery" program improves health assertiveness skills and reduces distress in burn and complex trauma outpatients. The present study provides evidence for the relationship between health assertiveness, styles of coping, and level of psychological distress, and helps guide group content to further improve program effectiveness. Further research utilizing a larger sample size is warranted to achieve an accurate representation of each population.

Applicability of Research to Practice: The "Road to Recovery" psycho-educational group program has a significant role in the rehabilitation of burn and complex trauma outpatients.

137. The Young Adult Outcome Questionnaire

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Introduction: Patient-centered health outcomes are useful in monitoring and predicting recovery from burns. An outcome questionnaire for young adults was developed and tested for validity, reliability and responsiveness to change.

Methods: This five year (2003-8) prospective controlled multi-center study included burned adults ages 19-30 years who completed the Young Adult Outcome Questionnaire (YAOQ) at initial contact, 10 days, 6 and 12 months. Similar aged non-burned controls completed the questionnaire. The YAOQ is assessed using factor analysis to establish the construct validity of the scales and reliability assessments using Cronbach's α and test-retest within 14 days. Recovery patterns of scales are investigated using generalized linear models with generalized estimating equations (GEE). Recovery curves for 48 months from injury were derived for 2 factors, pain and gross motor function. Scale scores were standardized to a mean of 50 based on controls and SD=10.

Results: There were 153 burn subjects and 112 controls. A total of 620 questionnaires were completed. Mean age was 24 ± 0.3 (SEM) years, TBSA burn was $11 \pm 1\%$ and time from injury to first YAOQ administration was 157 ± 36 days. Factor analysis based on oblique rotation gave 15 factors from 47 YAOQ items. The factors included gross motor function, fine motor function, pain, itch, perception of appearance, ability to function limited by appearance, acceptance at work/school, emotional status, recreational function, sexuality, satisfaction with symptom relief, satisfaction with ability to function, religiosity, family function, and family concern. The Cronbach's α ranged from 0.72 to 0.92, of which 11 scales were > 0.8 . Test-retest reliability ranged from 0.29 to 0.94 suggesting change in underlying health status for some limited scales. Test-retest correlations were positive and significant ($p < 0.05$). Burn subjects at baseline exhibited worse scores on all 15 YAOQ scales compared to controls ($p < 0.05$). Recovery curves showed positive recovery for pain ($p < 0.0001$) and gross motor function ($p < 0.0026$). Note that marked improvements occurred within 48 months of the burn, but scores remained below the reference score of 50 set by the controls.

Conclusions: The YAOQ is a reliable and valid instrument that assesses multi-dimensional outcomes in the young adult burn population.

Applicability of Research to Practice: The YAOQ will be used to assess long term patient outcomes following burn injury through the establishment of benchmarks for recovery from burns over time.



138. Improving Patient Satisfaction through the Delivery of Burn Telemedicine Clinics

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Introduction: Telemedicine has been widely utilized in health care. Telemedicine is the transfer of medical data via a variety of telecommunications technology in various settings. Our telemedicine program is primarily focused on caring for the reconstructive needs of burn survivors. Today, very little data exist on the impact of such clinics on patients/caregivers. We have developed a survey questionnaire, in order to continuously assess the efficacy and quality of our program focusing on patient/caregiver satisfaction.

Methods: The Survey Questionnaire is given to each caregiver/patient at the end of their telemedicine clinic visit. The survey consists of questions regarding hospital visits vs. telemedicine visits, satisfaction and willingness to return to the telemedicine clinic, audio/visual quality, psychological/comfort, travel time, time lost from work/school and travel expenses to the appointment.

Results: This report examines the responses reviewed from 60 questionnaires. Patients/caregivers (92%) indicated that they are satisfied with the concept of conducting telemedicine follow up visits instead travelling to the hospital and indicated that they are willing to return to future telemedicine clinic sessions (96%). The audio/visual quality of the telemedicine sessions was found to be very acceptable (96%). Psychologically, patients and caregivers (96%) indicated that they were equally comfortable, participating in the telemedicine sessions instead of actually being in the hospital. The overwhelming majority of caregivers reported that travel time to the follow up appointments decreased significantly. Average travel time for a hospital visit was 9.75 hours vs. 1.64 hours to the telemedicine clinic. Additionally, the average days away from work/school was 2 days when traveling to a hospital visit. The average time spent away from work/school to attend telemedicine sessions was 4 hours.

Conclusions: The use of telemedicine clinics for follow up appointments has produced positive feedback from patients/caregivers. Specifically, it has significantly decreased their travel time to the hospital setting and time off from work/school. The overall caregiver expense for travelling to the follow up appointment has significantly been reduced. Additionally, telemedicine sessions are perceived as very comfortable and easy to participate in. Ongoing, continuous feedback from caregivers helps adjust how clinics are conducted and helps improve patient satisfaction.

Applicability of Research to Practice: Patient satisfaction should remain the focus in providing high quality medical care and the provision of burn telemedicine programs may have a significantly positive effect on how patients/caregivers perceive and rate satisfaction.

139 . A Performance Improvement Initiative to Determine the Impact of Increasing the Time Interval Between Changing Centrally Placed Intravascular Catheters

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Introduction: Existing practice guidelines designed to minimize invasive catheter infections and insertion-related complications in general intensive care unit patients are difficult to apply to the burn population. Burn-specific guidelines for optimal frequency for catheter change do not exist, and a recent survey demonstrated great variation among institutions for this practice. Previously, our practice was to follow a fresh site insertion at 48 hours by a change over a guidewire which was followed 48 h later by a second change over a guidewire (stick-wire-wire at 48 h intervals = 48h group). As a performance improvement initiative, we attempted to determine if there would be any advantage or disadvantage to extending our intervals to 72 hours (stick-wire-wire at 72 h intervals = 72h group).

Methods: All patients with centrally placed intravascular catheters from October 2007-August 2008 were included in the 48h group, and all patients with catheters placed from September 2008-December 2009 comprised the 72h group. Catheter infection rates were determined using the National Healthcare Safety Network (NHSN) definition for central line associated bloodstream infections (CLABSI) and calculated as CLABSI/1000 catheter days.

Results: There were 3.1 CLABSI/1000 catheter days for the 48h group and 2.8 CLABSI/1000 catheter days for the 72h group (P = not significant by chi-square analysis).

Based on our average number of catheter days/year, we would perform 280 fewer catheter procedures per year with the 72h protocol than with the 48h protocol. Direct tangible cost savings for supplies were estimated to be \$28,000. Additionally, with the 72h protocol there would be 280 fewer procedures performed resulting in decreased needs for both nursing and respiratory therapy support.

Conclusions: Increasing our central catheter change interval from 48 to 72 hours did not result in any increase in our CLABSI rate. Implementation of this change in practice is expected to decrease supply costs by \$28,000 in addition to reducing clinical support services needed to perform the procedure.

Applicability of Research to Practice: The findings from this study are directly applicable to practice. The increased change interval (72h protocol) is currently our standard of care. CLABSI rates have not increased, and cost savings are being realized.

140 . Web-Based Burn Rounds: A Quality Care Initiative

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Introduction: In order to accommodate the need to maximize the number of burn team members present for Burn Rounds, a 'Web-Based' Burn Round was developed. The purpose of this study was to review this quality care initiative.

Methods: Approval was obtained from the Quality Care Committee. Weekly interprofessional Burn Rounds are attended 'in person' and patient's wounds are reviewed using digital photos. The digital photos are annotated using Powerpoint™ and converted to a WMV video file using Leawo™ Convertor™. The video file is then posted on a secure intranet site for all team members. After a six month period, a survey was distributed to all members of the Burn Team (n=70). The survey included two questions with normal and reflective phrases to test for internal consistency. All responses were anonymous and only the designation of the professional role was requested.

Results: The survey had a 50% response rate (n=35). Internal consistency was confirmed (Chi Squared p<0.05). Strongly positive responses supported that patient care (53%) and education (83%) of the patient's condition was effectively communicated. The survey responses positively supported that this type of communication would be effective in other patient areas (90%) and was applicable to other medical conditions (90%). Respondents disagreed (26%) with the assertion that they no longer felt that attending 'in person' rounds were necessary. Technical improvements in the audio and video were identified by the majority of responses (76%). The statement that "there were no risks or privacy concerns using this medium" was supported by 69% of the respondents. The majority (86%) of the responses supported web based rounds as a necessity now that it has been incorporated. Free text responses concerning methods to improve this forum, were focused on increasing the detail of the narration and the rationale for choices of dressings and analgesia. The overriding positive theme from free text comments were all focused on the fact that team members from the intensive care unit and outpatient departments who typically are not present during the weekly 'in person' rounds now had access to burn rounds.

Conclusions: This survey supports the use of web-based Burn Rounds in order to facilitate communication and optimize patient care in a pediatric tertiary care institution where the burn care occurs in separate geographic locations. Technical improvements in the video quality are required. The survey supported the incorporation of this medium as an addition to 'in person' weekly Burn Rounds.

Applicability of Research to Practice: Web based burn rounds should be considered as an additional option for burn units where the burn program is incorporated in separate geographic clinical areas in order to provide education of all the members of the burn team.

141. Telemedicine: The Operational Logistics of Developing and Implementing a State-Wide Program

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Barnabas Health, West Orange, NJ; The Burn Center at Saint Barnabas Medical Center, Livingston, NJ

Introduction: As the State's only designated burn treatment facility our Burn Center is entrusted by the State Department of Health and Senior Services (DHSS) to take the lead on all burn-related matters. In 2009 The Burn Center was charged with the acquisition and implementation of a statewide burn telemedicine program. The purpose of this program is two-fold; integrate newly developed burn mass casualty incident (MCI) protocols with existing triage and transport procedures for routine admissions.

Methods: Burn staff met with medical directors, nurse coordinators and information technology (IT) personnel at the ten State trauma centers. Discussions centered on equipment modalities, hospital inter-connectivity, encryption and confidentiality, IT capacity, policies and procedures and staff training. A national vendor was selected. Equipment was purchased over an 18 month period with funds from a DHSS/ASPR grant. Upon completion of staff inservices trauma centers signed a Memorandum of Understanding covering usage, warranties, maintenance and liability.

Results: Clinical staff was supportive, however the program initially met with resistance at two trauma centers. This was due to unfamiliarity by their IT staff with the scope and purpose of the program, and a concern for potential compromise of their respective internal information systems. These concerns were addressed at follow-up meetings and supported with equipment demonstration. Delivery logistics posed another problem. Dates and times had to be coordinated through an outside service. Afterwards there were site issues regarding security and storage. Once installed, test calls were conducted to register to respective border control systems and staff was in-serviced. Wireless capability was also provided, however in some instances could not be implemented due to bandwidth requirements.

Conclusions: Telemedicine capability offers the burn team an audio-visual opportunity to directly communicate with a referring facility to better evaluate wound severity, review medical management and optimize patient stabilization. This capability greatly improves quality of care for routine transfers. In the chaos and confusion of an MCI, it is expected to be extremely beneficial, especially for healthcare providers inexperienced with burn care. The next phase of this program is to regularly test and improve standards of usage for interfacility transport; implement educational conferencing opportunities and integrate with other existing Burn Center telemedicine systems.

Applicability of Research to Practice: Improved patient care practices.

142. The Financial Impact of Outpatient Burn Services

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Introduction: With the trend of discharging patients from the acute stay earlier, hospitals are forced to find new, creative ways in which to manage patient care needs. To provide our burn patients with ongoing high-quality care, our burn center has integrated the care of the outpatient with the inpatient burn center allowing the hydrotherapy department to provide continuity of care.

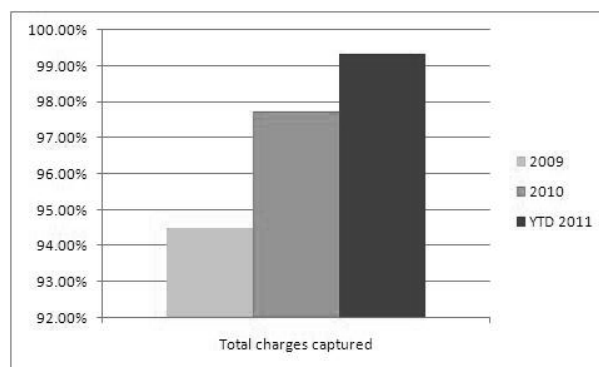
Methods: In order to assess the needs of our patients following discharge, we conducted an in-depth review of services offered including scheduling, treatment, documentation, billing, patient flow and a review of staff functions and responsibilities. We estimated that from missing documentation, scheduling issues and missed supply capture we lost approximately \$15,600 in outpatient reimbursement.* Reorganization of the program occurred between 2009 and 2010 which included the scheduling of outpatients, registration, charge system for supplies and services, physician order entry, physician progress note dictation, and nursing wound documentation using the electronic medical record. Outpatient registration accounts were created and charge structures for hydrotherapy services, wound care supplies and specialty dressings were reviewed and revised.

Results: Outpatient burn visits continued to increase from 669 in 2008 to over 2,600 in 2010. The demand for outpatient services paved the way for additional staffing approval to include two nurses and one burn technician in hydrotherapy as well as a patient information coordinator who could assume the clerical duties that were previously assigned to the nursing staff.

Conclusions: Through the collaborative efforts of various departments as well as institutional and technological support, our year to date loss is \$1,250.* This shows an improvement in charge capture from 94% to 99.3%. In addition, our compliance, quality of care, and patient flow has improved. With additional staffing, ease of access to documentation, scheduling, electronic charge entry and daily charge reconciliation we were able to ensure capture of charges while caring for a higher volume of outpatients.

Applicability of Research to Practice: Careful analysis and review of available resources is essential in the outpatient treatment of burn patients.

*Based on Medicare National average rates



143. Journal Club Promotes Clinical Research, Continuing Education and Evidence-Based Practice

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Introduction: While the journal club (JC) is a common part of physician training, there is a paucity of information within burn literature regarding the significant role JC can play in bridging the gap between research and clinical practice. The purpose of this study was to characterize outcome measures of a burn team JC in order to assess its effectiveness in promoting multidisciplinary education relative to research competencies, clinical knowledge and evidence-based practice.

Methods: In partial response to findings from a 2009 burn team research needs assessment whereby 24% indicated a knowledge deficit precluding participation in research, the longstanding JC for residents was redesigned into a monthly JC for clinicians and researchers. Following 2 years of the new multidisciplinary format, a survey was distributed to evaluate the impact of JC on clinical and research indicators. Opportunities for improvement represented a secondary aim.

Results: The 24 JC meetings studied included a variety of topics (wound healing, infection, nutrition, metabolism, sleep, medications, alternative medicine, research compliance, child abuse) and speakers (26% researchers, 23% MD, 20% RN, 31% other disciplines) with a mean of 29 participants/session (range 17 to 50). Clinical topics compared to research topics generated no difference in attendance (29.4 vs 24.4 participants, respectively). Survey results from 30 respondents indicated that 100% judged JC to be valuable to personal educational needs and 83% indicated that format did not warrant change. According to self-report data, JC enhanced medical knowledge (90%), patient care (73%), research competency (70%), critical thinking (63%) and evidence-based practice (63%). Three new studies were initiated and several novice clinical researchers evolved into active co-investigators as a direct result of the JC experience. Content analysis of data revealed that article accessibility and meeting advertisement represented two opportunities for process improvement.

Conclusions: This investigation provides much evidence to justify the JC. Results indicate the program was well received by participants and it promoted enhanced knowledge and improved patient care. Journal club participation also facilitated research participation. In the future, barriers to research initiatives and also integration of research findings into practice warrant follow-up study.

Applicability of Research to Practice: The modern concept of multidisciplinary JC can address many educational needs. JC also represents a performance improvement strategy. Therefore, JC should be incorporated into the learning curriculum of burn practitioners to promote critical thinking, clinical/research competencies and evidence-based practice.

144. Improving Employee Satisfaction: One Burn Center's Experience

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Introduction: Current literature supports the positive relationship between a supportive working environment, employee satisfaction, improved clinical outcomes, and increased patient satisfaction. As part of this large academic institution's standard human resources (HR) procedures and to better understand how this dynamic relates to the care of burn injured patients treated at this center, staff were asked to complete employee satisfaction surveys regarding their attitudes toward various dimensions of hospital culture and environment. It was hypothesized that burn center (BC) nursing staff satisfaction would rate highly and provide insight into further areas for improvement.

Methods: As part of the hospital's 2009 employee opinion survey, Burn Center (BC) nursing staff were asked to complete a Likert based, anonymous, validated survey distributed by an outside vendor regarding their attitudes towards 11 dimensions about the hospital's commitment to and support of staff as listed in Table 1. Results were compared to those of peer centers and applied to implementation of burn center based HR improvement strategies created to address identified deficits. Staff were resurveyed in fall 2010 according to the same methodology and results were compared using Fisher's Exact T-test ($p < 0.05$).

Results: In 2009, 48 of 96 staff responded as per Table 1. Employee driven improvement initiatives designed to address reported deficits, build respect and strengthen staff relationships with hospital leadership were implemented in 2009-10 and included: senior leadership and HR management rounds with staff, staff/colleague recognition, clinical shadow by VP of Nursing, table of organization education, increase in staff's organizational involvement, and identification & problem solving of staff concerns. In 2010, 48 of 99 staff responded to the survey. Increases in favorable responses were identified for all 11 dimensions; in 4 areas, these increases achieved statistical significance ($p < 0.05$). In comparison to peer norms, 2010 responses exceeded benchmarks in 7 of 9 categories.

Conclusions: Vast gains in many of the dimensions of staff satisfaction were noted in 2010 and support the employee improvement initiatives launched as a result of the 2009 findings. These initiatives will be continued, enhanced and combined with the feedback expected from the 2011 survey to further improve our staff experiences and ultimately those of our patients.

Table 1

	2009: Burn Center % Favorable Responses n=48	2010: Burn Center % Favorable Responses n=48	BC 2009 vs 2010 Significance (NS = not significant)	% Favorable Responses Academic Teaching Hospital Norm 2010
Overall Job Satisfaction	71	89	$p < 0.05$	71
Corporate Compliance	70	75	NS	N/A
Departmental Improvement Plan	38	75	$p < 0.05$	N/A
Management	64	75	NS	64
Respect	64	74	NS	66
Mission/Goal Alignment	61	76	$p < 0.5$	65
Teamwork/Cooperation	61	67	NS	67
Training/Development	79	81	NS	66
Physical Working Conditions	74	80	$p < 0.5$	81
Concern for Pt Care	72	86		70
Communication	64	72		76

145 . The Effect of CO2 Fractional Laser (Pixel®) on Hypertrophic Burn Scars

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Introduction: As burn and post-operative scars may cause some pains and itching senses, and cosmetic problems, proper treatments are required accordingly. Laser therapy is popular for non-invasive technique, short-performance time, and easiness. Especially fractional lasers leave surrounding tissue unaffected and intact allowing the skin to heal much faster. We report preliminary result with CO2 Fractional Laser (Pixel®) device for the therapy of hypertrophic burn scars.

Methods: 30 patients who visited our cosmetic surgery center during from Feb. 2010 to May 2011 were treated CO2 Fractional laser (Pixel®, Alma laser TM, Israel) for hypertrophic scars caused by burn and skin graft surgery. Treatment was performed 5-10 times at the interval of 3-4 weeks, and additional treatments were performed according to the progress. Basically, Spot size was set to be 9x9 Pixel, Power was set to be High (60 watt), Energy was set to be 70-100mJ/Pixel, and PPS was set 3Hz. For the objective assessment of improvement, Vancouver scar scales were used, and the thickness of hypertrophic scar was measured by the ultrasonic wave.

Results: Out of 30 subjects, female was 19 and Male was 11. The average age was 31.4 years. (± 15.8) The average follow-up period was 6 months. For the body part, we had 11 cases in head and neck, 9 cases in lower limb, and 2 cases in trunk. The scar scale was decreased by 53.7% from average 6.74 to 3.12, whereas the thickness was reduced from average 0.26cm to 0.19cm. After laser treatment, the redness occurred all cases and the blister formation was seen in 9 cases, but all of them were perfectly cured with the conservative treatment.

Conclusions: CO2 Fractional laser (Pixel®) generated micro thermal damage and gave the thermal effect to dermal layer. Consequently, it induced the collagen contraction immediately, collagen regeneration and dermis remodeling after long-term. These resulted in the decrease of scar thickness. The pliability and hypervascularity of scars appeared to be improved, whereas there was no remarkable effect on the improvement of the pigmentation at all. It was judged that this was because CO2 Fractional laser (Pixel®) didn't have the pigment-selectivity, and it could be complemented by combining other laser therapy such as fractional photothermolysis laser or Nd-YAG laser.

Applicability of Research to Practice: Management of burn scar by laser.

146 . Combination of Fractional Photothermolysis Laser (Er:Glass) and Fractional CO2 Laser for Burned Face

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Introduction: Face is the most exposed and aesthetically important part in the body. Various methods such as scar revision, silicone sheet apply, skin rehabilitation therapy, skin graft and laser therapy have been tried for burn scar in the face. As it is non-invasive, convenient and takes short time for procedure, laser treatment is highly used for burn scar in the face. Fractional laser is effective for treatment of burn scar by inducing skin regeneration and promoting formation of collagen in the dermal layer in selected area. At this hospital, a combination of fractional photothermolysis laser (FPT laser) and fractional CO2 laser (FCD laser) effectively treated various types of facial burn scar.

Methods: A total of 10 patients who visited this hospital in the period from January through August 2011 were included in this study. Fractional CO2 laser device (Pixel®, Alma laser, Israel) was performed on hypertrophic scar, non-ablative Er: Glass fractional laser device (Fraxel®, SR1500, Xena Inc, USA) on pigmented and irregular dysmorphic scar. Frequency of laser treatment was 5-10 sessions with interval of 3-4 weeks. FPT laser treatment was performed with strength of 20-30 mj/cm2 and density of 432-654 MTZ/cm2. FCD laser treatment was performed with spot size of 9x9 pixel/cm2 and power of 70-100 mJ.

Results: The mean age of the 10 patients who received FPT laser and FCD laser treatments were 31.7 years(± 15.42) with male to female ratio of 4:6. Vancouver scar scales performed 6 months after the treatment showed that the scores decreased by 15-21.74% on average: redness decreased by 18.75% from 1.6 to 1.3; elasticity by 18.43% from 1.9 to 1.55; thickness by 15% from 2.0 to 1.7; and pigmentation by 21.74% from 2.3 to 1.8. In 3 of the 10 patients, side effect such as redness and blister formation was observed. They recovered without permanent complications.

Conclusions: FPT laser induce thermal effect in the dermal layer by causing micro thermal damage to the tissue, and FCD laser promotes skin regeneration and formation of collagen in dermal layer via micro tissue ablation. FPT laser was effective for pigmented and dysmorphic burn scar, and FCD laser was effective for hypertrophic scar. A combination of the two laser treatments were effective for treatment of facial burn scar. At this hospital we performed laser treatment targeting at pigmented, hypertrophic and dysmorphic scar in patients with 2 kind of laser devices. Further studies with various lasers and with more diverse applications are required to improve facial burn scar.

Applicability of Research to Practice: Management of facial burn scar.

147 . Aesthetic Improvement of Burn Scar By Dermabrasion with Dermal Overgraft and Additional Laser Therapy

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Introduction: Various techniques such as pressure garment, laser, skin graft and dermabrasion and dermal overgraft(DOVG) are used to improve the appearance of the burn scar. Dermabrasion with DOVG can smooth out irregular texture, discoloration of burn scars in the exposed skin areas and can be both physically and emotionally therapeutic. After special skin graft mild hypertrophy or color difference of graft margin is sometimes unsatisfactory, additional laser can smooth out color difference and mild hypertrophy of graft margin. Combination of dermabrasion with DOVG and additional laser was performed on the patients who have burn scars and achieved good outcome and high level of patient's satisfaction.

Methods: Treatment was performed in a total of 5 patients with burn scar in the period from January 2008 through September 2011. Burn scar area is abraded to the level of dermo-epidermal junction with a dermbrader fitted with a diamond fraise wheel (Osada Inc. CA, USA). 4-5/ 1000 inch ultra-thin split thickness skin was harvested from patient's buttock by Zimmer® dermatome (Zimmer Inc, USA) and grafted to derm-abraded area. 1-2 months after operation, 4-5 sessions of laser treatment with interval of 3-4 weeks were performed using fractional photothermolysis laser device (Fraxel®, Xena Inc, U.S.A). Clinical digital photography was performed before operation, immediate postoperation and 12 weeks after the last laser treatment. The photographs were evaluated by 2 plastic surgeons according to the improvement of surface irregularity, dyspigmentation and hypertrophy. After completing each treatment, side effect was evaluated. Finally, at the 12th week after treatment patients were interviewed with satisfaction.

Results: The mean age of the 5 patients was 35 years (± 8.19) with male to female ratio of 2:3. The distribution of 5 patients's site of scar was 1 in the face, 3 in the upper limb and 1 in the lower limb. At 12 weeks after the last laser treatment, all 5 patients achieved smoothened irregular texture and postoperative marginal hypertrophy, improved skin texture and color difference in treated site. 4 of the patients were very satisfied with the outcome. 1 patient was satisfied with outcome. No side effect was observed.

Conclusions: Dermabrasion with DOVG is a cosmetic surgical procedure that removes the thin outermost layer of the skin on damaged scar and replace by new healthy skin. Fractional laser is effective for treatment of burn scar by inducing the skin regeneration and promoting formation of collagen in the dermal layer in selected area. Combination of laser treatment and dermabrasion and dermal overgraft achieved better aesthetic outcome and recommended as an effective procedure to improve aesthetic outcome in burn scars.

Applicability of Research to Practice: Improvement of burn scar.

148 . Review of Epinephrine Solution Use in 408 Consecutive Cases of Burn Reconstruction

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Introduction: Intraoperative tissue infiltration with solutions containing diluted epinephrine is commonly used in burn surgery. The complications, though rare, can be severe. We encountered two major complications and reviewed our experience.

Methods: Review of all the cases done with Pitkin solution over a 3-year period between July 2008 to July 2011. Data collection included medical record numbers, dates of surgery, age, volume of Pitkin solution infiltration, estimated blood loss, diagnosis, type of surgery, gender and complications.

Results: A total of 408 procedures were performed with Pitkin solution between July 2008 to July 2011. Of these, 171 (42%) were performed on female patients and 237 (58%) on males. The patients ages ranged between 11 months and 20 years with a mean of 10.22 ± 5.41 (mean + SEM). The mean volume of Pitkin solution utilized was 545.16 ml; being the minimum 2 ml and maximum 6000 ml. Mean blood loss was 31 ml. We had 14 complications (3.38%) in this series of cases, 2 of them directly attributable to the epinephrine infiltration: one case of acute carpal tunnel and one flash pulmonary edema.

Conclusions: The use of epinephrine solution in burn reconstruction can help diminish blood loss with infrequent but potentially life threatening complications. These complications and safety precautions are presented.

Applicability of Research to Practice: The benefits, technical aspects of infiltration options, available and commonly used solutions as well as the complications of this series are discussed and potential safety measures reviewed in detail.

149 . Reconstruction of Post Burn Ala Defect Using Adiposocutaneous Graft

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Introduction: As a central feature of the face, the nose has considerable significance in appearance and expression. Reconstruction of full thickness defects of the nasal ala has always been a challenge because of the 3-dimensional structure. For reconstruction of post burn defects of ala, skin graft, local or pedicled flap and composite graft are optionally available. We have reconstructed the ala defects using adiposocutaneous graft and observed the outcome.

Methods: From March 2003 to December 2010, 19 cases in 11 patients with scar contracture and defect on ala portion were performed operation using adiposocutaneous graft. As a donor site, we used the inguinal crease and posterior auricular area and the donor site was primarily closed. We made incision through the superior rim of ala and released fully. A graft is applied to recipient site with larger size than recipient volume.

Results: The mean age of the patient was 38.6 years (16-51), males are seven patients and females are four patients. The operation was performed bilaterally in 5 patients and unilaterally in 6 patients. Composite grafts were harvested from inguinal area in 13 cases and posterior auricular area in 6 cases. At one case, we did 4 times of operation to get enough volume. All the grafts were well taken. The mean size of the graft was 3.63cm².

Conclusions: For reconstruction of post burn defects of ala, it's not easy to use local flap or pedicled flap because of hardness and fibrosis of surrounding tissue. So, we choose adiposocutaneous graft for ala deformity reconstruction, got satisfactory outcome in color matching and texture.

Applicability of Research to Practice: By using adiposutaneous graft, we could correct ala deformity with a good result.

150 . Upper Eyelid Ptosis Following Early Repeated Release of Burned Eyelids

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Introduction: An early surgical intervention is considered to be essential in managing an upper eyelid contracture to minimize corneal injuries. Release of a contracted eyelid must be sufficient to allow coaptation of the two lids without undue tension. The resultant defect is usually grafted with a partial thickness skin graft. A total of 9 children out of 146 who had undergone repeated upper eyelid contracture release during the period of recovering from acute injuries developed eyelid ptosis.

Methods: Delineation of adnexal structures such as orbicularis oculi muscle and orbital septum was not possible at the time of exploring the ptotic eyelid because of scarring. The superior levator palpebral aponeurotic system was all found to be attenuated and could not be identified along the upper tarsal edge. Identification of the aponeurotic remnants, however, was possible with the clearance of scar tissues. Coaptation of the levator aponeurotic remnant to the superior tarsal edge was carried out with 5-0 clear nylon sutures. The resultant wound was covered with a piece of partial thickness skin graft.

Results: Healing of the wound was noted to be uneventful in all. Movements of upper eyelid returned in 6. Secondary release was necessary in the remaining three.

Conclusions: It is conceivable that an intemperate with overly aggressive tissue dissection was the factor responsible for separating/detaching the aponeurotic structures of the levator palpebrae superioris from its tarsal insertion resulted in this undesirable consequence of eyelid releasing procedure.

151. The Use of Transpositional Fasciocutaneous Flap alias 3/4 FC Z-plasty Technique in Burn Contracture Release

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Introduction: The Use of Transpositional Fasciocutaneous Flap alias 3/4 FC Z-plasty Technique in Burn Contracture Release

Methods: A total of 403 children underwent reconstruction of contractural deformities involving various bodily sites in five years between 2003 and 2007. A total of 888 flaps were fabricated. The flap was used most often in reconstructing contractural deformity involved the large joints; i.e., axilla, elbow, wrist, knee and the ankle. (Table 1) Description of Surgical Technique A right-angled triangle with its cathetus adjacent is drawn perpendicular to the line of proposed release or the long axis of the wound requiring flap closure. The angle adjacent of the triangle is set at 20°-30°. An initial skin cut is made along the cathetus adjacent of a triangle once the contracture is properly released. The dissection is continued through the subcutaneous tissues to identify the fascial layer. A back-cut is made at the apex of triangle that includes the fascia to complete a fasciocutaneous flap formation. The composite flap is rotated into the defect to complete wound closure

Results: Partial necrosis around the tip of triangular skin flap was encountered in 27. While the flap loss, though partial, was not very common, the incidence was noted to be much higher in the knee area. (Table 1) While tightness around the joint areas was relieved in all patients, the width of flap was observed to have doubled. The extent of increase was more prominent in joint structures with movements; i.e., axilla, elbow and knee

Table 1: Topographic distributions of FC flaps fabricated		
Topography	# of Flaps Fabricated	# Flap Loss
Abdomen	31	0
Upper Extremity	655	6
Shoulder	3	0
Trunk	42	0
Perineum	4	0
Lower Extremity	153	21
Total # Flaps	888	27

Conclusions: Fabrication of a fasciocutaneous flap is technically simple and the transfer of the flap to reconstruct the wound defect is readily achievable. The morbidities are minimal. The flap therefore, should be considered as a proper alternative to skin graft for burn scar contracture release.

152. Salvaging the Knee: The Use of Local, Pedicled, and Free Flaps for Limb Length Preservation

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Introduction: In our Burn Unit, patients with lower extremity wounds requiring amputation present a challenge in regards to limb length preservation. It is well known that patients with below-the-knee amputations (BKAs) require less expenditure of energy than patients with above-the-knee amputations (AKA). However, preservation of limb length is often difficult as adequate soft tissue coverage rather than vascular supply usually present as the limiting factor. The purpose of this study is to describe alternative methods to provide soft tissue coverage in cases in which AKAs would ordinarily have been considered the only option.

Methods: A retrospective chart review was performed of all patients admitted to the Burn Unit from 2003 to 2011. Of these patients, those undergoing lower extremity amputation with BKAs were chosen and operative technique to close the BKA stump was categorized if the BKA was not closed with a standard skin flap.

Results: In 8 patients, 12 BKAs were performed requiring alternative stump closure. Of these 8 patients, 3 had injuries as the result of burns, 1 from trauma, and 4 from purpura fulminans. Three categories of stump closure were identified: 6 extended skin or muscle flaps were performed, 4 fillet of sole flaps, and 2 free flaps. Of the 6 skin/muscle flaps, 3 were extended skin flaps based off of posterior or anterior tibial perforators, 2 flaps were based off of remaining gastrocnemius muscle, and 1 flap was a gastroc myocutaneous flap. Of the 2 free flaps, one was a parascapular flap and the other an anteriolateral thigh flap. All 14 amputations would otherwise have required AKAs secondary to insufficient proximal soft tissue coverage; however BKAs with alternative closure were performed allowing for salvage of the knee and limb length.

Conclusions: Our experience in using alternative means of soft tissue closure for BKA stumps has allowed preservation of limb length. The advantage of preserving leg length given the correlation between energy expenditure and level of amputation cannot be underestimated as BKAs are associated with faster rehabilitation and decreased work of ambulation compared to those patients who undergo AKAs. Our efforts to salvage the knee with a variety of local, pedicled, and free flaps provide durable stump coverage. While these procedures may increase operative time, the advantage of preserving a functional knee joint and limb length given better patient outcomes, compensates for the increased time and effort.

Applicability of Research to Practice: This study attempts to describe the manner in which knee salvage and limb length preservation can be performed for BKAs with insufficient soft tissue. The flaps used are readily available, provide durable coverage, and contribute to better long-term outcomes for patients.

153 . Characterization of Skin Allograft Use in Thermal Injury

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Introduction: Temporary coverage using skin allograft is a widely accepted standard in acute burn care, especially when the total burn surface area precludes single stage autografting. Despite its prominent role in burn management, the practice of skin allograft use is not well characterized and is the subject of this study.

Methods: Under an IRB approval protocol, patients injured between 23 March 2003 and 5 December 2010 and treated at our burn center were identified using a systematic review of burn registry records. Their electronic medical records were reviewed for allograft use, total burn surface area, anatomic location of burns, operative burden, inter-operative interval, intensive care unit length of stay, overall length of stay, injury severity score, transfusion requirement, and outcome.

Results: During the study period 844 patients were identified. Among them, 112 (13.27%) received allograft and 732 (86.73%) did not. The amount of allograft used per patient varied widely (μ : 57.17 sheets/patient, σ : 71.69). Patients were allografted an average of 12.75 times during their hospital stay and at each operation received an average of 6.09 sheets. Allografted patients sustained severe burns (μ : 51.62% TBSA), often required large volumes of transfusion (μ : 10.032 L PRBCs), and were grafted frequently - averaging every 7.45 days. Most commonly allograft was placed on the extremities (66.50%) and trunk (44.23%); however the vast majority of allografted patients also had concomitant burns of the head (91.07%) and hands (87.50%). All-cause mortality among the allografted patients was 15.32%.

Conclusions: Allograft exposure is common in the severely burned population. Although there are no anatomic limitations to the use of allograft there are distinct patterns of use. Given the prominent role skin allograft plays in the acute management of large burns, there is need for further investigation of its effect on mortality, morbidity, and antigenicity.

Applicability of Research to Practice: This study provides objective data to burn providers on the common practice of allograft usage in the severely burned patient. Furthermore, gaps in our knowledge are identified and areas for further research delineated.

154 . Intermediate-Level Disinfection with Accelerated Hydrogen Peroxide Prevents Accumulation of Bacteria during Repeated Daily Debridement of Infected Pork Hock with Versajet

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Introduction: Surgical debridement of necrotic tissue in an effective wound treatment. During an inpatient's stay for a burn-related injury, they are subjected to multiple tissue debridement. Currently, most centres use mechanical means to remove dead soft tissue. Cutaneous bacterial burden represents another challenge for wound care. Currently devices such as the VersajetTM system are used once and discarded for fear of contamination with successive use. We wanted to study the feasibility of using the VersajetTM system on a contaminated surface for up to 8 days with a daily intermediate-level disinfection (ILD) protocol.

Methods: We used the VersajetTM system to debride pork hocks inoculated with a known quantity of artificial test soil (ATS) and incubated for up to 8 days. A ILD protocol with the accelerated hydrogen peroxide (AHP)-containing OxivirTB[®] was employed.

Results: An intact pork hock inoculated with ATS yielded $6.1-6.8 \times 10^6$ cfu/cm² bacteria. After debridement with the VersajetTM, the pork hock surface yielded fewer bacteria (range: $5.9-6.4 \times 10^6$ cfu/cm²). Bacterial counts on the handpiece and discharge hose also increased throughout the study after debridement, ranging from mean of $5.19 \log_{10}$ cfu/ml on day 3 to a peak at day 8 ($6.43 \log_{10}$ cfu/ml). The ILD protocol with OxivirTB[®] resulted in a 6-log reduction in bacterial counts on the handpiece and discharge hose. Similarly, we observed a reduction of protein, a surrogate marker of bioburden, during the study. Compared to a maximum level of protein ($57.9 \mu\text{g/ml}$) obtained before ILD, handpiece and discharge hose protein levels reached a maximum of $9.8 \mu\text{g/ml}$ and $13.8 \mu\text{g/ml}$, respectively, throughout the study.

Conclusions: Subsequent disinfection of the handpiece and discharge hose after debridement with OxivirTB[®] resulted in a 6-log reduction in colonies. In addition, protein levels were also reduced 4.2 fold when handpiece and discharge hose were disinfected with OxivirTB[®].

Applicability of Research to Practice: An ILD protocol with OxivirTB[®] may be a feasible method to allow for successive debridements with VersajetTM system on infected skin.

**155 . Pediatric Toxic Epidermal Necrolysis:
Institutional Review and Guideline
Development**

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Introduction: Toxic epidermal necrolysis (TEN) in the pediatric population is rare. The purpose of this institutional review in a large tertiary pediatric hospital was to retrospectively determine outcome and develop a care guideline.

Methods: A retrospective chart review examining TEN cases admitted to the intensive care unit (ICU) between June 1, 2002 and June 1, 2011 was conducted. Data concerning total body surface area (TBSA) involvement, causative agents, treatment, length of stay, length of intubation, and complications were reviewed. Nutritional feeding information was collected and compared with calculated and measured (calorimetry) requirements. ICU outcome measures including SCORTEN, Pediatric Index of Mortality 2 scores (PIM2) and PELOD scores were reviewed.

Results: There were 10 TEN patients with significant skin involvement (mean TBSA=33.75%) requiring ICU admission. Biopsy was used to confirm the diagnosis in 60% of cases. More males (n=6) than females (n=4) presented to the hospital with a mean age of 6.5 years. Prescription drugs were the most common causative factor (n=7). Intravenous immunoglobulin (IVIG) and corticosteroids were used for treatment in 8 and 2 of the cases respectively. The dosing of IVIG had a range of 1-2 mg/kg/day over 1-3 days. Biobrane™ application after intraoperative skin debridement was done in all cases after 2009 (n=4) and two cases were treated with amniotic membranes for ocular involvement. The small number of cases did not allow for determining any significant relationship between length of stay in ICU (mean=10.2 days) and TBSA. Mechanical ventilation was required in 70% of cases with the mean length of intubation being 8.6 days. Tracheotomy was not required. Half of the patients (n=5) incurred a significant respiratory complication and one a gastrointestinal complication requiring surgical intervention. Measured calorimetry scores (n=4) were uniformly lower than calculated scores (mean=1259 kcal/day versus mean=1858 kcal/day). For the 9 patients receiving feeds, the mean actual feeds (calories=1058kcal/day and protein=85g/day) were lower than the mean calculated feeds (calories=1786kcal and protein=38g/day). There were no mortalities and SCORTEN Day 1 (mean=1.7), PIM2 (mean probability of death= .00991) and PELOD Day 1 (mean=4.3) scores all predicted high likelihood of survival.

Conclusions: This retrospective review revealed a lack of uniform practice for treatment of this rare disease. A guideline has been created to address the ocular, nutritional, therapeutic and wound care issues so that future cases can obtain the best possible treatment.

Applicability of Research to Practice: This data will help to provide insight into TEN/SJS, and eventually inform an evidence-based best treatment approach for future cases in children.

**156 . A Case of Argyria and Acute Leukopenia
Associated with the Use of an Antimicrobial
Soft Silicone Foam Dressing**

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Introduction: Silver has had an important role in preventing burn-related infections for decades. Relatively few side effects is one factor that has led to its wide spread use. Silver is found in a variety of forms in wound care products. While in the past most silver-containing products existed in the form of solutions, creams, or ointments, there are now several wound care dressings which contain silver. Here we present the first case of argyria, acute leukopenia, and possibly acute kidney injury associated with the use of a silver sulfate containing soft silicone foam dressing.

Methods: A 56-year-old lady was transferred to the burn center with 70% TBSA skin sloughing diagnosed as toxic epidermal necrolysis associated with trimethoprim/sulfamethoxazole. On presentation she appeared to have clinical sepsis and was started on vancomycin and piperacillin/tazobactam. Her SCORTEN score was 4. Clinical sepsis resolved within several days. Initial wound care consisted of daily topical double antibiotic and 3% Bismuth Tribromophenate petroleum gauze. After several days the wounds were covered with a silver sulfate containing soft silicone foam.

Results: After seven days the leukocyte count declined from 18,000 to 600/cm³. Silver toxicity was suspected and the dressings removed. Initial serum silver level was 190 µg/L and 249 µg/L one week later. The leukocyte level normalized within seven days. During this time period there were no signs of sepsis and the patient was hemodynamically stable. Over the following days and weeks, the patient's skin began to show blue-gray coloration consistent with argyria. The patient subsequently developed acute kidney injury requiring hemodialysis and multiple organ failure. She eventually succumbed to her illness.

Conclusions: Though controversy exists about the causal relationship between silver containing dressings and leukopenia, we believe this case represents one of acute leukopenia and argyria from the use of silver sulfate soft silicone foam dressing. The leukopenia resolved soon after the cessation of the product. It may have been a contributing factor to the development of acute kidney injury as well.

Applicability of Research to Practice: Given the potential for toxicity from silver, we consider it important to understand the chemical properties of silver-containing wound care products and to monitor the concentrations of silver in plasma or urine in patients undergoing such treatment especially when utilized for larger body surface areas.

157. **Does Appropriate Preoperative Surgical Antimicrobial Prophylaxis Affect Post Operative Surgical Site Infections in Burn Patients**

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Introduction: Multiple randomized clinical trials have established the importance of appropriate perioperative antimicrobial prophylaxis. This has led the Centers for Medicare & Medicaid Services Surgical Care Improvement Project (SCIP) to issue practice guidelines. Studies supporting these guidelines have widely excluded wounds that were categorized as either contaminated or dirty and, therefore, burn wounds have not been included in these guidelines. The purpose of this study was to review our institutional experience with antibiotic prophylaxis in burn patients. We hypothesized that application of appropriate surgical antimicrobial prophylaxis reduces the incidence of surgical site infections in burn patients.

Methods: We reviewed 168 acute and reconstructive operative cases for the development of surgical site infections (SSIs) from April 2010 to June 2011. The primary group of interest consisted of patients who either did not receive the appropriate antibiotic coverage for MRSA colonization and/or did not receive their antibiotics within one hour of their incision. Controls who received the proper preoperative surgical antimicrobial prophylaxis were matched to the study group by surgeon for the given time period. Patients were excluded from review if they required multiple staged operations or had active signs of preoperative infections. SSIs were identified by criteria outlined by the American Burn Association Board of trustee's consortium for burn wound infections.

Results: Of the 77 patients who received the inappropriate antimicrobial prophylaxis, 27 patients met the criteria above and were reviewed for the development of a SSI. Of the 91 patients who received appropriate preoperative surgical antimicrobial prophylaxis, 43 met criteria for review. Eight patients (19%) developed postoperative SSIs, of which 63% were from MRSA isolates. Three patients (11%) developed postoperative SSIs with one hundred percent of infections isolating MRSA.

Conclusions: Surgical management of burn patients continues to be plagued by perioperative wound infections. This study further supports the need to prospectively evaluate the utility of perioperative antimicrobial prophylaxis and the antimicrobial spectrum of coverage for burn patients.

Applicability of Research to Practice: Introduces the applicability of current preoperative antimicrobial prophylaxis guidelines to the care of burn patients.

Demographic and Infection Relationships Between Inappropriate and Appropriate Abx Prophylaxis

Variable	Inappropriate Abx	Appropriate Abx	p-value
Age	31.1 (19.0)	33.0 (21.8)	0.72
TBSA (%)	5.9 (8.5)	5.4 (6.7)	0.47
BMI	26.9 (7.1)	25.7 (7.1)	0.21
SSI (%)	11.1	18.6	0.40
MRSA (%)	100	62.5	0.21
LOS	8.4 (9.5)	10.9 (11.2)	0.30

158. **Experience with the Crane Flap for Hand Burn Reconstruction**

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Introduction: Deep burns to the dorsum of the hand and digits present a challenge for acute burn management. They are often the result of combined crush, pressure, and thermal injury resulting in exposed tendons and an inadequate wound bed for primary wound closure with skin grafting. The crane flap represents a useful technique for management of these serious injuries.

Methods: The registry at a verified Burn Center was queried to identify patients with acute hand burns requiring reconstruction other than primary skin grafting. In the past ten years, three patients were identified that were managed with a crane flap. These charts were reviewed for demographics, patient length of stay, photo documentation of injury and reconstruction, complications, and outcomes.

Results: Three patients were identified in a ten-year period from 2001 - 2010. Successful crane flaps were performed for salvage of the hands and digits with exposed tendons. No digits were lost. There was minimal donor site morbidity. No patient required further reconstructive procedures. All patients had excellent functional outcome of the reconstructed hand.

Conclusions: The crane flap is a useful technique for the management of deep burns to the dorsum of the hand and digits with exposed tendons. It compares favorably to alternative treatment measures due to its simplicity and functional results. This is a useful procedure in the armamentarium of the burn surgeon dealing with complex thermal injuries to the hand and digits.

Applicability of Research to Practice: Deep hand burns with exposed tendons present a therapeutic challenge. The crane flap is a useful technique in the burn surgeon's armamentarium.

159 . Management of Purpura fulminans in a Burn Treatment Center

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Introduction: Purpura fulminans (PF) is a rare disease usually involving massive dermal and soft tissue hemorrhage and necrosis associated with SIRS and refractory hypotension. Between 2006 and 2011 our burn treatment center (BTC) admitted 7 patients with a diagnosis of PF. We noted 2 distinct forms of PF: infectious and levamisole-induced. All aspects of burn care treatment were used in their management.

Methods: An IRB-approved retrospective study was initiated to investigate PF admissions to our BTC. Data collected from the medical records included: medical/surgical history, date of symptom presentation, date of admission, date of transfer to our BTC, time to diagnosis, length of stay, location of tissue necrosis, limbs amputated, suspected levamisole use, use of activated drotrecogin alfa, and deaths. Descriptive statistics were generated for these patients and treatment was reviewed.

Results: There appeared to be delays in diagnosis as well as transfer to our BTC. The average time from admission to diagnosis at outside hospitals was 3 days. Transfer to our BTC occurred, on average, 8 days after admission to the outside hospital. Body surface area involvement with tissue necrosis was $31.2 \pm 20.7\%$ and length of stay (LOS) for these patients was 78.0 ± 43 days.

The most common sites of necrosis were the arms, hands, legs, and feet. Drotrecogin alfa was used in 3 patients. Amputation was required in 5 patients and 2 patients expired from complications of their PF. The deaths were not associated with larger wound sizes with areas of necrosis on these 2 patients 8 and 33%. It appeared that levamisole exposure was responsible for non-infectious PF in 2 patients. These patients did not meet the criteria for sepsis and did not require pressors. Their wounds appeared to be more focal, involving the ears and digits. In addition to aggressive surgical treatment, numerous wound closure strategies were utilized.

Conclusions: Early diagnosis of this cryptic disease may be difficult. However, once diagnosed, aggressive management in a BTC setting may promote improvement of limb salvage and survival. There appears to be a non-infectious form of PF associated with levamisole adulteration of illicit drugs.

Applicability of Research to Practice: Early recognition of PF may allow more timely transfer to a BTC and proper management. Efforts should be made to heighten the awareness that levamisole may cause PF and death.

160 . Preliminary Report: Chronic Ulcerations and the Incidence of Squamous Cell Carcinoma in Burn Patients

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Introduction: Although quite rare, chronic ulcerations in patients with burn injuries may degenerate into squamous cell carcinomas (SCCa) better known as "Marjolin ulcers". The recent reports of SCCa developing in patients with large total body surface area (TBSA) burns has caught the attention of many physicians who treat burn patients in the acute and reconstructive phases of care. Although the incidence of SCCa in patients with large TBSA burns is believed to be low, based on retrospective reviews, this preliminary report documents the incidence of SCCa in patients with large TBSA burns with chronic ulcerations.

Methods: Children with large TBSA burns who were covered with cultured epithelial autograft (CEA) or cultured skin substitute (CSS) were invited to return to the clinic if they had any changes in their wounds. Thus far, seven patients have returned for biopsies of chronic ulcers.

Results: Seven patients with burn injuries were noted to have chronic ulcerations. Six of these patients were male and one female. The mean total body surface area burn in this group was 91.3% with 86.3% being full thickness. The average age of these patients at the time of burn injury was 4.5 years of age. The period between the time of injury and biopsy was 11.5 years. One patient with a 99% total body surface area burn, with 99% full thickness, developed SCCa in three separate sites: the abdomen, the left foot and the left knee. This patient died of metastases. Biopsies taken from the remaining patients totaled eight with none of these being positive for cancer.

Conclusions: It is quite clear that patients with large total body surface area burns continued to have chronic ulcerations with breakdown and closure either surgically or non-surgically. Fortunately, to this date, the majority of these patients have not developed SCC. The literature indicates that in burn patients who develop SCCa, the latency period is between 20 and 30 years. The average interval after burn for our patients is seven years. Thus, it is important to continue to monitor these patients in order to screen for the repeated ulcerations and the development of SCCa.

Applicability of Research to Practice: This raises the question of whether patients treated with cultured epidermis may have increased risk of later development of scar carcinomas, and whether they follow a particular pathway of carcinogenesis.

161 . Pyoderma Gangrenosum: A Difficult Diagnosis Best Managed in a Burn Treatment Center

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Introduction: Pyoderma Gangrenosum (PG) is a rare immunological disorder with infiltration of white blood cells into the epidermis, characterized by necrosis and excruciating pain. Diagnosis is made through a process of exclusion, which may delay proper treatment. Many patients (pts) are subject to surgical intervention and wound care that exacerbates the condition prior to diagnosis of PG. Between 2004 and 2010, 5 pts with PG were admitted to our burn treatment center (BTC). A wide range of treatment modalities were used on these pts.

Methods: An IRB-approved retrospective study was initiated to investigate pts admitted to our BTC with PG. Collected data included: demographic information, onset of symptoms, time to admission to our BTC, time to diagnosis, length of stay (LOS), wound care, use of corticosteroids, and surgical interventions. Medical history was reviewed for predisposing diagnoses associated with PG.

Results: The average age of the pts was 64.6 (43 to 81) years. There were 3 male and 2 female pts. Pts presented with symptoms on average 129.4 days prior to BTC admission, however, 1 patient (pt) had a rash for 1 year and a non-healing lesion prompted BTC admission. Removal of this pt provided an average onset of PG of 70.5 days. LOS averaged 24 days (range 3 to 40 days) and the average time to diagnosis was 18.7 days (range 5 to 43 days). The average involved area was 3.9% (range 0.5 to 7%) with 4 of the 5 pts having lesions on the lower extremities and 1 involving the abdomen. Predispositions included a history of inflammatory bowel disease in 2 pts, malignant melanoma in 1, and psoriasis in 1. Prednisone was administered to 4 pts and 1 of those 4 also received dapsone. Initiation of corticosteroids occurred 1.75 days after admission for 4 of the 5 patients. No corticosteroids were administered to 1 pt. Of the 5 PG pts, 3 had excision and/or skin grafting. Vacuum-assisted wound closure was used on 4 pts. There was 1 death associated with sepsis which was diagnosed prior to admission to our BTC.

Conclusions: Making the exclusionary diagnosis of PG is difficult and pts may receive improper care in the interim. Skin grafting may result in progression of lesions. Persistent wounds that don't heal with conservative therapy, especially those with pain disproportionate to the findings, should be considered for a diagnosis of PG. Prompt diagnosis and specialized care in a BTC may greatly improve outcomes for pts with PG.

Applicability of Research to Practice: PG is often a diagnosis of exclusion, which may delay proper treatment causing undue pain and suffering for the pt. Further research is needed to facilitate earlier diagnosis and improve treatment modalities.

162 . The Use of a Dermal Regeneration Template in the Reconstruction of Traumatic Soft Tissue Injuries

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Introduction: Trauma is a leading cause of morbidity and mortality worldwide, especially in children and adults up to 44 years of age. Traumatic degloving injuries are common and are typically caused by a high-energy shearing force that avulses skin and often other soft tissue away from their blood supply. Traditionally degloving injuries have been treated with debridement followed by skin grafting alone or flap reconstruction. Many degloving injuries extend to tendon and bone. The decreased vascularity in these areas can lead to poor healing of skin grafting alone. Flap reconstruction has variable success in regard to long-term viability of the flap and morbidity at the donor site. Integra has been proven effective in the reconstruction of burn and traumatic wounds. Advantages to this method include successful reconstruction over poorly vascularized wound beds including bone and tendon, and decreased morbidity at donor sites.

Methods: All patients with traumatic degloving injuries who were treated with Integra at a Level 1 Trauma Center between January 2009 and July 2010 were included in the study. Data for eligible patients was abstracted from the trauma registry and patient medical records. Patient demographics, injury severity scores, mechanism of injury, location, size, and depth of degloving injury, comorbidities, time interval from injury until admission, administration of antibiotics, interval from injury to debridement, interval from debridement to placement of Integra, interval from placement of Integra to placement of split-thickness skin graft, hospital length of stay, outcome, disposition and mortality are summarized.

Results: Ten patients were studied. Eighty percent had significant preexisting co-morbid conditions. All had traumatic degloving injuries of an extremity ranging from 50 - 1000 cm². Nine patients had injuries extending to bone and/or tendon. Patients underwent placement of Integra at an average of 17.1 days after the initial debridement. Split thickness skin grafting was performed an average of 13.4 days after application of Integra. Of the ten patients, two had complications with their grafts. There were no mortalities.

Conclusions: Degloving injuries are common in trauma. The depth of injury often extends to tendon and bone which poses challenges to repair due to decreased vascularity in these areas. Placement of Integra followed by skin grafting is a viable alternative to the traditional methods of repair.

Applicability of Research to Practice: The use of a dermal regeneration template may represent a viable alternative for closure of traumatic soft tissue injuries.

**163 . Toxic Epidermal Necrolysis:
A 13-Year Retrospective Review**

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Introduction: The management of toxic epidermal necrolysis syndrome (TEN) remains a challenge to the medical arena. It is a very uncommon disease that comes abruptly following the short-term ingestion of a drug. Although Lyell elegantly described it more than five decades ago, the pathology of the disease is still poorly understood. The mortality associated with this syndrome may have improved over the years; nevertheless it remains as high as 70%, especially when there is delayed referral to a burn center.

Methods: Herein we performed a 13-year retrospective review (1998-2011) of one hundred consecutive patients admitted with TEN in our regional burn center. Our variables included age, gender, ethnicity, total body surface affected (TBSA), inciting agent, sepsis, steroid administration, and time interval between the onset of rash and admission to a burn center. Statistical analysis was performed using the Fisher's exact test and logistic analysis.

Results: The mean age of the population was 59.22 years and the mean total body surface (TBSA) injury was 55.5% and progressed to a mean TBSA OF 63.2%. Male to female ratio was 19:48 for survivors and 12:22 nonsurvivors. We identified an offending agent in 88% of the cases. The majority of the patients were admitted to the Intensive Care Unit. Fifteen patients required ventilator support and 21% had sepsis. Steroids use approached 60% in this study population. The overall mortality was 34% and reached 35%, 38% and 41% with delayed referral, in the presence of sepsis and with prolonged use of steroids respectively.

Conclusions: Our retrospective review highlights once again the importance of the early identification and referral of the patient with TEN to a burn center.

It also emphasizes on the early recognition of the factors that may contribute to the patient's mortality.

Applicability of Research to Practice: TEN still represent a conundrum to the burn clinician. Optimizing its management can only improve patient's care and long-term outcome.

164 . Novel Surgical Approach for Axillary Hidradenitis Suppurativa Utilizing a Bilayer Skin Regeneration Template and Thin Split Thickness Skin Grafts: A Retrospective Case Series

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Introduction: Hidradenitis Suppurativa (HS) is a chronic debilitating disease of apocrine gland-bearing skin characterized by recurrent abscesses with subsequent rupture, scarring and draining sinus tracts affecting most frequently the axillary, inguinal and anogenital regions. The pathogenesis of the disease is poorly understood but is postulated to be the cumulative effects of genetic, pubertal and personal hygienic factors leading to follicular occlusion and subsequent pilosebaceous unit rupture. This results in an inflammatory response and secondary bacterial infection. Conservative and temporizing treatment methods have been used for mild to moderate disease but are ineffective for extensive HS. Upon reviewing historical and current literature most surgeons agree that wide local excision of diseased tissue is necessary. This often results in a large soft tissue defect for which there is no consensus for reconstruction. Historically, these defects were closed by primary repair, local advancement, free or pedicle tissue flaps and split thickness skin grafts (STSG). Recovery has been hampered by disease recurrence, tissue necrosis and reoperation. The goal of this case series is to offer an alternative surgical approach to treating severe HS.

Methods: All surgical procedures were performed at the regional burn center by dedicated burn surgeons using a two-stage surgical approach. First, wide local excision of affected axillary tissue was performed and then the bilayered skin regeneration template (with a dermal matrix component composed of bovine type-1 collagen and shark derived chondroitin-6-sulfate) was placed into the defect. This was secured with a negative pressure wound therapy dressing. The patient returned to the OR for the second stage: thin split thickness skin grafting.

Results: Results of four patients are described. There were no recurrences of HS. Two patients did require reoperations to address granulation tissue overgrowth and two small areas of STSG loss. One patient experienced bilayer skin replacement loss on re-operation due to infection.

Conclusions: Inadequate excision of HS is the leading cause of disease recurrence. With the use of a bilayered skin regeneration template and a thin STSG, surgeons can be confident and generous in their excision of HS, ensuring no axillary recurrence and secondarily achieving satisfactory functional and cosmetic results.

Applicability of Research to Practice: Surgeons treating HS now have an alternative method to achieve coverage of the large soft tissue defect created from wide local excision.

165 . The Dermis Graft: Another Autologous Option for Acute Burn Wound Coverage

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Introduction: Split-thickness skin autografts are the gold-standard in providing permanent acute wound closure in major burns. Split-thickness dermal grafts harvested from the same donor site may provide an additional autologous option for permanent acute coverage and increase the number of potential autologous donor sites.

Methods: We performed 16 dermis grafts (DG) harvested from the skin of the back in 9 consecutive burn patients. A control donor site consisted of an area of adjacent back skin from which a standard split-thickness skin graft was harvested. The mean age was 63 years (range 23-79 years). The mean initial burn size was 24% TBSA (range 2-40% TBSA). The size of the 16 DG recipient wound beds ranged from 20 to 180cm(2), with mean and median sizes of 62 and 45cm(2), respectively.

Results: Dermis graft take was complete in 15/16 cases. All grafts recorded >90% epithelialisation by 4 weeks. There was no significant difference in dermis graft and control donor site healing times (p value 0.05).

Conclusions: Dermis grafts can provide an additional autologous option for permanent coverage in acute major burn wounds without increasing donor site size or morbidity.

166 . Amish Burn Wound (ABW) Ointment and Burdock Leaf Dressings: Assessments of Antimicrobial and Cytotoxic Activities

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Introduction: The Amish have developed a burn wound ointment which contains honey, lanolin, olive oil, wheat germ oil, marshmallow root, aloe vera gel, wormwood, comfrey root, white oak bark, lobelia inflata, glycerin, bees wax and myrrh. Though there are many anecdotal reports that the ointment covered with a boiled burdock leaf dressing promotes burn wound healing, little scientific testing of this treatment has occurred. The goal of this study was to evaluate in vitro some of the components of this treatment modality for antimicrobial and cytotoxic activities.

Methods: To test for sterility, ABW ointment was applied onto agar plates and incubated. Because of the semi-solid, lipid-based nature of the salve, it was not possible to test the at-use product in other standard tests. The vendor provided samples of burdock leaves and the dry ingredients of the ointment. Our Engineered Skin Laboratory prepared 5% aqueous extracts of the dry ingredients (DI) and of the burdock leaves (BL) that were lyophilized and stored for cytotoxicity and antimicrobial testing. The dry extracts were reconstituted in Hepes-buffered saline, sterile filtered, and tested separately on keratinocyte and fibroblast cell cultures for cytotoxicity (growth inhibition assay) and against a panel of microbes for antimicrobial activity (agar-well diffusion assay) at concentrations between 0.001%-0.1% wt/vol.

Results: No microbes grew in the sterility test of the at-use ABW ointment. Neither extracts (DI or BL) demonstrated any antimicrobial activity against any of 9 strains of organisms tested. The DI extract inhibited keratinocyte growth at the higher (0.1-0.03% wt/vol) concentrations, but was not toxic to fibroblast growth. The higher concentration of the burdock leaf extract was cytotoxic to both the keratinocytes and the fibroblasts.

Conclusions: Tests for microbial growth from the at-use preparation of the ABW ointment were negative. Extracts of the dried ingredients and of the burdock leaf did not demonstrate any antimicrobial activity. Both extracts inhibited the growth of skin cells in vitro at the higher concentrations tested.

Applicability of Research to Practice: These results suggest caution in the use of the ABW ointment and burdock leaf wound treatment. The burn surgeon's monitoring and oversight is appropriate particularly when there is more than a minimal risk of complications from the burn injury and/or the topical treatment(s) used.

167 . The Use of Microskin Grafts in the Treatment of Massive Burn Patients

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Introduction: The mortality of burn greater than 70% TBSA is high as the wound treatment is challenging due to the paucity of skin donor site. Surgical technique such as microskin grafting and artificial dermis have been used, but the outcome and limitations of these techniques have seldom been reported. The purpose of this paper is to show our clinical experience in the treatment of burn greater than 70% TBSA using microskin graftings.

Methods: From the year 2000 to 2009, there were 32 patients with burn greater than 70% TBSA admitted to our burn center. Cases were studied retrospectively using chart and photo review. Besides patient demographic data, the treatment course, complications and mortality were recorded and analyzed. The wound treatment protocol included total burn excision plus allografting or xenografting within 14 days after burn, followed by repeated microskin graftings. Curettage removal of overgrowth granulations between grafts was necessary during the course of treatment. The allograft or xenograft was used to promote reepithelialization between grafts.

Results: Eighteen of 32 patients survived after aggressive treatment, and the mortality rate was 56.3%. The male to female sex ratio was 3.5:1. The mean age was 38. Male has 52% mortality and all of them were caused by flame burn. Meanwhile, there was 71% mortality in the female and 80% of the burns were caused by flame. In the survival group, the average day of admission was 129.3, while that in the mortality group was 41.9. The mortality in burn greater than 90% is 75%. All the survivals were male. The longest day of admission was 1 year and 7 months. Scalp and foot were common donors. Sepsis and multiple organ failure were the main causes of death. Prolonged hospitalization was due to high failure rate in micrograftings and slow reepithelialization between grafts. Secondary scar reconstruction is common in the survivals, but the long term outcome of the microskin grafting was relatively satisfactory.

Conclusions: Although we have shown the use of microskin grafting technique in the treatment of burn greater than 70% TBSA resulting in a lower mortality of 56.3%, this technique are associated with problems such as micrograft survivals, ideal dressings after graftings and reepithelialization between grafts. Further investigations are necessary to improve and refine the technical method and skill.

Applicability of Research to Practice: This paper adds more scientific knowledge to the clinical use microskin grafting in extensive burn patients, and may be helpful in developing a more advanced microskin graft technique, besides the Meek technique.

168 . Triple Drug Therapy: A Novel Alternative in the Management of Burn Wounds of Indeterminate Depth

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Introduction: Successful wound healing is the goal in burn management and requires a multifaceted approach: debridement and infection control. We compared the efficacy of two topical wound care regimens in the healing of burns of indeterminate depth. The first regimen involves the use of 1% silver sulfadiazine cream (SSD). The second regimen is a triple therapy combining collagenase, for its proteolytic properties, mafenide acetate for its eschar penetration and broad antibacterial activity and bacitracin zinc as a petroleum-based vehicle.

Methods: A prospective randomized study was performed on 20 consecutive patients with burn of indeterminate depth, as assessed clinically. Group 1 received silver sulfadiazine (SSD) alone (n=10), applied twice daily. Group 2 received a mixture of bacitracin, collagenase and mafenide acetate (10%) in equal parts (BCM, n=10). Two independent observers assessed the time to wound healing as measured by the rate of complete epithelialization and also determined the need for surgical excision of the burn wounds. Pain during the dressing change was quantified utilizing the Visual Analogue Rating Scale (VAS).

Results: In Group 1, conversion to deeper burns occurred in 4 patients, thus requiring excision and grafting (p=0.025). The average time to healing was 15.6 days (range 7-38). In Group 2, all wounds healed without requiring surgery. The average time to healing was 8.6 days (range 5-14). The incidence of pain was slightly higher in the SSD group than the BCM group (3.6 vs 1.6; p=0.002).

Conclusions: Our data suggest that BCM therapy is a novel and effective strategy to the approach of burns of indeterminate depth. The synergistic effect of the triple agents may be beneficial to reduce wound healing time and possibly obviate the need for surgery.

Applicability of Research to Practice: Burns of indeterminate depth constitute a significant challenge to the burn surgeon. The triple drug therapy is a welcome adjunct to the surgeon's armamentarium.

169 . Early Surgery for ALL Pediatric Scalds: Developing a Dermal Preserving Surgical Algorithm for the Benefit of Patients and Health Care Providers

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Introduction: Many protocols have been described to deal with pediatric scald injuries including the conservative dressing of such wounds until granulations dictate the need for a skin graft, through to the application of biological dressings and indeed early skin grafting. We present a new treatment algorithm that is dynamic in the management of these injuries with early dermal preserving surgery, minimisation of donor site morbidity, optimised wound healing, better scar and with significant cost savings.

Methods: From January 2011 all pediatric scald patients admitted to our burn centre have been treated as per the following algorithm. Patients referred to the burns centre are assessed, the burn wound is cleaned of any debris and a silver dressing is applied. 24-48 hours post injury the child is taken to the operating room for one of three procedures:

- Superficial Dermal: Clean +/- hydrodebridement and application of a biological dressing
- Mid and Deep Dermal: Clean, Mechanical Dermabrasion, Application of non-cultured autologous skin cells and a biological dressing
- Full Thickness: Clean, Mechanical Dermabrasion and split thickness skin graft
- Burns with varying depths are treated with a combination of techniques
- Patients are discharged home following their surgery with regular review in the outpatient clinic with the aim of full wound closure within 2 weeks of their scald.

Results: Patients managed by the new treatment algorithm have benefitted from early access to specialist services and the provision of first aid and antimicrobial dressings. Debridement of the burn wound in the operating room allows the burn team to assess the wound easily and commence a definitive surgical treatment depending on the depth of the injury. Since commencing the algorithm there has been a significant reduction in the number of skin grafts required, with the overwhelming majority of wounds suitable for treatment with the non-cultured autologous cells. Other findings have included faster wound healing, less donor site morbidity, better functional and aesthetic scar outcomes and reduced analgesic and dressing costs with savings of upto 29% compared to delayed surgery.

Conclusions: Early treatment of all patients in the operating room following scald injury allows all wounds to be 'rescued' from progression and more often than not dermal preserving surgery with dermabrasion, non-cultured cells and biological dressings to be the definitive wound closure for these wounds. Early wound closure equates to a reduction in hypertrophic scars and reduced overall costs and should be a 'standard of care' afforded to all children with scalds.

170 . Evaluation of Enzymatic Debridement of Deeply Burned Hand: A Prospective Randomized, Controlled Study

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Introduction: The burned hand is a common and difficult to care-for entity. Due to the anatomy of the hand (important and delicate structures crowded in a small limited space without sub-dermal soft tissue), surgical debridement of the burned tissue is technically difficult and may cause considerable complications. A previous retrospective study have demonstrated the potential of an investigational new Bromelain extract (NB) as fast, effective and selective enzymatic debrider in reducing the secondary surgical debridement injury to the traumatized burned tissue and in maximizing spontaneous epithelialization. This study evaluates the implication of the selective enzymatic debrider in the special field of deep hand burns.

Methods: A prospective, randomized controlled Phase III trial. Comparing results of enzymatic debridement (NB) to control group of burned hands treated by Standard Of Care (SOC). Surgical intervention incidence, wound area surgically debrided and autografted, escharotomy incidence and time to wound closure were the endpoints assessed.

Results: 31 NB and 41 SOC treated hands in the phase III study. Statistically significant decreased surgery, tangential excision and grafting were found compared to the 41 SOC hands. No escharotomy was performed in the NB group (0/31=0%) vs. 4 hands (4/41=9.7%) that were escharotomized in the SOC arm.

Conclusions: Debridement of deep hand burns by an enzymatic agent can significantly decreased the need for excisional debridement and skin graft coverage by preservation of viable tissue allowing spontaneous healing by epithelialisation and releasing/preventing burn induced elevated tissue pressure.

Applicability of Research to Practice: Standard use of Enzymatic debridement for treatment of deeply burned may reduce the need for surgical intervention and allow for improved outcome.

171 . **The Severity of Post-Burn Hypertrophic Scars is Dependent on the Burn Mechanism**

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Introduction: Recent work has attributed differences in local and systemic inflammation to the type of burn sustained: scald or flame. Although flame burns were associated with higher systemic inflammation, scald burns produced greater inflammatory cell infiltration at the burn wound border. Because the development of post-burn hypertrophic scarring is an inflammatory event with initiation during the wound healing phase, we hypothesized that the burn mechanism influenced the severity of scarring. Here we tested two of the factors associated with severe scarring in a matched patient cohort.

Methods: Vancouver scar evaluations were conducted 6, 9, 12, and 24 months post-burn on patients with $\geq 40\%$ of TBSA burned. For this matched-cohort study, patients with scald burns ($n=29$) were matched to those with flame burns ($n=29$). Using logistic regression, propensity scores were calculated according to age, time of admission, %TBSA, 3rd degree %TBSA, Hispanic, and sex. Patients were blindly matched according to nearest propensity score. Logistic regression and matching were performed with the use of SAS software (v.9.1). Scar severity was compared at each time point. Student's t-test was used for continuous variables, Fisher's exact test was used for categorical variables, and two-way ANOVA with post-hoc Bonferroni correction was used to compare Vancouver scores. Significance was set at an alpha level of 0.05.

Results: As expected, the factor with the greatest impact on scar severity was month post burn ($p<0.01$); severity decreased over time. The type of burn was the second most important determinant of scarring severity, accounting for 3.22 % of the variance in the Vancouver Scores ($p<0.05$), with flame burns associated with more severe hypertrophic scarring.

Conclusions: Defects in healing, such as development of hypertrophic scarring, are highly dependent on the type of insult sustained. Here we demonstrate that flame-burns are associated with more severe scarring. Future studies will focus on determining whether the scars from each type of injury have similar characteristics.

Applicability of Research to Practice: Hypertrophic scarring occurs in up to 90% of severely burned patients; elucidation of the differences in scars based on their source may allow development of specific wound healing and anti-scarring strategies that are based on the type of burn injury.

172 . **Too Hot to Handle: An Examination of Hot Water Temperature and Water Heaters in a Sample of Urban Homes**

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Introduction: Tap water burns result in an estimated 1500 hospital admissions and 50 deaths in the United States annually. Children and older adults are at an increased risk for tap water scald burns. Hot tap water is associated with more deaths and hospitalizations in children than any other hot liquid. The Consumer Product Safety Commission recommends that water heater manufacturer's preset the temperature to 120 degrees. This study reports on knowledge and observed temperature of the hot water in 500 urban homes.

Methods: Data on knowledge and observed hot water temperature were recorded as part of a home observation in a randomized community trial which aimed to improve home safety behaviors. Homes were visited between 6-9 months after a visit from the fire department to check the status of home safety behaviors. Temperature of the hot water, type of water heater, size of hot water heater, date of manufacture and type of temperature gauge were recorded. Knowledge items and demographic data including number of people in the home were also recorded.

Results: Hot water was observed to be above the recommended 120 degrees in 43% of homes. A minority (30%) of respondents correctly reported the recommended temperature setting for water heaters. The majority of respondents (86%) had not tested the temperature of their hot water in the past 6-9 months. No difference was found between the presence of safe water temperature and the type (gas or electric) of water heater. A variety of types of hot water temperature gauges was observed in this sample. Additional analyses will examine the relationship between the type of temperature gauge and temperature of the water as well as the relationship between age of heater and water temperature. We also plan to explore the relationship between number of residents in the home, size of water heater and temperature of the hot water.

Conclusions: Our results suggest hot water remains at dangerously high temperatures in our urban sample despite national efforts to preset water heater to safe temperatures at the factory. Effort is needed to improve knowledge and testing behaviors in this sample.

Applicability of Research to Practice: Passive injury prevention countermeasures, like preset temperature settings on water heaters, are often considered foolproof. This research reminds safety advocates of the need to educate about continued scald burn prevention measures.

173 . Burn Prevention Education for Community Based Family Services Providers: A Pilot Initiative

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Introduction: In an effort to prevent pediatric burns, this burn center partnered with local family services agencies within its catchment area to implement a burn safety education program. Program delivery targeted case management staff who work with families at risk or enrolled into foster care placement. It is hypothesized that by providing burn safety education to the agency staff, the information would not only be shared with and used by (foster) parents but also integrated into the mandatory client home safety assessments, thereby decreasing potential burn hazards.

Methods: A burn/fire safety presentation and evaluation tool for case management staff were created. A program overview, educational materials and invitation for a presentation to staff and/or clientele were sent to all family preservation agencies listed in a municipal directory. An interactive burn prevention presentation was provided to accepting family services staff. At program conclusion, participants completed an anonymous, 8 question survey about injury prevention, need for / experiences with burn safety education, quality of presentation, and applicability to clinical practice.

Results: In 1/10, materials were sent to the 205 family services agencies. Of those, 9 agencies (4%) requested and received educational programming. During an 8 month period, 165 staff attended the presentations; 120 (71%) completed / returned the survey. Twenty-one and 22% percent retrospectively reported that smoke alarms and carbon monoxide detectors are always installed during home visits. Most (92%) reported learning new fire/burn safety information; 86% affirmed fire/burn safety is very important in comparison to other leading childhood health problems. A majority (92%) rated program content as excellent, and 93% intend to apply the information to clinical practice. Feedback supported the development and distribution of new burn prevention brochures distributed for staff and client education.

Conclusions: These pilot results support continued education of family service providers in this community. As a result of this effort, case workers are empowered not only to gain and share burn safety information and materials with their clients, but they can also improve their own professional practice and quality of their mandatory home safety assessments. Going forward, this burn center will continue to collaborate with local family services agencies in anticipation of increasing knowledge and decreasing burn injury incidence in this area.

174 . Burn Prevention Education for Parents of Low-Income Pre-Schoolers: Results of a Local Initiative

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Introduction: Previously published data indicate that the burn injuries disproportionately affect the youngest and most socio-economically disadvantaged throughout the US. To address these findings, a community based burn prevention education program targeting low-income families participating in local, federally subsidized, established pre-school programs was created and implemented. It was hypothesized that attendees would actively engage in this program to gain burn prevention education knowledge and reduce their families' risk of burn injury.

Methods: A family focused burn prevention program inclusive of a didactic presentation and educational aids was created and offered to 100 federally recognized preschool programs listed in an online directory and located within a single city between 6/09 - 2/11. Program content included an overview of risk factors for burn injury, local burn injury data, etiology of injury, prevention, and emergency preparedness for parents and families, was offered in several languages, delivered on-site, and scheduled to maximize parental participation. Anonymous follow-up surveys investigating program quality, knowledge gained, and parent feedback were distributed and collected at the conclusion of each encounter.

Results: Presentations were provided to 20 local preschools and content was delivered to 454 attendees (20% institutional response rate). Of these, 302 parents completed surveys and reported the following: 60% had not received burn safety information from a health care provider within the 5 years prior; 89% reported learning new information from the presentation; 96% reported that fire safety and burn prevention was very important to their family's health. A majority (95%) affirmed that they will apply this information to their family's daily routines, and 94% rated the quality of the information as excellent.

Conclusions: In an attempt to provide burn prevention education to those most at risk in this community, this burn center partnered with local Head Start programs to help reduce burn injuries among at risk preschoolers and their families. Based on the positive feedback obtained, this partnership will continue to expand this program to further reduce the risk of burns in this community.

175 . Full Thickness Burn Injury after Gel/Fuel Firepot Explosion: A Need for Public Awareness

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Introduction: Gel candles have been marketed to the public since 1998. The original gel candles were only 3oz in size, but due to the flames burning too high and becoming a fire risk, the candles were voluntarily recalled after 3 months at the recommendation of the Consumer Product Safety Commission (CPSC). In December 2009, a new gel fuel firepot was marketed. The gel fuel which is a clear liquid, can ignite and splatter when poured into a pot that is hot or still burning. Most of the gels consist of petroleum distillates which can be harmful if ingested or aspirated into the lungs. To date 68 incidents, including 37 serious burn injuries of which 2 were fatalities have been reported. Numerous respiratory complications have also been reported to the CPSC from the use of odorless and Citronella Gel Firepots.

Methods: A 46 year old female sustained severe burn injuries when her husband was lighting a ceramic gel fuel firepot at their son's high school graduation party. The gel pot exploded covering the victim's face arms and legs with burning gel. She was unable to extinguish the flames with 'stop, drop and roll' but a family member was able to put out the flames with a garden hose. Witnesses to the event stated that it looked like a napalm bomb had exploded as the gel continued to burn on the victim, grass and roof of the home. The victim was transported to a local hospital, intubated due to respiratory compromise and air transported to our Burn Center.

Results: She sustained 12%TBSA deep partial and full thickness burns to her face, hands and legs requiring multiple procedures for debridement and grafting.

Conclusions: Consumers need to be aware that even when products are labeled as 'safe' they need to follow all direction and precautions related to fire safety and fire prevention. The potential for serious burns and respiratory complications is real. In June 2011 the CPSC issued a warning to consumers to take all necessary precautions and not add gel fuel to warm or burning pots. In September 2011 9 major retailers voluntarily recalled the products. As an organization we need to continue to promote fire prevention and fire safety.

Applicability of Research to Practice: Increase public awareness of the hazards of gel fuels and firepots.

176 . Instant Noodles: A Significant Cause of Scald Burn Morbidity in All Populations

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Introduction: Observational analysis of burn consultations and admissions revealed a concerning frequency of scald burn injuries secondary to instant noodle preparation and consumption. A review of the literature reveals a paucity of literature with small sample sizes limited to the pediatric population and studies of container engineering as causes of these burns. No literature to date has included the adult population. Further, analyses of treatment and short term outcomes have been neglected. With these deficiencies in mind, we sought to review our experience with burns secondary to instant noodles.

Methods: All new patient encounters at the burn center from January 1 2007 until May 15 2011 were reviewed for injuries occurring secondary to instant noodles. Both pre-packaged and noodles requiring preparation with hot water were included. Patient demographics, burn characteristics, treatment, short term outcomes including length of stay, number of operative interventions, and complications were analyzed to determine central tendencies.

Results: 852 total patients were seen as outpatients and 460 were admitted for scald burns of all etiologies. Of these, 121 patients (14%) were seen for burns secondary to instant noodles; 63 males and 58 females. Race distribution was 70 African American, 34 were Caucasian, and 14 Hispanic. 48 patients were over the age of 4 (group 1), and 73 were under the age of 4 (group 2). Total body surface area (TBSA) for the entire population was 1.91 partial thicknesses and 0.50 full thickness. TBSA was 2.34 in group 1 and 1.64 in group 2 ($p=0.04$). The most commonly burned areas in group 2 were chest ($n=32$) and extremity ($n=31$) and extremity ($n=43$) in group 1. No patients required additional specialty consultations. 2 patients in group 2 required operative intervention, both requiring 1 trip to the operating room. 7 patients in group 1 required operative intervention, with an average of 2 trips to the operating room. Length of stay for operative patients in group 1 and 2 were 3.5 and 6 days respectively. Average length of stay for all patients in group 2 was 5.13 days.

Conclusions: Burns due to mishaps with instant noodle preparation and consumption are the cause of significant morbidity in all age groups. Pediatric noodle burns often necessitate significant time for treatment as inpatients, despite frequently being managed conservatively. The non-pediatric population appears to have larger TBSA when burned and require more frequent operative intervention. Likely, the opportunity cost of burns secondary to instant noodles is not insignificant and deserves public education and container re-engineering in order to minimize future morbidity.

Applicability of Research to Practice: This research gives our burn center an appreciation for the frequency and severity of this etiology of burns.

177 . **Juvenile Firesetters: Are We Contributing to the Problem?**

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Introduction: Each year thousands of children are burned while playing with fire. The Juvenile Firesetters program is designed to educate and thereby prevent children with a history of playing with fire from further injury. Understanding the epidemiology of juvenile firesetters may assist in preventing the initial event. The purpose of this study was to identify the demographic and situational factors contributing to firesetting activity.

Methods: This study analyzed a regional juvenile firesetters database for demographics (age, gender, ethnicity, residence), details of the firesetting incident (location, method of ignition, items ignited), and distance from firesetters home to the fire scene. Deidentified data were entered into a secure electronic database for analysis.

Results: A total of 898 firesetter incidents were analyzed. Firesetter mean age was 12.4 ± 0.11 (range 2-21 years), and 81% were male. The vast majority were Caucasian (55.0%), followed by Hispanic (12.5%), African American (9.5%), Asian (4.2%), and other or unknown (9.2%). All were flame incidents with the most frequent inciting instrument being lighters (47.3%), matches (18.1%), fireworks (10.1%), gasoline (9.5%), aerosol can (4.1%). Additional methods included Molotov cocktail, flares, chemicals, and bombs. Fires were set in the town the firesetter resided in 89.3% of the cases; the distance from the firesetters' home to the fire scene for the remaining 10.7% was 14.7 ± 2.5 miles. Frequent locations of firesetting included school bathrooms and grass fields using toilet paper.

Conclusions: Juvenile firesetters are most frequently teens who set fires near their place of residence. The majority of fires are started with lighters or matches readily available in the home or fireworks, sold in convenience stores. Prevention of these incidents may be best accomplished by educating parents who smoke to control lighter access or limiting lighter sales to adults.

Applicability of Research to Practice: More burn prevention education is evident.

178 . **Napalm for Sale in the Garden Aisle?**

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Introduction: The fire pot label reads "The Safe Pourable Gel". The patients whose lives have been affected describe it as "napalm". The relatively new, decorative fire pots, which are manufactured by Napa Home and Garden Inc. Of Duluth, GA., are responsible for several burn injuries across the United States. The alcohol-based fuel is poured into a gel in a ceramic decorative pot. When lit, the jelly-like liquid fuel burns blue or clear, with almost no smoke, making it difficult to determine whether or not there is a flame. The fire pots reportedly explode in a flash, the gel substance sticks to skin and clothing and the flame does not extinguish even with stop-drop-rock n roll.

Methods: At our burn center, from May - July 2011, six patients were treated for burn injuries from fire pot accidents. One patient required skin grafting to bilateral lower extremities. Due to the perceived extreme danger associated with the product, The Consumer Product Safety Commission issued a recall of the Napa Home and Garden Firepots in June 2011.

Results: This presentation will describe our experience treating patients with fire pot injuries. We will also discuss three immediate city-wide media coverage that helped facilitate prevention efforts and increase community awareness regarding the significant danger associated with the product. As a result of our local prevention efforts, the fire pots were recalled from all local vendors.

Conclusions: Our burn team was faced with a new etiology of burn injury this past spring. We immediately notified our hospital's media relations contact and initiated a media campaign about the dangers of these firepots. Our success with the recall was best seen in the absence of any other injuries this summer.

Applicability of Research to Practice: Prevention works. This problem also highlights the benefits of a close relationship with media relations at your institution.

179 . Safe Signals: A Burn Education and Prevention Program for High Functioning Young Adults with ASD

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Introduction: One in 110 children and one in 70 boys are diagnosed with autism spectrum disorder. Young adults that are higher functioning on the ASD spectrum have challenges as they seek increasing independence. Parents and caregivers recognize that they have persistent core deficits that require specific education and life skills interventions. One particular challenge often involves a limited understanding of basic safety skills and self-protection from everyday home tasks that might lead to accidental burn injury. Few opportunities for such education targeting this audience are available. We devised a bilingual safety and burn prevention program specifically targeting these young adults.

Methods: The Safe Signals™ project, a video role modeling skills kit for parents and their ASD young adult, was developed. The kit includes a video, Safe Signals™ stickers, and a workbook for parents. The program focuses on key avoidance behaviors for burns and scalds and promotes general home and community safety.

Results: All materials were developed and translated into Spanish. To reach the primary beneficiaries, the program will be instituted through the Aspirations Program, a program designed to give young adults (ages 18-30) years with ASD an opportunity to discuss their own vocational and social experiences and be guided in ways to improve those skills. This program will also be available through Autism Speaks.

Conclusions: This program helps close the educational gap for safety skills in both English and Spanish speaking audiences. Safe Signals™ is a tool kit for parents, emergency responders, and life safety and burn educators to teach burn prevention and fire safety skills to young adults on the autism disorder spectrum.

Applicability of Research to Practice: Prevention of burn injuries in a high risk population.

180 . A Standard, Institution-Wide Approach to Central Lines Facilitates a Low Burn CLBSI Rate

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Introduction: Central Line Associated Blood Stream Infections, (CLSBIs) are associated with significant morbidity and mortality. Many burn units employ unit-specific practices in an attempt to address the issue. We report a six-year experience with a hospital-wide standardized approach to line placement and site care which appears to produce an exemplary CLSBI rate in a combined trauma and burn unit while avoiding separate line care protocols.

Methods: After obtaining IRB approval, we reviewed our trauma registry for the period 2005-2011 and obtained records for all trauma and burn patients who required inpatient care and central venous (CV) access during the study period. Pertinent data including demographics, ISS, Mortality, Length of Stay and Complications, were abstracted. CLBSIs were defined using CDC National Healthcare Safety Network (NHSN) criteria. Data were compared using Chi Square, two-tailed t, one-way anova or Cox regression analysis as appropriate. Line placement and management is standardized at our institution and is supervised both at CV insertions and at ongoing dressing changes, by a dedicated vascular access nursing service. We employ antibiotic-coated catheters as well as chlorhexidine-augmented occlusive dressings where possible. No substantive differences in our practice over the study period or between burn and non-burned patients were identified.

Results: Of a total 718 patients admitted to the burn and trauma service during the study requiring central venous catheters, 100 were admitted as the result of burn injury. Demographics were comparable though the non-burn patients were somewhat older. A total of 2003 burn-line-days and 7917 non-burn-line-days were analyzed. Four burn and six non-burn CLBSIs were identified. All 10 patients with CLSBI survived to discharge. Our CLBSI rates 1.99/1000(burns) and 0.758/1000 (trauma) were substantially lower than median rates for similar institutions. (2009 NHSN CLBSI 50th percentiles 3.8/1000 and 1.7/1000 respectively)

	Burn	Trauma	
Age	38+20	44+23	p=.02
% Male	74	70	ns
ISS	23+17	26+13	ns
%surviving	74	78	ns
CLSBI/1000	1.99	0.76	Rel. risk 2.6

Conclusions: Our multidisciplinary approach to CV catheter insertion and management results in a low rate of CLSBI. While still more common in burns, our rate remains substantially lower than averages reported in comparable institutions.

Applicability of Research to Practice: Use of our standardized hospital-wide line care algorithm produces infrequent burn CLBSIs.

181 . Trimethoprim-Induced Hyperkalemia (HK) in Burn Admissions Treated with Intravenous or Oral Trimethoprim Sulfamethoxazole (T/S) for Infections - Nature or Nurture?

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Introduction: Drug-induced adverse effects are expected findings with the use of antibiotics. In addition to rashes, T/S causes HK in 10 to 20% of patients (Pts). An important consideration is whether T/S pharmacokinetic changes in burns further impact serum potassium (SK).

Methods: This IRB approved retrospective study identified 224 T/S treated Pts. T/S dose adjustment is recommended at creatinine clearance (CLCR) ≤ 30 mL/min. Conservatively we excluded 24 of the 224 Pts with CLCR < 50 mL/min. Two definitions for HK were used: 1) a ≥ 1 mEq/L rise from the pre-treatment (PreK) SK and 2) "marked" HK as a SK of ≥ 5.5 mEq/L. The PreK and a SK during T/S therapy (TxK) were collected. Demographic data included creatinine clearance (CLCR), total body surface area burn (TBSA), ISS, burn probability survival score, ventilator days (Vent days), length of stay (LOS), mg/kg of trimethoprim (D TMP) and survival. Data was analyzed using students' t-test and X2.

Results: Between 2005 and 2010, 200 Pts with *Stenotrophomonas maltophilia* or methicillin resistant *Staphylococcus aureus* and CLCR > 50 mL/min received T/S. Of the 200 Pts, 34 Pts (16.8%) had SK elevation by definition 1 and 13 (6%) had marked SK by definition 2 (> 5.5 mEq/L) requiring drug discontinuation. NHK was seen in 166 Pts (82%) with PreK 3.9 ± 0.4 and TxK 4.4 ± 0.5 mEq/L. HK was seen in 34 Pts (15.5%) by definition 1 with Pre K 4.0 ± 0.5 and TxK 5.3 ± 0.6 mEq/L. Survival for NHK Pts was 97% and 94% for HK Pts. Twelve published risk factors for T/S caused HK are described but only two risk factors; hypertension and intubation was significantly different for HK Pts. T-test comparison of the above parameters was not statistically significant except for TBSA, LOS and D TMP ($P < 0.05$) (see below). Age < 30 years was 25.9% for NHK versus 21% for the HK Pts. TBSA $> 20\%$ was 15% for NHK and 35% for HK Pts.

Conclusions: HK by definition 1 was 15.5% in burn Pts and serious HK was 6% by definition 2. This was consistent with the reported 10 - 20% incidence in non-burn Pts. This data would suggest comparable risk of HK among burn Pts. Routine SK monitoring following T/S initiation and prior to discharge should be done to screen for HK.

Applicability of Research to Practice: T/S is frequently used for discharged Pts with small burns. We saw sufficient HK to warrant monitoring even with < 10 mg/kg trimethoprim doses.

Demographic Data for T/S Patients

	Age (years)	CLCR (mL/min)	TBSA (percent)	Vent Days	LOS (days)	D TMP (mg/kg/day)
NHK Pts						
Median	46	95	6	11	11	4.0
I-Q 25-75 range	30 to 57	71 to 123	2 to 15	6.3 to 24.5	6 to 24	3.3 to 4.8
HK Pts						
Median	51	96	10	20	21	4.6
I-Q 25-75 range	33 to 63	58 to 132	2 to 25.2	6 to 66	15 to 62.5	3.8 to 5.7

182 . Diagnosing Ventilator-Associated Pneumonia in Burn Patients: Endotracheal Aspirates Versus Bronchoalveolar Lavage

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Introduction: Ventilator-associated pneumonia (VAP) is associated with increased mortality, ventilator days, intensive care unit days and length of stay, especially in the thermal burn patient. In addition to poorer patient outcomes it is estimated that VAP increases the cost of care. The prevention of VAP is a high priority within healthcare, yet there is no universal standard for definitive diagnosis. Criteria typically include clinical suspicion, radiography and microbiological testing. Methodology for the collection of specimens differs between institution and patient populations and there is controversy regarding the utility of certain approaches. The purpose of this study was to correlate results of endotracheal tube swabs (ETT), endotracheal aspirates (TA) and bronchoalveolar lavage (BAL) in burn patients with suspected VAP.

Methods: This was a non-interventional prospective study of 22 burn patients with suspected VAP. Respiratory specimens via ETT, TA, and BAL were collected. Basic demographics, clinical signs and symptoms and culture results were collected and descriptive statistics were performed.

Results: Concurrent cultures were performed on the 22 patients with suspected VAP. Means were calculated for age (39.73 years, ± 16.56), days on vent (20.73 , ± 20.73), temperature (38.53 C ± 0.92), total body surface area burn (42% , $\pm 24\%$) and leukocytosis (13.23 , ± 6.59). Of the 22 patients, 54.5% were male and 45.5% female. Clinical parameters included increased sputum (86.4%) and infiltrates (68.2%) on chest radiograph. Culture results were compared between the three groups. The three cultures identified the same organisms only 27% of the time. BAL and ETT results correlated in 59% of the population and BAL and TA correlated in 68% of the patients.

Conclusions: TA and ETT culture do not accurately predict causative micro-organism in burn patients with VAP. Diagnosis of VAP in this patient population must be suspected on clinical grounds and confirmed with bronchoscopy and BAL.

Applicability of Research to Practice: Diagnosis of VAP in burn patients remains difficult. This study demonstrates the utility of BAL in diagnosing VAP.

183 . The Impact of Reusable Isolation Gowns on Infection Rates in a Burn Unit: Clean, or Contraindicated?

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Introduction: Contact precautions are part of the "Prevention Bundle" and have shown to lessen the spread of nosocomial infections among Burn Intensive Care Unit patients. The relationship between nosocomial infection rates and protective gown type is unknown. Single-use plastic gowns are the gold-standard for treating these patients, but create excessive waste. The purpose of this project was to describe the effect of switching from single use plastic gowns to reusable cloth gowns on infection rates, cost, staff satisfaction, and (department) waste.

Methods: Data were gathered from a large burn center through center-wide shifts from optional cloth or plastic (through 1/09), to only plastic (through 2/09), to only cloth gowns (05/2010). Other interventions including patient isolation began at the time of the conversion to plastic gowns. A survey was administered to 47 staff to assess reasons for gown type preference. The relationship between gown type and any infection, along with infection rates, were assessed. Cost analysis considered purchase, care and disposal of both gown types. Impact on total inpatient cost was also assessed.

Results: Prior to the shift to plastic gowns, the overall infection rate was 10.7 per 1000 patient days. The infection rate since the shift to plastic gowns has decreased to 0.7 per 1000 patient days, and has not increased since the return to cloth gowns ($P = 0.05$ for shift from plastic back to cloth). Among survey participants, 31/47 reported that plastic gowns were too hot, and 37/41 identified the environment as a factor in their gown type preference. Reusable cloth gowns were cleaned using a recycled water system creating little environmental impact. This system recycled 7.6 million gallons of water across the facility, and saved 5.6 thousand therms of natural gas per year.

Conclusions: Overall reusable cloth gowns make a positive impact on the environment without increasing infection rates, costs or difficulty of use.

Applicability of Research to Practice: Reusable isolation gowns are a cost-effective and environmentally friendly option, and do not risk infection risk to patients.

184 . Impact of Multiple Drug Resistant (MDR) *Acinetobacter baumannii* (AB) on Changes in Antibiotic Susceptibility of *Pseudomonas aeruginosa* (PA) in a Burn Treatment Center

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Introduction: The transmission of resistance genes from one MDR organism to a potentially more virulent organism is worrisome. Following eradication of 2 clones of MDR AB in 2007, there was concern that MDR genes were transferred to PA. PA isolates from admissions to our burn center between 1999 and 2010 were reviewed with this focus.

Methods: This IRB approved retrospective study identified 233 patients with at least one isolate of PA during their admission. The year, type of culture, number of cultures, antimicrobial agents selected, duration of antimicrobial therapy, changes in antimicrobial therapy due to emerging resistance, and exposure to MDR AB were recorded. Data were stratified by age, percent total body surface area involvement (TBSA), creatinine clearance, and survival status. Data were analyzed using students' t-test, ANOVA and nonparametric tests with X-square analysis for categorical data.

Results: PA isolates from 1999 through 2010 were reviewed. Data were incomplete for 13 patients leaving 230 evaluable patients (96%). Mean \pm standard deviation data for age (49.3 ± 20 years) and TBSA ($25.3 \pm 23.0\%$). Survival status was significant for advanced age ($T = 2.83$; $P < 0.05$) and TBSA ($T = 2.087$; $p < 0.05$). AB and PA caused co-infections in 65 patients (20%). No significant difference in patient demographics, ISS score, burn survival probability, ventilator support days, duration of first antimicrobial therapy, days prior to isolation of PA or length of stay (LOS) was noted. Survival for PA patients was 83.9% and for PA plus AB 89.2%. Number of positive cultures for sputum, central catheters, blood, urine, wounds and total cultures were not statistically different between groups indicating comparability. Analysis demonstrated changes in PA susceptibility in 145 of 1672 (8.6%) isolates from enrolled patients. The AB plus PA subset had 37 of 65 patients with 683 isolates with susceptibility pattern like the 2 clones of AB representing 40% of all PA isolates.

Conclusions: For nearly identical patient populations, the number of PA plus AB patients remained less than the PA only infected patients each year. This indicated that PA might be more virulent or more capable of colonizing burn patients than AB. Resistance genes from AB demonstrated temporary residence in 8.7% of PA plus AB patients but this was not sustained following the 2007 eradication of AB.

Applicability of Research to Practice: Resistance gene transfer from one bacterial species to another must be assessed particularly for MDR organisms associated with sepsis in the burn center.

185 . Decreasing Infection Rates: Is it Ever Enough?

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Introduction: Hospitals are under a lot of pressure to improve infection control practices with the threat of non payment for preventable infections. Web sites display hospital infection rates so potential patients and their families can choose which hospital they go to, not understanding the challenge of Burn Centers and their patient populations. Burn patients are at particular risk due to skin loss and with potentially long lengths of stay in the hospital.

Methods: Reporting of data at our hospital was limited in 2005 due to a small Infection Control department and change of staff. Resources were reprioritized to build a robust Infection Control department and work 1 on 1 with Burn Center and other department staff. Our Infection Control program is constantly under the microscope.

Results: In 2005, surveillance cultures for acinetobacter were obtained on admission and every 7 days. In 2006, MRSA was added to these cultures. In 2007, the ICUs started using chlorhexadine 2% wipes on intact skin once a day. We used cloth gowns whenever a patient was in isolation for an identified infection. In 2008, we started isolating all MRSA positive patients and switched to plastic gowns for isolation. Alcohol hand gel dispensers were liberalized throughout the units. Hand wash audits were instituted on every unit. In 2009, plastic bath basins were cultured as they were also being used for storage of patient supplies in rooms and were found to be contaminated. We then switched to steel bath basins that are cleaned daily. In 2010, we started to put all patients with wounds over 15%TBSA in presumptive isolation as well as anyone with a history of MRSA. We switched back to cloth gowns due to the high volume of use. In 2011 we switched to cleaning wounds with chlorhexadine 4% soap and water baths and eliminated the wipes and prepackaged wipes. Every 2 years or more often if we see a change in our MRSA rates, we perform nasal swabs on staff. We also review all our equipment including using scissors one time only.

Conclusions: MRSA rates have continued to drop since really focusing on improving our comprehensive infection control practices from 10.7/1000 patient days in 2007 to our current rate of 0.7/1000 patient days in 2011. We don't believe we can eliminate all cases MRSA in our burn population but we have proven that we don't have to think of it as the norm anymore.

Applicability of Research to Practice: Infection Control continues to move forward and working as a team provides the data and means to keep making changes for the care of our patients.

186 . Case Study: A Rare Fungal Infection in Tornado Victims

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Introduction: A small city of 45,504 was declared a national disaster site when it was hit by an EF5 tornado on May 22, 2011. The National Weather Service reported it to be the deadliest tornado since 1950, killing 160 people and injuring hundreds more. This case report reviews three patients presenting with multiple traumatic injuries admitted to a Level 1 Trauma and Burn Center. All three patients developed an aggressive fungal infection, Zygomycosis (mucormycosis). Zygomycosis is a rare, rapid spreading deep fungal infection which is often life threatening. The fungus is typically found in soil and decaying wood which embedded in victims hit by debris. Mucormycosis fungal infections have been reported with natural disasters but not from a tornado.

Methods: Patient #1 was a 50 y/o female with a past medical history of diabetes mellitus. Initial site of fungal infection was a 10cm scalp laceration. Tissue surrounding scalp laceration became progressively ecchymotic extending down over eyes and nose which then became necrotic with exposed cranium becoming necrotic as well. Within 24 hours of surgical excision, wounds again appeared dusky purple to black with fuzzy white patches of fungus visible. Treatment included aggressive surgical excision, administration of IV and topical antifungal medications. Despite efforts, patient expired. Patient #2 was a 48y/o male, noted to have drainage from the lower left flank wound with some evidence of necrotic tissue present and cellulitis of multiple lacerations. Wound cultures confirmed a Zygomycosis infection. Treatment included surgical debridement and the addition of antifungal therapy. Patient improved with treatment. Patient #3 was a 17 y/o male, tunneling wound to lower extremity was slow to progress. Patient developed cellulitis accompanied with leukocytosis related to pseudomonas and a fungal infection. Treatment included surgical excision; antibiotics and antifungals were administered. Patient went on to recover from his injuries.

Results: This is the first time Zygomycosis infections have been documented as a result of injuries sustained during a tornado. The Center for Disease Control released an extensive evaluation of the fungal infections associated with victims injured in this tornado. A total of 18 suspected and 13 confirmed cases of cutaneous mucormycosis were identified. Ten patients required admission to the ICU and 5 died. This Trauma and Burn Center received 3 patients with the identified fungal infection. One patient expired and two survived to be discharged home.

Conclusions: Although a rare entity, early diagnosis and aggressive surgical excision combined with both topical and IV antifungal therapies are necessary to treat these fungal infections.

Applicability of Research to Practice: These 3 patients were admitted to the Burn Center for complicated burn and wound care.

187 . Eradication of *Acinetobacter baumannii* Outbreak at a Burn Centre

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Introduction: Multidrug-resistant *Acinetobacter* outbreaks are associated with enhanced mortality and length of stay, especially in burn units. From 1996 onwards, *Acinetobacter* was isolated from our burn unit at an increasing rate. Several eradication attempts were unsuccessful. In 2000, we had multiresistant *Acinetobacter baumannii* in 18 % of all our burn patients. Active measures were taken to control the outbreak. The aim of this study is to present the results of these measures.

Methods: The wound treatment protocols were changed from using moist dressings with low concentration of chlorhexidine to dryer choices. Positive bacterial cultures from the shower room and a shower cream bottle resulted in changes in showering practices.

Results: The number of *Acinetobacter* colonisation and infections decreased substantially. The number of *Acinetobacter* bacteraemia cases per year fell from six to one in the immediate post-intervention period. Multiresistant strains of *Acinetobacter* disappeared. This has remained since until the end of the study period 2009 with only sporadic multiresistant *Acinetobacter baumannii* cases.

Conclusions: Abandoning occlusive wet dressings and revising the shower policy had the most effective impact on decreasing the incidence of *Acinetobacter* colonisation. Thereafter, *Acinetobacter* strains detected have been sensitive to most beta-lactams.

Applicability of Research to Practice: Direct influence on shower practices and dressing materials.

188 . Effect of Burn Bandages on Hand Goniometry Measurements

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Introduction: Accurate assessment of joint angles by goniometry is important to document burn patient outcomes. In the burn literature, goniometry has been reported reliable in patients with burns. However, these studies were not performed on patients when bandages covered joints. The purpose of this investigation was to determine the effect bandages had on the accuracy of measuring joint angles of the hand with the notion that burn bandages caused less accurate measurements, i.e. angles were measured as less acute.

Methods: Bilateral manikin hands with articulating fingers had various fingers and joints positioned at fixed angles. Phalangeal joints of the right thumb, middle and small fingers and left index and ring fingers were used. Joint angles were secured in place by splinting material and verified by a certified hand therapist. The fingers and hands were then bandaged with 8-ply gauze in a typical burn wound dressing fashion. The hands were stabilized on a table and 12 burn rehabilitation staff measured each bandaged joint twice. Measurements were performed over the dorsal surface of the finger using a standard, flat-metal finger goniometer. The goniometer had its angle values masked with tape to prevent staff member recall of previous measurements. After each measurement, the goniometer was given to an independent therapist who determined the joint angle using a sized protractor. Finger joint measurements were performed either sequentially or in a repeated manner. Descriptive statistics, univariate analysis and Wilcoxon Signed Rank Test were performed comparing actual joint angles to the measured joint angles and correlated to clinician years of experience.

Results: A total of 336 measurements were recorded on 14 finger joints by rehabilitation staff with an average 8.2 years total rehabilitation experience and 3.5 years in burns. Nine of the 14 joints (64%) were measured at less than the established joint angle and 5 at a greater angle ($p < 0.0001$). The overall joint measurement average differences were $-1.77^\circ + 7.2^\circ$. The extent and range of discrepancy varied between joints measured. Rehabilitation experience (> 6.5 years) had a significant impact on goniometry accuracy ($p = 0.03$). Joint measurement order had no significant effect ($p = 0.14$).

Conclusions: Burn bandages had an effect on hand joint goniometric measurement using this in vitro set-up; however, the effect was less than anticipated as the margin of error fell within acceptable clinical norms. In this burn center, more experienced clinicians demonstrated better goniometry accuracy. A similar project is suggested for other burn centers for competency.

Applicability of Research to Practice: Burn rehabilitation staff should be made aware of possible goniometric measurement variations when burn patients have bandages covering joints.

189 . Collaborative Approach in the Development and Implementation of Educational Programs on Positioning and Splinting for Patient Optimal Functional Outcomes

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Introduction: Two important procedures --patient positioning and splinting to prevent or reduce burn scar contractures-- are shared by therapists and nurses. Although therapists develop and implement detailed plans, it is essential that nursing staff understand and carry out these plans to ensure optimal functional outcomes. The purpose of this study was to compare the perceptions of the nursing staff and therapists regarding nursing knowledge of positioning and splinting strategies.

Methods: An initial, anonymous 8 item Likert-type survey was distributed to all the nursing and therapy staff. The survey required the nurses to self-assess their perceptions regarding positioning and splinting of burn patients. The identical survey was given to the therapy staff to obtain their views concerning nursing staff's understanding and use of positioning and splinting. The responses were compared to determine areas of discrepancy.

Results: A total of 33 nursing and 10 therapy surveys were collected. Respondents of the nursing survey were predominantly female (76%) staff RNs (70%) with the majority (40%) having 0 - 2 years of burn experience. There were equal numbers of male/female therapy respondents. Therapists were distributed among PT (60%) and OT (40%) with the majority (50%) having 11-15 years of burn experience. When compared to therapist's responses, nursing staff rated their familiarity higher in 7 of the 8 questions; 'Splints are essential' ($p=0.0126$), 'Ability to place splints' ($p=0.0009$), 'Reason for use of splints' ($p<0.0001$), 'Assessing for pressure areas' ($p=0.0014$), 'Assessing for breakdown' ($p=0.0096$), 'Other splinting complications' ($p<0.0001$) and 'Ability to locate splint schedules' ($p=0.0264$). There was no significant difference when asked 'Do you know whom to contact with questions?' Additionally 97% of nurses and 100% of therapists agreed more education was needed.

Conclusions: Data collected show there is discrepancy between nursing and therapy perception regarding nursing staff's familiarity of splinting and positioning. This may be explained by the varying degrees of burn care experience. The survey demonstrates the need for a collaborative approach in the development and implementation of an educational program on positioning and splinting. Educational programs incorporating videos, reference manuals, computerized teaching modules, hands-on inservices, and bedside information will all be developed to assist in bridging this gap.

Applicability of Research to Practice: This survey will be used to develop an in-house educational program to address the staff needs.

190 . A Novel Gaming System for Children with Upper Extremity Burn

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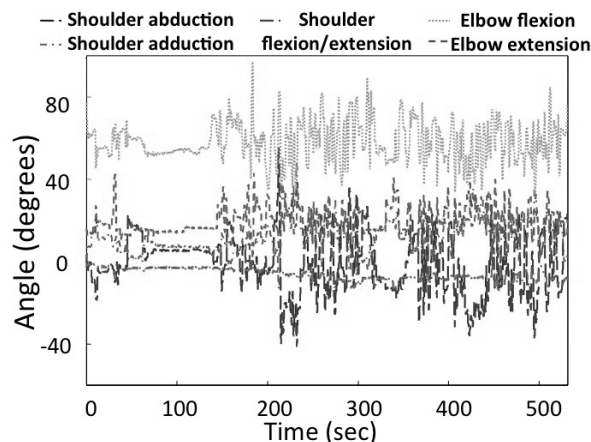
Introduction: Burn contractures are common, difficult to treat and negatively impact quality of life and function. There is a clinical need for novel treatment approaches to this important problem. Gaming and virtual reality have been explored in burn wound care management, but there is a paucity of data regarding its use in rehabilitation interventions.

Methods: This is a pilot feasibility study examining the use of an exoskeleton robotic arm in conjunction with an interactive gaming system for children with burn contractures. Inclusion criteria include children with upper extremity burn contractures aged 10-18 years. Demographic data, patient-reported standardized functional measures, upper extremity range of motion and 10-point pain scale are collected before testing. Five interactive computer games were tested. Dynamic shoulder and elbow movements were recorded by the gaming system to determine range of motion activity over time during game playing. The children rated each game on measures of enjoyment, difficulty, and comfort on a 10-point scale.

Results: Two subjects completed the pilot. Participants had no open wounds, burn injuries occurred greater than 1 year ago, total body surface area burned was 40 and 70%, and range of motion deficits were greatest in shoulder abduction and elbow extension. Gaming sessions did not cause pain. Games exhibited mean ratings of 8.6/10 for enjoyment, 4/10 for difficulty, and 10/10 for comfort. Each of the games demonstrated active range of motion at the shoulder and elbow (Figure 1).

Conclusions: This novel interactive gaming system exhibits feasibility for upper extremity range of motion therapy. Future analysis is needed to evaluate the efficacy of this intervention in treating upper extremity burn contractures.

Applicability of Research to Practice: This novel interactive gaming system is a potential therapeutic intervention for burn contractures that combines rehabilitation exercises with dynamic quantitative measurements.



191 . **A Comparison of Three 7th Generation Video Game Platforms During Burn Rehabilitation**

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Introduction: As research literature supports the use of Nintendo® Wii™ in various rehabilitative settings, the availability of new video game technologies warrants an assessment of the potential use during burn rehabilitation. This is a comparative, pilot evaluation of experienced occupational and physical therapists' (OTs/PTs) perspectives on the applicability of Wii, Microsoft Xbox 360® Kinect™, and Sony PlayStation 3® Move™ to burn therapy practices. Consensus and feedback was used to map preliminary clinical guidelines for the three systems at this burn center.

Methods: The burn center's OTs/PTs completed an orientation and subsequent competency checklist for each video game system. Then over a 3-month period, OTs/PTs clinically utilized the systems each with similar sports-software. OTs/PTs were asked to complete a confidential internet survey that assessed therapeutic benefits and applications of each system. The survey consisted of queries with a 5-point Likert scale reflecting levels of agreement. Qualitative data was retrieved through 1:1 interviews yielding primary themes translated to guidelines.

Results: Eight burn therapists (4 OTs/4 PTs; mean 6 ± 5.5 years of burn experience) reported incorporating the video game systems into the following average total number of treatment sessions since orientation: Wii = 34, Kinect = 47, and Move = 25. Areas of survey consensus (Table 1) were supported by overriding themes from interviews. Based on simplicity of operation and as an affordable commonplace console, therapists agreed that Wii is appropriate for pediatric patients and a feasible supplement to home exercise programs upon discharge. The whole-body movements required to navigate with Kinect contribute to improved endurance, function, and overall participation during treatment. Given Kinect's camera-based motion control precluding the use of hand-held controllers, the potential reductions in the spread of infection in a high-risk patient population was also highlighted. Therapists suggested Move's superior graphics and motion calibration provide optimal immersive properties for adjunctive pain management, improved coordination, and range of motion with limited compensations.

Conclusions: The experiences and perspectives of burn therapists that use current video games platforms will help direct clinical use and future research on their efficacy as treatment modalities.

Applicability of Research to Practice: Therapy guidelines for the appropriate selection of video game systems.

Table 1.
OTs/PTs' (n = 8) agreement on benefits and applications of each system, % (n).

Therapeutic Benefits and Applications	Wii (Haptic-based sensory interface)	Kinect (Camera-based motion interface)	Move (Haptic and camera hybrid interface)
↑ Range of motion	50 (4)	88 (7)	100 (8)
↓ Pain	75 (6)	88 (7)	100 (8)
↑ Balance	63 (5)	88 (7)	88 (7)
↑ Coordination	63 (5)	88 (7)	100 (8)
↑ Strength	13 (1)	25 (2)	25 (2)
↑ Endurance	63 (5)	100 (8)	88 (7)
↑ Function	75 (6)	100 (8)	88 (7)
↑ Participation	75 (6)	100 (8)	88 (7)
↑ Self-esteem	38 (3)	88 (7)	88 (7)
Pediatrics	100 (8)	75 (6)	50 (4)
Adults	75 (6)	88 (7)	88 (7)
Easy operation	88 (7)	75 (6)	50 (4)
Safety (Infection control)	75 (6)	100 (8)	75 (6)
Home exercise program	100 (8)	50 (4)	50 (4)

192 . **The Use of Low-Load, Prolonged Stretch, Dynamic Splinting To Improve Functional Elbow Range of Motion after Deep Thermal Injury: A Case Report**

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Introduction: Low-load, prolonged stretch, dynamic splinting (LLPSDS) provides a low intensity force over a prolonged duration to deliver a biomechanically correct stimulus in flexion and extension. This case report describes a 20-year-old male who sustained full-thickness flame burns involving a total body surface area of 95%. The soft tissues surrounding the patient's right elbow required microvascular free tissue transfer and skin grafting for acute coverage. Post-operatively, the active range of motion (AROM) and active assistive range of motion (AAROM) were greatly limited. After 8 weeks, it was noted that conventional burn therapy interventions alone were not effectively increasing available ROM. Because the contralateral upper extremity had been amputated, additional intervention to attain functional joint ROM in the remaining arm was imperative. The purpose of this case report is to describe the effectiveness of LLPSDS as an intervention for achieving greater joint ROM in relation to function.

Methods: Over a period of 7 weeks, two dynamic elbow splints, flexion and extension, which allowed for adjustable, low-load, prolonged stretching were employed. Splint tensile load and wear time were incrementally increased. In addition, the patient completed a consistent number of AROM and AAROM repetitions. Goniometric measurements were collected before and after each episode of wear. Each therapy session also included incorporation of elbow ROM into functional activity. The Functional Status Questionnaire (FSQ), a tool allowing patient self assessment of physical, psychological, social, and role functions, was administered before and after the 7-week period.

Results: After 7 weeks of LLPSDS, the patient demonstrated increases in both AROM and AAROM. The measurements display evidence of consistent and significant progress toward the defined functional goals of 130 degrees of flexion and 30 degrees of extension. Also post-splint, the patient gained an increased level of self-perceived functional status. (Table 1)

Conclusions: The use of LLPSDS, in combination with conventional interventions, is an effective modality to improve functional joint ROM and aids in restoring quality of life.

Applicability of Research to Practice: The use of LLPSDS may be a valuable addition to the burn therapist's conventional approach to restore joint ROM and level of function. Future studies are warranted with more patients and extended follow-up times.

Table 1. Average ROM (Degrees) and Function (Percentage) Gains

	Pre-Splint	Post-Splint	Total Increase
AROM Flexion	70	112	42
AROM Extension	80	115	35
AAROM Flexion	45	30	15
AAROM Extension	35	30	5
Physical Function	22	67	45
Psychological Function	40	72	32
Role Function	0	22	22
Social Function	60	84	24

193 . **A Randomized, Multisite Study on Virtual Reality Pain Distraction in Pediatric Burn Patients during Physical Therapy**

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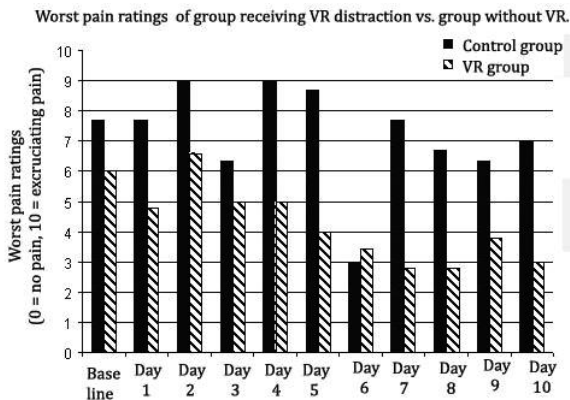
Introduction: Virtual reality has been shown to reduce pain during severe burn wound care and physical therapy. But to date, the efficacy of VR distraction when provided over the course of multiple days has not been adequately examined. This study explored whether VR continued to be effective over the course of 10 days of treatment in pediatric patients with large burn wounds.

Methods: Eight pediatric burn patients who reported a worst pain intensity of 5 or more (on a 0-10 scale) during baseline physical therapy were randomly assigned to a group that received VR during physical therapy, or to a group that received physical therapy without VR (control group) during 20 minute physical therapy sessions. Subjective pain ratings were measured after physical therapy of joints targeted in this study after baseline, and on each of the 10 study days. Seventy-five % of these patients were Hispanic, and the average burn size was 45.25% TBSA (range 14% to 73%).

Results: A repeated measures ANOVA showed worst pain ratings across the 10 treatments sessions were significantly lower for the VR group than for the control group ($F(1,6) = 12.12$, $p = .01$, see Figure below). No significant Time X Treatment interaction effect emerged, indicating that VR did not diminish in analgesic effectiveness over the 10 days of treatment.

Conclusions: These findings support the conclusion that VR distraction continues to be effective for reducing acute procedural pain for 20 minute physical therapy sessions even when provided for 10 days.

Applicability of Research to Practice: VR distraction significantly reduced acute procedural pain of pediatric patients with severe burns for clinically relevant treatment durations and frequencies.



194 . **Smokers Experience Increased Pain and Itch after Major Thermal Burn Injury**

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Introduction: Smoking status has been associated with increased post-operative and chronic pain, but the influence of smoking status on pain and itch after burn injury is not known.

Methods: We evaluated the association between smoking status and pain and itch intensity in 43 individuals hospitalized after major thermal burn injury. Eligible and consenting patients admitted to four network burn centers within 72 hours of thermal burn injury completed daily evaluations of pain and itch symptoms for 19 days. Daily assessments included an evaluation of worst pain, least pain, worst itch, and least itch (each assessed on a 0-10 NRS) as well as an evaluation of pain and itch frequency. Smoking status was obtained via self-report. The association between smoking status and individual pain and itch symptoms during the 19-day study period was calculated using binary regression, adjusted for time since admission, gender, age, and education, with random slopes for times. Because subjects were enrolled in a randomized drug intervention on study day 3, the model was also adjusted for group (control vs. active).

Results: Most patients were young European American males with some education or training past high school and who worked full time. Nineteen (44%) patients were self-reported smokers, with an average cigarette use of 14 ± 11 per day. Compared with nonsmokers, smokers had higher worst pain ($\beta=0.94$, $p=.03$), higher least pain ($\beta=1.24$, $p=.05$), higher worst itch ($\beta=2.39$, $p=.0004$), and higher frequency of itch ($p=.001$).

Conclusions: These findings suggest that smokers experience increased pain and itch symptoms after major thermal burn injury. Further studies of the potential association between smoking status and pain and itch outcomes and of the impact of nicotine replacement and smoking cessation on chronic pain and itch outcomes after major thermal burn injury are needed.

Applicability of Research to Practice: Smokers may benefit from tailored interventions to improve post-burn pain and itch outcomes. In addition, if smoking cessation reduces chronic pain and itch after burn injury, this knowledge may encourage burn patients to quit smoking.

195 . Improved Donor Site Pain Control after Skin Graft Harvesting Using Ultrasound Guided LFCN (Lateral Femoral Cutaneous Nerve) Block

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Introduction: Many burn patients experience more intense pain from the split thickness skin donor site than in the grafted burn wound and require a significant amount of analgesics in their postoperative period. Often, split thickness autografts are harvested from the lateral thigh area, which is innervated by the lateral femoral cutaneous nerve (LFCN). Sonographic nerve localization has been an increasingly popular technique to provide regional nerve blocks and we explore its role in improving pain control during skin harvesting. The objective of this study was to quantify and compare the post-operative pain at the donor site and the amount of analgesic used when split thickness skin grafts were harvested with an ultrasound guided LFCN block and without.

Methods: Ultrasound guided LFCN block was used to provide regional anesthesia for harvesting split thickness skin grafts in 17 patients with a variety of wounds treated at a burn center. The control group of 17 patients did not receive any regional anesthesia. Pain at the donor site, the frequency of oral and parenteral analgesia administration in both groups were surveyed, using specially designed questionnaire, within the 5-day post-operative period.

Results: Results show a significant decrease in the pain level ($p<.05$) post-operative day 0, 1 and 2. In addition, data shows a significant decrease in the amount of oral ($p<0.01$) and parenteral ($p<0.002$) analgesia use during post-operative days 0 and 1, as well as an additional decrease on post-operative day 2 for oral medications.

Conclusions: Significant reductions in both pain levels and narcotic medication use have been demonstrated using ultrasound guided block of the LFCN during split-thickness skin graft harvesting. This technique allows capitalizing on advantages offered by peripheral nerve regional blocks such as reduced recovery room times, decreased nausea, vomiting, and urinary retention, and improved post-operative analgesia. These benefits may translate into shortened hospital stays, decreased requirement for hospital admission, and an overall reduction in hospital costs and patient charges.

Applicability of Research to Practice: Ultrasound guided LFCN block technique requires basic knowledge and skills of sonographic imaging and regional anesthesia. In our practice, blocks are performed by burn surgeons and anesthesiologists with equal success. We are able to avoid general anesthesia in a number of cases, narcotic requirements are decreased, and we are looking forward to placement of indwelling catheters to prolong effects of regional anesthesia.

196 . Pain Assessment Measures: Review of the Literature with Recommendations for Clinical Use in a Burn Center

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Introduction: Acute pain following burn injury is common and pain assessment is vital to effective pain management. It is unclear which tool is best suited for the acutely injured burn patient. The purpose of this review was to conduct an evidence-based comparison of pain measurement tools and make recommendations for their clinical use with English-speaking burn patients.

Methods: A bibliographic search was conducted to identify existing tools for assessment of pain. Medical subject headings/key words included 'pain assessment', 'pain measurement', and 'burns'. Randomized controlled trials, systematic reviews, and recent evidence-based guidelines for pain assessment practices, both in the burn-injured and general populations, were reviewed. Only those manuscripts published in English were considered. Observational assessment tools for neonates were excluded. Each tool was then reviewed against the criteria for evidence-based assessment (LL Cohen et al, 2006) and only those tools that met the 'well-established assessment' category are recommended for clinical use.

Results: This search strategy resulted in over 24 tools for review. Substantial evidence exists for use of both self-reporting (SR) and observational (Obs) pain assessment tools. The table lists those tools that meet the well-established criteria for different age groups with different cognitive abilities. Of note, few tools have been tested in burn-injured populations.

Conclusions: Assessment of pain using appropriate, validated tools is an essential prerequisite to successful pain management. Currently, there is no single tool that can be used in all age groups and in all clinical situations. We conclude that those caring for the acutely injured burn patient must have at their disposal and be skilled at using any one of several pain assessment tools. The choice of which tool to use should be based on the individual patient, their age and cognitive ability. Self-reporting tools should be used whenever possible followed by observational tools.

Applicability of Research to Practice: This review identifies the measures to be used in clinical practice for assessment of acute pain due to burn injuries. Results may lead burn centers to re-evaluate their current selection of pain assessment tools.

Recommended Pain Assessment Tools

Tool Acronym	Complete Tool Name	Type*	Age Group
POCIS	Pain Observation Scale for Young Children	Obs	Very young
COMFORT-B	The COMFORT-Behavioral Pain Scale	Obs	Very young
FLACC	Face, Legs, Arms, Cry, Consolability Scale	Obs	Very young Pre-school Adults with communication impairments
Poker Chip	Pieces of Hurt	SR	Pre-school
FACES	Wong-Baker Faces Scale	SR	Pre-school
FPS-R	Faces Pain Scale-Revised	SR	Pre-school School-age Adolescents
VAS	0-10 Visual Analog Scale	SR	Adolescents Adults
NRS	0-10 Numerical Rating Scale	SR	Adolescents Adults
PAINAD	Pain Assessment in Advanced Dementia	Obs	Older adults with communication impairments
Abbey	Abbey Pain Scale	Obs	Older adults with communication impairments

*Obs-Observational tool SR-Self reporting tool

197 . Midazolam as Adjunctive Therapy in the Management of Procedural Pain Associated with Burn Injuries

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Introduction: Burn pain is one of the most excruciating types of pain and can be difficult to manage. Pain associated with burn dressing changes has the potential to cause anxiety and distress, which may exacerbate a patient's overall level of pain. Despite the known anxiolytic properties of benzodiazepines, few studies have evaluated their role in reducing pain by minimizing anxiety during burn dressing changes. The purpose of this study was to evaluate the safety and efficacy of midazolam as an adjunctive therapy during dressing changes in burn patients experiencing significant anxiety or uncontrolled pain with opioid monotherapy.

Methods: A retrospective cohort analysis comparing adult burn patients who received midazolam during dressing changes to control patients was performed. Patients were eligible for inclusion as control patients if they were admitted to the burn step-down unit between July 1, 2006 and June 30, 2009 and as midazolam patients if they were admitted following a protocol change on July 15, 2009 through December 31, 2010. Each midazolam patient was matched to up to 2 control patients who did not receive midazolam based on age, sex, total body surface area burned, and grafting requirement. The primary endpoint was the total oral morphine equivalents administered during hospitalization following initiation of midazolam.

Results: Thirty-six patients were included for evaluation with 14 patients in the midazolam group and 22 patients in the control group. Baseline characteristics were similar between the two groups, although patients in the midazolam group had higher pain scores and oral morphine equivalent requirements at baseline. When adjusted for baseline pain, day post-burn, age, gender, and grafting status, the mean oral morphine equivalents in midazolam patients was 15.1 ± 13.9 mg lower than the mean oral morphine equivalents required by control patients ($p=0.3$). Midazolam was administered a median 8 days [5-15] after the burn injury. One midazolam patient experienced oxygen desaturation with midazolam, but did not require flumazenil for reversal.

Conclusions: The use of midazolam during burn dressing changes in patients with poorly controlled pain and/or anxiety was not associated with significantly reduced requirements for oral morphine equivalents or lower pain scores during admission. Further research into the role of benzodiazepines in burn pain management is warranted with specific focus on the timing of initiation and dosing.

Applicability of Research to Practice: This research found that a nursing-driven protocol involving the use of midazolam as adjunctive therapy in patients undergoing burn dressing changes on a step-down burn unit was safe, but it also uncovered several questions regarding the optimal timing of midazolam initiation in these patients.

198 . Clinical Pathways for Pain, Anxiety, and Delirium in Burns

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Introduction: Pain, anxiety and delirium are common and have adverse effects over a long course of critical illness. These are difficult to recognize and treat, because of their inter-relatedness, both in clinical presentation and treatment effects. Our burn center embarked on an effort to identify and treat these distinct conditions, hoping to improve patient outcomes. This report summarizes pathway development and the early experience with them.

Methods: A multi-disciplinary task-force developed pathways for the management of pain, anxiety, and delirium in mechanically ventilated burn patients. The treatment of pain was considered to be the first priority. Management guidelines were designed to identify and treat procedural and background pain as separate entities. Goal directed sedation using the RASS score to direct benzodiazepine dosing was implemented. Protocols for dosing antipsychotic drugs were developed, and the CAMICU score was introduced to assess the presence of delirium. An education program was developed to educate the staff about relevant pharmacology and assessment and management of these entities in critically ill patients. Records of a random sample of critically ill burn patients treated in accordance with these pathways were reviewed. Total daily doses of narcotics (morphine equivalents), benzodiazepines, and Quetiapine were recorded as well as the highest and lowest RASS score and the CAMICU.

Results: A sample of 5 of 29 patients treated with these protocols was reviewed. Treatment lasted from 21 to 105 days following burn. Data from the first 3 weeks of care were summarized. Two patients were extubated on Day 16 and 19, but the others remained ventilated. RASS scores were recorded daily. The CAMICU was only recorded on 8 occasions. Based on the high RASS score, patients were categorized as agitated (high RASS +2 to +4), calm (-1 to +1), or oversedated (-4 to -2). Oversedated patients had significantly higher daily doses of narcotics than either of the other categories (245 mg morphine equiv ± 31 , $P=0.002$ by ANOVA) but lower doses of Quetiapine (39 ± 10 mg, $P<0.0001$). They also had higher sedative doses than agitated patients. Although calm and agitated patients had similar doses of all three medications, there was a trend toward higher Quetiapine dosing in the calm group (156 ± 23 vs 101 ± 23 , $P=0.11$).

Conclusions: This is one of the first efforts to identify and treat pain, anxiety, and delirium as separate but linked conditions in critically ill burn patients. Although the RASS score was incorporated into daily practice, the CAMICU was not embraced as readily. Treatment of delirium in addition to pain and anxiety may reduce the need for excessive doses of narcotics and sedatives and keep the patient calm. Further protocol development and staff education are warranted.

Applicability of Research to Practice: More humane care.

199 . Neuropathic Mechanisms in the Pathophysiology of Burns Pruritus: Redefining Directions for Therapy and Research

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Introduction: Pruritus is a distressing symptom associated with burns healing and has a significant impact on patients' quality of life. Histamine release in the wound has been implicated as the key mediator in symptom generation but no distinct pathophysiological mechanisms have been proposed in the literature.

Methods: Literature review and comparative study relating to burns pruritus and neuropathic nociception with particular emphasis on emerging anatomical, neurophysiological and pharmacological evidence.

Results: Pruritus seems to affect the majority of patients in the early phases of healing, with a significant proportion developing chronic symptoms. Its clinical presentation includes a range of positive and negative sensory phenomena, which is a feature of neuropathic conditions. Abnormal activity in the peripheral nervous system following injury appears to result from the loss of peripheral afferents (deafferentation) and a selective overexpression of neuropeptides including substance P. These changes appear to induce and maintain aberrant activity in the central nervous system accounting for the persistence of symptoms into a chronic state. The effectiveness of agents acting on the central nervous system including gabapentin, ondansetron and transcutaneous electrical nerve stimulation (TENS) provides further supporting evidence for the involvement of neuropathic mechanisms in burns pruritus.

Conclusions: There is emerging evidence that the central nervous system is a key player in the generation and maintenance of pruritic symptoms in burns patients via sensitization mechanisms similar to those implicated in neuropathic nociception. The proposed updated model of pathophysiology elucidates the currently unclear state of burns literature on underlying mechanisms of burns pruritus and accounts for its temporal pattern especially in the later stages of rehabilitation.

Applicability of Research to Practice: This work is the first attempt in burns research to integrate clinical, neuro-physiological and pharmacological data into a unified theory explaining this highly distressing symptom in burns rehabilitation and is likely to pave new avenues for research and effective management of burns pruritus.

200 . Discharge Phone Calls: Do They Make a Difference?

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Introduction: The Studer model for discharge phone calls was adopted as part of a hospital wide initiative to increase patient safety and satisfaction in March 2011. The program was designed to be used on the Acute Care floor. The discharge nurse or a designated person would call the patient the day after discharge. There has been an increasing number of patients discharged home from the intensive care unit due to the shortage of acute care beds. The discharge process was uncomfortable and time consuming for the nurse since patients were rarely discharged from the intensive care unit. We volunteered to be the pilot intensive care unit in order to better serve our patients.

Methods: First, we developed an educational tool to assist the physicians and nurses with the discharge process. The Studer model was designed for the discharge nurse to call the patient the next day but after reviewing the unit staffing, we found that 71% of the time, the discharge nurse was not scheduled the next day. The nurse manager, assistant nurse managers, and one staff nurse were designated to make the discharge phone calls

Results: From March 2011 to September 2011, our intensive care unit discharged 166 patients home. We were able to contact 97% of our patients after discharge. We found the following:

- 1) 98% of patients knew who to contact for concerns
- 2) 15% of patients had problems that were identified and immediately addressed
- 3) 6% of patients had questions regarding discharge instructions that were clarified during the phone call
- 4) 22% of patients had problems making discharge appointments. The patients were confused and frustrated regarding which clinic and the ability to make follow up appointments. We evaluated the clinic follow up process. First, we found that communication between the patient, hospital staff, and clinic staff needed improvement. We discovered some clinics required special referrals that took 24 to 48 hours to process. A clinic referral flow chart was developed to assist physicians in the referral process. The hospital staff informs patient and families in advance of referral wait time.

Conclusions: The follow up phone calls assist staff with early identification of concerns, questions, and problems regarding follow up plan of care to ensure any issues are addressed in a timely manner. The discharge phone call program is a valuable tool that can ensure patient safety and satisfaction after discharge from the intensive care unit.

Applicability of Research to Practice: Patient safety after discharge from the intensive care unit.

201 . Intravenous Warming Catheter Helps Burn Patients Maintain Core Body Temperature During Surgery

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Introduction: Maintaining burn patients' body temperature during surgery is a significant challenge. While increasing the ambient operating room temperature and other passive rewarming methods help, such measures have limited effectiveness and prove taxing on operating room personnel. Initial studies indicate that an intravascular warming catheter may improve and sustain burn patient body temperatures. We hypothesize that the catheter will help maintain patients' core body temperature during excision and grafting procedures.

Methods: This is a retrospective cohort study involving patients with major burns treated between January 2006 and June 2011. The intravascular warming catheter utilizes a closed loop of sterile saline circulated through a femoral central access. A bladder temperature probe was used for continuous core temperature monitoring. The saline bath temperature was automatically adjusted to maintain patient core temperature. As warming was maintained, the room temperature was gradually lowered to normal.

Results: Eleven patients were involved in 14 operative cases using the warming catheter. Patients were overwhelmingly male (86%) with a mean age of 56 years old (± 17) and TBSA of 42% (± 11). Total anesthesia time for each case averaged 371 minutes (± 99), while total surgery time was 286 minutes (± 101). Every case included burn excision, with a mean TBSA excision of 24% (± 8.8). Only one case did not include grafting. The mean temperature deviation for each case was -0.86°C (± 1.2 , range -2.2 to 1.8). Three patients began the case febrile (temperature $\geq 38.0^{\circ}\text{C}$) and were allowed to defervesce during the case. Operating room staff satisfaction has improved with decreased room temperatures.

Conclusions: An intravenous warming catheter reliably maintained patient core body temperature during surgery. To date, this is the largest cohort study of such a catheter among burn patients. This system may be more effective than current warming techniques, with the potential to decrease the total number of procedures and decrease the time to complete wound closure.

Applicability of Research to Practice: Utilizing warming catheters in burns patients has the potential to lengthen patient tolerance of surgical procedures and increase the extent of excision and grafting, while maintaining operating room staff comfort.

202 . Cellulitis Following Thermal Injury: A Retrospective Review for Quality Improvement

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Introduction: We have defined cellulitis in burn patients as a new area of redness and induration extending beyond the limits of the initial wound with or without pain, leukocytosis or fever. A literature review did not produce any pertinent papers describing the incidence of this condition for comparison. Our goal is to determine our incidence of cellulitis, identify those at high risk and implement a protocol to reduce this complication.

Methods: For quality improvement measure, we retrospectively reviewed the charts of patients admitted to our regional burn center from January 2010 to June 2011. Using burn center patient cards, demographic data were collected, including age, sex, burn size and location, time from injury to onset of cellulitis, time of injury to excision and antibiotics used for treatment. None of our patients received prophylactic antibiotics, except for 24 hours perioperatively. We identified three groups of patients: those admitted with cellulitis of the thermal burn, those developing cellulitis in the thermal burn after admission and those developing cellulitis after skin grafting.

Results: During this 18 month period, we saw 722 new thermal injury burn patients; 273 were admitted to the hospital, 226 fit into one of three groups. Fifteen (6.6%) patients admitted to our burn center were noted to have existing cellulitis. An additional 38 (16.8%) patients admitted without cellulitis, developed clinical cellulitis after admission around the thermal burns. Those who developed cellulitis were on average 48 years old with an 8.5% total body surface area (TBSA) burn versus 29 with a 4.8% TBSA burn. We admitted 182 burns of the upper extremity/hands, 103 burns of the lower extremity/feet, 74 burns of the anterior trunk, 48 burns of the back and 89 facial burns. The respective rates of infection were 8.8%, 28.2%, 5.4%, 6.3% and 1.1%. Patients with lower extremity burns were five times as likely to develop cellulitis compared to those burned in other locations. (OR=5.78; 95% CI=3.21-10.45). Most frequently, excision of burns $<15\%$ occurred on post burn day (PBD) 5. On average, cellulitis developed PBD 3. Although all of our skin graft patients received perioperative prophylactic antibiotics, 9 of 42 developed postoperative cellulitis. Risk factors for developing cellulitis included middle age and explosive burn mechanism.

Conclusions: These data suggest an unexpectedly high incidence of cellulitis in lower extremity/pedal thermal burns. As a result of this review our institution will design a study to determine if prophylactic antibiotics decrease the incidence of cellulitis in lower extremity burns.

Applicability of Research to Practice: Determine the incidence of cellulitis at our institution. Identify patients at high risk. Develop a protocol to decrease lower extremity/pedal cellulitis.

203 . Application of Lean Six Sigma Techniques to Enhance Burn Center Cost Savings

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Introduction: Burn Centers across the United States are concerned with improving performance and financial viability. Healthcare leaders and administrators are faced with the challenge to reduce costs and optimize patient care. Lean Six Sigma is a rigorous methodology applied to create continuous improvement. It has been found to be transferrable and valuable across industries including healthcare. This study demonstrates specific applicability of Lean Six Sigma to resource management in the Burn Center.

Methods: Hospital administration instituted Lean Six Sigma training for key personnel. The Lean Six Sigma process was then used by Burn Center Staff to identify two top priority issues for performance improvement: wasted burn dressings and lost sterile instruments. The methodology was then applied to evaluate and restructure each process. Improvement indicators were measured to assess efficacy.

Results: Analysis of the process to prepare daily burn dressings and sterile instrument use was performed. Control data was collected on wasted burn dressings and lost sterile instruments. Staff evaluated the processes and offered feedback. Burn dressings were being wasted at an average expense of \$55 per day. Approximately 200 sterile instruments were replaced. Restructuring the burn dressing process using Lean Six Sigma methods resulted in a projected savings of \$18,673 over a one year period and an estimated savings of \$1,481 from lost sterile instruments.

Conclusions: Lean Six Sigma provides an integrated approach to increase quality by reducing defects, variation, and costs. The process improvement method assists in quantifying deficiencies and allows direct involvement of the staff to complete work making improvement and cost savings a personal issue. The Lean Six Sigma process is an excellent program to improve Burn Center efficiency, thereby reduce waste and costs improving value to the patient and the organization.

Applicability of Research to Practice: The Lean Six Sigma process is an excellent program to improve Burn Center efficiency, thereby reduce waste and costs improving value to the patient and the organization.

204 . The Successful Use of a Bridle: A New Way to Wrangle a Pediatric Nasal Feeding Tube

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Introduction: Long term enteral nutrition is an integral part of care for burn patients in order to address the need for heightened calorie, protein, and nutrient requirements. During a prolonged treatment course, it is not uncommon for transnasally placed feeding tubes to become dislodged or accidentally removed. The purpose of this study was to examine the reasons for feeding tube replacement and to determine if the use of the AMT Bridle™ provided an effective mechanism to secure feeding tubes in the pediatric burn population.

Methods: Medical records of patients admitted between 3rd quarter 2009 and 2nd quarter 2011 were reviewed to capture the indications for tube replacement. The use of the bridle was implemented in 2009 as a performance improvement (PI) measure. The incidence of feeding tube replacement was compared before and after adopting the routine use of the nasal bridle.

Results: A 12% decrease in enteral feeding tube dislodgement was noted (19% to 7%) over the 2 ½ year period of bridle use. Use of the bridle had no association with tubes requiring replacement due to emesis, clogging or other causes. No patients acquired a mucous membrane pressure area from a bridle. No patients developed a documented upper respiratory tract infection that could be directly linked to a bridle.

Conclusions: The use of a nasal bridle was effective in reducing the number of nasogastric feeding tube replacements due to dislodgement.

Applicability of Research to Practice: This PI project indicates that a change in nursing practice improves tube feeding related outcomes. Use of the nasal bridle supports reduction in the incidence of feeding tube reinsertions; therefore, patients benefit from decreased fluoroscopy exposure, pain and anxiety related to the procedure of tube replacement, cost, physician time, and need for procedural sedation as well as improving the attainment of nutritional goals.

205 . Spontaneous Breathing Trial Protocol Experience in Pediatric Burn Patients

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Introduction: We implemented a spontaneous breathing trial (SBT) protocol for children in our Burn Intensive Care Unit (BICU) to facilitate timely discontinuation of mechanical ventilation (MV). Our aim was to standardize MV weaning and provide consistent information to enhance safe and efficacious discontinuation of MV.

Methods: We developed a screening flowsheet for clinical eligibility for SBT for all patients admitted to the BICU less than fourteen years of age and on MV greater than 24 hours, which was instituted in July 2009. Protocol consisted of respiratory therapist performing daily screening followed by a 15 min. SBT for indicated patients. Data was collected for all patients admitted in the following 18 months, and these were compared to an historical control group admitted 18 months before implementation. The following parameters were compared between groups: age, burn size, inhalation injury, PaO₂/FiO₂, Oxygen Index (OI), peak inspiratory pressure (PIP), mean airway pressure (MAP), hours on MV, BICU free days in the first 30 days of admission, re-intubation rate, and diagnosis of pneumonia.

Results: Data were collected for 29 subjects (n=14 historical, n=15 treatment). Age, burn size, and inhalation injury were not different between groups. Values for the following physiologic and ventilatory parameters at study entry were: PaO₂/FiO₂ (378±44 control vs 397±39 treatment); OI (2.8±0.6 vs 1.7±0.2); PIP (18.0±1.6 vs 17±1.5 cmH₂O); MAP (7.9±0.6 vs 8.0±0.3 cmH₂O). Screening and recording of SBT criteria were documented in 0% of controls and 82% with protocol (p<0.05), and SBTs were performed in the most timely fashion (within 24 hours of meeting criteria) in no controls and 84% with protocol (p<0.05). Compliance with completing the screening flowsheet and performing indicated SBT increased significantly with time (p<0.05). However, we found no differences between groups for ventilator hours (267±38 vs 269±42), ICU-free days in first 30 (13.6±2.1 vs 16.0±2.0), reintubation rate (14% vs. 20%), or diagnosis of pneumonia (14% vs. 13%).

Conclusions: We found that performance of SBTs in burned children increased with institution of a defined screening process performed by respiratory therapy personnel. Furthermore, compliance with the screening protocol and recommended actions increased with time. To date, however, these have not translated into improved clinical outcomes perhaps associated with type II statistical error. Data collection continues.

Applicability of Research to Practice: A standardized approach to SBT has led to improved daily documentation complementing the physician decision to extubate.

206 . Quality Improvement in Donor Site Management with Mepilex Ag

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Introduction: Although various dressings exist for the management of donor sites, no single one has been preferred by most burn centers. Donor sites are known to be very painful and uncomfortable, and there is a real need to identify the ideal donor dressing. At this academic burn center, Mepilex Ag, a soft silicone foam silver dressing, is used for shallow burns and donor sites. We had previously proven it efficacious for partial thickness burns, but had no data regarding its use in donor sites. As a quality improvement (QI) initiative, we undertook a prospective observational study of donor site healing with Mepilex Ag.

Methods: From May - July 2011, 21 burn patients with 30 donor sites were enrolled in this QI project. Depending on surgeon choice and patient indications, grafts between 10 - 14 /1000 inch were harvested with a Padgett Electric Dermatome from the trunk, thighs, or buttocks. After donor site hemostasis was achieved, Mepilex Ag dressings were applied, secured with Hypafix and an ace bandage. Depending on the location of the skin grafts patients were allowed to ambulate. Ace wraps remained in place at all times. Dressings were changed when judged clinically necessary. All wounds were evaluated by a research nurse daily while patients remained hospitalized, and followed during clinic visits up to 30 days postoperatively. Photos were taken at days 7, 14, and all clinic visits, and donor sites were evaluated for bleeding, infection and blisters.

Results: The mean age of patients enrolled was 42.89±15 years (81% male) and the mean TBSA of burns 12.27±14%. Mean healing time of donor sites was 10.77±2.9 days and the average total length of stay was 24.1±19.2 days. Due to excessive exudate retention, 6 donor sites had their Mepilex Ag dressings replaced prior to day 7 (days 4-6), 6 other donor dressings were replaced on day 7-10, while 18 of the donors stayed in the Mepilex Ag dressing until healed (7-16 days). Healing rate was influenced by the patient's depth of donor, age, and comorbidities. No hematomas, infections, or blisters were observed in any of the donor sites. According to patient feedback, the dressing was comfortable for mobilization.

Conclusions: We have found that Mepilex Ag continues to have a role in the burn center as a dressing for donor sites. It decreases the need for patient donor site dressing education and does not seem to inhibit mobilization. In addition, Mepilex Ag is a favorite choice of nursing staff at our center due to ease of application and removal. With low infection and hematoma rates, Mepilex Ag's effectiveness on donor sites should be further investigated in a randomized comparative study.

Applicability of Research to Practice: Findings may assist clinicians in deciding whether to use Mepilex Ag in donor sites.

207 . Are Cultured Epidermal Autografts Worth the Cost?

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Introduction: Burns comprising greater than 30% total body surface area (TBSA) can present significant challenges in obtaining autologous coverage of deep dermal wounds. Cultured epidermal autografts (CEAs) have been used for wound coverage in larger burns alone or in conjunction with autografts. Previously reports note various scaffolds for application of CEA with successful graft adherence of 15 - 85%. This study examined the graft adherence rates of CEA placed with a novel methodology; providing insight on whether the practice is financially responsible.

Methods: All patients receiving CEAs from January 2005 - August 2006 were identified. Areas of the body in square centimeters grafted with CEAs was compared to the same body parts in square centimeters subsequently autografted. The percentage of CEA graft adherence was then defined as the amount of autograft placed after initial CEA application divided by the amount of CEAs applied initially. Methodology includes, in all cases, removing the CEA's mesh backings prior to the application then covered with 2:1 meshed allograft. When possible, meshed autograft (usually 6:1) was placed on top of the CEA prior to allograft placement. Demographics, TBSA and outcome were also reviewed for significance.

Results: Twenty two patients received CEAs for wound closure; 20 in the acute setting and 2 after hypertrophic scar revision. Demographics were 54.5% male, average age of 24.6 years, range of 4 - 60 years. Average TBSA was 59.7%. Three patients succumbed to their injuries. In the 19 survivors, CEA graft adherence was 72.9%. Two patients had complete failure of CEAs. Five patients had nearly 100% adherence as the sites where CEAs were applied never required subsequent autograft ($p=0.039$). Patients who required subsequent autograft also had significantly larger areas of burn to which CEAs were applied ($p=0.009$). There were no statistical differences in patient age, TBSA burned, or the percent difference between the area where CEAs applied and the area which required subsequent autograft.

Conclusions: This scaffold technique yielded a high CEA adherence rate and although use of CEA is expensive, the improved success rate of CEA incorporation appears to justify the added cost. Further study needs to determine if CEA leads to quicker closure of larger TBSA burns thereby reducing hospital stay and overall expenses.

Applicability of Research to Practice: In patients with large TBSA burns, and limited donor sites, the use of this CEA, using this methodology, appears to be both prudent and cost-effective.

208 . The Positive Effect of Therapy Interventions on the Burn Patient Population

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Introduction: In the spring of 2009, our facility conducted a quality improvement project in the area of rehabilitation service delivery to the burn patient population. We reviewed the needs of our burn patients and determined that the current therapy compliance of 84% needed to improve. The new goal for therapy compliance was set at 90% by the Burn Service at our facility. At that time our LOS in the Trauma Burn Unit was 7.4 days and the ventilator days was 1.25 on average.

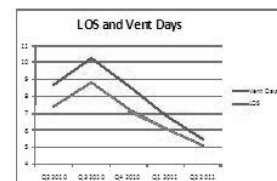
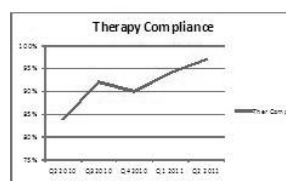
Methods: A plan of action was developed to address therapy compliance as well as early mobilization, patient education, and continuing education for the therapy staff.

The changes we implemented included:

- a better defined burn rehabilitation program
- a clear set of goals for PT and OT services
- identifying a primary PT and OT for this area
- ensuring that the primary PT and OT had annual CEU's in the area of burn rehab
- implementing a real time tracking tool for burn therapy compliance
- implementing an audit spreadsheet to perform quarterly audits
- outpatient therapy referral cards for the continuum of care specific to the burn population

Results: After 5 quarters of data tracking, our therapy compliance has improved to 97%. The LOS has decreased to 5.1 days and ventilator days have decreased to .37 days on average.

Conclusions: The increase in therapy compliance is associated to a decrease in LOS and ventilator days which has carried over into a cost savings for our facility. The average controllable cost of a 1 day stay in our TBU was approximately \$1350. With over 130 admissions in Fiscal Year 2011, this savings would equate to \$250,000 in controllable cost savings for our facility.



209 . The Impact of a Warmed Operating Theatre on the Thermal Status of Surgical Personnel

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Introduction: To prevent potentially dangerous hypothermia in patients during large burn operations the room temperature is maintained at 29.9°C. Minimal research has examined the effects of warmed operating environments on surgical personnel. Studies in non-healthcare settings have demonstrated increased fatigue and decreased acceptable working times as a result of impaired thermoregulation from protective attire. Given the impermeability of surgical gowns, it is possible that similar effects occur in gowned surgical staff working in a warmed theatre. The purpose of this study was to determine the impact of a warmed operating theatre environment (29.9°C) on the core body temperature (CBT), weight change, and metabolic rate of surgical personnel who are gowned and non-gowned.

Methods: Weight change and the range in CBT were measured in gowned and non-gowned surgical personnel participating in burn-plastic surgeries with an ambient room temperature of 29.9°C. This data was compared to that of a surgical team working under standard conditions of 21°C. A metabolic cart assessment was carried out on select individuals who were gowned and working at 29.9°C. Mean values were collected for resting energy expenditure and the respiratory coefficient (RQ).

Results: The analysis of 40 participants revealed no differences in the range of CBT. Measurements taken from 16 participants revealed that gowned individuals in heated operating theatres had a mean weight loss of 1.44lb. This was significantly different when compared to both gowned ($p=0.004$) and non-gowned ($p=0.030$) participants in non-heated rooms who lost 0.35lb and 0.50lb respectively. The metabolic cart assessment showed gowned individuals in heated rooms to have a mean RQ change of -0.18.

Conclusions: The weight change of gowned personnel in warmed theatres suggests a greater risk for dehydration while the differences in core body temperature between groups are unlikely to pose any clinical danger. The drop in RQ suggests that surgical personnel in warmed theatres metabolize fat to a greater extent throughout a surgical day. The clinical significance of this would require further study.

Applicability of Research to Practice: There is a need for updated protocol to address the vulnerability of gowned personnel in warmed theatres to dehydration. "Rehydration breaks" at specific intervals and the employment of cooling vests for those who are gowned have been suggested as possible solutions.

Descriptive Data for Range in CBT and Weight Change Between Groups

Group	Highest CBT (°C)	Lowest CBT (°C)	Range in CBT (°C)	Weight Change (lb)
29.9°C; Gowned	37.16 ± 0.35	36.62 ± 0.31	0.54 ± 0.30	-1.44 ± 0.58
29.9°C; Non gowned	37.26 ± 0.35	36.72 ± 0.28	0.58 ± 0.2	-0.88 ± 0.66
21°C; Gowned	36.90 ± 0.31	36.50 ± 0.19	0.40 ± 0.27	-0.34 ± 0.47
21°C; Non gowned	36.93 ± 0.21	36.54 ± 0.22	0.41 ± 0.21	-0.50 ± 0.21
All values presented as Mean ± SD.				

210 . Simulation in Advanced Burn Life Support: The Way of the Future

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Introduction: Simulation is a training method using interactive mannequins in which the learner gains knowledge through a simulated patient experience and observer feedback. Prior to using high fidelity simulation in our Advanced Burn Life Support (ABLS) course, patient assessment stations were dependent upon a live model to bring the station to life. The availability and skills of these models varied and the ability to moulage while providing modesty was limited. Students were also limited in the skills they were able to demonstrate on human models.

Methods: In 2009 planning began to incorporate high fidelity simulation into our ABLS course. The course director and instructor team spent time at the simulation lab on campus familiarizing ourselves with the principles of simulation and group debriefing. We worked with the simulation technicians to ensure the mannequins were programmed to deliver the ABLS scenarios as they exist in the curriculum to ensure that course objectives would be met. In October of 2009, our first simulation class was held. To evaluate the student experience, we requested that they complete a pre and post course survey.

Results: Surveys were given to the students participating in our first two courses held at the simulation center. The questionnaire asked specifics about age and learning style. We were pleased to find that simulation was not a learning barrier for the older student and that most of the students preferred style of learning was hands on. The majority of the students rated their confidence in demonstrating the ABLS primary and secondary survey as low prior to the course. All of the students rated their confidence in demonstrating the ABLS primary and secondary survey high upon completion of the course. In addition, we observed an increase in registration for our course after incorporating simulation.

Conclusions: Our survey findings reflect the importance of providing a learning environment that allows students to function as close to reality as possible. Use of human simulators allowed us to moulage without restrictions allowing for better assessment of burn size and depth. The students were able to talk to the simulator and elicit pertinent history. The students were able to demonstrate important skills including intubation and tube verification. For many of our rural participants, opportunities to practice these skills are few and far between.

Applicability of Research to Practice: Our findings are generalizable to other burn centers offering Advanced Burn Life Support as a part of their outreach mission. Simulation is not without cost; our hospital is committed to quality education and uses the proceeds of the ABLS course to fund simulation. Simulation is becoming more popular in academia and in hospital staff competency training. Advanced training such as ABLS should match current educational trends.

211 . The Accurate Estimation of the Burn Surface Area by Japanese EMTs

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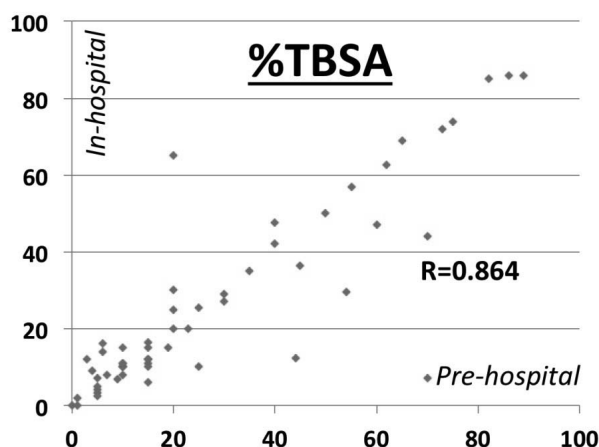
Introduction: In Japan, the prehospital emergency medical system depends on adequate decisions regarding the severity of the patients. Emergency medical technicians (EMTs) are required to transport the right patients to the right hospitals so that serious patients are admitted to critical care centers. In this report, we evaluated the accuracy of the burn surface area (%TBSA) estimated at the prehospital scene by EMTs.

Methods: From Jan 1, 2006 through Dec 31, 2010, 454 burn patients were transported by EMTs, belonging to our six local fire departments. Of those, 202 patients were transported to our critical center. Medical charts of those patients were reviewed retrospectively. %TBSA estimated by EMTs in the prehospital setting was compared with %TBSA obtained by emergency physicians in the hospital, using the Lund and Browder burn sheet on the day of arrival.

Results: Among 202 patients, 147 cases were excluded because of no admission or admission to a department other than the critical care center, no record of %TBSA, inhalation injury only, and other exclusion criteria. Frequently %TBSA was missed in very critical cases and those in which inhalation injury was suspected. The figure shows the correlation between prehospital and in-hospital %TBSA in 55 patients.

Conclusions: The high correlation coefficient indicates that EMT estimation of %TBSA is good enough to make an appropriate triage of the burn patients.

Applicability of Research to Practice: Improvement for paramedic activities.



212 . Walking the Walk: Team Steps

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Introduction: Health care including quality of care and patient safety have come under a great deal of focus the last few years. In 1999 the IOM published the report To Err is human, building a Safer Health care System. The report described that an important aspect of patient safety is the ability of the health care team to perform effectively because the delivery of health care requires team members to coordinate, communicate and support each other. In 2006 AHRQ released Team STEPPS which stands for Team Strategies and Tools to Enhance Performance and Patient Safety. Team STEPPS is a tool kit that uses four core components of team work. Leadership, Communication, Mutual support and situation monitoring.

Methods: Several members of our hospital became Team Steps Master Trainers and presented the program to the ED and Burn Center. The Burn team put a group together from each part of the Burn Center and participated in meetings to learn about the program. Each area chose one pilot project to work on. The BICU chose to develop and improve daily Wound Rounds (WR), a designated time in the day where the entire Burn team rounds and evaluates certain patients wounds. Staff was educated on the Team Steps process. A form for WR's was developed and stocked in easy reach of the Charge Nurse in the BICU. A dry erase board was placed in full view of the BICU nursing station so the Team could write down who was on wound rounds that day. WR's are evaluated on a daily basis with feedback given immediately to the entire team. The completed WR sheet is then returned to the Nurse Manager for review and follow up.

Results: BICU staff were surveyed before and after our WR Team Steps process began. Staff felt satisfied with communication only 35% of the time in the BICU before we implemented Team Steps. The number one complaint was that decisions were made as the team walked out of the patient's room or in the hallway with the RN out of the loop. Satisfaction has improved dramatically and now staff reports an 93% satisfaction rate on WR. The Charge Nurse is more involved and leading the team to each patient, making sure the team knows the name of the RN in charge of the patient and the team doesn't leave the room until the RN repeats the plan back to the Attending MD.

Conclusions: Wound Rounds occur daily in the BICU and follow the same consistent standard approach. Communication has improved dramatically during WR, following a simple plan of giving and getting immediate feedback to all team members as well as expecting that the feedback will be given. You have to walk the walk.

Applicability of Research to Practice: Communication is one of the leading causes of break down when working as a Team. The Team Steps program can be used in a variety of situations and formed to meet a Teams needs. Burn Care is a team sport in every way, shape and form.

213 . Improving Patient Throughput in the Burn Center: Results of a Pilot Experience

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Introduction: Improving patient throughput has been correlated to increases in patient and employee satisfaction, interdisciplinary collaboration, and revenue. This burn center had struggled with reaching institutional goals of decreasing length of stay (LOS). Beginning in 2010, the burn center within a large, tertiary academic medical center initiated initiatives to reduce LOS and improve throughput, and developed target metrics to evaluate these efforts. The following reviews these efforts and results.

Methods: Actual and target LOS, case mix index (CMI) and total number of discharges were measured in 2010 for all patients admitted to the Burn Center, including “off service” patients with non-burn diagnoses and compared to the same data points for 2011 to date. Findings were shared with the staff, and unit based initiatives were implemented to improve work flow, staff engagement, interdisciplinary collaboration and communication.

Results: In 2010, the average LOS and variance for all patients admitted were 9.58 days and 3.78 days, respectively. For that period, the LOS variance for burn injured patients was 6.36 days while CMI was 3.44. The variance and CMI for non-burn injured patients was 1.6 days and 1.57. The total number of discharges for burn injured patients was 476 which was similar to previous years, while the total number of discharges for off-service patients increased by 56% to 330. As of 8/11, the overall LOS variance decreased by 1.51 days. Among burn injured patients, the LOS variance decreased to 3.83 days and the CMI increased to 3.71. For off-service patients, the LOS variance decreased to 1.33, while CMI was 1.51. Unit initiatives facilitating the decrease in LOS variance included: night and day shift nurse champions, creation and implementation of a hydrotherapy nurse and multidisciplinary burn center operations work group, engagement of bedside/clerical/case management staff in the process, management staff participation in surgical barrier reduction team meetings, multidisciplinary chart reviews to identify missed opportunities of discharging patients earlier, staff nurse night/day rotations. Unanticipated benefits included the creation of additional FTE slots and decreased nurse “floating.”

Conclusions: The burn center will continue efforts to improve care, satisfaction, and revenue opportunities. The impact of additional initiatives, such as implementation of conditional discharge orders and continued clarification and expansion of the hydrotherapy nurse role, will also be examined.

214 . From Door to Floor: (ED to BICU) Timing is Everything...

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Introduction: The Institute of Medicine states that ED crowding is a major health concern. During a literature review looking at ED to ICU timing and transfer, the focus has always been on communication as a primary factor in delays. Our Burn Center Leadership chose to review and focus on decreasing length of stay in the ED for the Burn ICU patient. The burn patient is at particularly high risk due to hypothermia, inconsistent fluid management and inconsistent pain control. The Burn Center’s goal for length of time in the ED to the BICU (door to floor) is 30 minutes.

Methods: Data was collected for burn patients admitted to the BICU. The time of arrival and discharge to the BICU was obtained from the ED admission sheet since there is a standard location for this documentation. Upon receipt of the data, times were reviewed, looking at reasons for the ED LOS both long and short.

Results: In 2010, 41% of patients arrived in the BICU within our allotted time frame. We looked at reasons that the other 59% had a longer ED LOS. Our research showed that the data pulled included all admits to the BICU not just ICU admits. When the Acute care floor is full, floor boarders are placed in the BICU if beds are available; this leads to a longer LOS in the ED looking for beds. Other reasons included patients needing airway management, trauma work ups or a full census requiring moving patients to make beds. In 2011, 58% of our patients arrived within our allotted time frame. Recent delays are typically due to three reasons: receiving several burn patients at one time, a delay in writing the actual orders which is required to move out of the ED and difficulty in deciding if the patient should go to the BICU or Acute Care floor.

Conclusions: Our hospital does not allow us to do direct admits to the ICU and we do not have an ED within our Burn Center. In order to work on two of the three current barriers, the BICU Charge Nurse and Resident communicate in a timely manner so that orders can be written in the BICU when the patents come up so as not to delay care. We also involve the night shift Resident with both the BICU and Acute Care Charge RN early on when a patient arrives in the ED and it’s not clear which unit should admit the patient. This data has also raised staffs awareness of LOS and the need to bring patients up as quickly as possible. We will continue to review our data as we try to break down other LOS barriers.

Applicability of Research to Practice: This collaborative effort provides better care for the burn injured patient by arriving earlier to the Burn ICU. Patients remain normal thermic while having their fluid and pain managed in a more controlled environment.

215 . Out Patient in a Bed: A Novel Approach to Comprehensive Acute Burn Care Delivery

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Introduction: Many patients who seek and receive burn care in the emergency room (ER) or physician's office do not meet criteria for admission. ER physicians and primary care physicians often provide highly variable wound care, inconsistent instructions to patients, improper advice, and poor follow-up. In an effort to improve and provide comprehensive acute burn care, the "Out Patient in a Bed (OPIB)" concept was developed. This allows patients to receive standardized wound care and teaching by our burn nurses, evaluation by occupational and physical therapy, nutritional assessment, social care needs evaluation, arrangements for home delivery of wound care supplies, and clinic follow-up.

Methods: To begin this process permission was obtained from administration to change the flow of burn patients in our hospital. Patients with small burns presenting to the ER or called into our communication center would be triaged directly to the burn unit. Different burn team members would then assess and provide the care and teaching they need prior to discharge. The current nursing work flow was evaluated for changes necessary to accommodate and facilitate this new process. We worked with both admitting and billing to establish a method to register these patients, document the care provided, and submit charges. Education of all involved personnel and departments was undertaken while the process was being finalized and implemented.

Results: OPIB was implemented in January of 2010. As of May 2011 we have admitted 660 patients, 118 of which utilized OPIB representing 18% of the total population. Patient's ages ranged between 1 month and 17 years. Total body surface area burn ranged from 0 to 5%. The length of stay on the unit ranged from 15 to 993 minutes with an average of 234 minutes. Prior to implementation of OPIB, 6.5% of burn unit admissions were for patients who required admission several days after their burn in order to receive proper wound care. A statistically significant decrease in the rate of these delayed admissions was seen after implementation of OPIB (6.5% vs. 3%, $p=0.015$, Fisher's exact test).

Conclusions: OPIB provides expert and comprehensive burn care, with close follow up to patients with small burns. It reduced the number of patients with delayed admission to the burn unit after outpatient treatment failure. This process improves outcomes for these patients. This process will continue to be monitored and changed as insurance and reimbursement standards are modified.

Applicability of Research to Practice: The paper introduces a new practical concept in providing comprehensive, high quality acute burn care in the outpatient setting.

216 . A Retrospective Analysis: Perceptions after 56 ABLS Classes (In Four Years)

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Introduction: The Burn Disaster Program began in 2005. Early into program development, a key deficiency noted was the general lack of comfort in caring for patients with burn injuries. It became apparent that the first goal was to establish a baseline for the care of the burn patient. The Advanced Burn Life Support (ABLS) was chosen as the core program to be used to meet this need. After four years of offering ABLS, a retrospective survey was conducted to measure perceptions regarding key objectives that were to be accomplished during the delivery of ABLS.

Methods: In accordance with IRB approval, a survey was distributed to all who are involved either as volunteers or career members of disaster medical services in our region. Furthermore, the survey was distributed directly to everyone who had taken an Advanced Burn Life Support (ABLS) Course with a valid email address currently on file with the Burn Disaster Program. The survey had three components. For the purpose of this work, Section II which focused on ABLS will be discussed.

Results: Of the 1153 that completed ABLS during this four year period, 211 responded to the survey. Representatives of the group completed ABLS during 2007, 2008, 2009, 2010, 2011 and represent 13%, 13%, 37%, 31% and 6% respectively.

Questions included, since completing ABLS, in your professional opinion, are you better prepared to:

- Assess the size of the burn injury (TBSA)? 93%Y/7%N

Change or influence others to change:- IV fluid infusion for an adult burn patient to flow rates consistent with the Consensus or Modified Parkland Formula? 76%Y/24%N

- fluid infusion for an adult burn patient to Lactated Ringers as soon as it was available? 64%Y/36%N.

- Assured burn patients are managed at a verified burn center? 79%Y/21%N

- To more closely monitor and treat the pain control needs of a burn patient? 84%Y/16%N- Changed or influenced others to more closely monitor burn patients for inhalation injuries and manage the airway accordingly? 86%Y/14%N

- Do you have a better understanding of the role the burn center has in a medical disaster? 96%Y/4%N

Conclusions: The basic objectives included patient assessment, fluid resuscitation, pain management, airway control, and the role of the burn center in a disaster. These objectives were clearly met and retained, and are important to improve the outcomes of patients with burn injuries.

Applicability of Research to Practice: It is our experience that ABLS is a valuable class in helping achieve our goals of improving the knowledge, skills and abilities of those who initially manage the burn injured patient. This also includes understanding the value of a verified burn center for the burn injured patient and the role of the burn center in a medical disaster.

217. Development of an Electronic Acute Kidney Injury Smart Alert System

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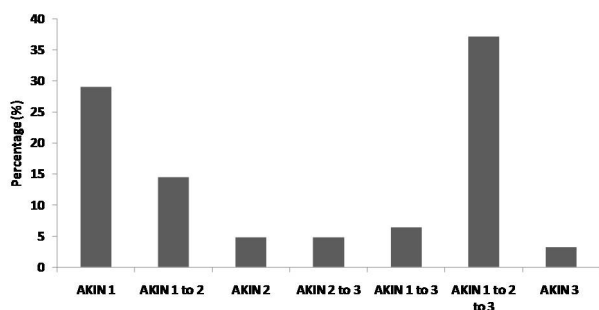
Introduction: Accurate and prompt identification of acute kidney injury (AKI) may be critical for effective management of burn patients. We have developed a smart alert system that scans the patient charts continuously to check for indicators of AKI in our burn patients as defined by the Acute Kidney Injury Network (AKIN) criteria. The system automatically alerts the ICU core staff when one of these conditions are found via a secure email notification system. The objective of this study was to analyze rates of AKIN alerts in our burn ICU patients.

Methods: We performed a retrospective review of all consecutive patients admitted to our burn ICU from Feb 2011 to Aug 2011 who had at least 1 AKIN alert during their ICU stay. AKIN alerts were classified into AKIN 1, 2, and 3 stages (or as increased criteria - i.e. AKIN 2 to 3) depending on the patient's serum creatinine (SC) values and urinary outputs (UOP) as defined by the standard AKIN criteria. Additionally, patients requiring continuous renal replacement therapy (CRRT) were also classified as AKIN 3 and alerted on.

Results: There were 329 patient admissions to the ICU during the study period. The smart alarm system generated AKIN alarms on 19% (62/329) patients for a total of 640 alerts. Overall, there were 1.94 (640/329) alerts per patient over the study period with an average of 10 (640/62) alerts per patient for those who met AKIN criteria. AKIN 1 alerts constituted 35% (227/640) of total alerts, AKIN 2 (including increase to AKIN 2) was 27% (170/640), and AKIN 3 (including increase to AKIN 3) was 37% (243/640). There were 29% (18/62) patients who did not get above AKIN 1 and 37% (23/62) who passed through the entire AKIN spectrum (1, 2, and 3) (Figure 1). Average number of days from ICU admission till first alert was 2.33 ± 3.30 .

Conclusions: This analysis demonstrated that a smart AKIN alarm system is viable in the ICU environment. AKI may begin early after admission, and patients who increase in severity from AKIN 1 are prone to develop the full spectrum of AKI. Further analysis is warranted to determine if the use of this alarm system contributes to effective intervention.

Applicability of Research to Practice: AKI is common in burn ICU patients. By increasing provider awareness of AKI, a smart alarm system may improve outcomes in critically ill burn patients.



218. Achieving Burn Pediatric Specialty Clinic Designation in a Non Pediatric Hospital

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Introduction: Most states have regulatory agencies regarding the well being, health, and safety of the children under its jurisdiction. Our facility was being surveyed by such a regulatory agency to assess that the facility was practicing within the standards and guidelines that the agency has placed for the care of a pediatric population. The initial review was being performed to look at the inpatients. Due to the high volume of patients that are being seen in our burn clinic, this regulatory agency had initiated a new requirement that burn clinics be deemed "specialty clinics".

Methods: A retrospective review of outpatient medical records was performed. Based on our findings, our best practice standards of documentation were reviewed, revised, and implemented reflecting the new specialty clinic designation guidelines. Staff (medical house staff, midlevel providers, and nursing) were educated on the guidelines, as well as changes being implemented to the documentation standards. Quarterly reviews were then performed to reflect compliance with changes in documentation standards from a random sample of medical records. 13 data points were chosen reflecting elements of documentation showing a pattern of inconsistency, such as medication reconciliation, photo documentation, nursing and physician assessment, school and work readiness and vital signs including height/weight and head circumference.

Results: 420 pediatric patients with 1340 clinic visits were seen over the year. 54 medical records equally 167 visits were reviewed. Overall completeness of documentation rose from 49% to 79%. 3 elements had the most significant improvement: medication reconciliation- 12 to 60%, school readiness - 10 to 80%, and height/weight - 47 to 100%.

Conclusions: Increasing regulatory requirements and oversight in the face on limited manpower resources has become more challenging to meet. Well thought out solutions to meet these regulatory requirements may be difficult to implement due to the multiplicity of providers and the scope of the requirements. Only by systematically mapping and linking common requisite documentation and compliance with directives can one stay on top of the increasing volume of legislative mandates. Long term compliance with early initiative seem to wan as new directives are added The electronic record needs to be leveraged in order to assist with these tasks, but in the end it is the clinic personnel who can only assure the tasks are completed.

Applicability of Research to Practice: This research demonstrates compliance with required documentation not only to meet regulatory guidelines but to reflect adherence to our current best practice standards.

**219 . A Dedicated Student Nurse Extern Program:
Effective for Burn Nurse Retention**

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Introduction: Burn Nursing is often overlooked as an employment opportunity among experienced nurses and new graduates secondary to the nature of care provided and limited exposure during nursing school. Since 1993 our burn unit has offered a dedicated 12 week student nurse extern program. Students are hired for pay without benefits and are precepted by an experienced burn nurse throughout the summer and are integrated within the multidisciplinary team. At the completion of the program, students may be selected to stay on as employees and work while attending classes to complete degrees. The purpose of this abstract is to review our nurse retention rates between those nurses who started as a student in the burn center compared to nurses hired without burn student experience.

Methods: Through the help of the human resource department at our institution, a retrospective data report was pulled of all nurses and students hired to the burn center between 2002-2010. Retention rates were calculated for all nurses hired during this time period. The mean retention rate duration of nurses hired with extern student experience (Group A) was compared to the mean retention rate duration of nurses hired without an extern student experience (Group B).

Results: From 2002-2010, 25 student nurses (Group A) were hired within the burn center. Following graduation, 16/23 students (70%) were hired within the burn center as graduate nurses and transitioned to RN's. Two students were not offered positions secondary to performance. Eleven of the sixteen (68.75%) remain working in the burn center today. During the same time period, 16 nurses (Group B) were hired to the burn center without a burn student experience. The mean retention duration of Group A is 38.15 months (range = 7-121months). Comparatively, Group B's (16 nurses) mean retention duration was 15.53 months (range = 1 month - 36 months). When comparing Group A and Group B's mean retention rates the difference was found to be statistically significant ($p = 0.0198$).

Conclusions: The ability to offer student nurse experience within the burn center is vital to burn nurse retention within our burn center. Our student nurse extern program is a critical aspect of team building and emersion to grow and develop future burn nurses. We currently offer observation experiences to local and statewide nursing schools within our burn center. Additionally our team provides professional burn education lectures to several statewide nursing schools as a way to promote burn care as a profession.

Applicability of Research to Practice: The use of student nurse programs to increase retention of burn nurses.

**220 . Healing Efficacy of Sea Buckthorn
(*Hippophae rhamnoides* L.) Seed Oil on
Burn Wounds in Sheep**

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Introduction: Sea buckthorn (*Hippophae rhamnoides* L.) seed oil is a rich source of unsaturated fatty acids, phytosterols, carotenoids and flavonoids, which are known to have significant anti-atherogenic and cardioprotective activity. Recently it is becoming an essential component of skin care products. It is abundant with Omega-7, which is known to promote epithelization of skin and mucosal tissue. The aim of the present study was to investigate the efficacy of Sea buckthorn seed oil on the burn wound healing.

Methods: Three adult sheep were subjected to homogenous 3rd degrees flame burn. Two burn sites (10cm×10cm each) were made on the right dorsum of the animal with 2cm space between. At 24 h after injury, eschar of burned tissue was removed and wound was autografted and sheep were monitored for 3 weeks. The skin for graft harvested from other side was meshed to 1:3 ratio and trimmed to the size of the wounds. The autograft was placed directly on the fascia and 20ml of Sea buckthorn seed oil (kind gift from Gangar Co Ltd., Ulaanbaatar, Mongolia) were topically applied on one of recipient and donor sites. The remaining sites were treated with vehicle. Opsite® (Smith&Nephew Inc.,FL), was placed over the first dressing layer. All wounds were closed by tie over dressing with 5 sheets of gauze. The wounds of the donor site were closed with ALLEVYN®(Smith&Nephew Inc.,FL). The wound healing was monitored for 3 weeks. The wound blood flow (LASER Doppler machine, PeriFlux System 5000 ModelPF5001, PERIMED), and epithelization (ultrasound machine, Veno 770 High-Resolution imaging system, VisualSonics and histology) were determined at 6, 14 and 18days after the injury.

Results: Six days after grafting, no remarkable difference between treated site and untreated sites was observed. But 14 days after grafting, total percentage of epithelization in treated site was greater than in untreated site ($95 \pm 2.8\%$ vs. $83 \pm 4.4\%$). The total percentage of epithelization of donor site was also higher in treated site ($92 \pm 8\%$ vs. $81 \pm 4.6\%$). This was associated with much greater peripheral blood flow in both treated recipient (60 vs. 50PU) and donor sites (120 vs. 100PU) compared to untreated sites, respectively. Ultrasound and histological examination revealed faster and more regular epithelization of autograft treated with Sea buckthorn seed oil.

Conclusions: In conclusion, Sea buckthorn seed oil has significant wound healing activity in full-thickness burn wounds and split-thickness harvested wounds. The future studies will be designed to explore the underlying mechanisms of salutary effects of buckthorn seed oil.

Applicability of Research to Practice: The findings could be directly translated to clinical practice.

221 . Debridement of Burn Eschar Using Bromelain Preparation (DGD)

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Introduction: DGD, a Bromelain based enzyme, aims to achieve rapid, complete and selective, non surgical eschar removal, ending with a raw wound bed that can be accurately diagnosed for depth, grafted or allowed to epithelialize spontaneously. The retinue of chemical/enzymatic debriding agents is generally perceived as slow and inefficient. We present our experience using DGD in the frame of three phase II and one phase III international multicentre trials.

Methods: The first two studies were controlled versus standard of care (SOC), comparing the safety and efficacy of DGD with SOC. Patients who had sustained 4%-30% TBSA, Ilo / IIIo thermal burns were included. After a two hours soaking of target wounds with saline swabs, DGD was applied (within 48h of sustaining the thermal injury) and left in situ for four hours. After a further two hours of saline soaking to wash the residual enzyme the wound was examined, and dressed with framycetin cream and hydrocolloid gel. Wounds were subsequently skin grafted or allowed to heal spontaneously by epithelialization.

Results: A total of 21/36 patients were treated with DGD and showed satisfactory enzymatic debridement (average >90%) achieving red wound bed with fresh capillary bleeding. Average BSA treated with DGD ranged from 10.5-16.5% in the four trials. Average pain assessment on VAS score increased from 4.2 pretreatment to 5.2 after DGD in the first trial. However, prophylactic analgesia 30 min before DGD application in last three trials actually lead to pain reduction during DGD application. All superficial partial thickness burns healed in 3 to 5 weeks. Decision to skin graft the debrided wounds were taken within first week of debridement. An average of 4% BSA grafting was carried out in 4/8 patients treated with DGD in the first trial. There were no serious adverse events or adverse events in the trial barring one death in the first trial in a patient who died because of worsening COPD. In subsequent trials COPD patients were part of exclusion criteria.

Conclusions: DGD application leads to adequate and selective debridement of burn eschar and rapid epithelialization by preserving viable dermis. The selective debridement quite often obviates the need for autografting.

Applicability of Research to Practice: It can be employed as a minimally invasive method for debriding burn wounds up to 30% TBSA per protocol. This appears to be a very reliable debriding agent for the developing world where a large number of patients are still managed by conservative techniques.

222 . Efficacy of Pirfenidone in Post-Dermal Burns Hypertrophic Scars: A Multicenter Experience

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Mexico*

Introduction: Pirfenidone, (5-methyl-1-phenyl-2-[1H]-piridone) has been shown to be useful in the treatment of several fibrotic diseases, including skin hypertrophic scars. Its main mechanism resides in its Anti-TNF α and Anti-TGF β action, inducing a decrease in the synthesis and deposition of extracellular matrix.

Methods: We show the use of Pirfenidone in the treatment of post-burns hypertrophic scars. Bio-availability of the drug was carried out in healthy human subjects. Sixty patients with variable times of scar evolution (6-36 months) whom they were virgin of treatment were included. They were followed up for six months using clinical parameters and the Vancouver scale. Photographic measurements were recorded each month during six months. Patients were recruited at 2 different hospitals. Patients had different extensions of scars involved ranging from 1 to 30% of body surface. Pirfenidone was applied in specific hypertrophic scar areas in the form of a 8% gel, three times a day during six months. Safety follow up was determined by the presence of adverse events and monitoring laboratory and hematology parameters.

Results: No serious adverse effects were observed. Only minor side events were noted in 15 % of the patients, i.e. itching, local erythema, which resolve after one hour of topical application with no further co-adjuvant medication. Patients responded to the treatment with variable degrees. Twenty patients experienced a notable reduction in vascularity, pigmentation, pliability and elevation of the scar, which was quantitatively measured by Vancouver scale (50-55% reduction). Twenty one patients, as measured by the same parameters, showed a 40 % improvement. The rest of the patients showed a different degree of response varying from 23 to 30 %.

Conclusions: These results demonstrate the uniqueness of patient response to the treatment. This therapeutically strategy might be considered as a useful alternative for patients with hypertrophic scars.

Applicability of Research to Practice: This study opens the opportunity to begin more and completed studies about new antifibrotic agents such as Pirfenidone in the treatment of post burn scars.

223 . Selectivity of a Bromelain Based Enzymatic Debridement Agent: A Porcine Study

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Introduction: Debridement of the burn eschar is a fundamental of burn wound care. Rapid enzymatic debridement with a bromelain-based agent has recently been investigated. The current study was designed to further investigate the selectivity of Debrase to burned eschar.

Methods: A prospective animal experiment was conducted to determine the effects of Debrase on normal skin, burns, donor site and skin punch biopsy wells. Partial thickness dermal burns and donor sites were created on a pig and treated with a 4-hour application of Debrase or its control vehicle. Punch biopsy samples were taken before and after treatment and observed under conventional light microscopy for evidence of tissue viability and thickness.

Results: Rapid dissolution of the burn eschar was noted in all Debrase but not vehicle treated burns. There was no apparent damage to the underlying sub eschar dermis, donor sites, normal skin or punch biopsy wells after exposure to Debrase. While the thickness of the treated tissues increased due to edema, the increase in dermal thickness was similar after treatment with Debrase or its vehicle. The increase in the surface area of the treated punch biopsy wells was similar after treatment with Debrase and its control vehicle.

Conclusions: Exposure of the burn eschar to Debrase results in its rapid dissolution. Exposure of normal skin or non-burned dermis to Debrase has no effects demonstrating its selectivity to eschar.

Applicability of Research to Practice: These findings support the clinical safety of Debrase for debridement of human burns.

224 . The Effect of Controlled Mild Hypothermia on Survival in a Resuscitated Rat Model of Large Scald Burns

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Introduction: Although early surface cooling of burns reduces pain and depth of injury, there are concerns that cooling of large burns may result in hypothermia and worse outcomes. In contrast, controlled mild hypothermia improves outcomes after cardiac arrest and traumatic burn injury. The authors hypothesized that controlled mild hypothermia would prolong survival in a fluid resuscitated rat model of large scald burns.

Methods: Forty Sprague-Dawley rats (250-300 g) were anesthetized with 40 mg/kg intramuscular ketamine and 5 mg/kg xylazine, with supplemental inhalational isoflurane as needed. A single full-thickness scald burn covering 40% of the total body surface area was created per rat using a Mason-Walker template placed in boiling water (100°C) for a period of 10 seconds. The rats were randomized to hypothermia (n=20) and non-hypothermia (n=20). Core body temperature was continuously monitored with a rectal temperature probe. Hypothermia was induced through intraperitoneal injection of cooled (4°C) saline. The core temperature was reduced by 2°C and maintained for a period of 2 hours, applying an ice or heat pack when necessary. The rats were then rewarmed back to baseline temperature. In the control group, room temperature saline was injected into the intraperitoneal cavity and core temperature was maintained using a heating pad as needed. The rats were monitored until death or for a period of 7 days, whichever was greater. The primary outcome was death. The difference in survival was determined using a Kaplan-Meier analysis or log rank test.

Results: The mean core temperatures were 32.5°C for the hypothermic group and 35.6 °C for the normothermic group. The mean survival times were 124 hours for the hypothermic group (95% confidence interval [CI] = 98 to 150) and 100 hours for the normothermic group (95% CI = 68 to 132). The seven-day survival rates in the hypothermic and non-hypothermic groups were 67% and 53%. These differences were not significant, P=0.33 for both comparisons.

Conclusions: Induction of brief mild hypothermia increases but does not significantly prolong survival in a resuscitated rat model of large scald burns.

Applicability of Research to Practice: In the future, large animal models should be used to more closely approximate human physiological response.

225 . Chronological Histological Findings of Cultured Epidermal Autograft over Artificial Dermis Focusing on Basement Membrane Proteins

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Introduction: Bilayer artificial dermis has been used for dermal coverage after debridement of burns from the late 1990s and has become a common procedure for burn treatment. After regeneration of dermal layer, it need to be closed with thin split thickness auto skin graft. To minimize the donor site morbidity, cultured epidermal autograft (CEA) is used.

However, CEA over regenerated dermis is very fragile and easily falls off, in a early period after CEA application, because the attachment of CEA and dermis is very week.

Methods: To investigate the fragility of CEA, we performed chronological histological studies were performed. Immunohistochemistry of anti-type IV, VII collagen, and laminin for evaluating basement membrane proteins, anti-type III collagen for dermal comporment, and H&E/EVG staining were performed.

Results: (showen in the table)

Conclusions: Absence or immature of basement membrane protein is one of the cause of these problems.

Applicability of Research to Practice: Preserving basement membrane in manufacturing process of CEA is desirable.

Days after CEA applicatuin (Integra replacement)		0(28)	58(30)	107(80)	184(159)	272(245)	321(294)
Basement membrane	Type IV	(-)	week	+	+	+	+
	Laminin	(+)	week	no	no	no	+
	Type VII	(+)	no	no	no	no	no
Dermis	Inflammation		+	week	week	week	week
	Elastic fibers			no	no	week	+
	Type III		no	+	+	+	+

226 . Wounds Healing of Partial Thickness Burns with Biological Dressing of Cultured Human Keratinocytes Live (EPIFAST)

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Introduction: Commonly partial thickness burns are a combination of superficial, deep and full thickness, which makes the treatment as a graft may be too, and a advanced dressing may not be enough, as important is the quality of life that we are offering the patient burned, so that the aesthetic sequel takes on major importance in the treatment, with the autografts sequel we always will have a functional and aesthetic perhaps: in the case of advanced dressings if delayed re-epithelialization, the possibility of a hypertrophic scar is almost 80%. Therefore it is desirable to explore technologies that promote rapid epithelialization, minimizing the use of autografts.

Objective: To evaluate the effectiveness of EPIFAST, a biological dressing releasing growth factors (VEGF, TGF, EGF, TGF-b and a) which promote the proliferative and remodeling phase of an injury, leaving aside the inflammatory phase (aided by tangential scarectomy) and thus promoting rapid re-epithelialization of the wound.

Methods: Patients with burns by scald and fire, which during the first 48 hours after burn was performed tangential scarectomy with dermatome Silver, and was supplemented with versajet; Epifast and bandage was applied for 4-6 days, subsequently the wound was revised the balneotherapy, according to its evolution choose a new application of Epifast vs. autograft for waste areas. A sample of scarectomy for histological confirmation of the depth of the lesion and the level of scarectomy.

Results: We included 72 patients with an age range from 1 to 9 years, 38 male and 36 female, 23 were burned by fire 31.94%) and 49 with scald burns (68.05%). The BSTB rank was from 10 to 42%%. We obtained re-epithelialization with 2 application of epifast alone in the 95% of the wound in 51 patients (70.85%), and 2 applications of epifast and autograft in 21 patients (29.15%), because these patients have wound healing in the 85% of the original wound. The histopathological study reported dermatome cutting depth to the reticular dermis.

Conclusions: Having made this wound a deep partial thickness with the scarectomy, and having achieved a total epithelialization with epifast alone in 70% of the patients within the first two weeks, this dressing could be considered as a very valid option for this deep partial thickness burns, because these injuries most often finish late in autografts.

Applicability of Research to Practice: Wound early healing.

227 . **Wound Closure over Integrated Polymer Neo-Dermes Using Cultured Epithelial Autograft and Composite Cultured 'Skin Equivalents'**

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Introduction: The immediate application of a biodegradable temporising matrix post-burn excision requires later definitive closure. We hypothesised that cultured keratinocytes would not successfully engraft and that a robust cultured composite skin equivalent would be necessary. To test this hypothesis, we undertook two porcine studies.

Methods: Study 1 - Four 8cm x 8cm wounds were created on the backs of three large white/landrace sows, to the panniculus adiposus, after split skin grafts had been harvested. Biodegradable polyurethane dermal matrices were implanted and allowed to integrate. The epidermes from the grafts were cultured into keratinocyte suspensions and sheets. Suspensions were injected under the sealing membrane of some dermal matrices at day 7 with sealing membrane removal at day 14. Sheets were applied after delamination of the remaining matrices at day 14. Euthanasia occurred at day 29. Study 2 - Three identical wounds to Study 1 were created on the backs of 6 similar pigs after split skin graft biopsy. Sealed dermal matrices were implanted into each wound. Fibroblasts and keratinocytes were isolated for each animal and placed into culture. These were seeded onto an unsealed plasma gel-filled 1mm polyurethane scaffold in a bioreactor and used to create three 10 x 10cm composite skin equivalents, each equivalent autologous for the recipient animal. At day 28, the sealing membranes were removed and the composites applied to two of the matrices. A split skin graft was harvested from the 'fourth' wound site and applied to the final integrated matrix. The donor site was converted to a deep wound and the third autologous composite applied onto the panniculus adiposus. Euthanasia occurred on day 42.

Results: Study 1 - despite the clinical suggestion of neo-epidermal development, histological analysis failed to demonstrate any epidermal structure after application of either form of CEA. Study 2 - creation of the autologous composites progressed to completion, validating the bioreactor model. By the abstract submission deadline, the animals had all dermal matrices integrated and were 8 days from composite application. The full results of this study will be available at the 44th ABA Conference.

Conclusions: Success reported with CEA application over dermal matrices is rare. We thus suspected that CEA, applied when ready and thus of clinical value, would not meet with take. The development of composite skin equivalents using a biodegradable polyurethane scaffold has been successful in incorporating both dermal and epidermal elements. Since their creation takes longer, the dermal matrix is more adequately vascularised and at least 'proof of concept' is expected.

Applicability of Research to Practice: This work has led to pilot human trials.

228 . **Burns Occurring to Rural Older Adults: The Implications of Geography and Access to Care**

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Introduction: The older adult population in rural areas is increasing at a faster rate than in urban areas. Older adults in rural areas have different patterns of burn injury and unique care issues related to geographic isolation. In much of the rural Western United States, specialized burn care may be many miles away and local communities have limited health care resources for the acute and rehabilitative treatments of burns. The purpose of this study is to describe the geographic factors associated with burns in rural older adults in a Western state and their implications to both burn care and return to independent living.

Methods: A probabilistic linkage of state Emergency Department (ED), Hospital Discharge (Hosp) and Vital Records (Death) databases was performed to identify adults 65 years of age and older who were treated for injuries during 2007-2008. All ED, Hosp and Death records occurring after the initial injury were included in the final dataset in order to examine injury treatment trajectories. Individuals were categorized as rural residents if they lived in counties with population densities of less than 100 people per square mile.

Results: There were 32,437 older adults injured during the two year study period. Of these, 180 (0.6%) experienced burn injuries. One third (n=58) of burns occurred to older adults from rural areas. The majority of rural burns (60%) occurred to men and the mean age was 72 years. Fire/flame scalds (41%) were the predominant etiology followed by scald (26%) and chemical burns (19%). The majority (72%) of rural older adults with burns were treated at an ED only, 17% were hospitalized for burn treatment, and 10% died from burn injuries. Only 30% of hospitalizations were in a local rural community and 50% of hospitalized patients were admitted to the regional burn center. Nearly 20% of rural burn patients had subsequent ED and hospital visits for non-burn related diagnoses resulting in an additional 3% mortality during the study period.

Conclusions: The majority of burns occurring to older rural adults do not result in hospitalization. However, burns requiring hospitalizations are rarely treated locally. The transfer of rural older adult burn patients to regional hospitals, usually located some distance from their homes, can result in isolation from family members while in the hospital. Further, discharge planning can be complicated by the rural health care resources and the longer distances older rural burn patients must travel for follow-up burn care.

Applicability of Research to Practice: Understanding that older rural adults have unique injury risks and health care access issues related to geography can help burn care providers in assessing the local health care resources available for rural.

229 . The Correlation Between Burn Mortality Rates and Economic Status of Countries

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Introduction: Over 90% of burn deaths occur in low- and middle-income countries globally. However, the association between burn mortality rates and economic health has not been evaluated for individual countries. This study seeks to answer the question, how strong is the correlation between burn mortality and national indices of economic strength?

Methods: A retrospective data review was performed of 189 countries with economic data from the World Bank as well as mortality data from the World Health Organization. Countries were divided into 5 groups based on income level according to stratification by the World Bank (low-income, lower middle-income, upper middle-income, and high-income [OECD and non-OECD]). Data were available from 2002-2010. The Pearson Correlation was used to estimate presence and strength of association among death rates, country income level, GINI coefficient (measure of inequality of distribution of wealth), gross domestic product (GDP) per capita, and gross national index (GNI) per capita.

Results: There were statistically significant associations ($p < 0.0001$) between burn mortality and country income ($r = 0.5$), GDP per capita ($r = 0.41$), and GNI per capita ($r = 0.42$). However, the association between burn mortality and GINI coefficient had only a weak correlation (0.13) and was not statistically significant. Unfortunately, GINI coefficients were only available for 157 countries, making conclusions based on this analysis less reliable.

Conclusions: The income level of a country is negatively correlated with burn mortality—the lower the country income level, the higher the burn mortality rates. However, the degree to which income within a country is equitably or inequitably distributed does not correlate with burn mortality. In 2008, the WHO published a plan for burn prevention and care, in which specific action items are detailed (http://whqlibdoc.who.int/publications/2008/9789241596299_eng.pdf). Governments and non-governmental organizations should be urged to enact this action plan.

Applicability of Research to Practice: Efforts of both governmental and non-governmental organizations need to focus on preventing burns in low-income countries.

230 . Feasibility and Accuracy of Photographic Assessment of Thermal Injury: Innovative Approach to Evaluation of Burn Wounds in a Resource-Poor Setting

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Introduction: Burn injuries contribute significantly to global burden of disease, and the vast majority of burns occur in low- and middle-income countries. Measurement of Total Body Surface Area (TBSA) and wound characteristics provides useful prognostication, and guides decisions regarding management, such as timing of wound care and necessity for skin grafting. There is a dearth of burn trained clinicians. Therefore an innovative solution to optimize burn wound assessment in resource poor settings is to utilize digital photographic images for remote burn assessment, to circumvent the lack of trained health care providers in the vast number of rural settings. The purpose of this research is to investigate the accuracy of remote photographic burn wound assessment as an alternative to direct clinical exam.

Methods: Burn wounds of patients admitted to Kamuzu Central hospital (KCH) burn ward were photographed during routine dressing changes while, simultaneously, an experienced clinician estimated the TBSA, wound depth, location, evolution, and necessity of skin graft by clinical inspection. Photographs were then presented to the burn clinician blinded, after an interval of 4-6 weeks. Correlation between clinical assessments and remote photographic image evaluations were made using Kappa score for categorical variables and Pearson's Correlation Coefficient for continuous variables. Statistics were performed using STATA v11.

Results: Forty-five wounds were included in evaluation of burn characteristics, and twenty in evaluation of TBSA. Average %TBSA for clinical evaluation and photographic review was 19.2 and 18.8%, respectively. Average difference between the two estimations was 2.65(range 0-8%) with a Pearson's correlation coefficient of 0.9543($p < 0.001$). Correlation coefficients for proportion of wound that was full thickness was 0.9483($p < 0.001$), or partial thickness was 0.9463($p < 0.001$), and for percentage of epithelialized superficial wounds was 0.8847($p < 0.001$). Kappa scores for agreement of location, evolution of full thickness wounds, and prognosis were 0.8323(SE 0.13 $p < 0.001$), 0.5673(SE 0.09 $p < 0.001$), and 0.7082(SE 0.15 $p < 0.001$), respectively. These correlate to agreement that ranges from moderate to almost perfect (Landis, Koch 1977).

Conclusions: We were able to feasibly and accurately assess burn wounds by evaluation of digital photographic images.

Applicability of Research to Practice: This innovative strategy is a viable alternative to in situ presence of a burn-trained clinician and can be adopted by modern cell phone technology—readily available across the world, including sub-Saharan Africa. This we believe will form the basis for affordable telemedicine for burn care in developing countries.

231 . Guidelines for the Treatment of Burns on Volunteer Missions

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Introduction: Burn surgical missions do not fit the mold of classic surgical missions. Preop analysis, intraop decision-making, and postop care require much more sophisticated knowledge and experience than for example cleft or eye surgery. Furthermore, burn reconstruction complications can be life or limb-threatening.

Methods: This presentation represents a compilation of data and photographic documentation gathered from more than 40 trips, 35 years worth of volunteer missions, many of which involved acute and reconstructive burn care and education. It includes algorithms and recommendations for site visit criteria, team composition, preop screening, surgical scheduling, postop clinic and an atlas of burn reconstruction tips from head to toe.

Results: From this personal and professional experience can be shared knowledge and wisdom gathered as well as pearls and pitfalls.

Conclusions: Medical tourism from the health provider point of view can be an extremely formative and exciting adventure as well as a spiritual uplift. Care must be taken to do no harm, be aware that there is no such thing as pure altruism and to hope-fully participate in a mutually beneficial endeavor.

Applicability of Research to Practice: As there are more and more burn missions in an attempt to alleviate a worldwide need for burn reconstruction and education, we must make sure we are doing the best we can and learn from past experience.

232 . An Emergency Healthcare Coalition-Based Approach to Burn Mass Casualty Planning

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Introduction: Burn mass casualty incidents (MCI) on and since 9/11/2001 have underscored the need for local and regional burn mass casualty plans (MCP). A significant burn MCI in any large city could exceed the surge capabilities of the local burn centers. Our purpose was to develop a comprehensive burn mass casualty plan for this urban area.

Methods: Interested professionals from the local adult and pediatric burn centers, the local Emergency Healthcare Coalition (EHC) and the local Department of Health convened to develop a burn MCP. Based on experience with prior disaster drills and available literature, a preliminary draft was prepared and was evaluated by outside experts prior to implementing a final plan.

Results: Identifying a reporting and responsibility matrix was considered the key to success. The Burn MCP utilizes the EHC Healthcare Crisis Response Team (HCRT) to coordinate a city-wide response. During a crisis, the HCRT facilitates communication and provides situational awareness within the city, activates a Burn Advisory Task Force, and notifies the Regional Burn Disaster Consortium (RBDC). The Burn Advisory Task Force provides clinical guidance to caregivers and assists with secondary triage and transport of victims based on American Burn Association (ABA) guidelines. In addition, the RBDC works with the ABA and HHS to locate available burn beds throughout the region.

Conclusions: Developing a Burn MCP for this city was a first step in providing a coordinated response to a burn MCI in the region. A full-scale exercise will be staged to evaluate and refine the plan. Further integration with neighboring states, as well as the adjacent ABA regions, is needed to fully prepare for a burn MCI in this city and the burn center's local service regions.

Applicability of Research to Practice: This collaborative work illustrates planning for MCI with a regional approach.

233 . Outcomes of Burn Patients Transferred by Aircraft

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Introduction: As burn care becomes more regionalized, patients are being transported longer distances via air to reach a burn center. The risk-benefit ratio of patient air transport has been questioned. The purpose of this study was to analyze the patient outcomes after burn center transfer via aircraft and identify mortality risk factors in air transport.

Methods: This was a retrospective TRACS database and chart review of burn air transports to a regional pediatric burn center from 1997-2010. Variables analyzed included patient demographics (age, gender, race), injury characteristics (burn size, inhalation injury, PRISM score), transportation issues (interval from injury to burn center arrival, complications, transfer origin), and outcomes (hospital and ICU length of stay, mortality).

Results: In the 783 air transports assessed, mean patient age was 7.1 ± 0.3 years, total body surface area (TBSA) burn $25.5 \pm 0.8\%$, and 22% had inhalation injury. Mean interval from injury to burn center admission was 8.3 ± 1.1 days, and mortality 6.3%. For transports within the first week of injury (571), survivors (S) differed from non-survivors (NS) in TBSA (22.9 ± 0.9 vs. 58.2 ± 3.9 , $p < 0.01$), inhalation injury (18.7% vs. 82%), PRISM score (10.5 ± 0.8 vs. 18.6 ± 2.5 , $p < 0.01$), and duration of mechanical ventilation (9.7 ± 1.0 vs. 30.9 ± 7.4 , $p < 0.01$). No difference existed in interval between burn injury and arrival at the burn center (1.7 ± 0.1 vs. 1.8 ± 0.2 , $p = 0.7$). Patients transported from outside the U.S. (total of 340) differed from U.S. transfers (total 271) in age (7.3 ± 0.3 non-U.S. vs. 6.0 ± 0.3 U.S. years, $p < 0.01$), TBSA burn (35.0 ± 1.2 non-U.S. vs. 15.3 ± 1.0 U.S., $p < 0.01$), inhalation injury (30% non-U.S. vs. 15.5% U.S.), ICU stay (26.6 ± 1.9 non-U.S. vs. 8.2 ± 1.6 U.S., $p < 0.01$), and mortality (10.5% non-U.S. vs. 3.9% U.S.). NS from non-U.S. transports had more inhalation injury (83% vs. 27%) and longer interval from injury to burn center arrival than U.S. transports (2.2 ± 0.2 vs. 1.3 ± 0.5). TBSA, age, length of stay, PRISM score, and ventilation duration did not differ between U.S. and non-U.S. transports.

Conclusions: Outcomes from air transport of burned children depend on burn size, inhalation injury, and U.S. vs. non-U.S. transport. Non-survivors in the U.S. and non-U.S. groups had similar injury characteristics, but transport delays were greater and survival lower for non-U.S. transports. U.S. air transports were smaller (15% TBSA) and may not have required air transport. Expedient air transport and protocols emphasizing inhalation injury and large burn management should be developed for international transports.

Applicability of Research to Practice: Identification of risk factors for air transport.

234 . Survey of Burn Care and Proposal for Burn Center in East Africa: An International Academic Burn Center Exchange

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Introduction: Burn injury in low and middle-income countries (LMIC) is a leading cause of disability-adjusted life years (DALYs), though improving care remains challenging. To address this burden of injury from an academic institutional approach, the burn center of a United States (US) medical center partnered with its affiliate hospital in East Africa to consider the development of a burn center there. It was hoped that the institutional partnership would provide a unique opportunity to promote sustainable academic exchange and build burn care capacity in the East African region.

Methods: In August, 2011, two US burn surgeons collaborated with the East African department of surgery to conduct an assessment of its current burn care capabilities. The inpatient wards, Emergency Department (ED), operating theatre, burn care, rehabilitation, nutrition, and fire department/outreach were reviewed.

Results: The East African hospital is an academic 900-bed regional referral center serving a population of 15 million; no burn center exists in the area. In 2009-10, burn cases represented 36/4262 (0.8%) adult and 81/2549 (3.2%) pediatric admissions, and 58/3800 (1.5%) operative cases. The ED initiates resuscitation, but intubation capabilities are limited. Surgeons operate in five rooms with general anesthesia. Burn surgery instrumentation is limited to a Watson handle without blades and skin mesher and dermatome in need of repair. Patient's families perform wound care without pain medication, and burns are managed using the open technique with grafting on granulation tissue; topicals are cost-prohibitive. Three rehabilitation therapists consult as needed. Nurses provide general care to approximately 40 patients. Porridge, beans, and milk are provided three times daily with meat twice a week and vegetables as available. There is no nutritional supplement and no hospital dietitians. Two stations with 20 paid firefighters and three engines serve the city, utilizing its fire hydrant system; firefighters receive limited training and protective gear. Public health outreach initiatives are possible through village-based traditional communication networks.

Conclusions: Infrastructure to support the development of a burn care center exists in this academic East African institution, but the clinical attention given to burns currently is limited. Accepted LMIC burn data suggests that low numbers of burn patients in these local ward logs may be inaccurate. A multi-disciplinary burn care center could standardize record keeping, track and improve outcomes, encourage referrals from district hospitals, and facilitate training/outreach through the fire department and village networks.

Applicability of Research to Practice: International Outreach.

235 . The Effectiveness of Propranolol in Controlling Symptoms of General Anxiety and Depression in Pediatric Burn Survivors

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Introduction: Research investigating the effects of propranolol for prevention of posttraumatic stress disorder among adult trauma survivors has shown mixed results. To date limited work has been done to evaluate the psychological benefits of propranolol with pediatric burn survivors. We hypothesized that propranolol given during the acute phase of burn recovery would lead to better psychosocial outcomes (fewer depression and anxiety disorders) for pediatric burn survivors given the medications buffering effect on memory reconsolidation and the physiological reduction of emotional sequelae evident during stress.

Methods: Participants initially treated with propranolol in a double-blind-randomized study and controls were invited to participate in this study at their follow-up appointments. They were administered self-report inventories to measure current anxiety (RCMAS) and mood (CDI) (ages 6-17) and (BDI) (ages 18-21).

Results: We collected data on a sample of 181 participants, (72 in the propranolol group and 109 in the control group). The present results are presented primarily between these two groups. The mean age of this sample at the time of burn was $7.2y \pm 4.7$ (propranolol) and $7.5y \pm 4.5$ (control); the mean age at time of recruitment was $12.6y \pm 4.4$ (propranolol) and $13.6y \pm 4.4$ (control); and the mean TBSA was $56\% \pm 15$ (propranolol) and $57.0\% \pm 15$ (control). The majority of the participants were Hispanic/Latino 94%. Comparison of the these groups on the RCMAS total anxiety score and 4 subscales, CDI total depression score and 5 subscales, and BDI total score revealed no significant differences ($p < .05$).

Conclusions: Overall, children in this study appeared well adjusted post-burn. The hypothesis that propranolol given in the acute phase of recovery would prevent later depression and anxiety disorders was not proven. It is possible that early psychological intervention following initial trauma may have prevented future psychosocial difficulties. However, it is important to take into account cultural factors and support networks that may have affected results.

Applicability of Research to Practice: More research about the benefits of propranolol in pediatric burn care is indicated.

236 . Effect of Propranolol on Social Anxiety in Youth with Large Burns

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Introduction: Extant research has examined the effects of propranolol on anxiety symptoms in adult burn survivors, but no studies have investigated the impact of propranolol on anxiety symptoms in children or adolescents. For this reason, the present study examined whether propranolol administered in the acute phase of recovery affected the development of social phobia in pediatric burn survivors. We expected that children who received propranolol during the acute phase of recovery would have less social anxiety than children who did not receive this drug.

Methods: Participants initially treated with propranolol (prop) and controls in a randomized clinical trial were invited to participate in this study during follow-up. The groups were matched on age and total body surface area burned (TBSA). Both groups were evaluated for current social anxiety with the Social Phobia and Anxiety Inventory for Children (SPAI-C), which assesses frequency of cognitive, behavioral, and somatic symptoms, yielding a total score and three scale scores.

Results: Preliminary data included 183 pediatric burn survivors (68 prop, 115 control), 117 (64%) males and 66 (36%) females. The majority were Hispanic. Mean TBSA burned was $56.3\% \pm 14.8$ (prop) and $57\% \pm 15$ (control). Mean age at time of burn was $7.2y \pm 4.7$ (prop) and $7.5y \pm 4.5$ (no-prop), and mean age at assessment was $12.6y \pm 4.4$ and $13.6y \pm 4.4$. There were no significant differences between groups in overall social anxiety or anxiety across different situations (assertiveness, traditional social encounters, and public performance). However, 14.68% of controls reported clinically significant social anxiety compared to 9.5% of the prop group.

Conclusions: Results did not support a significant difference in social anxiety symptoms between the two groups but did suggest that prop may reduce risk of severe social anxiety symptoms. A possible explanation for the findings may be that both groups had protective factors in the acute phase, such as psychosocial interventions and family support.

Applicability of Research to Practice: More research about the benefits of propranolol for pediatric burn survivors is warranted.

237 . The Utility of Virtual Reality in Minimizing Procedural Distress with Pediatric Burn Patients

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Introduction: While recent studies show distraction is beneficial, the immersive qualities of virtual reality (VR) may provide additional benefit on management of distress and pain during burn wound care. This study examines the comparison of VR application to standard distraction techniques on an inpatient pediatric burn unit.

Methods: Newly admitted burn patients, ages 7-18 without face or head burns, were recruited over a 4-year period. Consent and assent were obtained prior to first dressing change. State/Trait Anxiety Scale (STAIC) was administered prior to dressing change. Patients were randomly assigned to VR or standard care. Children in the VR group used a headset containing the VR program during initial dressing change. The standard care group received traditional forms of distraction (ex: TV, talking). Pain and distress ratings from patients, parents, and nursing staff were recorded pre and post wound cleansing using the Faces/VAS and FLACC scales.

Results: Forty children (28 males, 12 females, M AGE = 10.3 years) completed the protocol; twenty children were randomized to VR. Twenty-three percent of patients had premorbid behavioral diagnoses. Results suggest participants in the control group reported higher post-procedure pain ratings compared to the VR group, although this was not significant ($t = 1.17$, $p = .25$). Age of participant was correlated with pain ratings ($r = .36$, $p < .05$). Groups did not significantly differ in age. While parent and nursing report indicated a higher degree of pain when compared to child report ($t = 3.5$, $p = .01$) and ($t = 1.66$, $p = .10$), respectively) these ratings were not significantly different between treatment groups. Pain ratings were not correlated with TBSA or premorbid behavioral diagnosis. Participants demonstrated greater state anxiety than trait anxiety across conditions ($t = 18.73$, $p = .00$).

Conclusions: While older patients appear to have more difficulties with pain management, application of VR during dressing changes did not lead to significant differences in reported pain levels. TBSA and premorbid behavior diagnoses did not appear to be predictors of pt's level of pain. Interestingly, both nursing staff and parents endorse an increase in pain ratings, suggesting a discrepancy between ratings and pain report assessed among the three groups. Future studies should include a larger sample size so mediating factors such as age, type of dressing, and state anxiety level could be considered. In addition, recent advances in interactive technology may provide additional benefits.

Applicability of Research to Practice: While anecdotal evidence suggests benefits of VR during painful medical procedures, statistics suggest other forms of distraction may be as beneficial.

238 . Are Pain and Itching Causing Sleep Disruption in Pediatric Burn Patients?

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Introduction: Pain and itching are two negative consequences commonly associated with burns. While it is well-documented that these issues occur in the initial healing period for burns, there is little information regarding the duration of related problems in pediatric survivors. This study sought to determine if burn-injured children report pain and itching as sleep disruption factors.

Methods: Burn-injured youth, ages 7-18, completed a comprehensive, age appropriate, sleep-screening survey as separate cohorts. Questions regarding pain and itching as Usually, Sometimes or Rarely causing sleep disturbance were included.

Results: The survey was completed by 107 children, mean age 10.6 (sd +/-1.7) and 97 adolescents, mean age 14.7 (sd +/-1.5). Duration of years since injury for children was 4.6 (sd +/-3.3), for teens 8.7 (sd +/-4.2). Many children reported that pain awakened them Usually (65%) or Sometimes (26%) vs. fewer teens Usually (6%) or Sometimes (26%). Children reported itching as Usually (70%) or Sometimes (20 %), wakening them with teens at Usually (7%) or Sometimes (22%). Female teens ($n=47$) reported both pain and itching more often than males ($n=50$) ($p \leq .05$). Teens with Scald burns reported itching more often than those with Flame/Fire burns ($p=.02$). Etiology and gender were not significant for children. Report of pain and itching were modestly correlated ($r=.43$) in both children and teens.

Conclusions: Pain and itching as chronic problems (children in this study were surveyed an average of 4.6 years post-burn) can cause significant distress in burn patients. Both can result in diminished concentration, sleep disruption and delayed healing. Stressful life events and disorders like depression and anxiety have been linked to increased reports of pruritis and pain. A majority of the children in this study reported common sleep disruption related to both, while the majority of teens, average 8.7 years post- injury, did not.

Applicability of Research to Practice: Since increased reports of pain and itching may be related to sleep disruption as well as emotional stress; several issues should be considered. The presence of pain and itching should be discussed with child burn survivors and if present the emotional well-being of the child should be considered in post-acute care treatment. The impact on other areas of the child's life such as social integration and academic success may be also be compromised and should also be addressed in the management of burn-related aftercare.

239 . **Effect of Social Environment on Brain Metabolism after Burn Injury in Rats**

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Introduction: Early childhood psychosocial deprivation has well established adverse effects on both behavior, cognition, and physical health in both humans and animals. The animal literature suggests that these problematic outcomes are long term consequences of early deprivation on brain function. In order to provide a translational tool that links the emerging data on neurobiological effects of social deprivation in the animal literature with those from the human literature, the current study compared brain glucose metabolism of sham burned (non-burned) group reared (GR) to isolation reared (IR) rats using fluorodeoxyglucose positron emission tomography (FDG PET), and between GR and IR rats after a burn injury. We hypothesized that such FDG PET scan comparisons would identify differential brain glucose metabolism between sham burned and burned injured IR and GR rats.

Methods: On post natal day 20, rats were separated into the IR or GR conditions following the procedure described previously. Briefly, rat pups were removed from the cage with their dam and randomly divided into two different housing conditions:

1) In the condition designed to model the absence of social enrichment, IR rats were singly housed.

2) In the condition designed to model the presence of social enrichment GR rats were housed with littermates in two groups of three rats.

For the comparison of IR and GR rats after burn, prior to placing the animals in these two conditions, each rat from both groups were anesthetized and subjected to a 20% total body surface scald burn, (9 s at 90 degree water). For the sham burn, the rat were anesthetized, but not subjected to burn injury. Rats were imaged using Siemens's Focus 220 scanner. This device was designed to study small animals (7.6 cm axial field of view and 19 cm transaxial field of view) intrinsic spatial resolution of 1.4 mm at the center of field of view. The rats were fasted 24 hours prior to imaging and were injected with approximately ~1 mCi of 18F FDG via tail vein. They were imaged one hour after injection for 5 min.

Results: After 4 weeks of isolation rearing, compared to sham GR rats, sham IR rats had lower mean FDG uptake in the region of the diencephalon corresponding to the thalamus. In addition, at 4 weeks post burn, IR rats had lower whole brain FDG uptake compared to burn injured GR rats.

Conclusions: FDG brain neuroimaging can be utilized to reveal unexpected, but potentially critical, changes in brain function due to the effects of differential early environmental conditions, and on how such differential environmental conditions impact burn injury healing.

Applicability of Research to Practice: The techniques developed here can be used monitor to the effects of interventions on regional brain metabolism in burn patients with various psychiatric co-morbidity.

240 . **A Novel Initiative to Support Pediatric Burn Survivor Recovery**

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Introduction: Many counseling, camp and reentry programs focus on individuals to assist pediatric burn survivors in recovery but the availability of programs that combine individual and family healing is limited. To address this, a multidisciplinary team developed a recovery program that integrates peer support with hands-on family learning experiences. The following reports on the creation, implementation and evaluation of the initiative

Methods: Anecdotal feedback from a 2006 pediatric pilot was combined with the results of a 2009 needs assessment survey distributed to those affected by burns to create a program foundation. The team created and operationalized a 3 day course for 7 - 17 yr olds and families affected by burns which was held at a survivor conference in parallel to adult programming. Prior to, immediately following and 6 months after program completion, participants/caregivers completed surveys about social experiences and perceptions. Pre- and post- results were compared using X2 (p<0.05).

Results: Between 2009-10, the team designed the program to support the goal of creating a safe accepting environment that engaged peer support and social skills to facilitate community reintegration. In 10/10, 30 youth participated, taking part in small and large group activities to promote re-integration. Pre-program, 30 of 39 participating kids (70% survivors) and 32 caregivers (78% parents) completed the survey while 23 youth and 20 caregivers and 2 youth and 15 caregivers responded immediately and 6 months post-program, respectively. When comparing results within cohorts, the program did not significantly reduce respondents' reports of difficulties in any of the areas (sampled in tables below). When comparing all pre- and immediate post-results for participants, attendees reported less difficulty with social issues following program completion.

Conclusions: The above program offered a unique, positive psychosocial experience for youth and families affected by burns. Given these findings, the program will be refined and continued.

Pre-WBC vs. Post: Youth

	PreWBC Little Difficult N=30	PostWBC Little Difficult N=23	PreWBC Not Difficult N=30	PostWBC Not Difficult N=23	PreWBC Somewhat Difficult N=30	PostWBC Somewhat Difficult N=23	PreWBC Very Difficult N=30	PostWBC Very Difficult N=23
Community	13.3	17.4	53.3	43.5	6.7	4.3	0	4.3
Bullying/Teasing	13.3	13.0	43.3	39.1	10.0	8.7	3.3	4.3
Pain	10.0	4.3	43.3	43.5	10.0	8.7	6.7	8.7
Looks	16.7	17.4	46.7	43.5	6.7	4.3	6.7	0
Family	16.7	8.7	56.7	65.2	3.3	4.3	0	0
Self	10.0	13.0	56.7	65.2	6.7	0	0	0
Loss	10.0	4.3	33.3	43.5	20.0	13.0	10.0	8.7
Peer Support	10.0	8.7	60.0	69.6	13.3	4.3	3.3	0
Social	6.7	8.7	80.0	65.2	3.3	4.3	0	0.0
Guilt	13.3	13.0	43.3	47.8	10.0	4.3	3.3	4.3

241 . Examining Experiences of Support: Making Meaning in a Burn Survivor Support Group

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Introduction: The purpose of this qualitative study was to explore the meaning that burn survivors make in a burn survivor support group. The needs for and the efficacy of social support in the burn survivor population are well documented. Burn survivor support groups can be one such way of providing that support. Understanding the experience of the individuals utilizing support groups can strengthen the ability of practitioners to address their needs. By soliciting the perspectives of burn survivors attending a support group, the factors that encourage the psychosocial adaptation can be highlighted.

Methods: A qualitative methodology was used. A non-random, purposeful convenience sample of six self-identified burn survivors involved in a long-standing local burn support group were interviewed. For interviewing, a guided in-depth interview technique exploring their experiences in the support group was used. Key informant interviews and group observations served to triangulate the data collected in the individual interviews. Content analysis was preformed, focusing on emergent categories and themes.

Results: Multiple themes of meaning were identified in the survivors' experiences and organized into the following categories: normalization of struggles, learning from survival stories, encouragement by others, mastery of identity, empowerment, and community. Additionally, suggestions for continued group growth were offered.

Conclusions: The findings clearly demonstrated the overall positive impact the support group had on psychosocial recovery. Describing an encouraging and safe environment, new survivors reported unique growth opportunities that allowed them to integrate their injury into their overall sense of self. Through group discussions, immediate concerns about physical healing were addressed. Of particular impact was the sense of community and "not being alone" on the road toward psychosocial recovery. Furthermore, overall group experiences allowed survivors to identify their struggles and "come closer to their new self." Long-term members of the group continued their personal growth and recovery through mentoring other survivors, describing a sense of giving back and assisting others in their growth. Certain factors, such as improving overall attendance were addressed, as both survivors and support staff suggested novel methods aimed at reaching others in need of recovery assistance.

Applicability of Research to Practice: This knowledge allows practitioners from multiple disciplines to understand burn survivor's experiences in a support group and can guide the implementation of such groups. In turn, these findings inform an evidence base that can be used to direct psychosocial interventions after burn injuries.

242 . Self-Silencing Following Burn Injury: Psychological Care Implications

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Introduction: The survival rate of individuals with burns has significantly increased due to medical advances in burn care. This has lead to a great need to focus on psychological aspects of burn recovery. The literature indicates that burn size and severity are not directly associated with the degree of distress but that subjective interpretations of the body are pertinent. Thus, it is vital to examine narratives from burn survivors in order to understand how they interpret and make sense of their injury. This has important ramifications for psychological adaptation after a burn as body image has been found to be associated with disorders such as depression and anxiety.

Methods: Semi-structured, in-depth interviews were conducted with ten female burn survivors. Interviews were audio recorded and later transcribed. Using a narrative-discursive analytic approach, transcripts were coded for major themes. Structural and performative aspects were then organized into a comprehensive framework to understand how burn survivors come to make sense of their injury.

Results: Thematic analysis revealed several themes which are congruent with current literature: findings included psychological distress, social isolation and body dissatisfaction. Based on the performative analysis, the women appeared to be self-silencing regarding their difficulties following their injuries. That is, they tried to present themselves as resilient and well-recovered while more subtle aspects of their narratives revealed suffering and distress.

Conclusions: This study found women to be self-silencing regarding many difficult aspects of their injuries, particularly changes to their bodies. This self-silencing may lead to further distress and seems to result in a lack of insight into their experiences. Self-silencing is known to be linked to depression and anxiety and thus addressing body image concerns and encouraging women to discuss their difficulties with health care professionals and significant others are key issues to address with burn survivors during rehabilitation.

Applicability of Research to Practice: An important dimension of burn injury is revealed when patients share how they understand and cope with their injury through narrative. These findings indicate that women are not always forthcoming about distress they may be experiencing, thus suggesting a need for more proactive psychological intervention by health care professionals. This study explores a dimension of burn injury that has been under reported and allows better preparation of patients for reintegration following burn injury. These findings will be discussed in terms of psychological interventions, specifically helping women accept their changed bodies and encouraging them to share their psychological difficulties.

243 . Self Inflicted Burns: A Systematic Review of the Literature

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Introduction: Burn centers in the US provide care for a variety of injuries. Patients who attempt suicide by burning are challenging as their combined medical, psychiatric and social complexities require intensive acute management as well as continued care for chronic needs upon discharge. Their characteristics are not well understood and long term outcomes are unknown. The purpose of this review is to identify characteristics of patients who attempt suicide by burning, to understand outcomes and to assess the quality of published articles.

Methods: We conducted a comprehensive literature search using PubMed, Scopus, PsychInfo, ISI, Embase, POPLINE and Dig Dissertations data bases. Key search terms were: suicide, suicide gesture, suicide attempts, or self-injurious behavior; and burns. Articles about non US populations and/or children under the age of 16 were excluded. There were no exclusions based on type of article. Two authors independently reviewed articles by title, abstract and full text. A bibliographic review identified additional articles. Inconsistencies regarding inclusion criteria were resolved by a third author.

Results: Our search retrieved 2,921 potentially relevant articles. Eighteen met eligibility for full text review and abstracting. Half of the studies (9) were retrospective record reviews which provided demographic data such as mean age range (30-59), male/female ratio (no consistency in findings), ethnicity, marital status, history or presence of a psychiatric disorder (e.g. schizophrenia or major depression) and alcohol and/or drug abuse. Seven articles mentioned length of stay and mortality rate. Contextual factors were mentioned inconsistently: recent stressors (8), use of an accelerant (7), planned vs. impulsive act (4), living situation (2), incident scene (2) and suicide note (2). Three studies analyzed databases from national registries. Other articles were case studies or literature reviews. Most articles were based on small samples and/or specific geographic areas.

Conclusions: Published literature on self inflicted burns in the US is scarce, inconclusive and weakly designed. Inconsistent data on this sub group of burn patients is problematic and makes it difficult to gather information, draw conclusions or identify best practices. Most studies had limited contextual information and no discussion or analysis of long-term outcomes.

Applicability of Research to Practice: Better information and understanding of this sub group of patients could lead to the development of best practices in every phase of treatment and recovery: acute management of the injury, discharge planning and provision of long term resources for those patients who are at risk for medical and/or psychosocial relapse.

244 . The Challenges of Starting a Burn Support Group in a Rural Area

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Introduction: Support groups for burn survivors have been shown to be an effective aid in psychological healing after a major or minor injury. Initiating support groups for burn survivors is a challenge in many areas, and in providing this opportunity to survivors in a rural setting there are many unique issues to consider. The challenges to starting a support group at a burn center with a large catchment area include: effective communication regarding meeting logistics, setting up a useful structure within the group, long distance travel required to attend, and the use of alternative modalities to reach participants.

Methods: Our first support group meeting was held in September, 2010. Meetings occur on the second Friday of every month at the burn center hospital. The survivors created a list of topics of interest. On alternating months a guest speaker is invited to discuss a requested topic. During the other meetings, the discussion is left open to any issues the participants would like to address. Burn center staff is present as resources to participants. The group is lead by a survivor. All patients discharged from the inpatient unit and new to the outpatient clinic are sent an invitational letter, identifying the support group logistics, goals of participation, topics of interest and how to become involved. Informational newsletters are sent out on a monthly basis reiterating discussion from the previous meeting, and highlighting dates and topics of future meetings. A line is set up for participants who would prefer to call into the session. Survivors may utilize the hospital's courtesy housing to ease travel.

Results: In 12 months of support group meetings, 20 different people have attended: 3 people attend regularly and the 17 other people attended 1 to 3 times. Our survivors have traveled from 3 to 351 miles to attend. We have had 3 people use the bridge line to call into and participate in the meetings.

Conclusions: After one year of meetings we have developed a strong foundation and structure to our program. We plan to continue the monthly support group. We are working on strategies to grow attendance. With video telecasting, survivors will be able to go to their local community hospital or public library to video conference into the meetings. We have a support group website under production that will allow participants to "chat" and have open discussion anonymously. Our team will use this website to communicate the newsletter, reaching farther than the mailings and at much less expense. The support group is offered to patients upon discharge, and is advertised in the local newspaper, on the hospital website, and in materials given to our regional referring providers.

Applicability of Research to Practice: Patients benefit from peer support after injury. Methods are described for providing this support in a rural, medically underserved catchment area.

245 . Stress and Coping in Burn and ICU Nurses

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Introduction: Staff stress levels in burn and other intensive care units are heightened because of the intensity of care required. Staff in four burn units and in the intensive care units at the lead hospital estimated their levels of job-related and life stress. The purpose of this multi-site study is to determine levels of job-related and life stress and contributing factors, and assess whether this differs by experience level and place of work.

Methods: Nursing staff at the Burn Center, Transplant, Neurosurgical, Surgical, and Medical intensive care units at the lead hospital and at three other burn centers were invited to complete a Nursing Stress Scale (NSS; 1981), a demographic questionnaire, Perceived Stress Scale (PSS; 1983), and the Brief COPE (a general stress questionnaire, 1997). Descriptive, correlational, and comparative (Wilcoxon and Kruskal-Wallis tests) analyses were performed. An electronic survey link was sent to all nursing staff in all units.

Results: Ninety-four individuals across all sites completed the survey after receiving an email describing the study; participants were instructed that consent was assumed with their anonymous completion of the electronic survey. There were significantly more females than males, and fifty percent were between 18 and 30 years old. Seventy-six percent had a bachelor's degree, and 59% had five or fewer years of nursing experience. Average scores on the NSS ($M = 36.10$; $SD = 13.05$) were relatively low compared to other published NSS samples, but average scores on the PSS ($M = 32.38$; $SD = 3.65$) were higher than those of a probability sample. Nonparametric tests showed a significant difference in use of emotional support and instrumental support. Higher education was related to a higher score on the substance use items on the Brief COPE.

Conclusions: The results indicated that older, more experienced nursing staff are reporting use of less adaptive coping (emotional and instrumental support), and more active coping including denial, but also more substance use. However, stress levels overall are not different among different age and experience levels, among those in committed relationships versus not, or those with or without children. The low response rate may have limited the generalizability of our results. Studies examining methods to address the stress response in our burn centers and other high stress units within the hospital are needed.

Applicability of Research to Practice: Representatives from the lead Burn Center and another Midwest burn center will discuss how the results of the study were presented to their staff through staff meetings to discuss opportunities for improvement in patient care and staff performance to reduce stress. The presentation will conclude with a discussion of how positive psychological approaches can be used in order to improve patient care and satisfaction.

246 . The Effect of Healing Touch on Sleep Patterns of Pediatric Burn Patients

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Introduction: Prior work has demonstrated fragmented sleep of poor quality during and after hospitalization for thermal injury. Complementary therapies such as Healing Touch (HT) are increasingly utilized in the management of pain, anxiety and sleep disorders; however the efficacy of HT during burn convalescence is unknown. The primary aim of this investigation was to determine if HT mediates polysomnographic (PSG) changes during nocturnal sleep in pediatric burn patients.

Methods: Patients were randomly assigned to one of two treatment groups utilizing a 2-period cross-over design that determined the order of HT intervention versus no HT treatment. Half of the group of patients received HT on study day 1 and no HT on study day 2 and the reverse for the other group. HT was performed by two certified practitioners who followed standardized HT procedures whereby non-invasive and gentle use of the practitioner's hands either directly on the clothed body or slightly above the patient's body was performed. PSG began at onset of HT and continued for 8 hours (2200-0600). Soft music played for both study nights for 45 minutes after the initiation of PSG recordings. Demographics, sleep stage %, total sleep time (TST) and number of awakenings were collected. Comparisons of differences between HT and non-HT nights were done by paired t-tests and the Wilcoxon signed rank test.

Results: Six reconstruct burn patients consented to the study. Four were male and two female. The mean age during time of HT procedure was 18.2 ± 1.2 years, mean % TBSA was $38.2 \pm 12.0\%$, full thickness burn size was $31.2 \pm 14.4\%$, and mean time post-burn was 12.3 ± 1.5 years. All patients reported that they felt relaxed during the HT intervention. There were no statistically significant changes in sleep stages, although percentages of N2, N3 and REM stages of sleep were higher on HT nights. TST was enhanced (345.6 vs. 286.1 min) and wake time was reduced (168.0 vs. 207.4 min) for the HT night. No effect was observed on number of awakenings or order of HT.

Conclusions: HT is associated with clinical improvement in N2, N3 and REM sleep stages and HT patients slept an extra hour (increased TST), however statistical significance was not achieved. Based on the findings to date, HT appears to benefit the quantity and quality of restorative sleep in pediatric burn patients.

Applicability of Research to Practice: This preliminary and ongoing HT study forms the basis for encouraging greater attention to complementary and alternative therapy in the treatment of sleep disorders including postburn dyssomnias.

Effect of Healing Touch on Sleep and Awakeness

	Non-HT	HT	p-value
Awake (%)	42.1 + 8.2	33.0 + 5.5	0.24
N1 (%)	6.1 + 0.3	5.4 + 0.7	0.51
N2 (%)	32.8 + 6.2	37.0 + 4.8	0.34
N3 (%)	7.0 + 3.4	10.9 + 3.4	0.19
REM (%)	12.1 + 2.2	13.7 + 1.7	0.64
TST (min)	286.1 + 40.3	345.6 + 32.3	0.15
Awakenings (n)	29.2 + 1.8	32.17 + 3.2	0.63
mean + SEM			
TST, Total Sleep Time			

247 . The Role of a Dedicated Psychiatrist as Part of the Burn Team

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Introduction: The incidence of psychiatric disorders in the burn-injured population may be higher than that of the general population and, in some cases, contributes to the injury itself. Due to the nature of burn injury, even patients without underlying psychiatric illnesses benefit from evaluation and treatment by a psychiatrist during their hospitalization and beyond. For the past two years, our burn team has included a full-time, dedicated, psychiatrist to assist with multi-disciplinary burn care. We have reviewed all patients treated by our psychiatrist in order to better understand the role of such dedicated psychiatric care, both acutely and during rehabilitation.

Methods: A retrospective review performed on all patients evaluated by our staff psychiatrist identified 89 patients between August, 2008 and April, 2010. Charts were reviewed to determine: history of psychiatric illness, history of substance abuse, indication for psychiatric consultation, and pharmacologic intervention. Furthermore, we sought to improve both our psychiatric care and education with a regular burn psychiatric clinic, inclusion in multi-disciplinary rounds, and weekly didactic resident/staff education.

Results: Among burn patients evaluated by our staff psychiatrist, the prevalence of preexisting psychiatric disorders was 58.4% and evidence of substance abuse existed in 43.8% of patients. The most common indications for psychiatry evaluation were: pain (28.1%), alcohol dependence (25.8%), anxiety (24.7%), illicit drug abuse (16.8%), depression (15.7%), post-traumatic stress disorder (8.9%), and sleep disturbance (8.9%). Pharmacologic intervention was implemented in 91.0% of all patients evaluated. Of the 33 patients without psychiatric or substance abuse history, pharmacologic interventions were performed in 84.8%.

Conclusions: The inclusion of a dedicated psychiatrist as a member of the burn team has improved our ability to provide comprehensive burn care. In addition to evaluation and treatment of pre-existing psychopathology, early psychiatric evaluation typically resulted in interventions associated with acute and chronic pain management.

Applicability of Research to Practice: The role of psychiatrists as members of the burn team is multi-factorial and improves upon our ability to provide comprehensive burn care.

248 . Proteasome Activity in Skeletal and Cardiac Muscle during Burn Induced Hypermetabolism

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Introduction: Severe burn injury leads to the development of hypermetabolism, which can persist for years after the initial injury, leads to muscle catabolism and has been associated with adverse outcomes. However, the underlying molecular mechanisms are poorly understood. Although proteasomes, the major non-lysosomal proteases in all eukaryotes, have been implied in the regulation of muscle catabolism early after burns, their role in the pathophysiology of persistent hypermetabolism after burns is unknown. Therefore, the aim of this study was to determine whether burn injury is associated with long term changes of proteasome activity in skeletal and cardiac muscle in rats.

Methods: Anesthetized rats were subjected to 30%TBSA or sham procedure, resuscitated (Parkland formula) and observed for 1, 3 and 6 weeks post injury (n=5/group). Resting energy expenditure (REE) was determined by indirect calorimetry and body weight measured. Skeletal (pectoral) and cardiac muscle were harvested and tissue extracts prepared. Proteasome peptidase activities (PA) were measured using fluorogenic chymotryptic (CT)-, tryptic (T)- and caspase (C)-like peptide substrates in combination with epoxomicin (proteasome inhibitor). PA is given in % of uninjured (mean±SD). Statistics: ANOVA/Dunnett's post-test.

Results: Burn injury resulted in persistent hypermetabolism, as indicated by significant increases in REE and loss of body weight at 3 and 6 weeks post injury ($p < 0.05$ vs. sham). While PA was not significantly altered after burns in skeletal muscle, cardiac PA increased time dependently (PA at week 1, 3 and 6, respectively: CT: $126 \pm 34\%$, $146 \pm 102\%$ and $212 \pm 46\%$ ($p < 0.05$ vs. sham); T: 53 ± 26 , 172 ± 93 and $694 \pm 590\%$ ($p < 0.001$ vs. sham); C: $89 \pm 52\%$, $108 \pm 155\%$ and $166 \pm 119\%$).

Conclusions: Hypermetabolism after burns is associated with a time dependent increase in myocardial proteasome peptidase activity. Increased myocardial proteasome activity during post-burn hypermetabolism may reflect persistent cardiac stress and could contribute to long term morbidity in burn victims.

Applicability of Research to Practice: Understanding the pathobiology of hypermetabolism after burn injury will help to develop novel treatment strategies for burn patients.

249 . The Effects of Metformin and Fenofibrate on Post-Burn Rat Liver

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Introduction: Severe burn injury causes hepatic dysfunction that result in major metabolic derangements such as hypercatabolism and insulin resistance, and is associated with hepatic endoplasmic reticulum (ER) stress. Although the physiological consequences of such derangements have been delineated, the underlying molecular mechanism remains unknown. Recently, it has been shown by others that metformin and fenofibrate improve patient outcome by attenuating post-burn stress responses. The aim of the present study is to determine the effects of metformin and fenofibrate on post-burn hepatic ER stress.

Methods: In the first study, we randomized rats to sham, burn injury, burn injury plus metformin. In the second study, rats were randomized to sham, burn injury, and burn injury plus fenofibrate. The animals received 60% total body surface area burn and were sacrificed at various time points.

Results: In the first study, there was a significant increase in p-AMPK levels in the metformin treated livers (1.8 ± 0.2 vs 1.0 ± 0.1 shams, relative expression levels, $p < 0.05$), verifying proper drug administration. Burn-induced decrease in albumin mRNA and increase in IL-6 mRNA were not normalized by metformin treatment. In addition, ER stress markers activating transcription factor 6 (ATF6), glucose-related protein 78 (GRP78)/BIP, phospho-protein kinase R-like ER kinase (p-PERK), and phospho-inositol-requiring enzyme 1 (p-IRE1) were similarly increased in burn injury with or without metformin compared to sham.

In the second study, to determine the fenofibrate efficacy on the liver, we measured PPAR α target gene Cpt1 α and observed a ~50-fold upregulation in fenofibrate treated rats (54.4 ± 8.1 vs 1.0 ± 0.2 sham, relative expression levels, $p < 0.05$). Burn-induced decrease in albumin mRNA and increase in IL-6 mRNA were not normalized by fenofibrate treatment. There were no differences in the protein expression of ER stress markers, ATF6, BIP, p-PERK, and p-IRE1, between fenofibrate treated and non-treated burn injury groups.

Conclusions: Our results indicate that, while thermal injury results in hepatic ER stress, metformin and fenofibrate do not ameliorate post-burn stress responses by correcting hepatic ER stress. Further studies are necessary to understand the precise molecular mechanisms.

Applicability of Research to Practice: The results of our research have potential clinical implications by significantly improving morbidity and mortality of burn patients as well as other trauma and critically ill patients who experience similar stress-induced diabetic responses.

250 . Effect of Atorvastatin on Metabolic Effects of Thermal Injury

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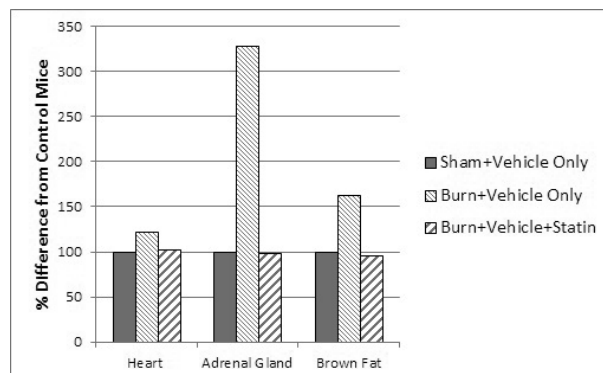
Introduction: Infection and sepsis associated with burn injury are major causes of morbidity and mortality in burn patients. Statins have been shown to increase survival rates and reduce insulin resistance in mice with burn injury. Previously, we have demonstrated that treatment of burned animals with simvastatin produced dose-dependent reductions in 18F labeled 2-fluoro-2-deoxy-D-glucose (18FDG) accumulation in the heart and brown adipose tissue (BAT), but did not affect accumulation in the brain. Since the clinical use of simvastatin has recently been restricted by the FDA, in the current study we evaluated the effect of another statin, atorvastatin, on burn injury.

Methods: CD-1 male mice (~25g) were subjected to sham burn or full thickness 30% total body surface area burn injury followed by resuscitation by I.P. injection of saline. The mice were divided into 3 groups and treated as follows; (1) Sham + vehicle only (n=8), (2) burn + vehicle only (n=8) and (3) burn + vehicle + atorvastatin (1 mg/kg, IP, b.i.d., n=5). All animals were treated twice daily for 7 days. The animals were then fasted overnight and injected with 50 μ Ci of 18FDG via the tail vein. Approximately one hour after 18FDG injection, biodistribution was measured.

Results: Burn injury produced an increase in 18FDG accumulation in the heart, adrenal glands and BAT, and treatment with atorvastatin in burn mice demonstrated a tendency to reduce accumulation in these tissues. Since it is well established that activity of BAT is modulated via the adrenergic nervous system which also increases cardiac workload, our findings are consistent with the anti-hypermetabolic effect of atorvastatin. Less prominent effects were detected in other tissues that were studied.

Conclusions: These results indicate that atorvastatin is able to reverse the burn-induced accumulation of 18FDG in the heart, adrenal glands and BAT. Although further research with larger groups of animals is required, our results indicate a favorable trend in the modulation of tissue specific glucose metabolism, similar to our previous results with simvastatin. These effects may aid in alleviating the hypermetabolic state associated with burn injury.

Applicability of Research to Practice: Patients suffering from severe burn injury may benefit from the use of statins.



251 . Body Mass Index and Burn Injury: What Happens after Discharge?

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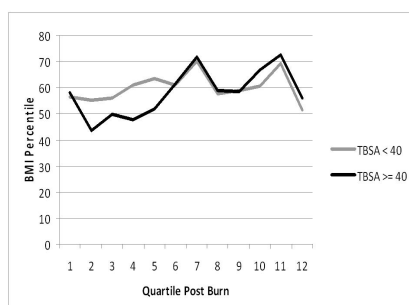
Introduction: Severe burn injury increases metabolic rate up to twofold. To mitigate the weight loss of burn hypermetabolism, patients are fed a high calorie, high protein diet. This feeding strategy, while important in the hypermetabolic phase, can result in long term weight gain. We hypothesized that burned children lose weight in the first year after injury, but gain weight after 2 years.

Methods: Children burned between 2005-2008 admitted to a single institution with $\geq 20\%$ total body surface area burn were studied. Data recorded included patient height and weight as well as height and weight percentiles at burn admission, discharge, and all follow-up visits post-discharge. Body mass index (BMI) was calculated from height and weight measurements and body mass index percentile (based on age and gender) was calculated from standardized pediatric growth charts. BMI percentile (BMI%) changes over time were calculated with mixed modeling and expressed per quartile.

Results: A total of 168 burned children (111 male) with mean age of 7.8 ± 5.6 years and burn size of $39.1 \pm 16.9\%$ were assessed. Mean follow-up duration was 2.08 years (range 0.08-5.42 years). Burns 20-39% (LB) were younger (6.5 ± 5.1 vs. 10.1 ± 5.6), had smaller burns (28.1 ± 5.5 vs. 57.4 ± 13.2), and shorter hospital length of stay (38.6 ± 24.8 vs 82.6 ± 54.2) than the $\geq 40\%$ group (MB) (all $p < 0.0001$). There was no difference in admission BMI% (59.6 ± 33.7 LB vs. 67.6 ± 34.7 MB, $p = 0.6$). The BMI% decrease of 1.1 per month for the first six months after injury in the LB group differed significantly from the MB group, which decreased by 5.3 per month for the first 6 months post-injury ($p < 0.001$). (Figure 1) BMI% between MB and LB converged at the 18 months (6th quartile) after injury and remained $> 60\%$ for age thereafter. During follow-up emaciation development (BMI% < 3) did not differ between LB and MB ($p = 0.37$) or in the development of obesity (BMI% > 95) ($p = 0.43$).

Conclusions: Burned children lose weight for 6 months post injury, but by 18 months achieve BMI percentile within normal range. Children with larger burns initially have larger BMI decreases than children with smaller burns, but at 1.5 years both groups have normal BMI levels. These data suggest that aggressive nutrition in the first 6 months after burn injury is warranted, but that dietary regimens should be assessed to avoid the development of obesity during long term follow-up.

Applicability of Research to Practice: Modification of diet after discharge.



252 . Initiation of Nutrition within 24 Hours of Admission to Burn Intensive Care Unit

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Introduction: Early nutritional support is beneficial in the outcome of major burn patients. Satisfactory delivery of early nutrition is one of the key factors in successful treatment of severe burns. Often enteral nutrition is required to supplement oral intake or provide nutrition in patients who are unable to take oral intake in severely burned patients. Our hypothesis was to determine the feasibility of initiation of early enteral nutrition in severely burned pediatric patients within 24 hours of admission.

Methods: Medical records of pediatric burned patients from January 2010 to December 2010 with burn size greater than or equal to 40% were reviewed.

Results: Forty-four patients were admitted to our burn intensive care unit from January 2010 to December 2010 with burn size greater than or equal to 40%. There were thirty males and fourteen females. Mean age was 5.9 years (9 months old to 18 years old) with mean burn size of 53% (40% to 75.5%). Twenty-three patients had flame burn; sixteen had scald burn; four had electrical injury; and one had chemical burn. All patients had nasointestinal tube placed for enteral feeding. Forty-two patients had enteral feeding initiated within 24 hours of admission (42/44, 95%). Mean time to initiation of enteral nutrition was 11.36 hours from the time of admission. 50% of patients achieved goal rate of tube feeding within 24 hours of admission (22/44). 90.1% of patients achieved goal rate of tube feeding within 48 hours of admission (40/44). 97.7% of patients achieved goal rate of tube feeding within 72 hours of admission (43/44). 100% of patients achieved goal rate of tube feeding within 96 hours of admission (44/44).

Conclusions: Nasointestinal tube feeding was successfully initiated in the severely burned pediatric patients within 24 hours of admission. Initiation of early enteral nutrition within 24 hours of admission is feasible in severely burned pediatric patients.

Applicability of Research to Practice: Early nutritional support would improve care of burn patients.

253 . NPO Times in Pediatric Population Undergoing Anesthesia Procedure: Are We at Best Practice?

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Introduction: Historically pediatric anesthesia procedures had been performed in post anesthesia Care Unit (PACU). These procedures competed with general operative cases resulting in scheduled time delays due to emergent operative cases and anesthesia manpower issues. We noted our pediatric patients were experiencing increasing length of NPO times and in some cases greater than twelve hours. Patient and parental dis-satisfaction as well as loss of nutrition was the impetus for practice change. We developed a more liberal policy of NPO in order to limit the time a child is without nutrition. The NPO policy permitted children to maintain the ability to eat within 6 hours and drink within 4 hours of the procedure. Our hypothesis was this practice change would decrease NPO hours. This abstract reports our findings.

Methods: A retrospective review of pediatric patients requiring conscious sedation or general anesthesia in our pediatric sedation room was undertaken. NPO time, procedural start and end time, and first nutrition order was performed. NPO times were patient specific, procedural start times designated and nursing personnel scheduled. NPO time was limited to 6 hours for solids and 4 hours for fluids pre-procedure. If a child was scheduled for late morning (>10AM) the child would be able to take liquid nutrition up to 0600 hours. A pre-procedure checklist was developed to establish team start times, schedule nursing resources, and most important established patient specific NPO time.

Results: A total of 246 pediatric sedations for academic year 2010-2011 were performed. The average scheduled NPO time was reduced by 7 hours from a mean of 12 hours down to 4 hours and 50 minutes. However, upon further analysis the actual time the children went from last meal to the first post procedure meal was not reduced. Children who had the ability to eat until 0600 infrequently did so and children with a later procedure time did not recover soon enough to eat lunch or a snack. The reduction of NPO order times did not change actual NPO time.

Conclusions: Our new practice standard to limit actual time a time a child did not eat did not decrease the actual time the child was without nutrition. Allowing a child to eat before 0600 did not translate into the children actually eating up to that time. This finding has led to a more extensive review of our practice.

Applicability of Research to Practice: Reduction of time specific NPO orders has not reduced the actual time the child was without nutrition.

254 . Assessment of Serum Zinc Levels in Critically Ill Burn Patients

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Introduction: Involved in protein synthesis, cellular replication, and collagen formation, zinc is a critical micronutrient for burn metabolism and wound healing. Serum zinc levels decrease early after burn injury due to hemo-dilution, insensible losses, redistribution, as well as decreased albumin levels (carrier protein). In many conditions, serum zinc levels remain low despite supplementation until the patient's inflammatory response subsides and C-reactive protein (CRP) levels normalize. In order to better understand zinc metabolism in our patients, we reviewed our experience with enteral zinc supplementation and weekly serum zinc levels.

Methods: We retrospectively reviewed all acute burn admissions from March 2010 to July 2011. By unit protocol, adult patients received 220mg zinc sulfate daily from admission until serum zinc levels normalized, defined as 60-120 µg/dL. Children received weight-based dosing until normalization. Routine peripheral blood zinc levels were measured weekly in all patients. Those with only 1 or 2 zinc levels recorded were excluded. We dichotomized patients into 2 groups based on mean time to normalization. We then compared patient, injury and treatment characteristics between groups by descriptive statistical techniques.

Results: All 31 patients who met study criteria had low zinc levels on admission (mean 32 ± 10.5 µg/dL). The mean time to zinc normalization was 32 hospital days (HD) and 26% of patients never achieved normal zinc levels during their intensive care stay. Improvement in transthyretin (prealbumin) and serum zinc level only correlated modestly well ($R^2=0.37$). Differences between patients with and without normalized zinc level by HD 32 are summarized in Table 1. Patients that could not normalize their zinc level tended to be older, have lower BMI, higher TBSA, lower admission zinc level, lower TTHY levels, higher CRP levels, and increased time on the ventilator.

Conclusions: We found major variations in time to normalization of zinc levels in this cohort of severely burned patients. Contrary to expectation, weekly zinc levels only modestly correlated with improvement in transthyretin (prealbumin), and did not correlate with CRP trends over time.

Applicability of Research to Practice: Expect differences in normalization of zinc levels among severely burned patients.

Variable	Zinc normalized by HD 32 (n = 16)	Zinc not normalized by HD 32 (n = 15)	P value
Age	38.8 ± 20.0	43.7 ± 23.8	0.54
BMI	28.4 ± 6.7	24.6 ± 4.6	0.06
TBSA	32.7 ± 15.1	36 ± 13.8	0.46
Percentage with inhalation injury	56.3%	26.7%	0.05
Admission zinc level	35.6 ± 8.5	28.1 ± 28.1	0.05
Admission transthyretin	10.0 ± 5.7	8.0 ± 4.1	0.26
Transthyretin on HD 27-37	32.0 ± 12.3	19.8 ± 6.6	0.003
Admission CRP	206.3 ± 111.5	216.1 ± 80.8	0.72
CRP on HD 27-37	132.0 ± 104.1	149.8 ± 79.9	0.39
HD of final autograft surgery	35.2 ± 19.5	34.8 ± 18.2	0.98
LOS	56.5 ± 22.3	63.0 ± 27.0	0.65
Ventilator days	20.3 ± 24.5	28.4 ± 23.9	0.10
Mortality	6.3%	6.7%	0.96

1Results reported as mean ± standard deviation (SD) or percent, where appropriate

255 . The Predictive Value of Nutritional and Inflammatory Indices in Pressure Ulcer Development in Pediatric Burns

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Introduction: A variety of laboratory parameters have been implicated as useful predictors in the risk assessment of pressure sore development in other populations. Data relevant to the etiology of pressure ulcers in pediatric burns is limited. The purpose of this study was to determine if differences in nutritional and inflammatory indices exist between patients who develop significant pressure sores versus those with minimal to no decubitus ulcer formation to assist with predictive risk in burns.

Methods: A review of medical records of patients from May 1999 through June 2011 identified 13 patients admitted within 2 weeks of injury who developed either a stage 3 or stage 4 pressure ulcer (PU) during their hospital stay. These patients were matched by age, percent burn and percent full thickness injury to 13 patients with negligible evidence of skin breakdown (NPU) during hospitalization. Paired t-test (continuous) was used to differentiate weekly serum labs between groups leading up to ulcer development: albumin, transferrin, prealbumin, nitrogen balance, glucose and CRP. Using McNemar's test (categorical), calorie and protein intake and percent of preburn weight at discharge (Pre-wgt at D/C) were also compared between the PU and NPU patients.

Results: The groups were similar in age, percent burn, percent full thickness, preburn weight and inhalation injury. No significant differences were noted between groups for any lab parameter evaluated. Calorie and protein intake, as well as weight status, were also comparable in both groups.

Conclusions: Pressure ulcer development in pediatric patients was not predicted by nutritional and inflammatory markers typically used for clinical assessment in burns.

Applicability of Research to Practice: Given the relative low incidence of stage 3 and 4 pressure ulcer incidence at our institution, the standard preventative protocols employed appear generally effective. Future studies are needed to elucidate other predictors of pressure ulcer formation in this population to further reduce occurrence.

Comparison of Indices Among the Pressure Ulcer (PU) and No Pressure Ulcer (NPU) Groups

Variable	PU (n=13) mean + SEM or n (%)	NPU (n=13) mean + SEM or n (%)	P value
Age (years)	10.5 + 1.5	10.4 + 1.6	0.81
TBSA (%)	61.0 + 5.2	64.1 + 5.6	0.09
Full thickness (%)	53.1 + 6.7	54.7 + 5.9	0.66
Preburn weight (kg)	48.9 + 8.0	48.0 + 7.0	0.81
Inhalation Injury	5 (38.5%)	4 (30.8%)	0.56
Albumin (g/dL)	2.0 + 0.1	2.0 + 0.1	0.30
Transferrin (mg/dL)	85.5 + 6.4	91.8 + 6.9	0.40
Prealbumin (mg/dL)	9.4 + 1.0	10.3 + 0.9	0.52
Nitrogen Balance (g)	4.4 + 1.5	5.3 + 1.2	0.74
CRP (mg/dL)	19.2 + 2.4	16.3 + 2.1	0.26
Glucose (mg/dL)	142 + 7.0	139 + 7.4	0.84
Kcals/kg	71.4 + 10.0	70.1 + 5.9	0.77
Protein g/kg	3.4 + 0.4	3.2 + 0.3	0.64
Pre-weight at D/C (%)	104 + 5.1	93 + 3.9	0.26

256 . Impact of Constipation on Critically Ill Burned Adults

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Introduction: Constipation in critical illness (CICI) has been variably described as lack of defecation for greater than 72 hours in one study or after more than 6 days in another. In nonburned patients, constipation is associated with a longer intensive care unit (ICU) length of stay (LOS), increased infectious complications, and higher ICU mortality. In part due to large amounts of narcotics needed for pain management, we hypothesized that CICI is frequent in thermally injured patients requiring ICU admission. The purpose of this study was to determine the incidence and effect of CICI on outcomes in critically ill, severely burned adults.

Methods: With IRB approval, a 2-year review was undertaken to determine the incidence of CICI defined by no bowel movement for >6 days, and its impact on outcomes. Patients were included if they sustained burns >20% TBSA, required mechanical ventilation, and had no known intestinal motility disorders. Outcomes were compared between patients demonstrating CICI and patients without CICI. In addition, a performance improvement project to attempt to decrease the rate of constipation in burn ICU patients was initiated midway through the study period that added 17 g of polyethylene glycol (PEG) 3350 BID to our standard bowel regimen of 100 mg of bisacodyl BID. Data are reported as median values [IQR 1,3].

Results: Among 83 patients included for analysis, 30 (36%) patients met criteria for CICI, 53 (64%) did not. Age (46 yrs [32-62] vs 48 yrs [34-57], p=0.82) and TBSA burned (39% [28-53] vs 34% [27-51], p=0.63) were similar between CICI and nonconstipated patients, respectively. Patients with CICI had a longer ICU LOS (37 days [19-65] vs 21 days [12-41], p=0.05) and more frequently received total parenteral nutrition (23% vs 4%, p=0.006). No significant difference was found between the 2 groups when comparing hospital LOS, ileus, or 28-day and in-hospital mortality. Of the 46 patients receiving PEG 3350, there was no impact on CICI or other clinical outcomes.

Conclusions: Lower GI tract dysfunction, manifested by CICI, is frequent in thermally injured adults who require ICU admission. These patients experience longer ICU LOS and more frequent use of parenteral nutrition. A reliable method to improve laxation in burn ICU patients is needed.

Applicability of Research to Practice: Identifies elevated risk of constipation in burn patients, so that interventions can be implemented and complications may be prevented.

257. The Impact of Oxandrolone on Length of Stay Following Major Burn Injury: A Clinical Practice Evaluation

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Introduction: Catabolism of lean muscle mass following major burn injury is associated with significant morbidity and prolonged length of stay (LOS). The anabolic agent oxandrolone (OX) has been used to decrease muscle loss and assist in wound healing, and has previously been shown to decrease LOS following burn injury of 20-60% total body surface area (TBSA). This study uses the Comprehensive Severity Index (CSI) to control for severity of illness and explore the relationship between OX and LOS in a broadly selected sample of burn patients.

Methods: A practice-based evidence study was conducted at a single regional burn center to examine the relationship between OX and LOS in burn patients. Maximum severity of illness (MCSIC) was measured using a burn-specific physiologic severity measurement instrument. Data on 167 consecutive surviving patients with TBSA $\geq 15\%$ were analyzed using bivariate and multiple regression procedures. Thirty-eight of these patients received OX during their course of care at clinician discretion.

Results: Median patient age was 42.7 years (IQR 29.3- 51.7), median TBSA was 23% (IQR 18-35), and median LOS was 21 days (IQR 14-41). OX patients had larger median TBSA (38% vs. 22%) and greater severity of illness as measured by CSI (127 vs. 68) than those who did not receive OX. Multivariate regression analysis demonstrated a positive relationship between TBSA and LOS ($p < 0.001$) and MCSIC and LOS ($p < 0.001$); it also showed an inverse relationship between OX and LOS ($p < 0.001$) when the interaction terms of OX with TBSA ($p = 0.012$) and OX with MCSIC ($p < 0.001$) were included in the model. Subset analysis of patients with the most severe MCSIC scores (≥ 105) showed that OX did not contribute to a decreased LOS.

Conclusions: In a natural practice environment, a practitioner bias may exist for selection of patients with both larger TBSA and greater MCSIC for receipt of OX. OX is associated with a shorter LOS after controlling for use of OX in patients with larger TBSA and higher MCSIC. However, OX may not benefit those burn patients with greatest severity of illness.

Applicability of Research to Practice: Oxandrolone may not have benefits for decreasing LOS in the most severely ill burn patients.

258. Nutritional Demands in Patients with Toxic Epidermal Necrolysis

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Introduction: Stevens Johnson syndrome (SJS) and toxic epidermal necrolysis (TEN) are severe, acute exfoliative diseases of the skin often treated in burn centers. Treatment includes aggressive wound care, medical and nutritional intervention. To date, there has been little published about the nutritional needs and interventions for SJS/TEN.

Methods: With IRB approval, we reviewed adult patients admitted with a diagnosis of SJS/TEN from 2006-2010. Data collection included demographics, oral involvement, medical interventions, nutrition support and outcomes.

Results: Eighteen patients were included in the review; four patients died (22%). All patients reported oral lesions or mouth pain; eight required mechanical ventilation. Twelve patients (67%) required enteral nutrition (EN) with most (75%) placed on high protein formulas. Parenteral nutrition was not used for any patient. At discharge, all survivors were able to meet their needs with oral intake alone. Most patients on EN had at least one calorimetry measurement. Median energy needs were 138% of calculated basal energy expenditure (BEE) though with a wide range (81-272%). Eleven patients (61%) required sliding scale insulin, only four of whom had a history of diabetes mellitus.

Conclusions: Patients with SJS/TEN are hypermetabolic and require complex nutritional management best delivered by a multidisciplinary burn team. All patients had oral lesions that affected intake but were managed with a combination of oral and enteral nutrition, and parenteral nutrition was not required.

Applicability of Research to Practice: This study shows that SJS patients require individualized nutritional management best suited to multidisciplinary team available at burn centers.

Male (n)	27.8% (5)
Age*	39.0 (30.6-62.9)
BMI*	32.5 (26.7-34.6)
GI involvement (n)	100% (18)
Days to EN (post admit)* (n=12)	2 (2-4)
Days on EN* (n=12)	5.5 (4-13.5)
1st day post admit to oral intake*	3 (1-8)
Days post admit until 100% oral intake*	6 (5-16)
Calorimetry % BEE** (9 pt; 22 measurements)*	138% (115-177)
Ventilator days* (n=8)	9.5 (5-14)
*Median (IQR); **Harris-Benedict BEE	

259 . The Safety and Efficacy of Parenteral Nutrition among Pediatric Patients with Burn Injuries

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Introduction: Although enteral nutrition (EN) is the ideal mode of nutrition support during burn injuries, it is often interrupted during bouts of severe sepsis and hemodynamic instability, leading to significant energy and protein deficits. Parenteral nutrition (PN) is not commonly used in burn centers due to concern that it will lead to hyperglycemia, infection, and increased mortality. However, PN is often utilized in our burn unit when goal rate EN is not feasible. Our customized PN solution is a lipid-free, high nitrogen formula (calorie nitrogen ratio of 80:1) aimed to achieve glucose oxidation rates of 5-7 mg of carbohydrate per minute, and an energy intake between 75-80% of basal metabolic rate (BMR). The purpose of this study was to determine the safety and efficacy of our standard PN therapy.

Methods: A review of all children admitted to our hospital over 8 years with burns $\geq 30\%$ total body surface area was conducted. Only patients admitted within 1 week of injury and survived > 24 hours after admission were included in this study. Data collection included demographic information, infection rates, vasopressor requirement, and hyperglycemia requiring insulin therapy. Utilization of PN was analyzed.

Results: Of the 110 patients who met the inclusion criteria, we studied the 92 (84%) who received PN due to slow EN advancement. The primary reason for lack of EN progression was hemodynamic instability (82%). The requirement for PN averaged 14 ± 12 days. EN was started on day 5 ± 4 , although 49% of patient started EN by day 3. Average intake (PN and EN) was 126% of estimated BMR and 2.5g/kg protein. While 44% of patients required sporadic insulin therapy, only 11 (12%) patients progressed to continuous insulin infusion. Blood (31%) and respiratory (25%) infection rates were modest and were not related to use of PN or PN days. Mortality was low (3%), as most patients (97%) achieved wound closure and were discharged home.

Conclusions: Judicious use of PN is a safe and effective means of nutrition support when goal EN cannot be achieved. A hypo-caloric, high nitrogen PN solution can reduce energy and protein deficits while minimizing complications commonly associated with PN usage.

Applicability of Research to Practice: This research suggests that PN can safely be utilized when goal EN is not possible.

260 . Pseudomonas aeruginosa Infection Following Burn Injury Induces a Systemic Anti-Inflammatory Response

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Introduction: Early after severe burn injury there is a significant increase in serum pro-inflammatory cytokines and chemokines. These molecules, which include interleukin (IL)-6, interferon-gamma (IFN- γ), monocyte chemotactic protein-1 (MCP-1), and tumor necrosis factor- α (TNF- α), subsequently influence the downstream immune response and are associated with increased morbidity and mortality. Since burn patients are at high risk of developing bacterial infections, the influence of bacterial exposure on these pro-inflammatory mediators was evaluated in a murine model of burn injury.

Methods: Female C57BL/6 mice between the ages of 8-12 weeks underwent either a 20% TBSA full thickness contact burn or sham procedure. Twenty-four hours later mice were given a subcutaneous injection of 20,000 CFU of *Pseudomonas aeruginosa*. Mice were sacrificed forty-eight hours following the infection to determine bacterial burden. Also, various serum cytokine levels were measured by cytometric bead array.

Results: Burn mice had bacterial dissemination indicated by positive cultures from lung, liver, spleen, perfused heart, brain, and spinal core samples. However, no bacteria were recovered from the sham mice, even at the site of initial injection. As for serum cytokine levels, burn injury induced increased amounts of IFN- γ and TNF- α as expected. Yet, these cytokines were not influenced by bacterial challenge. IL-6 and MCP-1 were also increased after burn injury. However, these molecules were significantly higher in infected burn mice when compared to both uninfected burn and infected sham mice. In addition, there was an elevated amount of circulating IL-10 in the infected burn mice that was not observed in uninfected burn and infected sham mice.

Conclusions: Burn injury induced an early pro-inflammatory response marked by increased serum IL-6, IFN- γ , MCP-1, and TNF- α . Layering a clinically relevant infection with *P. aeruginosa* led to a further increase in IFN- γ and MCP-1, as well as a significant elevation of the anti-inflammatory cytokine IL-10. This increase in IL-10 could contribute to further immune suppression.

Applicability of Research to Practice: This study demonstrates how infection impacts the post-burn serum cytokine profile and suggests that a strong IL-10 response could be indicative of a bacterial infection.

261 . **The Role of Estradiol in Immunomodulation Following Burn Injury**

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Introduction: Our group and others have identified changes in cell-mediated, humoral, and innate immunity following burn injury. Contrary to observed findings in traumatic injury, burn injury is associated with higher mortality rates among female compared to male patients. Estradiol, a potent immune modulator, has been shown to be correlated with increased mortality in traumatically injured patients and studies in animal models of burn injury have postulated that estradiol may have a dichotomous effect on the immune system, acting largely through its modulation of the inflammatory cytokine, IL-6. Reproductive levels of estradiol act to maintain physiological levels of IL-6, resulting in immune stimulation, whereas supra-reproductive levels of estradiol stimulate increased production of IL-6 beyond physiological levels, resulting in immunosuppression. We sought further evidence of estradiol's regulation of IL-6 and subsequently, the larger immune dysregulation following burn injury in male and female patients. Our hypothesis is that serum estradiol and IL-6 levels will be higher in female patients and will correlate with severity of injury in both genders.

Methods: We enrolled 29 patients meeting criteria for admission: 9 with large burns (>30% TBSA) and 20 with small burns (< 30% TBSA). Whole blood was collected within 24 hours, at 24-48 hours, and at 72-120 hours following burn. Serum estradiol and IL-6 levels were assessed by ELISA in patient samples and compared to unburned controls.

Results: Levels of estradiol and IL-6 are elevated following burn injury and there is a positive correlation between both inflammatory mediators and burn size (Estradiol: unburned normals 47.8pg/ul, small burns 67.16pg/ul, large burns 237.6pg/ul***; IL-6: unburned normals 12.53pg/ul, small burns 23.33pg/ul*, large burns 168.0***; *p<0.05, ***p<0.0001). Furthermore serum levels of both estradiol and IL-6 are comparable between male and female patients following burn injury.

Conclusions: These data indicate that elevated estradiol likely plays a crucial and deleterious role in the immune dysregulation following burn injury in human patients due to immunosuppressive effects mediated at least partially via IL-6 modulation. It is less likely, however, that estradiol plays a role in the gender differences seen in mortality following burns as serum levels in male and female patients are comparable.

Applicability of Research to Practice: The role of estradiol in burn shock is a contentious one, as it challenges its established function in trauma. This study will help characterize estrogen in the paradigm of burn injury and lend to creating therapies and treatment models to better outcome.

262 . **Statewide Ban on Recreational Fires Resulted in a Significant Decrease in Campfire Related Summer Burn Center Admissions**

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Introduction: Each summer, there is an increase in the number of burns caused by accidents around campfires. Due to a drought, high winds and uncontrolled wild fires, a statewide ban on recreational fires was instituted from June to July 2011. We hypothesized that this legislation had a significant impact on burn admissions caused by campfire related injuries. A retrospective review of summer admissions to a state burn center was conducted to assess the effect of this ban on recreational fire injuries and compared to the previous summer where no ban was in effect.

Methods: All burn admissions to a state burn center were reviewed from Memorial Day to Labor Day in 2010 and 2011. Data collected included etiology, % TBSA, age, days of hospitalization, ICU days, and total surface area grafted. Nonparametric statistical analysis was performed with Fisher's Exact Test for dichotomous data and Mann-Whitney test for continuous data with significance at $p < 0.05$.

Results: There were 164 burn center admissions between Memorial Day and Labor Day in 2010 (n=82) and 2011 (n=82). Compared to all summer burn center admissions, patients burned by campfires were younger (18 years vs 37 years; $p=0.002$) with smaller total surface area burns (3.2% vs 6.2%; $p=0.41$) and had shorter lengths of stay (10-11 days vs 6-7 days; $p=0.62$). There was more than a three fold decrease in burn admissions due to recreational fires over the study period (n=14 (17%) in 2010 and 4 (5%) in 2011; $p=0.02$). This resulted in a decrease in the number of patient-days from 91 in 2010 to 25 in 2011. Half of the camp fire admissions required skin grafts to definitively close the wounds (6/14 in 2010 and 2/4 in 2011).

Conclusions: Recreational fire bans targeted at controlling wild fires during conditions favoring rapid spread were associated with a three to four fold decrease in campfire related burn admissions. Compared to a summer where no fire ban was in effect, the number of patient-days decreased from 91 to 25.

Applicability of Research to Practice: Fire prevention legislation aimed at limiting ecological and property damage during a drought can have a significant impact on decreasing the incidence of thermal injury. Further consideration of government sanctions promoting fire prevention is needed to evaluate the preservation of health to its constituents.

263 . Sustaining Burns from Household Heating Pads: Who Is At Risk?

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Introduction: Heating pads are commonly used to alleviate muscle and joint soreness due to sports, arthritis, pain syndromes, menstrual cramps, IV infiltration, and post-surgical pain. Unfortunately, some patients sustain self-inflicted burns with these devices. We sought to characterize patients at risk for heating pad burns.

Methods: The burn registry at a Level I Burn Center was retrospectively queried for patients who presented with burns attributable to contact with heating pads (2004-2011). Information was gathered by reviewing the patients' electronic medical record. Specific information obtained includes age, gender, severity of burns, need for operation, comorbidities, and body region burned.

Results: 23 patients were identified with confirmed burns due to heating pads. Their ages ranged from 10 days to 83 years old (mean 46); 13 were female, 10 were male. Of these, 9 (39%) had full-thickness injury. TBSA burned ranged from 0.06 to 2.7%. Twelve patients (52%) eventually went on to require either excision and grafting (7 patients), local tissue rearrangement (4 patients) or a combination of the two (1 patient). The remaining 11 patients healed with local wound care. The mean number of comorbidities per patient was 10.3 with the most common comorbidities being HTN (44%) and DM (35%). Burns were much more common on the lower extremities (65%) than torso (30%) and upper extremity (5%). 40% of the patients suffered their burn while asleep. 52% of patients had conditions associated with chronic pain and 56% had conditions associated with altered cutaneous sensation including paralysis, DM, neuropathy, or a recent operation. Overall, 87% had either chronic pain, altered cutaneous sensation, or both. In addition, 1 patient was an infant.

Conclusions: Retrospective review demonstrated that the typical patient with heating pad burns has significant and numerous medical comorbidities as well as conditions associated with altered cutaneous sensation and/or chronic pain. Their routine use should be cautioned in patients with these comorbidities. In addition, patients who are recuperating from an operation should not use a heating pad at their operative site. Lastly, heating pads should never be used on an infant.

Applicability of Research to Practice: Characterizes patients who are high-risk for heating-pad related injuries.

264 . Kids At Risk Every Second (KARES): A Review Process of Pediatric Burns to Assess Likelihood of Intentional Injury

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Introduction: Burns are a common way that children are abused and it is difficult to prove that the injuries have been intentional. Up to 22% of all pediatric burns may be intentional. There is obvious harm to the child and potentially their siblings if intentional injuries are not recognised and steps taken to prevent further violence. Automatic reporting of every pediatric burn to child protective services (CPS) is the practice in many emergency centers (EC). This causes unnecessary stress to innocent families and wastes CPS resources. It is the responsibility of a burn center to develop a system for assessing the risk of intentional injury in all pediatric burns.

Methods: The KARES team was developed, members include: general surgery attending, surgical resident, burn ICU nurse, CPS, burn clinic nurse practitioner, trauma and burn services coordinator, psychologist, social worker and RN case manager. All children 0-18 years of age with burn injuries have burns photographed in the EC prior to any burn care. All pictures are saved to a secure shared file in the event the child is discharged from the EC. EC staff photograph the burns so that all areas are thoroughly documented, this may take multiple photos. On admission photos are taken again during wound care. Staff pay attention to how the child and the caregivers interact and are suspicious of inappropriate behavior. The attending burn surgeon assesses the child and the burns within 24 hours of admission to verify that the injury is consistent with the stated mechanism. If the details are unclear or suspect, an interview with the caregiver is conducted. If there is suspicion for intentional injury at this point CPS is consulted and a formal inquiry is begun. Monthly the KARES team meets. Each pediatric burn patient presenting to the hospital is reviewed for abuse potential. Each case is presented and mechanism of injury, history of event and burn pictures are reviewed. The team then determines if the child's injuries are consistent with the story. CPS follows up on concerns and will initiate a investigation of any case deemed potentially an abuse case.

Results: The KARES system began June 2001 and 1,101 admitted pediatric burn cases have been reviewed. Upon evaluation the incidence of suspicious injury was 22%; of cases that were deemed suspicious for intentional injury, only 26% were prosecuted, and 11% resulted in convictions.

Conclusions: The KARES system is a vital component of holistic pediatric burn care, that may be replicated at other burn centers.

Applicability of Research to Practice: The KARES system has provided an integrated multi-disciplinary approach to the evaluation of pediatric burns, and helped reduce the number of unnecessary consults to CPS while assuring a detailed evaluation of each case and timely, appropriate referral.

265 . **Are Flame and Scald Burns Different in Children?**

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Introduction: Many studies have evaluated burn mortality based on burn extent. However, there is a paucity of data comparing different burn etiologies on outcomes. The goal of this investigation was to determine if there is a difference in the two most frequent burn causes in children, scald and flame burns, with respect to outcomes.

Methods: A retrospective chart review was performed utilizing the TRACS database for children with burn size $\geq 20\%$ admitted to a high-volume pediatric burn intensive care unit (ICU) over a 12 year period, from January 1999 to December 2010. Primary outcomes analyzed were hospital mortality, total length of stay (LOS), ICU LOS, and number of ventilator days. Patients were grouped primarily into flame or scald injury. Subgroup analysis was performed amongst the flame burn patients into those with an associated inhalation injury and those without. Subgroup analysis was also performed on the patients with scald burns, based on the offending liquid (cooking-related versus non cooking-related). Statistical analysis was performed using Chi-square tests and students t test.

Results: The total number of children included in the study was 454. Mean age and burn size were 8.35 years old and 45.1%, respectively, in the flame group vs. 3.39 years old and 31.9%, in the scald group. Overall mortality was 41/300 in the flame group (13.7%) as compared to 7/154 (4.6%) in the scald burn group ($p=0.003$). Flame burns also demonstrated more morbidities when compared to scald burns, with an increased hospital LOS (59.6 days (Standard Error of the Mean (SEM)=3.0) vs 34.4 days (SEM=3.0), $p<0.001$), increased ICU LOS (36.0 days (SEM=2.6) vs 17.5 days (SEM=2.1), $p<0.001$) and more ventilator days (24.3 days (SEM=2.4) vs 8.6 days (SEM=1.5), $p<0.001$). On subgroup analysis, patients with flame burn injury and concomitant inhalation injury had a much higher mortality than those without inhalation injury (33.3% vs 2.6%, $p<0.001$). In children with a scald burn injury, there was a trend towards increased mortality with non-cooking related burns (6.3% vs 3.8%, $p=0.49$).

Conclusions: The mechanisms of burn injury sustained in the pediatric population does matter: flame injuries are associated with a higher mortality and higher resource utilization than scald injuries.

Applicability of Research to Practice: Better understanding of the outcomes associated with various pediatric burn injuries allows burn physicians to have realistic expectations for patient survival.

266 . **Pediatric Burn Survivors from Mexico are Different than Comparable U.S. Survivors**

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Introduction: The purpose of this study was to investigate differences in pediatric burn survivors from two countries, helping to refine practice guidelines and prevention efforts. As part of a larger multi-center study, data was collected over a 14-year period from several sites in the U.S. One site, in the southern U.S. also serves patients from Mexico. Injury characteristics and demographic differences in these two populations are described.

Methods: Demographic and descriptive data from Mexico and the U.S. were collected. Additional data was collected at 6, 12, and 24-months post burn. Follow-up data from Mexico are collected via clinic appointments or outreach trips. Follow-ups for U.S. participants are collected in clinic, phone calls, or mail-out surveys. Data were analyzed with linear and logistic regressions.

Results: There were 1,813 participants under the age of 18, alive at discharge who agreed to participate in the follow-up study. They were 66% male, 51% Hispanic and 31% White. The mean (SD) age was 7.36 (5.44) years. Mexico contributed 34%, and the U.S. 66%. The U.S. population was 25% Hispanic. The Mexico population was older than the U.S. (7.49 [5.24] vs. 7.28 [5.6] $p=0.0103$) and had higher total body surface area burned (50% [17.46] vs. 22% [18.94] $p<0.0001$). Participants from Mexico were 46% more likely living in a house at the time of their burn compared to the U.S. ($p=0.0423$) and were 45% less likely to be living with at least 1 parent/step-parent ($p=0.0232$). Participants from Mexico were 2.68 times more likely to have concomitant medical problems than participants from the U.S. ($p=0.0029$), but the U.S. population was 3.36 times more likely than Mexico to have suffered a burn that was suspected to be intentional (assault, self-inflicted, or arson) in nature ($p=0.0062$). The U.S. participants were 76% more likely to provide data at the 6-month follow-up ($p<0.0001$) 2 times more likely at 12-months ($p<0.0001$) and 2.6 times more likely at 24-months ($p<0.0001$) than the Mexico participants.

Conclusions: The two populations are different in many ways. Prevention efforts in the U.S. could focus on abuse and self-infliction. Life style and living condition interventions might be appropriate in the Mexico population. Data which document source of burn is needed to specify appropriate interventions in pediatric survivor populations. Efforts to increase follow-up data collection from Mexico participants need further investigation.

Applicability of Research to Practice: Describing differences in pediatric cases from different countries will help clinicians determine if different practices and guidelines need to be developed and followed for the two populations, and lend to prevention, focusing these efforts appropriately for the targeted population.

267 . **Impact of Children with Special Needs on Differences in Fire Safety Priorities and Preferred Method for Parent Education**

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Introduction: Children with special needs are at a higher risk for the devastating effects caused by a burn injury (e.g. pain, appearance and mobility changes); however, little is known about their burn prevention needs. The purpose of this project was to determine the epidemiology of children with special needs, their burn prevention needs, and preferred method of parent education.

Methods: A novel instrument measuring fire safety education needs, priorities and preferred method of education was administered to n=139 parents of and educators/para-professional; both working with children with special needs and children without special needs (using a 2X2 factorial design). Then we tested for differences in each outcome variable between the four groups. Chi-square tests were used to test for differences in categorical variables and ANOVA techniques were used to test for differences in continuous variables.

Results: Parents and professionals ranked burn prevention safety areas differently ($p < 0.001$) and preferred different methods of parent education ($p < 0.001$). Disability did not, however, impact the ranking of burn prevention safety areas ($p > 0.05$) or preferred method of parent education ($p > 0.05$).

Conclusions: Fire safety education may need to be tailored for parents and professionals, but different educational techniques may not be needed for children with and without disabilities.

Applicability of Research to Practice: Further research in this area is indicated. Information from this project will be used to develop, and test a community-based intervention within a large metropolitan area in north central Kentucky.

268 . **Nursing Related Articles in the Burn Literature**

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Introduction: The involvement of nursing in burn research has increased over time, but the contribution to the literature has not been established. The aim of this study was to identify all nursing-related articles published in the burn literature from the past 70 years.

Methods: A search of the literature was conducted in the Web of Science database, which includes the Science Citation Index, for the period of 1940-present using the search terms: "burn" and "thermal" and the search string "nurs*" with the limits of human subjects and English language. Further inclusion criteria were a primary focus on burns and the discipline of nursing. Articles were included based on the consensus of two reviewers who are burn and nursing subject matter experts. The articles were categorized by major themes and decade and analyzed to determine the frequency of key topics and time trends for burn nursing publications.

Results: A total of 469 articles were identified, of which 361 were excluded based on lack of relevance to the discipline of nursing during the review ($n = 108$). The most common topics were: General nursing concerns, including staffing/retention ($n = 63$); psychosocial, such as anxiety, coping ($n = 23$); pain such as alternatives, management ($n = 22$); wound care ($n = 16$); physical assessment ($n = 13$); and patient/staff education ($n = 10$). Of note, some of the least frequently cited themes were: advanced practice nursing ($n = 1$); 1 evidence-based practice ($n = 1$); nursing resilience ($n = 1$); burn resuscitation ($n = 2$); infection control/management ($n = 2$); and collaboration ($n = 3$). A total of 15 articles were published during the 50-year period from 1940 through 1989; that number nearly doubled in the 1990's ($n = 28$) and again during 2000 to 2011 ($n = 65$). The most frequently referenced article was Choniere et al, 1990 titled "Comparisons between patients and nurses assessment of pain and medication efficacy in severe burn injuries", (Pain 1990; 40:2, 143-152) cited 150 times to date.

Conclusions: This study identified a substantial increase over time in nursing publications in burn literature, especially during the most recent decade. The most common burn nursing research topics were anticipated; however the paucity of published articles on nursing issues such as evidence-based practice, resuscitation, the role of the advance practice nurse highlights gaps in the literature.

Applicability of Research to Practice: There is an increased need for research to further evaluate nurses' impact on burns and for nurses to become more engaged and involved in producing burn research. Understanding gaps in burn nursing literature will encourage future nursing research in key areas.

269 . A Descriptive Study of Oilfield Burns

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Introduction: Burns related to oilfield accidents are uncommon nationwide, secondary to the geographic concentration of resources in specific areas. Our regional burn center is located within an epicenter of oil production, and admits several of these injuries each year. We attempted to evaluate this patient population and provide features and outcomes related to their injuries.

Methods: A retrospective review using the burn registry data of all patients injured in an oilfield setting and admitted to our regional Burn Center between April 2006-March 2011 was used. Variables included age, sex, race, type of injury, TBSA, body area involved, additional trauma, and location of incident. Outcome measures used included measures of multisystem organ failure, time on a ventilator, operations performed, length of both ICU stay and hospitalization, and disposition.

Results: A total of 88 patients were involved in oilfield accidents over a 5-year period. Of these, 36 (41%) patients suffered burns. The majority of patients were white (55.6%) and the remainder being Hispanic (41.7%) or of another nationality (2.8%). All were men. Only 2 patients (5.6%) had inhalation injury. Most were thermal burns (97.2%) caused by oilfield flash or explosion (72.2%) or steam (16.7%), with one person being burned by hot mud/cement (2.8%). The remainders were one electrical burn, one pressured-water wound, and one patient with a chemical burn using an unknown cleaning substance. Only 3 burn patients (8.3%) suffered additional trauma. A majority of the burns were to the face (63.9%), anterior torso (47.2%) and upper extremities (50%). Many required ICU stays (83.3%) with a mortality rate of 13.9% (5/36). Surgical grafting was required in 14 patients (38.9%). The remainders of patients were either discharged home (72.2%) or to a facility (8.3%).

Conclusions: Burns arising from oilfield accidents tend to affect healthy young men, and primarily involve the upper body. The incidence of associated trauma was lower than expected, at only 8%.

Applicability of Research to Practice: The use of these results and future studies related to this data will be used to better anticipate the needs of this population and provide appropriate care.

Oilfield Demographics

Variables	Mean	Median	Range
Age (years)	37.9	37.5	19-59
% Total Body Surface Area	20.8	8.75	0-85
# Ventilator Days	16.9	5.5	1-75
# Operations	2.6	1	0-24
Length of Stay in ICU (days)	16.0	9.5	1-88
Total Length of Stay (days)	14.8	7.5	1-88

270 . Do Patterns of Grease Burns Differ with Hand Dominance?

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Introduction: Scald burns accounted for 31% of all burns according to the National Burn Repository Annual Report for 2010. Hot water is the most frequent agent causing scald burns followed by grease, which includes cooking oil. Grease heats to higher temperatures than water before it boils and thus needs less contact time with skin to cause deeper burns. Also, grease is more viscous than water, thus it tends to remain in contact with the skin longer, causing more thermal damage to tissues. The current literature on grease burns is small and limited to studies with small numbers of patients and case reports.

Methods: A retrospective review of data collected from burn patients at a regional burn center from 2004 to the present date was performed. Data collected included location of the burn, hand dominance of the patient, burn size and depth, and need for excision and grafting. Those with incomplete medical records were excluded.

Results: One hundred and sixty five patients were found to have upper extremity burns from either hot water or grease (including grease only and grease with flames). There was no statistical difference in age between the groups (37 ± 19 vs 35 ± 16 , $p = 0.55$). Males were less likely to suffer scald from water but more likely to suffer grease burns (10/32 vs 73/133 males, $p = 0.019$). There was no difference in length of stay between the groups (1.5 ± 2.2 vs 2.4 ± 5.4 , $p = 0.57$). There was no statistical difference in total burn size between groups ($2.2\% \pm 2.9\%$ TBSA vs $1.8 \pm 4.0\%$ TBSA, $p = 0.54$) and no difference in full thickness burn size ($0.2\% \pm 0.6\%$ vs $0.5\% \pm 2.0\%$, $p = 0.48$). Dominant extremity burns were more frequent in grease burns (14/32 vs 92/133, $p = 0.037$). Bilateral upper extremity burns were also more frequent in the grease group (0/32 vs 17/133, $p = 0.045$).

Conclusions: Grease burns are more likely to affect the dominant upper extremity and bilateral upper extremities when compared to scalds from water. Thus, grease burns have the potential for more functional impairment than scald burns. Since many of these injuries happen most often at home, it is important to encourage the general population to use caution when cooking with oil at home and keep children out of the kitchen when preparing food.

Applicability of Research to Practice: We hope these results will help guide burn surgeons in early of grease burns to optimize outcomes. Also, we hope the general public will exercise caution when cooking with grease as these burn injuries carry significant morbidity.

271 . Burn Patients Treated at a Combat Support Hospital in Afghanistan

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Introduction: The 31st Combat Support Hospital (CSH) was mobilized to Afghanistan in January of 2010 with the primary mission of providing medical support to US and coalition troops and secondary mission of providing humanitarian medical assistance to local nationals in the region. The hospital began to treat military and civilian combat casualties in June of 2010. The objectives of this study were to characterize the experience of treating burn patients in this combat zone and compare it with the overall trauma experience.

Methods: The medical records of all thermally injured patients and all trauma patients that were admitted to the 31st CSH from June 1, 2010 to January 15, 2011 were reviewed. Data was also obtained from Joint Theater Trauma System (JTTS) registry database. Demographic, clinical and outcome data were analyzed.

Results: Six hundred and ninety-eight trauma patients were admitted to 31st CSH in Afghanistan during this time period. Of these admissions, 42% (293 patients) were U.S. or coalition forces and 53% (365 patients) were local nationals. Of all the trauma patients, 4% (26 patients) were burn patients. None of the thermal injuries were related directly to combat. The average age of burn patients was 9.9 years while the average age of the trauma patient was 23.3 years ($p < 0.0001$). 85% of all burn patients were male. Hot liquids caused 50% of burns, 46% were caused by flame and the remainder caused by various other mechanisms. The average %TBSA was 13.4%. ICU length of stay trended higher in the burn population (1.96 vs. 1.08, $p = 0.059$). Hospital length of stay for burn patients was double that of the trauma population (8.23 vs. 3.96, $p < 0.0001$). Average total days that patients required mechanical ventilation was greater in burn patients (1.03 vs. 0.43, $p = 0.027$). Overall mortality rates were similar in both populations (7.7% vs. 6.2%, $p = \text{NS}$).

Conclusions: The experience of burn care at the 31st CSH during this time period was overwhelming pediatric and not related directly to the military conflict. Scald and flame burns occurred in almost equal frequency. Even though burn patients comprised a small percentage of the total trauma population, they had significantly longer hospital length of stay and more days of ventilator support. Deployed military medical units providing care to local national patients should have the expertise and equipment to care for pediatric burn patients and should plan to have the resources to provide burn care for an extended period of time.

Applicability of Research to Practice: This research applies to the treatment of burn patients by military surgeons in the combat zone.

272 . Adolescents: Large Children or Small Adults?

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Introduction: Due to developmental limitations, the pediatric population varies in the type of burn injury incurred. An urban burn center pediatric population includes patients up to 14 years old. The purpose of this retrospective study is to determine whether adolescent demographics are more similar to those of children or adults.

Methods: An in-house patient registry was reviewed for patient demographics from March 1999-July 2011. Of 6532 patients seen, 1683 were age 0.1-18 years old (28.5%). Adolescents (15-18 years) comprised 243 (13%) of this pediatric population. One hundred thirty (53%) were hospitalized and 113 were treated and released from the Trauma Bay and/or Emergency Room. Statistical analysis implemented descriptive statistics and chi-squared.

Results: Infants and children were more likely to be admitted in the winter and fall. The adolescents were most frequently admitted in the summer, as were the adults. Compared to 3% in the adults, the adolescent mortality rate was <1%, similar to that in children. While all have scald and flame as their major mechanisms of injury, adolescents had scald and flame burns in a similar distribution to adults.

Conclusions: Adolescents with burn injuries are demographically more similar to adults than children and infants.

Applicability of Research to Practice: Quality assurance and research reports will continue to include adolescents aged 15 years and older with the adult population.

Urban Burn Center Admission Demographic Characteristics

Group (Median)	Age (years)	%TBSA/Hospital Days	Scald %	Flame %	Contact %	Sex Ratio M:F
0.03-12 months n=203	0.75	4.0/4.0	65	2	28	1.3:1
1-5 years n=582	2.0	4.0/5.0	73	8	13	1.6:1
6-14 years n=237	9.0	4.0/4.0	51	27	11	1.4:1
15-18 years n=130	17.0	4.0/4.0	37	29	11	1.6:1
Adults n=2639	43.0	4.0/6.0	29	32	10	2:1

273 . The Hot 100: An Analysis of the Highest Impact Burn Papers in the Last 55 Years

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Introduction: The evolution of burn research, its impact on the scientific community, and important gaps that need to be addressed, can be analyzed by a review of the papers most frequently cited. This study identified the 100 most cited burn-related papers over the last half-century.

Methods: The Web of Science (including Science Citation Index) was searched for the most cited papers related to burns published from 1955 to the present. The search terms were "Burns or thermal" AND "wound or injury"; OR "inhalation injury." Results of the initial search were reviewed by two burn researchers; publications found not to have a specific focus on burns were excluded. Data for the top 100 cited papers are reported.

Results: Most of the papers were published in the *Annals of Surgery* (n = 23), followed by the *Journal of Trauma* (n=8), *New England Journal of Medicine* (n = 7), and *Surgery* (n = 7); one was published in the 1950's and more than half in the 1980's and 1990's (n = 25 and 44 respectively). The most cited paper was "Permanent coverage of large burn wounds with autologous cultured human epithelium," Gallico GG, et al., *NEJM*, 1984 (711 cites). BA Pruitt Jr (2320 cites), DN Herndon (1972 cites) and AD Mason Jr (1435 cites) were the most cited authors. Most of the papers were on pathophysiology (n = 37), wounds, tissue or dressings (n = 31), or organ failure/sepsis (n = 17); few were on inhalation injury (n = 5), pain (n = 3), resuscitation (n = 2), or psychological health (n=1). Seventy-eight reported on adults, two on children, and 1 on both; the rest were on non-clinical topics. One focused on prevention and none addressed patient education or rehabilitation.

Conclusions: This study identified some of the key contributions to research related to burn care and the areas of greatest scientific interest to the specialty during the last 5 decades. These articles helped shape the direction of clinical research and thus contributed to the evolution of modern burn care. For several topics including inhalation injury, burn resuscitation, pain control, and burn rehabilitation, few or no papers appeared among the top 100 cited.

Applicability of Research to Practice: This study provides a useful perspective regarding some of the research publications that have contributed most to advances in burn care.

274 . Incidence and Frequency of Burn Injury in the American Civil War as Compared to Modern Day Conflicts

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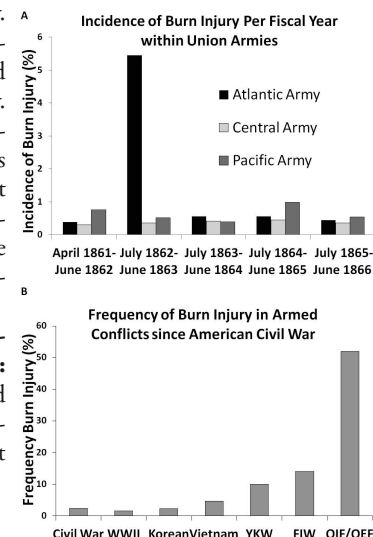
Introduction: The treatise *Medical and Surgical History of the War of the Rebellion* (MSH) was compiled from field surgeons' reports for the duration of the American Civil War (1861-1865) as well as for 1 year after combat ended. This record serves as one of the most detailed, but often forgotten, accounts of wartime injury. While most reported sickness and deaths were caused by disease and infection, over 10,000 burn injuries are reported. We reviewed the records of burn injury in the MSH to evaluate evolving trends of burn injury in the history of warfare.

Methods: Monthly cases of burn injuries and deaths for both black and white soldiers occurring between April 1861 to July 1866 in the Union Armies of the Atlantic, Central and Pacific divisions along with the mean strength of each army were extracted from the MSH and transcribed into an electronic database. Frequency and incidence of burn injury were then calculated. Burn injury frequencies from WWII, Korea, Vietnam, Yom Kippur War (YKW), Falkland Islands War (FIW), and Operation Iraqi and Enduring Freedom (OIF/OEF) were obtained for comparison after performing a literature search of more recent reports.

Results: The MSH reported 408,072 cases of wounds, accidents and injuries during the Civil War. The most common injuries were from gunshots (269,238 or 65%), whereas 10,198 (2.4%) were burn injuries. 98 deaths (0.97%) resulted from burn injury. The most serious burn injuries involved powder and munitions explosion. Yearly incidence of burn injury during the war within each army ranged from 0.3% to 5%, but mostly remained under 1% for each army per fiscal year (Figure A). The incidence of burn injury in the year after the Civil War ranged from 0.3% to 0.5% within each of the armies. Frequency of burn injury sustained during the Civil War was similar to WWII and the Korean War, but much lower than Vietnam, YKW, FIW and OIF/OEF (Figure B).

Conclusions: Recorded burn injuries sustained during the Civil War were likely of a trivial nature with a low frequency, incidence and mortality. More recent wars demonstrate an increased frequency of burn injury. These increasing frequencies of burn injuries in war seen throughout history suggest burn injuries will continue to be a significant source of injury in modern warfare.

Applicability of Research to Practice: Knowledge of burns and burn management remains a critical skill set in modern warfare.



275 . Combined Trauma and Burn Injury

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Introduction: The patient presenting with combined burn and non-thermal traumatic injury is a unique patient with uncommon injuries that continue to present challenges in their care. The purpose of this study was to evaluate the incidence, mechanisms, and outcomes of patients with combined trauma and burn injury at our institution.

Methods: A retrospective review was performed of all patients admitted with combined trauma and burn injury from January 2008 through to the present. A query of the Trauma System Foundation's State Registry was performed using ICD-9 codes to identify combined trauma and burn patients. In order to exclude patients with minor traumatic injuries such as lacerations or abrasions, trauma injuries were defined as ICD-9 codes 800-869, 900-904, and 950-957. Burn injuries were identified as ICD-9 codes 940-949. Also, patients with ISS of less than 8 were excluded from the study. Age, sex, mechanism of injury, percent of total body surface area burned (TBSA), associated injuries, Injury Severity Score (ISS), and patient outcomes were identified.

Results: There were 805 burn and 4,766 trauma admissions during this time. Forty patients (or 5% of all burn admissions) were identified as having combined trauma and burn injuries. There were 33 males and 7 females ranging in age from 16 to 81 years of age, with a mean age of 42.4 years. Mean ISS was 25.4 and average percent total body surface area burn was 19.9%. Associated injuries included long bone fractures in 15 patients, intracranial hemorrhage in 8, pelvic fractures in 11, rib fractures in 11, spine fractures in 13, and solid organ injury in 6 patients. Mechanism of injury was industrial in 3, motor vehicle collision in 13, all terrain vehicle collision in 2, house fire in 10, high voltage electrical injury with subsequent fall in 3, pedestrian struck by vehicle in 2, firework injury in 1, boat explosion in 1 and other in 5. Skin grafting was performed in 19 patients. Nine patients died. Mean ISS and average TBSA was 20.8 and 14 respectively, in survivors, versus 41.2 and 40.1 in non-survivors. Eight of the nine deaths occurred within 24 hours of admission. Cause of death was intracranial hemorrhage in 2 patients, burns greater than 85% TBSA in 2 patients, and combined injury in the remaining patients.

Conclusions: Combined burn and trauma injury represents a rare injury pattern that is associated with significant morbidity and mortality. Both ISS and TBSA were significantly greater in the non-survivor group, with death largely occurring within the first 24 hours.

Applicability of Research to Practice: Multiply injured burn patients present unique management challenges that require a multidisciplinary approach to care. Increasing knowledge of mechanism, patterns of injury, and the potential for increased morbidity and mortality will aid the team in caring for such patients.

276 . Revisiting Serum Lactate and Base Deficit as Markers for Burn Mortality: Beyond Age, TBSA and Inhalation Injury

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Introduction: Age, total burn surface area (TBSA), and inhalation injury are the only currently established indicators of mortality risk for burn patients. We studied base deficit and serum lactate level as possible indicators of burn mortality in this study.

Methods: We performed retrospective chart review of all patients admitted to our burn center between 2006 and 2008 with TBSA of 15% or more. Demographics, injury mechanism, outcomes, and complications data was collected. Multiple serum laboratory markers were obtained including base deficit, serum lactate (mg/dL), as well as total resuscitative fluids utilized in the first 24 hours. Statistical analysis was performed (ANOVA) for comparing age, TBSA, full thickness TBSA (FT TBSA), serum lactate both admission and peak value, and initial base deficit between survivals and mortality groups. Each factor was also studied as independent risk factor with univariate regression analysis.

Results: We collected data for 65 patients off which there 14 deaths (21.5%). There was no statistically significant difference between survivals and non-survivals for age, TBSA, and prevalence of inhalation injury. Comparing the risk factors between non-survivals and survivals with ANOVA; only the FT TBSA ($p=0.04$), initial lactate ($p=0.02$), peak lactate ($p=0.03$), and base deficit ($p=0.01$) showed statistically significant difference. Regression coefficient for Age, TBSA, FT TBSA, initial lactate, peak lactate, and initial base deficit as independent mortality risk for burn was 0.89, 0.91, 0.98, 0.90, 0.99, and 0.92 respectively. Serum lactate level of 30 mg/dL (1.5X normal upper limit) at six hours after admission (2nd time point after admission) had positive predictive value of 0.9, negative predictive value of 0.93, specificity of 0.96, and sensitivity of 0.78. The detailed data is presented in table 1.

Conclusions: In addition to age, TBSA and inhalation injury; FT TBSA, initial lactate level, peak lactate level, and initial base deficit were correlated with burn mortality. Study with larger sample is warranted to improve the reliability of these parameters. We have continued to collect data to study patient population up to 2011.

Applicability of Research to Practice: Identification of new independent risk factors for burn mortality.

Table 1. Mortality risk indicators (mean values)

Risk factor	Survivals	Non survivals	ANOVA (p value)
Age	37.1	48.4	0.065
TBSA	36.7	47.4	0.175
FT TBSA	24.4	41.9	0.043
Initial lactate	23.8	62.3	0.021
Peak lactate	29.3	71.2	0.030
Initial base deficit	2.6	8.25	0.011

277 . Do Local Burn Center Populations Reflect the Demographic Characteristics of the National Burn Repository?

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Introduction: With the National Burn Repository, many publications are available on the demographics of the North American burn population. In terms of burn prevention and community activities for pediatric patients, it is still important to assess the local burn population. The purpose of this retrospective study was to determine whether the demographics in the National Burn Repository reflect those in an local urban burn center.

Methods: An in-house patient registry was reviewed for patient demographics from March 1999-July 2011. Of 6532 patients seen, 1683 were age 0.01-18 years old (28.5%). Statistical analysis implemented descriptive statistics and chi-squared.

Results: The 2007 National Burn Repository has the Caucasian population as 53 % with people of color as 47%. The major mechanisms of injury are scald and flame for all groups. Similar to published reports, the local Caucasian population has fewer scald injuries compared to the non-Caucasian population. Unlike the published National Burn Repository demographics, this urban center has a higher proportion of patients of African-American and Hispanic ethnicity. Infants and children are more likely to be injured by scald and contact rather than scald and flame.

Conclusions: For local burn prevention community interventions, the local or regional demographics need to be identified to better tailor the activities to the local population.

Applicability of Research to Practice: Although national burn demographics are useful, local demographic characteristics still play a role in determining burn prevention and community activities.

Urban Burn Center Admission Demographics

Group (Median)	Age(years)	%TBSA	Scald %	Flame %	Contact %	Caucasian %	Hispanic %	African-American %
0.03-12 months n=203	0.75	4.0	65	2	28	2	28	68
1-5 years n=582	2.0	4.0	73	8	13	6	33	59
6-14 years n=237	9.0	4.0	51	27	11	4	26	67
15-18 years n=130	17.0	4.0	37	29	11	9	34	57

278 . Comparison of Scald and Flame Burns: A 17-Year Study

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Introduction: Scalds and flame burns make up the majority of burns in most burn centers. We compared the characteristics of burn patients admitted to a regional burn center with scald and flame burns. We hypothesized that flame burns would be larger and deeper than scald burns and that the length of stay in the burn unit would be longer with flame burns.

Methods: Retrospective medical chart review. Setting: Regional burn unit covering a population of approximately 1.5 million. Patients: All patients admitted to the burn unit from 1994-2010. Measures: Demographic (age, gender) and burn characteristics (etiology, location, depth, % total body surface area (TBSA). The primary outcome was length of stay (LOS) in the burn unit. Data Analysis: Descriptive statistics were used to summarize the data. Patients with scald burns and flame burns were compared with chi-square and t-tests and multivariate logistic regression.

Results: During the study period there were 1377 admissions for burns. Mean age was 31.6+/-24.2, 68% were male, and 32% were under age 18. The overall LOS was 10.9 (21.8) days. The most common burn etiologies included scalds (39.0%), flames (31.5%), contact with a hot surface (4.9%), electrical (4.8%), and chemical (4.6%). Patients with scald burns were younger than those with flame burns (22+/-24 vs. 39+/-22; P<0.001) and more likely to be females (41.8% vs. 26.4%, P<0.001). Compared with scald burns, patients with flame burns had larger (14.5+/-16.4 vs. 8.9+/-8.0 %TBSA; P<0.001), and deeper (34.5% vs. 13.3% full thickness; P=0.001) burns. The total LOS in the burn unit was also longer for flame burns (15.4+/-29.9 vs. 8.7+/-19.4 days; P<0.001). Adjusting for age, gender, and depth of burn, there was no significant difference in LOS between scald and flame burns. This is due to confounding between type and depth of burn, which had a significant (P<0.001) effect on LOS in the multivariate model. Age was also significantly associated with LOS in the model, while gender was not.

Conclusions: Scalds and flame burns continue to make up the overwhelming majority of patients admitted to a regional burns unit. Flame burns are larger and deeper and result in longer admissions than scald burns.

Applicability of Research to Practice: Our data confirm that flame burns are worse than scalds and require more resources.

279 . Comorbidities or Significant Medical History in Firefighters Increases Likelihood of Larger Burn Injuries

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Introduction: Given the latest advances in gear technology one would expect that firefighter burn injuries have decreased and that firefighter admissions to burn units would become a thing of the past. However, we continue to see firefighter admissions every year at burn centers despite these advances. A more comprehensive picture of the admitted patients is needed to help elucidate why continued firefighter injury occurs. The aim of this study was to determine if firefighters with significant past medical histories or comorbidities had a higher likelihood of sustaining larger burns on the fire-ground.

Methods: The records of a large urban burn center were queried for firefighters who had sustained a burn injury from 2000-2009. Inclusion criteria included patients who were > 18 years old, had an occupation of firefighter, self-identified as being Caucasian or Black, and had an inhalation or burn injury requiring medical treatment at this institution.

Results: Of the records queried, 286 patients met criteria for analysis. The majority (73%) of patients were male. Ninety-five percent of patients were Caucasian. The mean length of stay (LOS) was 1 day with a mean age of 31 years. The average %Total Body Surface Area (TBSA) burn was 3%. Twenty-five percent of patients had a comorbid condition or other significant past medical history on admission. Those patients with a significant past medical history had, on average, 5.2% larger burns. All but one patient was discharged home without the need for additional care. Almost all patients' care was covered under workers' compensation. The most prevalent etiologies of injury were fire/flame, unknown and contact with a hot object. No mortalities were recorded. A LOS >1 day was significantly associated with an elevated carboxyhemoglobin ($p<.0001$) and having a comorbid condition or significant past medical history ($p=.047$). Older firefighters had smaller burns than younger firefighters.

Conclusions: Identification of possible comorbid and significant medical problems from the beginning of a firefighter's career may help physicians optimize care for these patients and more effectively prepare them for a longer, healthier career. This study is a retrospective series, therefore only limited information could be gathered about the circumstances in which these injuries occurred. We were unable to obtain information regarding level of training and whether the patients were career or volunteer firefighters. Future prospective, longitudinal studies may be conducted to determine if improved medical management of comorbid conditions can reduce the frequency and severity of potentially career-ending injuries.

Applicability of Research to Practice: Insight into firefighter burn injury.

280 . A Longitudinal Burn Outcome Database: Updates on a Multicenter Study

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Introduction: A multi-center study to collect longitudinal outcome data on burn survivors was initiated in 1994. A previous analysis of the data highlighted significant loss to follow-up in the database. In 2005, changes to study enrollment (to include only those with the most severe injuries) and data collection methods (strategies such as use of locator services, close and frequent monitoring of issues and increased accountability) were instituted in an effort to reduce the risk of attrition and increase the generalizability of the findings generated from this database. The purpose of this study is to examine the impact of such changes on the demographic profile and rate offollow-up in this database.

Methods: Demographic and descriptive data from all centers involved were summarized for both time periods (1997-2004 vs. 2006-2011) for both pediatric and adult survivors. Comparisons were made between groups for demographic and follow-up data using chi-square tests and t-tests.

Results: For the post comparison period (2006-2011) 990 patients were alive at discharge and consented to follow-up data collection. Twenty-seven percent ($n = 270$) were 16 years and younger. Patient race/ethnicity varied depending on the geographic location of each center. The majority of patients over the age of 18 were employed at time of burn (62% post) with no significant difference between enrollment periods. Comparisons between groups are summarized in table 1.

Conclusions: The database continues to be an expansive repository for data on both injury characteristics and outcomes. The results demonstrate that the change in the enrollment criteria did change the population, shifting it to a survivor group with a significantly larger total body surface area (TBSA) burned, and a significantly older population. Other demographic variables were not significantly different between the two time periods. The change in criteria also significantly improved follow-up rates for all time-points.

Applicability of Research to Practice: This longitudinal database is a valuable tool for providing researchers with quality data to explore outcomes of burn survivors.

Table 1. Summary of differences for post vs. prior

	1997-2004	2006-2011
% Male	70.5	71.5
Mean age	26.5	31.0**
Mean % TBSA burned	23.4	26.7**
Fire/flame (% sample)	59.6	60.8
Some assessment, 6 months (%)	67.4	72.8*
Some assessment, 12 months (%)	61.6	70.4**
Some assessment, 24 months (%)	54.0	60.7*
* $p<0.05$; ** $p<0.0001$		

281 . Ethnicity and Etiology in Burn Trauma

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Introduction: The purpose of this study was to retrieve data from the burn unit registry with a focus on ethnicity and how it is involved in burn trauma. It is hypothesized that mechanism, severity and other patient characteristics differ between ethnic groups. If true, this data can be used to augment community-specific burn prevention strategies.

Methods: Data for burn patients admitted 1979-2009 were reviewed from our burn unit registry. Data was subdivided for the following four ethnicities: Caucasian, Aboriginal, Asian and Indoasian reflecting the population distribution of the region. Age and gender were also assessed. Burn mechanism, severity, and contributing factors were then compared between these four ethnic groups.

Results: Caucasians were the largest group (79.1%) and included the biggest male:female ratio (3.3:1), with a high incidence of flame injury (53.9%). Caucasians present with the highest mortality rates (6.6% compared to 4.1% for all other ethnicities, $p < .006$). Asian patients (8.1%) showed significantly higher incidence of urban (64%) and workplace (28.9%) injuries with a larger proportion of scald injury (38.9%). Indoasian patients included larger numbers of women (36.4%) and household scald injuries (33.9%) while Aboriginals suffered the highest rates of flame injury (60.1%) in rural areas with more frequent contributing factors such as alcohol.

Conclusions: Our review has revealed differences in burn mechanism, gender injured, contributing factors and mortality rates when comparing between four different ethnic groups.

Applicability of Research to Practice: Though the exact reasons for these differences are difficult to say with certainty, the results of this study provide the opportunity to focus communication and burn prevention strategies within specific communities and ethnic groups.

282 . Differential Gene Expression in Airway Submucosal Gland Cells in an Ovine Model of Smoke Inhalation and Burn Injury

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Introduction: Airway submucosal gland (SMG) cells are important in innate airway defense and their proliferation plays a vital role in airway surface restoration after epithelial exfoliation following inhalation injury. The objective of this study was to investigate the effects of smoke and burn injury on gene regulation in SMG cells.

Methods: 6 female sheep (28-40 kg) were divided into 2 groups: instrumented sham and inhalation injury. After tracheostomy, cotton smoke (48 breaths) was insufflated per protocol. The sheep were mechanically ventilated, resuscitated with Ringer's, and sacrificed at 48h after injury. SMG cells were obtained by laser capture microdissection performed in specially stained frozen bronchial tissue sections using a Veritas System (Arcturus). Total RNA was isolated using a micro kit (Applied Biosystems, CA) and converted to cDNA using an mRNA amplification kit (Clontech) and RNA quality was assessed using a bioanalyzer (Agilent). Gene expression was assessed on an Agilent-019921, Ovis Aries custom 8X15k microarray. The data set was normalized using Agilent-GeneSpring Software. The gene expression differences were compared between groups and filtered based on >2-fold change in expression. Functional gene analysis was performed by Ingenuity Pathway™ (IP).

Results: Data indicate differential expression of at least 600 genes between injured and sham animals. Of these 48% was up regulated. Several members of the TGF- β family, inflammatory cytokines, and oxidative stress genes were upregulated.

Conclusions: The study indicated significant changes in SMG cell gene expression. Future studies examining the role of TGF- β on the inflammatory potential of these cells are warranted.

Applicability of Research to Practice: Knowledge of the differential expression of genes in airway gland cells is important for development of therapies to inhibit mucus hypersecretion and inflammation after inhalation injury in burn victims.

283 . Implications of Alcohol Intoxication at the Time of Burn and Smoke Inhalation Injury: An Epidemiologic and Clinical Analysis

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Introduction: Each year nearly 80,000 deaths in the U.S. are linked to excessive alcohol use. Moreover, binge drinking is associated with violence and unintentional injuries, and up to half of those presenting with burn injuries have a history of acute alcohol exposure. However, the effect of binge drinking on burn patients with inhalation injuries (INI) is not well described.

Methods: In a prospective study, bronchoscopy was performed on 75 burn patients when INI was suspected. Of these, 22 were excluded for either having not had an INI or having no blood alcohol content (BAC) measured within 4 hours of presentation. The final cohort of 53 patients were grouped as BAC negative (n=37), BAC 1-79 mg/dL (n=4), and BAC \geq 80 mg/dL (n=12). Those in the latter group were designated as binge drinkers according to NIAAA criteria.

Results: Compared to BAC negative patients, binge drinkers with an INI had much higher carboxyhemoglobin (COHb) levels (median 5% vs 23%; $p=0.03$), though the groups did not differ in terms of INI grades (mean 2.2 vs 2.3), hospital charges (median \$221,282 vs \$201,137), antibiotic days (median 10 vs 13), days on the ventilator (median 14 vs 19), ICU days (median 23 each), hospital length of stay (median 26 vs 24 days), or the incidence of sepsis (27% vs 17%), pneumonia (59% vs 50%), and transfusions (59% vs 50%). Despite similarities between groups, binge drinkers had considerably smaller skin burns than did their non-drinking counterparts (mean % TBSA 11 vs 25; $p=0.07$) and significantly lower revised Baux scores [$\text{Age} + \% \text{TBSA} + 17 \times \text{INI}$ (No=0, Yes=1)] (mean 76 vs 95; $p=0.03$). Though no binge drinking patient succumbed to their injuries as compared to 32% of non-drinkers, the difference in survival was not significant after adjusting for age and % TBSA ($p=0.28$).

Conclusions: In our cohort, binge drinkers with an INI had smaller cutaneous burns than non-drinkers. Despite this difference, however, outcomes and consumption of health care resources were similar between binge drinking and non-drinking patients. In the added context of transfusion requirements and prolonged courses of systemic antibiotics, the impact of binge drinking at the time of INI cannot be ignored, especially had the risk of injury by excessive drinking been avoided. Additional studies are required to elucidate the potential biological effect of increased % COHb in these patients.

Applicability of Research to Practice: Binge-drinking patients with inhalation injuries should be suspected of carbon monoxide exposure, and to potentially have considerable resource utilization even in the face of relatively small cutaneous burns.

284 . The Effects of Airway Pressure Release Ventilation (APRV) on Tissue Antioxidant Status in a Swine Wood Smoke Inhalation Injury Model

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Introduction: Our laboratory has previously shown that acute respiratory distress syndrome (ARDS) develops following exposure to significant amounts of wood smoke. Best ventilation strategy in the management of early smoke inhalation injury remains controversial and little is known of the role of APRV in this practice. To further our overall evaluation of APRV use in the early management of smoke inhalation injury, the present study determined antioxidant status in tissues from swine subjected to smoke inhalation and ventilated with APRV without a spontaneous ventilation component compared to conventional mechanical ventilation (CMV).

Methods: Anesthetized swine (n=22) inhaled 30 L wood bark smoke and were randomized to either APRV (n=10) or CMV (n=12) for 48 hr. Time controls (Cont; n=6) were uninjured, but mechanically ventilated similar to the CMV group. At 48 hr after smoke exposure, animals were euthanized and lung, liver, heart and kidney tissue was collected for determination of total antioxidant status, glutathione concentrations and activities of antioxidant enzymes. Survival was assessed via Kaplan-Meier analysis. Data were analyzed by ANOVA and $p < 0.05$ was considered statistically significant.

Results: Smoke inhalation induced ARDS, but the PaO₂-to-FiO₂ (PFR) at 48 hr, although higher in the APRV group, was not significantly different from the CMV groups (257±58 vs 137±46, respectively). There were also no differences in survival between the 2 ventilation groups. At 48 hr after smoke inhalation in the APRV and CMV groups, total lung antioxidant potential, superoxide dismutase activity and glutathione peroxidase activity were 29%, 30% and 35% lower, respectively, compared to Cont. In contrast lung glutathione concentrations in the APRV and CMV groups were 71% higher than Cont after smoke inhalation. No significant differences were observed in any of the other indices of oxidative or nitrosative stress between the APRV and CMV groups in lung or any of the other tissues assayed.

Conclusions: In an assessment of ventilator strategies for the early management of smoke inhalation injury, APRV did not demonstrate any significant improvement over CMV in oxygenation or markers of oxidative stress in the first 48 hr after smoke inhalation.

Applicability of Research to Practice: Animal models can be a useful tool towards understanding the physiologic and inflammatory changes associated with modes of mechanical ventilation. These data do not support APRV as a significantly better mode of mechanical ventilation for the early treatment of smoke inhalation injury.

285 . Does the Storage Age of Transfused Blood Affect Outcome in Burn Patients?

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Introduction: The effects of the storage age of transfused blood are not well understood. Patients with major burns receive numerous units of blood, each with a different shelf age. The purpose of this study was to examine the effects, if any, of the storage age of transfused blood on outcomes in burn patients.

Methods: Retrospective analysis of all patients with burns > 20% TBSA who received at least one blood transfusion during the 1st 30 days of treatment at an adult regional ABA-verified burn center. Subjects were stratified a priori into one of two groups based on the mean storage age of all transfused blood given during the 1st 30 days post burn (PB) : either > 28 days (Old) or ≤ 28 days (Fresh). All values are reported as the mean ± SD.

Results: Subjects in the Old group (n=39) did not differ significantly from those in the Fresh group (n=88) in age (50 ± 16 vs 47 ± 17 yrs, $p=0.307$), burn size (41 ± 16 vs 42 ± 17 %TBSA, $p=0.729$), full thickness burn (28 ± 23 vs 31 ± 20 %TBSA $p=0.474$), or incidence of inhalation injury (36% vs 40% , $p=0.692$). The storage age of transfused blood in the Old group was 32.8 ± 3.7 days with 70% of the units being > 28 days old, which differed significantly from the Fresh group where the storage age was 21.2 ± 4.8 days with 86% of units being < 28 days old ($p < 0.001$). The Old group received their 1st transfusion later than the Fresh group (5.6 ± 4.2 vs 3.7 ± 3.1 days post burn, $p=0.004$), and received less blood during the 1st 30 days PB (10.4 ± 8.6 vs 14.2 ± 9.3 units, $p=0.02$). There were no significant differences in the number of surgical procedures/1st 30 days. Outcomes are shown in the table.

Conclusions: During the acute treatment phase (i.e the 1st 30 days PB), there do not appear to be any adverse effects associated with transfusion of blood whose storage age is predominantly > 28 days old compared to blood which is predominantly < 28 days old, among adults with major burn injuries.

Applicability of Research to Practice: These findings suggest that there is no need for blood banks to specifically provide blood of a certain storage age for transfusion to burn patients.

Outcomes

	old (> 28 days)	fresh (≤ 28 days)	p value
Rate of bloodstream infections/day/1st 30 d	0.021 ± 0.018	0.024 ± 0.020	0.364
Mean SOFA score/30days	5.8 ± 2.8	6.2 ± 2.9	0.540
Peak SOFA score/30 days	10.2 ± 2.9	10.5 ± 3.4	0.593
Duration mechanical ventilation (days)	27 ± 25	33 ± 28	0.207
Time to wound healing(days)	38 ± 29	48 ± 48	0.276
Length of stay (days)	58 ± 51	68 ± 58	0.373
30 day mortality	0.20	0.21	1.0
In-hospital mortality	0.28	0.25	0.660

286 . Heparin-Binding EGF-Like Growth Factor (HB-EGF) Attenuates Acute Lung Injury Following Scald Burn in Mice

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Introduction: Acute lung injury (ALI) is a significant component of the multi-organ dysfunction syndrome that accompanies severe burns in children. Impaired gut barrier function has been implicated in the development of ALI following burns. HB-EGF has been shown to reduce inflammation and preserve gut barrier function in intestinal ischemia/reperfusion and hemorrhagic shock and resuscitation models. The role of HB-EGF in the prevention of ALI following severe burn injury has yet to be investigated.

Methods: Mice were divided into sham, burn, and burn + HB-EGF groups. The HB-EGF group received HB-EGF ($1,200 \mu\text{g/kg}$) via gavage both 12h and 1h prior to burn injury. Anesthetized mice were subjected to either 25% TBSA full-thickness dorsal scald burn or to sham injury, followed by fluid resuscitation with 1 mL LR. Mice were sacrificed 8h after scald or sham and lung tissue assayed for myeloperoxidase (MPO) and cleaved caspase-3 immunohistochemistry. Additional animals were subjected to measurements of lung resistance and bronchial reactivity using the SCIREQ Flexivent system.

Results: Scalded mice (n=4) had increased lung MPO activity compared to sham mice (n=3), whereas mice subjected to scald + HB-EGF (n=7) had significantly decreased lung MPO activity compared to scalded mice (3.2 ± 2.1 vs. 6.7 ± 2.0 U/g, $p < 0.02$). Immunohistochemistry for cleaved caspase 3 showed that scalded mice (n=6) demonstrated significantly increased pulmonary apoptosis relative to sham (n=5) (5.3 ± 0.5 vs 0.1 ± 0.1 apoptotic bodies/HPF, $p < 0.001$), whereas mice subjected to scald + HB-EGF (n=7) had significantly decreased pulmonary apoptosis compared to scalded mice (0.7 ± 0.5 vs. 5.3 ± 1.9 apoptotic bodies/HPF, $p < 0.001$). Administration of HB-EGF prevented the elevated airway resistance (n=7 per group, $p < 0.002$) and increased airway reactivity (n=5 per group, $p < 0.001$) seen in scalded mice (all $p < 0.05$).

Conclusions: These data suggest that HB-EGF protects mice from ALI following scald burn. Prior studies suggest that the underlying mechanism may be related to preservation of gut barrier function and downregulation of the systemic inflammatory response. Additional studies are needed to elucidate the exact mechanisms by which HB-EGF exerts its protective effects after scald injury.

Applicability of Research to Practice: Scald burns represent a major source of morbidity and mortality in children less than five years of age. Early delivery of HB-EGF following severe burn injury may attenuate the ensuing acute lung injury, and may represent a novel therapeutic agent that can protect the lungs from secondary injury after scald burns.

287 . Oliguria and Non Responders to Fluid Therapy during Burn Resuscitation

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Introduction: Fluid therapy is titrated to a target level of urinary output (UO) by varying infusions of crystalloid, often with albumin. Fluid overload and associated morbidities are not uncommon. Our goal was assess the occurrence of patients that had oliguria and were non-responders to fluid resuscitation.

Methods: We analyzed a cohort of 55 consecutive burn patients at one institution with TBSA > 20% admitted in 2009-10. Infusion rates of lactated Ringers were guided using a computerized burn fluid decision support system. Data collection and analysis had IRB approval.

Results: A total of 1,020 hours of burn center therapy during the first 24hrs postburn (PB) were analyzed. Patients arrived at the burn center at 4.2 ± 2.8 hours PB. We define hourly oliguria as being UO < 0.5 ml/kg per hr and hourly severe oliguria as being UO < 0.2 ml/kg per hr. A non-responder hour was defined as oliguria with an hourly infusion rate (ml/kg per %TBSA) of over Parkland rate (0.25 during first 8-hrs PB or 0.125 for next 16-hrs). Table shows the percent of hours in the first 24 hrs PB for each category (* p < .01 survivors versus non-survivors, Students t Test) as well as the mean UO for all patients and grouped per survival. Oliguria was a frequent hourly event in the first 24 hrs of burn care and varied widely with a range of 0 to 100% of hours in non-survivors and 0% to 32% in survivors with no significant difference in mean values. Hourly occurrence of severe oliguria also varied widely among patients, but was significantly greater in non-survivors, but again with a wide variance; non-survivor hours of oliguria ranged was 0% to 100. Non-survivors received 959 ± 701 ml of albumin vs. 497 ± 678 ml in survivors. Albumin dose did not correlate with hours of oliguria or non-responder hours. About half the oliguria hours were associated with infusion rates greater than Parkland rate and thus were defined as a non-responder hour.

Conclusions: Occurrence of hourly oliguria is frequent in both survivors and non-survivors, despite mean 24-hr urinary outputs being in target range. Computerized decision support based on urinary output is ineffective during a non-responder period.

Applicability of Research to Practice: Algorithms based on other vital signs and linked to therapeutics other than fluid are needed to optimize burn resuscitation.

Results: Mean \pm SD * = p < .01

Group	n =	Oliguria % of hrs	Severe Oliguria % of hrs	Non- Responder % of hrs	Mean UO ml/kg per hr
All subjects	55	43 \pm 24	16 \pm 19	18 \pm 18	0.82 \pm .40
Survivors	43	40 \pm 21	13 \pm 9*	14 \pm 10	0.81 \pm .41
Non-survivors	12	53 \pm 31	29 \pm 36	19 \pm 20	0.85 \pm .37

288 . Morphine and Intra-Operative Fluid Resuscitation in a Burn Operating Room

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Introduction: Morphine is a commonly used analgesic that is also used as a component of balanced anesthesia. It is considered the benchmark for all new analgesic development. It gained popularity on the Civil War battlefields and continues to serve as the main option for pain relief on today's battlefields. Despite these beneficial attributes, morphine has significant side effects including altered hemodynamics, which could increase fluid requirements in burned patients. This study examines the relationship between morphine usage and resuscitation fluids administered during burn surgery.

Methods: After IRB approval and in accordance with the approved protocol, the medical records of burn patients from June 2004-April 2011 were examined to determine drugs given during the operation, length of the surgery, fluids given during the operation, and estimated blood loss. Because length of surgery may impact the amount of morphine given, the ratio of morphine dose to length of operation was calculated. Operations were categorized as: no morphine, < 0.045 mg/min, 0.045 to 0.09 mg/min, and > 0.09 mg/min.

Results: There were 2696 operations lasting 10-840 minutes. Of those sessions, 160 received morphine during the surgery. The patients receiving morphine had more severe injuries and larger TBSA. However, all groups had similar amounts of body surface areas being excised ($10.64\% \text{ TBSA} \pm 14.58$ vs $11.39\% \text{ TBSA} \pm 12.69$, p=0.21) and similar body surface areas being harvested for grafting ($6.08\% \text{ TBSA} \pm 7.42$ vs $7.96\% \text{ TBSA} \pm 9.06$, p=0.85). There was a significantly greater amount of fluids required in the high morphine (>0.09 mg/min) group compared to the no morphine group ($21.53 \text{ ml/min} \pm 24.80$ versus $14.33 \text{ ml/mg} \pm 14.48$ p<0.001).

Conclusions: This study suggests that high morphine consumption (>0.09 mg/min) is associated with increased fluid requirements during surgery in burn patients. It does not address mechanism or specific fluids used. This is a small retrospective study so there are several limitations. Future randomized, prospective, appropriately powered trials are required to further clarify the findings of this study.

Applicability of Research to Practice: In a resource-limited environment, the association of high morphine administration with increased fluid requirement has negative logistical implications. This advocates for further research into morphine alternative analgesic strategies. These may include regional anesthesia, total intravenous anesthesia, and multi-modal analgesia to restrict the use of opioids.

289 . The Use of Apheresis Collected Plasma (ACP) during the Initial Resuscitation of Major Burn Injuries Helps to Limit “Fluid Creep”

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Introduction: Controversy remains regarding the role of colloids in burn resuscitation. The recognition that modern burn patients were receiving fluids in excess of that predicted by the Parkland Formula (“fluid creep”) has brought interest once again to colloid use. At our institution, burn resuscitation is non-protocol driven except for the use of the Parkland Formula. Apheresis collected plasma (ACP) is utilized when there are signs of inadequate perfusion despite adequate crystalloid administration. This study was undertaken to assess the effectiveness of this approach.

Methods: A retrospective chart review was conducted on all patients ≥ 18 years with $\geq 20\%$ TBSA burns admitted from January 1, 2007 to December 31, 2009 who survived at least 72 hours after injury. Patient demographics and fluid resuscitation data were collected. Outcome data included ventilator days, hospital length of stay (LOS), morbidity (e.g., infections, acute lung injury, abdominal compartment syndrome), and mortality.

Results: A total of 66 patients were identified. After initial chart review, 28 patients were excluded due to incomplete data or mortality < 72 hours. The remaining 38 patients were divided into those requiring only crystalloid fluids (CR) and those receiving both crystalloid and colloid (CO) in the form of ACP (11 and 27 patients, respectively). Results are shown in tabular form. Of those receiving ACP, 74.1% (20/27) received it within 24 hours and as early as ≤ 8 hours (18.5%, 5/27). Hospital acquired infections were more frequent in the CO group, ARDS more frequent in the CR group. Abdominal compartment syndrome occurred in one patient in the CO group.

Conclusions: The use of colloid in the form of ACP, as early as the first 8 hours, resulted in successful burn resuscitation and helped to limit “fluid creep.” While there were differences in some outcome parameters, causality cannot be determined as this study is observational and patients were not randomized to two groups upon arrival.

Applicability of Research to Practice: The use of colloids in burn resuscitation, especially during the early phase, is controversial. However, its role must be clearly delineated. A multi-center randomized, prospective study is necessary and must address the issues of timing, dose, and type of colloid to be utilized. Also, the effects of colloids on outcomes can only be elucidated in this manner.

Resuscitation Results (averages presented, range in parentheses)

	Number of Patients	Age (years)	Weight (kg)	%TBSA	Ventilator Days	Hospital LOS(days)	mL/kg/%TBSA fluid received	mL/kg/hr urine output first 24 hrs	Mortality
CR	11 (9M:2F)	45 (18-90)	84.5 (55-110)	37.2 (20-70)	14.6 (0-63)	27.2 (4-69)	3.3 (0.59-5.6)	1.33 (0.46-2.98)	3/11 27.3%
CO	27 (25M:2F)	39.4 (18-77)	88.1 (61.1-130)	42.3 (20-77)	13.8 (2-45)	38.8 (5-147)	4.6 (0.55-8.6)	0.88 (0.23-2.0)	1/27 3.7%

290 . Point of Care Glucose Measurement is Inaccurate during High Dose Vitamin C Infusion for Burn Shock Resuscitation

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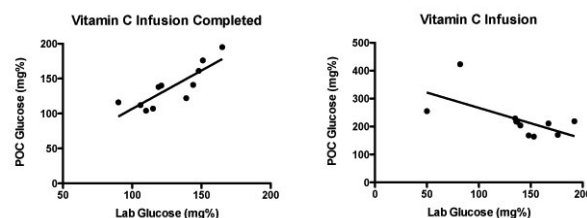
Introduction: The use of high dose Vitamin C (hdVC, 66mg/kg/hr x 18h) is a useful adjunct to reducing fluid requirements during resuscitation of burn shock. Routine point of care glucose analysis (POCG) has been inaccurately high in observed patients undergoing hdVC. This is a retrospective analysis of plasma glucose measurements from a central laboratory (LG) compared to POCG during and 24 hours following hdVC infusion.

Methods: Records of adult patients receiving hdVC infusions during burn resuscitation over one year were reviewed. Charts selected for analysis included those with glucose measurements using POCG and LG that were taken simultaneously were taken during hdVC infusion and 24 hours after completion. All specimens were drawn from arterial lines. POCG was measured with Accu-Chek Inform (Roche, Indianapolis, IN) and LG was measured by Siemens Dimension Vista 500 (Siemens, Deerfield, IL) using biochromic analysis. Nonparametric statistical analysis was performed using Wilcoxon Matched Pairs Test and Spearman Correlation with significance at $P < 0.05$.

Results: Of 18 adult patients undergoing burn resuscitation with hdVC infusion, 5 were chosen for analysis (%TBSA 40 ± 15 ; age 51 ± 18). All data was pooled with 11 comparisons both during and after hdVC. The mean POCG (225 ± 71) was significantly higher than mean LG (138 ± 41) on hdVC ($p=0.002$). There was no difference between POCG (138 ± 30) and LG (128 ± 23) after hdVC was finished ($p=0.09$). There was a negative correlation between POCG and LG on hdVC (-0.64 , $p=0.04$) and a positive correlation off hdVC (0.89 , $p=0.0005$).

Conclusions: POCG analysis on hdVC infusion is significantly higher than LG measurements. Once the hdVC infusion is complete, POCG and LG measurements are not statistically different.

Applicability of Research to Practice: POCG analysis is inaccurate during hdVC infusion for burn shock and should be avoided. Treating erroneously high glucose based on POC testing is potentially dangerous. After completion of hdVC infusion, the POCG testing regains its clinical accuracy to LG measurements.



291 . Lactate Clearance in the Burn Patient

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Introduction: A severe burn results in a devastating and unique derangement called burn shock. Historically, resuscitation has been guided by a combination of basic laboratory values, invasive monitoring and clinical findings, but the optimal guide to the endpoint of resuscitation remains controversial. This study examines the clinical utility of the lactate clearance in the reanimation phase. We hypothesize that a high lactate clearance in 24 hrs is associated with decreased mortality rate.

Methods: We prospectively studied 147 consecutive burn patients admitted to our Burn Unit. Sociodemographics and comorbidities data were recorded. Clinical data was collected to calculate Acute Burn Severity Index. Resuscitation according to the Parkland formula was guided by a urinary output of 0.5 to 1 ml/h and the results of monitoring the blood pressure. Crystalloid solution (Ringer's acetate) was given exclusively during the first 24 hours. The lactate clearance was defined by the equation $[(\text{lactate initial} - \text{lactate delayed}) / \text{lactate initial}] \times 100\%$, for which lactate initial was the measurement at the start of the resuscitation and lactate delayed was another measurement 24 hours after resuscitation was initiated. A positive value denotes a decrease or clearance of lactate named "patient who clear", whereas a negative value denotes an increase in lactate after 24 hrs named "patient who not clear". The primary outcome was mortality.

Results: A total of 147 patients were analyzed with a mean age of 46.98 ± 19.38 years and a mean TBSA burn injury of 22.82 ± 20.25 . The flame was the most frequent mechanism. The mortality range in the study group was 17%. Serum lactate at admission ≥ 2 mmol/l was associated with 31.3% mortality versus 6% in patients with a serum lactate at admission < 2 mmol/l ($P < 0.05$). "Patients who not clear" were associated with 32.4% mortality versus 13.8% in the "patients who clear" ($p = 0.024$).

Conclusions: We believe that measuring lactate and lactate clearance may help to detect critically injured patients either for adequacy of treatment, or selection of other therapeutic options. Lactate clearance early may indicate a resolution of global tissue hypoxia and is associated with decreased mortality rate.

Applicability of Research to Practice: Lactate clearance could be a good end point to guide the resuscitation in critical burn patients.

292 . Evaluation of 48-Hour Fluid Resuscitation in Burn-Injured Patients at a Single Burn Center

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Introduction: "Fluid creep" is a well-known phenomenon in burn resuscitation, but it primarily has been characterized in the first 24 hours post-burn injury. The purpose of this study was to evaluate a resuscitation protocol at a single burn center; establish a formula to quantify resuscitation result for the second 24 hours; describe the relationship between the first and second 24 hours of resuscitation; and, identify which patients required high resuscitation volumes.

Methods: Based on a review of this center's resuscitation practices that showed an average administered volume of 8.3 cc/kg/TBSA, a protocol based on urine output for $>15\%$ TBSA burn-injured patients output was implemented. The Parkland formula was used to calculate initial fluid rates, and adjusted to meet the goal rate of 30-50 cc/hr; protocol compliance was defined as appropriate fluid titration to maintain urine output. Resuscitation result of the second 24 hours was tabulated as follows: total fluid given/(evaporative loss+maintenance fluid+estimated colloid), with ideal ratio being 1.0. Resultant data were prospectively collected over a two-year period from 2009-2011. T-test was used to compare the differences between groups. Regression analyses were used to predict volume administered. P value < 0.05 was statistically significant.

Results: 32 patients with $> 15\%$ TBSA met criteria for protocol treatment. Mean age, burn size, and resuscitation volumes in the first and second 24 hours were as follows (mean + SD): 48.8 + 20.4 years, 31.9 + 14.9% TBSA, 7.14 + 4.02 cc/kg/% TBSA, and a ratio of 1.67 times expected volume (SD=1.40). Incidence of inhalation injury (IHI) was 34.%, length of stay was 54.0 + 69.2 days, and mortality was 25.0%. Protocol compliance was 40%. Resuscitation volumes were highest in intubated patients: 9.0 cc/kg/hr (SD=4.7) in the first 24 hours and 2.48 times expected (SD=1.67) in the second 24 hours. Non-intubated patients had volumes of 5.6 cc/kg/hr (SD=2.4) in the first 24 hours ($p=0.018$), and 0.98 of expected volume (SD=0.41) in the second 24 ($p=0.002$). A high resuscitation result in the first 24 hours significantly predicted a high resuscitation result in the second 24 hours ($p=0.003$).

Conclusions: Initiation of a resuscitation protocol showed decrease in fluid volume from 8.3 to 7.1 cc/kg/hr. A significant relationship was seen between the first and second 24 hours of resuscitation, with intubated patients requiring higher volumes in both 24 hour periods. This data suggests that future efforts to reduce fluid volumes should focus on intubated patients. Finally, an accurate formula to evaluate resuscitation result in the second 24 hours may be based on total fluid given/(evaporative loss+maintenance fluid+estimated colloid), with an ideal value of 1.0.

293 . Venous Thromboembolism: Do We Have All the Information Necessary to Identify At Risk Burn Patients? A Retrospective Review of a 21 Year Experience

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Introduction: Recent review of the National Burn Repository (NBR) demonstrated that %TBSA burn, ICU days, and the number of operations were independently associated with increased VTE risk. When controlling for other risk factors, however the conclusions were limited because of the lack of details in the NBR. A retrospective review of burn patients was performed to assess the impact of these missing data points on screening and prevention of VTE's.

Methods: A database of 7583 patients, admitted to the burn center between 1989 and 2010 was reviewed. Patients selected had symptomatic VTE's confirmed by CT Angiography, Duplex or MRI imaging. The specific risk factors identified by the NBR: % TBSA burn, ICU length of stay (LOS), # of operations, central venous access, use of chemoprophylaxis, and lower extremity burn were analyzed. All patients received chemoprophylaxis.

Results: Ninety five patients were identified with VTE. The incidence of VTE was 0.01%. The incidence of combined PE/DVT, DVT only and PE only was 0.001, 0.009 and 0.002% respectively. The overall VTE mortality rate was 27 %. Risk factors identified for VTE overall were central venous access, ICU LOS (Mean 31.9) and TBSA burn (mean 33.6). Timing of VTE's also varied in patients admitted to the ICU versus patients not admitted to the ICU. Sample characteristics of means for age, LOS, BMI, and number of operations were 40.2 yrs, 54.3 days, 30.9 and 3.1 respectively.

Conclusions: Chemoprophylaxis has become the accepted standard of care for the hospitalized burn patient. It appears this may account for our low incidence of VTE's. Despite this fact there are definitely groups of patients that suffer from VTE despite appropriate chemoprophylaxis, often with significant mortality. Patients at high risk (long ICU stay, higher percentage TBSA burns, and prolonged and repeated central venous access) should definitely be placed on chemoprophylaxis and may benefit from increased screening with duplex ultrasound and possibly IVC filter insertion in certain clinical circumstances. Further studies are needed to determine if these measures would produce a significant benefit.

Applicability of Research to Practice: Identifying patient risk factors and preventing VTE's in burn patients.

**Addendum to the Proceedings of the American Burn Association,
Supplement to the *Journal of Burn Care & Research*, March 2012, Volume 33, Number 2**

Abstract	Title	Statement of Grant Support
1	Improving Fire and Burn Prevention through Enhanced Community Promotion	This study was supported by H059216
3	Longitudinal Function and Participation Outcomes are Predicted by Satisfaction with Appearance and Perceived Social Exclusion	This study was supported by H133A070045 from the National Institute on Disability and Rehabilitation Research in the Office of Special Education and Rehabilitation in the U. S. Department of Education
4	Internet Informational Needs Survey: Burn Injury Population	This study was supported by National Institute on Disability and Rehabilitation Research (NIDRR)
5	Anatomy of the National Burn Repository	This study was supported by USAMRMC Award #W81XWH-09-1-0691
6	Using Monte Carlo Simulation for Modeling Surge Capacity in the ABA Southern Region	This study was supported by USDHHS/ASPR/NCOEMS-#00025380
9	Functionality of IDO Expressing Allogenic Engineering Skin Composite in a Fibrotic Animal Model	This study was supported by Canadian Institute of Health Research
10	Distinct Phenotypes of Deep vs. Superficial Keloid Fibroblasts in Keloid Skin Substitutes Transplanted to Mice	This study was supported by Shriners Hospitals for Children
11	A Bilayer Hydrogel with Stem Cells Derived from Debrided Human Burn Tissue for Improved Skin Regeneration	This study was supported by US Army Medical and Materiel Command
12	Hydrogel Incorporation within a Collagen: GAG Matrix Results in an In Situ Gelling Scaffold with Improved Functionality for the Burn Patient	This study was supported by CIHR, CIHR Dermatology Scholar, CIHR Transplantation Scholar
17	Pruritus in Adult Burn Survivors: Incidence, Characteristics and Risk Factors	This study was supported by National Institute on Disability and Rehabilitation Research, Office of Special Education & Rehabilitative Services, U.S. Department of Education (H133A070047)
19	Longitudinal Mediation of Pain and PTSD Symptom Clusters	Supported by a grant from the National Institute on Disability and Rehabilitation Research, Grant No. H133A070045
20	The Effects of Virtual Reality Pain Distraction on Voluntary Range of Motion in Adult Burn Patients	This study was supported by NIH award R01GM042725-17A1, and by Scan Design by Inger and Jens Bruun Foundation.
22	Hypnosis Delivered through Immersive Virtual Reality for Wound Care: A Randomized, Controlled Study	This study was supported by NIH award R01GM042725-17A1, and by Scan Design by Inger and Jens Bruun Foundation.
25	Assessment of Cardiopulmonary Function During Exercise in Severely Burned Pediatric Patients	This study was supported by National Institute for Disabilities and Rehabilitation Research grants H133A070026, H133A70019, the NIH grants P50-GM06338 and R01-HD049471, T32-GM8256 and Shriners Hospitals for Children grant 84080,8741,8760
26	Temperature Regulation Is Impaired in Well-Healed Adult Skin Graft Patients Exercising in the Heat	This study was supported by NIH GM068865
27	Effects of Early Exercise on the Number of Joint Release Interventions in Children with Severe Burns	This study was supported by National Institute for Disabilities and Rehabilitation Research grant H133A070026, the National Institutes of Health grants R01-GM56687-11, R01-GM56687-11S1, R01-HD049471, T32-GM008256 and P50-GM60338, and Shriners Hospitals for Children grants 84309
29	Fatigue in Electrical Injury Patients	This study was supported by Catherine Manson Chair in Movement Disorder grant
30	Roles of Positive Coping and Positive Personality Traits in Long Term Physical and Emotional Recovery after Burn Injury	This project was supported in part by a grant (H133A070045) from the National Institute on Rehabilitation Research in the Office of Special Education and Rehabilitation of the U.S. Department of Education.

Abstract	Title	Statement of Grant Support
32	Severe Burn and Disuse Effects on Bone Structure and Strength in Rats Over Time	This study was supported by US Army MPMC & Juvenile Diabetes Foundation
33	Effects of Leukotriene Antagonist Treatment on Pulmonary Function in Ovine Smoke Inhalation Injury	This study was supported by Shriners of North America – 87420, 84060, 84050.
34	Nebulization with Gamma-Tocopherol Ameliorates Acute Lung Injury after Burn and Smoke Inhalation in the Ovine Model	This study was supported by NIH GM66312-01 and GM60668, Shrine Hospitals for Children Grants 8630, 8520, 8954, 84060 and 8450
39	Effects of Pneumonia on Clinical Outcomes in Burned Children with Inhalation Injury	This study was supported by SHC 84088, 80100 and NIH-RO1 GM056687
40	Effects of Mechanical Ventilation on Cardiopulmonary Function in Burned Patients with Inhalation Injury	This study was supported by National Institute for Disabilities and Rehabilitation Research grants H133A070026, H133A70019, the NIH grants P50-GM06338 and R01-HD049471, T32-GM8256 and Shriners Hospitals for Children grant 84080,8741,8760
41	Essential Roles for ACVR2B and its Ligands in Burn Injury Survival and Muscle Wasting	This study was supported by T.A.Z: National Cancer Institute R01-CA122596, National Institute for General Medical Studies R01-GM092758, American Cancer Society, DeWitt Daughtry Family Dept. of Surgery, and Div of Burn. F.E.P: GM092758-01A1S1.
42	Long Term Characterization of Muscle Protein Synthesis in Pediatric Burns	Supported by the National Institutes of Health grants R01-GM56687-11, R01-GM56687-11S1, P50 GM060338 and Shriners Hospitals for Children grants 84090, 84309, 86600.
43	Evaluation of Glucagon-Like Polypeptide-1 (GLP-1) Effect in Burn Injury by Intragastric Glucose Tolerance Test (IGGTT)	This study was supported by grants from the National Institutes of Health (5P50 GM 021700 and P30 DK 004056s) and Shriners Hospitals for Children (Grants 84070 and 85700).
45	Oral Administration of Propranolol Diminishes Extremity Blood Flow in Pediatric Burned Patients	This study was supported by the National Institutes of Health grants R01-GM56687-11, R01-GM56687-11S1, and Shriners Hospitals for Children grants 84090, 84309, 86600.
54	Multi-Center Testing of a Burn Prevention Teaching Tool for Amish Children	This study was supported by IAFF-Burn Foundation
57	Red Blood Cells Associated 14-3-3 Proteins Function as Anti-Scarring Factors	This study was supported by Canadian Institute of Health Research
58	Simvastatin Protects Burn-Injured Hepatocyte from Apoptosis by Suppressing the TNF- α /Caspase-3 Signal Pathway	This study was supported by grants from Shriners Hospitals for Children (Grant 87100) and the National Institute of Health (50, 21700).
60	Alternative Erythropoietin Signaling Prevents Sub-Acute Deep Dermal Micro Vascular Thrombosis, Thus Reducing Progressive Ischemia and Necrosis in a Mouse Burn Model	This work was funded by the Shriners Hospitals for Children.
62	Quantifying Extent of Thermal Protein Denaturation by MR Imaging	This study was supported by NIH R01GM064757 (Rlee)
63	Infra-Red Contrast Imaging to Non-Invasively Monitor Burn Injuries in a Porcine Burn Model	This study was supported by Armed Forces Institute of Regenerative Medicine (AFIRM), and Harvard Apparatus
67	Heal or Die: Burn Wound Healing Trajectories and Their Impact on Survival	This study was funded in part by the Combat Critical Care Engineering Task Area, US Army Medical Research Material Command
72	Long Term Scarring and Quality of Life in Bromelain Based Enzymatically Debrided Patients: A Controlled Study	This study was supported by MediWound
73	Pseudomonas aeruginosa Modulates Pulmonary Host-Response and Dissemination through the Transactivator OxyR after a Burn Injury	This study was supported by DOD Grant –W81XWH-09-1-0619) and Dr. Ralph and Marion C. Falk Medical Research Trust
76	Novel Clinical Parameters to Predict Burn Sepsis Are Superior to American Burn Association Consensus Criteria	This study was supported by TriService Nursing Research Program

Abstract	Title	Statement of Grant Support
80	Lincosamide Antibiotic Treatment Inhibits Virulence Factor Production in MRSA-Infected Burn Wounds	This study was supported by Pfizer IIR WS498134–Awarded to Shupp
83	Social Exclusion and Appearance Dissatisfaction Effect Psychological and Social Recovery	This study was supported by H133A070045 from the National Institute on Disability and Rehabilitation Research in the Office of Special Education and Rehabilitation in the U. S. Department of Education
84	Social Exclusion and Pain Among Severe Burn Survivors	This study was supported by H133A070045 from the National Institute on Disability and Rehabilitation Research in the Office of Special Education and Rehabilitation in the U. S. Department of Education
85	Reasons for Distress Among Burn Survivors at Discharge, 6, 12, and 24 Months Post-Discharge	This study was supported by National Institute on Disability Rehabilitation Research (NIDRR) #: H133A020402
91	Assessment of Hair Density and Sub-Epidermal Tissue in Burn Scars Using High Frequency Ultrasound	This study was supported by Pool and Anderson Trust Funds
101	The Effect of Propranolol on Cardiovascular Parameters Measured by Transpulmonary Thermodilution in Severely Burned Children	This study was supported by R01GM56687, R01GM56687-11S1, P50GM60338, T32GM08256, SHC 8660, 8760, 84080, 84309
102	Parecoxib Reduces Systemic Inflammation and Acute Lung Injury in Burned Animals with Delayed Fluid Resuscitation	This study was supported by Defence Research & Technology Office, Ministry of Defence, Singapore.
103	Differences in Resuscitation in Morbidly Obese Burn Patients May Contribute to Mortality in this High-Risk Group	This study was supported by National Institutes of Health. Inflammation and host response to burn injury
105	Immuno-Protective Role of CD4+CD25-Converted to Regulatory T Cells in Allogenic Skin Graft	This study was supported by CIHR, Worksafe BC, Transplant Training Program
106	Myeloid Suppressor Cells Invade the Burn Wound Site Early after Injury	This study was supported by NIH grant GM079122
107	Superantigen Virulence Factors in Wound Biopsies and in Kidney Tissue of Animals with Staphylococcus Aureus-Infected Burn Wounds	This study was supported by Pfizer IIR WS498134–Awarded to Shupp
108	Peripheral Blood Mononucleocyte-Derived Erythroid Progenitors and Erythroblasts are Decreased in Burn Patients	This study was supported by NIH T32, R03 AI 079530-01 and Dr. Ralph and Marion C. Falk Medical Research Trust
109	The Impairment of Neutrophil Chemotaxis after Burn in Rats	This study was supported in part by funds from the National Institutes of Health: GM092804 and Shriners Hospitals for Children: #84080, #84053, #85100, #85050
110	Radiation Combined with Thermal Injury: A Role for Myeloid-Derived Suppressor Cells in Chronic Immunosuppression	This study was supported by NIH T32 Trauma Training Grant
113	Comparison of Sleep Parameters Obtained from Actigraphy and Polysomnography during the Rehabilitative Phase Postburn	This study was supported by Shriners Hospitals for Children
116	Retrospective Examination of the Effectiveness of Zolpidem for Sleep in Pediatric Burn Patients with a Known History of Attention Deficit/Hyperactivity Disorder	This study was supported by Shriners Hospitals for Children
117	Impact of Obesity on Body Image Dissatisfaction and Social Integration Difficulty Among Adolescent and Young Adult Burn Injury Survivors	This study was supported by NIDDR AO20102 – 03
118	Measuring Depression in Adults and Children with Burn Injuries	This study was supported by National Institute on Disability and Rehabilitation Research (NIDRR) #: H133A070047 and #H133A060070

Abstract	Title	Statement of Grant Support
119	Does Propranolol Prevent Symptoms of Posttraumatic Stress Disorder (PTSD) in Children with Large Burns?	This study was supported by Shrine Grant: 71000, NIH: P50-GM60338, NIDRR: A020102-03, RO1: RO1HD04947105
121	Propranolol Reduces Vascularity and Inflammation in Post-Burn Hypertrophic Scars	This study was supported by KL2RR029875, NIH UL1RR029876, Wound Healing Society Foundation 3M Fellowship, SHC71001, SHC84080, SHC8660, SHC8760, P50GM060338, R01GM056687, H133A020102, T32GM008256
122	Propranolol Reduces Endoplasmic Reticulum Stress Markers in Skeletal Muscle from Severely Burned Children	This study was supported by Shriners Hospitals for Children (84080, 86900, 8760, 8660), National Institute of General Medical Sciences (RO1-GM56687, RO1-GM081685, P50-GM60338), National Center for Research Resources (KL2RR029875, UL1RR029876)
124	A Model to Investigate Using Adult Human Skin Precursors to Improve Outcomes in Split Thickness Skin Grafts	This study was supported by Canadian Institutes of Health Research
127	Prospective Characterization of the Burn Wound Microbiome	This study was supported by Department of Defense Grant W81XWH-08-1-0386
128	Cutaneous Barrier Disruption Extends Beyond the Burn	This study was supported by NIH-NIAAA 1P30-AA019373-01, NIH 2T32-GM008750-11
141	Telemedicine: The Operational Logistics of Developing and Implementing a State-Wide Program	This project was funded by a grant from the New Jersey Department of Health and Senior Services; #09-27D-HBT
171	The Severity of Post-Burn Hypertrophic Scars is Dependent on the Burn Mechanism	This study was supported by NIDRR H133A070026, NIH grants R01-GM56687-11, R01-GM56687-11S1, T32-GM008256, KL2RR029875, UL1RR029876, and P50-GM60338, Wound Healing Society Foundation 3M Fellowship and Shriners Hospitals for Children grants 84080, 87600, 71001
172	Too Hot to Handle: An Examination of Hot Water Temperature and Water Heaters in a Sample of Urban Homes	The study was approved by the Johns Hopkins Institutional Review Board and supported through a grant from the Centers for Disease Control and Prevention (R18 CE001339) and the National Institute of Child Health and Human Development (R01 HD059216-04)
173	Burn Prevention Education for Community Based Family Services Providers: A Pilot Initiative	This study was supported by US Dept. of Homeland Security/FEMA/Grant No.EMW-2010-FP-01777
174	Burn Prevention Education for Parents of Low-Income Pre-Schoolers: Results of a Local Initiative	This study was supported by US Dept. of Homeland Security/FEMA/Grant No.EMW-2010-FP-01777
179	Safe Signals: A Burn Education and Prevention Program for High Functioning Young Adults with ASD	This study was supported by Autism Speaks
190	A Novel Gaming System for Children with Upper Extremity Burn	This research was conducted with the support of a pilot grant from Harvard Catalyst The Harvard Clinical and Translational Science Center (NIH Grant #1 UL1 RR 025758-02 and financial contributions from participating institutions).
193	A Randomized, Multisite Study on Virtual Reality Pain Distraction in Pediatric Burn Patients during Physical Therapy	This study was supported by NIH award R01GM042725-17A1, and by Scan Design by Inger and Jens Bruun Foundation.
209	The Impact of a Warmed Operating Theatre on the Thermal Status of Surgical Personnel	Stipendiary funding for the principle investigator was provided by Office of the Dean of Medicine at the University of Manitoba
216	A Retrospective Analysis: Perceptions after 56 ABLS Classes (In Four Years)	This study was supported by USDHHS/ASPR/NCOEMS-#00025380
217	Development of an Electronic Acute Kidney Injury Smart Alert System	This study was supported by U.S. Army Combat Casualty Care Research Program
220	Healing Efficacy of Sea Buckthorn (Hippophae rhamnoides L.) Seed Oil on Burn Wounds in Sheep	This study was supported by Shriners of North America 8630,8541,8450

Abstract	Title	Statement of Grant Support
221	Debridement of Burn Eschar Using Bromelain Preparation (DGD)	This study was part of a multicenter international trial conducted by a company
223	Selectivity of a Bromelain Based Enzymatic Debridement Agent: A Porcine Study	This study was supported by MediWound, Ltd
224	The Effect of Controlled Mild Hypothermia on Survival in a Resuscitated Rat Model of Large Scald Burns	This study was supported by Suffolk County Volunteer Firefighters Burn Center Fund
227	Wound Closure over Integrated Polymer Neo-Dermes Using Cultured Epithelial Autograft and Composite Cultured “Skin Equivalents”	This study was supported by South Australian Government agency, BioInnovationSA
228	Burns Occurring to Rural Older Adults: The Implications of Geography and Access to Care	This study was supported by the John A. Hartford and Atlantic Philanthropies Claire M. Fagin Postdoctoral Fellowship
235	The Effectiveness of Propranolol in Controlling Symptoms of General Anxiety and Depression in Pediatric Burn Survivors	This study was supported by the Shrine Grant 71000, NIH P50-GM60338, NIDRR A020102-03, RO1 RO1HD04947105
236	Effect of Propranolol on Social Anxiety in Youth with Large Burns	This study was supported by the Shrine Grant: 71000, NIH: P50-GM60338, NIDRR: A020102-03, RO1: RO1HD04947105
237	The Utility of Virtual Reality in Minimizing Procedural Distress with Pediatric Burn Patients	This study was supported by the Intramural Grant through Nationwide Children's Hospital
239	Effect of Social Environment on Brain Metabolism after Burn Injury in Rats	This study was funded by grants from the Bensen-Henry Foundation and Shriners Hospitals for Children #87000 and 84060.
242	Self-Silencing Following Burn Injury: Psychological Care Implications	This study was supported by the Social Sciences and Humanities Research Council and The Manitoba Medical Research Foundation
246	The Effect of Healing Touch on Sleep Patterns of Pediatric Burn Patients	This study was supported by the Shriners Hospitals for Children
248	Proteasome Activity in Skeletal and Cardiac Muscle during Burn Induced Hypermetabolism	This study was supported by the DOD-W81XWH-10-2-0172, NIHT32GM008750, Falk Medical Research Trust
250	Effect of Atorvastatin on Metabolic Effects of Thermal Injury	This study was supported by the Shriners Hospital Grants No. 71000 and 84053
260	Pseudomonas aeruginosa Infection Following Burn Injury Induces a Systemic Anti-Inflammatory Response	This study was supported by the RO1GM076250
261	The Role of Estradiol in Immunomodulation Following Burn Injury	This study was supported by the Doris Duke Charitable Foundation Clinical Research Fellowship
266	Pediatric Burn Survivors from Mexico are Different than Comparable U.S. Survivors	This study was supported by the National Institute on Disability and Rehabilitation Research (grant # H133A070006)
280	A Longitudinal Burn Outcome Database: Updates on a Multicenter Study	This study was supported by the National Institute on Disability and Rehabilitation Research (grant # H133A070006)
282	Differential Gene Expression in Airway Submucosal Gland Cells in an Ovine Model of Smoke Inhalation and Burn Injury	This study was supported by the Shriners of North America – grants 87420, 84060, and 84050.
283	Implications of Alcohol Intoxication at the Time of Burn and Smoke Inhalation Injury: An Epidemiologic and Clinical Analysis	This study was supported by the NIH T32 AA013527 (EJK), R01 AA012034 (EJK), R01 AA015067 (TJE), P30 AA019373 (EJK), and the Dr. Ralph and Marian C. Falk Medical Research Trust
287	Oliguria and Non Responders to Fluid Therapy during Burn Resuscitation	This study was supported by the NIH 1R01HL092253-01, U.S. Army Combat Casualty Care Research Program and the U.S. Army Combat Critical Care Engineering Research Task Area.

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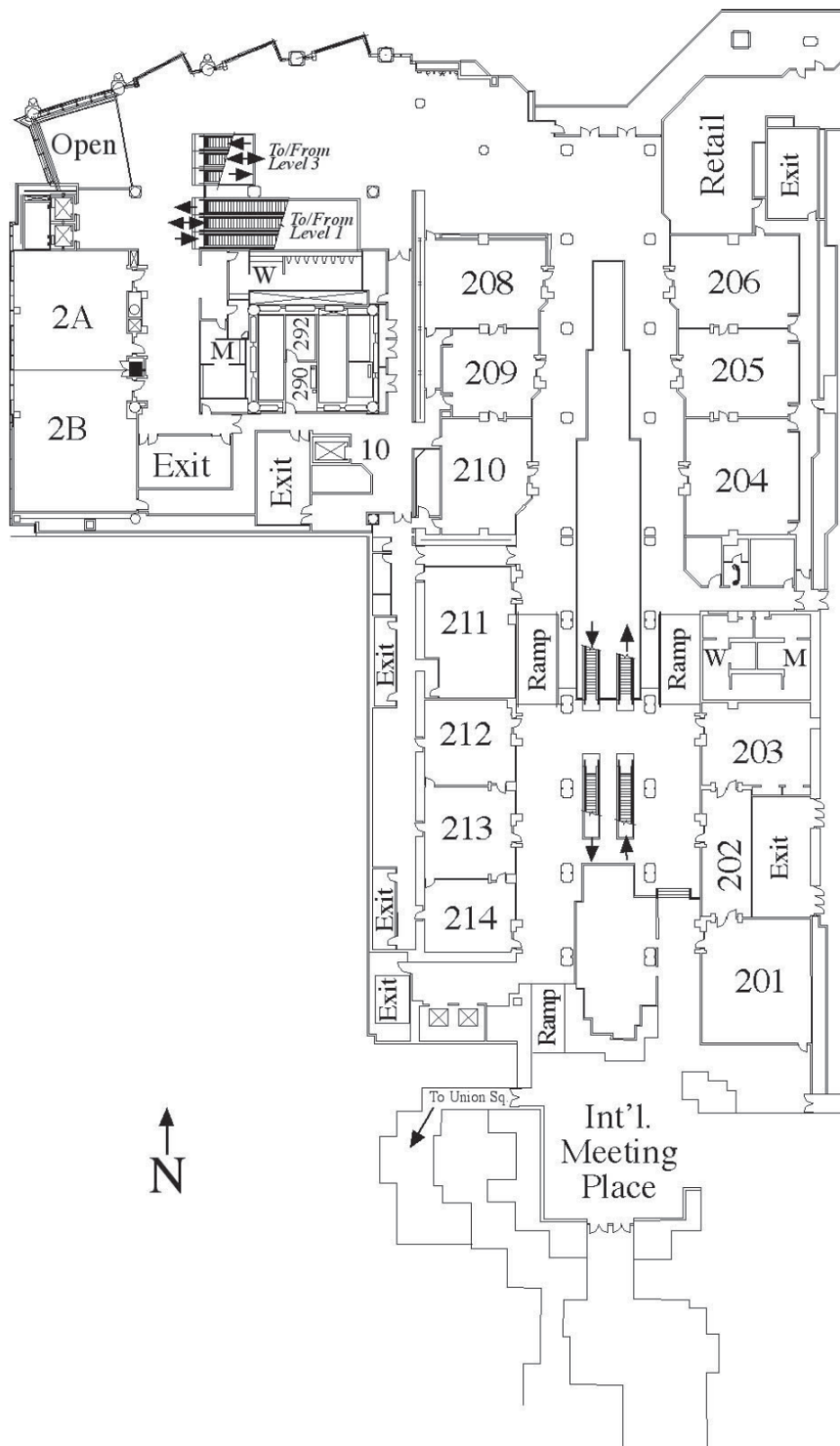
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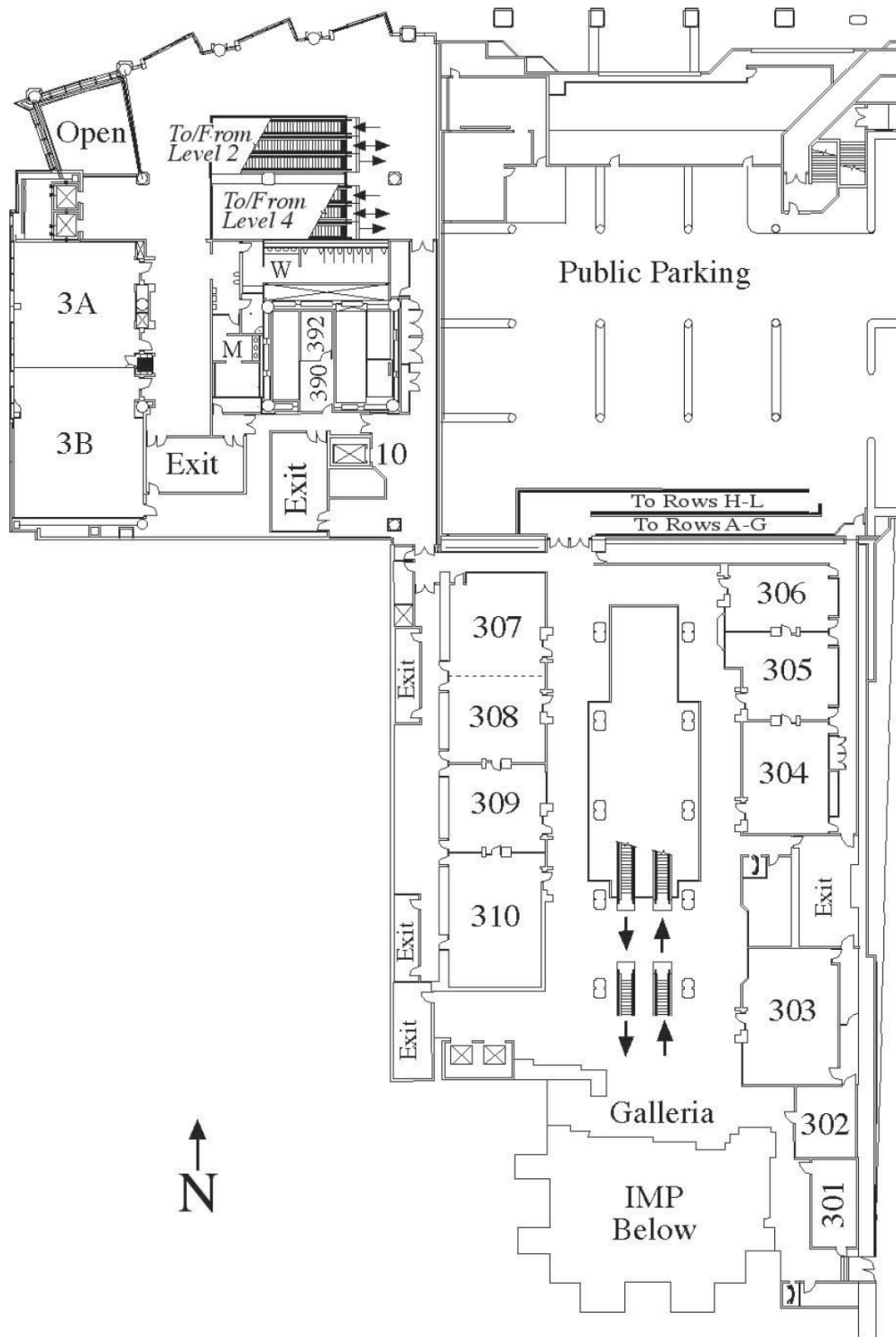
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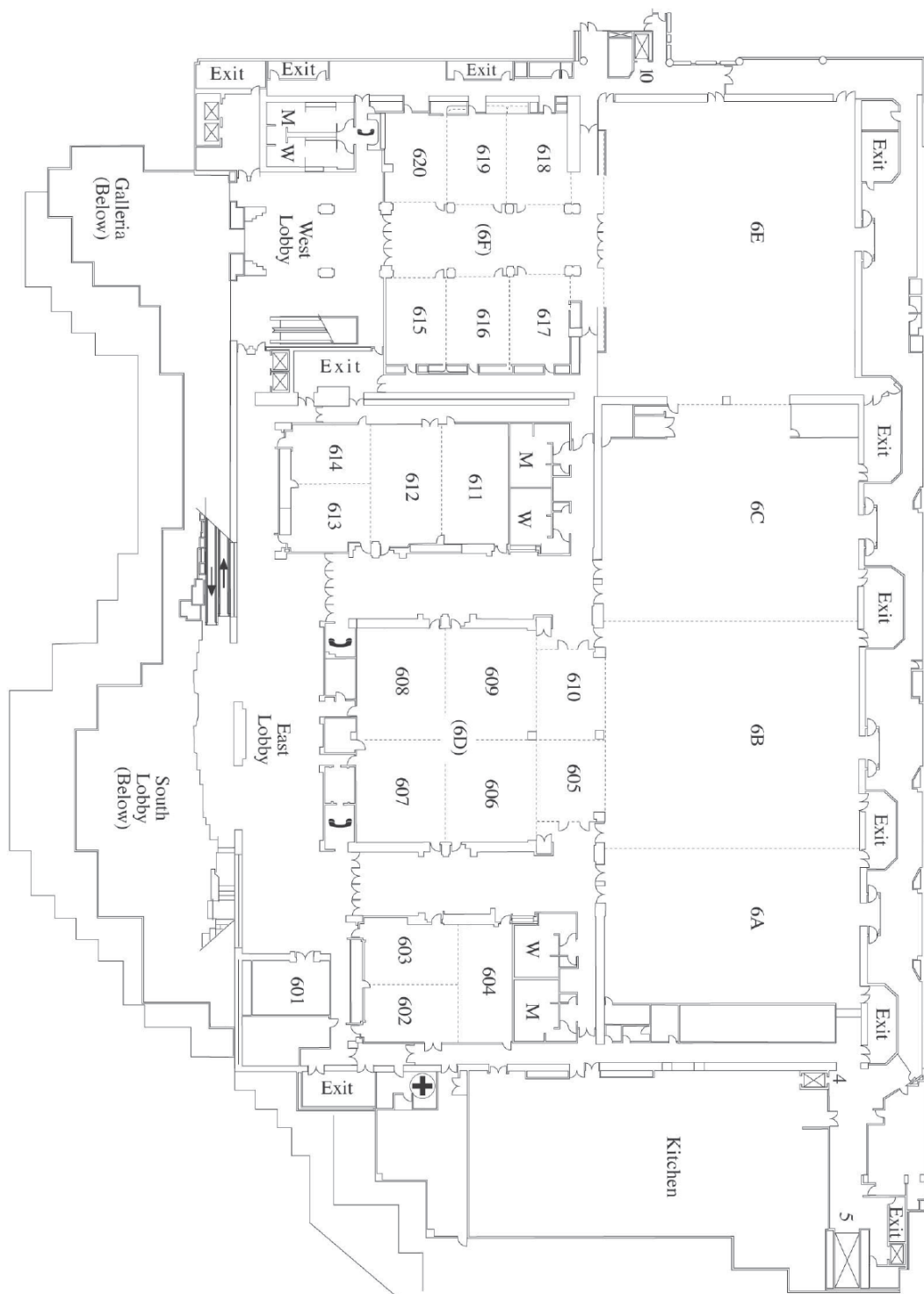
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WEDNESDAY		THURSDAY		FRIDAY	
6:30 – 7:45	Sunrise Symposia	6:30 – 7:45	Sunrise Symposia	6:30 – 7:45	A Repeat of the Three Most Popular Sunrise Symposia/Best In Category Posters
8:00 – 9:30	Awards & Presidential Address 4th Floor	8:00 – 9:30	Presidential Plenary 4th Floor	8:00 – 9:30	Plenary I: Disaster Management Ballroom 6C Plenary II: Return to Work Ballroom 6A
9:30 – 10:00	Coffee with Exhibitors Exhibit Hall 6th Floor	9:30 – 10:00	Coffee with Exhibitors Exhibit Hall 6th Floor	9:30 – 10:00	Coffee Break Exhibit Hall 6th Floor
10:00 – 12:00	Correlative Sessions I – VI I - Room 603: Public Health II - Room 607: Wounds - Tissue Engineering III - Room 608: Pain and Comfort Measures IV - Room 612: Rehabilitation V - Room 615: Critical Care - Inhalation VI - Room 620: Nutrition/Metabolism	10:00 – 12:00	Correlative Sessions VII – XII VII - Room 620: Burn Epidemiology/Prevention VIII - Room 612: Wounds - Basic Science IX - Room 607: Wounds - Clinical X - Room 608: Critical Care - Infection XI - Room 615: Psychosocial XII - Room 603: Reconstruction	10:00 – 12:00	Correlative Sessions XIII – XVIII XIII - Room 607: Critical Care - Resuscitation XIV - Room 603: Immunology XV - Room 620: Psychosocial XVI - Room 608: Wounds - Clinical XVII - Room 615: Rehabilitation XVIII - Room 612: Quality Improvement
10:00 – 12:00	Firefighter I: Modern Fire Environment Room 3A	10:00 – 12:00	Firefighter II: Injury Awareness Room 3A	10:00 – 12:00	Firefighter III: Residential Fire Sprinklers Room 3A
12:15 – 1:45	Lunch with Exhibitors Exhibit Hall 6th Floor	12:15 – 1:45	Lunch with Exhibitors Exhibit Hall 6th Floor	12:15 – 1:45	Luncheon Symposia Ethics Case Presentation Room 6A
12:30 – 1:30	Poster Rounds w/Professors & Authors Exhibit Hall 6th Floor	12:30 – 1:30	Poster Rounds w/Professors & Authors Exhibit Hall 6th Floor		
2:00 – 4:00	Postgrad A: Room 603 Postgrad B: Room 607 Postgrad C: Room 608	2:00 – 4:00	Postgrad A: Room 603 Postgrad B: Room 607 Postgrad C: Room 608	2:00 – 4:00	Consensus Conference: Room 612 Improved Care Through Research: Room 607 International Burn Care: Room 608 Laser Technology: Room 603
4:15 – 5:45	Multi-Center Trials Group Town Hall Meeting: Room 612	4:15 – 5:30	Year In Review: Room 612 Changing Places: Room 2B	4:15 – 5:15	Business Meeting Room 605
5:00 – 6:30	Wine & Cheese Reception Exhibit Hall 6th Floor	4:15 – 5:45	Local Burn Center Tour		

MONDAY		TUESDAY	
8:00 – 9:30	Burn Registry Committee Room 3B	4:00 – 5:30	Verification Committee Room 304
8:00 – 3:30	Membership Advisory Committee Room 2A	5:30 – 6:30	Ad Hoc Conflict of Interest Committee Room 306
9:00 – 5:00	Burn Prevention Committee Room 604		
9:30 – 10:30	Ad Hoc Coding Committee Room 308	8:00 – 11:00	Organization and Delivery of Burn Care Committee Room 201
10:00 – 11:00	Education Committee Room 614	8:00 – 11:00	Research Committee Room 617
10:00 – 11:30	NBR Committee Room 3B	8:30 – 3:30	Board of Trustees Meeting Room 208
12:00 – 1:30	IAC/Government Affairs Luncheon Room 606	9:30 – 11:00	International Outreach Committee Room 616
12:00 – 2:30	Aftercare Reintegration Committee Room 612	11:30 – 2:00	Board of Trustees/Committee Chair Lunch Room 2A
1:30 – 2:30	Bylaws Committee Room 306	2:00 – 3:00	Rehabilitation Committee Room 616
2:30 – 4:00	Burn Science Advisory Panel Room 305	3:00 – 4:00	Archives Committee Room 619
3:30 – 5:00	ABLS Advisory Committee Room 309	3:00 – 5:00	Ethical Issues Committee Room 201