PROCEEDINGS OF THE

AMERICAN BURN ASSOCIATION

46th Annual Meeting
Tuesday through Friday
March 25-28, 2014

Sheraton Boston Hotel
Boston, Massachusetts
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Sacramento, California

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Susan M. Browning, MPH, Deputy CEO
Chicago, IL
Past Presidents

<table>
<thead>
<tr>
<th>Year</th>
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<tr>
<td>1969</td>
<td>Curtis P. Artz, MD*</td>
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<tr>
<td>1970</td>
<td>Boyd W. Haynes Jr., MD, FACS*</td>
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<tr>
<td>1971</td>
<td>John A. Moncrief, MD*</td>
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<td>1972</td>
<td>Robert M. McCormack, MD, FACS</td>
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<td>1973</td>
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<td>1974</td>
<td>Bruce G. Macmillan, MD*</td>
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<td>1975</td>
<td>John A. Boswick Jr., MD, FACS*</td>
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<td>1976</td>
<td>Basil A. Pruitt Jr., MD, FACS</td>
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<td>1977</td>
<td>William W. Monofo Jr., MD, FACS*</td>
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<td>1978</td>
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<td>1979</td>
<td>Duane L. Larson, MD, FACS*</td>
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<td>1980</td>
<td>Arthur D. Mason Jr., MD*</td>
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<td>1981</td>
<td>Charles E. Hartford, MD, FACS</td>
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<td>1984</td>
<td>P. William Curreri, MD, FACS</td>
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<td>1985</td>
<td>J. Wesley Alexander, MD, ScD, FACS</td>
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<td>Martin C. Robson, MD, FACS</td>
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<td>Joseph A. Moylan, MD, FACS*</td>
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<td>2013</td>
<td>Tina L. Palmieri, MD, FACS, FCCCM</td>
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- 1986-1987: Barry K. Bennett, LCSW
- 1984-1985: Mary Jo Baryza, PT, MS, PCS
- 1983-1984: Kathy G. Supple, MSN, ACNP, CCRN
- 1982-1983: Tammy L. Coffee, MSN, RN, ACNP
- 1981-1982: Ingrid S. Parry, MS, PT

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- 2001-2002: Michelle Gottschlich, PhD, RD
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- 1998-1999: Patricia W. Gillespie, RN, MS
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- 1995-1996: Mary Jo Baryza, PT, MS, PCS
- 1994-1995: Kathy G. Supple, MSN, ACNP, CCRN
- 1993-1994: Tammy L. Coffee, MSN, RN, ACNP
- 1992-1993: Ingrid S. Parry, MS, PT

*Deceased
2014 Award Winners

To be presented before the Presidential Address on Wednesday, March 26th

**Harvey Stuart Allen Distinguished Service Award**

*presented to*

Nicole S. Gibran, MD, FACS

**Lifetime Achievement Award**

*presented to*

Alan R. Dimick, MD, FACS

**Special Achievement Award**

*presented to*

Mehmet Haberal, MD, FACS, FICS

**President’s Leadership Award**

*presented to*

David B. Hoyt, MD, FACS

**Curtis P. Artz Distinguished Service Award**

*presented to*

Patricia E. Blakeney, PhD

**Burn Prevention Award**

*presented to*

Carlee R. Lehna, PhD, APRN-BC
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 will be provided to all meeting attendees when they check in at the meeting. In addition, ABA members and Journal of Burn Care & Research subscribers will receive this supplement with the May/June mailing of the journal. The Program Book provides attendees 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 Fundamentals of Burn Care is presented on the day preceding the first correlative sessions. The topics for this session are rotated through a cycle of several years and are designed to provide basic information for the novice burn care provider. You must register to attend this session.

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. 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: Integrating the Family as Burn Care Team Members: Tapping into Home Team Talent; Clinical Practice Guidelines: Can They Be Used to Improve Burn Care?; and Pro/Con Debate: Controversies in Modern Burn Care.

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 five correlative sessions being presented simultaneously.

NEW THIS YEAR: The top six abstracts will be presented at the Friday Morning Plenary session.

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 live activity for a maximum of 31 **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 the Exeter Room. 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.

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<thead>
<tr>
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<th>March 24</th>
<th>12:00 pm - 4:00 pm</th>
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<tr>
<td>Mon</td>
<td>March 25</td>
<td>8:00 am - 5:00 pm</td>
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<td>Tue</td>
<td>March 26</td>
<td>7:00 am - 5:00 pm</td>
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<td>Wed</td>
<td>March 27</td>
<td>7:00 am - 5:00 pm</td>
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<td>Thu</td>
<td>March 28</td>
<td>7:00 am - 2:00 pm</td>
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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

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<th>Date</th>
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<tr>
<td>April 21-24, 2015</td>
<td>Chicago, Illinois</td>
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<td>May 3-6, 2016</td>
<td>Las Vegas, Nevada</td>
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<td>March 21-24, 2017</td>
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<td>April 10-13, 2018</td>
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<td>April 9-12, 2019</td>
<td>Las Vegas, Nevada</td>
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### Committees

#### ABLS Advisory Committee

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<th>Name</th>
<th>Year</th>
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<tr>
<td>Tam N. Pham, MD, Chair</td>
<td>2016</td>
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<tr>
<td>Gerarda M. Bozinko, RN, BSN</td>
<td>2014</td>
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<td>Agnes M. Burris, RN, ADN</td>
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<tr>
<td>Stefanos Papadopoulos, MD</td>
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<td>Richard L. Wigle, MD</td>
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<td>Connie E. Handel, RN</td>
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<td>Kathleen A. Hollowed, RN, BSN, MSN</td>
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<td>Larry M. Jones, MD, FACS</td>
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<td>Annemarie O’Connor, RN</td>
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<td>Kevin K. Chung, MD</td>
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<td>Salil Gulati, MD, FRSC(Ed)</td>
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<td>Joseph A. Molnar, MD, PhD</td>
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<td>Christopher A. Noel RN, BSN, CCRN</td>
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<td>Basil A. Pruitt Jr., MD, FACS, Senior Advisor</td>
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#### Aftercare Reintegration Committee

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<tr>
<td>David G. Greenhalgh, MD, FACS, Chair</td>
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<tr>
<td>Amy R. Acton, RN, BSN, Co-Chair</td>
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<tr>
<td>Radha K. Holavanahalli, PhD, Vice Chair</td>
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<td>Phoenix – CoChair - TBD</td>
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<td>Lori A. Anderson, MEd</td>
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<td>Karen L. Badger, MSW</td>
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<td>Chenicheri Balakrishnan, MD</td>
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<td>Sigrid A. Blome-Eberwein, MD</td>
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<td>James Bosch</td>
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<td>Elena Combs</td>
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<td>Anita M. Fields, RN, BSN</td>
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<td>Christine M. Gilyard, MA</td>
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<td>Elizabeth D. Hess, LSW</td>
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<td>Lisa Marie Jones</td>
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<td>Stacey M. Loen, RN, BSN, MA, ACNP</td>
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<td>Amanda G. Maldonado, MA</td>
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<td>Larry A. Medina</td>
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<td>Laura Ann Thomas</td>
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<td>Ann G. Cook, BS, MSW</td>
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<td>Mikki J. Rothbauer, MSW</td>
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<td>Kelly McElligott, MA (LCSW)</td>
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<td>Ruth B. Rimmer, PhD</td>
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<td>Gretta E. Wilkinson, RN</td>
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#### Archives Committee

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<td>Tammy L. Coffee, MSN, RN, ACNP</td>
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<tr>
<td>Steven T. Boyce, PhD</td>
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<tr>
<td>Nicole S. Gibran, MD, FACS</td>
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<tr>
<td>Tina L. Palmieri, MD, FACS, FCCM</td>
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<td>Ingrid S. Parry, MS, PT</td>
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<tr>
<td>Maureen T. Kiley, Staff Liaison</td>
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<tr>
<td>Mark Postilion, Staff Liaison</td>
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#### Awards Committee

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<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Palmer Q. Bessey, MD, FACS, MS, Chair</td>
<td>2014</td>
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<tr>
<td>Sidney F. Miller, MD, FACS</td>
<td>2014</td>
</tr>
<tr>
<td>Nicole S. Gibran, MD, FACS</td>
<td>2015</td>
</tr>
<tr>
<td>Kathleen A. Hollowed, RN, BSN, MSN</td>
<td>2014</td>
</tr>
<tr>
<td>Tina L. Palmieri, MD, FACS, FCCM</td>
<td>2016</td>
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<tr>
<td>Larry V. Kaczmarek, Staff Liaison</td>
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### Burn Prevention Committee

<table>
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<tbody>
<tr>
<td>Karla S. Ahrens-Klas, RN, BSN, CCRP, Chair</td>
<td>2016</td>
</tr>
<tr>
<td>Gerarda M. Bozinko, RN, BSN, CCRN</td>
<td>2014</td>
</tr>
<tr>
<td>Rebecca A. Coffey, RN, MSN, CNP</td>
<td>2014</td>
</tr>
<tr>
<td>Quinnie Gloger, RN</td>
<td>2014</td>
</tr>
<tr>
<td>Kelsey Hartman-Viega</td>
<td>2014</td>
</tr>
<tr>
<td>Stephen J. Lupinacci, BS</td>
<td>2014</td>
</tr>
<tr>
<td>Annette F. Matherly, RN, CCRN</td>
<td>2014</td>
</tr>
<tr>
<td>Angela D. Mickalide, PhD, MCHES</td>
<td>2014</td>
</tr>
<tr>
<td>Curtis L. Ryun, RN</td>
<td>2014</td>
</tr>
<tr>
<td>Lucy Wibbenmeyer, MD, FACS</td>
<td>2014</td>
</tr>
<tr>
<td>Charis Kelly, RN(EC), MN</td>
<td>2015</td>
</tr>
<tr>
<td>Phillip J. Tammaro, FF</td>
<td>2015</td>
</tr>
<tr>
<td>Colleen E. Macner, PT, DPT</td>
<td>2016</td>
</tr>
<tr>
<td>Eileen McDonald, MS</td>
<td>2016</td>
</tr>
<tr>
<td>Jody M. Rood, BSN, PHN</td>
<td>2016</td>
</tr>
<tr>
<td>Bonnie Y. Sawusch, BSN, JD</td>
<td>2016</td>
</tr>
<tr>
<td>B. Daniel Dillard, Ad Hoc</td>
<td>2014</td>
</tr>
<tr>
<td>Larry V. Kaczmarek, Staff Liaison</td>
<td>2014</td>
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### Burn Registry Committee

<table>
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<tr>
<th>Name</th>
<th>Year</th>
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<tbody>
<tr>
<td>Matthew B. Klein, MD, Chair</td>
<td>2015</td>
</tr>
<tr>
<td>Mary Lou Patton, MD, FACS, Vice Chair</td>
<td>2015</td>
</tr>
<tr>
<td>Barbara A. Latenser, MD, FACS</td>
<td>2014</td>
</tr>
<tr>
<td>Joan M. Weber, RN, BSN, CIC</td>
<td>2014</td>
</tr>
<tr>
<td>Rhonda S. Willis</td>
<td>2014</td>
</tr>
<tr>
<td>Deborah Lee, MBA</td>
<td>2015</td>
</tr>
<tr>
<td>Cynthia L. Reigart, RN, BSN</td>
<td>2015</td>
</tr>
<tr>
<td>Margie Finocchiaro, BA</td>
<td>2016</td>
</tr>
<tr>
<td>Naiwei Hsu-Chang, AA</td>
<td>2016</td>
</tr>
<tr>
<td>Sidonie J. Moses, MSN</td>
<td>2016</td>
</tr>
<tr>
<td>Palmer Q. Bessey, MD, FACS, MS Ad Hoc</td>
<td>2015</td>
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<tr>
<td>Christopher W. Lentz, MD, FACS, FCCM, Ex Officio</td>
<td>2015</td>
</tr>
<tr>
<td>Julie Violante, Vendor Liaison</td>
<td>2015</td>
</tr>
<tr>
<td>Susan M. Browning, MPH, Staff Liaison</td>
<td>2015</td>
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<tr>
<td>Maureen T. Kiley, Staff Liaison</td>
<td>2015</td>
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### Burn Science Advisory Panel

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<tr>
<th>Name</th>
<th>Year</th>
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<tbody>
<tr>
<td>James H. Holmes IV, MD, FACS, Chair</td>
<td>2014</td>
</tr>
<tr>
<td>David G. Greenhalgh, MD, FACS, Vice Chair</td>
<td>2014</td>
</tr>
<tr>
<td>Elizabeth Mann-Salinas, PhD, RN</td>
<td>2017</td>
</tr>
<tr>
<td>Melissa A. Pressman, PhD</td>
<td>2017</td>
</tr>
<tr>
<td>David T. Harrington, MD, FACS</td>
<td>2018</td>
</tr>
<tr>
<td>Karen J. Kowalske, MD</td>
<td>2018</td>
</tr>
<tr>
<td>Robert C. Cartotto, MD, FRCSc(c), Ex Officio</td>
<td>2015</td>
</tr>
<tr>
<td>Linwood R. Haith, MD, FACS, FCCM, Ad Hoc</td>
<td>2015</td>
</tr>
<tr>
<td>Susan M. Browning, MPH, Staff Liaison</td>
<td>2015</td>
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### Bylaws Committee

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<th>Name</th>
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<tbody>
<tr>
<td>Michael D. Peck, MD, ScD, FACS, Chair</td>
<td>2014</td>
</tr>
<tr>
<td>David H. Ahrenholz, MD, FACS</td>
<td>2014</td>
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<tr>
<td>James H. Holmes IV, MD, FACS</td>
<td>2014</td>
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<tr>
<td>Marion H. Jordan, MD, FACS</td>
<td>2014</td>
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<tr>
<td>Michael A. Serghiou, OTR, MBA</td>
<td>2016</td>
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<tr>
<td>Mark Postilion, Staff Liaison</td>
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### Conflict of Interest Committee

<table>
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<tr>
<td>Marion H. Jordan, MD, FACS, Chair</td>
<td>2015</td>
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<tr>
<td>Peter C. Esselman, MD, MPT</td>
<td>2014</td>
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<tr>
<td>James H. Holmes IV, MD, FACS</td>
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<tr>
<td>Michael J. Mosier, MD</td>
<td>2015</td>
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<td>Michael A. Serghiou, OTR, MBA</td>
<td>2016</td>
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<tr>
<td>William G. Cioffi, Jr., MD, FACS</td>
<td>2014</td>
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<tr>
<td>Susan M. Browning, MPH, Staff Liaison</td>
<td>2014</td>
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<tr>
<td>John A. Krichbaum, JD, Staff Liaison</td>
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### Education Committee

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<tbody>
<tr>
<td>Amalia Cochran, MD, FACS, FCCM, Chair</td>
<td>2014</td>
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<tr>
<td>Victor Joe, MD, Vice Chair</td>
<td>2014</td>
</tr>
<tr>
<td>Lenore L. Ammons, MA</td>
<td>2014</td>
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<tr>
<td>Barbara R. Birmingham, CRNP</td>
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<tr>
<td>Kristin A. Calvitti, RN, BSN, CMSRN</td>
<td>2014</td>
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<tr>
<td>Philip Chang, MD</td>
<td>2014</td>
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<tr>
<td>Jennifer R. Carter, RD, CNSC</td>
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<tr>
<td>Karen M. Coles, DNP, RN</td>
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<tr>
<td>Philip E. Fidler, MD</td>
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<tr>
<td>Anjay K. Khandelwal, MD, FICS</td>
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<tr>
<td>Booker T. King, MD</td>
<td>2014</td>
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<tr>
<td>Naiem S. Moiemen, MD</td>
<td>2014</td>
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<tr>
<td>Jenny A. Ziembicki, MD</td>
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<tr>
<td>Theresa L. Baker, RN, BSN</td>
<td>2015</td>
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<tr>
<td>Kendrea M. Jones, PharmD</td>
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<tr>
<td>Candyce N. Kuehn, RN, BAN, MBA</td>
<td>2015</td>
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<tr>
<td>Catherine Semenoff, BSN, MSN, FNP-BC</td>
<td>2015</td>
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<tr>
<td>Soman Sen, MD</td>
<td>2015</td>
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<tr>
<td>Daniel M. Caruso, MD</td>
<td>2016</td>
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<tr>
<td>Mark Johnston, RN, BSN</td>
<td>2016</td>
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<tr>
<td>Samuel P. Mandell, MD, MPH</td>
<td>2016</td>
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<tr>
<td>M. Jane Burns, Staff Liaison</td>
<td>2014</td>
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### Exhibitor Advisory Committee

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<tr>
<td>Staff Liaison</td>
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### Institutional Advisory Council

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<tr>
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<tbody>
<tr>
<td>Walter J. Meyer, MD</td>
<td>2014</td>
</tr>
<tr>
<td>Sarah Matt, MD</td>
<td>2014</td>
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<tr>
<td>Karen B. Levinson, MSW</td>
<td>2014</td>
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<tr>
<td>James M. Cross, MD, FACS, Chair</td>
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### Institution Liaisons

<table>
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<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Maureen T. Kiley, Staff Liaison</td>
<td>2014</td>
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### Project Liaisons

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<tr>
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<tr>
<td>Kitty Vineyard, Ad Hoc</td>
<td>2014</td>
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<tr>
<td>Sarvesh Logsetty, MD</td>
<td>2016</td>
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<tr>
<td>Gennadiy Fuzaylov, MD</td>
<td>2016</td>
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<tr>
<td>Robert L. Sheridan, MD, FACS</td>
<td>2015</td>
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<tr>
<td>Debra A. Reilly, MD, FACS</td>
<td>2015</td>
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<tr>
<td>Pirko Maguina, MD, FACS</td>
<td>2015</td>
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<tr>
<td>Carol W. Horvitz, BA</td>
<td>2015</td>
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<tr>
<td>Paula C. Fillari, RN, CCRN</td>
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<tr>
<td>Maggie L. Dylewski, PhD, RD</td>
<td>2015</td>
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<tr>
<td>Ariel Miranda, MD</td>
<td>2014</td>
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<tr>
<td>Giavonni Lewis, MD, FACS</td>
<td>2014</td>
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<tr>
<td>Michael C. Buffalo, RN, CCRN, MSN</td>
<td>2014</td>
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<tr>
<td>Gretchen J. Carrougher, RN, MSN, Vice Chair</td>
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<tr>
<td>M. Jane Burns, Staff Liaison</td>
<td>2014</td>
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Ethical Issues Committee

James M. Cross, MD, FACS, Chair 2015
Rick Boatwright, FF 2014
Sherman Everett, MBA 2014
Karen B. Levinson, MSW 2014
Sarah Matt, MD 2014
Walter J. Meyer, MD 2014
Patricia S. Regojo, RN, MSN 2014
Heather M. Schaewe, RN, BSN 2014
Patricia A. Sharp, OTR/L 2014
Debra D. Thompson, MSN 2014
Mohamed S. Elfar, MD 2015
Jonathan S. Friedstat, MD 2015
Linda Gibbons, RN, MS 2015
Sheila A. Giles, RN 2015
M. Jane Burns, Staff Liaison 2015

Exhibitor Advisory Committee

Linwood R. Haith, MD, FACS, FCCM, Chair 2015
Emily J. Butcher, Molnlycke Health Care, US 2015
Bettty C. Glander, Hollister Inc. 2015
Doug Stiebeling, Osiris Therapeutics, Inc. 2015
Johnathan Niszczak, MS, OTR/L 2016
Bio Med Sciences, Inc
Nemesh Patel, Aquacel 2016
M. Jane Burns, Staff Liaison 2016

Government Affairs Committee

William G. Cioffi, Jr., MD, FACS, Chair 2015
Daniel M. Caruso, MD, FACS 2014
Kevin K. Chung, MD 2014
Robert M. Dembicki, RN, MS 2014
James H. Holmes IV, MD, FACS 2014
Abraham P. Houn, MD 2014
Brian Porshinsky, MD 2014
Sidney F. Miller, MD, FACS 2015
Joan M. Weber, RN, BSN, CIC 2015
Gerald B. Demarest, III, MD 2016
Thomas R. Flamm, FF 2016
Lawrence J. Gotlibie, MD, FACS 2016
Kenneth J. Guidera, MD 2016
Susan M. Browning, MPH, Staff Liaison 2015
John A. Krichbaum, JD, Staff Liaison 2015

Institutional Advisory Council

Robert M. Dembicki, RN, MS, Chair 2014
Ronald Hitzler, BS, MBA 2014
Richard J. Kagan, MD, FACS 2015
Dana M. Kyles, RN, MS 2015
Chris A. Ruhren, RN 2015
Candycy N. Kuehn, RN 2016
Nicole A. Leahy, RN, BSN MPH 2016
William G. Cioffi, Jr., MD, FACS, Ex Officio 2015
Larry V. Kaczmarek, Staff Liaison 2015
Maureen T. Kiley, Staff Liaison 2015

International Outreach Committee

Nathan A. Kemalyan, MD, FACS, Chair 2014
Gretchen J. Carrougher, RN, MN, Vice Chair 2014
Michael C. Buffalo, RN, CCRN, MSN 2014
Giavonni Lewis, MD 2014
Ariel Miranda, MD 2014
Maggie L. Dylewski, PhD, RD 2015
Paula C. Fillari, RN, CCRN 2015
Carol W. Horvitz, BA 2015
Pirko Maguina, MD, FACS 2015
Debra A. Reilly, MD, FACS 2015
Robert L. Sheridan, MD, FACS 2015
Ann T. Cooper, BSN, MS 2016
Gennadiy Fuzaylov, MD 2016
Tracy Gaboury, BS, OTR/L 2016
Sarvesh Logsetty, MD 2016
Barbara A. Latenser, MD, FACS, Ad Hoc 2014
Kitty Vineyard, Staff Liaison 2014

Membership Advisory Committee

Kathleen A. Hollowed, RN, BSN, MSN, Chair 2014
Jill L. Sproul, RN, MS, Vice Chair 2014
Lezli Matthews, RN, BSN 2014
Kuzhali Muthu, PhD 2014
Jason Woods, Fire Fighter 2014
Kathe M. Conlon, RN, BSN, CEM 2015
Maggie L. Dylewski, PhD, RD 2015
Jane Faris, PharmD, BCPS 2015
Shari Honari, RN, BSN 2015
Dana Y. Nakamura, BS, OTR/L, CLT, CLMC 2015
Vincent A. Gabriel, MD, MSc, FRCPC 2016
Sara E. Bils, DPT 2017
Linda Gibbons, RN, MS 2017
Elizabeth D. Hess, LCSW 2017
Tammy L. Coffee, MSN, RN, ACNP, Ex Officio 2014
Edward E. Tedget, MD, MSc, Ex Officio 2014
Ingrid S. Parry, RN, BSN, CCRN, Ex Officio 2015
Agnes M. Burris, RN, Ex Officio 2016
Shelley A. Wiechman, PhD, Ex Officio 2017
Michael A. Serghiou, OTR, MBA, Ex Officio 2018
Maureen T. Kiley, Staff Liaison 2018

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NBR Advisory Committee-
Christoph er W. Lentz, MD, FACS, FCCM, Chair 2015
Iris Faraklas, BSN 2015
Michael J. Mosier, MD 2015
Bruce M. Potenza, MD, FACS, FCCM 2015
Cynthia L. Reigart, RN, BSN 2015
Nicole Bernal, MD 2016
Steven A. Kahn, MD 2016
Mohammad Mian, MD, PhD, MPH 2016
Margie Finocchiaro, BA, Ad Hoc 2014
Sidney F. Miller, MD, FACS, Ad Hoc 2014
Palmer Q. Bessey, MD, FACS, MS, Ad Hoc 2014
Matthew B. Klein, MD, Ex Officio 2014
Susan M. Browning, MPH, Staff Liaison 2014
Maureen T. Kiley, Staff Liaison 2014

Nominating Committee
Sidney F. Miller, MD, FACS, Chair 2014
Kathleen A. Hollowed, RN, BSN, MSN 2014
Nicole S. Gibran, MD, FACS 2015
Tina L. Palmieri, MD, FACS, FCCM 2016
Palmer Q. Bessey, MD, FACS, MS 2017
Susan M. Browning, MPH, Staff Liaison 2014
John A. Krichbaum, JD, Staff Liaison 2014

Organization & Delivery of Burn Care Committee
James C. Jeng, MD, FACS, Chair 2014
William L. Hickerson, MD, FACS, Vice Chair 2014
J. Kevin Bailey, MD 2014
Jennifer L. Brandt, PharmD 2014
Christine W. Casavant, RN, BSN 2014
Susan K. Dodson, RN, BSN 2014
Kevin N. Foster, MD, MBA, FACS 2014
Christopher W. Lentz, MD, FACS, FCCM 2014
Andrea Valenta, RN, MSN 2014
Jonathan B. Lundy, MD 2015
Kenneth T. Furu kawa, MD 2015
Karen J. Kowalske, MD 2015
Annette F. Matherly, RN, CCRN 2015
Brett D. Arnoldo, MD 2016
Kevin K. Chung, MD 2016
Kathe M. Conlon, BSN, RN, CEM, MSHS 2016
Lee D. Faucher, MD 2016
Ryan M. Fey, MD 2016
Elizabeth Henderson, MSN 2016
Colleen M. Ryan, MD, FACS 2016
Larry V. Kaczmarek, Staff Liaison 2016

Program Committee
Steven E. Wolf, MD, FACS, Chair 2016
Agnes M. Burris, RN, Assoc. Chair 2016
Gretchen J. Carrougher, RN, MN 2014
Marcia M. Halerz, RN, BSN, MBA 2014
Celeste C. Finnerty, PhD 2015
David T. Harrington, MD, FACS 2015
Tonja L. Kelly, RN, BSN 2015
Christopher W. Lentz, MD, FACS, FCCM 2015
Crystal G. New, RN 2015
Michael J. Schurr, MD, FACS 2015
Lucy Wibbenmeyer, MD, FACS 2015
Warren L. Garner, MD, FACS 2016
Cynthia L. Reigart, RN, BSN 2016
Shelley A. Wiechman, PhD 2016
Amalia Cochran, MD, FACS, FCCM, Ex Officio 2014
Kathleen A. Hollowed, RN, BSN, MSN, Ex Officio 2014
Jill L. Sproul, RN, MS, Ex Officio 2015
Michael A. Serghiou, OTR, MBA, Ex Officio 2016
M. Jane Burns, Staff Liaison 2014

Rehabilitation Committee
Bernadette Nedelec, PhD, BSc, OT, Chair 2014
Ingrid S. Parry, MS, PT, Vice Chair 2014
Catherine T. Calvert, PhD, CRC 2014
Lisa Forbes-Duchart, OT, MS 2014
Yvonne L. Karanas, MD 2014
Jeffrey C. Schneider, MD 2014
Melinda Shetler, OTR/L 2014
Matthew S. Godleski, MD 2015
Phala A. Helm, MD 2015
Radha K. Holavanahalli, PhD 2015
Shu-Chuan Chen Hsu, OTR/CHT 2015
David J. Lorello, DPT 2015
Oscar E. Suman, PhD 2015
Lynne Benavides, BS, OT 2016
Annick Chouinard, PT, BS 2016
Rachel Shon, MOT 2016
M. Jane Burns, Staff Liaison 2014
Research Committee

Robert C. Cartotto, MD, FRCS(C), Chair 2015
Chenicheri Balakrishnan, MD 2014
Mashkoor A. Choudhry, PhD 2014
Vincent A. Gabriel, MD, MSc, FRCPC 2014
Aziz Ghaahary, PhD 2014
Abraham P. Houng, 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
Yong Ming Yu, MD, PhD 2014
Bruce H. Ackerman, PharmD 2015
Iris H. Faraklas, RN, BSN 2015
Celeste C. Finnerty, PhD 2015
Warren L. Garner, MD, FACS 2015
Shari Honari, RN, BSN 2015
Lynda Painting, BS, CCRP 2015
Anthony Papp, MD, PhD 2015
Jeffrey W. Shupp, MD 2015
Dorothy M. Supp, PhD 2015
Agnes M. Burris, RN 2016
Melissa A. Pressman, PhD 2016
Karen J. Richey, RN, BSN 2016
M. Jane Burns, Staff Liaison

Verification Committee

Nicole S. Gibran, MD, FACS, Chair 2018
Steven E. Wolf, MD, FACS 2015
Charles J. Yowler, MD, FACS 2015
David G. Greenhalgh, MD, FACS 2017
Linwood R. Haith, MD, FACS, FCCM 2017
Kathy G. Supple, MSN, ACNP, CCRN 2017
David T. Harrington, MD, FACS 2018
Michael D. Peck, MD, ScD, FACS 2018
Palmer Q. Bessey, MD, FACS, MS 2018
Leopoldo C. Cancio, MD, FACS 2018
Sharmila Dissanaike, MD 2019
Lucy Wibenmeyer, MD, FACS 2019
John E. Greenwood, MD, FRACS, BSc, Ad Hoc 2014
Ingrid S. Parry, MS, PT, Ad Hoc 2014
Folke B. Sjoberg, MD, PhD, Ad Hoc 2014
Richard L. Gamelli, MD, FACS, Senior Committee Member
David M. Heimbach, MD, FACS, Senior Committee Member
David N. Herndon, MD, FACS, Senior Committee Member
Alan R. Dimick, MD, FACS, Senior Committee Member
Richard J. Kagan, MD, FACS, Senior Committee Member
Sidney F. Miller, MD, FACS, Senior Committee Member
Jeffrey R. Saffle, MD, FACS, Senior Committee Member
Rajiv Sood, MD, FACS, Senior Committee Member
John A. Krichbaum, JD, Staff Liaison
Alice Zemelko, Staff Liaison

March 25 – 28, 2014 • Boston, Massachusetts

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2013-2014 Ad Hoc Committees

Ad Hoc Burn Quality Improvement Program Committee (BQIP)
Nicole S. Gibran, MD, FACS, Chair
Palmer Q. Bessey, MD, FACS, MS
William G. Cioffi, Jr., MD, FACS
Christopher W. Lentz, MD, FACS, FCCM
Jill L. Sproul, RN, MS
Susan M. Browning, MPH, Staff Liaison

Ad Hoc Coding Committee
William L. Hickerson, MD, FACS, Chair
David H. Ahrenholz, MD, FACS
Donna J. Cartwright, MPS, RHIA, CCS
James H. Holmes IV, MD, FACS
Pamela A. Howard, MD, FACS
Richard J. Kagan, MD, FACS
Richard A. Korentager, MD, FRCSC
James J. Kraatz, MD
Claudette A. Mansour, RN, MPH
Michael D. Peck, MD, ScD, FACS
Lynne C. Yurko, RN, BSN, ME-BC
Karen Zupko, Consultant
Maureen T. Kiley, Staff Liaison
John A. Krichbaum, Staff Liaison

Ad Hoc Committee on Technology
Michael D. Peck, MD, ScD, FACS, Chair
Elizabeth A. Mann-Salinas, RN, PhD, Vice Chair
Amy R. Acton, RN, BSN
Leopold C. Cancio, MD
Gretchen J. Carrougher, RN, MN
Kevin K. Chung, MD
Amalia Cochran, MD, FACS, FCCM
Iris H. Faraklas, RN, BSN, CCRN
James C. Jeng, MD, FACS
Anjay K. Khandelwal, MD, FICS
George C. Kramer, PhD
Jonathan Niszczak, MS, OTR/L
Melissa A. Pressman, PhD
Jose Salinas, PhD
Jeffrey W. Shupp, MD
Nam K. Tran, BS
Kitty Vineyard, Staff Liaison
Mark Postilion, Staff Liaison

Ad Hoc CME Evaluation Committee
Edward E. Tredget, MD, MSc, FRCS(C), Chair
Kathleen A. Hollowed, RN, BSN, MSN
Tina L. Palmieri, MD, FACS, FCCM
Jill L. Sproul, RN, MS
M. Jane Burns, Staff Liaison

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 Strategic Budgeting Committee
Palmer Q. Bessey, MD, FACS, MS, Chair
David H. Ahrenholz, MD, FACS
Richard L. Gamelli, MD, FACS
Linwood R. Haith, MD, FACS, FCCM
Kathleen A. Hollowed, RN, BSN, MSN
John A. Krichbaum, JD, Staff Liaison
Susan M. Browning, MPH, Staff Liaison
Janet Turner, Staff Liaison
2013 Special Interest Groups

**Advanced Practice Registered Nurse/Physician Assistant SIG**

*Tuesday, March 25 10:00 am - 12:00 pm  Gardner B*

John F. Bishop, PA-C, MS, CWS, CPC, CGSC, CPRC is a Certified Professional Coder through the AAPC with surgical specialty certification in Plastic/Reconstructive Surgery, Burn/Trauma and General Surgery. Mr. Bishop will be discussing coding, auditing, reimbursement and compliance for non-physician providers, APRN’s and PAs. In addition he will discuss the difficulties that APRN’s and PAs face in regards to reimbursement. And the additional difficulties we may have next year with the changes occurring in health care.

**Anesthesiology/Respiratory SIG**

*Tuesday, March 25 9:00 am - 12:00 pm  Jamaica Pond*

This SIG provides a forum for inter-professional (physicians, nurses, respiratory therapists) and interdisciplinary (anesthesia, surgery, critical care, pain, psychology) discussions of frequent and/or challenging issues in the perioperative care of burn patients, including operating room anesthesia, pain management, critical care, and respiratory care.

**Bioengineering/Biophysics SIG**

*Tuesday, March 25 11:00 am - 1:00 pm  Arnold Arboretum*

Bioengineering and Biophysics Special Interest Group will discuss topics of cellular and tissue physics and engineering related to burn care. Presentations will include a visiting guest lecturer and others from the Special Interest Group.

**Burn Camp SIG**

*Monday, March 24 3:00 pm - 6:00 pm  Republic B Ballroom*

Benefits of Building a Psyche/Social Team at Your Burn Camp - Bob Ditter is a well-regarded child, adolescent and family therapist from Boston, Massachusetts. He is a nationally recognized trainer and consultant and works with organizations that work with young people.

**Burn Center Disaster Planning SIG**

*Tuesday, March 25 12:00 pm - 1:00 pm  Dalton*

This SIG is a forum to develop partnerships and collaborate on disaster related issues. The goal of the meeting is to bring together all disciplines to improve access to disaster planning resources and to foster collaborative partnerships for planning and responding to mass casualty events.
<table>
<thead>
<tr>
<th>Event Name</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Burn Center Physicians SIG</strong></td>
<td>Tuesday, March 25</td>
<td>11:00 am - 1:00 pm</td>
<td>Liberty A Ballroom</td>
<td>An informal meeting of physicians and others who are interested in discussing issues, such as Burn Unit management, physician role responsibilities and reimbursement. Focus will be on current challenges in Burn Unit management.</td>
</tr>
<tr>
<td><strong>Burn Prevention SIG</strong></td>
<td>Tuesday, March 25</td>
<td>8:00 am - 1:00 pm</td>
<td>Independence Ballroom</td>
<td>This dynamic SIG provides a forum to collaborate and network with other attendees on prevention related issues. This year’s program will focus on using technology to create effective prevention programs, the positive and negative influences of social media in fire safety messages and overcoming common challenges. Anyone with an interest in injury prevention, fire safety, public education, safety advocacy, or community outreach is encouraged to attend this educational session.</td>
</tr>
<tr>
<td><strong>Burn Registry Users SIG</strong></td>
<td>Tuesday, March 25</td>
<td>8:00 am - 9:00 am</td>
<td>Gardner A</td>
<td>The Burn Registry SIG provides an opportunity for all users of the Burn Registry to network with other registry users and ABA leadership of the National Burn Repository. This year we will be providing updates of NTRAC Burn Module and National Data Burn Standard implementation. It provides a forum for the exchange of information, problem sharing, and problem solving.</td>
</tr>
<tr>
<td><strong>Burn Survivor and Reintegration SIG</strong></td>
<td>Tuesday, March 25</td>
<td>8:00 am - 10:30 am</td>
<td>Republic A Ballroom</td>
<td>The road back to work after a burn injury – Returning to work after a burn injury may pose many obstacles. We will discuss the physical and mental preparations necessary for the journey back.</td>
</tr>
<tr>
<td><strong>Canadian SIG</strong></td>
<td>Monday, March 24</td>
<td>7:00 pm - 10:30 pm</td>
<td>Constitution A Ballroom</td>
<td>This SIG promotes interaction all members of the burn team including firefighters from across Canada. Presentations and posters are given from abstracts submitted to the organizing committee. A prize is awarded for the top presentation and poster. A guest speaker is invited to give a 30-45 minute presentation. A cross-Canada survey of burn care activity is provided and the program ends with a wine and cheese reception.</td>
</tr>
<tr>
<td><strong>Epidemiology SIG</strong></td>
<td>Monday, March 24</td>
<td>3:00 pm - 5:00 pm</td>
<td>Independence East Ballroom</td>
<td>Attendees will assess the annual update/upgrade of the ABA Burn Incidence fact sheet. The applicability of health-related (e.g., NBR) and administrative (e.g., NIS) data sets to burn prevention will be reviewed, along with possible collaboration with the National Fire Protection Association in developing an on-line fire/burn data forum.</td>
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</tbody>
</table>
Federation of Burn Foundations SIG  
*Monday, March 24*  
*5:00 pm - 8:00 pm*  
*Public Garden*

Home cooking fires account for a significant percentage of burn injuries. Effective prevention is comprehension and addresses the “E”s: education, engineering, and enforcement solutions. The presentation will facilitate a discussion on advocacy and the role of burn foundations. Guest speaker, Earl Diment, is a retired firefighter and prevention officer from Portland (OR) Fire Department. He is currently the Chief Safety Officer for Pioneering Technologies.

Firefighters SIG  
*Monday, March 24*  
*12:00 pm - 5:00 pm*  
*Back Bay B Ballroom*

Firefighter SIG- History of Firefighters and the ABA to be presented by retired Oak Bay, British Columbia Fire Chief Gerry Adam.

Fluid Resuscitation SIG  
*Tuesday, March 25*  
*7:30 am - 10:30 am*  
*Back Bay D Ballroom*

This year’s meeting will cover the following topics: Albumin Use, U.S. Army Trial Grants, Report from Texas Burn Consortium, Nurse Driven Resuscitation, Abdominal Compartment Syndrome, Resuscitation of Sepsis, and Resuscitation Apps.

Nursing & Psychosocial SIG  
*Tuesday, March 25*  
*11:00 am - 1:00 pm*  
*Back Bay A Ballroom*

This year’s joint Nursing/Psychosocial SIG meeting will focus on palliative care.

Nutrition SIG  
*Tuesday, March 25*  
*8:00 am - 10:00 am*  
*Riverway*

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

Occupational Therapy/Physical Therapy SIG  
*Tuesday, March 25*  
*8:00 am - 1:00 pm*  
*Back Bay B Ballroom*

With overwhelming feedback and response, the OT/PT SIG will present the principles, pearls and problems of splinting and positioning that burn therapists encounter in the acute care setting. Veteran burn therapists will share knowledge and experience of treating survivors during their inpatient hospital stay.
Pediatric Burns SIG

_Tuesday, March 25_  
11:00 am - 1:00 pm  
Back Bay D Ballroom

The Pediatric SIG strives to cover a wide spectrum of issues from EMS to Rehab. Cases and presentations are offered followed by Q/A sessions. Anyone is welcome to attend our meeting and the format is always an open and active one. If you would like to present, please contact one of our Chairs. In 2014, we are planning a special panel discussion on “international challenges of pediatric burn care”.

Pharmacy SIG

_Tuesday, March 25_  
10:00 am - 1:00 pm  
Olmsted

This year’s Pharmacy SIG will be divided into two distinct sections: ‘Difficult Cases’ and a ‘Year in Review’. The ‘Difficult Cases’ will involve presentation of several challenging patient cases to facilitate an interactive discussion of medication therapy and dosing strategies in the burn patient. The ‘Year in Review’ will highlight high impact publications related to pharmacotherapy from past year.

Reconstructive SIG

_Tuesday, March 25_  
9:00 am - 11:00 am  
Dalton

This year’s meeting will consist of three parts: 1) Difficult Case Presentations; 2) Follow up Discussion on Pathophysiology and Role of Fat Grafting in Burn Reconstruction; and 3) Update on Enrolling Patients in Composite Tissue Allograft Transplantation.

Research SIG

_Tuesday, March 25_  
11:00 am - 1:00 pm  
Riverway

“Improving Safety in Clinical Research Trials” - Developing safety monitoring plans that are commensurate with study risks and burn pathophysiology. We will address regulatory requirements and explore innovative approaches to safety. The session will include speakers and an interdisciplinary expert panel. Additionally, feasibility study posters from ABA membership will be presented.
## Forty-Sixth Annual Meeting Program Summary

### Monday, March 24

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>6:30 am - 5:00 pm</td>
<td>Registration</td>
<td>Ballroom Foyer</td>
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<tr>
<td>7:30 am - 5:00 pm</td>
<td>ABLS Provider Course</td>
<td>Fairfax</td>
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<tr>
<td>8:00 am - 9:30 am</td>
<td>Burn Registry Committee</td>
<td>Dalton</td>
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<tr>
<td>8:00 am - 3:30 pm</td>
<td>Membership Advisory Committee</td>
<td>Republic A Ballroom</td>
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<tr>
<td>9:00 am - 12:00 pm</td>
<td>Burn Science Advisory Panel</td>
<td>Gardner B</td>
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<tr>
<td>9:00 am - 3:00 pm</td>
<td>Burn Prevention Committee</td>
<td>Independence East Ballroom</td>
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<tr>
<td>9:30 am - 10:30 pm</td>
<td>Ad Hoc Coding Committee</td>
<td>Gardner A</td>
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<tr>
<td>10:00 am - 11:00 am</td>
<td>Education Committee</td>
<td>Hampton</td>
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<tr>
<td>10:00 am - 11:30 am</td>
<td>NBR Advisory Committee</td>
<td>Dalton</td>
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<tr>
<td>11:30 am - 1:00 pm</td>
<td>MAC/SIG Chair Luncheon</td>
<td>Republic A Ballroom</td>
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<tr>
<td>12:00 pm - 5:00 pm</td>
<td>ABLS Course Breakouts</td>
<td>See page S20</td>
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<tr>
<td>12:00 pm - 2:30 pm</td>
<td>Aftercare Reintegration Committee</td>
<td>Back Bay A Ballroom</td>
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<tr>
<td>12:00 pm - 5:00 pm</td>
<td>FireFighters SIG</td>
<td>Back Bay B Ballroom</td>
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<tr>
<td>12:00 pm - 1:30 pm</td>
<td>IAC/Government Affairs Luncheon</td>
<td>Commonwealth</td>
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<tr>
<td>12:00 pm - 4:00 pm</td>
<td>Speaker Ready Room</td>
<td>Exeter</td>
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<tr>
<td>1:00 pm - 5:00 pm</td>
<td>Rehabilitation Practice Guidelines Workshop</td>
<td>Back Bay D Ballroom</td>
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<tr>
<td>1:30 pm - 2:30 pm</td>
<td>Bylaws Committee</td>
<td>Gardner A</td>
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<tr>
<td>2:30 pm - 3:30 pm</td>
<td>Conflict of Interest Committee</td>
<td>Dalton</td>
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<tr>
<td>3:00 pm - 6:00 pm</td>
<td>Burn Camp SIG</td>
<td>Republic B Ballroom</td>
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<tr>
<td>3:00 pm - 5:00 pm</td>
<td>Burn Epidemiology SIG</td>
<td>Independence East Ballroom</td>
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<tr>
<td>4:00 pm - 6:00 pm</td>
<td>Verification Committee</td>
<td>Gardner B</td>
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<tr>
<td>5:00 pm - 8:00 pm</td>
<td>Federation of Burn Foundations SIG</td>
<td>Public Garden</td>
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<tr>
<td>5:30 pm - 6:30 pm</td>
<td>Ad Hoc Technology Committee</td>
<td>Dalton</td>
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<tr>
<td>7:00 pm - 10:30 pm</td>
<td>Canadian SIG</td>
<td>Constitution A Ballroom</td>
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### Tuesday, March 25

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<tr>
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<td>Registration</td>
<td>Ballroom Foyer</td>
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<tr>
<td>7:30 am - 9:30 am</td>
<td>ABLS Instructor Course Lecture</td>
<td>Fairfax</td>
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<td>7:30 am - 10:30 am</td>
<td>Fluid Resuscitation SIG</td>
<td>Back Bay D Ballroom</td>
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<tr>
<td>8:00 am - 1:00 pm</td>
<td>Burn Prevention SIG</td>
<td>Independence Ballroom</td>
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<tr>
<td>8:00 am - 9:00 am</td>
<td>Burn Registry Users SIG</td>
<td>Gardner A</td>
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<tr>
<td>8:00 am - 10:30 am</td>
<td>Burn Survivor and Reintegration SIG</td>
<td>Republic A Ballroom</td>
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<tr>
<td>8:00 am - 10:00 am</td>
<td>Nutrition SIG</td>
<td>Riverway</td>
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<tr>
<td>8:00 am - 1:00 pm</td>
<td>Occupational Therapy/Physical Therapy SIG</td>
<td>Back Bay B Ballroom</td>
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<tr>
<td>8:00 am - 11:00 am</td>
<td>Organization and Delivery of Burn Care Committee</td>
<td>Public Garden</td>
</tr>
<tr>
<td>8:00 am - 11:00 am</td>
<td>Research Committee</td>
<td>The Fens</td>
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<tr>
<td>8:00 am – 5:00 pm</td>
<td>Speaker Ready Room</td>
<td>Exeter</td>
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<tr>
<td>8:30 am - 3:00 pm</td>
<td>Board of Trustees Meeting</td>
<td>Commonwealth</td>
</tr>
<tr>
<td>9:00 am - 12:00 pm</td>
<td>Anesthesiology/Respiratory SIG</td>
<td>Jamaica Pond</td>
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<tr>
<td>9:00 am - 3:00 pm</td>
<td>Poster Set-Up</td>
<td>Hall D/Hynes Convention Center</td>
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<tr>
<td>9:00 am - 11:00 am</td>
<td>Reconstructive SIG</td>
<td>Dalton</td>
</tr>
<tr>
<td>9:30 am - 11:30 am</td>
<td>International Outreach Committee</td>
<td>Boston Common</td>
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<tr>
<td>10:00 am - 1:00 pm</td>
<td>ABLS Course Breakouts</td>
<td>See page S20</td>
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<tr>
<td>10:00 am - 12:00 pm</td>
<td>Advanced Practice Registered Nurse/Physician Assistant SIG</td>
<td>Gardner B</td>
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<tr>
<td>10:00 am - 1:00 pm</td>
<td>Pharmacy SIG</td>
<td>Olmsted</td>
</tr>
<tr>
<td>11:00 am - 1:00 pm</td>
<td>Bioengineering/Biophysics SIG</td>
<td>Arnold Arboretum</td>
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<tr>
<td>11:00 am - 1:00 pm</td>
<td>Burn Center Physicians SIG</td>
<td>Liberty A Ballroom</td>
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<tr>
<td>11:00 am - 1:00 pm</td>
<td>Nursing &amp; Psychosocial SIG</td>
<td>Back Bay A Ballroom</td>
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<tr>
<td>11:00 am - 1:00 pm</td>
<td>Pediatric Burns SIG</td>
<td>Back Bay D Ballroom</td>
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**Tuesday, March 25 (continued)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>11:00 am - 1:00 pm</td>
<td>Research SIG</td>
<td>Riverway</td>
</tr>
<tr>
<td>11:30 am - 2:00 pm</td>
<td>Board of Trustees/Committee Chair Luncheon</td>
<td>Constitution A Ballroom</td>
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<tr>
<td>12:00 pm - 1:00 pm</td>
<td>Burn Center Disaster SIG</td>
<td>Dalton</td>
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<tr>
<td>1:00 pm - 5:00 pm</td>
<td>Fundamentals of Burn Care</td>
<td>Hampton</td>
</tr>
<tr>
<td>1:00 pm - 2:00 pm</td>
<td>Northeast Regional Meeting</td>
<td>Dalton</td>
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<tr>
<td>1:00 pm - 4:00 pm</td>
<td>SOAR Coordinator Course</td>
<td>Boston Common</td>
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<tr>
<td>1:30 pm - 3:30 pm</td>
<td>ABLS Coordinator Course</td>
<td>Fairfax B</td>
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<tr>
<td>2:00 pm - 3:00 pm</td>
<td>Rehabilitation Committee</td>
<td>Public Garden</td>
</tr>
<tr>
<td>2:30 pm - 3:30 pm</td>
<td>Southern Regional Meeting</td>
<td>Liberty A Ballroom</td>
</tr>
<tr>
<td>2:30 pm - 3:30 pm</td>
<td>Western Regional Meeting</td>
<td>Boston Common</td>
</tr>
<tr>
<td>3:00 pm - 4:00 pm</td>
<td>Archives Committee</td>
<td>Dalton</td>
</tr>
<tr>
<td>3:00 pm - 5:00 pm</td>
<td>Ethical Issues Committee</td>
<td>Berkeley</td>
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<tr>
<td>3:00 pm - 7:00 pm</td>
<td>Exhibits Open/Poster Viewing</td>
<td>Hall D</td>
</tr>
<tr>
<td>3:30 pm - 5:30 pm</td>
<td>Rehabilitation Workshop</td>
<td>Back Bay B Ballroom</td>
</tr>
<tr>
<td>4:00 pm - 5:30 pm</td>
<td>ABLS Advisory Committee</td>
<td>Fairfax A</td>
</tr>
<tr>
<td>4:00 pm - 5:00 pm</td>
<td>What's New in Burn Registry</td>
<td>Hampton</td>
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<tr>
<td>5:00 pm - 7:00 pm</td>
<td>Opening Reception</td>
<td>Hall D</td>
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**Wednesday, March 26**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>6:30 am - 6:30 pm</td>
<td>Registration</td>
<td>Hall D</td>
</tr>
<tr>
<td>6:30 am - 6:30 pm</td>
<td>Poster Viewing</td>
<td>Hall D</td>
</tr>
<tr>
<td>6:30 am - 7:45 am</td>
<td>Sunrise Symposia 1-13</td>
<td>See page S23</td>
</tr>
<tr>
<td>7:00 am - 7:45 am</td>
<td>New Member Welcome Breakfast</td>
<td>Commonwealth</td>
</tr>
<tr>
<td>7:00 am - 5:00 pm</td>
<td>Speaker Ready Room</td>
<td>Exeter</td>
</tr>
<tr>
<td>8:00 am - 9:30 am</td>
<td>Opening Ceremony, Awards &amp; Presidential Address</td>
<td>Grand Ballroom</td>
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<tr>
<td>9:30 am - 10:00 am</td>
<td>Coffee with Exhibitors</td>
<td>Hall D</td>
</tr>
<tr>
<td>9:30 am - 1:45 pm</td>
<td>Exhibits Open</td>
<td>Hall D</td>
</tr>
<tr>
<td>10:00 am - 12:00 pm</td>
<td>Corr I: Wounds - Basic Science</td>
<td>Back Bay A Ballroom</td>
</tr>
<tr>
<td>10:00 am - 12:00 pm</td>
<td>Corr II: Acute Care - Inhalation &amp; Nutrition</td>
<td>Back Bay C Ballroom</td>
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<tr>
<td>10:00 am - 12:00 pm</td>
<td>Corr III: Public Health - Burn Care Delivery</td>
<td>Constitution Ballroom</td>
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<tr>
<td>10:00 am - 12:00 pm</td>
<td>Corr IV: Psychosocial</td>
<td>Independence Ballroom</td>
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<tr>
<td>10:00 am - 12:00 pm</td>
<td>Corr V: Rehabilitation</td>
<td>Republic Ballroom</td>
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<tr>
<td>10:00 am - 12:00 pm</td>
<td>FF I: Boston Marathon</td>
<td>Fairfax</td>
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<tr>
<td>12:00 pm - 2:00 pm</td>
<td>DSMB</td>
<td>Hampton</td>
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<tr>
<td>12:00 pm - 1:45 pm</td>
<td>Lunch with Exhibitors</td>
<td>Hall D</td>
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<tr>
<td>12:30 pm - 1:30 pm</td>
<td>Poster Rounds with Professors &amp; Authors</td>
<td>Hall D</td>
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<tr>
<td>2:00 pm - 4:00 pm</td>
<td>Postgraduate Course A</td>
<td>Constitution Ballroom</td>
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<tr>
<td>2:00 pm - 4:00 pm</td>
<td>Postgraduate Course B</td>
<td>Back Bay C Ballroom</td>
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<tr>
<td>2:00 pm - 4:00 pm</td>
<td>Postgraduate Course C</td>
<td>Back Bay A Ballroom</td>
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<tr>
<td>4:00 pm - 6:30 pm</td>
<td>Exhibits Open</td>
<td>Hall D</td>
</tr>
<tr>
<td>4:15 pm - 5:00 pm</td>
<td>Midwest Regional Meeting</td>
<td>Boardroom</td>
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<tr>
<td>4:15 pm - 5:45 pm</td>
<td>MCTG Town Hall Meeting</td>
<td>Independence Ballroom</td>
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<tr>
<td>5:00 pm - 6:30 pm</td>
<td>Wine &amp; Cheese Reception – Posts with Authors</td>
<td>Hall D</td>
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</table>
Thursday, March 27

6:30 am - 5:00 pm  Registration
Ballroom Foyer

6:30 am - 7:45 am  Sunrise Symposia 14-26
See page S33

6:30 am - 1:45 pm  Poster Viewing
Hall D | Hynes Convention Center

7:00 am - 8:00 am  International Attendee Breakfast
Commonwealth

7:00 am - 5:00 pm  Speaker Ready Room
Exeter

8:00 am - 9:30 am  Presidential Plenary: Improving the Quality of Care
Grand Ballroom

9:30 am - 10:00 am  Coffee with Exhibitors
Hall D | Hynes Convention Center

9:30 am - 1:45 pm  Exhibits Open
Hall D | Hynes Convention Center

10:00 am - 12:00 pm  Corr VI: Wounds - Clinical
Back Bay A Ballroom

10:00 am - 12:00 pm  Corr VII: Acute Care - Infection
Independence Ballroom

10:00 am - 12:00 pm  Corr VIII: Public Health - Epidemiology
Constitution Ballroom

10:00 am - 12:00 pm  Corr IX: Nursing
Back Bay C Ballroom

10:00 am - 12:00 pm  Corr X: Translational Science
Republic Ballroom

10:00 am - 12:00 pm  FF II: Challenges for the FF
Fairfax

12:15 pm - 1:45 pm  JBCR Editors Lunch
Commonwealth

12:15 pm - 1:45 pm  Lunch with Exhibitors
Hall D | Hynes Convention Center

12:30 pm - 1:30 pm  Poster Rounds with Professors & Authors
Hall D | Hynes Convention Center

2:00 pm - 4:00 pm  Postgraduate Course A
Constitution Ballroom

2:00 pm - 4:00 pm  Postgraduate Course B
Back Bay C Ballroom

2:00 pm - 4:00 pm  Postgraduate Course C
Back Bay A Ballroom

4:15 pm - 5:30 pm  Local Burn Tours
Shriners | MGH | Brigham & Women’s

4:15 pm - 5:30 pm  Changing Places
Fairfax

4:15 pm - 5:30 pm  The Year in Review: The Top Journal Publications in 2013
Independence Ballroom

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Friday, March 28

6:30 am - 7:45 am  Repeat of Three Most Popular Sunrise Symposia
Hampton | Berkeley | Gardner

7:00 am - 4:30 pm  Registration
Ballroom Foyer

7:00 am - 2:00 pm  Speaker Ready Room
Exeter

8:00 am - 9:30 am  Friday Plenary: Top 6 Abstracts
Grand Ballroom

10:00 am - 12:00 pm  Best in Category Posters
Hall D | Hynes Convention Center

10:00 am - 12:00 pm  Corr XI: Wounds - Basic Science & Clinical
Back Bay C Ballroom

10:00 am - 12:00 pm  Corr XII: Acute Care - Resuscitation
Back Bay A Ballroom

10:00 am - 12:00 pm  Corr XIII: Public Health - Prevention
Republic Ballroom

10:00 am - 12:00 pm  Corr XIV: Psychosocial
Independence Ballroom

10:00 am - 12:00 pm  Corr XV: Reconstruction
Constitution Ballroom

12:15 pm - 1:45 pm  Luncheon Symposia 27-36
See page S44

12:15 pm - 1:45 pm  Ethics Case Presentation
Liberty Ballroom

2:00 pm - 4:00 pm  Pro/Con: Controversies in Modern Burn Care
Constitution Ballroom

2:00 pm - 4:00 pm  Integrating Family as Burn Care Team Members
Back Bay A Ballroom

2:00 pm - 4:00 pm  Clinical Practice Guidelines
Back Bay C Ballroom

4:15 pm - 5:15 pm  Business Meeting
Independence Ballroom

7:45 pm - 12:30 am  Annual Banquet
Grand Ballroom

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Saturday, March 29

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

ABLS Provider Course

Monday, March 24  7:30 am - 5:00 pm  Fairfax A

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

ABLS Instructor/Coordinator Course

Tuesday, March 25  7:00 am - 3:30 pm  Fairfax A

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.


Rehabilitation Practice Guidelines

Monday, March 24  1:00 pm - 5:00 pm  Back Bay D Ballroom

What’s New in Burn Registry

Tuesday, March 25  4:00 pm - 5:00 pm  Hampton

2014 will bring major enhancements to the ABA Burn Registry software. This session will focus on the newest improvements and updates of the Burn Registry v6.0 software, the National Burn Data Standard (NBDS), and transition update from ICD-9 to ICD-10. The new NBDS will be the basis for the NBR. The Burn Registry v6.0 will contain the integrated ABA Burn Validator tool, checking for errors and inconsistencies in the data, and alerting the registrar at the time of data admission. Join this session to learn more about the newest improvements of the ABA burn registry.

New Member Welcome Breakfast

Wednesday, March 26  7:00 am - 7:45 am  Commonwealth

Are you 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. Learn more about the educational opportunities, projects, activities, Committees and Special Interest Groups (SIGs) of the ABA.

International Attendee Welcome Breakfast

Thursday, March 27  7:00 am - 7:45 am  Commonwealth

All international attendees at the ABA Annual Meeting are invited to this informal breakfast session where they can get to know ABA leadership and learn more about the ABA educational opportunities and initiatives.
Fundamentals of Burn Care

Wounds and Scars

*Tuesday, March 25 1:00 pm - 5:00 pm  Republic Ballroom*

**Course Directors:** Theresa Baker, RN and Amalia Cochran, MD, FACS, FCCM

**Course Description:** New burn care providers must have a solid foundation in wound healing and wound care as well as understanding the process of scarring. In addition, they need to be familiar with complications of both wound healing and scar formation. Knowledge in these areas allows them to participate more fully in the care of burn patients and to provide those patients with education about their injury and the healing and scarring processes.

As a result of attending this live activity, the learner should be able to: (1) Describe the biology of wound healing and understand its relationship to scar formation; (2) Identify options for wound care based upon the characteristics of a patient’s wounds; (3) Discuss different modalities for the management of “routing” early scar and for hypertrophic scar; (4) Recognize common complications in wound healing and scarring; (5) Educate patients and families about expectations for wound healing and scarring post-burn injury; and (6) Converse knowledgeably about new technologies and concepts in wounds and scars.

1:00 pm - 1:30 pm  **Biology of Wounds and Scars**  
Dennis P. Orgill, MD, PhD, FACS

1:30 pm - 2:25 pm  **Topical and Other Agents for Wound Care**  
Bret W. King, RN

2:25 pm - 2:55 pm  **Management of Early Routine Scar**  
Miranda L. Yelvington, OTR/L

2:55 pm - 3:10 pm  **Break**

3:10 pm - 3:55 pm  **Wound and Scar Complications**  
Robert C. Cartotto, MD, FRCS(C)

3:55 pm - 4:30 pm  **Educating Patients and Families**  
Michelle L. Broers, PT, DPT, CWS, FACCWS

4:30 pm - 5:00 pm  **“Hot Topics” in Wounds and Scars**  
Philip H. Chang, MD  
Anjay Khandelwal, MD, FICS
SOAR Coordinator Course

**Tuesday, March 25**  
1:00 pm - 4:00 pm  
**The Fens**

*Speaker: Pam Peterson, RN, BSN*

Survivors Offering Assistant 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 live 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.

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Topic</th>
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<tbody>
<tr>
<td>1:00 pm - 1:15 pm</td>
<td>Introduction</td>
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<tr>
<td>1:15 pm - 2:30 pm</td>
<td>Implementing a Successful Program: Overview and Startup</td>
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<tr>
<td>2:30 pm - 2:45 pm</td>
<td>Break</td>
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<td>2:45 pm - 3:05 pm</td>
<td>What Does It Take to Offer a SOAR Program?</td>
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<td>3:05 pm - 3:25 pm</td>
<td>What Resources and Materials Are Available?</td>
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<td>3:25 pm - 3:45 pm</td>
<td>Effective Communications for Coordinators</td>
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<tr>
<td>3:45 pm - 4:00 pm</td>
<td>Program Evaluation and Forms</td>
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Rehabilitation Workshop

**Rehabilitation Outcomes:**

**A Review of Standardized Metrics for Use in Clinical Practice**

**Tuesday, March 25**  
3:30 pm - 5:30 pm  
**Back Bay B Ballroom**

*Moderator: Bernadette Nedelec, PhD, BSc, OT*

During this workshop expert clinicians will review standardized instruments that are used in clinical care to assess rehabilitation outcomes. The focus of the review will be on metrics that assess hand function, mobility and global function. After a series of short lectures on these topics, there will be a break-out session to discuss practical issues of clinical implementation in a small group format.
### Sunrise Symposia - Wednesday

**Wednesday, March 26  6:30 am - 7:45 am**

1. **Treatment of Scalds: Old School or Innovation?**  
   Room: Berkeley  
   *Moderators: Frederick Endorf, MD and Vimal K. Murthy, MD, FACS*

2. **Patient Motivation in Rehabilitation**  
   Room: Clarendon  
   *Moderators: Sara E. Bills, PT and Vincent A. Gabriel, MD, MSc, FRCPC*

3. **Diabetes and Burns: Different Treatment or the Same?**  
   Room: Dalton  
   *Moderators: Lee D. Faucher, MD and Ryan M. Fey, MD*

4. **Burn Coding and Reimbursement**  
   Room: Hampton  
   *Moderators: William L. Hickerson, MD, FACS and Richard J. Kagan, MD, FACS*

5. **Conscious Sedation and Wound Management in Pediatrics**  
   Room: Fairfax A  
   *Moderators: Gennady Fuzaylov, MD and Robert L. Sheridan, MD, FACS*

6. **Laser Therapy for Burn Patients**  
   Room: Fairfax B  
   *Moderators: John K. Bailey, MD, FACS and Charles S. Hultman, MD*

7. **Burn Camps**  
   Room: Gardner  
   *Moderators: Donna K. Crump, PT and Thomas R. Flamm, FF*

8. **Dosing Drugs in Burns**  
   Room: Boston Common  
   *Moderators: Jennifer L. Brandt, PharmD and Patricia J. Faris, PharmD, BCPS*

9. **Nurse Management in the Burn Unit**  
   Room: Public Garden  
   *Moderators: Rebecca A. Coffey, RN, MSN, CNP and Mark Krugman, RN*

10. **CRRT in the Burn Center: Is This a Good Idea, and Who Should Be Doing It?**  
    Room: The Fens  
    *Moderators: Kevin N. Foster, MD, MBA, FACS and Maria L. Serio-Melvin, RN*

11. **Burns of the Foot and Ankle**  
    Room: Riverway  
    *Moderators: Mohamed S. Elfar, MD and Bruce M. Potenza, MD, FACS, FCCM*

12. **Nutrition and the Burn Nurse**  
    Room: Jamaica Pond  
    *Moderators: Karla S. Abrns-Klas, RN, BSN, CCRP and Jamie Heffernan, ADN, BSN, CCRN*

13. **Pain Scores and the Relevance to Treatment**  
    Room: Arnold Arboretum  
    *Moderators: Carolyn B. Blayney, RN, BSN and Clare Card, RN*
Opening Ceremony, Awards Presentation and Presidential Address

Wednesday, March 26  8:00 am - 9:30 am  Grand Ballroom/Liberty

How D’Ye Know

Presented by:
Palmer Q. Bessey, MD, FACS, MS
Weill Cornell Medical College
New York Presbyterian Hospital
New York, NY

As a result of attending this activity, the learner should be able to: Develop a common definition of quality and use that definition to set national guidelines for burn care.
Correlative I: Wounds - Basic Science

10:00 am - 12:00 pm    Back Bay A Ballroom

Moderators: Adam J. Singer, MD and Edward E. Tredget, MD, MSc, FRCS(C)

1. Deficient Recruitment of Progenitor Cells into the Skin of Old Mice Contributes to Delayed Cutaneous Healing Post Thermal Injury
2. Isometric Force Measurement in a Murine Model of Muscle Injury
3. Hypoxic Conditioned Medium of Bone Marrow Derived Mesenchymal Stem Cells Enhances Murine Wound Healing Through Paracrine Signaling
4. Two Small Anti-Fibrogenic Factors, FS1 and 2, Prevent Hypertrophic Scarring in a Fibrotic Animal Model
5. A Novel Immune Competent Murine Hypertrophic Scar Contracture Model: A Tool to Elucidate Disease Mechanism and Develop New Therapies
6. The Effects of Topical Nitric Oxide on Reepithelialization of Partial Thickness Porcine Burns
7. Effect of Wound Dressings on Primary Keratinocyte Growth from Biopsy Derived in vitro Cultured Skin
8. Upregulation of TLR-9 Expression by Wound γδ T-cells after Burn

Correlative II: Acute Care: Inhalation Injury & Nutrition

10:00 am - 12:00 pm    Back Bay C Ballroom

Moderators: Leopoldo C. Cancio, MD, FACS and Maggie L. Dylewski, PhD, RD

9. Early Extubation of Burn Patients: An Achievable Performance Improvement Goal?
10. More Than One-Third of Intubations in Patients Transferred to Burn Centers are Unnecessary
11. The Utility and Predictive Value of Physical Exam Findings for Burn Inhalation Injury
12. Application of the New Berlin Definition of Acute Respiratory Distress Syndrome (ARDS) to Burn Patients
13. Provision of Micronutrients to Pediatric Burn Patients Using Adult Enteral Nutrition Formulas
14. Burn-Induced Mitochondrial Dysfunction Is Associated with Suppressed Expression of Mitochondria-Localized Sirtuins in Skeletal Muscle
15. The Role of Skeletal Muscle Mitochondrial Dysfunction in the Hypermetabolic Response to Burn Injury
16. Compensating with a “Correction Factor” to Improve Delivery of Prescribed Enteral Nutrition in Burn Patients
Correlative III: Public Health - Burn Care Delivery

10:00 am - 12:00 pm  Constitution Ballroom
Moderators: James C. Jeng, MD, FACS and Stephen E. Morris, MD, FACS

17. Concomitant Trauma and Death in Patients of the National Burn Repository
18. Are Burn Patients Really At Risk For Thrombotic Events?
19. Reduction in Cost for Temporary Skin Coverings
20. Frailty Score on Admission Predicts Outcomes in Elderly Burn Injury
21. Comorbidity-Polypharmacy Score Predicts In-Hospital Complications and the Need for Extended Care Facility in Older Burn Patients
22. Burn Care in Developing Countries: Establishing Sustainable Healthcare
23. A 15-Year Experience with Pediatric Toxic Epidermal Necrolysis
24. Workforce Deployment in U.S. Burn Centers

Correlative IV: Psychosocial

10:00 am - 12:00 pm  Independence Ballroom
Moderators: Radha K. Holavanahalli, PhD and Shelley A. Wiechman, PhD, ABPP

25. Comparison of Long-Term Quality of Life of Pediatric Burn Survivors with and without Inhalation Injury
26. Gender, Size of Burn and Visible Scarring Appear to Contribute to the Psychological Challenges of Burn-Injured Youth
27. Best Practices for Child Life Interventions in the Pediatric Burn Clinic Setting
28. Investigating Burn Survivors Thoughts: Body Image versus Traumatic Memories
29. A Child Life Pilot Study: Addressing Psychosocial Needs through Continuity of Care
30. Relationship Between Zolpidem Concentrations and Sleep Parameters in Pediatric Burn Patients
31. Family Support for the Pediatric Burn Patient: A Key Contributor to Resiliency
32. Long Term Quality of Life of Burn Survivors Using World Health Organization Disability Assessment Scale II (WHODAS) and Burn Specific Health Scale- Brief (BSHS-B): A Comparison
Correlative V: Rehabilitation

10:00 am - 12:00 pm  Republic Ballroom

Moderators: Karen J. Kowalske, MD and Ingrid S. Parry, MS, PT

33. A Prospective Randomized Controlled Trial Comparing Video Games to Standard Physical Therapy: Six Months Follow Up
34. Effects of Community Based Exercise in Children with Severe Burns
35. Assessing the Ability of Comorbidity Indices to Capture Comorbid Disease in the Inpatient Rehabilitation Burn Injury Population
36. Cutaneous Functional Units Relate Better than Total Body Surface Area to Burn Patient Outcomes
37. Impact of Burn-Related Amputations on Return to Work: Implications for Burn Rehabilitation in the U.S.
38. Gait Outcome of Pediatric Lower Extremity Amputation Patients with and without Skin Grafts
39. Heat Acclimation Increases Plasma Volume in Burn Survivors
40. A Randomized Controlled Trial to Test an Expanded Delivery Model for Patients with Burn Injuries

Firefighter Courses

Firefighter Course I: Response to the Boston Marathon Bombing

Wednesday, March 26 10:00 am - 12:00 pm  Fairfax

Course Description: This session will contain an overview of the fire service response and the importance of the first responder. In addition, planning for an event and preparing for an incident will be discussed.

Speaker: Chief Dennis Costin, FF
Postgraduate Course A: Quantitative and Qualitative Outcomes in Burn Care - Evaluation and Endpoints

Wednesday, March 26 and Thursday, March 27 2:00 pm - 4:00 pm Constitution Ballroom

Course Directors: Robert L. Sheridan, MD, FACS and Gretchen J. Carrougher, RN, MN

Course Description: The focus of outcomes research is moving from easily defined and measured short-term outcome variables (such as survival, length of stay, units of blood transfused, etc.) to variables that are more difficult to define and measure (such as satisfaction with life, success in relationships, emotional health). Quality outcomes research assumes the ability to clearly define and measure these outcome variables. Unfortunately there is little agreement as to how this should be done. This course attempts to rectify this deficiency so that the burn field can move forward in this important domain.

As a result of attending this activity, the learner should be able to: (1) List important “soft” endpoints in burn outcomes; (2) Describe options for measuring specific aspects of burn outcomes in domains such as emotional health, satisfaction with life, and reentry into schools and work.

Wednesday, March 26

2:00 pm - 2:05 pm Introduction of Agenda and Speakers
Robert L. Sheridan, MD, FACS

2:05 pm - 2:20 pm History of “Soft Endpoint” Studies in Burns
Lewis E. Kazis, ScD

2:20 pm - 2:35 pm Defining and Measuring Acute and Chronic Stress
Frederick J. Stoddard, MD

2:35 pm - 2:50 pm Statistical Techniques for Outcome Studies
Iris H. Faraklas, RN, BSN

2:50 pm - 3:05 pm Measuring Depression, Anxiety and Emotional Health
Shelley A. Wiechman, PhD, ABPP

3:05 pm - 3:20 pm Creative Use of Existing Datasets
Jeffrey C. Schneider, MD

3:20 pm - 3:35 pm Burn-Specific Tools: BSHS to BOQ and Beyond
Nicole S. Gibran, MD, FACS

3:35 pm - 4:00 pm Panel Discussion with all Speakers
Robert L. Sheridan, MD, FACS
Walter J. Meyer, III, MD


**Thursday, March 27**

2:00 pm - 2:05 pm  
**Introduction of Agenda and Speakers**  
Gretchen J. Carrougher, RN, MN

2:05 pm - 2:20 pm  
**Measuring Happiness and Satisfaction**  
J. Michael Murphy, Ed.D

2:20 pm - 2:35 pm  
**Measuring Impact of Injury on Family Members**  
Liza Gamelli, LSW

2:35 pm - 2:50 pm  
**PROMIS and NeuroQOL: Public Resources for Outcomes Investigators**  
Dagmar Antmann, PhD

2:50 pm - 3:05 pm  
**Measuring School and Social Function in Children**  
Ruth B. Rimmer, PhD, CLCP

3:05 pm - 3:20 pm  
**Measuring Workplace and Social Function in Adults**  
Colleen M. Ryan, MD, FACS

3:20 pm - 3:35 pm  
**Notable Example Studies**  
Tina L. Palmieri, MD, FACS, FCCM

3:35 pm - 4:00 pm  
**Panel Discussion with all Speakers**  
Gretchen J. Carrougher, RN, MN  
Ronald G. Tompkins, MD, ScD, FACS
Course Description: Pediatric Care for burns has selective differences over the entire spectrum of burn care. Because there is a falling incidence of major pediatric burns, often times the burn unit team is not exposed to pediatric burns. It is important to review basic pediatric wound care, how it differs from adults and the controversial areas when treating pediatric burn patients.

As a result of attending this activity, the learner should be able to: (1) Identify critical care issues for pediatric patients that are controversial; (2) Understand the theoretical basis for pain management in the pediatric population; (3) Understand the rationale and incorporate closed dressing technique for the pediatric burn patients; (4) Prepare for pediatric specific issues as it relates to burn center verification; and (5) Incorporate the skills of child life in the daily care of pediatric burn patients.
Post-Graduate Course C: The Impact of the Electronic Medical Record in Burn Care

Wednesday, March 26 and Thursday, March 27 2:00 pm - 4:00 pm Back Bay A Ballroom

Course Directors: Agnes M. Burris, RN and David T. Harrington, MD, FACS

Course Description: The digital revolution has arrived in the realm of burn care. The Electronic Medical Record (EMR) has the potential to transform how we interact, diagnose, treat our patients. This revolution will not be easy for it has the potential to both positively and negatively impact care. It will also consume a significant amount of resources in terms of personnel time and dollars. This course will explore both the upsides and downsides of this transformation and will look at the background of human thinking and computer computing, work flow in this new electronic era, the financial impact of the transition to EMR, opportunities for clinical decision support and education, and suggest some strategies for how practitioners should get involved and advocate for their patients and themselves.

As a result of attending this activity, the learner should be able to: (1) Understand the difference in how humans think and computers compute; (2) Know what a GUI interface is; (3) Appreciate the impact of an electronic burn diagram; (4) Recognize how EMR may change workflows; (5) Know the financial impact of the change to an EMR; (6) Understand the essentials of how to build templates; (7) Create strategies for surviving ICD-10; (8) Understand the concept of electronic Clinical Decision Support; (9) Appreciate the educational impact of the EMR; and (10) Create strategies for your burn center's EMR in the future.

Wednesday, March 26

2:00 pm - 2:40 pm  Human Vs. Computer: A Primer
                     David T. Harrington, MD, FACS

2:40 pm - 3:20 pm  Work Flow in the New Electronic Era
                     Tammy L. Coffee, MSN, RN, ACNP

3:20 pm - 4:00 pm  EMR and the Bottom Line
                     Dhaval Bhavsar, MD

Thursday, March 27

2:00 pm - 2:40 pm  EMR and the Patient Portal
                     Tammy L. Coffee, MSN, RN, ACNP

2:40 pm - 3:20 pm  The EMR of Tomorrow
                     Steven E. Wolf, MD, FACS

3:20 pm - 4:00 pm  EMR Advocacy in your Burn Unit
                     Richard L. Gamelli, MD, FACS
## Multi-Center Trials Group Meeting

*Wednesday, March 26*  
*4:15 pm - 5:45 pm*  
*Independence Ballroom*

### 4:15 pm - 4:20 pm
**Call to Order and Welcome**  
James H. Holmes IV, MD, FACS

### 4:20 pm - 5:05 pm
**Updates and Progress Reports on Current Projects**

- **BORI I (aka - Boxer I)**  
  Tina L. Palmieri, MD, FACS, FCCM

- **BORI II (aka - Boxer II)**  
  Tina L. Palmieri, MD, FACS, FCCM  
  Raul Coimbra, MD, PhD

- **ACT**  
  Reginald L. Richard, PT, MS

- **Transfusion Trigger**  
  Tina L. Palmieri, MD, FACS, FCCM

- **Combat Casualty Care**  
  Steven E. Wolf, MD, FACS  
  1. RESCUE  
  2. Sepsis  
  3. COMBEX  
  4. Glutamine  
  5. ISIS

- **Propranolol**  
  David N. Herndon, MD, FACS  
  Celeste C. Finnerty, PhD

### 5:05 pm - 5:30 pm
**New and Future Projects**

- **Albumin in Burn Resuscitation**  
  David G. Greenhalgh, MD, FACS

- **Vitamin C in Burn Resuscitation**  
  Christopher W. Lentz, MD, FACS, FCCM

- **Electronic Burn Diagram**  
  James C. Jeng, MD, FACS  
  Melissa A. Pressman, PhD

- **RE-ENERGIZE (Glutamine in Burns) Definitive Trial**  
  Sarvesh Logsetty, MD  
  Paul E. Wischmeyer, MD  
  Daren Heyland, MD, MSc

- **International Nutrition Practices in Burns Survey**  
  Daren Heyland, MD, MSc

### 5:30 pm - 5:45 pm
**New Business and Open Floor**  
James H. Holmes IV, MD, FACS

### 5:45 pm
**Adjourn**
### Sunrise Symposia - Thursday

**Thursday, March 27 6:30 am - 7:45 am**

14. **The Difficult Discharge...**  
   Room: Boston Common  
   *Moderators: Elizabeth Dideon Hess, LCSW and Victor C. Joe, MD*

15. **The Non-Compliant Patient**  
   Room: Clarendon  
   *Moderators: Annemarie O'Connor, RN, MSN, APN, FNP and Mary Lou Patton, MD, FACS*

16. **‘Fixed’ Contractures and Non-Operative Techniques**  
   Room: Dalton  
   *Moderators: Karen J. Kowalske, MD and Bernadette Nedelec, PhD, BSc, OT*

17. **Confusion Assessment Method-ICU: Any Use in the Burn Center?**  
   Room: Hampton  
   *Moderators: Gerarda M. Bozinko, RN, BSN, CCRN and Katrina A. Falwell, RN*

18. **Burns in the Obese**  
   Room: Fairfax A  
   *Moderators: Philip E. Fidler, MD, FACS and Michael J. Mosier, MD*

19. **Non-Pharmacological Approaches to Managing Pain**  
   Room: Fairfax B  
   *Moderators: Hunter Hoffman and Laura Rosenberg, PhD*

20. **Vocational Rehabilitation**  
    Room: Gardner  
    *Moderators: Catherine T. Calvert, PhD, CRC and Beth J. Franzen, OT*

21. **Core Competencies for Burn Nurses**  
    Room: Berkeley  
    *Moderators: Shari Honari, RN, BSN and Mary Jaco, RN, MSN, NEA-BC*

22. **Translational Research and the Burn Patient**  
    Room: Public Garden  
    *Moderators: Elsa C. Coates, MS, RN, CCRN and Melissa A. Pressman, PhD*

23. **Surgery for Hand Burns**  
    Room: The Fens  
    *Moderators: Larry M. Jones, MD, FACS and Howard G. Smith, MD*

24. **The Role of the Child Life Specialist in the Burn Center**  
    Room: Jamaica Pond  
    *Moderators: Mikki J. Rothbauer, MSW, LICSW and Jolyn D. Schmerse, CCLS, CTS*

25. **Early Mobilization of the Burn Patient**  
    Room: Riverway  
    *Moderators: Peter C. Esselman, MD, MPT and Ingrid S. Parry, MS, PT*

26. **Burn Prevention for Seniors**  
    Room: Arnold Arboretum  
    *Moderators: Annette F. Matherly, RN, CCRN and Curtis L. Ryun, RN*
Presidential Plenary

Improving the Quality of Care

Thursday, March 27 8:00 am - 9:30 am Grand Ballroom

Course Description: Like many professional medical associations, the American College of Surgeons (ACS) has long advocated for high quality care. For many years, the College focused a major portion of its efforts in this regard on the education of individual practitioners. Recently the College has revamped its Quality programs, incorporating a broader, multi-disciplinary, systems based approach. It is vigorously promoting these programs in hospitals across the country to drive improvement in outcomes for surgical patients. The ABA has always had a multidisciplinary perspective and emphasized the burn team.

As a result of attending this activity, the learner should be able to: Identify the ACS quality initiatives and discuss the applicability of the initiatives to the burn care community.

Speaker: David B. Hoyt, MD, FACS
Executive Director
American College of Surgeons
Correlative VI: Wounds - Clinical

10:00 am - 12:00 pm Back Bay A Ballroom

Moderators: Rodney K. Chan, MD and Michel M.E. Hermans, MD

41. Improving Outcomes in Acute Severe Frostbite: Institution of an Evidence Based Protocol
42. Is Palmar Surface Area a Reliable Tool to Estimate Burn Surface Areas in Obese Patients?
43. A Novel Approach to the Management of Facial Firework Tattooing using Serial Punch Biopsy
44. Epigenetic Modification in Keloid Scars
45. Randomised Controlled Trial of Verapamil for Prevention of Keloid Recurrence after Surgical Removal
46. Fat Grafting with or without Enrichment of Mesenchymal Stem Cells Improves Deep Partial Thickness Burn Wound Healing
47. Management of Pediatric Skin-Graft Donor Sites: A Randomized Controlled Study of Three Wound Care Products
48. What Vancouver Scar Scale Score Constitutes a Hypertrophic Scar? Results from a Survey of American Burn Care Providers

Correlative VII: Acute Care - Infection

10:00 am - 12:00 pm Independence Ballroom

Moderators: Michael J. Schurr, MD, FACS and Joan M. Weber, RN, BSN, CIC

49. Single Institution and National Burn Registry Analysis of Factors Associated with Burn Wound Cellulitis
50. An Increased Incidence of Acute Kidney Injury in Severely Injured Burns Patients Is Associated with Administration of Vancomycin with Piperacillin-Tazobactam
52. Use of PET Imaging for Early Detection of Infection Foci after Burn Injury
53. Burn Injury Alters Intestinal Microbiota and Increases Gut Permeability and Inflammation
54. Successful Outcomes Associated with Implementing the Use of Alcohol Impregnated Port Protectors in a Burn Unit
55. Neutrophil Gelatinase Associated Lipocalin Testing During Nephrotoxic Antimicrobial Therapy in Severely Burned Adult Patient: A Pilot Study
56. The Rate of CRBSI in Burn Patients Treated with 5-Lumen Antibiotic-Impregnated CVCs
Correlative VIII: Public Health - Epidemiology

10:00 am - 12:00 pm  Constitution Ballroom

Moderators: Carlos Jimenez, MD and Stephen M. Milner, MD, FACS, BDS

57. Incidence of National Burn Injury Treated in Emergency Departments
58. Real-Time Prediction for Burn Length of Stay Via Median Residual Life Methodology
59. Socio-Economic Deprivation Indices and Clinical Frailty Scoring in Elderly Burn Patients: Useful Predictors of Survival on Admission?
60. Factors Impacting the Likelihood of Death in Patients with Small TBSA Burns
62. Does Race, Gender, Age or Insurance Status Influence Recovery from Burn Injury?
63. More Than Twice the Risk of Dying: Burn Injured Women Admitted to Intensive Care Units
64. Post-Discharge Cause-Of-Death in Combat Burn Casualties

Correlative IX: Nursing

10:00 am - 12:00 pm  Back Bay C Ballroom

Moderators: Kathleen A. Hollowed, RN, BSN, MSN and Brad Wiggins, RN, BSN

65. Improving HCAHPS in a Challenging Population: Burns and Trauma
66. High Fidelity Human Patient Simulation: Bridging Burn Care Education with Modern Technology
67. Implementation of an Electronic Burn Admission Flowsheet Aids in Nursing Documentation, Initial Fluid Resuscitation, and Quality Improvement
68. Demonstrated Benefits of an Evidence-Based Burn Precepting Program
69. Should a Military Version of the Burn Specific Health Scale Be Developed?
70. Continuous Renal Replacement Therapy Sustainability in a Burn ICU: A Coordinator Perspective
71. Implementation of a Nursing Based Journal Club in a Burn Center, and its Impact on Nursing Practice
72. Staff Initiated Adult and Pediatric Burn Care Competency among Nursing Staff in a Regional Burn Center/Non-Pediatric Hospital
Correlative X: Translational Science

10:00 am - 12:00 pm       Republic Ballroom

*Moderators:* Steven T. Boyce, PhD and Celeste C. Finnerty, PhD

73. TNF-alpha Is Involved in Burn/Smoke Induced Bronchial Epithelial Apoptosis
74. Ex Vivo Generated Regulatory T Cells Have Potent Inhibitory Function with a Two-Week Life Span *In Vivo*
75. Topical Nanoemulsion Therapy Abolishes Burn Wound Progression and Improves Skin Healing in Swine Model of Thermal Burn Injury
76. New Therapeutic Approaches to Treat Heterotopic Ossification in Burn Patients
77. The Immune Response to Burn and Excisional Injuries: What's the Difference?
78. Pulsed Electric Fields for Burn Wound Disinfection in the Murine Model
79. Severe Burn Injury Alters the Morphology of Subcutaneous White Adipose Tissue
80. Connexin 32 Deficient Mice Display a Mitigated Acute Phase Response and Reduced Muscle Wasting following Severe Burn Injury

Firefighter Courses

Firefighter Course II: Challenges for the Firefighter

*Thursday, March 27    10:00 am - 12:00 pm    Fairfax A*

Course Description: Topics will include Search Techniques and Reading Smoke. FireFighter Cancers, Smoke Composition, and Presumptive Cancers United States and Canada.

*Speaker:* Ron “Yogi” Schreiber, FF
Postgraduate Courses

Monday, March 25 – 28, 2014 • Boston, Massachusetts

Local Tour
Thursday, March 27 4:15 pm - 5:30 pm

Available tours will include the adult care unit at Sumner Redstone Burn Center at Massachusetts General Hospital, the pediatric burn unit at Shriners Hospitals for Children, and the burn unit at Brigham and Women’s Hospital. An overview of the direct care and research for the facilities will be given.

The Year in Review: The Top Burn Journal Publications in 2013
Thursday, March 27 4:15 pm - 5:30 pm Constitution A

Moderator: Tina L. Palmieri, MD, FACS, FCCM

Course Description: The editors or key representatives for the Journal of Burn Care & Research, Burns, The Journal of Trauma and Acute Care Surgery, and Wound Repair and Regeneration will discuss the top publications in their journal over the past year.

As a result of attending this live activity, the learner should be able to:
(1) Examine top publications in the Journal of Burn Care & Research, Burns, The Journal of Trauma and Acute Care Surgery, and Wound Repair and Regeneration; 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 & 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 Trauma and Acute Care Surgery
Basil A. Pruitt Jr., MD, FACS

5:05 pm - 5:20 pm
Wound Repair and Regeneration
David G. Greenhalgh, MD, FACS

5:20 pm - 5:30 pm Questions

Postgraduate Courses

Wednesday, March 26 and Thursday, March 27 2:00 pm - 4:00 pm

Postgraduate Course A: Quantitative and Qualitative Outcomes in Burn Care - Evaluation and Endpoints
Constitution Ballroom

Postgraduate Course B: Pediatric Burn Care
Back Bay C Ballroom

Postgraduate Course C: The Impact of the Electronic Medical Record in Burn Care
Back Bay A Ballroom

Changing Places

Thursday, March 27 4:15 pm - 5:30 pm Fairfax A

Moderator: Jason Woods

Speaker: Dan Bates, Prescott Fire Dept. Prescott, AZ

In Memory of Robert Caldwell, Travis Clay Carter, Eric Marsh, Jesse Steed, Travis Turbyfill, Clayton Whitted, Andrew Ashcraft, Dustin Deford, Christopher MacKenzie, Grant McKee, Sean Misner, Scott Norris, Wade Parken, John Percin Jr., Anthony Rose, Joe Thurston, William Warneke, Kevin Woyjeck, and Garret Zuppiger

On Sunday, June 30th, nineteen members of Granite Mountain Hotshot Crew were killed battling the Yarnell Hill fire near Prescott Valley, Arizona. The crew was tasked with digging a fire line and creating an escape route when an approaching storm front caused an abrupt wind shift which drove the fire towards the crew. The crew's lookout saw the blaze change directions and warned his team by radio from his hilltop perch. The new conditions forced him to leave his spot and he was trying to go to another lookout point when the fire overtook the crew. As the conditions changed rapidly, the 19 lied down under their fire shelters but the flames overwhelmed them. All nineteen perished marking the deadliest day for the US fire service since the terrorist attacks on September 11, 2001.
Local Burn Tour

*Thursday, March 27* 4:15 pm - 5:30 pm

Available tours will include the adult care unit at Sumner Redstone Burn Center at Massachusetts General Hospital, the pediatric burn unit at Shriners Hospitals for Children, and the burn unit at Brigham and Women’s Hospital. An overview of the direct care and research for the facilities will be given.

The Year in Review: The Top Burn Journal Publications in 2013

*Thursday, March 27* 4:15 pm - 5:30 pm  
*Independence Ballroom*

**Moderator:** Tina L. Palmieri, MD, FACS, FCCM

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

As a result of attending this live activity, the learner should be able to: (1) Examine top publications in the *Journal of Burn Care & Research*, *Burns*, *The Journal of Trauma and Acute Care Surgery*, and *Wound Repair and Regeneration*; 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 & 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 Trauma and Acute Care Surgery**  
  Basil A. Pruitt Jr., MD, FACS

- **5:05 pm - 5:20 pm**  
  **Wound Repair and Regeneration**  
  David G. Greenhalgh, MD, FACS

- **5:20 pm - 5:30 pm**  
  **Questions**
Three Most Popular Sunrise Symposia

Friday, March 28
6:30 am - 7:45 am

Laser Therapy for Burn Patients

Hampton

Moderators: John K. Bailey, MD, FACS and Charles S. Hultman, MD

Core Competencies for Burn Nurses

Berkeley

Moderators: Shari Honari, RN, BSN and Mary Jaco, RN, MSN, NEA-BC

Surgery for Hand Burns

Gardner

Moderators: Larry M. Jones, MD, FACS and Howard G. Smith, MD

Plenary

Friday Plenary: Top 6 Abstracts

Friday, March 28
8:00 am - 9:30 am
Grand Ballroom

Moderators: Palmer Q. Bessey, MD, FACS, MS and Steven E. Wolf, MD, FACS

81. Increased Burn Rehabilitation Treatment Time Improves Patient Outcome
82. Effect of Transfers between Short-Term Hospitals on Costs and Length of Stays for Pediatric Burn Patients
83. Line of Duty Firefighter Fatalities: An Evolving Trend Over Time
84. Keeping Patients Calm: The Mixed Blessing of Benzodiazepines
85. Clinical Outcomes and Health Care Improvement Diagnosing Ventilator-Associated Pneumonia in Burn Patients: Endotracheal Aspirates Versus Bronchoalveolar Lavage
86. A Protocol for the Treatment of Posttraumatic Stress Disorder (PTSD), Depression, Psychological Impact of Scarring and Community Reintegration following Burn Injury
Correlative XI: Wounds - Basic Science & Clinical

10:00 am - 12:00 pm Back Bay C Ballroom

Moderators: Sharmila D. Dissanaike, MD and David G. Greenhalgh, MD, FACS

87. AQP 3 is Upregulated in Human Burn Wounds
88. Fibrocyte Antagonists Improve Hypertrophic Scar In Vivo
89. Histological and Optical Characteristics of Pigmented Scars in a Swine Model of Human Wound Healing
90. Three-Year Experience with Porcine Xenograft for Treatment of Superficial Partial-Thickness Burns in Pediatric Patients
91. Epigenetic Changes after Burn Injury: A Profile of Human Scar Fibroblasts
92. Debriding Gel Dressing: The Pediatric Experience
93. A Bilaminate Synthetic Skin Substitute for Temporary Wound Closure of Excised Deep Burns
94. Extra-Large Negative Pressure Wound Therapy Dressings for Burns: Technique, Fluid Management, and Outcomes

Correlative XII: Acute Care - Resuscitation

10:00 am - 12:00 pm Back Bay A Ballroom

Moderators: Kevin K. Chung, MD, FCCM, FACP and Tam N. Pham, MD

95. Adjuvant High Dose Ascorbic Acid Reduces Both the Volume of Burn Resuscitation Fluids and the Time to Complete Resuscitation in Burn Shock
96. Admission Cell Free DNA as a Prognostic Factor in Burns: Quantification by Use of a Novel Technique
97. Full-Thickness Burn Size: More Important than Total Burn Size in Determining Fluid Needs during Burn Resuscitation?
98. Beta-Adrenergic Blockade following Burn Has Differential Erythropoietic Responses in the Bone Marrow and Spleen
99. Intra-Abdominal Hypertension in Critical Burn Patients Resuscitated with a Restrictive Fluid Protocol
100. Admission Rapid Thrombelastography® Values Predict Resuscitation Volumes and Patients Outcomes after Thermal Injury
102. An Institutional Review of Moderate to Severe Burn Injury and Therapeutic Plasma Exchange
Correlative XIII: Public Health - Prevention

10:00 am - 12:00 pm  Republic Ballroom
Moderators: B. Daniel Dillard and Jason Woods, FF

103. A Multicenter Study of Pediatric Burns from Glass Fronted Gas Fireplaces
104. Healthcare Costs of Burn Patients from Homes without Fire Sprinklers
105. The “Wattage Wheel”: Innovation in Practice for Burn Prevention
106. Butane Hash Oil Manufacturing Related Burn Injury: A Disturbing Trend
107. Microwave Prepared Food: Assessing the Burn Risk
108. Burn Center Education for Emergency Medical Service (EMS) Providers: An Opportunity to Establish Best Practices
110. The Increasing Trend of Cannabis Use in Burn Patients

Correlative XIV: Psychosocial

10:00 am - 12:00 pm  Independence Ballroom
Moderators: Walter J. Meyer III, MD and Ruth B. Rimmer, PhD, CLCP

111. The Construction and Validation of a Novel Post-Burn Pruritus Scale for Infants and Children Aged Five Years or Less
112. The Psychometric Properties of the 5-D Itch Scale
113. Safety and Efficacy of a Ketamine Protocol for Use during Burn Wound Care
114. Prospective Clinical Evaluation of Delirium Screening in a Burn Intensive Care Unit
115. Long Term Health Outcomes of Older Adults Following a Major Burn Injury
116. Which Burn Outcomes Are Most Important to Patients?
117. The Story of Northstar
118. A Profile of Burn Camp Volunteers and an Assessment of Participant’s Emotional Intelligence and Self-Compassion
Correlative XV: Reconstruction

10:00 am - 12:00 pm  Constitution Ballroom

Moderators: Dhaval Bhavsar, MD and Robert J. Spence, MD, FACS

119. Prospective Evaluation of Fractional CO2 Laser Treatment of Mature Burn Scars
120. Long Term Effectiveness of the 3/4 Z-plasty in Burn Scar Release
121. Mucosal Y-to-V Plasty for Burn Microstomia Reconstruction in Burn Children Revisited
122. Airway Management for Surgical Repair of Microstomia in Pediatric Patients
123. Novel Treatment for Burn/Trauma Induced Heterotopic Ossification Using Bmp Receptor Type 1a Small Molecule Inhibitors
124. Successful Grafting of a Novel Autologous Tissue-Engineered Skin Substitutes (Dermis and Epidermis) on Twelve Burn Patients
125. Removal of Sentinel Lymph Nodes Impedes Lymphatic Drainage and Skin Allograft Recognition
126. Management of Severe Axillary Contractures in Children Using the Parascapular Flap

Best in Category Poster Presentations

10:00 am - 12:00 pm  Hall D | Hynes Convention Center

Moderator: Kathleen A. Hollowed, RN, BSN, MSN

The professors will award one poster for each category as “Best in Category”. These 11 Best in Category posters will be judged by Steven E. Wolf, MD, FACS, Program Committee Chair, Robert C. Cartotto, MD, FRCSC, Research Committee Chair, and Kathleen A. Hollowed, RN, BSN, MSN, Membership Advisory Committee Chair on Friday, March 28 at 10:00 am - 12:00 pm. If your poster is awarded Best in Category, you are expected to participate in this session where you will present a two to three minute overview of your poster. 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.
Luncheon Symposia - Friday

Friday, March 28  12:15 pm - 1:45 pm

27. Certification of Burn Disciplines: An Idea Whose Time Has Come?
Room: Hampton
Moderators: Richard A. Gamelli, MD, FACS and Michael A. Serghiou, OTR, MBA

28. Product Development: Navigating the Regulatory Waters of the FDA
Room: Boston Common
Moderators: Adam J. Singer, MD and Suzanne B. Schwartz, MD, MBA

29. Implementing Change in the Burn Unit
Room: Clarendon
Moderators: David H. Abrenholz, MD, FACS and Katherine A. Lee, RN, MSN

30. NLC and Government Action
Room: Commonwealth
Moderators: Robert M. Dembicki, RN, MS and Michael D. Peck, MD, ScD, FACS

31. International Outreach and the American Burn Association
Room: Dalton
Moderators: Nathan A. Kemalyan, MD, FACS and Giavonni M. Lewis, MD

32. Leveraging the ABA Website
Room: Fairfax
Moderators: Amalia Cochran, MD, FACS, FCCM and Jeanie M. Leggett, RN, BSN, MA

33. Growing a Burn Center
Room: Riverway
Moderators: Daniel D. Lozano, MD, FACS and Rajiv Sood, MD

34. Burn Out and Strategies for Mitigation
Room: Berkeley
Moderators: Elizabeth A. Mann-Salinas, RN, PhD and Shelley A. Wiechman, PhD, ABPP

35. Disaster Planning/Mass Casualty
Room: Public Garden
Moderators: Randy D. Kearns, DHA, MSA, CEM and Andrea L. Valenta, RN, MSN

36. Burn Center Verification
Room: Gardner
Moderators: Nicole S. Gibran, MD, FACS and Sue L. Vanek, MBA, RN
Ethics Case Presentation: Developing an ABA Code of Ethics

Course Director: James M. Cross, MD, FACS

Friday, March 28 12:15 pm - 1:45 pm Liberty Ballroom

There is no accepted code of ethics for all of the members of the American Burn Association. One of the tasks of the Ethical Issues Committee is to develop a Code of Ethics for the ABA. This presentation will describe a brief history of medical ethics, current ethical codes of other medical disciplines, and how we are developing a code of ethics for the ABA.

As a result of attending this activity, the learner should be able to: Understand the historical perspective of medical ethics and how it applies to the modern burn professional.

12:15 pm - 12:35 pm A Brief History of Medical Ethics
James M. Cross, MD, FACS

12:35 pm - 12:40 pm Overview of Medical Ethics of Other Organizations
James M. Cross, MD, FACS

12:40 pm - 12:55 pm Outline of Ethical Code: Burn Professional-Patient Interaction
Todd M. Huzar, MD

12:55 pm - 1:10 pm Outline of Ethical Code: Burn Professional-Burn Professional Interaction
James M. Cross, MD, FACS

1:10 pm - 1:25 pm Outline of Ethical Code: Burn Professional-Industry Interaction
Sharmila D. Dissanaike, MD

1:25 pm - 1:45 pm Overview/Questions with Panel
Integrating the Family as Burn Care Team Members: Tapping into Home Team Talent

Friday, March 28
2:00 pm - 4:00 pm
Back Bay A Ballroom

Course Directors: Karen L. Badger, PhD, MSW and Jill L. Sproul, RN, MS

When a loved one is injured, family members provide crucial support throughout the continuum of care. At the onset of injury, family members assume new roles as burn team members and provide support to the burn survivor—while they manage their own healing and adjustment process. This session provides a conceptual framework, family member testimonials, and recommendations to assist healthcare providers to understand the experience of family members of burn survivors, their support needs, and mechanisms to assist them to be contributing members of the burn team.

As a result of attending this activity the learner should be able to: (1) Recognize the stages of recovery and psychosocial stressors or challenges family members of burn survivors may experience during the healing process post burn; (2) Describe strategies through which burn team members can work together to respond to the aftercare needs of family members of burn survivors to optimize psychosocial quality of life and post-burn adjustment; and (3) Identify specific resources that are available to assist family members with support and healing during the aftercare phase of a burn injury.

2:00 pm - 2:10 pm
Introduction: The Interprofessional Team - Professionals, the Burn Survivor, and the Family
Jill L. Sproul, RN, MS

2:10 pm - 2:20 pm
Stages in Recovery: Understanding the Family’s Experience
Kelly Mcelligott, AM, LCSW

2:20 pm - 2:35 pm
Family Member Testimonial: Recovery Stages
Carly Bowers

2:35 pm - 2:55 pm
Potential Impact of a Burn Injury on Family across the Care Continuum
Karen L. Badger, PhD, MSW

2:55 pm - 3:10 pm
Family Member Testimonial: Impact of a Burn Injury
Kristi Fowler, MA

3:10 pm - 3:25 pm
Providing Support while Setting Professional Boundaries
Sandra J. Yovino, RN

3:25 pm - 3:40 pm
An Overview of Support Resources
Amy C. Clark, BS
Pamela Peterson, RN, BSN

3:40 pm - 3:50 pm
Family Member Testimonials: Support Resources and Healing
Barb Vinacco, RN

3:50 pm - 4:00 pm
Questions and Evaluation
Karen L. Badger, PhD, MSW
Jill L. Sproul, RN, MS
Clinical Practice Guidelines: Can They Be Used to Improve Burn Care?

Friday, March 28 2:00 pm - 4:00 pm Back Bay C Ballroom

Course Director: Kevin K. Chung, MD, FCCM, FACP and Michael J. Mosier, MD

Evidence based standardization of care through the development and broad adoption of Clinical Practice Guidelines (CPGs) has been thought to be instrumental in improving the level of care across various populations to include trauma, the military and critical care in general. Burn care around the world is largely characterized by regional and even intra-institutional practice variations that are a result of numerous factors which may hinder progress in our field.

As a result of attending this activity, the learner should be able to: Apply the proven methods to generate various CPG’s for the advancement of burn care in civilian and military cases.

2:00 pm - 2:05 pm Introduction, Course Objectives, and Format
Kevin K. Chung, MD, FCCM, FACP

2:05 pm - 2:25 pm Surviving Sepsis Campaign Guidelines: A Model Example
Mitchell M. Levy, MD

2:25 pm - 2:45 pm Military Trauma Experience with CPGs Utilized during Combat Operations
Col. Jeffrey Bailey, MD

2:45 pm - 3:05 pm Civilian Trauma Experiences with CPGs
Elliott R. Haut, MD, FACS

3:05 pm - 3:25 pm CPGs in Burn Care
Leopoldo C. Cancio, MD, FACS

3:25 pm - 3:45 pm Not So Fast! There is an Art to Burn Care
James C. Jeng, MD, FACS

3:45 pm - 4:00 pm Q & A with Panel
Pro/Con Debate: Controversies in Modern Burn Care

Friday, March 28  
2:00 pm - 4:00 pm  
Constitution Ballroom

Course Director: Christopher W. Lentz, MD, FACS, FCCM and Dixie Reid, PA-C

There are frequently choices of modern burn care that are accepted therapies and modalities that have not been verified by prospective randomized studies. These choices have become accepted standards in American burn care each with supporting research and case reports. This course will highlight four controversial areas of care dealing with critical care, burn wound care, reconstruction and rehabilitation. Experts will defend their stance on a particular care plan or strategy. Audience polling will be used to identify their biases before the debate and then repolled to see if the data presented affected changes in practice.

As a result of attending this activity, the learner should be able to: (1) Outline four controversies in Modern Burn Care that have become accepted standards without the support of multicenter prospective randomized studies; (2) Compare scientific support and experience from experts in critical care, wound care, reconstruction and rehabilitation; and (3) Analyze the rationale to either support their particular practice bias or change their bias based on current evidence available.

2:00 pm - 2:30 pm  
Blister Should Be Removed from Second Degree Burns
Pro: Amalia Cochran, MD, FACS, FCCM
Con: Philip E. Fidler, MD, FACS

2:30 pm - 3:00 pm  
Silicone Gel Sheeting is Useful for Burn Scar Management
Pro: Robert J. Spence, MD, FACS
Con: Edward E. Tredget, MD, MSc, FRCS(C)

3:00 pm - 3:30 pm  
Albumin is Required for Burn Resuscitation
Pro: Robert C. Cartotto, MD, FRCS(C)
Con: Tina L. Palmieri, MD, FACS, FCCM

3:30 pm - 4:00 pm  
High Dose Vitamin C Should Be Used for Burn Resuscitation
Pro: Christopher W. Lentz, MD, FACS, FCCM
Con: Richard L. Gamelli, MD, FACS

Business Meeting

Friday, March 28  
4:15 pm - 5:15 pm  
Independence Ballroom

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 president.
President Palmer Q. Bessey, MD, FACS, MS
cordially invites the attendees of the
2014 Annual Meeting
to an evening celebrating the

46th Anniversary of the
American Burn Association
Annual Banquet

Friday, March 28, 2014

Cocktail Reception
7:00 pm

Dinner
8:00 pm

Grand Ballroom
Sheraton Boston Hotel
Poster Sessions

Hall D | Hynes Convention Center
Abstracts 127 - 297

Poster Set-Up (for Wednesday Rounds) Tuesday, March 25 12:00 pm - 2:00 pm
Poster Set-Up (for Thursday Rounds) Wednesday, March 26 3:00 pm - 5:00 pm
Poster Viewing Tuesday, March 25 3:00 pm - 7:00 pm
Wednesday, March 26 6:30 am - 6:30 pm
Thursday, March 27 6:30 am - 1:45 pm

Rounds with Professors and Authors

Wednesday, March 26 12:30 pm - 1:30 pm
Psychosocial, Nursing, Acute Care - Basic Science (I),
Acute Care - Clinical (I), Nutrition/Metabolism (I),
Public Health, Quality Improvement, Wounds (I),
Reconstruction, Acute Care - Clinical (II)

Thursday, March 27 12:30 pm - 1:30 pm
Acute Care - Basic Science (II), Acute Care - Clinical (III),
Nutrition/Metabolism (II), Psychosocial (II), Quality
Improvement (II), Wounds (II), Rehabilitation,
Public Health/Prevention, Acute Care - Basic Science (II)

Wine & Cheese Reception with Authors

Wednesday, March 26 5:00 pm - 6:30 pm

Poster Dismantle (after Wednesday Rounds)

Wednesday, March 26 2:00 pm - 3:00 pm

Poster Dismantle (after Thursday Rounds)

Thursday, March 27 2:00 pm - 3:00 pm

Topic: Psychosocial

Moderators: Tina L. Palmieri, MD, FACS, FCCM and Linda H. Yoder, RN, PhD, MBA

127. Failure to Thrive in Burns Suspicious for Child Abuse
128. Causes and Effects of Acute Mental Illnesses in the Burn Patient: A Population-Based Outcome Study of 979 Burn Patients from the Nationwide Inpatient Sample (NIS) Database Over a Ten Year Period (2001-2010)
129. Partnering with a Community Non-Profit to Enhance Adult-Centered After-Care Support
130. Benefits of Burn Center Visitors from the Patient’s Perspective
131. Addressing Posttraumatic Stress Symptomatology in a Pediatric Hospital Setting
132. “How Does It Make You Feel?”: The Addition of a Social Worker to Burn Camp
133. The Effects of Stress and Coping on Psychosocial Functioning in Pediatric Burn Survivors
134. Burn Survivors Find Inspiration Supporting Other Survivors
135. A Survey of Parental Satisfaction with the Outcome of Their Child’s Burn Care
**Topic: Nursing**

*Moderators: Paula C. Fillari, RN, BSN, CCRN and Lavelle Grub, RN*

136. Application of the Double Emergency Procedure (DEP) on the Severely Burned Patients
137. Use of an Adult Resuscitation Protocol in a Burn Center
138. Comparison of Pediatric Burn Wounds >20% TBSA Colonization and Contamination of the Environment
139. Delayed Admissions to Specialized Burn Units: Practice Makes Perfect
140. Evaluation of a New Fast Track Process of Care for Patients with Minor Burn Injuries
141. Gaining Acceptance in the Plain Community for High Tech Burn Care
142. Optimal Transferring Method for Burn Patients with Posterior Trunk Skin Grafting
143. Eradication of Multi-Drug Resistant Acinetobacter baumannii in a Burn Unit
144. Outreach Burn Education to Providers in the Post-Acute Setting
145. Incorporating an Adult Extra Corporal Life Support Program in the Burn Intensive Care Unit
146. The Role of a Research Coordinator (RC): A Guide for Novice Coordinators

**Topic: Acute Care - Basic Science (I)**

*Moderators: Robert C. Cartotto, MD, FRCS(C) and Stewart C. Wang, MD, PhD*

147. Recombinant Human CC10 for Treatment of Smoke Inhalation Lung Injury
148. Activation of Death Receptor Signaling Pathway Contributes to Apoptosis in Diaphragm after Severe Burn Injury in Rats
149. Nebulized Epinephrine Attenuates Pulmonary Dysfunction after Burn and Smoke Inhalation Injury.
150. Efficacy of Budesonide Nebulization in the Acute Airway Pathology following Inhalation Injury
151. Pharmacokinetic Study of Parecoxib in Burn Rats
152. Intestinal I/R Induced Acute Lung Injury Is Mediated by TLR4
153. Comparison of Various Resuscitation Fluids for the Treatment of Burn Injury-Induced SIRS/ARDS in a Rat Model
**Topic: Acute Care - Clinical (I)**

*Moderators: Brett D. Arnoldo, MD and Marc G. Jeschke, MD, PhD*

155. Peripherally Inserted Central Venous Catheters in the Burn Unit: Are They As Safe As We Think?
156. Haemophagocytic Lymphohistiocytosis in Burn Patients
157. Eliminating Waterborne Pathogens in a Burn Unit
158. Chlorhexidine Gluconate (CHG) Impregnated Central Line Patch Associated Skin Necrosis in Complicated Skin Disorder Patients
159. Pathogenic Bacteria on Common Access and Identification Cards: A Search for Badge Bugs
160. The Effect of Evidence-Based Bundles on Hospital Acquired Catheter Associated Urinary Tract Infections
161. A Systematic Review of Vancomycin Dosing and Monitoring in Burn Patients
162. Colonizing Bacteria Impact Local Host Response to Inflammation and Wound Healing for Burn Wounds: A Preliminary Burn Wound Microbiome Analysis

**Topic: Nutrition/Metabolism (I)**

*Moderators: Caran Graves, RD, MS and Beth A. Shields, RD, LD, CNSC*

163. Frequency of Liver Function Tests Abnormalities in Pediatric Patient with Large Burns Given Oxandrolone
164. During the Ebb Phase, Disuse Potentiates Burn Induced Catabolism in Rats
165. The Clinical Safety of Probiotic Administration Following Burn Injury
166. Nutritional Status and Oxidative-Antioxidative Balance in Severe Burns
167. Evaluation of Practice Guideline for the Treatment of Diabetic Patients with Foot Burns
168. Dual Enteral and Intravenous Zinc Supplementation in Severe Burns
169. Bone Mineral Density and Risk Factors for Bone Depletion in Burned Children
170. Nursing Placed Feeding Tubes in Burn Patients Using an Electromagnetic Tracking System: Does It Improve Delivery of Nutrition?
Topic: Public Health

Moderators: Hamed Amani, MD, FACS and Anjay K. Khandelwal, MD, FICS

171. Breaking the Myth About Early Blood Transfusions in a Burn Mass Casualty Incident
172. Piloting an International Burn Registry: Implications for Clinical Practice
173. The Perfect Storm: Invasive Mold Outbreak at a Regional Burn Center Following Hurricane Sandy
174. Evaluation of a New Return to Work after Burn Injury Website
175. A Multidisciplinary Approach to the Treatment of Severe Cold Exposure Injuries: An Angiographic Case-Series Supporting the Use of Catheter-Directed Thrombolysis to Prevent Morbidity in Severe Frostbite
176. Use of an Existing Web Based Platform to Support International Remote Clinical Mentorship
177. Evaluation of Baseline Knowledge in Reference to Scald Burns in the Lviv Provence, Ukraine (Primary Result)
178. Phase I in Development of the Midwest Region Burn Disaster Plan
179. Tweens Feel the Burn: Salt and Ice Challenge Burns

Topic: Quality Improvement (I)

Moderators: Agnes M. Burris, RN and Lawrence J. Gottlieb, MD, FACS

180. Organ Donation from Burn-Injured Patients: A National Perspective
181. Insurance Status and Follow-Up after Burn Injury: Barriers to Access
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**Moderators: Soman Sen, MD and Steven J. Thomas, MD**

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**Moderators: William L. Hickerson, MD, FACS and Louis H. Riina, MD**

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March 25 – 28, 2014 • Boston, Massachusetts

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**Moderators:** Kathe M. Conlon, BSN, RN, MSHS and Jill L. Sproul, RN, MS

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**Moderators:** Deborah L. Carlson, PhD and David T. Harrington, MD, FACS

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Abstracts

1. **Deficient Recruitment of Progenitor Cells into the Skin of Old Mice Contributes to Delayed Cutaneous Healing Post Thermal Injury**
   
   **S. Amini-Nik, MD, PhD, A. Abdullahi, MSc, L. Yu, BSc, M. G. Jeschke, MD, PhD**
   Sunnybrook Research Institute, Sunnybrook Health Sciences Centre, Toronto, ON, Canada; University of Toronto and Sunnybrook Health Sciences Centre and SRI, Toronto, ON, Canada

   **Introduction:** As people age, they become more vulnerable and this impacts their socio-economic circumstances and consequently their health. Elderly experience numerous physical and cognitive changes and that make them more exposed to fire and burn injury. This is more important nowadays as advances in health care and economic prosperity are contributing to a longer life span. Once burned, deficient healing, in particular skin healing, contributes to high morbidity and mortality in elderly patients. Therefore, examining the relationship between ageing and wound healing is critical. We postulate that the lack of progenitor cells play a role in deficient healing of elderly patients and hypothesized that Wnt/β-catenin signalling is involved in post-burning skin healing.

   **Methods:** Having access to a large number of burned elderly specimens together with using animal model of burning, we compared skin healing characteristics of old patients (as well as old mice) with the young ones. Young (8 weeks old) and old mice (>52 weeks old) were subjected to 30% full thickness burn and their skin healing were monitored up to two weeks post burning.

   **Results:** We observed a delayed healing in aged mice (and human) together with higher mortality. Lack of granulation tissue, deficient collagen deposition and altered keratinization were observed in aged mice in compare with young mice. We then explored the underlying mechanism of this deficient healing post burning. Flow cytometry analysis showed lack of mesenchymal stem cells (MSCs) in the wound bed of elderly patient (as well as old mice) when compared with their young counterpart. While in old mice, the border of healing bed were enriched for Sca1+ cells in compare with the young mice, we observed a significant dilution in the number of this progenitor cells toward the center of healing bed. This pattern was not observed in the number of Ki67+ cells at two weeks post-burning, implying that young mice passed their pick of proliferation phase while aged mice are still proliferating.

   **Conclusions:** Lack of mesenchymal stem cells (MSCs) in the wound bed of old mice led to a delayed healing. This was also observed in elderly patients in compare with young ones. Altered recruitment of MSCs into the granulation tissue is the essential mechanism behind the lack of progenitor cells in the wound bed of burned mice and this hindered healing. Wnt/β-catenin signalling is regulating this recruitment and thus local modulation of Wnt/β-catenin signalling might be a critical step in the management of elderly burned patients.

   **Applicability of Research to Practice:** The results may shed light on why elderly have poor wound healing leading to an increased morbidity and mortality.

   **External Funding:** CIHR 123336. CFI 25407. NIH GM087285-01. PSI.


2. **Isometric Force Measurement in a Murine Model of Muscle Injury**
   
   **M. Saeman, MD, J. De Libero, MD, K. Despain, BS, J. Song, MD, S. E. Wolf, MD, FACS**
   University of Texas Southwestern Medical Center, Dallas, TX

   **Introduction:** Severely burned patients suffer from significant muscle loss. Many animal models exist to evaluate muscle tissue growth and regeneration which will be relevant to addressing this concern. Here we examined a murine model with muscle laceration as a model of muscle loss, and evaluated muscle recovery in vivo using isometric contractile analysis.

   **Methods:** Adult C57BL/6 male mice received muscle laceration under general anaesthesia. One group (n=9) received a large muscle injury of the gastrocnemius muscle by excising 60% of the muscle length, 75% of the muscle width, and 100% thickness; another group received a smaller injury of the gastrocnemius muscle upon 25% of the muscle length and 75% width. Isometric contractile properties of the gastrocnemius muscles were then analyzed (ASI Dynamic Muscle Control v5.300) at 42 or 60 days after injury. Under anesthesia, the gastrocnemius muscle was gently dissected free of surrounding musculature, skin, and fascia taking care to maintain the neurovascular pedicle as well as the proximal and distal attachments. The Achilles tendon was sutured and attached to the lever arm of a dual mode servo muscle lever system (Aurora Scientific, inc mod 305c). The femur was secured to the platform. Electrodes were implanted into the sciatic nerve and the twitch, tetanic and fatigue isometric functions of the muscle were analyzed after optimal length (Lo) of the muscle was achieved.

   **Results:** Statistical analysis demonstrated a significantly lower twitch force in the large and small injuries compared to control and sham (P<0.05) at 60 days after injury. Paired comparison of 42 and 60-day large injury to contralateral control showed a significantly lower tetanic force (p=0.031 and 0.001 respectively). Fatigue analysis demonstrated a lower force in the 60 day large and small injury compared to control (P<0.05). There was no statistical difference between the sham and control group of any of the measures. Interestingly, there was no statistical difference between the large and small injury for the twitch, tetanic or fatigue measures.

   **Conclusions:** In summary, we observed similar function impairment following both larger and smaller size of muscle injury. We speculate this is due to the same width of laceration in both injury models and the difference in length between 60 and 25% does not impact the loss of fiber function.

   **Applicability of Research to Practice:** This model can be applied to evaluate generalised loss of muscle function such as in severe burns.

   **External Funding:** NIH T32 Research Fellow Training Grant; Department of Defense W81XWH-12-2-0074-01.
Introduction: Growing evidence indicates that bone marrow derived mesenchymal stem cells (BM-MSCs) paracrine signaling is the predominant mechanism responsible for enhanced wound repair. Because variety of oxygen concentration can affect the innate characteristics like stemness and migration of BM-MSCs, especially the paracrine of cytokines and growth factors that may provide therapeutic benefits of cutaneous wounds healing, so it is interesting to compare and elucidate the effects of normoxic and hypoxic culture condition on BM-MSCs paracrine signaling contributed cutaneous wound repair in murine.

Methods: qRT-PCR analyses of BM-MSCs and ELISA test of the conditioned medium of BM-MSCs harvested under normoxia (norCM) and hypoxia (hypoCM) were used to evaluated the level of cytokines and active proteins involved in wound healing (VEGF, bFGF, MIP-1, MCP-5, EGF, and KGF). norCM and hypoCM conditioned keratinocytes, fibroblasts, endothelial cells and macrophages were cultured and tested for migration, FPCL and endothelial cell network formation assay. In the animal studies, conditioned medium was injected into the full-thickness cutaneous wounds created on the dorsum of BALB/C mice. Wound contraction was quantified on selected time points. Tissue was harvested for pathology analysis to determine if hypoCM can enhance wound healing of murine. ANOVA was used to determine statistical significance and P<0.05 was considered significant.

Results: Growth factors known to be important in normal wound healing were up-regulated in hypoCM (P<0.05). Compared to norCM, hypoCM not only enhanced the migration of keratinocytes, fibroblasts, endothelial cells and macrophages, but also increased the fibroblast contractile force. Additionally, hypoCM significantly enhanced endothelial cells tube formation on Matrigel compared with norCM conditioned cells (P<0.05). Echoing what we found in vitro, wound contraction of BALB/C mice treated with hypoCM was significantly accelerated. HypoCM increased the level of epithelialization, cell proliferation, neovascularization and inflammatory macrophages recruitment of mice wounds (P<0.05).

Conclusions: These findings suggest that BM-MSCs may benefit cutaneous wound healing via a paracrine mechanism enhanced by hypoxia.

Applicability of Research to Practice: Results may benefit wound healing.

External Funding: Program of National Key Clinical Specialties.
5. A Novel Immune Competent Murine Hypertrophic Scar Contracture Model: A Tool to Elucidate Disease Mechanism and Develop New Therapies

M. M. Ibrahim, MD, J. Bond, PhD, A. Bergeron, BA, K. J. Miller, BA, T. Ehanire, BA, C. Quiles, MD, E. R. Lorden, BS, M. A. Medina, MD, K. Leong, PhD, H. Levinson, MD

Division of Plastic and Reconstructive Surgery, Department of Surgery, Duke University School of Medicine, Durham, NC; Department of Biomedical Engineering, Duke University, Durham, NC

Introduction: Hypertrophic scar contraction (HSc) after burn injury leads to contractures. They are painful and disfiguring. Current therapies are not effective. To study pathogenesis and develop new therapies, a murine HSc model is needed. We have created a validated immune competent murine HSc model. We unexpectedly found that murine scar brittle characteristics as compared to uninjured skin.

Methods: A third-degree burn was created on the back of C57BL/6 mice. Three days post-burn, the tissue was excised, wounds were grafted with ear skin. Graft contraction was analyzed and tissue harvested on post-operative days 3 through 168. HSc outcomes were compared to human HSc to validate the model. To confirm graft survival, green fluorescent protein mice (GFP) were used. The role of the panniculus carnosus (PC) in scar contraction was analyzed by tagging the PC with titanium clips and X-raying mice. The clip area was measured by ImageJ. Cellularity was assessed with DAPI. Collagen maturation was assessed with sirius red. Mast cells were stained with Toluidine blue. Macrophages were detected with F4/80 immune. Vascularity was assessed with CD31 immune. RNA for contractile proteins was detected by qRT-PCR. Elastic moduli of human and mouse skin and scar tissue were analyzed using a microstrain analyzer.

Results: Skin grafts contracted to 45% of their original size by day 14. Grafting of GFP mouse skin onto wild type mice and analysis of dermal thickness and hair follicle density in skin grafts, confirmed graft survival. Interestingly, hair follicles disappeared and regenerated in ear skin configuration by day 30. Radiological analysis revealed the PC does not contribute to contraction. Microscopic analyses demonstrated that skin grafts show increase in cellularity. Granulation tissue formed after day 3. Collagen analysis revealed increases in collagen maturation, with more immature collagen fibers on day 7 and more mature collagen present on day 168. CD31 stain revealed an increase in vascularity compared to normal skin. Macrophages and mast cells were increased compared to normal skin. qRT-PCR demonstrated upregulation of TGF-β, ASMA, NMMII, and ROCK2 in HSc. Tensile testing revealed that under low extension rate, human skin and scar tissues are tougher than mouse skin and scar tissues. Both scar tissues displayed increased brittle characteristics as compared to uninjured skin.

Conclusions: We have created a validated immune-competent murine HSc model. We unexpectedly found that murine scar contraction occurs independent of the PC. We observed that murine skin graft hair follicles go through a period of dissolution followed by regeneration, indicating our model may also serve to study hair growth.

Applicability of Research to Practice: This model will facilitate the study of HSc pathogenesis and accelerate new discoveries to prevent HSc.

6. The Effects of Topical Nitric Oxide on Reepithelialization of Partial Thickness Porcine Burns

A. J. Singer, MD, Y. Choi, MD

Stony Brook University, Stony Brook, NY

Introduction: Burns are common injuries that often lead to significant disfigurement and dysfunction. Unlike mechanical wounds, burns tend to progress over time possibly due to inflammation. Nitric oxide is a substance released in the body in response to injuries such as burns that may play a significant role in inflammation and healing. We hypothesized that topical application of nitric oxide would speed wound reepithelialization compared with its vehicle in a porcine model of partial thickness burns.

Methods: We performed a randomized controlled animal experiment in four female domestic pigs. Standardized deep partial thickness burns were created on the flanks of anesthetized animals using an aluminum bar preheated to 80 degrees Celsius and applied with gravity alone for 20 seconds. After gently removing the necrotic epidermis, the burns were randomized to a topical formulation of nitric oxide or its vehicle that was applied 3 times weekly for the first two weeks then twice weekly for the next two weeks. Full thickness biopsies were obtained at 2, 8, 11, 14, and 28 days after injury to determine burn depth, percentage wound reepithelialization and scar depth using standard H&E staining. Evaluations were performed by a board certified dermatopathologist blinded to treatment assignment. A sample of 20 burns in each group had 80% power to detect a 25% difference in percent reepithelialization.

Results: A total of 20 wounds each were treated with a topical nitric oxide formulation or its vehicle in a porcine model of partial thickness burns. Treatment of burns with the topical nitric oxide resulted in higher percentages of wound reepithelialization at days 8 (14.2 vs. 8.8, difference 5.4 [95% CI, 4.1 to 6.8]) and 14 (70.5 vs. 63.1, difference 7.4 [95% CI, -12 to 32.0]) respectively. Burn depth at day 2 and scar depth at day 28 were similar between burns treated with topical nitric oxide and its vehicle. There were no infections in any burns.

Conclusions: Treatment of deep partial thickness burns with a topical formulation of nitric oxide speeds wound reepithelialization compared with its vehicle in a porcine burn model.

Applicability of Research to Practice: Further development of the topical nitric oxide formulation may lead to improved healing in future clinical trials.

External Funding: Novan, Inc., / NIH #1R43GM103011-01A1 / Title: Use of a nitric oxide-loaded gel to improve healing outcomes of burn injuries.
7. **Effect of Wound Dressings on Primary Keratinocyte Growth from Biopsy Derived in vitro Cultured Skin**

R. Esteban, PhD, J. Gerlach, MD, J. Ziembicki, MD, A. Corcos, MD
McGowan Institute of Regenerative Medicine, Pittsburgh, PA; UPMC Mercy, Pittsburgh, PA

**Introduction:** Isolated skin cell spray-transplantation is under evaluation for partial-thickness burn treatment. Wound dressings, that will cover the sprayed cell grafts, may have a negative effect on keratinocyte growth. We aimed to test different commercially available wound dressings to identify the possible toxic effect on in vitro keratinocyte growth.

**Methods:** The skin cells from biopsies of healthy skin were singularized using enzymatic tissue digestion with dispase and trypsin for basal keratinocyte isolation. The cells were then placed on a 60mm petri-dish coated with collagen Type I for further expansion. Dressings (Adaptic, Xeroform, Mepilex and Polyskin) with and without Bacitracin were then placed on the final passage of cells. Two ml of Epilife supplemented with EDGS was poured over the dressings to culture the cells. To study the cell adherence and morphology, microscopic pictures were then taken at 24h, 48h, 3 days, and 7 days. Using Real-Time Polymerase Chain Reaction, various differentiation stage markers were also analyzed to study the genetic effects of the dressings on keratinocytes.

**Results:** Bacitracin did not appear to affect the cell shape, growth, or genetics. Cell growth was inhibited by both Adaptic and Xeroform. Changes in cell shape were detected on cells cultured with both Adaptic and Mepilex, which also showed a higher expression of differentiation markers CK13 and LOR when compared to control. Expression of the stem cell marker CK15 was increased with Adaptic and Xeroform as well. Mepilex showed variable results on cell growth. Polyskin demonstrated good cell growth without significant changes in gene marker expression.

**Conclusions:** Increased expression of stem cell markers and inhibited cell growth shown with the use of both Adaptic and Xeroform may be the result of the selection of stem cells that do not divide as rapidly as transit amplified cells. Soluble factors released by both Adaptic and Xeroform may impair dividing cells. Polyskin appeared to have no negative effects on cell growth or gene expression.

**Applicability of Research to Practice:** Evaluation of the different dressings used in topical burn therapies may direct the physician in their usage not only for autologous skin cell transplantation but for the treatment of all burn wounds.

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8. **Upregulation of TLR-9 Expression by Wound γδ T-cells after Burn**

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**Introduction:** Burn induces an immunopathological response involving multiple immune cell types. Potent immune activation of these cells can be mediated via toll-like receptors (TLRs), which represent a key link between tissue injury, inflammation, and infection. While T-cells constitute a predominant immune cell population during tissue remodeling in human skin wounds, the role of T-cells, TLRs and their activation at the wound site after burn is not clearly understood.

**Methods:** Male C57BL/6 mice were subjected to a major burn (3rd degree, 25% TBSA) or sham procedure. At 1, 3, and 7 days thereafter, skin samples were collected and single cells were prepared by enzymatic digestion. T-cell populations were analyzed for phenotypic markers (CD3, αβ TCR, γδ TCR) and their activation status (TLR-2, -4, -9, CD69) by flow cytometry.

**Results:** A 3-fold increase in the T-cell population was observed at the wound site, as compared with skin from sham mice. These wound infiltrating T-cells were predominantly αβ T-cells (95%); whereas T-cells in sham skin were predominantly γδ T-cells (76%). TLR-2 and -4 and -9 were expressed by γδ T-cells, whereas only TLR-9 was expressed by αβ T-cells. TLR-9 expression was profoundly increased (up to 20-fold) in wound γδ T-cells, as compared with cells from sham skin. In marked contrast, TLR-9 expression in wound αβ T-cells was unchanged or even suppressed. The expression of TLR-2 and -4 by wound γδ T-cells was also significantly upregulated, but to a lesser degree than TLR-9 (~20-90%). Burn increased the expression of the activation marker CD69 by wound γδ T-cells, which was not evident in wound αβ T-cells.

**Conclusions:** Burn wound γδ T-cells strongly upregulated the expression of TLR-9, which likely plays an important role in their ability to respond to tissue injury and subsequently regulate the immunoinflammatory response.

**Applicability of Research to Practice:** These findings suggest that burn wound γδ T-cells may represent a novel target for therapeutic intervention to improve burn wound healing.

**External Funding:** NIH grant GM79122.
9. Early Extubation of Burn Patients: An Achievable Performance Improvement Goal?

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Introduction: Ventilator Associated Pneumonia (VAP) is a nosocomial pneumonia that develops in patients receiving mechanical ventilation. VAP develops at an estimated rate of 1% to 3% per day of mechanical ventilation for the first 5 days. Pneumonia in burn patients requiring mechanical ventilation has been shown to increase mortality by 40-60%. Early extubation of patients from mechanical ventilation has been shown to decrease VAP. The purpose of this study was to examine if early extubation (within 96 hours of intubation) of pediatric burn patients is an achievable performance improvement (PI) goal.

Methods: All pediatric patients who required mechanical ventilation in 2012 were prospectively reviewed as part of a Performance Improvement project. Patients were randomized into two groups; inhalation injury (n=28) vs. non inhalation injury (n=30). All patients received daily Spontaneous Breathing Trials and were extubated as soon as clinically indicated. Outcome variables included demographics, length of ventilation (LOV) and incidence of re-intubation. The PI goal was 90 percent of mechanically ventilated patients will be extubated with 96 hours of initial intubation. Data reported as %, Significance was accepted at p=0.05.

Results: There was no significant difference between inhalation injury and non-inhalation injury on burn size or LOV. The overall compliance rate for extubation within 96 hours was 75.8%. The incidence of extubation in patients with inhalation injury was 75% vs. 77% for non-inhalation injury (p=0.88). Four patients in the inhalation injury group required re-intubation within 48 hours vs. three patients in the non-inhalation in jury group. The VAP rate in both groups was zero.

Conclusions: Our study suggests that early extubation of burn patients within 96 hours of initial intubation was achievable in only 75 to 77% of patients. We conclude that further work is necessary to achieve this goal.

Applicability of Research to Practice: A PI goal of early extubation can reduce VAP, length of stay and length of ventilation.

External Funding: Shriners Hospitals for Children-Galveston Grant # 84080.

10. More Than One-Third of Intubations in Patients Transferred to Burn Centers are Unnecessary

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Introduction: Advanced Burn Life Support has an aggressive policy for endotracheal intubation for patients with facial burns prior to transfer to a burn center to prevent airway obstruction. Intubation is not a benign procedure and should not be undertaken lightly. Many patients are intubated prior to transport and many are extubated shortly after arrival at the burn center. We hypothesize that many intubations performed prior to burn center transport are unnecessary.

Methods: We conducted a retrospective review of all children and adults who were intubated prior to burn transfer and survived to discharge from August 2003 to June 2013. Intubations that had fewer than 3 ventilator days (i.e. potentially unnecessary intubations) were compared to those lasting longer than 3 days. Data collected included: age, ventilator days, length of stay, TBSA burn, % second degree, % third degree, and etiology of burns.

Results: A total of 723 patient met inclusion criteria. Of these 171 patients (23.7%) were intubated 1 days or less, and a total of 266 (36.6%) patients remained intubated for ≤3 days. Patients who were intubated 3 days or less differed from those intubated >3 days with respect to age, TBSA burned, percent 3rd degree burn, and hospital days (See table). Burn etiologies were similar with the majority being fire/flame burns (83% vs. 80%), followed by scald (12% vs. 12.4%). Those intubated greater than 3 days had a higher number of electrical burns (5% vs. 2.25%).

Conclusions: As a burn community we have pushed for early intubation prior to transfer for those who have sustained significant burns, inhalational injury or facial burns. Unfortunately this has led to many potentially unnecessary intubations that expose patients to unnecessary complications. While we are good at suggesting early intubation, maybe we should also stress when intubation is unnecessary.

Applicability of Research to Practice: Many patients sustain facial burns, but not all of them necessarily require intubation.

<table>
<thead>
<tr>
<th>&lt;3 days (n=266)</th>
<th>&gt;3 days (n=458)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>32.78 (±1.3)</td>
<td>27.26 (±1.1)</td>
</tr>
<tr>
<td>TBSA burned</td>
<td>13.74 (±0.7)</td>
<td>36.26 (±0.9)</td>
</tr>
<tr>
<td>% 2nd degree</td>
<td>7.26 (±0.4)</td>
<td>6.80 (±0.4)</td>
</tr>
<tr>
<td>% 3rd degree</td>
<td>6.67 (±0.7)</td>
<td>30.23 (±1.0)</td>
</tr>
<tr>
<td>Hospital Days</td>
<td>15.49 (±1.0)</td>
<td>59.12 (±2.3)</td>
</tr>
<tr>
<td>Ventilator days</td>
<td>1.40 (±0.04)</td>
<td>27.8 (±1.6)</td>
</tr>
</tbody>
</table>
11 . The Utility and Predictive Value of Physical Exam Findings for Burn Inhalation Injury

J. L. Shah, BS, J. A. Ching, MD, W. G. Payne, MD, D. J. Smith Jr, MD
University of South Florida, Tampa, FL

Introduction: First responders frequently diagnose burn inhalation injury and intubate patients relying on the classic physical exam (PE) findings of singed nasal hair, carbonaceous sputum, and facial burns. In this study, we evaluated the utility and predictive value of these PE findings for burn inhalation injury.

Methods: An IRB-approved, retrospective chart review of admissions from November 2011 to April 2013 was conducted. All patients were suspected to have burn inhalation injury, intubated, and underwent bronchoscopy. Data collected included: percent burned total body surface area (TBSA), burn injury mechanism, admission PE findings (singed nasal hair, carbonaceous sputum, facial burns), and bronchoscopy findings (consistent or inconsistent with inhalation injury). A bronchoscopy diagnosis of inhalation injury was used to determine sensitivity (SN), specificity (SP), positive predictive value (PPV), and negative predictive value (NPV) of the admission PE findings. Data was analyzed in groups by burned TBSA, burn injury mechanism, and all patients. PE findings were evaluated individually and combined.

Results: Thirty-five males and 12 females met inclusion criteria (n=47, mean age=51.7 years). The highest PPV of 0.57 occurred when the combinations of carbonaceous sputum and facial burns or carbonaceous sputum, facial burns, and singed nasal hair were present with burns greater than 20% TBSA (n=25). The combination of carbonaceous sputum and facial burns also had the highest SP of 0.74 for all patients. Carbonaceous sputum alone had a NPV greater than 0.65 for all patients, flame burns in enclosed spaces (n=20), and burns less than 20% TBSA (n=22). Facial burns alone had a NPV greater than 0.65 for all patients, flame burns in enclosed spaces, and burns greater than 20% TBSA. Singed nasal hairs or facial burns had the greatest SN of 0.82 in burns greater than 20% TBSA. The majority of SNs, SPs, PPVs, and NPVs calculated were less than 0.65 and did not increase appreciably when multiple PE findings were combined.

Conclusions: Contrary to the classic tenet that PE findings reliably indicate the presence of inhalation injury, our data suggest the findings of singed nasal hair, carbonaceous sputum, and facial burns overall have limited reliability, although may have utility and predictive value in some situations. Thus, these PE findings should not be interpreted in isolation but as one component of the history and physical to avoid unnecessary intubation.

Applicability of Research to Practice: This study indicates that the classic PE findings of singed nasal hair, carbonaceous sputum, and facial burns may not be reliable predictors of burn inhalation injury, and therefore, are not absolute indicators for intubation.

12 . Application of the New Berlin Definition of Acute Respiratory Distress Syndrome (ARDS) to Burn Patients

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Introduction: The new Berlin definition of ARDS addresses limitations of the old AECC definition. The Berlin definition defines risk factor and timing of onset, eliminates PAWP requirements and the acute lung injury (ALI) category, specifies minimum PEEP, and clarifies chest radiograph criteria. The purpose of this study was to apply the Berlin ARDS definition to burn patients.

Methods: Retrospective review of intubated and ventilated burn patients admitted to an ABA-verified adult regional burn centre from 1/1/07 to 6/1/13. In keeping with the Berlin definition, we identified ARDS that developed within 1 week of a known clinical insult (burn ≥ 10% TBSA and/or inhalation injury (inhal)). Subjects were followed to a maximum of 14 days to identify progression of ARDS. Each subject’s de-identified chest radiographs were evaluated with blinding to all clinical information. Values are presented as the median (IQR).

Results: Out of 147 eligible subjects, [age 47(35-59), %TBSA 28 (18-39), full thickness (FT) %BSA 12 (0-29), and with a 67% incidence of inhalation], there were seventy (48%) that developed ARDS. Subjects with ARDS were older (p=0.05), had larger %TBSA burns (p<0.001) and FT burns (p=0.004), but showed no significant difference in inhalation injury (p=0.960), compared to those without ARDS (NOARDS). The median day of ARDS onset was on post burn day 3 (2-4). Mortality in ARDS is higher than NOARDS (21% Vs. 9%, p=0.05). Subjects with ARDS had significantly fewer ventilator free days/1st 30days (5 (0-17) vs 14 (5-22) p=0.004) and significantly longer duration of ventilation among survivors (19 (12-34) vs 16 (8-23), p=0.03) than NOARDS . Mild ARDS (formerly ALI in the old definition) was initially diagnosed in 61% (n=43), moderate ARDS in 36% (n=25), and severe ARDS in 3% (n=2). Mild ARDS progressed to moderate ARDS in 44% and to severe ARDS in 2%. Moderate ARDS progressed to severe ARDS in 4%. Mild, moderate and severe ARDS are compared in the Table. Application of the new criteria was straightforward, but radiograph interpretation was sometimes difficult due to bulky overlying burn dressings.

Conclusions: The Berlin ARDS definition appears to be applicable to burn patients and yields results similar to prior studies that used the AECC definition. We would now like to expand application to capture ARDS that develops later in the post burn course arising from other risk factors such as sepsis.

Applicability of Research to Practice: The Berlin ARDS definition can be applied to burn patients.

<table>
<thead>
<tr>
<th>Table</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N(%)</td>
<td>23(33)</td>
<td>43(61)</td>
<td>4(6)</td>
<td></td>
</tr>
<tr>
<td>Vent free days</td>
<td>17(1-19)</td>
<td>4(0-12)</td>
<td>1.5(0-5.5)</td>
<td>0.01 (mild vs mod)</td>
</tr>
<tr>
<td>Duration vent (d)</td>
<td>13(11-28)</td>
<td>29(16-39)</td>
<td>27(22-31)</td>
<td>0.03 (mild Vs mod)</td>
</tr>
<tr>
<td>% Mortality</td>
<td>5</td>
<td>27</td>
<td>50</td>
<td>0.04</td>
</tr>
</tbody>
</table>
13. Provision of Micronutrients to Pediatric Burn Patients Using Adult Enteral Nutrition Formulas

J. Hall, MS, RD, LD, M. L. Dylewski, PhD, RD, K. Prellasck, PhD, RD, P. Chang, MD, R. L. Sheridan, MD, FACMShriners Hospitals for Children, Boston, MA

Introduction: Micronutrient (MN) supplementation among pediatric burn patients is considered necessary to prevent deficiency and to aid in wound healing. However, precise micronutrient requirements among burn patients is not known. Adult enteral nutrition formulas (AF) are utilized at our hospital, as they accommodate the high protein requirements of pediatric burn patients. These formulas also contain higher levels of MN compared to pediatric formulas. The goal of this study was to evaluate MN intakes of pediatric burn patients receiving AF.

Methods: A retrospective analysis of pediatric burn patients between the ages of 1 and 18, admitted to our burn unit from 2007 to 2012 was conducted. All patients received continuous enteral nutrition support with our standard AF to meet 130-175% of their basal metabolic rate and 2.5-3.5 g protein/kg/day. Intakes for vitamin D (D), Calcium (Ca), selenium (Se), copper (Cu), and zinc (Zn) at goal rate were determined. Actual intakes in a subset of patients (N=43) with a gradual progression to goal TF rate because of suboptimal tolerance, or prolonged NPO status were also assessed over a 4-week period. MN intakes were compared to the recommended dietary allowances (RDA) for healthy children.

Results: A total of 118 patients aged 6.7 ± 3 years of age with 39.6 ± 16% total body surface area burns were included in this study. Table 1 shows the adequacy of their MN intakes when receiving target AF volumes. All age groups received over 100% of the RDA for Ca and Cu and Cu requirement without additional supplementation. Children between ages 14-18 years exceeded the RDA for all nutrients by over 200% with the exception of Zn and Cu. Intakes of vitamin D (D), Calcium (Ca), selenium (Se), copper (Cu), and zinc (Zn) at goal rate were determined. Actual intakes in a subset of patients (N=43) with a gradual progression to goal TF rate because of suboptimal tolerance, or prolonged NPO status were also assessed over a 4-week period. MN intakes were compared to the recommended dietary allowances (RDA) for healthy children.

Conclusions: AF provided at goal rate eliminates the need for additional micronutrient supplementation. Patients who are slowly progressing are at risk for becoming deficient for Ca, D, Cu, and Se during the early stage of burn injury and may need supplementation of these nutrients.

Applicability of Research to Practice: Utilization of AF among pediatric burn patients eliminates the need for additional supplementation of MN.

Table 1. Micronutrient Intakes (% RDA) in Burned Children Receiving Adult Formulas

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>1 - 3 years</th>
<th>4 - 8 years</th>
<th>9 - 13 years</th>
<th>14 - 18 years (boys)</th>
<th>14 - 18 years (girls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>121</td>
<td>165</td>
<td>181</td>
<td>210</td>
<td>259</td>
</tr>
<tr>
<td>Ca</td>
<td>194</td>
<td>185</td>
<td>156</td>
<td>130</td>
<td>150</td>
</tr>
<tr>
<td>Zn</td>
<td>436</td>
<td>357</td>
<td>244</td>
<td>486</td>
<td>778</td>
</tr>
<tr>
<td>Se</td>
<td>182</td>
<td>165</td>
<td>135</td>
<td>515</td>
<td>707</td>
</tr>
<tr>
<td>Cu</td>
<td>356</td>
<td>376</td>
<td>258</td>
<td>502</td>
<td>655</td>
</tr>
</tbody>
</table>

14. Burn-Induced Mitochondrial Dysfunction Is Associated with Suppressed Expression of Mitochondria-Localized Sirtuins in Skeletal Muscle

M. Fu, PhD, R. H. Kaszynski, PhD, M. Yamada, PhD, Y. Yu, MD, PhD, A. J. Fischman, MD, PhD, J. Martyn, MD, R. G. Tompkins, MD, ScD, FACS, M. Kaneki, MD, PhD

Massachusetts General Hospital and Shriners Hospitals for Children, Boston, MA; Harvard Medical School, Charlestown, MA

Introduction: Metabolic derangements are a major complication of burn injury and affect the clinical outcome of burn patients. Burn-induced metabolic alterations include muscle insulin resistance, mitochondrial dysfunction, hyperlactatemia and pseudohypoxia (predominance of glycolytic ATP synthesis over mitochondrial oxidative phosphorylation under aerobic condition). Sirt3 and Sirt4 are members of the sirtuin family and localized in the mitochondria. Deficiency of Sirt3 or Sirt4 causes insulin resistance, mitochondrial dysfunction and pseudohypoxia. To study a role of Sirt3/4 in burn-induced metabolic dysfunction, we examined the effects of burn on Sirt3/4 expression in mouse skeletal muscle.

Methods: A full thickness third degree burn injury (30% total body surface area) was produced under anesthesia by exposing the abdomen and flanks to 80°C water for 8 and 4 sec, respectively, in male CD-1 mice at 8 weeks of age. At 3 days after burn or sham-burn, rectus abdominis muscle was excised under anesthesia and Sirt3/4 expression was evaluated by real-time RT-PCR and immunoblotting. Complex I activity was measured and mitochondrial morphology was examined by electron microscopy. Plasma lactate levels were measured at 1, 2, 3 and 7 days after burn.

Results: Burn increased plasma lactate levels in a time-dependent manner and the maximum lactate levels were observed at 3 days post-burn. At 3 days after burn, Sirt3 and Sirt4 mRNA levels were decreased in muscle of burned mice to 23% and 20% of those of sham mice, respectively (p<0.01). Likewise, burn significantly decreased Sirt3 and Sirt4 protein expression compared with sham mice (p<0.01). In contrast, protein expression of Sirt1, which is localized in nucleus and cytosol, and GAPDH were not altered. Burn significantly reduced mitochondrial complex I activity and caused mitochondrial morphological changes, including elongated mitochondria and loss of cristae structure, as compared with sham-burn.

Conclusions: Our study demonstrates that burn decreased Sirt3 and Sirt4 expression at mRNA and protein levels in skeletal muscle, which was associated with hyperlactatemia, and dysfunction and morphological changes of the mitochondria. These results suggest that the suppressed Sirt3 and Sirt4 expression may play a role in muscle mitochondrial dysfunction, hyperlactatemia and insulin resistance after burn. Our findings suggest that Sirt3/4 may be novel potential molecular targets to improve the clinical outcome of burn patients by reversing metabolic dysfunction.

Applicability of Research to Practice: Our results suggest that activators for Sirt3 and/or Sirt4 may have therapeutic potential to reverse metabolic derangements in burn patients.

External Funding: Shriners Hospitals for Children.
15. The Role of Skeletal Muscle Mitochondrial Dysfunction in the Hypermetabolic Response to Burn Injury

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Introduction: Burn injury results in prolonged hypermetabolism. Increased substrate turnover is thought to account for - 50% of this hypermetabolic response, with the remaining 50% largely unaccounted for. Uncoupling mitochondrial respiration from ADP phosphorylation is a means of generating heat in vivo. We hypothesized that uncoupling of skeletal muscle mitochondria contributes to post burn hypermetabolism.

Methods: Skeletal muscle biopsies from the m. vastus lateralis were collected from 23 burned patients (≥ 30% of total body surface area burned; 5 adults and 18 children; mean age 16±13 years old; 13±10 days post burn) and 8 unburned healthy adults (39±16 years old). Mitochondrial respiration was determined in saponin permeabilized myofibers following the addition of substrates and inhibitors. Citrate synthase activity was determined in muscle samples as a proxy of mitochondrial density.

Results: Mitochondrial oxidative phosphorylation capacity was lower in burn patients vs. controls (18.1±1.9 vs. 37.5±1.4 pmol/sec/mg; P<0.001) as was citrate synthase activity (32.9±3.6 vs. 82.3±14.6 nmol/g/min; P<0.01). The ratio of State 2 leak respiration to coupled State 3 respiration (the respiratory control ratio) was lower in burn patients vs. controls (1.39±0.13 vs. 2.01±0.14, P<0.05), whereas the ratio of State 3 respiration to oligomycin insensitive State 4 respiration (uncoupled respiration where ATP synthase is inhibited) was higher in burn patients vs. controls (0.64±0.04 vs. 0.46±0.01, P<0.01).

Conclusions: Skeletal muscle mitochondria from burn patients are insensitive to ADP and the ATP synthase inhibitor oligomycin. These derangements in mitochondrial respiratory control suggest a greater degree of proton leaking, and thus thermogenesis within skeletal muscle of burn victims. Strategies which restore skeletal muscle mitochondrial function following a severe burn injury should be explored as a means to attenuate hypermetabolism.

Applicability of Research to Practice: This research highlights the importance of strategies which restore skeletal muscle function following burn injury.

External Funding: Supported by NIH (R01-GM60338, R01-AG03761, R01-GM056687, R01-HD049471, P30-AG024832,UL1TR000071), NIDRR (H133P110012 and H133A120091) and Shriners Hospitals for Children (71006, 71008, 71009, 84090, 84080 and 84085) grants.

16. Compensating with a “Correction Factor” to Improve Delivery of Prescribed Enteral Nutrition in Burn Patients

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Ross Tilley Burn Centre, Toronto, ON, Canada

Introduction: Enteral Nutrition (EN) is frequently interrupted during the routine care of burn patients. We have previously demonstrated that this results in significant under-delivery of nutrition. To address this problem, our burn center introduced a “correction factor” in which the Dietitian’s prescribed feeding rate was increased by a factor of 1.3 to compensate for the anticipated interruptions in feeding. The purpose of this study was to determine if this approach improved the delivery of prescribed EN.

Methods: Retrospective review conducted at an adult regional ABA-verified burn center. We studied patients ≥ 15 yrs. of age with ≥ 10% TBSA burns who were prescribed and given EN for at least 24 hours during the 1st 14 post burn (PB) days. Patients prescribed EN between Nov 1/12 and March 31/13, before introduction of the correction factor (control group-CONTR), were compared to patients prescribed EN between April 1/13 and Aug 31/13, after introduction of the correction factor (intervention group-INTER). Values are shown as a median (range) or mean ± SD where appropriate.

Results: We studied 32 subjects with a median age of 48 yrs (15-78), median %TBSA burn of 28% (11-69), median full thickness (FT) burn of 14% (0-66), with a 48% incidence of inhalation injury. There were no significant differences between CONTR (N=16) and INTER (N=16) in age, sex, burn size, FT burn size, or incidence of inhalation injury. EN was prescribed and received on a median of 13 days (3-15) in CONT and on a median of 13 days (1-15) in INTER, p=0.831. Under-delivery of EN was prevalent in both groups. There was a deficit in prescribed calories on every study day ranging between 506 to 1285 kcal/day in CONT and 111 to 872 kcal/day in INTER. Subjects in the CONT group received a median of 73.5% (11.4-142) of prescribed calories over the entire study period, which did not differ significantly from the subjects in the INTER group who received 81.4% (0-143) of prescribed calories, p=0.651. Causes of interruptions in EN resulting in discrepancies between prescribed and received EN were similar in both groups and included gradually increasing feed rate to goal rate, NPO for surgery, extubation, procedures and dressings, and feed intolerance.

Conclusions: The findings confirm that under-nutrition due to interruptions in EN is widespread, corroborating our previous findings. However, the use of a 1.3 X “correction factor” to compensate for these interruptions in EN did not improve delivery of prescribed calories. Possibly the correction factor is not large enough, or, an alternative strategy, such as daily volume-based feeding, is required.

Applicability of Research to Practice: Prescribed EN is routinely not received and use of a simple compensation factor approach may not be sufficient to correct this problem.
Introduction: It is not infrequent that burn patients present for treatment after experiencing trauma in addition to their burns. We aimed to characterize the concomitant trauma seen in burn patients recorded in the National Burn Repository.

Methods: The NBR child data set Diagnosis was queried for concomitant trauma. Microsoft Excel was used to prepare the data for further analysis. Abbreviated Injury Scores (AIS), injury sites, age, sex, work related injuries, and TBSA were examined within this group of records using multivariate logistic regression in SAS Statistical Software.

Results: Data from the NBR Diagnosis set represented 7424 patients with 22319 entries. The least severe injuries, represented by Abbreviated Injury Scores (AIS) of 1, occurred 8428 times. The most severe injuries, represented by AIS 6, occurred 23 times. Of those, only 5 survived hospitalization. By a multivariate logistic regression model, patients with an AIS score of 6 were 40.7 times more likely to die than those without an AIS of 6 (95% CI [8.5,193.7], p<0.0001). Similarly, AISs of 5, 4, 3, or 2 increased the likelihood of death by 17.9, 3.3, 2.1, or 0.6 times, respectively (95% CI [12.3,25.9], [2.3,4.7], [1.4,3.1], [0.4,0.9]). An AIS of 1 did not contribute in a statistically significant way to the likelihood of death as an outcome. The upper extremities were the most commonly reported injury sites, appearing 6161 times. Least frequent were neck injuries, appearing 212 times. Taking age, sex, work related injuries, and TBSA into account, injury sites that were statistically more significantly associated with an outcome of death were head, thorax, and abdomen. A head injury was associated increased the odds of a death outcome by a factor of 3.17 (95% CI [2.89,4.77], p<0.0001). The same was true of thoracic injuries, with a factor of 2.69 (95% CI [2.08,3.48], p<0.0001), and abdominal injuries, with a factor of 1.629 (95% CI [1.20,2.22], p<0.0001).

Conclusions: Injuries with an AIS of 6 are, not surprisingly, associated with high death rates in patients represented in the National Burn Repository. As these scores decrease, so do the association with an outcome of death. Injuries to specific body sites also correlate in some instances with likelihood of death as an outcome. Head, thoracic, and abdominal injuries were more likely to be associated with deaths in patients represented by the National Burn Repository.

Applicability of Research to Practice: Many variables impact the recovery course of a burn patient, but an awareness of those types of injuries which are more commonly associated with the poorest outcomes may help our community better focus therapeutic goals.

External Funding: DC Firefighters Burn Foundation.

18. Are Burn Patients Really At Risk For Thrombotic Events?

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University of Miami, Miami, FL

Introduction: There continues to be debate about the routine use of deep vein thrombosis (DVT) prophylaxis in burn patients. While burn patients meet all 3 criteria of Virchow’s triad, there is concern that the routine use of prophylaxis may lead to bleeding or thrombocytopenia. The debate hinges on the incidence of DVT and its relation to the risk-benefit ratio. This study sought to estimate the true rate of DVT in burn patients, and to evaluate possible risk factors to its development.

Methods: The Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality was queried for all patients ≥ 18 years with ICD-9 codes for burn injuries, excluding isolated eye injuries (991-949). Demographic data, comorbidities, total body surface area (TBSA) burn, burn location, length of stay, total charges, number of procedures, presence of central venous catheter (CVC) and mortality were recorded. Patients were classified based on the presence of DVT. Student’s t-test, chi-squared test and multivariate logistic regression were performed to identify risk factors.

Results: A total of 37,200 burn patients were identified. The rate of DVT was 1.29%. Patients with DVT were older, had longer hospitalization, more procedures and higher charges (Table 1). Results of univariate and multivariate analysis are shown in Table 2. In multivariate logistic regression, age, TBSA, CVC, excision, wound infection, and mechanical ventilation were significant predictors of DVT. The DVT rate was double in patients who expired (p=0.0001).

Conclusions: This is the largest series to date. DVT develops in approximately 1.2% of burn patients. Patients with TBSA ≥20% have 3-fold odds of developing DVT and warrant heightened awareness. Identification of these additional risk factors may allow targeted patient prophylaxis. Additionally, patients with DVT incurred higher total charges and longer hospitalization.

Applicability of Research to Practice: Estimation of a national DVT rate can contribute to the discussion of risk-benefit to routine prophylaxis. Additionally, identification of risk factors may help to target patients at risk for DVT.

Table 1. Patient Characteristics.

<table>
<thead>
<tr>
<th></th>
<th>Patients with DVT (mean ± SD)</th>
<th>Patients without DVT (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>54.6±18.1</td>
<td>49.1±19.0*</td>
</tr>
<tr>
<td>Length of Stay (days)</td>
<td>14.2±20.3</td>
<td>8.3±13.2</td>
</tr>
<tr>
<td>Number of procedures</td>
<td>4.9±5.0</td>
<td>2.2±2.9*</td>
</tr>
<tr>
<td>Total Charges (dollars)</td>
<td>162,657.98 ± 212,344.26</td>
<td>50,056.77 ± 105,915.72*</td>
</tr>
</tbody>
</table>

*p-value <0.001

Table 2. Results of Univariate and Multivariate Analyses.

<table>
<thead>
<tr>
<th>UNIVARIATE ANALYSIS</th>
<th>MULTIVARIATE ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odds Ratio (95% CI)</td>
<td>p-value</td>
</tr>
<tr>
<td>Odds Ratio (95% CI)</td>
<td>p-value</td>
</tr>
<tr>
<td>Age</td>
<td>1.013 (1.004-1.021)</td>
</tr>
<tr>
<td>TBSA20%</td>
<td>1.505 (1.415-1.605)</td>
</tr>
<tr>
<td>CVC presence</td>
<td>1.372 (1.291-1.458)</td>
</tr>
<tr>
<td>Excision of burn wound</td>
<td>1.388 (1.281-1.496)</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1.261 (1.203-1.321)</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>2.912 (2.312-3.467)</td>
</tr>
</tbody>
</table>

*p-value <0.001

S68 46th Annual Meeting of the American Burn Association
Reduction in Cost for Temporary Skin Coverings
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Introduction: Temporary skin substitutes are clinically useful in the management of burn wounds. Our Burn Center’s protocol for temporary coverage of partial-thickness burns in patients with large total body surface area (TBSA) involvement prior to 2013 was human allograft. Human allograft is also our center’s gold standard to provide temporary coverage for deep dermal and full thickness wounds after excision awaiting autografting. Medicaid reimbursement in California changed to a DRG system in July 2013 increasing the pressure to decrease cost while maintaining patient outcomes. Porcine xenografts have been used for over 40 years as a dressing for partial-thickness burns, donor sites and as a temporary covering for excised deep dermal or full-thickness wounds. Burn Centers must comply with all federal, state and JCAHO requirements for the use of allograft tissues. Porcine xenograft does not have the same storage, transport and documentation requirements as allograft and therefore has decreased cost associated. Our Burn Center sought to decrease the temporary wound coverage costs while maintaining or improving patient outcomes by increasing utilization of porcine xenografts.

Methods: In July 2012, we changed our protocol for the treatment of large TBSA partial-thickness burns replacing human allograft with porcine xenograft. Porcine xenograft also replaced human allograft on selected patients after excision of deep dermal and full thickness wounds. A retrospective data analysis of the skin usage for three years was conducted. The fees for transportation of human allograft from the tissue bank were also reviewed. The usage of porcine xenograft was calculated from July 2012 through June 2013.

Results: Human allograft usage in 2010 was 336,943 cm2 at a cost of $453,880.00; in 2011, 291,469 cm2 was issued at a cost of $425,545; in 2012, 464,438 cm2 was issued for a total cost of $682,725.00. Additionally, from July 2012 to June 2013, total usage of porcine xenograft was 395,966 cm2. Human allograft for same usage would cost $588,608. The total cost for porcine xenograft was $74,776 providing a total savings of $513,832. There were no adverse outcomes for patients with porcine xenograft. Many patients with porcine xenograft on partial thickness burns also did not require a return to the OR for removal.

Conclusions: Data analyses indicate the use of porcine xenograft is a cost-effective temporary skin substitute and alternative to human allograft for the care of partial thickness, deep dermal, and full thickness wounds.

Applicability of Research to Practice: Fiscal viability of burn centers in the United States is important with health care reform. The ultimate goal is to use this data and compare hospital costs and LOS to reimbursement per insured source.

Frailty Score on Admission Predicts Outcomes in Elderly Burn Injury
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Introduction: With longer life expectancy, the number of burn injuries in the elderly continues to increase. Outcome prediction in the elderly is complicated by pre-injury physical condition and co-morbid illness. We hypothesize that admission frailty assessment would be predictive of outcomes in the elderly burn population.

Methods: A two year retrospective chart review was performed of all admitted acute burn patients 65 years or older. Data collected included: age, gender, %TBSA (total body surface area) burn, presence of inhalation injury, in-hospital mortality, hospital length of stay, ventilator days, ICU length of stay, surgical procedures, insurance status, and discharge disposition. Frailty scores were assessed from admission data and calculated using the Canadian Study of Health and Aging clinical frailty scale. Mean values are represented as mean ± standard deviation and p<0.05 was considered statistically significant.

Results: A total of 89 patients met entry criteria. Mean age of the total population was 75.3±8.1 years and consisted of 62 men and 27 women. Mean TBSA was 9.6±9.1% and mean frailty score (FS) was 4.5±1.2. Eighty patients survived to discharge and 9 died. Non-survivors had significantly higher FS compared to survivors (5.2±1.2 vs. 4.4±1.2). FS were also significantly higher in patients discharged to skilled nursing facilities (SNF) (5.34±0.9) compared to those who were discharged home (4.1±1.2) or to physical rehabilitation facilities (4±1.5). Multivariate linear regression analysis revealed that age (B=0.04) and discharge to SNF (B=1.2) are independently associated with higher FS. However, survivors were independently associated with a significantly lower FS (B=−1.3). Multivariate logistic regression analysis revealed high admission FS independently increased the risk of discharge to SNF (odds ratio of 2.5 (1.3-4.8, 95% confidence interval).

Conclusions: Frailty scores on admission were associated with poor outcome. Frailty scores may improve assessment of elderly patient outcomes and can be used to establish models to benchmark burn injury outcomes for both clinical and research purposes.

Applicability of Research to Practice: Describes a tool for admission assessment of elderly burn patient outcomes.
21. Comorbidity-Polypharmacy Score Predicts In-Hospital Complications and the Need for Extended Care Facility in Older Burn Patients

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Introduction: Burn injury is a major cause of morbidity and mortality in older patients. Advancing age is associated with increased mortality despite smaller burn size. Chronic conditions are increasing with age, resulting in polypharmacy. The Comorbidity-Polypharmacy Score (CPS), previously described by our group, combines the number of pre-injury medications with number of comorbidities, thus facilitating quantitative assessment of the severity of co-morbid conditions. Our aim was to define the relationship between CPS and outcomes in geriatric burn patients.

Methods: A retrospective IRB approved study of 920 burn patients ≥45 years admitted with acute burn injuries between 1/1/06-12/31/12 was conducted. Age ≥45 was used because it represents a point at which polypharmacy increases. Subjects were stratified into three groups according to CPS ranges. Regression modeling was performed. Data collected included demographics, TBSA, inhalation injury, ICU/hospital days, complications, discharge disposition and mortality. CPS was calculated by adding all pre-injury comorbidities and medications. Factors influencing complication risk, discharge to a facility, and mortality were evaluated by multivariate analysis.

Results: Demographics and univariate analysis results are shown in the table below. The risk of in-hospital complication is independently associated with CPS (OR 1.36), age (OR 1.03), initial TBSA (OR 1.05) and inhalation injury (OR 3.26). Independent predictors of discharge to a facility include inhalation injury (OR 4.63), in-hospital complications (OR 2.88), CPS (OR1.61), initial TBSA (OR 1.08), and age (OR 1.07). Mortality is related to inhalation injury (OR 5.88), initial TBSA (OR 1.14) and age (OR1.11). While increasing CPS was associated with decreasing TBSA, mortality remained unchanged.

Conclusions: CPS is an independent predictor of in-hospital complications and the need for transfer to extended care facilities in older burn patients.

Applicability of Research to Practice: In the era of medication reconciliation, a tool such as the CPS is useful in estimating the risk of complications and the need for transfer to extended care facilities in older burn patients.

22. Burn Care in Developing Countries: Establishing Sustainable Healthcare

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Introduction: More than 2 billion people worldwide still use open fires for cooking, light, and warmth. Fire-related deaths are in the top 15 causes of death for ages 5-29 globally. This NGO burn care program has aided in education, empowerment, and support of burn units in the developing world since 1994. The goal of the program is to support and train those who work with burn patients in the developing world.

Methods: A teaching model combining hands-on and didactic training is utilized. There are 4 phases evaluating competency levels in multiple healthcare disciplines to enhance professional standards. Phase one is Exploring, where needs are identified and investigated with strategic intent. Goals are established, a 3-5 year plan for the program including budget, measurement of objectives and timeline is set. Step 2, Grow phase, approximately 3 years in length, with goals set forth for eventual self-reliance and protocols implemented. Sites transition to the train the trainer program and develop strategies for the next 3-5 years. Sustaining the program follows for 3 years. Yearly goals with the partner are set and strategies for the next 3-5 years discussed and the international medical educators (IME’s) are sent. The sites demonstrate success on measurements of the objectives. Lastly, Self-reliance, approximately 1-2 years. Strategies to reduce the sites dependency on the NGO for supplies are discussed, education and needs assessments continue. The professionals become models for other training within the region and explore new opportunities.

Results: Since 1989, there have been over 650 medical mission teams in more than 60 countries. In 2012 burn care represented 18% of all missions. Training 748 healthcare workers by telecommunications, and hands-on workshops. Total 2,380 volunteer hours were spent supporting the burn care program. A 2012 external evaluation of the burn care program revealed on average each professional in the developing world trained by an IME’s goes on to train 5 professionals via hands-on training and 90 through lecture

Conclusions: Providing aid in developing countries is necessary but providing sustainable healthcare that can be reciprocated throughout the world is key. By training, supporting and empowering local healthcare professionals in the underserved populations of the world we can raise the bar on quality and care.

Applicability of Research to Practice: Establishing sustainable burn care throughout the world is necessary to lower the burn related deaths worldwide.
Introduction: Toxic epidermal necrosis (TEN) and Stevens-Johnson Syndrome (SJS) are diseases characterized by widespread loss of the epidermal skin layer. The incidence of SJS/TEN is approximately 0.4 to 1.2 cases per million, though it is lower in the pediatric population. Due to the rare, yet serious nature of SJS/TEN, we sought to review our experience with pediatric SJS/TEN over the last 15 years.

Methods: Over the 15-year period of October 31, 1997 to August 31, 2012, 41 patients ≤ 18 years of age were identified from our burn center repository with a diagnosis of SJS/TEN and were further reviewed in this study. Data was obtained from the hospital’s written and electronic medical record, and the following variables were collected: age, sex, race, causative agent, comorbidities, percentage of total body surface area (%TBSA) slough, ocular and mucosal involvement, medical treatment, operative procedures, time from symptoms to initial treatment, time to admission to the burns intensive care unit (BICU), time to wound closure, ventilator days, ICU length of stay, and hospital mortality. The data was then analyzed to provide descriptive statistics.

Results: Patients were relatively evenly split between male and female (49 vs 51%), with an average age at time of admission of 11.2 ± 4.5 years and mean epidermal sloughing of 39.7 ± 26% TBSA. The presumptive inciting agent was a medication in 90% of cases; most commonly anticonvulsants (37%), antibiotics (34%), and acetaminophen/NSAIDs (14%). Mycoplasma pneumoniae was implicated in 2 cases (5%) and 5% had an unknown etiology. Encouragingly, patients were recognized early, as the average time between onset of symptoms and BICU admission was 3.6 ± 2.0 days and only 2 cases were admitted to the BICU ≥7 days after onset of symptoms. Acutely, 73% of patients exhibited ocular involvement, 88% needed supplemental enteral nutritional support, and 51% required mechanical ventilation. On average, subjects spent 19.9 ± 13.9 days in the ICU for treatment secondary to their SJS/TEN diagnosis. While acute mortality was 0%, 63.4% of patients still experienced long-term complications and 19.5% required follow up procedures.

Conclusions: When compared to current literature, the epidemiology, presentation, acute hospitalization and long-term outcomes of our 41 patients is similar to that of pediatric SJS/TEN at other institutions. SJS/TEN is an acutely severe disease with potentially serious long-term complications.

Applicability of Research to Practice: Due to the rare, yet serious nature of SJS/TEN, efforts must be made to conduct multicentered, collaborative research to further optimize treatment methods and recognize the morbidity for pediatric SJS/TEN to improve acute and long-term outcomes.
Introduction: Inhalation injury is an important predictor of morbidity and mortality and thought to negatively impact quality of life. Limited information is available on the long-term outcome of pediatric burn survivors who initially sustained inhalation injuries. The purpose of this study was to evaluate the long-term quality of life of patients with and without inhalation injuries. We hypothesized that patients with inhalation injury would report more disability and lower quality of life.

Methods: Inhalation injury was defined acutely by bronchoscopy and clinical findings. We looked at the NIDRR database for patients who were treated acutely at this pediatric facility, were age > 16, and were 10 years post-burn. The World Health Organization Disability Assessment Scale II (WHODAS II) measured disability and the Burn Specific Health Scale-Brief (BSHS-B) measured psychosocial quality of life. The WHODAS II contains 32-items: cognition, mobility, self-care, getting along, life activities, and participation. The BSHS-B contains 40 items: affective, body image, interpersonal relationships, sexuality, heat sensitivity, simple abilities, treatment regimens, hand function, and work. Significance was set at (p < 0.01) given the multiple comparisons.

Results: This study focused on 20 burn patients (12 males, 75% Hispanic). Nine had inhalation injury and 11 didn’t. The mean age of burn of participants with inhalation injury was 7.8±2.7, mean TBSA 68%±28, and mean ventilator days 24.6±21. The mean age of burn of participants without inhalation injury was 7.6±3.8, mean TBSA 49%±19.7, and mean ventilator days 1.9±2.8. On the WHODAS II, patients with inhalation injury reported more difficulties; however, no statistically significant differences were found between the groups. On the BSHS-B, statistically significant differences were found between the groups in the areas of hand function, interpersonal relationships, and work (p < 0.01), with patients with inhalation injuries reporting worse outcomes. Regression analyses to test for relationships with demographic variables including TBSA, age of burn, age, questionnaires administered, gender, ethnicity, ventilator days were not statistically significant. Burn location did not explain differences between the groups.

Conclusions: Patients with inhalation injury reported more difficulties, which may be explained by the energy expenditure required for these tasks. A larger study needs to be done to identify differences in the long-term quality of these patients.

Applicability of Research to Practice: More research is needed to determine the long-term quality of life of pediatric burn survivors with and without inhalation injury.

External Funding: Pediatric Burn Injury Rehabilitation Model System NIDRR: H133A120091.
Introduction: Certified Child Life Specialists (CCLS) are used in a variety of pediatric settings to decrease anxiety, perception of pain, medical trauma, and to promote a positive coping plan. In the pediatric clinic burn care setting, the CCLS must assess the patient quickly and continuously in order to select the most effective tools to engage the patient throughout the procedure. In effort to establish best practices for CCLS working in this setting, a Quality Improvement survey was distributed to parents of children seen in our clinic.

Methods: Survey criteria included parents of patients receiving CCLS support during a clinic procedure. Demographic information and CCLS notes were retrieved from the medical record. Validated surveys containing questions regarding parent/patient interactions with the CCLS as well as a CCLS assessment of therapy was used to collect main outcomes.

Results: Patients aged 13 months - 11 years (N=25) were included in this study. Primary reasons for admission include wound debridement (44%), dressing change (44%), and stent down or staple/suture removal (12%). Procedural preparation, procedural support, and post procedural support were the leading interventions viewed as beneficial. Although 68% of parents predicted high anxiety for their child, the need for redirection during the procedure was overall low. Only 20% required high (>7) redirections; followed by 16% requiring medium (3-7), 64% with low (<3). The most effective tool in conjunction with CCLS interventions was the tablet for all age groups. Table 1 shows patient interaction with the tablet, and traits of applications (apps) that were most effective by age group.

Conclusions: Parents found that CCLS interactions for preparation, procedural support, and post procedural support, played a powerful role in their child's coping. When used in conjunction with CCLS interventions, the tablet was the most effective tool in stress reduction for patients as young as 13 months. Parent support was also highly effective. The CCLS should be an integral part of the treatment team and should provide the aforementioned interventions and tools as a standard in this setting.

Applicability of Research to Practice: Revision of our current best practises and further development of a higher standard of care that improves patient coping and satisfaction.

<table>
<thead>
<tr>
<th>Age range</th>
<th>Apps Attempted</th>
<th>Apps Traits</th>
<th>Example Apps</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>3.08 (2.9)</td>
<td>PP, PC, VI</td>
<td>Peedog in the car, Thomas the Train music video,</td>
</tr>
<tr>
<td>2-4</td>
<td>2.4 (1.4)</td>
<td>PP, AF, DM, SE</td>
<td>Dinosaur Train, Cake Doodle, Toca Hair Salon</td>
</tr>
<tr>
<td>4-6</td>
<td>3.7 (1.4)</td>
<td>AP, DM, C, SE</td>
<td>Walking Around, Toca House, PP Music</td>
</tr>
<tr>
<td>5-12</td>
<td>3.2 (1.2)</td>
<td>AP, DM, SE, SS</td>
<td>Cake Doodle, Where's My Water?, Plants vs. Zombies</td>
</tr>
</tbody>
</table>

PP = Passive participation; MC = Musical Companion; VI = Visual Interest; AF = Active Participation; DM = Decision-making; SE = Self-expression; FS = Problem Solving; SS = Strategy.
29. A Child Life Pilot Study: Addressing Psychosocial Needs through Continuity of Care

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Introduction: A child life (CL) program to address psychosocial concerns about hospitalization was a pediatric standard of care and was formally integrated into this center's inpatient (inpt) care in 8/10. Positive anecdotal feedback from staff, patients, and families suggested the need for similar outpatient (outpt) services. It was hypothesized that expansion of CL services to outpt care would be desired, well received by patients, families, and staff, and contribute to continuity of care. The following reports this experience to date.

Methods: In 11/12, an outpt CL specialist was hired and initiated a 30 week pilot mirroring the inpt program. To establish program interest, surveys were distributed to families prior to clinical outpt CL availability. Between 7/13-9/13, parents and staff completed post-surveys to assess impact of CL on the outpt experience. All surveys were anonymous. All in- and outpt cases treated by CL in 2013 to date were reviewed for frequency of treatment provided (per patient mean ± SD, range): educational preparation (EP), procedural accompaniment (PA), therapeutic play and art sessions (TP/A) and school re-entry programs.

Results: Between 1/13- 8/13, CL treated 196 inpts and 309 outpts at 397 office visits; 106 patients received inpt and outpt CL services; 74% of inpts and 69% of outpts received >2 intervention modalities. See Table 1 for intervention results. 54/66 outpts returned pre-CL surveys (89%); 66% desired education/preparation by CL. 38/78 outpts (48%) completed post-CL surveys reporting that 80% received pre-procedure education by CL and that the most helpful interventions during wound care were CL presence (29%), iPad (17%) and bubbles (18%). 80% requiring pressure garments received supplemental teaching about these by CL. Parents favored the CL interventions of provision of activities while waiting for evaluation (32%); distraction during treatment (24%); and talking with children about living with a burn injury (18%). In 8/13, 73% of 11 staff strongly agreed that CL has impacted psychosocial continuity of care; 78% reported PA as a top priority for outpt CLS care; and CL is “very effective” in decreasing outpts anxiety.

Conclusions: The integration of CL into the burn team has brought new opportunities to improve patient care at this center. Going forward, CL will continue to work with the burn center team to expand programming to better serve patients, families and staff.

| TABLE 1 |
|-----------------|-----------------|-----------------|
|                  | Inpatient       | Outpatient      | Total |
| Motivational index ≤ 50 |               |                 |       |
| Interactions     |                 |                 |       |
| TP (pre-op/medication, no support) | 154 (2,13,15,19,79) | 148 (1,11,15,16,45) | 293 |
| # Patients       | 179 (97%)       | 198 (97%)       | 377 |
| PA (behavioral, music, PA) | 222 (25,33,13,4,10) | 210 (25,33,13,4,10) | 432 |
| # Patients       | 182 (94%)       | 180 (94%)       | 362 |
| DPA             | 154 (72%)       | 155 (72%)       | 309 |
| # Patients       | 161 (98%)       | 132 (78%)       | 293 |
| School re-entry  | 21 (12%)        | 21 (12%)        | 42 (12%) |
| Total # interventions | 21 (12%)    | 21 (12%)        | 42 (12%) |

30. Relationship Between Zolpidem Concentrations and Sleep Parameters in Pediatric Burn Patients

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Introduction: Zolpidem is a short-acting non-benzodiazepine hypnotic commonly used for the treatment of sleep disturbance following burn injury. This is the first pharmacokinetic (PK) and pharmacodynamic (PD) evaluation of zolpidem in pediatric burn patients. The purpose of this study was to evaluate the relationship between serum concentrations of zolpidem and sleep parameters.

Methods: Standard age-based zolpidem dosing (2-4y; 2.5mg; 5-10y; 5mg; >10y; 10mg) practices were employed. Zolpidem tablets were crushed, dissolved in 5 ml of water and administered via a nasoduodenal feeding tube followed by 5 ml flush. Serum levels of zolpidem were obtained at 0, 1, 2, 4, 5, 6 and 8 h and were assayed by HPLC. The relationship between zolpidem concentrations and sleep parameters was evaluated using population PK/PD methods. Overnight polysomnography (PSG) data were obtained while on placebo and also following 4 days of zolpidem administration.

Results: 11 patients (8M, 3F) receiving either a single nightly dose (n=2) or two doses of zolpidem separated by 4 h (2200 & 0200 h; n=9) were studied. Patient demographics (median, range) were: age: 8 (4-17) y; weight: 28 (17-60) kg; burn size: 50 (28-85) %TBSA. Concentrations (mean ± SEM) of zolpidem at 1 h post-dose #2 @ 0200 h were significantly higher than that following dose #1 @2200 h (407 ± 72 vs. 269 ± 34 ng/ml, P=0.008). Corresponding areas under the concentration-time curves (AUC) were also higher (1193 ± 248 vs. 809 ± 138 ng.h/ml, P=0.008). Compared to controls, the time awake on zolpidem decreased from 33.4% to 28.2%, (P>0.05) and time spent in REM sleep increased 2.2 %, (P>0.05) while on zolpidem. There was a significant correlation between higher zolpidem levels following the 2nd dose and improved Stage 3 sleep (r= 0.77, P<0.01).

Conclusions: Zolpidem resulted in a modest improvement in sleep parameters in pediatric burn patients. Higher serum levels of zolpidem were measured following the 2nd dose. Although Stage 3 sleep was not increased in the latter half of the night, increased zolpidem concentrations were associated with increased Stage 3 sleep; however, interpatient variability was substantial. Further analysis linking zolpidem serum levels and sleep parameters will be critical to understanding the concentration-effect relationship and aid in defining optimal dosing strategies in pediatric burn patients.

Applicability of Research to Practice: This PK/PD study forms the initial basis for optimizing the safe and effective dosing of zolpidem in pediatric burn patients.

External Funding: Sponsored by Shriners Hospitals for Children research grant #70097.
31. Family Support for the Pediatric Burn Patient: A Key Contributor to Resiliency

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Arizona Burn Center, Phoenix, AZ; A T Still University, Mesa, AZ; Maricopa Medical Center, Phoenix, AZ

Introduction: Resilience has been defined as a person’s ability to overcome an adverse event and be strengthened or transformed by it. Serious pediatric burns are adverse events that significantly impact the patient’s emotional and physical well-being, especially during the acute care phase. Research has revealed that while some youth experience psychological maladjustment after their burn injuries, others exhibit resilience. This study sought to determine what key elements a large group of pediatric burn survivors would report as major contributions to their resilience after burn injury.

Methods: Burn-injured youth, with parental consent, were invited by a psychologist to voluntarily complete the 28-item Child and Youth Resilience Measure, designed as a screening tool to assess resilience in youth and determine what resources (individual, relational, communal and cultural) bolster their resilience.

Results: Participants included 146 burn-injured youth, 50% female and 49% male, mean age 13.5 years. Cause of burn included Scald 41%, Fire/Flame 46%, Other 13%, with an average of 7 years since burn injury. Average age at burn was 5.8 ± 3.7 years. Youth reported support at home to be just right (49%), a lot (35%) a little (10%) too much (5%) and none (2%). 25% of participants reported hidden burn scars, 33% visible and 42% both. The mean score for the group was 112.3 as compared to the normed population mean of 113.1 among high-risk children. Significant positive correlations (p < 0.001) were found between resilience scores and level of family support; Total Score, r = -.42, Individual Score r = -.336, Relationship with Caregivers r = -.455 and Sense of Belonging r = -.399.

Conclusions: Strong family support, as has been shown in other burn-injured populations, is a key contributor to greater levels of patient resilience. Burn care professionals should encourage family participation and involvement with pediatric patients, not only in the acute phase of burn care, but in the post-hospital environment as well. Staff should communicate the importance and benefits of family support to caregivers and emphasize its influence on improved long-term outcome.

Applicability of Research to Practice: Screening for resiliency allows for early identification of potentially at risk youth. When patients show non-resilient traits they can be referred for further testing and potential psychological intervention. Parenting skills education can also be recommended.

External Funding: International Association of Firefighters.

32. Long Term Quality of Life of Burn Survivors Using World Health Organization Disability Assessment Scale II (WHODAS) and Burn Specific Health Scale- Brief (BSHS-B): A Comparison

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Introduction: To determine the level of long term psychological distress and quality of life (QOL) in pediatric burn survivors 5 and 10 years post-injury and compare the World Health Organization Disability Assessment Scale II (WHODAS) and the Burn Specific Health Scale- Brief (BSHS-B).

Methods: This site-specific study focused on 50 burn survivors 16 years old and older (56% male, 82% Hispanic): 10 were 5 years post-burn and 40 were 10 years post-burn. Subjects completed the WHODAS and BSHS-B. The WHODAS measures health and disability, where higher disability scores indicate lower QOL. The BSHS-B measures psychosocial and physical difficulties, where higher scores show fewer problems and a higher QOL.

Results: There was no significant difference between survivors 5 and 10 years post-burn. In most domains, as Total Body Surface Area Burned (TBSA) increased, QOL decreased. Female burn survivors, survivors burned prior to school entry and adolescents who had yet to transition into adulthood reported better QOL than their counterparts. In all domains except Participation, the WHODAS consistently identified more individuals with lower QOL than the BSHS-B, and therefore in need of follow-up.

Conclusions: Despite no significant differences in the QOL 5 and 10 years post-burn, further analysis revealed the importance of long term psychosocial intervention for survivors with larger TBSA, males, those burned after school entry, and all survivors transitioning into adulthood. Furthermore, the WHODAS and the BHS-B are useful tools for assessing burn survivors’ QOL and both should be given as they discern different individuals. However, the WHODAS is more sensitive in identifying QOL issues. Long term follow-up is crucial for survivors’ QOL.

Applicability of Research to Practice: This research gives more insight into QOL in long term pediatric burn survivors by showing what long term QOL can be expected and by providing an example of how to identify groups that need extra attention. It also reveals the WHODAS is more sensitive to flagging lower QOL individuals than the BSHS-B in most domains. If possible, clinicians should give both instruments to ensure every survivor with lower QOL is identified. However, if forced to choose between instruments, the WHODAS is a more sensitive tool for identifying survivors with psychological distress and lower QOL. This implies that regardless of surgical needs, long term mental health follow up is crucial for survivors QOL.

External Funding: Pediatric Burn Injury Rehabilitation Model System NIDRR: H133A070026, 133A120091. NIH: P50 GM 060388; R01 GM056687; HD049471. Shriners: 71008; 71009; 84080; 9145.
A Prospective Randomized Controlled Trial Comparing Video Games to Standard Physical Therapy: Six Months Follow Up
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Introduction: Commercially available, interactive video games used clinically in burn rehabilitation have been shown to facilitate functional range of motion (ROM) but their efficacy with burn patients has not yet been proven. This pilot prospective, randomized controlled trial was conducted to investigate whether rehabilitation with interactive video games is more effective than traditional physical therapy in recovery of ROM after burn injury.

Methods: School aged children (N=17) with limited shoulder ROM from burn injury were randomized to receive therapy using standard ROM activities (ST) or interactive video games (VG). Patients received 3 weeks of the designated therapy intervention twice/day. They were then given a home program of either video games or standard exercises to do regularly for 6 months. Standard goniometry and 3D motion analysis during functional tasks were used to assess ROM at baseline, 3 weeks, 3 months and 6 months. Pain was measured before and after each treatment session during the 3 week intervention. Linear mixed models and correlations were used to analyze data.

Results: Demographic data is reported in Table 1. Patients in both the ST and VG groups showed significant improvement in shoulder flexion (p<0.001), shoulder abduction (p<0.001), shoulder external rotation (p=0.1), shoulder internal rotation (p=0.05), and elbow flexion (p=0.1) range of motion from baseline to 6 months as measured with goniometry. Subjects in both groups also showed significant gains in elbow flexion (p=0.04) and shoulder flexion (p=0.06) during the task of hand to head and shoulder flexion during high reach (p=0.04). There was no difference in ROM gains between the groups. VG subjects had less pain over time during the intervention compared to ST subjects (VG r=0.044, ST r=0.073, p=0.08).

Conclusions: This pilot study is the first prospective randomized controlled trial to evaluate the therapeutic efficacy of using video games throughout a 6 month course of rehabilitation with burn patients. Therapy with interactive video games resulted in similar improvements in ROM and function as traditional therapy and subjects showed less pain over time with video game therapy. Interactive video games are a useful adjunct to therapy and should be considered for home use following hospital discharge to maintain ROM after burn injury.

Applicability of Research to Practice: Evaluation of a clinical intervention.

External Funding: Shriners Hospitals 71000.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>ST (N=9)</th>
<th>VG (N=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects</td>
<td>11.6 (94.4)</td>
<td>12.8 (94.4)</td>
</tr>
<tr>
<td>TBSA (%)</td>
<td>51.6 (25.3)</td>
<td>55.5 (25.0)</td>
</tr>
<tr>
<td>Burn Age (days)</td>
<td>70.9 (59.9)</td>
<td>85.6 (39.3)</td>
</tr>
</tbody>
</table>
Assessing the Ability of Comorbidity Indices to Capture Comorbid Disease in the Inpatient Rehabilitation Burn Injury Population

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Introduction: Burn patients requiring inpatient rehabilitation often have comorbidities that influence outcomes. Comorbidity indices using administrative databases predict survival and cost outcomes in the acute hospital setting. The purpose of this study is to evaluate the extent to which existing Comorbidity Measures capture comorbidities in the burn inpatient rehabilitation population.

Methods: Data from Uniform Data System for Medical Rehabilitation (UDSMR) from 2002 to 2011 was used to study adults with burn injury in the inpatient rehabilitation setting. International Classification of Diseases, 9th Revision (ICD-9) codes were used to assess comorbidities. Etiologic codes for burn injury were used to describe the extent of burn injury in the population and not treated as comorbidities. Three different Comorbidity Measures (Charlson Comorbidity Index, Elixhauser Comorbidity Index, and Centers for Medicare and Medicaid Services Comorbidity Tiers) were used. The number of subjects captured by each Comorbidity Measure was calculated. The number of unique comorbidity codes occurring in greater than 1% of the total population was calculated and compared to the frequency of codes captured by each Comorbidity Measure.

Results: There were 5347 patients in our study population. Subjects had a median total body surface area burn decile of 20-29% and mean age of 51.6 years. A majority of subjects were male (68%). The mean number of comorbidities per patient was 7.6±2.9. There were 2809 unique ICD-9 comorbidity codes in the database. Elixhauser Comorbidity Index did not capture 24%, Charlson Comorbidity Index did not capture 65%, and CMS Comorbidity Tiers did not capture 56% of subjects. 107 etiologically distinct comorbidities occurred in greater than 1% of the study population. Of these, 79 (74%) were not captured by either the Elixhauser or Charlson Comorbidity Indices and 69 (64%) were not captured in all three Comorbidity Measures.

Conclusions: Adults with burn injury exhibit multiple comorbidities in the inpatient rehabilitation setting, some of which have been shown to affect outcomes at the acute care level. Commonly used comorbidity indices do not accurately reflect the extent of comorbid disease in the inpatient rehabilitation burn population. These results corroborate recent findings that existing comorbidity indices do not correlate with inpatient rehabilitation outcomes.

Applicability of Research to Practice: Descriptive analysis of frequent comorbidities in this population may help with the development of alternatives to existing comorbidity indices. Future research may help determine the impact of comorbidities not captured in current Comorbidity Measures on functional outcomes.

External Funding: NIDRR.

Cutaneous Functional Unit is a better index than Total Body Surface Area related to burn patient outcomes

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Introduction: Previous research has shown a disparity in the relationship of burn scar contracture (BSC) or joint limitation in motion (LOM) to total body surface area (TBSA). Cutaneous Function Units (CUF) are fields of skin associated with BSC sites. The objective of this study was to evaluate if CUF are a better index of BSC development than TBSA.

Methods: Data was collected prospectively at 14 verified burn centers from 2010-13. Time spent undergoing rehabilitation was recorded daily. Range of motion measurements of CUF areas were assessed at the time of discharge and were assigned to either a contracted group (CG) or a non-contracted group (NC). Subjects had their TBSA calculated using an electronic Lund/Browder diagram. The areas of CUF identified with either BSC or LOM were compared to both overall TBSA and CUF involvement using linear and multiple logistic regression. Receiver Operating Characteristic curves were plotted and the area under the curve (AUC) was computed for both models to determine accuracy of predicting BSC/LOM.

Results: A total of 284 subjects were used in the analysis. Subjects had a median age of 42 years (IQR 29-54), were mostly male (70%), with a median TBSA of 7.5% (IQR 4.3-15.0). The vast majority of subjects (80%, n=226) had a BSC/LOM. The median rehabilitation time/CFU in the NC group was significantly greater than in the CG (5.4 vs. 2.4 minutes, p<0.0001). Linear regression of CFU to total number of BSC/LOM demonstrated a stronger correlation than TBSA respectively (r² = 0.567 vs. 0.298 p-value < 0.05). Both logistic regression models showed skin grafting (SG) as a significant predictor of developing a BSC/LOM. After adjusting for SG, daily rehabilitation time per CFU was significant while daily time per TBSA fell out of the model (CFU: OR 1.08, 95%CI 1.04, 1.13; TBSA: OR 2.96, 95%CI 0.36, 22.6)). The AUC for CFU and SG was significantly higher than the AUC for SG and TBSA (0.75 vs. 0.66, p=0.005).

Conclusion: From these results, CUF is a better indicator of BSC/LOM than TBSA. Use of CFU may render better clinical information than TBSA in terms of anticipating the development of BSC/LOM.

Applicability of Research to Practice: The ability to predict where BSC/LOM will occur is an important clinical feature to establishing a burn rehabilitation program.

External Funding: USAMRAA Award #W81XWH-08-1-0683.
37. Impact of Burn-Related Amputations on Return to Work: Implications for Burn Rehabilitation in the U.S.
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Introduction: Amputations following a burn injury are infrequent but may impact community re-integration and create a barrier to returning to work. We sought to describe and compare patient, injury, quality of life, and employment status for those with and without amputation using a national longitudinal database of burn injuries.

Methods: We performed a retrospective review of prospectively collected data and examined group differences via descriptive statistics. Depending on the outcome variable, linear or logistic regression was used to identify factors statistically significantly associated with amputation, return to work rates, and SF12 physical (PCS) and mental health (MCS) scores at three time points (discharge, 6- and 12-months postburn). Univariate analyses were first conducted to identify significant associations, which were then put into multivariate regression models.

Results: From a review of 2,955 records, 182 individuals required at least one amputation (6%). The table summarizes patient, injury, and treatments between those individuals with and without amputation. Amputations were associated with three causes of injury: frostbite/cold injuries (OR 12.67, 95% CI 1.7-92.3), electrical injuries (OR 8.88, 95% CI 5.6-14.1), and contact with hot object (OR 6.17, 95% CI 3.4-11.2). Working pre-injury was associated with employment after injury (β = .20, p = .003). Working pre-injury was associated with employment at 12-months postburn (OR 11.4, 95% CI 8.4-15.4). At 12-months postburn, people with amputations were less likely to be working than those without amputations (OR 0.13, 95% CI 0.08-0.22). Amputation was not a statistically significant predictor of SF12 scores with the exception of the PCS, 6-months after injury (β = -.18, p = .013).

Conclusions: Amputations are relatively rare following burn injury but can be predicted based on type of injury. Whereas, people with amputations were less likely to be employed at 12-months postburn, those who were employed prior to the injury were more likely to return to work as those who were not. People with amputations reported similar health related quality of life as those without amputations.

Applicability of Research to Practice: Compared to people without amputations, people with amputations are at risk for unemployment and may require additional vocational rehabilitation services.

External Funding: National Institute on Disability and Rehabilitation Research #H133A120024 and #H133A130004.

38. Gait Outcome of Pediatric Lower Extremity Amputation Patients with and without Skin Grafts
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Introduction: Gait in patients with lower extremity (LE) amputation is dependent on the case and efficiency with which the patient is able to use a prosthesis. Soft tissue deficits that accompany many traumatic LE amputations, such as with severe burn injury, often require skin grafts to maximize limb length and preserve joints. However, this practice is controversial due to case reports that claim skin grafts do not tolerate the long term shearing forces of prosthetic use. Our study tested the hypothesis that LE amputees with skin grafts on the amputation site had poorer function than LE amputees without skin grafts. Specifically we evaluated gait parameters (time/ distance), gait efficiency, duration of daily prosthetic use and self-reported function.

Methods: This prospective case control study assessed children aged 6-20 years with below knee or more proximal LE amputations in two groups: 1) those with skin grafts on their residual limb stump (SG) and 2) those with no skin grafts (NSG). Both groups underwent gait evaluation of time/distance parameters using three dimensional motion analysis and energy consumption/expenditure test using the Cosmed K4b2. Patients wore a Step Activity Monitor (SAM) for 3 continuous days to assess gait parameters (time/ distance), gait efficiency and self-reported function. Unpaired, two tailed Student t tests were used to compare groups. Significance was set at p<.05.

Results: A total of 13 children with a mean age of 13.5 (±4.6) years were enrolled (SG=6, NSG=7). Normalizing gait for age and gender, there were no differences between the groups for velocity, stride length and cadence. Gait parameters for both groups did not differ significantly from normal able-bodied children except for velocity in the SG group which was less (p=.01). SG subjects showed no difference in gait efficiency compared to NSG or normal children. SG subjects used their prosthetic device equally as often and reported similar functional ability as compared to NSG subjects (Global SG=86 vs. NSG=89, p=.67). Table 1.

Conclusions: Children with amputation and skin grafts demonstrate comparable gait quality, gait efficiency, prosthetic use and self-reported functional ability compared to children with amputation alone. The findings of this study suggest that skin grafting to LEs after amputation does not result in impaired function or gait compared to amputation alone.

Applicability of Research to Practice: Role of skin grafting and amputation in gait outcome.
39 . Heat Acclimation Increases Plasma Volume in Burn Survivors
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University of Texas Southwestern Medical Center, Dallas, TX

Introduction: This project tested the hypothesis that a seven day heat acclimation regimen increases plasma volume in burn survivors with well healed split thickness grafts, and that the magnitude of this increase is related to improvements in thermal tolerance.

Methods: Thirty three burn survivors with well-healed split thickness grafts were stratified into two groups: 17-40% BSA grafted (N=15) and >40% BSA grafted (N=18; range: 40-75%). Eight similarly aged, non-injured subjects served as controls. Subjects underwent a 7 day heat acclimation regimen wherein they exercised daily for 90 min in an environmental chamber (40° C, 30% relative humidity). Increases in core body (intestinal) temperature were measured during exercise bouts of identical intensity on the first and final day of the heat acclimation regimen. Plasma volume (via carbon monoxide rebreathing) was measured 24 hours before Day 1 and 24 hours after Day 7 of the heat acclimation regimen, when subjects were euhydrated.

Results: Seven grafted subjects were unable to complete 90 min of exercise on Day 1 due to core body temperature achieving 39.5 °C, while all but one subject completed 90 min of exercise on Day 7. The elevation in core body temperature was significantly attenuated following heat acclimation, with the greatest attenuation occurring in the >40% grafted group. Prior to heat acclimation, there were no differences in plasma volume between groups (control: 49.1±3.5 ml/kg; 17-40% grafted: 45.6±6.2 ml/kg; >40% grafted: 45.9±4.9 ml/kg). Plasma volume was elevated by heat acclimation in all groups (main effect of group P=0.02; control: 51.3±6.5 ml/kg; 17-40% grafted: 47.7±9.0 ml/kg; >40 grafted: 47.6±5.9 ml/kg), but the magnitude of the elevation in plasma volume was similar between groups (P=0.95 for interaction). Finally, there was no relationship between the magnitude of the elevation in plasma volume (r=0.26; P=0.11) following heat acclimation and the attenuation in the elevation of core body temperature during exercise after heat acclimation.

Conclusions: Seven days of heat acclimation attenuated the increase in core body temperature during exercise and increased plasma volume in well healed burn survivors. However, the magnitude of the increase in plasma volume was not related to the attenuated elevation in core body temperature.

Applicability of Research to Practice: These data demonstrate that thermal tolerance can be improved in skin graft patients, thereby improving safety and perhaps thermal comfort during prolonged exercise in the heat; although the magnitude of this response is not related to accompanying increases in plasma volume.

External Funding: NIH GM068865.

40 . A Randomized Controlled Trial to Test an Expanded Delivery Model for Patients with Burn Injuries
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University of Washington, Seattle, WA; Santa Clara Valley Medical Center, San Jose, CA

Introduction: The goal of this study was to improve outcomes after burn injury in a number of domains by utilizing an expanded care coordinator (ECC) to manage patient-specific barriers to effective burn rehabilitation.

Methods: This between group, randomized controlled trial compared a control group (n=41) that received standard care to an experimental group (n=40) that received expanded care services. These services included assignment to a bachelor's level ECC who called the patient at set intervals (24 hours post discharge, 2, 4, 8, 12 weeks post discharge and 5, 7, 9 months post discharge). The ECC received training in motivational interviewing, crisis intervention and solution-focused counseling aimed at helping a patient meet their stated goals.

Results: Table 1 lists the demographics by group. For the ECC group the majority (56%) completed 7 to 8 calls over 1 year. Outcome measures included patient identified goals utilizing the Goal Attainment Scale, the BSHS, the SF-12, a Patient Satisfaction Survey, and the number of days to return to work. All were assessed using general linear models and adjusted for gender, age, length of stay, rural residence, TBSA, and ethnicity. There was no difference between the groups on any of the outcome measures at either 6 or 12 months. See Table 2.

Conclusions: Our goal was to supplement the multidisciplinary care that our patients receive. One possible explanation for the lack of difference between the groups is the strength of the standard of care provided. Patients routinely receive phone calls from an acute care nurse 24 hours after discharge who helps them to problem solve any issues that may have arisen. The goal setting measure may also have served as an intervention as many commented on how much they enjoyed it. Although the majority of patients with burn injuries may not need an intervention that is this intensive, there is likely a subset of patients who are at higher risk that could benefit from these services.

Applicability of Research to Practice: Future research should aim to identify those patients most at risk for poorer outcomes.

External Funding: National Institute on Disability and Rehabilitation Research. H133A070047.

Table 1. Demographics by Group

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<th>Experimental (mean, sd)</th>
<th>Control (mean, sd)</th>
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<tr>
<td>Age (years)</td>
<td>43.2 (16.9)</td>
<td>43.7 (17.1)</td>
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<tr>
<td>Length of Hospitalization (days)</td>
<td>19.1 (19.3)</td>
<td>18.4 (18.5)</td>
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<tr>
<td>TBSA (%)</td>
<td>35.5% (42.9)</td>
<td>38.0% (43.4)</td>
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<tr>
<td>Sex (%male)</td>
<td>63% (25)</td>
<td>71% (29)</td>
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<tr>
<td>Ethnicity (%White)</td>
<td>90% (35)</td>
<td>80% (32)</td>
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<tr>
<td>Location (%urban)</td>
<td>85% (34)</td>
<td>80% (33)</td>
</tr>
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</table>

Table 2. Outcome Measures

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<tr>
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<th>6 months</th>
<th>12 months</th>
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<tr>
<td>Goal Attainment Scale</td>
<td>F=2.38, P=.13</td>
<td>F=2.98, P=.09</td>
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<tr>
<td>Patient Satisfaction</td>
<td>F=3.04, P=.13</td>
<td>F=3.25, P=.09</td>
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<tr>
<td>SF12 MCS</td>
<td>F=1.12, P=.73</td>
<td>F=.06, P=.81</td>
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<tr>
<td>SF12 PCS</td>
<td>F=.80, P=.42</td>
<td>F=.37, P=.72</td>
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</table>
41. Improving Outcomes in Acute Severe Frostbite: Institution of an Evidence Based Protocol

A. L. Lambert, MD, FACS, R. M. Nygaard, PhD
Hennepin County Medical Center, Minneapolis, MN

Introduction: Alteplase is a tissue plasminogen activator that was traditionally indicated for use in cardiovascular and pulmonary embolic events. Increasing evidence has since shown that the use of thrombolytic therapy in the acute setting of severe frostbite reduces the incidence of amputation. Hennepin County Medical Center averages 20-25 severe frostbite admissions yearly and has been using thrombolytics since 1989. Recently, an evidence-based protocol was instituted for all patients admitted with severe frostbite. The goals of the protocol were to provide a consistent approach to the management of frostbite patients and to improve amputation and complication outcomes.

Methods: This study is a retrospective review of all frostbite patients admitted for a 10 year period prior to the protocol change and for 2 years following implementation of the protocol. The protocol included bone scans on arrival and after treatment, Alteplase given systemically within 6 hours of rewarming when indicated clinically and/or by bone scan, aloe vera as a topical applied QID, non-weight bearing status as indicated until significant healing had occurred, and no debridement or early amputation of 3rd and 4th degree frostbite. Data was collected on the number of patients treated, their demographics, bone scan results, amputation and complication rates.

Results: Prior to the implementation of the protocol, seventeen patients received Alteplase. Twelve of the seventeen patients (70.6%) subsequently underwent amputation and two patients developed complications (not related to the administration of alteplase) associated with treatment. Post-protocol, ten patients received systemic Alteplase. Median time to treatment following implementation of the protocol was 4.2 hrs compared to 10.1 hrs prior to implementation (P<0.001). Following implementation of the frostbite protocol, no patients that received Alteplase have required amputation and no complications associated with treatment have been observed. The overall amputation rate, with or without alteplase, was 18% after implementation of the protocol versus 33% pre-protocol.

Conclusions: Development and implementation of a frostbite management protocol has reduced overall complication and amputation rates in severe frostbite patients admitted to the Burn Center. The Burn Center receives frostbite patients from a large catchment area (6 states) and secondary to this an aggressive outreach/education mission, mailings and online teaching was implemented throughout this area to stress the importance of receiving patients in a timely fashion.

Applicability of Research to Practice: Timing of administration of thrombolitics in frostbite patients and an aggressive management protocol decreases amputation rates.

42. Is Palmar Surface Area a Reliable Tool to Estimate Burn Surface Areas in Obese Patients?

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Introduction: Estimating burn surface areas is critical to the initial management and fluid resuscitation of patients who have sustained burn injuries. There are many tools and shortcuts established to estimate the total body surface area (TBSA) burned such as the ‘Rule of Nines’ and Lund and Browder charts. These tools work reasonably well in the typical 70 Kg person but may not be very reliable in the obese population where total body surface area may be increased disproportionately throughout the body. The surface area of scattered burn injuries are frequently estimated using the patient’s palmer surface area (PSA), which is classically cited as being approximately 1% of the TBSA. This study investigates the relationship of PSA to TBSA as reflected by body mass index (BMI) in obese, overweight and normal people.

Methods: Age, sex, race, weight, height, and palm surface area was collected from obese and non-obese volunteers. PSA was calculated with and without including the fingers, BMI was calculated by dividing the weight in kg by height in m^2 and TBSA was calculated with the Mosteller, DuBois-DuBois, Livingston and Scott and Yu formulas. The percentage of PSA relative to TBSA was calculated by dividing the weight in kg by height in m^2 and TBSA was calculated with and without including the fingers, BMI was calculated with the Mosteller, DuBois-DuBois, Livingston and Scott and Yu formulas. The percentage of PSA relative to TBSA was calculated in obese and non-obese volunteers. Obese was defined as subjects having a BMI ≥ 30.

Results: Data from 71 subjects was collected. 39 (55%) subjects had a BMI ≥ 30 and 32 (45%) had a BMI <30. The average age was 40 years old and ranged from 22 to 77 years old. There were 49 (69%) females and 22 (31%) males. PSA ranged from 0.49% of TBSA with a BMI of 58.7 to 1.15% of TBSA with a BMI of 22.6. This correlation of PSA to BMI was statistically significant with all of the formulas.

Conclusions: The percentage of PSA to TBSA decreases as BMI increases. We should not assume that the PSA is always 1% of TBSA especially in obese patients.

Applicability of Research to Practice: BMI should be considered when using palmar surface area to calculate burn surface area in obese patients.
43. A Novel Approach to the Management of Facial Firework Tattooing using Serial Punch Biopsy

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**Introduction:** Firework and blast injuries to the face can cause unsightly and disfiguring ‘tattooing’ from gunpowder and explosive debris. These injuries can be difficult to treat as wide resection may cause greater disfigurement, and the ingrained particles may not respond to laser therapy. We present a novel approach to the management of facial gun-powder tattooing.

**Methods:** We present a comprehensive photographic record of the management of a firework blast injury to the face. The case patient was assembling a faulty industrial sized firework when it exploded before he could walk away. He suffered superficial corneal injuries, an orbital floor ‘blow-out’ fracture, and multiple facial lacerations and extensive tattooing with gun powder deposits.

**Results:** The case patient underwent a number of ocular and facial procedures for reconstruction of the orbit and eyelids and was referred for laser therapy. Unfortunately, the laser therapy did not provide any improvement in the patient’s appearance. As a last resort, some of the larger deposits were excised using punch biopsy. The recovery was remarkable, with virtually no scarring at the punch biopsy sites. The patient went on to have a further five punch biopsy procedures over the following three years, with between 50 and 100 punch biopsies being taken at each setting. He was discharged from the service five years following the injury with a remarkable improvement in appearance with almost all of the deposits having been removed leaving no significant scarring.

**Conclusions:** Though seemingly unconventional, this technique has lead to a dramatic improvement in this patient’s appearance. This patient developed no significant scarring from the ‘biopsy’ procedures, and is delighted with the result.

**Applicability of Research to Practice:** This procedure is easy to perform, quick, cheap, and has few side-effects or complications. It is a useful adjunct to the range of procedures available to the plastic surgeon for amelioration of the appearance of blast injuries. The results may be dramatic with limited scarring.

44. Epigenetic Modification in Keloid Scars

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School of Surgery, University of Western Australia, Perth, Australia; Department of Dermatology, Gentofte University Hospital, Copenhagen, Denmark; Centre for Genetic Origins of Health and Disease, University of Western Australia, Perth, Australia; Burns Service of WA, Royal Perth Hospital, Perth, Australia

**Introduction:** Keloid scarring is characterised by abnormal fibroproliferation during skin regeneration beyond original wound boundaries. The molecular mechanisms are poorly understood. Epigenetic mechanisms involve DNA modifications other than sequence changes (e.g. methylation) and have been implicated in development, cancer and fibrotic disorders. We hypothesize that epigenetic regulation of specific gene sets underlies keloid scar aetiology. This study aims to expand our understanding of keloid scarring and identify novel targets in their treatment through the systematic analysis of integrated genome-wide methylation and transcriptome data.

**Methods:** Keloid tissue was obtained from 13 patients undergoing surgical excision. Dermal fibroblasts from the tissue samples were cultured in vitro to passage 2. DNA was harvested, bisulfite converted and analysed using Illumina Methylation Genechips. Simultaneously gene expression data was obtained by mRNA analysis and transcriptome profiling (Affymetrix Gene 1.0 ST arrays). Bioinformatic analysis was undertaken to compare keloid fibroblasts with 6 paired sets of fibroblast DNA and mRNA derived from mature ‘normal’ scar and matched skin. Differentially methylated and expressed genes were identified. Putative epigenetically regulated loci associated with keloid phenotype were confirmed by interrogation of the DNA methylation data.

**Results:** Significant differential methylation was observed between keloid fibroblasts and control fibroblasts. Our data showed that out of the 485,577 loci studied, there were 25% differentially methylated loci between keloid fibroblasts and normal skin fibroblasts. Of these, 81% of the loci were hypermethylated. When keloid fibroblasts were compared with fibroblasts from normal scar, significant differential methylation was observed at 27% of the loci with 81% hypermethylated. Important genes, known to play a major role in the development and function of cells were among those with the most significantly altered methylation. Bioinformatic analysis of the transcriptome data and integration with the methylome data is continuing and will be presented.

**Conclusions:** Significant changes of DNA methylation were observed in keloid fibroblasts and will enable identification of potential target genes. Targets will require validation as potential points of therapeutic intervention to limit keloid pathogenesis.

**Applicability of Research to Practice:** This integrated approach to identifying epigenetic mechanisms of gene regulation in keloid scar will help to better understand the pathogenesis and may eventually lead to identification of molecular markers for treatment.

**External Funding:** King Khalid University (Saudi Arabia) and Wound Management Innovation CRC (Australia).
Introduction: Keloid scarring is a severe disease of the skin with no reliable treatment. Verapamil is a calcium channel antagonist known to modulate collagen synthesis. It has been tested in previous studies for intralesional keloid treatment and is recommended in European International Guidelines for keloid scar management. This study compared steroid and verapamil for preventing keloid recurrence after surgical removal.

Methods: The study was a randomized controlled trial with a paired design using a split scar. Subjects and assessors were blinded. Thirty patients with keloid scars undergoing surgical removal were to be recruited. Subjects were invited to participate if the excision would result in a 2 - 10cm linear scar. Each scar half was randomly assigned to receive triamcinolone acetonide 10mg/ml (2mg/cm: max total dose 10mg; reduced to 1 mg/cm: max total dose 5mg after adverse event review) or verapamil 2.5mg/ml (0.5mg/cm; max total dose 2.5mg). Intralesional excision was performed by one surgeon with a standardized technique. Intralesional injections were performed along the suture/scar line after surgery and 1, 2 and 3 months post-surgery. At each visit and 6 and 12 months post-surgery, assessment of scar (VSS, POSAS, spectrophotometry) and side-effects were made on each half. Primary end-point was time to keloid recurrence. Subjects were withdrawn from the study for an adverse event requiring unblinding of treatment or when the primary endpoint was reached. An unblinded safety-committee met on 2 occasions before completion: (1) to review adverse events; (2) to compare keloid recurrence rates (Kaplan-Meier survival analysis). No additional subjects were recruited following the latter.

Results: Fourteen subjects were recruited and followed up for 6 months. One subject withdrew voluntarily, 6 reached the primary end-point, 4 were withdrawn due to adverse events and 3 were continuing to 12 month visit. Adverse events: 4/11 consecutive subjects (36%) who had commenced the study experienced atrophy/dehiscence in the steroid half of the scar. The steroid dose was subsequently reduced to 1 mg/cm (max total dose 5mg). No adverse events were observed in the steroid half thereafter. No adverse events were observed with verapamil. Efficacy: No recurrences were observed in the steroid half of the scar and 6 recurrences were observed in the verapamil half. Kaplan-Meier analysis demonstrated a significantly higher recurrence rate in the verapamil half of the scar at 6 months (Log-rank [Mantel-Cox] test p=0.0114).

Conclusions: Intralesional verapamil is safe but not as effective as triamcinolone in preventing keloid recurrence after surgical removal.

Applicability of Research to Practice: Generating evidence to inform clinical practice.
47. Management of Pediatric Skin-Graft Donor Sites: A Randomized Controlled Study of Three Wound Care Products

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Introduction: Skin grafts are used to treat many types of skin defects in children, including burns, traumatic wounds, and revision of scars. However, the existing research has primarily investigated donor site management in adults. This randomized controlled study compared the effectiveness of three dressing types for pediatric donor sites: calcium alginate, foam and hydrofiber.

Methods: Children admitted to the pediatric Burns & Plastics Service between October 2010 and March 2013 with an acute wound or burn, or who required reconstructive surgery, were recruited to the study. A standardized protocol was devised for dressing application and subsequent wound management. Patients were randomly assigned to the two experimental groups, foam or hydrofiber, and to the control group, calcium alginate. Children in each group were assessed daily and data gathered included leakage of exudate, pain scores and time to healing.

Results: Fifty-seven children with a mean age of 4.9 years (1-16 years) requiring skin grafting were randomly assigned to the experimental groups, hydrofiber (n=19) and foam (n=19), and to the control group, calcium alginate (n=19). Fifty-six patients had evaluable data and one participant from the control group was lost to follow up. The majority of children required skin grafting for a burn injury (78%). The mean size of the donor site was 111.39 cm² (8-600). The calcium alginate group recorded a lower median value of days to healing (Md=7.5 days) compared to the other two groups, which recorded median values of 8 days (hydrofiber) and 9.5 days (foam). Overall, children in this study, regardless of dressing type, had greater leakage of exudate on Day 2 post grafting than any other day. When compared across each group, 44% of the foam group had moderate to heavy leakage, compared to 23% of the hydrofiber group and 16% of the calcium alginate group. No significant difference was found in pain scores across each of the three dressing groups, with p>0.05.

Conclusions: Calcium alginate dressings emerged as the optimum dressing for pediatric donor site healing in this study.

Applicability of Research to Practice: In the presence of a standardized approach to the application of wound dressings, calcium alginate is a readily available, clinically effective and cost effective dressing product for skin graft donor sites in children.

External Funding: The authors acknowledge the support of the National Children’s Research Centre, Dublin in funding this study.

48. What Vancouver Scar Scale Score Constitutes a Hypertrophic Scar? Results from a Survey of American Burn Care Providers

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Introduction: What constitutes hypertrophic scar (HTS) & how scar evolves can challenge clinicians & researchers. The Vancouver Scar Scale (VSS) was introduced in 1990 & has been widely described in the literature. To date, no study has asked burn care providers to correlate a score on this scale with a clinical diagnosis of HTS.

Methods: An anonymous online survey was sent to 1,000 burn care providers & researchers. Among other questions, respondents were asked “What score on the VSS constitutes HTS?” They were shown photos & asked if they believed the scar was hypertrophic; they were separately asked to give the scar a VSS score.

Results: We had 130 respondents (13%); several respondents felt that they were not able to adequately assess pliability by photographs & abstained from completing the survey. A low response rate is not unexpected since many recipients may be involved in early patient management & may not be comfortable with scar assessment. Most respondents were physicians (43.9%) & had worked in burn care for over 10 years (63.1%). Most did not use the VSS in clinical practice (58.5%). The median response to the question “What total score on the VSS constitutes HTS?” was 7; responses demonstrated significant variation (Figure). There was no difference in median response when respondents were classified by job title, years in burn care, or use of VSS in practice (p=0.36, 0.66, 0.31). When asked specifically whether each scar example was HTS, the response of “yes” correlated with median scores of 8, 8, & 10 and “no” corresponded with scores of 3 & 4 (Table).

Conclusions: Our survey suggests that the VSS is not widely used by burn clinicians & that even with those that use the scale there is wide variation in perceptions of what constitutes a HTS. This study illustrates the need for an objective tool to characterize scars & standardize HTS definition for clinical & research purposes, which could lead to a robust & descriptive multi-center burn scar database.

Applicability of Research to Practice: Illustrates that we do not have a consensus on what score on the VSS constitutes HTS, highlighting an area for future research & development.

Results Table

<table>
<thead>
<tr>
<th>Scar 1</th>
<th>Scar 2</th>
<th>Scar 3</th>
<th>Scar 4</th>
<th>Scar 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this constitute a HTS? (% Yes)</td>
<td>97.7</td>
<td>98.5</td>
<td>3.8</td>
<td>82.3</td>
</tr>
<tr>
<td>Total VSS (mean±SD)</td>
<td>8.4±1.5</td>
<td>9.9±1.5</td>
<td>2.7±1.3</td>
<td>7.6±2</td>
</tr>
<tr>
<td>Pigmentation (mean±SD)</td>
<td>1.3±0.8</td>
<td>1.6±0.7</td>
<td>1±0.3</td>
<td>2±0.2</td>
</tr>
<tr>
<td>Pliability (mean±SD)</td>
<td>3.1±0.6</td>
<td>3.7±0.7</td>
<td>0.7±0.8</td>
<td>2.4±0.8</td>
</tr>
<tr>
<td>Height (mean±SD)</td>
<td>2.3±0.6</td>
<td>2.5±0.6</td>
<td>1.4±0.4</td>
<td>1.4±0.6</td>
</tr>
<tr>
<td>Vascularity (mean±SD)</td>
<td>1.5±0.6</td>
<td>2.1±0.5</td>
<td>0.8±0.5</td>
<td>1.8±1.4</td>
</tr>
</tbody>
</table>
49. **Single Institution and National Burn Registry Analysis of Factors Associated with Burn Wound Cellulitis**

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**Introduction:** Burn wound cellulitis (BWC) is a commonly reported complication. Variations in burn etiology, socioeconomic status, demographics and burn care practices may predispose BWC. We sought to determine clinical risk factors that can be linked to BWC so that targeted prevention could be possible.

**Methods:** Medical records for burn patients treated at a Midwest burn center between 4/2009 and 4/2013 were reviewed retrospectively for ICD-9 or clinical diagnoses of BWC within seven days of injury. These patients were matched 1:2 with a contemporaneously treated control group who did not incur BWC. Similarly, the National Burn Repository (NBR) was queried to identify burn patients who had BWC between 2002 and 2011. Data sets were analyzed separately. Univariate analysis and multiple logistic regression (MLR) analysis were used to determine significant associations between the independent variables and the dependent variable. IRB and ABA approval was obtained.

**Results:** Institution incidence of BWC was 19%. The average time to occurrence was 3.45 days post burn. Older age, delayed care, injury severity score (ISS), extremity burns, smoking, diabetes, obesity, positive MRSA screen and renal disease were significantly associated with the development of BWC (p<0.04 for all). For institution specific data, delayed treatment, lower extremity burns, smoking status, ISS, and older age remained independently associated with BWC on MLR analysis. NBR analysis showed similar associations. Although BWC was the second highest complication, the national incidence of BWC was lower at 3%. Gender (female), older age, larger burns, size/location of partial thickness burns, third and second degree extremity burns, flame burns, and burns occurring on a farm were associated with cellulitis nationally (p<0.001 for all). Both institution specific and NBR analysis showed BWC patients have significantly longer hospital stays, more surgeries and higher cost associated with their care.

**Conclusions:** Cellulitis remains a significant problem for the burn community. The factors found to be significantly associated with BWC may be useful to identify a target group for earlier operative intervention or prophylaxis. Future prospective analyses needs to clarify the impact of these factors as well as the impact of the place of injury and the method used to extinguish the burning process.

**Applicability of Research to Practice:** Since BWC is one of the most common complications seen in a burn population it is therefore also a frequent reason for hospital admission or readmission. Preventing BWC from occurring through the use of targeted prophylactic therapy or identifying BWC early will help reduce the significantly higher cost of care for these high risk patients.

**External Funding:** UICCOM Summer Research Program.

50. **An Increased Incidence of Acute Kidney Injury in Severely Injured Burns Patients Is Associated with Administration of Vancomycin with Piperacillin-Tazobactam**

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**Introduction:** Patients with burn injury display a dramatic catabolic inflammatory response, which ultimately leads to an immunosuppressed state. In addition massive fluid shifts place the patient at risk for acute kidney injury. Therefore when considering antibiotic regimens for a patient it is crucial to consider the risk of acute kidney injury. Several studies presented at the Society of Critical care medicine suggested a synergistic nephrotoxicity between vancomycin and piperacillin-tazobactam. However, little is known about the impact of these medications on the incidence of acute kidney injury in burns patients.

**Methods:** A retrospective review of all patients over the age of 18 admitted to our surgical burn unit over the last three years was performed. One hundred and eleven patients with burns greater than 10% who received vancomycin alone (n=25) and vancomycin with piperacillin-tazobactam (n=86) were included in the study. Patients were excluded if they expired during admission or received these antibiotics for less than 48 hours. Serum creatinine levels were recorded at admission and at the peak during antibiotic administration. An elevation in serum creatinine of 0.3 mg/dL or 1.5 fold elevation in serum creatinine from admission was defined as acute kidney injury. We then compared the frequency and severity of acute kidney injury in patients receiving vancomycin alone versus vancomycin in conjunction with piperacillin-tazobactam.

**Results:** Demographic data for each group were similar. Acute kidney injury was significantly more common and more severe in those patients taking vancomycin and piperacillin-tazobactam (incidence 46%, mean rise in Cr 0.8mg/dL) vs those taking vancomycin alone (incidence 8%, mean rise in Cr 0.1mg/dL) (p<0.05).

**Conclusions:** The use of antibiotics that have additive nephrotoxic effects should be minimized in all surgical intensive care units. Alternative medications should be sought wherever possible to reduce increased morbidity in this high-risk population.

**Applicability of Research to Practice:** This result gives us a vital insight into the increasing incidence of acute kidney injury in burns patients. Investigation needs to be directed at the synergistic effect of antibiotics within the same critically ill patient to reduce this unnecessary morbidity.

**External Funding:** SHIC Special Shared Facility for Clinical Research: 84080 and 71008. NIDRR (H133A070026 and H133A70019), National Institutes of Health (P50-GM60338, RO1-GM56687, KL2RR029875 and NIH UL1RR029876).

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Introduction: Hospital acquired methicillin-resistant Staphylococcus aureus (HA-MRSA) is the cause of the highest number of hospital associated infections and is a significant concern for burn centers. The use of 2% chlorhexidine impregnated wipes and nasal mupirocin has been shown to significantly decrease the rate of HA-MRSA in a recent study of adult ICU’s. A universal decolonization protocol was implemented in a high-volume burn center. This study aims to examine how the rate of MRSA transmission after implementation of this protocol changed, as well as rates of catheter associated urinary tract infections (CAUTI), central line blood stream infections (CLABSI) and ventilator associated pneumonia (VAP).

Methods: All new admissions to the burn service after February 4, 2013 were started on a daily chlorhexidine scrub from the neck down as well as a 5 day course of nasal bactroban, repeated monthly, during their entire hospital stay. Patients not able to get a full shower secondary to wound dressings utilized the 2% chlorhexidine impregnated wipes. Prior to the implementation of the decolonization protocol the standard in the burn center was to culture all patients on admission with nasal and wound swabs and then weekly nasal and wound cultures. This culturing practice was continued following implementation of the protocol.

Results: In the 14 months preceding the protocol change there were 31 new cases of MRSA for a rate of 11.46/1000 patient days. Following the decolonization protocol there have been no reported cases of MRSA over 1095 patient days.

Conclusions: Secondary to the loss of the skin barrier and suppressed immune systems, burn patients are at great risk for invasive infection leading to severe complications and death. The prevalence of MRSA in the burn center has been significantly reduced following the implementation of a universal decolonization protocol. In addition to the reduction of MRSA, we observed similar reductions in CAUTI, CLABSI, and VAP rates.

Applicability of Research to Practice: A universal decolonization protocol can significantly reduce the incidence of MRSA in burn center populations.

52. Use of PET Imaging for Early Detection of Infection Foci after Burn Injury

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Introduction: Infection is a common complication of burn injury (BI) and early detection is important in BI treatment. The present study aims at exploring the feasibility of using PET tracers to detect focal sites of infection.

Methods: Three studies were conducted 1) Animals received BI with burn surface infected with pseudomonas transfected with luciferase, followed by injection of luciferin and serial bioluminescence images (Biol) with a CCD (charge-coupled device) camera to monitor the extent of infection during the wound healing process. 2) Animals with the same infection were injected with both luciferin to evaluate Biol, and 18FDG to measure regional glucose metabolic activity by μPET. 3) Two PET tracers 18FDG and 18FLT (3’deoxy-3’[18F]fluorothymidine) to differentiate bacterial infection and sterile turpentine inflammation.

Results: The Biol demonstrated amelioration of the bacterial infection during the natural healing course of the infected wounds (Fig. 1), indicating the accuracy of CCD-Biols. The extent of infection showed linear relation with the accumulation of 18FDG in the infection area (Fig 2). Since 18FDG accumulation indicates increased regional metabolic activities which could be caused by either sterile inflammation or bacterial infection, we further compared PET imaging with 18FDG and 18FLT in a turpentine induced sterile wound. 18FLT is a thymidine analogue which is trapped in bacteria via the thymidine salvage pathway but not significantly by local host cells, Sterile wounds showed intense 18FDG accumulation but minimal 18FLT activity (Fig 3).

Conclusions: The results demonstrate the feasibility of using whole body imaging to monitor the molecular events associated with the growth of a bacterium, and the subsequent systemic changes induced by this infection at both the genetic and metabolic level.

Applicability of Research to Practice: Modern imaging of early infection.

External Funding: Shriners85110&.NIHP50.
53. Burn Injury Alters Intestinal Microbiota and Increases Gut Permeability and Inflammation

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Loyola University Chicago, Maywood, IL; Loyola University Medical Center, Maywood, IL

Introduction: Burn injury is of considerable importance with nearly half a million cases and 4,000 deaths reported nationally every year. Burn patients suffer a global immune dysregulation characterized by a breakdown in epithelial barrier integrity in the gut, enhanced production of proinflammatory mediators, and increased bacterial translocation leading to an increased susceptibility to systemic septic infections. However, it is not known how the diversity of the intestinal microbiota changes following thermal injury and its implications in immune function and inflammation. We hypothesized that burn injury alters the intestinal microbiota, which accompanies a decrease in antimicrobial peptides (AMPs) leading to increased bacterial translocation and inflammation in the gut.

Methods: Male C57BL/6 mice were subjected to a -20% total body surface area burn or sham burn and sacrificed on days 1, 3 and 5 thereafter. To measure intestinal transit and permeability, mice were gavaged with FITC-dextran. After 90 min, the luminal contents of the GI tract were removed, blood was drawn, and the dye was measured spectrophotometrically. The distal small intestine (ileum) and feces were collected. DNA and RNA were purified (Qiagen mini kits) from the feces and intestine tissue and subjected to qPCR to measure gene expression (Applied Biosystems) of AMPs and copy number of the 16s bacterial gene. A multiplex assay (BioRad) was performed on homogenized intestine tissue to measure cytokines levels.

Results: We observed a significant decrease in intestinal transit and an increase in intestinal permeability one day after burn injury relative to sham (p<.05). QPCR analysis of 16s showed that burn increased copy number of total bacteria ~20 fold and the Gram-negative γ-Proteobacteria and Enterobacteriaceae ~1000-4000 fold respectively in the feces (p<.05). The intestine tissue similarly showed an increase in Enterobacteriaceae with a corresponding decrease in lactobacillus (p<.05). Gene expression analysis of AMPs from the intestine showed a 50% decrease in α-defensins with a 50-60% decrease in the c-type lactins and lactoferrin, respectively (p<.05). Furthermore we observed a significant increase in a number of proinflammatory cytokines in the intestine of the burned mice (IL-6, -13, -31,-33,G-CSF, KC, MCP-1, p<.05).

Conclusions: Our data suggest that burn injury decreases intestinal transit, attenuates the expression of AMPs and promotes a dysregulation of microbiota in the gut. This may result in the observed increase of bacterial translocation and inflammation.

Applicability of Research to Practice: These results suggest that gut microbiota may play a role in post burn inflammation.

External Funding: W81XWH-10-2-0172 and RO1 AA015731-07A1.

54. Successful Outcomes Associated with Implementing the Use of Alcohol Impregnated Port Protectors in a Burn Unit

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Introduction: Contamination of the hub (entry point) of the Central Venous Catheters (CVC) is a risk factor for central line associated blood stream infections (CLABSI). The majority of burn patients need central lines and is a high risk population for blood stream infections given the need for high volume resuscitations, multiple surgical procedures, compromised immune systems and prolonged hospitalization. The National Healthcare Safety Network (NHSN) CLABSI rate for burn centers is 3.5 infections/1000 line days. We sought to determine if the use of alcohol-impregnated port protectors on all entry points of the CVC would decrease our center's rate of CLABSI.

Methods: An Evidenced Based Practice project was implemented based on identified fluctuations in CLABSI rates from 2009-2011, ranging from extremely high to within national standard rates. The infection control team at our regional burn/trauma center collaborated with the burn intensive care Unit Practice Council (UPC) and created a proposal to investigate current practices utilizing the standard 70% Isopropyl alcohol swab technique and compare after the implementation of a CVC alcohol-impregnated port protector cap. The change was proposed to the Nurse Manager and the UPC was approved to conduct the project. UPC collaborated with unit Clinical Nurse Specialist (CNS) and infection control department; the manufacturer agreed to trial their product. UPC coordinated with institutional stakeholders to start the requisition process which included going through the Resource Manager, Logistics, and Purchasing. Multiple in-services were given on the alcohol impregnated port protectors to staff in December 2011 and data collection began. Weekly audits were conducted in conjunction with current central line bundle on compliance with use of alcohol impregnated caps: spot correction was provided for non-compliance.

Results: Average CLABSI rates/1000 line days were: 17.7 in 2008; 16.8 in 2009; 3.6 in 2010 and 8.3 in 2011. During the January to June 2012 intervention period CLABSI rate was 2.4%; this was below the 3.5% NHSN rate for the first time in our Burn Center.

Conclusions: Within a 6 month period of trial of alcohol impregnated caps our CLABSI rate decreased by almost 4-fold. Based on an estimated cost savings of $44,000 per incidence of CLABSI, cost savings with the use of $0.25 alcohol impregnated caps has the potential for significant savings and improved health of our vulnerable population.

Applicability of Research to Practice: Coordinated efforts of the UPC to implement practice change contributed to our efforts to help decrease CLABSI, thereby improving patient care and potentially saving the hospital thousands of dollars in costs associated with this preventable infection.
Introduction: Burn patients are at risk for acute kidney injury (AKI) from both pathologic and iatrogenic etiologies. Studies report an AKI prevalence rate of 53.3% with nephrotoxic glycopeptide and aminoglycoside antimicrobial drugs associated with greater renal injury severity. Creatinine clearance (CrCl) is the “gold standard” for monitoring nephrotoxic antimicrobial therapy. However CrCl inadequately represents real-time changes in renal function due to the slow half-life of serum creatinine (SCr). Novel biomarkers of renal function such as, neutrophil associated gelatinase lipocalin (NGAL), may serve as an adjunct to CrCl in patients at risk for AKI. The goal of this study is to evaluate NGAL’s capacity to detect AKI and correlate with CrCl during nephrotoxic antimicrobial therapy.

Methods: We conducted a prospective observational study enrolling 21 adult (≥18 years) patients with severe burns (≥20% TBSA) receiving nephrotoxic vancomycin and/or tobramycin antimicrobial therapy for suspected sepsis. Whole blood NGAL measurements were paired with SCr and serum antimicrobial concentration testing. CrCl was estimated using the Cockroft-Gault formula. AKI was based on the RIFLE criteria determined at each sample collection time point.

Results: Thirteen out of 21 patients experienced AKI (61.9%) during the course of their nephrotoxic antimicrobial therapy. Age, burn size, and gender were similar between AKI and non-AKI patients. Eleven of the 13 AKI (84.6%) patients had microbiology confirmed sepsis. NGAL (254.4 ±90.0 v. 154.3±75.1 ng/mL, P=0.013) and SCr (1.53±0.58 v. 0.49±0.21 mg/dL, P<0.001) levels were significantly higher in patients with AKI. Vancomycin (17.2±3.8 v. 11.5±2.6 µg/mL, P<0.001) and tobramycin (8.1±1.6 v. 1.9±0.8 µg/mL, P<0.001) levels were significantly higher in patients with AKI. NGAL (R2=0.58, P<0.001) and CrCl (R2=0.30, P=0.005) served as significant predictors of vancomycin concentration respectively. In contrast, only CrCl served as a significant predictor of tobramycin concentration (R2=0.59, P=0.009).

Conclusions: AKI during nephrotoxic antimicrobial therapy occurs frequently in severely burned patients. NGAL served as a better predictor of vancomycin concentration than CrCl. In contrast, only CrCl was able to predict tobramycin levels. NGAL should be used in conjunction with CrCl to aid in the early detection of AKI and monitor for nephrotoxic damage.

Applicability of Research to Practice: NGAL testing can be performed on hospital and point-of-care platforms. Once validated, these tests can be used for routine patient care to monitor for AKI in critically ill patients.

External Funding: An intramural pilot grant and Medical Student Research Fellowship supported the study.
Incidence of National Burn Injury Treated in Emergency Departments

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University of Utah, Salt Lake City, UT

Introduction: The National Burn Repository reports only inpatient admission information from participating burn centers, meaning that sparse information exists about the true national incidence of burn injury. Nationwide Emergency Department Sample (NEDS 2010) is the largest all-payer emergency department (ED) database available in the United States. The purpose of this study was to use NEDS 2010 to evaluate national burn injury incidence and compare patient characteristics and outcomes with other trauma injury visits.

Methods: NEDS 2010 was constructed from linking State Emergency Department Databases and State Inpatient Database from 28 participating states. Stratification is based on geographic region, trauma center designation, urban-rural, teaching status and hospital ownership. With IRB approval, we isolated all ED visits that were injury related. All injuries are drawn from the classification system used by the Centers for Disease Control and Prevention. Two comparative groups were created: those with burn injury (Burn) compared to those with a non-burn injury (NB).

Results: Out of the estimated 128.9 million visits in 2010, 30.2 million were injury-related emergency visits and only 426,719 were burn related (1.4% of all injury-related ED visits). As shown in Table, Burns were significantly younger than NB (31.1 years old vs. 36.2 years old, p<0.001). Although fewer Burns were directly admitted to the hospital compared to NB (5.8% vs. 8.0%, p=0.005), Burns were significantly more likely to be transferred to another acute care hospital than NB (3.5% vs. 1.3%, p<0.001). Both Burn and NB patients were primarily treated at non-teaching, non-trauma centers. Burn hospital inpatient charges were significantly greater than NB ($59,887 vs. $45,314, p<0.001). The length of inpatient stay for Burn was significantly longer than NB (7.5 days vs. 5.2 days, p<0.001).

Conclusions: Based upon our findings, most injuries are treated significantly longer than NB (7.5 days vs. 5.2 days, p<0.001). The length of inpatient stay for Burn was treated at non-teaching, non-trauma centers. Burn hospital inpatient charges were significantly greater than NB ($59,887 vs. $45,314, p<0.001). The length of inpatient stay for Burn was significantly longer than NB (7.5 days vs. 5.2 days, p<0.001).

Applicability of Research to Practice: Understanding treatment, referral, and payer patterns assists in optimizing the care of the Burn patient.

Comparing Burn Injury to Non Burn Injury Using NEDS 2010*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Burn N=426,719 visits</th>
<th>Non Burn Injury N=29.8 million visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age in years (95% CI)</td>
<td>31.1 (30.6-31.5)</td>
<td>36.2 (35.8-36.6)</td>
</tr>
<tr>
<td>Disposition from ED:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated &amp; released</td>
<td>89.3% (88.3-90.2)</td>
<td>88.7% (88.2-89.1)</td>
</tr>
<tr>
<td>Transferred to another hospital</td>
<td>3.5% (3.2-3.7)</td>
<td>1.3% (1.2-1.4)</td>
</tr>
<tr>
<td>Admitted to hospital</td>
<td>5.8% (4.8-6.8)</td>
<td>8.0% (7.7-8.3)</td>
</tr>
<tr>
<td>Treated at:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-teaching hospital</td>
<td>61.6% (58.7-64.4)</td>
<td>63.4% (61.2-65.5)</td>
</tr>
<tr>
<td>Non-trauma hospital</td>
<td>61.1% (58.4-63.9)</td>
<td>65.0% (63.0-67.0)</td>
</tr>
<tr>
<td>Mean inpatient charges (95% CI)</td>
<td>$59,887 (49,262-70,511)</td>
<td>$45,314 (42,759-47,869)</td>
</tr>
<tr>
<td>Mean length of stay (95% CI)</td>
<td>7.5 days (6.7-8.1)</td>
<td>5.2 days (5.1-5.3)</td>
</tr>
</tbody>
</table>

* Results are reported as % (95% CI) unless otherwise noted, p<0.05
59. Socio-Economic Deprivation Indices and Clinical Frailty Scoring in Elderly Burn Patients: Useful Predictors of Survival on Admission?

C. M. Wearn, BSc, MBBS, MRCS(Eng), A. Kitsios, MBBS, V. Siddons, MBBS, P. Nightingale, PhD, N. S. Moiemen, MBBS, FRCS, FRCS(Plast)
Healing Foundation UK Centre for Burns Research, Birmingham, United Kingdom; Queen Elizabeth Hospital Birmingham, Birmingham, United Kingdom

Introduction: The elderly are more susceptible to sustaining burn injury than younger adults and experience poorer outcomes when controlling for burn size. Prediction of outcomes such as mortality, is vitally important to aid treatment decisions, internal audit, benchmarking and evaluation of new treatments. Our study aims to assess the utility of deprivation indices and clinical frailty scoring as predictors of survival of elderly patients admitted to a UK regional burns centre.

Methods: A 9 year retrospective case note review was conducted of all burn admissions aged ≥ 65 years to our burns centre between 1st January 2004 and 31st December 2012. Exclusion criteria included: no available notes, TENS and admission for comfort care. The Canadian Study for Health and Ageing (CSHA) Clinical Frailty score (CFS) was assessed for each patient using the medical, nursing and therapy notes. The UK Multiple Index of Deprivation (MID) was extracted from the UK Data service census support website. Demographics, burn injury and outcome data was extracted from the records, collated in a Excel® Spreadsheet (Microsoft®, USA) and analysed with SPSS V21 (IBM, USA).

Results: A total of 228 patients were included in the study after exclusion of 28 patients. In the study group the median age was 79 (IQR 71-84) years, median TBSA-burned was 5% (IQR 2-10) and 14% of patients sustained inhalation trauma. Median ABSI score on admission was 7 (IQR 6-8) and commonest burn mechanism was flame (40%) followed by scald (24%). Overall mortality was 20.4% (51/258) and study group mortality was 16% (36/228). Both median CFS and median MID were significantly higher in non-survivors (p=0.010, 0.018 respectively). Multi-variate logistic regression analysis showed CFS and MID to be significant predictors of mortality, independent of age and burn size (p = 0.043 and 0.027). ROC analysis and calculation of area under the curve (AUC) showed both CFS and MID to have good sensitivity and specificity (AUC = 0.892, 0.873). The odds ratio for mortality for each frailty point increase was 1.588 (95% CI: 1.156-2.179).

Conclusions: Clinical frailty scoring (CFS) is a measure of pre-morbid functional capacity that is an independent predictor of mortality in elderly burn patients. CFS scores greater than 5 were associated with greatly increased risk of mortality. Deprivation scoring using the UK Multiple Index of Deprivation (MID) is also an independent predictor of mortality in elderly burn patients.

Applicability of Research to Practice: Analysis of CFS and MID of a large cohort of elderly burn patients has demonstrated that they are independent predictors of mortality on admission. They may serve as useful adjuncts to currently available prognostic scores.

60. Factors Impacting the Likelihood of Death in Patients with Small TBSA Burns

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The Burn Center, Department of Surgery, MedStar Washington Hospital Center, Washington, DC; Firefighters’ Burn and Surgical Research Laboratory, MedStar Health Research Institute, Washington, DC

Introduction: Survival rates of burn patients have increased in past decades. However, to date, patients with relatively small burns may not survive their hospitalizations. Elucidating factors common to this subset of patients may allow concentration on therapeutic and preventative goals to improve their outcomes.

Methods: The NBR Main dataset was queried for record numbers associated with TBSA between 0.1 and 10 and a discharge status indicating death. Using SAS statistical software, the record numbers were matched for age, sex, and TBSA at a ratio of 2-3 controls (non-deaths) to 1 case (deaths). Chi-Square analyses of independence on categorical variables and two-tailed T-tests with unequal variance on continuous variables were used to identify fields of further interest. SAS was then used to build multivariate logistic regression models examining variable effects discharge status. The NBR Complications child dataset was queried and categorized for 12 types of complications for analysis.

Results: Multivariate logistic regression for discharge status, comorbidities, and complications showed that the presence of a comorbidity did not significantly impact discharge status, while the presence of a complication did. Complications (other than death) increased the odds ratio of a discharge status of death by a factor of 12.5 (95% CI [9.141, 17.076], p<0.0001). There were 1449 complications in the group of 618 cases and 804 identified complications in the group of 1577 controls. Infection-related complications were the most frequently seen, but these did not reach statistical significance in relation to discharge status. Multivariate logistic regression of complications in a model for death discharge status identified 4 categories as statistically significant: neurologic, cardiovascular, pulmonary, and renal (all p values <0.0001). In the model, patients with a discharge status of death were 6.95 times more likely to have a neurologic complication than patients with a live discharge status (95% CI [3.14, 15.36]).

Conclusions: In patients with small TBSA burns, complications significantly increase the odds ratio of death according to NBR data. Of the types of complications reported in the NBR, infectious complications are among the most frequent, but these do not appear to differentiate between likelihood of death in patients with TBSA ≤10. Four categories of complications do appear to contribute to these outcomes; neurologic, cardiovascular, pulmonary, and renal.

Applicability of Research to Practice: This work my highlight complications that can improve care in hospitalized patients with small burns.

External Funding: DC: Firefighters Burn Foundation.
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University of Utah, Salt Lake City, UT

Introduction: Although frostbite is a relatively uncommon injury the true incidence in the United States has not been quantified. The 2010 Nationwide Emergency Department Sample (NEDS 2010), the largest all-payer emergency department (ED) database available in the United States, contains information that approximate a 20% stratified sample of U.S. hospital-based EDs. We hypothesized that NEDS 2010 can be used to determine the incidence, charge, and outcomes of patients with frostbite injury in the United States.

Methods: NEDS was constructed by linking the State Emergency Department Database and the State Inpatient Database from 28 participating states. Stratifying on key hospital characteristics, NEDS provides a snapshot view of US hospital-based EDs. With IRB approval we extracted all patients with ICD-9 codes of 991.0-991.3 as having frostbite injury (FB) from all other encounters (ALL).

Results: Out of the estimated 128.9 million emergency department visits, 6,297 were identified as FB. Patients were mostly male (73%), many with chronic comorbid conditions (48%). The vast majority of comorbidities related to mental illness (72%). A small but significantly greater portion of FB than ALL reported lack of housing (12% vs. 0.2%, p<0.001). FB patients were significantly less likely than ALL to be treated and released (69.6% vs. 80.4%, p<0.001), more likely to be transferred to another hospital (4.7% vs. 1.5%, p<0.001) or were more likely to be admitted to the same hospital (23.7% vs. 15.3%, p<0.001). Almost half of FB (47%) patients were treated in large metropolitan area hospitals. FB patients were less likely to be treated in a non-trauma hospital (36% vs. 48%, p<0.001) or in a non-reaching center (51% vs. 61%, p<0.001). Although mortality was low for FB (0.6%), morbidity was significant since the most frequent inpatient procedure was lower extremity amputation (10%). The mean length of stay for FB was significantly longer than ALL (8 vs. 5 days, p<0.001). The mean FB inpatient hospital charge ($40,935) was also greater than ALL ($34,519). Self-pay or charity as the expected payer status was significantly more likely for FB versus ALL (29% vs. 17%, p<0.001).

Conclusions: Based upon our findings, vulnerable populations such as the mentally ill and homeless in urban metropolitan areas are at greater risk for developing frostbite. FB patients are more likely to be admitted as inpatients with their stay resulting in significant charges and morbidity.

Applicability of Research to Practice: By identifying vulnerable populations, public health officials can target information for proper prevention of and early intervention for frostbite injury.

62. Does Race, Gender, Age or Insurance Status Influence Recovery from Burn Injury?
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UC Davis Medical Center and Shriners Hospitals for Children - Northern California, Sacramento, CA

Introduction: The NIH defines health disparities as “differences in the incidence, prevalence, mortality and burden of disease that exist among specific population groups in the United States.” To examine health disparities in burn injuries, we investigated the relationship between race, gender, age and insurance status on mortality, length of stay, and discharge disposition.

Methods: We performed a 5-year review of adult patients admitted to our regional burn center. Data recorded included age, gender, race, total body surface area (TBSA) injured, length of stay per percent burn (LOSTBSA), inhalation injury, insurance status, and discharge disposition. All mean data are represented by mean ± standard error.

Results: We reviewed 1,182 patients. The demographic information is listed in the table below. Fewer non-Caucasians had private insurance (38.5% vs. 44.8%) but race did not influence LOSTBSA or discharge disposition. For insurance status, Medicare funded patients had a higher LOSTBSA (2.17±0.2*) compared to private insurance (1.57±0.1). Medicare patients either died (12%*) or were discharged to nursing homes or rehabilitation facilities (23%*) more often than other groups. Age (O.R. 3.92*) and inhalation injury (O.R. 13.1*) significantly increased mortality risk. (O.R. = Odds Ratio, *p<0.05)

Conclusions: For our burn patients, race and insurance status do not influence outcomes in adults. However, health disparities do exist for patients on Medicare (older patients) and research efforts should be directed towards improving care for the elderly to improve outcomes.

Applicability of Research to Practice: Identification of disparity in burn care among susceptible groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of patients</th>
<th>Age (years)</th>
<th>TBSA (%)</th>
<th>Mortality (%)</th>
<th>LOSTBSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>1182</td>
<td>45.8±0.5</td>
<td>13.9±0.5</td>
<td>6%</td>
<td>1.78±0.1</td>
</tr>
<tr>
<td>Male</td>
<td>853 (72%)</td>
<td>45±0.6</td>
<td>14.3±0.6</td>
<td>5.6%</td>
<td>1.74±0.1</td>
</tr>
<tr>
<td>Female</td>
<td>329 (28%)</td>
<td>47.9±1.0</td>
<td>13.0±0.9</td>
<td>6.7%</td>
<td>1.89±0.1</td>
</tr>
<tr>
<td>Private Insurance</td>
<td>507 (43%)</td>
<td>44±0.7</td>
<td>14.1±0.8</td>
<td>4.5%</td>
<td>1.57±0.1</td>
</tr>
<tr>
<td>Uninsured</td>
<td>195 (16%)</td>
<td>38±0.9</td>
<td>13.5±1.1</td>
<td>4.6%</td>
<td>1.64±0.2</td>
</tr>
<tr>
<td>Medicare</td>
<td>176 (15%)</td>
<td>62±1.5</td>
<td>13.9±1.2</td>
<td>11.9%*</td>
<td>2.17±0.2*</td>
</tr>
<tr>
<td>State Insurance</td>
<td>304 (26%)</td>
<td>45±0.9</td>
<td>14.0±1.0</td>
<td>5.6%</td>
<td>2.0±0.2</td>
</tr>
<tr>
<td>Asian</td>
<td>49 (4%)</td>
<td>45±2.8</td>
<td>14.2±2.8</td>
<td>6.1%</td>
<td>1.52±0.3</td>
</tr>
<tr>
<td>African American</td>
<td>59 (5%)</td>
<td>44±2.1</td>
<td>13.4±2.4</td>
<td>5.1%</td>
<td>2.05±0.3</td>
</tr>
<tr>
<td>Hispanic</td>
<td>202 (17%)</td>
<td>42±1.1</td>
<td>13±1.1</td>
<td>2.5%</td>
<td>1.77±0.2</td>
</tr>
<tr>
<td>Caucasian</td>
<td>869 (74%)</td>
<td>46±0.6</td>
<td>14.1±0.6</td>
<td>6.8%</td>
<td>1.79±0.1</td>
</tr>
<tr>
<td>Under 65 years of age</td>
<td>1002 (93%)</td>
<td>40±0.4</td>
<td>13.7±0.5</td>
<td>4.2%</td>
<td>1.8±0.1</td>
</tr>
<tr>
<td>65 years and older</td>
<td>180 (7%)</td>
<td>75±0.6</td>
<td>17.5±1.3</td>
<td>15%*</td>
<td>1.72±0.1</td>
</tr>
</tbody>
</table>
63. More Than Twice the Risk of Dying: Burn Injured Women Admitted to Intensive Care Units

E. Moore, MBBS, H. Cleland, MBBS, M. Bailey, PhD, D. Pilcher, PhD
The Alfred Hospital, Melbourne, Australia; Monash University, Melbourne, Australia

Introduction: In contrast to the higher mortality for men associated with trauma and sepsis, reported gender differences in mortality after burns are inconsistent. We report on an unexpected finding of a multicenter regional cohort study which included eight out of nine adult burns referral centres in 2 countries (The BEAM Study).

Methods: The Burns Evaluation and Mortality (BEAM) Study examined the outcomes of all patients admitted following thermal injury to the Intensive Care Unit (ICU) at eight out of nine adult burns referral centres in 2 countries between Jan 1, 2005 and Dec 31, 2011. Data from local burn unit registries and ICU databases included basic demographics (age, gender, date of injury); burns specific data (type and aetiology of burn, size and depth of burn, inhalational injury); severity of illness [Acute Physiology and Chronic Health Evaluation Score (APACHE) II] relating to the first intensive care admission; and outcome (length of stay, in-hospital survival).

Results: Multiple logistic regression analysis demonstrated female gender was independently associated with mortality after adjusting confounding factors (OR 2.35, 95%CI 1.38-4.01, p=0.002). This finding applied to all units. Other independent predictors of death were age, APACHE II (excluding age component) and %FTSA.

Conclusions: Women with burns admitted to ICUs in this study were more than twice as likely to die as men. Differences in injury patterns, and physiological and immunological responses to injury and management which may account for this observation require further examination.

Applicability of Research to Practice: Differential mortality rates on the basis of gender require further examination with a view to understanding their cause. At present it is not possible to identify changes in practice that may address poorer outcomes in women who suffer burns.

External Funding: Henry O’Hara Research Trust.

64. Post-Discharge Cause-Of-Death in Combat Burn Casualties

U.S. Army Institute of Surgical Research, JBSA Fort Sam Houston, TX

Introduction: Burn injuries are a known cause of morbidity and mortality in wartime, comprising as many as 5-10% of injuries and 4% of deaths. Burns have been associated with approximately 4% of the combat-related deaths from Iraq and Afghanistan. Although several studies of military populations have investigated risk factors for death among burn patients during the acute phase, no studies have reported mortality rates after hospital discharge. This study examined the case fatality rate and causes of death among 830 combat burn patients discharged from the sole burn center in the US Department of Defense, between 7 March 2003 and 6 March 2013.

Methods: Cause-of-death was determined through the Armed Forces Medical Examiner’s Office and the Office of the Secretary of Defense’s National Death Index (NDI).

Results: A total of 11 deaths occurred among the 830 burn cases, for an overall case fatality rate of 1.3%. The causes of death for 10 of the cases were obtained from the NDI and for 1 from a published obituary. The cases included 7 Army and 4 Marines; 9 injured in Iraq and 2 in Afghanistan; average time from date of injury to arrival at the burn center was 3.64 days; the average age at death was 25.5 years. The median time for length of stay was 15 days; for injury severity score was 9; for Total Body Surface Area was 12% and for full thickness burn was 9%. Of the 11 who have died, 4 deaths were related to accidental poisoning by an exposure to drugs; 3 were related to operations of war (2 after returning to the war zone), and the remaining 4 died through accidents (1 explosion, 2 vehicle crashes, and 1 fall). No statistically significant differences in post-discharge lifespan or age at death were found across the 3 categories.

Conclusions: There were no confirmed suicides and according to the 2000 Census, accidents are the cause of more than 50% of deaths among males aged 15-44 years. Our results suggest that having a combat burn injury does not contribute substantially to an increased risk of death post-discharge.

Applicability of Research to Practice: Establishing mortality rates of post-discharge combat burn patients is important for national comparisons to determine what additional risk of death, if any, as the result of experiencing a combat burn trauma.
Improving HCAHPS in a Challenging Population: Burns and Trauma

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UAB Hospital, Birmingham, AL

Introduction: Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) is a metric that represents the patient's perception of quality care received. Data supports that the patient's experience is linked to great clinical care, reduced medical error, and improved patient outcomes. HCAHPS is part of the value-based purchasing initiative that ties reimbursement to quality outcomes. Three categories of HCAHPS questions relate to communication. The purpose of this presentation is to describe the development and implementation of a standardized orientation process for trauma and burn patients and the positive impact on HCAHPS scores.

Methods: In an effort to increase the HCAHPS categories related to communication, a standardized orientation was created. A multidisciplinary team was formed including key stakeholders from the Trauma and Burn Intensive Care Unit, Neuro Intensive Care Unit, Emergency Department, Acute Trauma Care Unit, and the Trauma and Burn Nursing Unit. A review of current literature was completed and a best practice identified. The team decided to create a video that patients and families would view within the first 12 hours of admission. The team then decided to pilot the standardized orientation process on the Acute Trauma Care Unit. Education was provided to all members of the health care team. During this phase, documentation of the patient viewing the video with in the first 12 hours was validated. Nurse leaders on the unit spoke to every patient in the first 24 hours of admission to answer any questions, ensure compliance with the new process, and address any concerns. HCAHPS survey results were evaluated by discharge date during the month pilot phase.

Results: HCAHPS scores in the categories involving communication improved. Nurses involved in the pilot process reported positive feedback with qualitative data supporting the consistency and effectiveness of the new process. The exact process is now being utilized in several other units where burn patients receive care and other specialty areas that have used the process as a guide to create unit specific orientation videos.

Conclusions: A consistent patient and family centered orientation process, upon admission with individual one on one discussion with the bedside nurse, positively impacts the HCAHPS composites related to communication.

Applicability of Research to Practice: Success of the implementation of this initiative in practice relies on the commitment of key people within the organization to see activities through from planning, implementation, and evaluation. Involving key stakeholders in the project team, created buy in and provided support for sharing best practices throughout a large academic medical center.

High Fidelity Human Patient Simulation: Bridging Burn Care Education with Modern Technology

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Introduction: Meeting the learner's needs during an Advanced Burn Life Support (ABLS) Provider Course directs healthcare institutions to embrace new learning environments, clinical models and educational practices that replicate real-life clinical situations. We enhanced current ABLS simulated scenarios to include high fidelity human patient simulation (HFHPS) and adjuncts (e.g. radiographs, laboratory reports) which were utilized by learners, ABLS faculty and simulation center personnel. We assessed if these enhancements improved the learners understanding of the primary and secondary burn survey, improved participant's satisfaction and self-confidence in learning and promoted realism in the simulation.

Methods: An evidenced-based (EB) National League for Nursing (NLN) simulation design template was used to augment the ABLS simulation syllabus. The designed template was vetted through the simulation center personnel and the faculty. To measure effectiveness of these changes the NLN Educational Practices Questionnaire (EPQ), the Simulation Design Scale (SDS), and the Student Satisfaction and Self-Confidence in Learning Scale (SSSCL) were utilized. A Likert scale was used to measure each survey question, 1=lowest and 5= highest score. Learner experience was evaluated upon ABLS course completion.

Results: From Oct 2012 - Aug 2013, The NLN simulation was utilized by 71 learners who rotated thru 5 ABLS simulations during 3 courses, (n=355 experiences). Participation rate for all 3 surveys was 83% (59/71). SSSCL's overall satisfaction with learning and self confidence was 4.4±0.7 and 4.5±0.7, respectively. The EPQ survey showed active participation rating of 4.5±0.7; with an importance rating of 4.4±0.8. The SDS rating for scenario and simulation realism was 4.6±0.6 and 4.5±0.6, respectively. Overall importance of realism was rated 4.4±0.8. Standardization of ABLS content through HFHPS allowed for greater consistency among faculty.

Conclusions: Use of HFHPS based on an EB simulation design augmented perceived learner satisfaction/competence, engaged active participation, and strengthened the realism of our ABLS Course. HFHPS scenarios allowed the participants to role-play, delegate tasks, share information and increase communication skills. Consistency in HFHPS scenarios allowed for repetition until content was mastered.

Applicability of Research to Practice: Specific ABLS curriculum and evaluation tools designed for HFHPS activities will increase overall effectiveness in the learning environment. More research is needed to determine best practices in the use of HFHPS to achieve most advantageous learning experiences during the ABLS Course.
Implementation of an Electronic Burn Admission Flowsheet Aids in Nursing Documentation, Initial Fluid Resuscitation, and Quality Improvement

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University of Colorado Hospital, Denver, CO

Introduction: Documentation is a vital tool that provides critical information about the care plan, assessments, and care delivery. Research suggests that nurses spend 25-50% of their time documenting. Specialized patient populations, such as burn patients, require very specific care and documentation. Initial resuscitation of burn patients ultimately affects patient outcomes and, therefore, requires close monitoring to prevent complications. Creating a customized burn admission flowsheet within the electronic health record (EHR) that is specifically designed to calculate and document fluid resuscitation in real-time can mitigate potential issues in burn resuscitation by promoting timely interventions, facilitating efficient communication, and reducing the chances of human error.

Methods: An interdisciplinary team developed a standard burn admission flowsheet in the EHR. The team included an analyst from the EHR system, a Clinical Nurse Educator, and a bedside nurse. The Medical Director, Burn Unit Attendings, and Clinical Nurse Specialist were also consulted. The team developed an electronic flowsheet based on a review of our evidence-based policies and unit-based burn resuscitation guidelines. When a patient is admitted and a nurse enters pertinent data such as the patient's height and weight, percent total body surface area burned, time of injury, time of admission, and pre-hospital fluid volume directly into the patient's EHR, the flowsheet then automatically calculates the 2010 ABA Consensus Formula, appropriate fluid rates depending on whether the patient was over- or under-resuscitated prior to admission, and maintenance IV fluid rates. When total fluids are entered into the flowsheet, the IVY score is automatically calculated to promote timely interventions and decrease the risk of over-resuscitation complications.

Results: The creation of a burn-specific admission flowsheet directly within the EHR increases the efficacy and efficiency of nursing workflow. Nurses are more confident that an accurate resuscitation rate is calculated and the chances of inaccurate resuscitation are minimized. The extensive information included in the EHR also allows reports to be run from the single flowsheet. This data can be easily extracted to improve outcome tracking and aid in quality improvement.

Conclusions: The implementation of an optimized burn flowsheet within the EHR is a valuable tool for ensuring accuracy of fluid resuscitation calculations and real-time monitoring of a patient's resuscitation status. Predicted patient outcomes will improve as the likelihoods of over- or under-resuscitation are decreased.

Applicability of Research to Practice: Nursing Practice thing to disclose.

Demonstrated Benefits of an Evidence-Based Burn Precepting Program

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U.S. Army Institute of Surgical Research, Fort Sam Houston, TX

Introduction: Lack of a structured precepting program was recognized as a factor for nurse dissatisfaction and turnover in the burn unit compared to other hospital units. Staff evaluations exposed a need for more didactic instruction, hands-on learning, and preceptor support. The goal of this project was to implement an evidence-based (EB) precepting program specific to the burn specialty.

Methods: The Iowa Model of Evidence-based Practice served as the model for this project. A working group of nurse scientists, clinical nurse leaders, clinical nurse specialists, lead preceptors, staff nurse preceptors and wound care coordinators was formed. A systematic review of the literature was conducted focusing on nurse transition; Preceptor development and Preceptee training programs with competency assessment, ongoing multifaceted evaluation and retention strategies were created. The EB Vermont Nurses in Partnership (VNIP) clinical coaching program was selected and education was provided to all Burn Center staff. Benchmarks for basic knowledge assessment (BKAT) by work site and education level and burn wound care (WC) were established among current staff to evaluate new hires (NHs). Policies were modified to count Preceptor/Preceptee dyads as 0.5 FTE on the schedule. Multiple high fidelity simulation scenarios were created to expand hands-on opportunities.

Results: From SEPT 2012 to AUG 2013, 34 NHs participated: 20 complete, 3 incomplete, 2 exceptions, and 9 currently enrolled. VNIP training (n=88) included 32 interdisciplinary staff and 100% of identified preceptors (n=33). VNIP course satisfaction survey revealed a mean rating of 4.7±0.2 on a 1-5 (best) Likert scale. NHs (n=20) achieved passing BKAT scores >70% and WC scores >75% of the time; individual remediation was provided for those failing to achieve unit benchmarks. NHs competency progressions were evaluated weekly on a 1-10 (best) scale, with 7 indicating safe independent practice; initial ratings 5.3 ± 2.2, final rating 9.1 ± 1.2 (n=18).

Conclusions: Use of the Iowa Model for EB practice and the VNIP Precepting Program are demonstrating preliminary success with new hire retention and improved burn care competencies.

Applicability of Research to Practice: This program is being considered for system-wide implementation across our national health care organization.

External Funding: Triservice Nursing Research Program (HT9404-12-1-TS08, N12-P04).

March 25 – 28, 2014 • Boston, Massachusetts
Should a Military Version of the Burn Specific Health Scale Be Developed?

L. H. Yoder, RN, PhD, D. C. McFall, RN, MSN, L. C. Cancio, MD, FACS

The University of Texas, Austin, TX; U.S. Army Institute of Surgical Research, Fort Sam Houston, TX

Introduction: There are three versions of the Burn Specific Health Scale (BSHS) currently in use: Abbreviated, Revised, and Brief. These quality of life (QOL) instruments have demonstrated reliability and validity in civilian burn populations. However, because military burn patients are typically younger and have physically demanding military duties, these versions of the BSHS might not provide the right constellation of questions, while minimizing response burden to the patient.

Methods: Seventy-eight participants were enrolled in this descriptive longitudinal study at the time of discharge. Data were gathered using the BSHS-A at discharge; 3, 6, 12, and 18 months post-discharge. Frequencies on all items were examined to determine 1) areas in which the service members experienced the most difficulty post burn, and 2) the questions that might signal that additional screening would be warranted.

Results: The participants were primarily male (n=76), Army (74%), enlisted service members (96%) with an average age of 25 years; they served in the military for an average of 62 months. Most were Caucasian (69%), had at least a high school education or GED (56%) with an annual income of $40,000 or less (78%); 46% were single and 45% were married. They presented with thermal burns and polytrauma resulting from combat injuries and accidents with a mean total body surface area burned = 24% (median = 17%). At least 25% of the participants reported they had quite a bit to extreme difficulty in 13 areas that are not present in the BSHS-R or BSHS-B. Also, 6 questions only asked on the BSHS-A would indicate that further screening may be needed to determine mental health problems such as depression or post-traumatic stress or increased levels of pain. Furthermore, military participants indicated relatively few problems regarding 29 questions on the BSHS-A. Thirteen questions that can be found on all versions on the BSHS were identified as creating quite a bit to extreme difficulty among at least 25% of the service members regarding their QOL. If a BSHS-M version were created that consisted of the questions designated as the most important for military burn patients it would consist of 32 items with a Cronbach's alpha of .92.

Conclusions: Because of the unique demographic characteristics and circumstances in which military service members are burned, a parsimonious QOL measure may be needed for this population. Since most of the patients were treated as outpatients at a facility located in a southern state with extreme heat conditions, questions about skin issues were of particular importance.

Applicability of Research to Practice: A military version of the BSHS would focus on the areas of importance to military patients and clinicians while decreasing response burden.

External Funding: This study was funded by the TriService Nursing Research Program.

Continuous Renal Replacement Therapy Sustainability in a Burn ICU: A Coordinator Perspective

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Introduction: Continuous renal replacement therapy (CRRT) has been introduced to a number of burn centers worldwide, yet program management has traditionally been the responsibility of nephrology services. We describe the establishment and growth of a self-sustained burn nurse-managed CRRT program in our burn intensive care unit (BICU).

Methods: In JUL 2005 our regional 16-bed BICU identified the need for locally managed CRRT capability. Due to a multidisciplinary effort between the burn surgeons, medical intensivist, a clinical nurse specialist, and bedside critical care nurses, the first patients were successfully and safely treated with CRRT within 5 months. A comprehensive competency program was based on a train-the-trainer approach. Institutional requirements for supplies and equipment were identified, and detailed policy and procedure documents were generated. Sustainment programs were developed and outcomes evaluated.

Results: Initial 5-day nurse training was provided by the device vendor for 10 “super-users”, who were responsible for subsequent training of additional staff nurses. By the start of CRRT delivery NOV 2005, 15/97 (15%) of BICU nurses were certified as competent. Ongoing competency evaluation was conducted annually, with one-on-one evaluation, and refresher training incorporated in the semi-annual Skills Fairs; on-the-spot feedback and hands-on refreshers were provided by the PC and super-users. In JUL 2012, 70/82 (85%) of BICU nurses were certified. Since NOV 2005 > 300 patients have undergone CRRT for > 5800 therapy days. Basic competency training is now introduced during BICU orientation; in JUL 2013 26 staff had basic and 14 had expert level competency.

Conclusions: A comprehensive nurse-managed CRRT program facilitates safe delivery of CRRT in our BICU. Program flexibility addresses turnover and elevated patient census. A dedicated PC provides structured training and competency assessment.

Applicability of Research to Practice: This CRRT platform serves as a template for development of our nurse-managed/Intensivist-driven therapeutic plasma exchange and extracorporeal membrane oxygenation programs.
Introduction: The concept of a journal club is rooted in disseminating information for the purpose of medical education. Several benefits have been associated with participation in journal clubs, such as increased aptitude for performance of research critique, appraisal, and utilization. The purpose of this ongoing study is to assess the implementation of a nursing based journal club’s impact on nursing practice, and determine participant attitudes towards evidence based practice and professional development.

Methods: Two different surveys were distributed to the journal club participants: a quarterly survey and post intervention survey. The survey design utilized the five point Likert scale. The quarterly survey assessed participant demographics and attitudes towards evidence based practice. Post intervention surveys were distributed after each journal club session to assess the efficacy in meeting the goal of increasing the participants’ knowledge of the topic.

Results: A total of 16 quarterly surveys were collected. The majority of participants (75%, n=12) reported journal club participation has motivated them to perform a literature search in response to clinical inquiry. In terms of professional development, 100% (n=16) of the participants responded that obtaining Continuing Education Units and reading research articles are important to their practice. Thirty post intervention surveys were collected. The participants reported the session made them think about the topic differently (90%, n=27) and that they are going to apply the information they have learned as a result of participation (83%, n=25).

Conclusions: The results of this study indicate participation in journal club activities promote an increased understanding of the selected topics, increased application of evidence to clinical practice and increased likelihood of pursuit of best evidence by participants in response to their own clinical inquiry.

Applicability of Research to Practice: Based on this study’s findings, journal club sessions may be an effective method for encouraging research utilization among nursing professionals, and for facilitating the translation of evidence into clinical practice.
TNF-alpha Is Involved in Burn/Smoke Induced Bronchial Epithelial Apoptosis

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Introduction: Smoke inhalation is a serious complication of burn injury. Smoke injured airway mucosa shows significant “necrosis” but the mechanism of bronchial epithelial cell death remains unclear. The present study used an established burn/smoke inhalation (B/SI) model in wild-type (WT) and genetically modified mice to determine if B/SI injury induce airway mucosa apoptosis and the involvement of TNF-alpha (TNFα) in the process.

Methods: WT and TNF-alpha knock out (TNFKO) mice were subjected to 30% total body surface area burn injury and then received SI by inhaling smoke from burning 250 mg of cotton for 15 min. We collected the bronchoalveolar lavage (BAL) to assess the inflammatory response to B/SI. Lung tissues were harvested to evaluate apoptosis by TUNEL staining and the effects of TNFα deficiency on apoptosis, inflammatory response and survival rate. TNFα inhibitor was also administered to WT receiving B/SI to evaluate the effects of TNFα on apoptosis, BAL and survival rate. TNFα expression was evaluated by Western blot under a variety of conditions.

Results: 24 hours after the injury, B/SI injury induced marked apoptosis of the airway mucosa (Fig. 1; Sham vs B/SI): 3±1.5% vs. 16±3.7% (P<0.001), accompanied with increased lung TNFα expression (P<0.005), total cell counts in BAL (7.20±1.20 X10⁴ vs. 2.80±0.26 X 10⁵; P<0.001), and neutrophil counts in BAL (0.2±0.0 X10⁴ vs. 5.6±1.1 X 10⁴; P<0.001). Compared to WT mice, B/SI to TNFKO mice resulted in (WT vs. TNFKO) much less apoptosis in the bronchial mucosa (16±2.7% vs. 6.3±1.3%: P<0.01), higher survival rate (60% vs 85%; P<0.05), lower total cell counts in BAL (2.80±0.32 x 10⁵ vs. 0.85±0.06 X 10⁵; P<0.005) and neutrophil counts in BAL (1.71±0.25 x 10⁴ vs. 5.60±1.20 x 10⁴; P<0.005). TNFα inhibitor treatment to WT mice receiving B/SI reduced apoptotic cell counts in bronchial mucosa from 15±3.1% to 7.8±1.2% (P<0.01), total cell counts from 2.70±0.31 X 10⁵ to 1.05±0.12 X 10⁵ (P<0.01), neutrophil counts in BAL from 5.67±1.36 X 10⁴ to 2.11±0.12 X 10⁴ (<0.005), and increased the survival rate from 65% to 82% (P<0.05).

Conclusions: TNF-alpha is actively involved in the B/SI induced apoptosis of the bronchial epithelial cells.

Applicability of Research to Practice: Further understanding the path-physiology of burn/smoke inhalation injury

Fig. 1. TUNEL Method Indicates Increased Apoptosis of Bronchial Epithelial Cells after Burn/Inhalation Injury

External Funding: SBH Grant 85800, NIH Training Grant.
Topical Nanoemulsion Therapy Abolishes Burn Wound Progression and Improves Skin Healing in Swine Model of Thermal Burn Injury

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Introduction: We observed that a topical nanoemulsion with antimicrobial properties can abate burn wound progression in a rat thermal burn injury model. Swine skin is more similar to human skin than rat skin in physiologic healing of the burn wound. We developed and used a swine thermal burn injury model to study the effect of nanoemulsion therapy on burn wound progression and subsequent healing.

Methods: Anesthetized swine received thermal burns using a 5x5cm copper bar heated to 80°C in hot water. Skin exposure time was 20 seconds. Burned skin was topically treated with one of three concentrations of NB-201 (10%, 20% or 40%), silver sulfadiazine, or saline immediately after injury and on days 1, 2, 4, 7, 10, 14, and 17 post injury. Silver sulfadiazine or saline treatment was considered the control group and NB-201 treated wounds were the experimental group in this pilot study. Digital photographs were taken during dressing changes. Skin biopsies from burn skin and normal skin were obtained. Samples were H&E stained, examined, and graded by a pathologist on a 0-3 scale for epithelial/dermal integrity. Homogenized tissue samples were assessed for chemical evidence of inflammation using ELISA.

Results: Topical application of NB-201 prevented thermal burn wound progression to full thickness injury as determined by histological score (0.7 vs. 2.2, p<0.04 t-test, day 21) and visual evaluation (Figure). Silver sulfadiazine and saline treated wounds (control) converted to full thickness burn injury by day 4 (loss of epidermis, dermal necrosis, necrotic inflammation). The NB-201 treated wounds healed with re-epithelialization and without evidence of wound contracture. Production of inflammatory mediators (IL-8, 2801 vs. 20398 pg/mL, p<0.05 ANOVA, day 7) and neutrophil sequestration (MPO, p<0.05, ANOVA, day 10,14) were also suppressed by NB-201.

Conclusions: Topically applied NB-201 was effective in preventing the conversion of a partial thickness burn wound to full thickness burn injury and was associated with a concomitant decrease in dermal inflammation. Nanoemulsion therapy is a potential breakthrough treatment to reduce the extent of burn wound conversion from partial to full thickness injury.

Applicability of Research to Practice: NB-201 is a promising treatment for burn patients to avoid burn wound progression.

External Funding: Michigan Corporate Relations Network (MCRN) and NanoBio Corporation.

New Therapeutic Approaches to Treat Heterotopic Ossification in Burn Patients

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Introduction: Heterotopic ossification (HO) is defined as ectopic bone formation within soft tissues such as muscles, tendons and fascia. Genetic disorders (i.e., fibrodysplasia ossificans progressive), musculoskeletal surgeries (i.e., hip arthroplasty) and traumatic injuries (i.e., brain/spinal cord injuries, burns and amputations) have been associated with this clinical condition. Existing treatments for HO have inconsistent results, non-selective effects and high risk of complications. We found a significant presence of bone marrow-derived cells in HO specimens that could be targeted to prevent the HO progression.

Methods: Cell explantation was used to isolate cells from HO specimens. Bone marrow-derived cells were identified by flow cytometry and immunofluorescence by using LSP1 and type I procollagen as distinctive markers. Cell migration was studied with Transwell migration assay and CTCE-9908 treatment. Cell reprogramming was studied by using TGF-beta-deprived environment and mass spectrometry. To control cell proliferation, IFN-alpha 2b treatment was used, and cell response was confirmed by total cell count, MTT assay and real time RT-PCR.

Results: Transwell migration assays showed that recruitment of bone marrow-derived cells to HO lesions can be stimulated by the CXCR4/SDF1 pathway, and prevented by CTCE-9908 (CXCR4 antagonist). These recruited bone marrow-derived cells, with potential of osteogenic differentiation at injured sites, develop an alternative protein profile when they are in TGF-β1-deprived environment. Thus, in this culture condition, they release numerous proteins that modulate negatively the HO formation. For instance, CD63, CD109, TIMPs, fibrillin-1, vasotonin and MCSF-1 can be identified in conditioned media (mass spectrometry). In addition, the treatment of HO cells with IFN-alpha 2b for 2 weeks significantly reduced cell proliferation (total cell count and MTT assay). This response was associated with increase of p21 gene expression (real time RT-PCR).

Conclusions: The control of the recruitment and biological behavior of circulating bone marrow-derived cells at local level is a promising strategy to prevent HO progression. However, more research at in vivo level with animal models is required.

Applicability of Research to Practice: Outcomes from this study will help to develop novel approaches to treat HO in several clinical situations.
The Immune Response to Burn and Excisional Injuries: What's the Difference?
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Introduction: Skin trauma triggers an immune response; with the innate & adaptive systems critical to coordinate repair, prevent infection and limit damage. It is not clear, however, whether the immune response to different trauma etiologies is the same. Previous research is conflicting as to whether burn injury elicits a unique response or is solely a subset of trauma, with the response dependent on extent of injury. The aim of this study was to investigate whether the immune response to trauma to the skin is driven by the aetiology of the injury or solely by the extent of trauma.

Methods: Nine week old C57BL/6j mice received a full thickness dorsal injury (either excisional or burn) equivalent to 8% TBSA (n=8 for each time-point & treatment group). At days 1,3,7,14,28 and 84 post-injury samples were collected, including wound tissue, proximal draining lymph nodes, whole blood and serum. Wound tissues were stained using H1[(Unsuported Character - Codename &Ei)] lymph node cells were profiled for dendritic cells (DCs) & T-regulatory cells Tregs using FACS analysis.; whole blood was counted for cell populations; and serum was analysed for cytokine profiling using a multi-plex immuno-assays. This spectrum of data enabled assessment of the local, regional and systemic effects of the 2 injury modalities on both the innate and adaptive immune responses.

Results: Both injury mechanisms elicit a significant immune response. During the acute response, Dendritic cell (DC) changes are observed in both excisional and burn injured animals, with significant reductions in both 11b- and 11b-popolations. At the same time the monocyte population in the blood is significantly elevated. Interestingly, by 2 weeks post-injury there is a significant increase in CD11b-8a- DCs in the burn injured animals compared to both control and excisional injury groups. This increase is sustained up to the 3 month final time-point. Analysis of cytokine profiles is ongoing and will be presented.

Conclusions: Analysis to date suggests that there are significant differences in the immune response to a burn injury and an injury of equivalent extent to the skin. Importantly, the data suggests that the response to burn injury may cause a long-lasting change to the DC populations trafficking between the skin and lymph node, a change not observed in the equivalent excisional injury model. Further analysis and additional research will be important in understanding the long-term impact of these changes.

Applicability of Research to Practice: Understanding the immune response of burn injury is critical to generate the evidence necessary to improve clinical treatment, thus reducing morbidity and improving patient outcome.

External Funding: The Fiona Wood Foundation (Australia).

Pulsed Electric Fields for Burn Wound Disinfection in the Marine Model
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Introduction: Disinfection of burn wounds is a stubborn clinical problem. Here we report on a new, physical disinfection method using pulsed electric fields (PEF). High voltage PEF create non-thermal, permanent damage to cell membranes, presumably by an irreversible electroportation mechanism. In the last 4 decades, PEF has been emerging as an alternative disinfection method in the food industry. In medicine, PEF has recently been used for non-thermal ablation of solid tumors. We have expanded the application to burn wound disinfection.

Methods: A third degree burn was induced on the dorsal skin of C57BL/6 mice by skin surface contact with pre heated to 100oC electrodes. Immediately after the injury, the burn wound was infected with 40ul (108 CFU/ml) of multi-drug resistant Acinetobacter baumannii ATCC BAA 747 containing the luxCDABE operon. Thirty minutes after infection, the contaminated areas were treated with PEF. The following PEF protocols were used: 500 V/mm field strength, 700s pulse duration, 2Hz pulse frequency, 800 pulses (pulses were delivered in two groups of 40 pulses with 5 min interval between groups). Bioluminescence imaging system was used to quantify bacteria on skin. The calculation of the total pixel values (in relative luminescence units [RLU]) from the luminescence images of the infected wound area was performed. Imaging was performed immediately after the injury, 30 min after the infection, after 40 pulses, after 80 pulses and 3 hours after PEF treatment.

Results: Pulsed Electric Fields were effective in the disinfection of burned and infected murine skin. The degree of disinfection was correlated with the electric field strength and the number of delivered pulses. An electric field strength of 500V/mm delivered for 40 pulses led to 2 log(10) reduction in bacterial load; 80 pulses led to an immediate 3 log(10) reduction. Three hours after PEF, the bacterial load on the skin treated by 500V/mm, 80 pulses was 3 logs(10) lower than in untreated controls. Conclusions: We have demonstrated 3 log(10) reduction in the bacterial load of A. baumannii in the burn wound by direct application of pulsed electric fields. Three hours after treatment, the infection load was still 3 logs(10) lower than in untreated controls. PEF is a new powerful tool for bacterial disinfection.

Applicability of Research to Practice: The ability to treat infected burns in patients will lead to improved morbidity and mortality. Patients will be able to avoid life-threatening sepsis from antibiotic resistant infections. Not only will the infection be treated effectively, but the wound itself will also heal better in the absence of infection. We believe that PEF application in combination with currently used drugs will bring the largest benefit to burn patients.

External Funding: Shriners Grant #85120-BOS.
79 . Severe Burn Injury Alters the Morphology of Subcutaneous White Adipose Tissue

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Introduction: Severe burn injury induces a hypermetabolic stress response including but not limited to increased heart rate, body temperature, metabolic flux and whole-body energy expenditure. Adipose tissue is also significantly affected as evidenced by excessive release of free fatty acids leading to ectopic fat accumulation and insulin resistance. Furthermore, recent data from animal studies suggest that severe burn injury results in morphologic changes in white adipose tissue (WAT). However, the acute and long-term effects of severe burn injury on WAT morphology have not been studied in humans. The aim of this study was to investigate the impact of severe burn injury on WAT morphology. We hypothesize that WAT will adopt a more thermogenic phenotype in response to severe burn injury.

Methods: WAT samples were collected from seven burned children (11.4±2.4 years old; 54±19% of the total burn surface area burned; male:female ratio 4:3; 1 to 8 weeks post burn, height 146±4.3 cm; weight 46±16kg) and five healthy children (10±5 years old; male : female ratio 3:2; height 140±35 cm; weight 49±30 kg). Immunohistochemistry and morphometry were performed in WAT samples from both burn and unburned patients.

Results: There was an increase in the number of small elongated cells with ovoid nuclei that accumulated between adipocytes in the subcutaneous adipose tissue of burned patients compared to unburn control patients. Multiple small elongated cells with ovoid nuclei were present between typical adipocytes, the largest of which were smaller than in unburn control tissue. Multiple fat droplets were seen in some adipocytes, and some cells between the large adipocytes contained multiple small fat droplets. Many of these cells stained positively for uncoupling protein 1 (UCP1; a mitochondrial proton carrier) in burn WAT as compared to unburn WAT. In addition, a rim of UCP-1 positive cytoplasm could be seen adjacent to the large lipid droplet in some adipocytes, and occasionally this additional cytoplasm contained many very small lipid droplets. At the longer time intervals after injury, scattered large adipocytes were seen to contain several or many distinct fat droplets in place of the single large droplet seen in control subcutaneous tissue, and some of the smaller cells between large adipocytes contained multiple small fat droplets.

Conclusions: This study provides the first evidence of significant changes in WAT morphology following burn injury. This will help to discern the mechanisms underlying burn-induced abnormalities in adipose tissue. The subcutaneous white adipose tissue (S.WAT) of burned children shows altered adipocyte morphology and function compared to unburn control patients. The results suggest that burn injury may lead to adipocyte dysfunction and a shift towards a more thermogenic phenotype, which could contribute to the hypermetabolic stress response observed in severe burn injury. Further studies are needed to understand the molecular mechanisms underlying these changes and their implications for burn wound healing and complication prevention.

Applicability of Research to Practice: This study will help to discern the mechanisms underlying burn-induced abnormalities in adipose tissue. This knowledge could lead to the development of new therapeutic strategies for managing burn wound healing and complication prevention.

External Funding: NIH (5P01-GM60338, R01-GM05668) and Shriners Hospitals for Children (84090, 84080, 71008 and 71006) grants.

80 . Connexin 32 Deficient Mice Display a Mitigated Acute Phase Response and Reduced Muscle Wasting following Severe Burn Injury

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Introduction: Severe burn injury results in a prolonged hypermetabolic stress response that is associated with mortality and morbidity. Due to its metabolic, inflammatory, immune, and acute phase response (APR) functions, the liver plays a pivotal role in the creation and maintenance of this hypermetabolism and ensuing muscle wasting. Hepatocyte gap junctions, with connexin 32 (Cx32) as a major structural component, play a crucial role in propagating and amplifying innate immune signals throughout the liver. Thus, we hypothesized that inhibition of hepatocyte gap junction-mediated pro-inflammatory signaling in a mouse model of severe burn injury would mitigate the liver-dependent APR and burn injury-related muscle wasting.

Methods: Animals: C57BL/6 wildtype (WT) mice were purchased and Cx32-/- (KO) mice were a generous gift from K. Willecke and D. Paul. WT and KO mice (20±2 g) were separated into burn and unburned control groups. Burn: 20% body surface area, full thickness burns were imparted on the dorsal surface of the mice, followed by resuscitation with 20ml/kg saline. APR: After 24 hr, serum was collected and the levels of haptoglobin (Hp), serum amyloid p (SAP), albumin, ALT, IL-6, and MCP-1 were assessed by ELISA. Organomegaly and Muscle Wasting: At 14 days, mice were killed and the heart, spleen, liver, and calf muscles were collected and weighed.

Statistics: Assay values for burned WT and KO samples were normalized to their respective controls and compared by t-tests at P<0.05 significance.

Results: Serum analyte profiling at 24hr revealed a mitigated APR with significantly reduced levels of pro-inflammatory acute phase proteins (Hp and SAP), higher overall albumin levels, reduced ALT (hepatocyte injury) levels, and reduced cytokine levels (IL-6, MCP-1) in KO compared to WT mice (Fig. 1a-e). After 14 days, organomegaly of the liver and spleen, in contrast to significant calf muscle wasting, was apparent in the WT, but not the KO mice (Fig. 1f-g).

Conclusions: These data indicate that the APR and inflammatory signaling typically mounted by the liver and immune system following burn injury are mitigated when secondary signaling via Cx32 gap junctions between hepatocytes is inhibited.

Applicability of Research to Practice: We present a novel therapeutic target for mitigation of the APR after burn injury by leveraging hepatic gap junction signaling.

External Funding: Supported by grants from the Shriners Burns Hospitals and the NIH, including an NRSA F32 from NIDDK (WJM).
81. Increased Burn Rehabilitation Treatment Time Improves Patient Outcome

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Introduction: Burn scar contractures (BSC) continue to plague burn survivors while rehabilitation efforts to uncover optimal approaches to prevent BSC are pervasive. Cutaneous Functional Units (CFU) are fields of skin associated with BSC and joint range of motion. Scant objective information is available associating burn rehabilitation time (BRT) to patient outcomes. The primary aim of this investigation was to evaluate the association between burn rehabilitation time (BRT) and the development of BSC or limited joint range of motion (LOM) at acute hospital discharge (D/C).

Methods: The study was part of a multi-center investigation to characterize the physical outcome of burn survivors. Data was collected prospectively at 14 verified burn centers from 2010-13. Goniometric measurements of CFU associated joint range of motion (ROM) prone to BSC/LOM were recorded at D/C. Univariate analysis followed by Stepwise Forward Multiple Logistic Regression was used to identify the most predictive variables of developing a BSC/LOM. Determination of significant factors was based on Odds Ratios (OR) and Receiver Operating Characteristic (ROC) curves.

Results: A total of 284 subjects were analyzed; 173 had < 10% burn – see Table. Two groups were identified: No Contracture (NC) and Contracted (CG). For the total group, there were 7,509 ROM taken with 2,665 BSC/LOM (35%). In the < 10% group, 3,032 ROM were taken with 919 BSC/LOM (30%). Multivariate Logistic Regression revealed BRT by CFU as the highest predictor of BSC/LOM for both the N=284 group (OR= 1.08; 95% CI: 1.04 to 1.13); and the n=173 group (OR= 1.06; 95% CI: 1.02 to 1.10). The only other significant predictor used in the modeling was skin grafting for N=284 (OR = 0.91; CI: 0.84 to 0.97). Area under the ROC curve for N=284 was 0.75 indicating a good fit and n=173 was 0.67 (fair).

Conclusion: The highest predictor of preventing a BSC/LOM for both groups was amount of BRT/CFU. A direct relationship was found between increased BRT and a lower probability of developing a BSC/LOM after adjusting for SG.

Applicability of Research to Practice: These results give burn rehabilitation clinicians a baseline upon which to establish a patient treatment program in terms of minimal time requirements per CFU.

External Funding: USAMRAA Award #W81XWH-08-1-0683.

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82. Effect of Transfers between Short-Term Hospitals on Costs and Length of Stays for Pediatric Burn Patients

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Introduction: Hospitals vary widely in the services they offer to care for pediatric burn patients. When a hospital does not have the ability/capacity to handle a pediatric burn, the decision often is made to transfer the patient to another short-term hospital. Transfers may be based on available specialty coverage for children; which adult and non-teaching hospitals may not have available. The effect these transfers have on costs and length of stays (LOS) for pediatric burn patients is not well established. Research is needed in this area, especially given the prominent view that pediatric hospitals are inefficient/more costly when compared to adult/non-teaching hospitals. In addition, there is a need to see which patients/injuries are being transferred.

Methods: We examined inpatient admissions for pediatric burn patients in 2003, 2006 and 2009 using the Kids’ Inpatient Database (KID), which is part of the Healthcare Cost and Utilization Project (HCUAP). ICD-9-CM codes 940-947 were used to define burn injury. We tested if transfer status was associated with LOS and total charges for pediatric burn patients, while adjusting for traditional risk factors (e.g., age, total burn surface area, type of hospital [pediatric vs. adult; teaching vs. non-teaching]) by using generalized linear mixed-effects modeling.

Results: A total of n=28,777 children had a burn injury. Transfer status (p=0.003) and total burn surface area (p<0.001) was independently associated with LOS, while age and type of hospital was not associated with LOS. Similarly, transfer status (p=0.019) and total burn surface area (p<0.001) was independently associated with total charges, while age and type of hospital was not associated with total charges. In addition, the data suggests that the more severe pediatric burns (e.g., larger total burn surface area burns) are being transferred from adult and non-teaching hospitals to pediatric and teaching hospitals.

Conclusions: Transfers between short-term hospitals have a dramatic impact on costs and LOS for pediatric burn patients. Larger more severe Pediatric burns are being transferred to pediatric hospitals, which have increased ability/capacity to handle these conditions. This may explain the increased costs and LOS seen at pediatric hospitals. The type of hospital did not independently influence costs or LOS for pediatric burn patients. As a result, pediatric hospitals may not be inefficient in treating pediatric burns; the more difficult/expensive cases are being transferred into their care.

Applicability of Research to Practice: The results of this study support the efficiency and unique mission of pediatric teaching hospitals.

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46th Annual Meeting of the American Burn Association
**83. Line of Duty Firefighter Fatalities: An Evolving Trend Over Time**

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**Introduction:** Between 1990 and 2012, 2775 firefighters were killed in the line of duty. Myocardial infarction was responsible for approximately 40% of these fatalities, followed by mechanical trauma, asphyxiation, and burns. Protective gear, safety awareness, medical care, and the age of the workforce have evolved since 1990, possibly affecting the nature of mortality over this 22 year time period. The purpose of this study is to determine if the causes of firefighter mortality have changed over time to allow a targeted focus in prevention efforts.

**Methods:** The U.S Fire Administration fatality database was queried for all-cause on duty mortality between 1990-2000 and 2002-2012. The year 2001 was excluded due to inability to eliminate the 347 deaths that occurred on 9/11. Data collected included age range at time of death, sex, age at injury, complication (in Table), type of duty (on-scene, responding, training, returning, etc), incident type (structure fire, motor vehicle crash, etc), area of AFCC/LOM (myocardial infarction [MI], trauma, asphyxiation, cerebrovascular accident [CVA], and burns). Data was compared between the two time periods with a X-squared Test.

**Results:** Between 1990-2000, 1140 firefighters sustained a fatal injury while on duty; and 1174 were killed during 2002-2012. MI has increased from 43% to 46.5% of deaths (p=0.012) between the 2 decades. CVA has increased from 1.7% to 3.6% of deaths (p=0.002). Asphyxiation has decreased from 12.1% to 7.9% (p=0.003) and burns have decreased from 7.7% to 3.9% (p=0.0004). Electrocution has increased from 1.8% to 0.5% (p=0.004). Death from trauma was unchanged (27.8 to 29.6%, p=0.12). The percentage of fatalities of firefighters over age 40 has increased from 52% to 65% (p=0.0001). Fatality by gender was constant at 3%. The percentage of fatalities involving an MVC has increased from 4.6 to 9.3% (p=0.0001). Fatality during training have increased from 6.4 to 10.8% of deaths (p=0.0001).

**Conclusions:** The nature of firefighter mortality has evolved over time. In the current decade, line-of-duty mortality is more likely to occur during training or in a vehicle crash en route to or returning from a call. This alarming increase in training and vehicle-related death warrants further investigation and intervention. Mortality from burns, asphyxiation, and electrocution have decreased; but death from MI and CVA has increased. More fatalities are occurring in older firefighters and cardio/cerebrovascular diseases is a growing factor. Additional details about comorbidities still remain to be characterized. Outreach and education should be targeted towards vehicle safety, welfare during training, and cardiovascular disease prevention in the firefighter population.

**Applicability of Research to Practice:** Understanding mortality aids prevention efforts.

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**84. Keeping Patients Calm: The Mixed Blessing of Benzodiazepines**

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**Introduction:** Respiratory failure develops early after burn injury due to smoke inhalation or burns requiring high volume fluid resuscitation. This adds substantially to injury morbidity, in part because of associated delirium. The purpose of this study was to characterize this patient group and look for ways to mitigate risk factors.

**Methods:** Patients admitted between July 2011 and July 2013 and who required mechanical ventilation for at least 5 consecutive days early after injury were reviewed. Delirium was identified by the CAM-ICU. Doses of opioids and benzodiazepines during the first five days of ventilation were recorded. Ventilator days, days of bed rest, and hospital length of stay (HLOS) were calculated.

**Results:** Thirty-three patients met the inclusion criteria. Thirty patients developed delirium 9.2 ± 1.4 days (Mean ± SEM) after injury, and only 3 never did. This prevalence is consistent with reports of critically ill burn patients. Those without delirium had a significant burn (13, 14, and 54% TBSA), whereas of those with delirium, 12 (40 %) had no burn or only a small one (< 5% TBSA), 0.8 ± 0.4 % TBSA. There were four late deaths in those with delirium (24, 55, 56, and 91 days after injury). Age, mean burn size (TBSA), incidence of smoke inhalation, Carbon Monoxide Toxicity (COTOX), and HLOS were similar for those with and without delirium. Of those developing delirium, 17 (57 ± 9%) had a prior known psychiatric diagnosis, compared with none of those who never developed delirium. Total ventilator days were substantially greater in those with delirium: 40 ± 4 days vs 9 ± 2, p<0.001. Days of complete bed rest before sitting on the side of the bed also seemed greater: 31 ± 3 days vs 14 ± 3, p=0.13. There was no difference in total, daily mean, or maximum daily dose of opioids administered for any type of pain. In contrast, benzodiazepine doses were substantially greater in those who developed delirium: 5 day Total 86.4 ± 13.4 mg vs 12.7 ± 4.1, p<0.001; mean daily dose in first 5 days, 17.3 ± 2.7 mg vs 2.5 ± 0.8, p<0.001; maximum daily dose in first 5 days 29.3 ± 4.5 mg vs 6.3 ± 2.0, p<0.001. The daily mean RASS was lower for those with delirium: -2.41 ± 0.13 vs -1.3 ± 0.22, p<0.001.

**Conclusions:** Delirium commonly develops in burn patients with respiratory failure early after injury and is associated with prolonged mechanical ventilation. Age, burn size, smoke inhalation, and COTOX were not important predictors of delirium or prolonged respiratory failure. Prior known psychiatric diagnosis was more frequent in those with delirium. Benzodiazepine dosage early after injury was strongly associated with delirium, lower RASS, and prolonged mechanical ventilation. Re-evaluation of benzodiazepine doses to sedate critically ill burn patients is warranted.

**Applicability of Research to Practice:** Appropriate sedation of critically ill patients.
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, making the prevention of VAP a high priority within healthcare. While no “gold standard” diagnosis for VAP exists, criteria typically include clinical suspicion, radiography and microbiological testing. 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. While BAL is generally considered the most comprehensive method of specimen collection in the diagnosis of VAP, it is invasive and expensive. It is therefore important to determine the relatively accuracy of more cost-effective and less invasive collection methods such as TA and ETT. The hypothesis is that BAL will be more accurate at diagnosing VAP than TA.

Methods: This was a non-interventional prospective study of 48 burn patients with suspected VAP. Respiratory specimens via ETT, TA, and BAL were collected and cultured. Basic demographics, clinical signs and symptoms and culture results were collected and descriptive statistics were performed.

Results: Concurrent cultures were performed on the 48 patients with suspected VAP. Means were calculated for age (45.40 years, ± 16.70), days on vent (18.21, ± 17.32), temperature (38.20 °C ± 0.96), total body surface area burn (39%, ± 23%) and leukocytosis (14.79, ± 8.09). Of the 48 patients, 72.9% were male and 27.1% female. Clinical parameters included increased sputum (75%) and infiltrates (62.5%) on chest radiograph. Culture results were compared between the three groups. The three cultures identified the same organisms only 4.2% of the time. BAL and ETT results correlated in 8.3% of the population and BAL and TA correlated in 27% of the patients. However, when corrected for the presence/absence of polymorphonuclear leukocytes, the causative organisms were identified by all three cultures 29.2% of the time. BAL and ETT results correlated in 31.3% of the population, and BAL and TA correlated 89.6% of the time.

Conclusions: TA is nearly as reliable as BAL in identifying the causative organisms in VAP, and should be considered as an initial screening tool for VAP in burn patients. Diagnosis of VAP in this patient population must be suspected on clinical grounds and confirmed with BAL or TA cultures.

Applicability of Research to Practice: Diagnosis of VAP in burn patients remains difficult. This study demonstrates the potential utility of TA in diagnosing VAP.
87. **AQP 3 is Upregulated in Human Burn Wounds**

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**Introduction:** Aquaporins (AQP) are an abundant group of transmembrane protein channels that play a crucial role in water transport. AQP3 is expressed in keratinocytes along the stratum basale basement membrane and promotes wound healing in non-burned wounds. This study, which assesses the expression of AQP3 in patients with deep burn wounds, is the first to investigate the role of AQP3 in burn wound physiopathology.

**Methods:** 21 intraoperative specimens from 7 patients with partial thickness burns were obtained between 3 to 7 days post injury. A 6 mm full thickness punch biopsy was harvested from the central area of the burn, burn edge, and an area of unburned skin (donor site). For western blot analysis, skin samples were minced and further processed with Navy BulletBlender Lysis beads. BCA protein assay was used to normalize the samples before deglycosylation with PNGase-F. Samples were loaded onto 10% acrylamide gels and transferred onto PVDF membranes to detect Aquaporin-3. For immunofluorescence, skin samples were paraffinized onto slides, which were then deparaffinized and hydrated in various gradients of xylene, ethanol, and water. After blocking with 20% donkey serum, the slides were incubated with 1:100 AQP3 antibody overnight and tagged with 1:400 AlexaFluor488 rabbit secondary antibody.

**Results:** The results revealed that AQP3 protein expression was up-regulated in the burn wound edge (3.6 +/- 0.34) compared to the intact skin of the donor site, (2.1 +/- 0.28) (p< 0.05). There was a significant difference in the AQP3 expression using western blot analysis, with the ratio AQP3/actin as standardized measurement (figure 1). Immunofluorescence analysis showed a more intense signal in the burned wound edges compared to the unburned tissue (Figure 2).

**Conclusions:** Human keratinocyte AQP 3 is up-regulated in partial thickness burns. Since AQP-3 promotes early differentiation, and proliferation of keratinocytes, upregulation may have implications in the pathophysiolog of burn wound conversion.

**Applicability of Research to Practice:** Novel therapies such as the use of AQP3 induction agents or direct tissue transfection with AQP3 may someday allow us to limit conversion in partial thickness burns.

**External Funding:** Johns Hopkins Burn Research Grant.

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88. **Fibrocyte Antagonists Improve Hypertrophic Scar In Vivo**

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**Introduction:** Hypercellularity is an obvious histopathological characteristic of hypertrophic scars (HTS), which often occur following thermal injury to the deep dermis. Based on our previous work, we hypothesize that blood-borne cells are recruited to wound sites after burn injury through a signaling pathway of stromal cell-derived factor 1 (SDF-1) and its receptor CXCR4. These cells may be the progenitor cells of macrophages and fibrocytes. The latter further differentiate to fibroblasts and myofibroblasts on the sites and are involved in the development of HTS. I. Previously, we found that chemotaxis of peripheral blood mononuclear cells induced by recombinant human SDF-1 and fibroblast conditioned medium was inhibited by CTCE-9908 in vitro, suggesting that this strategy maybe useful for the treatment of HTS via CXCR4 antagonists.

**Methods:** Using human split thickness skin transplanted onto the nude mouse model, the fibrocyte antagonist, CTCE-9908 (100 mg/kg) or vehicle was injected subcutaneously daily for two weeks prior to grafting and weekly after transplantation. Five animals were sacrificed at two and eight weeks post-transplantation and their wounds evaluated. Scar contraction was measured serially, histologic assessment was conducted for scar thickness. Immunohistochemistry was used to assess macrophages and myofibroblasts cell counts, collagen fibrillogenesis and TGF-beta.

**Results:** Using the human HTS-like nude mouse model, split-thickness human skin grafts transplanted onto full thickness incision wounds on the backs of nude mice develop thick, red, raised scars resembling HTS. CTCE-9908 significantly attenuated scar formation in vivo, reducing the accumulation of macrophages and myofibroblasts, improving remodeling of collagen fibers, and down-regulating collagen fibrillogenesis in the xenografts.

**Conclusions:** Inhibition of bone marrow derived fibrocytes significantly improves hypertrophic scar and controls contraction in vivo. Systemic delivery of antifibrotic agents directed against bone marrow derived cells including fibrocytes may be useful to control and treat HTS following thermal injury.

**Applicability of Research to Practice:** Potential novel approaches to management of post-burn hypertrophic scar.

**External Funding:** Firefighter’s Burn Treatment Fund, Edmonton Civic Employees Grant.
Introduction: Scarring with abnormal pigmentation is a problem after thermal injury. Much of the published research on abnormalities in skin pigmentation relates to topical treatment or melanocyte involvement in dermatologic neoplasia, rather than the pathophysiology of scar pigmentation. Using a validated model of scar formation, we examined hyper- and hypopigmented scar samples for their histological and optical properties to help elucidate the mechanisms and characteristics of abnormal scar pigmentation.

Methods: Excisional full thickness wounds were created on the flanks of duroc pigs and allowed to reepithelialize. Biopsies from areas of hyperpigmentation, hypopigmentation, and uninjured skin were formalin-fixed and paraffin-embedded for histological examination. Sections were stained with Azure B to assess melanin content and anti-S100 antibody to identify immunofluorescently-labeled melanocytes. Image J software was used to quantify melanin staining and Zeiss Zen software was used to measure fluorescence intensity of melanocyte staining in histological sections. Spatial Frequency Domain Imaging (SFDI) was used to examine the optical properties of scars.

Results: Wounds began reepithelialization from their edges and were completely closed between weeks 5 and 6. Hyperpigmentation was first faintly noticeable in healing wounds around weeks 3-4, becoming darker from weeks 6-8, and most visible from week 9 on. Immunofluorescence-stained images showed no significant difference in fluorescence intensity for melanocyte markers. Azure B staining of intra- and extracellular melanin was significantly greater in histological sections from pigmented areas than sections from both uninjured skin and hypopigmented scar (p<0.00001). Azure B staining was also significantly greater in histological sections form uninjured skin than sections from hypopigmented scar (p<0.01). SFDI at a wavelength of 632 nm resulted in an absorption coefficient map correlating with visibly hyperpigmented areas of scars.

Conclusions: In this model of scar formation, melanocyte quantity does not appear to influence pigmentation, while the production of melanin does correlate with the pigmentation in skin and scars. These observations open the door to investigating melanocyte stimulation and the inflammatory environment within a wound that may influence melanocyte activity. SFDI can be used to identify areas of heightened absorption coefficient in mature, pigmented scars, which may lead to its usefulness in wounds at earlier time points before markedly apparent pigmentation abnormalities.

Applicability of Research to Practice: A better understanding of abnormal scar pigmentation may allow for efforts toward therapeutic intervention and prevention.

External Funding: NIH/NBIB.
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**Epigenetic Changes after Burn Injury: A Profile of Human Scar Fibroblasts**

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**Introduction:** The appearance of scar, underpinned by changes to the dermal matrix, is a life-long consequence of burn injury. Scar is maintained and, in the case of children, increases during periods of growth, suggesting the cells generating scar matrix retain phenotypic differences to those in normal skin. Epigenetic changes concern alterations to the DNA other than the sequence itself. Epigenetic changes are heritable and include DNA methylation, which is important in switching phenotype in many processes, including development and cancer. However, the role of epigenetics in scar development and maintenance is unknown. This study aims to characterise changes in DNA methylation and the relationship to transcriptome and phenotypic changes between ‘scar’ and ‘normal’ fibroblasts from human burn injury patients.

**Methods:** Anatomically matched 3mm punch biopsies were taken from both forearms of 6 male Caucasian burn patients aged 18-34 years with unilateral burn injury. Dermal fibroblasts were cultured in vitro to passage 2 and isolated DNA was bisulphite modified and analysed using Illumina Methylation arrays covering 485,000 CpG sites. Total RNA was also isolated and analysed using the Affymetrix Gene 2.0 ST array covering 47,400 transcripts. Bioinformatic analysis of changes in scar compared to normal skin fibroblasts was carried out using an integrative genomic approach combining methylation (Illumina Genome Studio, R), expression (R) and pathway analyses (Ariadne Pathway Studio).

**Results:** Differential methylation analysis identified 3298 CpG sites to be differentially methylated (p<0.05 with 5% false discovery rate (FDR)). 398 genes were found to be significantly differentially methylated in their transcription start sites (p<0.05 with 5% FDR). Differential gene expression analysis only showed 1 significant gene (p<0.05 with 5% FDR), however, gene set enrichment analysis identified 218 significantly differentially expressed gene groups, with the Proteinaceous Extracellular Matrix (ECM) gene set most significantly changed.

**Conclusions:** The results demonstrate that ‘scar’ fibroblasts have significant epigenetic changes and that these may suggest changes in gene network expression underlying the scar maintenance phenotype. Furthermore, this work has identified potential targets for therapeutic prevention and/or reversal of scar formation.

**Applicability of Research to Practice:** The results suggest that epigenetic changes are a key factor in scar formation and maintenance, providing a number of targets for potential therapeutic prevention and reversal of scar.

**External Funding:** Wound Management Innovation Cooperative Research Centre, Jack Dunn Foundation and Fiona Wood Foundation.

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**Debriding Gel Dressing: The Pediatric Experience**

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**Introduction:** Early removal of the eschar is a cornerstone of burn care. Excisional debridement followed by autografting is the preferred standard of care (SOC) but is associated with extensive surgery and potential complications. Phase II clinical trial data with Debriding Gel Dressing (DGD), a Bromelain derived enzymatic debriding agent for burns, also known as Debrase or Nexobrid, has shown increased efficacy in the pediatric subgroup population. The aim of the Phase III RCT study was to assess the efficacy of DGD as a debriding agent and its impact on the surgical burden, long-term cosmesis and function in the pediatric subgroup.

**Methods:** Seventy-Five children under the age of 18 suffering from deep partial thickness (DPT) to full thickness (FT) burns were treated with DGD in a prospective, single arm, single-center, Phase II trial. Data was retrospectively retrieved and analyzed for efficacy of enzymatic eschar removal and surgical burden. Thirty-three children under the age of 18, suffering from DPT to FT burns were treated with DGD or SOC as part of a Phase III, multinational, multi-center, open label, randomized, controlled clinical trial. Seventeen of these children were treated with DGD and 16 were treated according to SOC. Early end points included time to complete debridement, need for surgical excision and percentage of burn autografted. The Phase III patients also underwent long-term evaluation of scarring and quality of life.

**Results:** Phase II data shows that DGD efficiently removed the eschar in 92% of the areas treated, and only 34% of the debrided areas required skin-grafting. Graft take was 94.1%. The rest of the areas were healed by spontaneous epithelialization. Complete wound closure occurred after 21.4±16.5 days. Phase III data shows that DGD efficiently removed the eschar (100% vs. 93.8% in SOC), significantly reduced the time to complete debridement (0.9±0.7 days vs. 6.5±5.9 days in SOC, p<0.001), the need for excisional surgery (20.7% vs. 78.0% in SOC, p<0.0001), and the area of DPT burns excised (7.9% vs. 73.3% in SOC, p<0.0001). The need for autografting in DPT wounds (21.7% vs. 31.8% in SOC) and area autografted in DPT wounds (6.1% vs. 24.5%) were lower in the DGD group but did not reach statistical significance. Scar quality, quality of life and adverse event rates were similar in both groups.

**Conclusions:** Phase II data demonstrated the efficacy of DGD as an enzymatic debriding means. Phase III data further demonstrated that enzymatic debridement with DGD resulted in earlier eschar removal, reduced need for and extent of surgery compared with SOC while achieving comparable long-term results in children with deep burns.

**Applicability of Research to Practice:** The results point to the applicability of DGD as an efficient enzymatic debriding agent for pediatric burns.

**External Funding:** by MediWound LTD, Yavne, Israel.
A Bilaminate Synthetic Skin Substitute for Temporary Wound Closure of Exsiccated Deep Burns

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Introduction: A bilaminate synthetic skin substitute is used widely within a state-wide burn service for temporary wound closure (TWC) in patients with severe burn injury following surgical excision of deep burns. This study aimed to examine the role of this synthetic skin substitute in maintaining a healthy wound bed following surgical excision of deep burns and identify demographic or surgical factors associated with regrafting after removal of the synthetic skin substitute and initial skin grafting. We also wished to describe patients who would benefit from receiving the synthetic skin substitute in the acute setting for TWC and construct a clinical algorithm to aid the surgical decision making process.

Methods: A retrospective chart review was performed on patients with severe burns (≥20% TBSA), admitted to a state-wide burns service, from January 2009 to June 2012. Logistic regression analysis was performed to identify the predictors of need for regrafting.

Results: From 58 patients with median %TBSA burn of 30%, 24 patients (41.4%) required regrafting of at least one area previously treated with the bilaminate synthetic skin substitute and SSG. On univariate analysis, significant predictors of need for regrafting were increasing %TBSA (Odds ratio (95% CI): 1.04 (1.00-1.08); p=0.03). Age, gender, time to surgical debridement and synthetic skin substitute application, and anatomical region were not found to be associated with regraft.

Conclusions: A bilaminate synthetic skin substitute provides reliable and efficient wound closure in the majority of patients, however, in larger burns, the incidence of the need for regrafting points to a potential for improvement in wound bed preparation prior to autologous skin grafting in our institution.

Applicability of Research to Practice: Results of this study informed the development of a surgical algorithm for management of severe burns.

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Extra-Large Negative Pressure Wound Therapy Dressings for Burns: Technique, Fluid Management, and Outcomes

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Introduction: The use of negative-pressure-wound-therapy (NPWT) in burns has been associated with improved outcomes and accurate measurement of wound exudate, however it has typically been applied to smaller burns. We report our experience using extra-large (XL) NPWT dressings to treat ≥15% TBSA burns and describe our technique and early outcomes. We also sought to compare XL-NPWT dressing output to estimated insensible losses (EIL).

Methods: We performed a retrospective review of patients treated with XL-NPWT at our center. Following excision/grafting, non-adherent mesh gauze was placed over grafts and thin silver-impregnated non-adherent foam over donor sites. NPWT sponges were contoured/secured over both graft and donor sites. Large occlusive dressings were applied using sandwiching of large sheets for extremities, stapling in areas of shear/moisture, and wall suction for the initial seal. We documented wound size, dressing size, NPWT outputs, EIL defined as [(25 + %TBSA)(BSA) x24], graft take, wound infection, and length of stay (LOS).

Results: Eight burn patients (burn TBSA range 15-60%) were treated with one or more XL-NPWT dressings (dressing TBSA range 17-44%). Average graft take was 98%. No wound infections were noted. Two patients had burns ≥50% TBSA and their LOS was dramatically reduced compared to ABA averages (Table 1). XL-NPWT outputs demonstrated an initial rise over the first 2 days followed by a steady decline until dressings were removed. Although peak outputs approached EIL, the average output of each XL-NPWT dressing was on average 52% of EIL.

Conclusions: The use of XL-NPWT to treat extensive burns is feasible with attention to application technique. We feel that closed dressings improve graft take, eliminate pain and anxiety associated with daily wound care, decrease risk of infection, and decrease LOS. We expect overall cost savings due to decreased LOS in large TBSA burns. The standard calculation for EIL does not correlate well with XL-NPWT outputs observed. Further study is warranted to elucidate the various factors that contribute to improved outcomes with NPWT in burn patients, and to develop a reliable fluid management strategy for these patients.

Applicability of Research to Practice: Using the described techniques, burn surgeons can apply XL-NPWT to larger burns promoting a spectrum of improved patient outcomes.
95. **Adjuvant High Dose Ascorbic Acid Reduces Both the Volume of Burn Resuscitation Fluids and the Time to Complete Resuscitation in Burn Shock**

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**Introduction:** The standard for burn shock resuscitation (BSR) is the administration of i.v. Lactated Ringers (LR) over a 24 hr period using a volume of 2-4 mL/kg/percent total body surface area burned (%TBSA). Despite attempts at adhering to this strict fluid standard, patients still develop complications of over resuscitation including respiratory failure, ARDS, & extremity & abdominal compartment syndromes. Adjuvant high dose ascorbic acid (AHDDA) infusion during burn shock resuscitation offers the potential advantage of decreasing the fluid needs & complications associated with tissue edema formation. **HYPOTHESIS:** AHDDAA can reduce the resuscitation volume & time of burn shock resuscitation.

**Methods:** This is a retrospective chart review of patients undergoing Parkland (4mL/kg/%TBSA) BSR (PBSR) with AHDDA (66 mg/kg/hr x 18h) in a burn center with experience in this treatment modality. In addition to demographic data, total volume of LR was collected and then normalized with respect to weight (kg) and %TBSA burned. Fluids were titrated down each hour as long as urine output was 0.5 mL/kg/hr. Resuscitation was considered complete when patients remained hemodynamically stable at a calculated maintenance fluid rate (MFR=30 mL/kg/d + 1 mL/kg/%TBSA/d).

**Results:** From 2010 - 2012, 26 patients underwent adjuvant HHDA during burn shock resuscitation. Three patients were excluded from this analysis since the resuscitation protocol was not followed. The remaining 23 (age 52±14; %TBSA 39±17) received 3.08±0.82 mL/kg/%TBSA representing 30% less volume than predicted by Parkland. The average time to complete resuscitation was 17±5 hrs.

**Conclusions:** AHDDA reduces both the amount of resuscitation fluids and time to complete burn resuscitation.

**Applicability of Research to Practice:** Reducing both the amount of resuscitation volume and time to completion of BSR has the potential to reduce the complications associated with tissue edema in the management of burn shock.

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96. **Admission Cell Free DNA as a Prognostic Factor in Burns: Quantification by Use of a Novel Technique**

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**Soroka University Medical Center, Beer Sheva, Israel**

**Introduction:** Despite great advances in the treatment of burn patients, useful prognostic markers are sparse. During the past years there has been increasing interest in circulating plasma cell free DNA as a potential marker for tissue injury. We have developed a novel rapid direct fluorescent assay for cell free DNA quantification that allows obtaining accurate, fast and inexpensive measurements. The aim of this study was to use this novel technique for measuring plasma cell free DNA levels in burn patients and to further explore the use of cell free DNA as a potential marker for burn severity.

**Methods:** Plasma cell free DNA levels were obtained from 14 burn victims (mean TBSA 34.8%) within 6 hours of injury and from 14 matched healthy controls. DNA levels were quantified by a novel rapid fluorometric assay, the fluorochrome SYBR® Gold which does not require prior processing of samples, i.e. DNA extraction and amplification. The method was tested in comparison with the gold standard, Quantitative PCR, and was found to be in good correlation of R2=0.998 (p<0.0001).

**Results:** Admission cell free DNA levels were significantly elevated in the burn patients in comparison with those of controls (1797±1523ng/ml vs. 374±245ng/ml, p=0.004). There were statistically significant correlations between cell free DNA admission levels and burn degree (p=0.001) and total body surface area (p=0.02). We examined the mathematical manipulation of multiplying the TBSA percentages by the burn depth degrees (TBSA% x burn degree) as a means of quantifying the total burn volume (TBV). A statistically significant correlation was found between admission cell free DNA levels and TBV as well (p=0.014). We also found a significant difference (p=0.024) between the cell free DNA admission levels of the burn patients who died (mean=3264±2215ng/ml) and those who survived (mean=1211±614ng/ml). According to our results, an admission cell free DNA level of 1200ng/ml can be seen as an LD50 since of the eight patients with admission levels higher than 1200ng/ml four did not survive.

**Conclusions:** Admission cell free DNA levels may serve as a prognostic factor in burns. Additional studies with larger patient groups are needed in order to further assess these levels in burn patients.

**Applicability of Research to Practice:** Future routine use of cell free DNA levels can be made possible and cost-effective by use of our novel fluorometric assay.
Full-Thickness Burn Size: More Important than Total Burn Size in Determining Fluid Needs during Burn Resuscitation

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Introduction: Current formulas for predicting fluid requirements in burn patients are based solely on total body surface area burned (%TBSA); however, previous experience suggests that the percentage of full-thickness (%FT) injury will also have a significant effect on the resuscitation requirements. At our institution, fluid resuscitation is guided by a computerized decision support system (CDSS) that tries to optimize the resuscitation. The objective of this study was to determine the effects on fluid resuscitation when varying degrees of full-thickness injury were present.

Methods: We performed a retrospective review of patients admitted to our burn intensive care unit from December 2007 to January 2010 who were resuscitated using our CDSS. The CDSS provides fluid recommendations every hour after admission to maintain the patient’s urine output (UOP) in a target range of 30-50 ml/hr. We analyzed the relationship between full-thickness burn size and crystalloid fluid requirements using linear regression.

Results: We analyzed 92 patients admitted to our unit during the study period. Mean age and weight were 47±19 years and 83±21 kg respectively. Mean %TBSA was 42±20% with a mean FT of 18±23%. On average, 35% of the burn wound size was full thickness. Total crystalloid resuscitation volumes were 123±79 ml/kg in the first 24 hours, or 3.07±1.76 ml/kg/%TBSA. Multivariate linear regression showed that %FT was an independent predictor of 24-hour crystalloid volume (r2=0.44, p<0.001) with fluid requirements increasing by an average of 2.2 ml/kg for every percentage increase in %FT (Figure 1). TBSA was not found to be significant (p=0.08) in the linear analysis when %FT was included as part of the model.

Conclusions: This analysis showed that there was a significant increase in 24-hour fluid requirements as %FT increased. Linear modeling revealed that fluid requirements increased by more than 2 times for every one percent increase in %FT. Standard formulas that estimate fluid requirements in the first 24 hours solely on the %TBSA may need to be adjusted for %FT.

Applicability of Research to Practice: Patients with larger full-thickness burns may require significantly more fluid during burn resuscitation. Current approaches for estimating fluid needs may need to consider the patient’s %FT to provide more accurate predictions of fluid need. A larger sample size is required for subgroup analysis with different categories of %TBSA.

External Funding: US Army CCC Program and NIH 1R01HL092253.
99. **Intra-Abdominal Hypertension in Critical Burn Patients Resuscitated with a Restrictive Fluid Protocol**

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**Introduction:** In previous studies the prevalence of Intra-abdominal Hypertension was higher than 60% among the patients with >20% of TBSA burned or having inhalation injury. Our objective was to study the prevalence of IAH during the resuscitation phase using a lower fluid protocol.

**Methods:** 132 patients critically burned were prospective followed between October 2008 -October 2011. These patients underwent resuscitation guided by urinary output (0.5-1 ml/kg), lactate levels and Transpulmonary Termodilution(TPTD) with targets below normal (Cardiac index > 2.5 L/min/m2 and an intrathoracic blood volume index > 600 ml/m2). IAP was estimated by measuring their intrabladder pressure at admission and every 8 hours during 72 hours. and we used WSACS criteria for IAH. Statistical analysis using nonparametric correlations with Spearman’s rho and Mann-Whitney test was performed.

**Results:** 98 men and 34 women (mean age, 48±18 years) were studied. The mean total body surface area (TBSA) burned was 35%±22% and 99 patients (75%) needed mechanical ventilation. The mean fluid rate required to achieve protocol targets in the first 8 hours was 4.05 ml/kg/TBSA burned. Mean initial IAP were 9.7 (7.8-11.7) and increase to 12.1 (10.2-14.0) at 24 h (p NS). Forty four (33.3%) patients developed IAH: 15 grade I; 14 grade II; 9 grade III and 6 grade IV. Mortality in the patients without IAH was 15% and increases with IAH grade III and IV: 33 % and 66% respectively. No correlation was found between IAH grade and fluid reanimation, ABSI, PO2/FiO2 and mechanical ventilation. The five patients who developed ACS showed mortality of 80%.

**Conclusions:** the prevalence of IAH during the resuscitation phase using a restrictive fluid protocol is lower than others studies showed.

**Applicability of Research to Practice:** Lower fluid volume regimes can be used in order to decrease IAH and related complications including mortality.

100. **Admission Rapid Thrombelastography (rTEG*) Values Predict Resuscitation Volumes and Patients Outcomes after Thermal Injury**

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*University of Texas Health Science Center, Houston, TX*

**Introduction:** Using rapid thrombelastography (rTEG) values, trauma surgeons have demonstrated the ability to identify hypo- and hypercoagulable states on admission, to predict thromboembolic complications, and to identify patients likely to require large volume resuscitations and multiple transfusions. We sought to evaluate the use of rTEG in describing the coagulation status of major burn patients at the time of admission and to assess whether these rTEG values predicted resuscitation volumes and patient outcome.

**Methods:** We conducted a retrospective study of all patients admitted to our burn center between 01/10 and 12/12. We excluded those who were not major burn team activations, were less than <15% total body surface area (TBSA), were <18 years of age, and had mixed trauma and burns mechanisms requiring admission to the trauma ICU. Data on demographics, injury characteristics, fluid resuscitation, and admission laboratory data were collected. Previously published and validated cut-points for hypoocoagulable (ACT >128, k-time>2.5, angle<60, mA<55, LY30<3%) and hypercoagulable (mA>65) rTEG values were used. Supra-normal burn resuscitation was defined as >5.0 mL/kg/TBSA. Univariate and multivariate analyses were conducted using STATA 13.1.

**Results:** 65 patients met inclusion criteria. Median age was 45, with 74% male and 49% Caucasian. The median TBSA was 38% with 14% third degree burn TBSA. 60% of patients were hypercoagulable on admission, while 24% were hypoocoagulable, and 16% were normal. rTEG values predicted increased 24-hour resuscitation volumes, as well as plasma and platelet transfusions (p<0.05). Controlling for age, TBSA and base deficit, admission rTEG activate clotting time (ACT) >128 predicted a 5-fold increased likelihood of supra-normal resuscitation. Similarly, an alpha-angle <60 perfectly predicted in-hospital mortality.

**Conclusions:** While the majority of severely burned patients arrive hypercoagulable, those with admission rTEG values that are hypoocoagulable have increased resuscitation and transfusion requirements. Moreover, those with admission rTEG activate clotting time (ACT) >128 are at five-fold increased risk of receiving supra-normal resuscitation.

**Applicability of Research to Practice:** rTEG values (which are available within 5 minutes) predict patients at risk for supra-normal resuscitation and multiple transfusions.

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**Introduction:** The fluid resuscitation needs of children with small to moderate size burns < 20% total body surface area (TBSA%) can be difficult to predict. Some children drink, whereas others refuse and quickly dehydrate. We hypothesized that a novel computational algorithm called the Compensatory Reserve Index (CRI) originally developed for non-invasive monitoring of acute blood loss, could detect acute changes in the central volume status of children presenting with < 20% TBSA burns.

**Methods:** We recorded the pulse oximetry waveforms from bedside monitors in our emergency department (ED), which were later processed by the CRI algorithm. A CRI of 1 represents supine normovolemia and a CRI of 0 represents hemodynamic decompensation, with values between indicating the proportion of reserve remaining (figure). Average CRI values from the first 10 minutes of monitoring were compared to clinical data. Adequate UOP was defined as >0.5 mL/kg/hr. Student’s t-test and Spearman correlation coefficients were calculated, and a linear regression model was fitted using SAS version 9.3.

**Results:** Waveform data were available for 17 children with small to moderate size burns (4.5-20 TBSA%), out of 76 burn injured children admitted over a ten-month period. The average age was 6.4 ± 1.3 years, the average TBSA% was 11 ± 1%, and the average ED CRI was 0.33 ± 0.03. CRI inversely correlated with the TBSA% (p<0.0001). Twelve children were transfers with an average reported TBSA% of 16 ± 2%, which was significantly higher than the actual TBSA% (p=0.02). CRI correlated better with actual TBSA% compared to reported TBSA%. CRI correlated with the amount of fluid resuscitation given at the time of CRI measurement (p=0.06) and was inversely related to total fluids given/24 hours for children with adequate UOP in a linear regression model (p=0.07); however, these measurements did not achieve statistical significance with our small sample size.

**Conclusions:** The Compensatory Reserve Index is decreased in children with small to moderate size burns, indicating that these children are compensating for depleted central volume. They deserve close monitoring, often require IV fluids, and their fluid resuscitation volume correlates with CRI.

**Applicability of Research to Practice:** CRI is a non-invasive physiologic parameter that may be helpful in assessing the fluid needs of children with small to moderate size burn injuries.

**External Funding:** US Army Medical Research and Material Command (USAMRMC) Grant No. W81XWH-12-2-0112.

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**102. An Institutional Review of Moderate to Severe Burn Injury and Therapeutic Plasma Exchange**

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**Introduction:** For patients with moderate to severe burn injury, crystalloid resuscitation remains the foundation of initial therapy. Nevertheless, a subgroup of patients fail resuscitation and develop burn shock. Our institution has defined resuscitative failure and protocolized adjuncts including therapeutic plasma exchange (TPE). We have observed patients who fail to respond after initial TPE and subsequently undergo a second plasma exchange. For this project, we hypothesized that patients who require more than one plasma exchange do not survive.

**Methods:** An IRB approved retrospective review was conducted of all patients receiving plasma exchange at our burn center between January 2008 and June 2013. Data collected included age, burn size, revised Baux score, presence of inhalational injury, ventilator days, ICU length of stay and mortality. A review of patients and outcomes during the same time period with similar thermal injury at our institution were compared.

**Results:** A total of 365 pediatric and adult patients were admitted to our ICU with thermal injury greater than 15% TBSA between January 1, 2008 and June 31, 2013. A total of 44 (12%) patients received plasma exchange; 7 (2%) patients underwent 2 plasma exchanges; no patient underwent a third plasma exchange. Data are summarized in the Table.

**Conclusions:** Most patients respond to a single TPE with improved hemodynamics. Patients who require two plasmapheresis treatments tend to have significantly larger burns. Whereas the number of patients who require more than one plasma exchange have a significantly higher mortality rate than those who responded to one intervention - 30% did survive. Hence the need for more than one plasma exchange should not be considered to be an indication to withdraw aggressive critical care.

**Applicability of Research to Practice:** The need for more than one plasma exchange should not be considered to be an indication to withdraw aggressive critical care.

**Table 1**

<table>
<thead>
<tr>
<th>Patient (CAN$)</th>
<th>Total cost/total number of patients</th>
<th>Burn Severity</th>
<th>N</th>
<th>Mean age in years (SD)</th>
<th>Mean TBSA %</th>
<th>Mean Baux-revised</th>
<th>Inhalational Injury</th>
<th>Mean Ventilator Days</th>
<th>Mean ICU LOS</th>
<th>AKI*</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;20%</td>
<td>617</td>
<td>36.7 (20.7)</td>
<td>50.0 (16.7)</td>
<td>103.4 (27.8)</td>
<td>58 (17.7)</td>
<td>41 (19.3)</td>
<td>21 (22.8)</td>
<td>16%</td>
<td>21%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;40%</td>
<td>82</td>
<td>32.1 (20.6)</td>
<td>42.0 (16.5)</td>
<td>107 (23.8)</td>
<td>65%</td>
<td>35 (36.8)</td>
<td></td>
<td>7%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-40%</td>
<td>24</td>
<td>33 (18.9)</td>
<td>58 (17.7)</td>
<td>122 (14.3)</td>
<td>43%</td>
<td>30 (27.8)</td>
<td></td>
<td>7%</td>
<td>71%</td>
</tr>
</tbody>
</table>

* Acute Kidney Injury (AKI) requiring CRRT or CVVH

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46th Annual Meeting of the American Burn Association
A Multicenter Study of Pediatric Burns from Glass Fronted Gas Fireplaces

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University of Iowa, Iowa City, IA; Cincinnati Children’s Hospital, Cincinnati, OH; Burn Prevention Network, Allentown, PA; Children’s Hospital Colorado, Aurora, CO; Akron Children’s Hospital, Akron, OH; Massachusetts General Hospital, Shriners Hospitals for Children, and Harvard University, Boston, MA; Loyola University Medical Center, Maywood, IL; Arizona Burn Center, Phoenix, AZ; SUNY Upstate Medical University, Syracuse, NY

Introduction: Glass fronted gas fireplaces (GFGF) have an exterior front glass that can reach extremely high temperatures and are readily accessible to children. Single center studies report a much higher incidence of GFGF injuries than the 3.7 annual incidence reported by The Consumer Products Safety Commission (CPSC). The purpose of this multi-institutional study was to determine the magnitude and severity of GFGF injuries in North America.

Methods: Eleven of 46 verified pediatric burn centers (23.9%) and 3 non-verified centers participated. The study group consisted of children ≤10 years of age identified through ICD-9 codes for contact burns (E924.8 or E924.9), treated from January 1, 2006 to December 31, 2010. Manual review of these records for GFGF burns identified the study group. De-identified demographic, burn characteristics, financial and follow-up data were extracted and entered into a RedCap database collection tool at each site. Descriptive statistics were performed. Each center obtained internal institutional review board approval.

Results: There were 248 children who sustained injuries from contact with a GFGF. These injuries represented 4.7% of all contact burns in children ≤10 years of age (5,264). Two centers reported zero GFGF injuries. The mean age of the study group was 17.1 ± 14.5 months (range 1 month - 8 years). Although, the average burn size was small at 1.3 ± 1.5% (range 0.1 - 16%), the majority suffered burns to their upper extremities. Burns on the left hand (71%) paralleled burns on the right hand (76%) and more than 47% involved both hands. Burns seldom occurred to other parts of the body. Thirty-one (13%) children required admission for their injuries and 16 (7%) underwent surgery. The majority (10, 63%) only required one surgical procedure; however six (37%) required multiple surgical procedures with one requiring 5 operations. Twenty-eight children received follow-up visits only by their primary care physicians, the majority of whom sustained ≤1% burn (23, 85%). The remaining averaged 4 clinic follow-up visits. One hundred and forty five (63%) required therapy, 82 (39%) underwent casting, and 53 (24%) had splints. Seven centers reported financial data with average charges of $3,057 (median of $641).

Conclusions: Although this study sampled fewer than a quarter of burn centers treating children, the number of GFGF injuries reported was 16 times that of the CPSC estimate. For the affected children, these injuries can lead to long-term disability. Safety regulations should be developed and mandated to curtail these life-changing preventable injuries.

Applicability of Research to Practice: The epidemiology of childhood burn injuries is important in educating the public and establishing safety regulations for industry.

External Funding: University of Iowa Injury Prevention Center.

Healthcare Costs of Burn Patients from Homes without Fire Sprinklers

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Introduction: The treatment of burn injuries requires high-cost services to the healthcare system and society. Automatic fire sprinklers are a preventive measure that can decrease fire injuries, deaths, property damage and environmental toxins. Prevention requires resources prompting the question about economic balance between prevention and costs of treatment. This study’s aim was to conduct a cost-analysis of patients burned in a residential fire and to compare this to the cost of implementing residential automatic fire sprinklers.

Methods: We conducted a cohort analysis of burn patients admitted to our provincial burn center (1995-2012). Patient demographics and injury characteristics were collected from medical records and burn center databases. Costs were calculated using average cost per day at our intensive care, rehabilitation program, and transportation.

Results: During the study period, 3401 patients were admitted and 1139 (34%) had flame injury occurring at home. Of the 1139 the average percent total body surface area (TBSA%) burned was 22±1%, the average age was 47±1 years, and the average hospital length of stay was 19±1 days, and 284 (25%) had inhalation injury. There were 170 deaths (15%) over the 17-year period. The average total costs for a burn patient’s stay in hospital per day varied by burn severity (Table). The average cost of installing residential fire sprinklers in a new home is approximately CAN$1,61 per sprinklered square foot; a 2,500 square feet home would cost CAN$4,025.

Conclusions: This study shows the high cost of burn injuries occurring at home. These injuries are highly preventable and the implementation of automatic fire sprinklers should be mandatory for all new residential homes.

Applicability of Research to Practice: Focusing on the costs of burn injuries to the healthcare system is critical for burn prevention and policy changes.


Healthcare Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Number of Patients</th>
<th>Average Cost Per Patient (CANS)</th>
<th>Total Cost (CANS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>849</td>
<td>240</td>
<td>203,760</td>
</tr>
<tr>
<td>Burn Severity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c&lt;20%</td>
<td>617</td>
<td>37.526</td>
<td>23,153,542</td>
</tr>
<tr>
<td>20-40%</td>
<td>164</td>
<td>156.626</td>
<td>25,686,664</td>
</tr>
<tr>
<td>&gt;40%</td>
<td>82</td>
<td>268,516</td>
<td>22,018,312</td>
</tr>
<tr>
<td>Patients who died &lt;24 h</td>
<td>81</td>
<td>7.620</td>
<td>617,220</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>164</td>
<td>22.779</td>
<td>3,735,756</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>195</td>
<td>19.324</td>
<td>3,768,180</td>
</tr>
<tr>
<td>Total</td>
<td>1,139*</td>
<td>69.520f</td>
<td>79,183,434</td>
</tr>
</tbody>
</table>

* Includes: Burn Severity, patients who died <24h and Reconstruction
f Total cost/total number of patients
Introduction: Burn centers treat many children each year for scar burn injuries related to foods cooked in the microwave. Recommended cooking times on manufacturer packaging is usually based upon 700 watt microwaves. Following package cooking times in a microwave with a higher wattage causes food to be hotter than necessary and can increase the risk of a scald burn. Through outreach programs, it was found that not only are people unaware of the differences in microwave wattages, but most do not know the wattage of their home appliance. Providing accurate education, without the knowledge of specific microwave wattage, required the development of an interactive tool.

Methods: The “Wattage Wheel” (WW) was developed as a take-home tool to educate families on adjusted microwave cooking times. A common conversion formula was used: Time of recipe X 700W/ Wattage of Microwave Oven = Adjusted Cooking Time. Times were calculated based on 1, 1:30, 2, 3, 4, 5, and 10 minute recommended cooking intervals. Adjustments were made for microwaves ranging from 900-1600 watts. The tool also includes information on how to find personal microwave wattage information and a QR code, linking the user to further information on burn prevention.

Results: The WW was created, produced and is now being used at outreach events. To further disseminate the tool, the Outreach Department will collaborate with local Home Town Health Initiatives and fire departments to reach a larger audience. Initial responses from the public have been positive and the tool has already led to discussions about home microwave and cooking safety.

Conclusions: Studies show that microwaves are one of the leading home products associated with scalds. The WW is a novel education tool that can provide easy access to microwave conversion tables without requiring the user to perform calculations. This tool can help to fill the knowledge gap that is widely present and can stimulate discussions on cooking and microwave safety. It has sparked discussions on the risks of allowing children to use the microwave, with many people being surprised at the temperature at which microwaved foods are heated. In early testing, the WW has been easy to use and of interest to initial consumers.

Applicability of Research to Practice: In recent years there has been a marked increase in the number of burn injuries related to microwave use. Cost effective tools, such as the WW, can be an important piece of the prevention and education puzzle and can help reduce the number of preventable, microwave related burn injuries.

106. Butane Hash Oil Manufacturing Related Burn Injury: A Disturbing Trend

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Introduction: In December 2012 voters legalized recreational use of marijuana for those ages 21 and older. Citizens can grow up to three immature and three mature cannabis plants privately in a locked space, legally possess all cannabis from the plants they grow in that space, legally possess up to one ounce of cannabis while traveling, and give as a gift up to one ounce to other citizens 21 years of age or older. Soon after this legislation was passed, a new trend in burn injury was recognized in our burn center; explosion of butane gas while manufacturing hash oil otherwise known as honey oil, dabs, shatter, or earwax. During production of hash oil, the volatile butane permeates the air and can be easily ignited.

Methods: An etiology search of our TRACS Database (explosion of gases or ignition of highly flammable material) was completed 2 years prior to the change in legislation and 7 months post legislation change and a retrospective review of the electronic health record was performed. Those with explosion of gases related to hash oil manufacturing were included for this review.

Results: 11 Butane Hash Oil Manufacturing related injuries were treated at our burn center from 2011-2013. All of the injuries were related to private manufacturing by cannabis users. Only 2 patients were admitted after butane explosion in the 24 months prior to December 2012; however, 9 of the 11 (82%) injuries occurred in only 7 months after legislation passed in December 2012 legalizing marijuana for recreational use. The 9 patients were admitted after 3 separate butane ignitions over the last 7 months. Event 1 (n=2), Event 2 (n=5), Event 3 (n=2). 88% were male; the mean age was 31 years; mean TBSA 11.5%; and mean length of stay 10.6 days. The distribution of burns was as follows: face 8/9, arms 8/9, legs 2/9, back 1/9. 7 of 9 required surgical intervention for their injury: debridement and xenograft (2) autograft (4) orthopedic pinning for avulsion injury (1).

Conclusions: There has been a dramatic increase in hash oil manufacturing related burn injuries from butane explosions after legalization of recreational marijuana. The regional burn center has a responsibility to inform legislators when new patterns of injury are recognized to ensure safety standards are incorporated. Industry standards should be set prior to the continued liberalization of marijuana use. Burn prevention and outreach programs should be customized to local and regional injury patterns and targeted to the presenting demographic.

Applicability of Research to Practice: Increased awareness of butane hash oil associated burn injuries will lead to opportunities for prevention and education.
107. Microwave Prepared Food: Assessing the Burn Risk
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Arkansas Children’s Hospital, Little Rock, AR

Introduction: Scald burns are one of the most common causes of burn injuries for the pediatric population. Literature shows the largest percentage of household scalds occur in the kitchen and that scalds were twice as common as thermal burns in the home. With advancements in cooking technology, there has been a marked increase in the number of burn injuries related to microwave use. Microwaved foods are prepared and served at very high temperatures which can lead to rapid and often severe scald burn injuries.

Methods: This study measured temperatures and cooling times of several commonly available microwave prepared foods. Items were heated, in an 1100 watt microwave following package instructions, and immediately removed from microwave. Simultaneous quadrant temperatures were taken with four separate thermometers to assess evenness of heating. Subsequent temperatures were recorded at regular intervals to assess rate of cooling after removal from heat source. Data was recorded and analyzed.

Results: At the time of removal from the microwave, all products presented a significant scald risk. At 85.4 °C (Macaroni and Cheese), 87.5 °C (Ramen Noodles) and 96.9 °C (water), all were well above the temperature at which a third degree burn can occur in one second (65 °C). At rest, at a room temperature of 22.2 °C (72 °F), the Macaroni product took 40 minutes, the Ramen Noodles took 90 minutes and the water took 60 minutes to cool to a safe temperature.

Conclusions: The American Burn Association (ABA) recommends that children under the age of seven not be allowed to use the microwave. Our recommendations would go even further to state that children over the age of seven only be allowed to use the microwave with direct supervision. Other possible recommendations would be removal of the product from the cooking container, by an adult, adding cold water or an ice cube to cooked product, and allowing the food to cool at room temperature for at least 10 minutes prior to serving. Development of prevention materials for caregiver education is essential to reducing the number of microwave related scald burns which require medical care.

Applicability of Research to Practice: This information was used to develop educational information regarding the dangers of allowing children to handle microwaved foods. Education on the actual temperatures of these foods is a dramatic teaching tool that is expected to help decrease the number of microwave scald burn injuries in children.

108. Burn Center Education for Emergency Medical Service (EMS) Providers: An Opportunity to Establish Best Practices
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Introduction: Historically, EMS students participated in a 1-day clinical rotation at a large metropolitan burn center to observe wound care and rounds, shadow charge RNs and complete self-learning burn care e-modules as part of the required paramedic student education. As a result, student and staff experiences varied widely. To provide a more uniform, comprehensive experience, this center transformed the rotation into a burn specialty course. It was hypothesized that a more consistent, interactive format would positively impact staff and students’ experiences. The following outlines the experience to establish a best practice in the education of the prehospital providers critical to the positive outcomes for burn injured patients.

Methods: As of 7/12, 12 cohorts of 8-12 students/providers completed the reformatted 7-hour course presented by 1 of 2 nurse clinicians. Components include a unit tour, wound care observation, presentations on unique aspects of multidisciplinary care by area specific providers, an interactive lecture focused on the impact of EMS on the care continuum, and visit to the hyperbaric chamber. At conclusion, attendees completed a 25-question, core content exam and an anonymous 10 question survey about the experience. At 14 months post implementation, 25 charge RNs were surveyed about the redesigned format.

Results: Between 7/12-8/13, 118 students completed the rotation; 116 (94%) completed the exam (mean 94 ± 7 (72-100)) and 111 (94%) completed the survey. Most (strongly) agreed the lecture length to be appropriate (94%) and observing wound care improved understanding of burn care (88%). Most affirmed the lecture (96%) and tour (96%) increased insight into the role of EMS in the care continuum; 96% felt the rotation improved knowledge of emergency care of the burn injured patient. Free text reported wound care observation and course organization/format as very positive while more wound care observation and patient interaction were suggested improvements. Ten charge RNs (40%) responded, and reported that 60% support the new format; 80% believe that it provides a more consistent educational experience; 60% and 86% agree wound care observation supports EMS education and that the students are responsive to the wound care teaching.

Conclusions: The new format resulted in positive educational and clinical experience for EMS providers and staff and corroborates evidence of EMS student preference for an educational style focused on the clinical experience. Based on these findings, our center will build on this platform to further improve this burn specialty course. Other EMS training programs may benefit by instituting a similar format for burn training.

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tJohns Hopkins Bloomberg School of Public Health, Baltimore, MD

Introduction: In 2011, fires caused 17,500 injuries and more than 3,000 deaths, and resulted in more than $11 billion in property damage (Karter, 2012) in the US. Identifying and addressing fire risks that are present in homes can prevent fires. This analysis will examine the causes of fires and the prevalence of fire risks in an urban population and describe how prevalence and risk data was incorporated into fire prevention messaging on the Johns Hopkins CARES Mobile Safety Center.

Methods: 1)Data on the causes and room of origin of residential fires in Baltimore City from 2010-2011 were obtained from NFIRS. Causes and area of origin were tabulated. 2)As part of a case/control study to examine housing quality, we observed 175 homes in Baltimore of children <8 years old that had recently visited the PED for an illness or an injury. This data was collected from August 2012-April 2013. Homes were observed for the presence of fire risks such as fireplace guards, defective stove tops, and overloaded or defective electrical outlets. Risks were tabulated and described. 3)Fire prevention curriculum from the CARE Mobile safety center was reviewed and updated to more specifically address risk factors determined from fire incidence and home observations.

Results: From 2010-2011, there were 2,641 fires in Baltimore City. Among 2,023 fires with known causes, 1,156 fires (57.14%) were caused by cooking and 128 fires (6.33%) were caused by electrical malfunction (Table 1). 1,238 fires were contained to the item or container of origin; the majority (N=1152; 93%) of these were cooking fires which did not spread beyond the pot or pan of origin. Among 1,001 unintentional fires not contained to the item or container of origin, 24% originated in the kitchen, 8% in the living room, and 23% in the bedroom. Based on preliminary analyses from observations in 175 homes with children, overloaded electrical outlets were present in 28 living rooms (16%) and in 20 bedrooms (11%) of the child whom had recently visited the PED (Table 3). Six households (3%) reported frequently ‘blown’ fuses in at least one of the observed rooms. Most households had a gas (vs. electric) range (N=147; 84%) and defective stoves or ranges were observed in nine (5.14%) households.

Conclusions: Serious fire hazards exist in urban homes with children.

Applicability of Research to Practice: Fire prevention messages can be more effectively communicated when derived from fire incidence and observed risk factors.

External Funding: Funding for this research was provided by the Center for Disease Control and Prevention and a FEMA Fire Prevention and Safety Grant.

110 . The Increasing Trend of Cannabis Use in Burn Patients

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Introduction: The use of cannabis is increasing according to US Department of Health and Human Services (HHS). Surprisingly, cannabis use among burn patients is poorly reported in literature. In this study, rates of cannabis use in burn patients are compared to general population. Data from the National Burn Repository (NBR) was used to investigate incidence, demographics and outcomes in relation to use of cannabis as evidenced by urine drug screen (UDS).

Methods: Thousands of patients from the NBR from 2002 to 2011 were included in this retrospective study. Inclusion criteria were patients older than 12 years of age who received a drug screen. Data points analyzed were patients’ age, sex, UDS status, burn etiology, TBSA, length of stay, ICU days, and insurance characteristics. Incidence of cannabis use in burn patients from the NBR was compared against national general population rates (gathered by HHS) using chi-square tests. Additionally, the burn patient population was analyzed using bi-variate analysis and t-tests to find differences in the characteristics of these patients as well as differences in outcomes.

Results: 17,080 out of over 112,000 patients from NBR had information available for UDS. The incidence of cannabis use is increasing among the general population but the rate is increasing more quickly among patients in the burn patient population (p=0.0022). In 2002, 6.0% of patients in burn units had cannabis+ UDS which was comparable to national incidence of 6.2%. By 2011 27.0% of burn patients tested cannabis+ while national incidence of cannabis use was 7.0%. Patients who test cannabis+ are generally male (80.1%, p<0.0001) and are younger on average (35 years old vs 42, p<0.0001). The most common mechanisms of injury among patients who test cannabis+ or cannabis- are similar. Flame injury makes up >60% of injuries, followed by scalds which are >15%. In comparing cannabis+/cannabis- patients, cannabis+ patients are more likely to be uninsured (25.2% vs 17.26% p<0.0001). Finally, patients who test cannabis+ have larger burns (TBSA% of 12.94 vs 10.98 p<0.0001), have a longer length of stay (13.31 days vs 12.6, p=0.16) spend more days in the ICU (7.84 vs 6.39, p=0.0006) and have more operations (2.78 vs 2.05 p<0.0001).

Conclusions: The rate of patients testing positive for cannabis in burn units is growing quickly. These patients are younger and are less likely to be insured. These patients also have larger burns, spend more time in ICUs and have a greater number of operations. The increasing use of cannabis, as expected from legalization of cannabis in multiple states, among burn patient population may lead to increased burden on already tenuous healthcare resources.

Applicability of Research to Practice: Understanding epidemiology of cannabis use among burn patients and how it relates to patients hospital course and outcomes.
Introduction: Post-burn pruritus affects more than 80% of pediatric burn survivors. It can be more distressing than post-burn pain, and may impair wound healing if the burned area is persistently excoriated. Consequently, impact on patients’ quality of life during recovery can be significant. Management protocols and quantitative clinical research rely on sound rating scales. Existing burn pruritus scales require the comprehension and participation of the patient. As this is rarely possible in young children we designed and validated a novel behavioral scale for rating post-burn itch in infants and children aged less than 5 years.

Methods: We engaged an extensive range of professionals involved in the care of children with burns. This group generated a bank of example post-burn behaviors previously witnessed in pediatric burn survivors. We used Q-sort methodology in an interprofessional team exercise to group and stratify behaviors into categories of increasing severity, and then iteratively refined these into a draft scale. Following pilot implementation, users were interviewed using a structured script regarding the scale’s feasibility, usefulness, and content and face validity. Quantitative data were collected using Likert scales. The scale was further adjusted following multidisciplinary focus group sessions. To investigate reliability, we asked three raters to independently score the itch severity of thirty pediatric burn survivors and calculated the inter-observer agreement using Cohen’s kappa statistic.

Results: We generated a 4-point scale of itch severity with simple descriptors of each score. We also designed a separate guidance note and example behaviors that could be used to orientate new users without need for rater training. End-user interviews revealed high levels of feasibility and content validity. The reliability data showed moderate inter-observer agreement, with a Cohen’s kappa of 0.52 (P<0.001).

Conclusions: We present the first behavioural post-burn pruritus scale for children aged less than 5 years. We have demonstrated its usefulness, feasibility, validity and reliability. It has been implemented as a component of routine assessment of burn survivors at our institution.

Applicability of Research to Practice: Validated symptom scoring scales allow design of graduated management protocols and quantitative clinical trials investigating the efficacy of the different therapies.
113. Safety and Efficacy of a Ketamine Protocol for Use during Burn Wound Care

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Introduction: Adequate pain control during burn dressing changes is an essential component of burn wound management. Ketamine is a drug that produces profound analgesia and anesthesia with a limited side effect profile. Ketamine administration traditionally falls under conscious sedation guidelines, requiring physician presence for use. The University of Colorado Burn Center developed a protocol for ketamine administration during dressing changes without physician supervision. The protocol includes administration of ketamine 0.5-1 mg/kg IV over 1-2 minutes, followed by 0.25 mg/kg every 5-10 minutes as needed. The purpose of this study was to assess the safety and extent of pain control provided by this protocol.

Methods: We conducted a retrospective review of our experience with ketamine by conducting an audit of medical records for ketamine administration over the past 3 years. Nursing notes, procedure notes, and patient records were reviewed for this information. Statistical analysis included Student’s t-test and Wilcoxon rank-sum test.

Results: 27 patients received 56 ketamine administrations by CCRNs, with a mean dose of 62mg +/- 27mg per event. The patient population was 74% male with an average age of 39 years, and average TBSA of 24%. 19 patients had >10% TBSA, all 8 patients with <10% TBSA involved burns of the hands and feet. 48% of patients had mental health diagnoses, 22% of which included substance abuse. 1 patient required administration of naloxone due to a fentanyl complication. No other major or minor events (including intubation, nausea, vomiting, delirium and excessive salivation) were recorded (P<0.001).

Changes in respiratory rate, blood pressure, and heart rate at 15, 30, and 45 minutes after ketamine administration were not statistically significant (P=0.06-0.79). Benzodiazepine and opiate use decreased, from 3 +/- 9.5mg to 1 +/- 9.8mg versus equivalents (P<0.001) and 250 +/- 520mg to 100 +/- 47-mg fentanyl equivalents (P=0.003), respectively, after ketamine use. Pain scores were not adequately recorded for inclusion in this evaluation.

Conclusions: The administration of ketamine by CCRNs without physician supervision is safe for burn patients during dressing changes. It is associated with decreased benzodiazepine and opiate use. Patients who should be considered for ketamine use are those with major burns or hand burns. There is a need to prospectively study CCRN-administered ketamine in burn dressing changes to further identify advantages, including changes in pain score, PTSD rates, and changes in adjuvant drug use.

Applicability of Research to Practice: A nurse-supervised administration of ketamine to burn patients during dressing changes could dramatically change wound care practices.

114. Prospective Clinical Evaluation of Delirium Screening in a Burn Intensive Care Unit

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Introduction: Delirium is associated with increased morbidity and mortality, necessitating early identification and preventive measures. Because nurses are in an ideal position to provide continuous screening for delirium, we created a Delirium Assessment Working Group (DAWG) comprised of bedside nurses, a dualy certified advanced practice psychiatric nurse & family nurse practitioner (PNP), a critical care clinical nurse specialist, nurse scientist and physician to determine best evidence-based practice for bedside identification of delirium in the burn patient.

Methods: After a review of the literature, 2 delirium screening tools with established validity and reliability were prospectively compared in a burn ICU (BICU); the Intensive Care Delirium Screening Checklist (ICDSC) and the Confusion Assessment Method-Intensive Care Unit (CAM-ICU). Patients were screened by a DAWG member using both tools. ICDSC and CAM-ICU screening results were compared to the most recent CAM-ICU documented in the medical record by a non-DAWG bedside nurse and the physician’s (MD) daily progress note. The PNP evaluated each patient and served as the delirium diagnosis subject matter expert (SME). Descriptive statistics and Fisher’s Exact Test were used to describe the results.

Results: We performed 35 observations (obs) for 26 patients (mean 40±19.8 years); 16/35 (61.5%) sustained thermal injury with average 31±25% burn surface area. Compared with SME delirium determination (14/35 obs), agreement was noted with ICDSC 78.6% (p = 0.61), CAM-ICU 57%, (p = 0.79); bedside nurse 30.8% (p = 0.031) and MD 21.4% (p = 0.03) ICDSC assessment was performed 100% of time; CAM-ICU was obtained 71.5% of the time. No evaluation resulted in a false positive compared with SME determination.

Conclusions: DAWG members were more able to assess patients using the ICDSC than the CAM-ICU. Bedside nurse and physician documentation of delirium had poor agreement with the SME. ICDSC should be explored further as a tool to reliably diagnose delirium in the Burn ICU.

Applicability of Research to Practice: Application to Practice: The ICDSC was found to have greater reliability in our BICU for delirium screening. Nurse and Physician understanding of delirium should be further investigated.
115. Long Term Health Outcomes of Older Adults Following a Major Burn Injury

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Introduction: Previous investigations have confirmed that major burn injury impacts both functional outcome and quality of life in older adults (≥ 55 years of age). However, few studies have prospectively examined long-term health outcomes following a major burn injury in this cohort. The purpose of this study is to examine (1) the mental and physical health outcomes of a cohort of older adults at 5 and 10y post injury; and (2) changes in functional health and well-being over time.

Methods: The sample of older adults in this study, comprise a subset of a larger national sample of burn survivors enrolled in a multi-center longitudinal study. Outcomes data were collected using multiple standardized assessment tools. Health related quality of life data was obtained using SF-12 at pre-injury, discharge, 6 months, 1, 2, 5, and 10 y post injury. Outcomes data at 5 and 10y included the World Health Organization Disability Assessment Schedule (WHODAS II), Burn Specific Health Scale (BSHS-B), Patient Health Questionnaire (PHQ-9) and Insomnia Severity Index (ISI). Participants were stratified into 3 age groups: 55-64, 65-74, and ≥ 75 years. Comparisons between the 3 groups at 5 and 10y post injury were performed using Kruskal-Wallis and chi-square tests. Wilcoxon sign rank tests were used to compare the 5 and 10y SF-12 scores with age-matched normal population scores. The 5y (n=46) and 10y (n=50) data were combined together and Repeated Measures ANOVA was used to examine changes in SF-12 Mental and Physical Component Scores (MCS and PCS) over time.

Results: Of the 269 eligible for study participation, 96 (36%) provided data. This sample was predominantly male (65%), Caucasian (77%), with a mean age of 64y (SD=7.6). The mean Total Body Surface Area (TBSA) burn was 18% (SD=15.29), with a mean hospital stay of 27 days (SD=19.6), and mean days in rehab 2.5 (SD=7.6). No significant difference was noted at 5 and 10y post injury across the 3 groups in all outcome measurements listed above. The 5 and 10y burn SF-12 scores did not differ significantly from the norm scores. Examining changes over time in individual scores, the overall MCS and PCS ANOVA models were found statistically significant (F=3.34, p=0.000; and F=8.12, p=0.000 respectively).

Conclusions: In this study no significant difference was noted (a) across age groups at 5 and 10y post injury, and (b) between the 5 and 10y burn SF-12 scores and SF-12 norm scores. The physical and mental health of older adults significantly improved by 6 months post injury and remained unchanged thereafter. Neither physical nor mental health reached pre-burn level of functioning.

Applicability of Research to Practice: Appropriate age-specific interventions may help to improve long term functional health and well-being among aging older adults.

External Funding: NIDRR Grants H133A070024 and H133A130004.

116. Which Burn Outcomes Are Most Important to Patients?

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Introduction: There has been recent renewed emphasis on outcomes research and patient centered care. Thus burn therapies should focus on achieving outcomes that are most important to patients. However patients’ perspectives may differ based on demographic and clinical characteristics. We determined which outcomes were most important to patients and explored the association between demographic/burn characteristics and patient preferences.

Methods: A prospective, observational study was conducted at a regional, suburban burn center from 2008-2013. Patients with burns who were admitted to the burn unit or visited the burn outpatient clinic were enrolled in a longitudinal institutional burn registry. Standardized data collection included demographic, clinical, and burn characteristics. Patients were asked to rate the importance of several burn outcomes including cosmetic appearance, resumption of normal function, and the lack of pain/itching on a four-item Likert scale (not important, somewhat important, important, and extremely important). The association between demographic and burn characteristics with patients views on the importance of various outcomes was explored with chi-square and non-parametric tests.

Results: During the study period 776 patients were included in the institutional burn registry. Their mean (SD) age was 30 (22) and 58% were males. Most burns were thermal (94%); chemical, electrical, and unspecified burns each comprised 2%. The most common types of thermal burns were scalds (49%), flames (25%), and contact (24%). Burn location included extremities (72%), trunk (14%), and head/neck (14%). Surveys on outcomes were completed by 753 patients. Overall, function was extremely important to 96%, lack of pain/itching was extremely important to 85%, and cosmesis was extremely important to 59% of patients. Cosmesis was extremely important to more females than males (69% vs. 52%, p<0.001) and the mean age of patients in whom cosmesis was extremely important was lower than those in whom it was not (25 vs. 40, p<0.001). Cosmesis was more commonly extremely important in head/neck than extremity burns (67% vs. 57%, p<0.001).

Levels of importance for function and lack of pain/itching did not differ by gender, age, or burn location.

Conclusions: Return to normal function and lack of pain/itching appear to be more important outcomes than cosmetic appearance in burn patients. Cosmesis is of greater importance to younger patients, female patients, and those with head/neck burns.

Applicability of Research to Practice: Patient priorities with respect to the relative importance of function, burn appearance, and lack of pain/itching should be considered when evaluating burn outcomes.

External Funding: This study was supported by the SCVOL Firefighters Burn Center Fund.
**The Story of Northstar**
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*The Ohio State University Wexner Medical Center, Columbus, OH; The Ohio State University Gallbreath Equine Center, Columbus, OH*

**Introduction:** “A case that no one will forget,” is how the equine doctor describes the unique collaboration between Veterinary Medicine and the Department of Surgery. The assistant professor of Equine Emergency and Critical Care at the Equine Center and the human doctor, associate professor of clinical surgery and director of the Burn Center, and their teams joined to perform skin grafts on a horse who suffered a major burn injury with the goal of restoring a normal life.

**Methods:** Prior to skin grafting the doctors observed each other’s surgery. Literature reviews were done in the areas of the thickness of horse skin and wound healing and nutrition. The ability to use the same equipment on a horse, a dermatome and skin mesher, with regards to skin thickness was tested and researched.

**Results:** The seven year old horse, named Northstar, was maliciously attacked in 2012 by an unknown person or persons. He was doused with an accelerant and set on fire. Northstar’s owners found him in a field at their farm in shock and severe pain. The third degree burn covered nearly 50 percent of the horse’s body involving the back and shoulder. The wound extended to all layers of skin and exposed bone in some areas. With the use of STSG and human dressings the large wound is nearly closed.

**Conclusions:** Best outcomes can be achieved in severely burned animals when experts collaborate on care. In this presentation the equine and human doctors will present the story of Northstar, discuss the details of the project, and answer questions.

**Applicability of Research to Practice:** Collaboration of disciplines from the human and veterinary medicine can improve burn outcomes for all species.

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**A Profile of Burn Camp Volunteers and an Assessment of Participant’s Emotional Intelligence and Self-Compassion**
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*Arizona Burn Center, Phoenix, AZ; A T Still University, Mesa, AZ; Mid-Atlantic Burn Camp, Clarksville, MD*

**Introduction:** Volunteers are an integral part of burn camp. However, little is known about the individuals who donate significant time and resources to the camp process. This study sought to assess demographics and to measure the emotional intelligence and self-compassion of camp volunteers; two important characteristics to have when working with youth. Emotional intelligence measurement identifies one’s ability to identify, assess and control the emotions of oneself, others and groups, while self-compassion assessment reveals one’s ability to recognize failure and suffering as part of the human experience and to practice self-consideration and kindness, leading to improved treatment of others.

**Methods:** Burn camp volunteers from four burn camps across the U.S. completed demographic information, in addition to the Assessing Emotions Scale (AES) which measures emotional intelligence and the Self-Compassion Scale (SCS) which assesses self-compassion levels, both are reliable and valid screens. A psychologist administered the surveys.

**Results:** Participants included 166 adult burn camp volunteers. Ethnicity included Caucasian (75%), Hispanic (13%) & African American (6%) with the majority in the 20-36 year age range (68%). Profession included Firefighter (32%), Medical Professional (12%), Educator (7%), Other (49%), and Burn Survivors made up (22%) of the total. Females scored an (AES) mean of 134.5, comparable to norms, but males scored significantly higher 133.9 vs. a norm mean of 124.8 (p ≤ 0.001). The group mean SCS score of 2.9 was average, but females had significantly higher scores than males (p ≤ 0.05).

**Conclusions:** The groups’ AES scores were strong; important as they indicate individual optimism, impulse control, and greater empathic perspective taking. Males scored lower on the SCS which may have implications for pre-camp training. Of note, the majority of participating counselors were Caucasian, as compared to 35% of campers. If recruitment of more minority volunteers was increased the overall development of minority campers may improve.

**Applicability of Research to Practice:** As the ethnic demographics of children at burn camp change, a concerted effort for recruitment of more minority counselors and staff should be considered. Emotional Intelligence testing may be a good screening method for applicants as the competition for burn camp counselor slots continues to increase. Self-Compassion can be a learned skill and tips for improvement should be considered for inclusion in the camp volunteer training curriculum.
118. The Story of Northstar

Applicability of Research to Practice
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Methods

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Introduction

Columbus, OH; The Ohio State University Galbreath

University, Mesa, AZ; Mid-Atlantic Burn Camp, 

Arizona Burn Center, Phoenix, AZ; A T Still

DPT, I. J. Sadler, PhD, N. B. Alam, BS, K. N. Foster, 

R. B. Rimmer, PhD, R. C. Bay, PhD, E. T. Kalil, PT, 

119. Prospective Evaluation of Fractional CO2 Laser

Treatment of Mature Burn Scars

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MPH, D. Boorse, RN, CNP. P. Pagella, RN, CNP

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Introduction: Fractional CO2 laser treatment is one of the few interventions capable of treating the physiological properties and appearance of burn scars, even after maturity. A recent study published in the Journal of Lasers in Surgery and Medicine showed the histologic changes induced after fractional CO2 treatment. Unfortunately all studies to date lack a control group. This is a prospective study of fractional CO2 laser treatment of mature burn scars, comparing objective and subjective scar measurements evaluating at least one treatment and one control scar on the same patient pre- and post treatments.

Methods: Burn survivors with mature blantant Burn scars were invited to enter the study. Fractional CO2 Laser treatments were performed in an office setting, using topical anesthetic cream, at 40 to 90 mJ, 100-150 spots per cm2. A series of three treatments was performed in at least 4 week intervals. Subjective and objective measurements of scar physiology and appearance were performed before and at least one month after the treatment series on both, the treated and the control scar. IRB approval was obtained.

Results: A total of 80 scars, 48 treatment and 32 control scars, were included in the study. There was mild irritation and swelling post treatment in the treated scars. No blister formation or infection was noted. Treatment pain score averaged at 4.7/10 during and at 2.4/10 5 minutes after the treatment. By day 3 no more noticeable discomfort was reported. All treated scars showed improvement. Objectively measured thickness, sensation, erythema and pigmentation improved significantly in the treated scars (p<0.001, 0.001, 0.004 and 0.001). Elasticity improved, but without statistical significance. Vancouver scar scale assessments by an independent observer improved from 8 to 6, patient self-reported pain and pruritus remained unchanged in both groups.

Conclusions: Fractional CO2 laser treatment is a promising entity in the treatment of burn scars. Our results from this study show significant differences in objective measurements between the treated scars and the untreated control scars over the same time period. The patient observer- as well as the Vancouver scar scales seem questionable as a reliable assessment tool in scar treatment studies.

120. Long Term Effectiveness of the 3/4 Z-plasty in 
Burn Scar Release

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K. Walker, OTR

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Introduction: Scar contractures may develop across joints following deep burns to the adjacent, periarticular skin, leading to significant functional impairments. A variety of methods are available for management of this problem. The long term effectiveness of many techniques is compromised by the incorporation of skin grafts or scar tissue for resurfacing of the released area. A 3/4 Z-plasty is a reconstructive tool where a transposition flap (usually fasciocutaneous) of uninjured skin is rotated 90° into a scar release site. It has been our observation that a 3/4 Z-plasty provides superior maintenance of the release and actual improvement with time as the flap has the potential to stretch. Objective data is lacking to substantiate this observation so the purpose of the current study was to prospectively evaluate the results and dimensions of the flap with time.

Methods: Patients in whom a 3/4 Z-plasty was to be performed were entered into the study. Appropriate candidates for a 3/4 Z-plasty met the following criteria: 1. A burn scar contracture across a joint resulting in a functional impairment. 2. Available uninjured skin adjacent to the scar contracture. 3. The scar contracture was not a simple linear band. The patient’s demographics, burn details and specifics of the burn contracture (site, range of motion) were recorded. The flap’s height and width (base of flap) were measured at the time of surgery (“in situ” design before incision and following transposition and suturing into place) and at follow up visits in our burn office. All measurements were performed with the effected joint in a standardized position (e.g. Elbow - full extension).

Results: Thirteen ¾ Z-Plasty flaps sites were available for evaluation in ten patients. The average age was 28.6 years (range 4-66 yrs) and the original burn size was 26% (range 2-50%). The joints involved included the axilla (6 sites), elbow (4), wrist (2), and ankle (1). Average follow-up was 22.8 months (range 2-67). All patients had a normal range of motion of the effected joint at the time of their last evaluation. The average increase in the base width of the ¾ Z-Plasty flap was calculated to be 92% (range: -17% to 160%). The increase in the flap area was more moderate (60%) reflecting some loss of height and “flattening” of the flap.

Conclusions: The ¾ Z-Plasty flap is an effective reconstructive tool in selected deformities. It provides an immediate contracture release and has the potential to achieve additional gains with time, in our series averaging twice the original width. This effect is likely through “tissue expansion” under the influence of adjacent scar tension and stretching exercises.

Applicability of Research to Practice: Useful for decision making in reconstructive surgery.
121. Mucosal Y-to-V Plasty for Burn Microstomia Reconstruction in Burn Children Revisited

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Introduction: Microstomia is not an uncommon consequence of burn injuries involving the face especially the area around the mouth. Although various modalities of management, such as commissural splitting, peri-oral scar release with z-plasty and/or skin grafting have been advocated in the past, the efficacy remains undefined. In 2004, we first reported our experience in using the mucosal Y-to-V commissuroplastic technique in 37 patients at the annual meeting of American Burn Association. We concluded that the procedure was useful as it is technically simple and was effective in relieving contracture of the mouth contracture as the procedure provided an average increase in a stoma area by 38%. While we have continued to use this approach in managing microstomal in burn patients, we had the opportunity to review the experience accumulated between 2003 and 2012. The findings formed the basis of this report.

Methods: The records of 193 burn children treated for microstomia were reviewed. A total of 491 Y-to-V commissuroplasties were performed in this group of patients. There were 126 boys. The age of patients ranged between 2 years and 20 years, with a mean age of 4.91 years. In addition to the incidence of re-release of the mouth contracture and the subjective changes noted in the ability of mouth opening were used to assess the efficacy of procedure, a computerized planimetry was additionally used in 91 to determine objective changes attained with this technique.

Results: We had followed the patients for various length of time; the shortest was 6 months while the longest was 10 years. The average length of follow up was 4.91 years. An improvement in biting of food materials was experienced in all children. Re-release of the corner of the mouth, however, was needed in 50 sides in 38 out of 193 patients; i.e., a re-operation rate of 10.18% (50/491). The stoma area measurements before and after the releasing procedure obtained in 91 individuals varied between 1.08 cm² and 13.88 cm² before surgery, with an average of 4.4 cm². The extent of area increase following the procedure varied between 3.12 cm² and 26.74 cm² with an average of 9.8 cm²; the procedure appeared to provide 2.23-fold increase in the stoma area. Complications such as bleeding, infection and non-healing of the wound were not encountered in this group of patients.

Conclusions: The technique of Y-to-V mucosal commissuroplasty, despite a 10.18% incidence of re-operation, carries a low incidence of surgical morbidities. The procedure can double the stoma area and therefore, is considered to be effective in releasing stomal contracture in burn patients.

122. Airway Management for Surgical Repair of Microstomia in Pediatric Patients

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Introduction: Extensive burn scars involving the head and neck present significant challenges for airway management, especially for pediatric patients in need of surgical correction of microstomia. A method is needed that safely provides a secure airway but does not interfere with the surgical procedure. Direct laryngoscopy may be impossible in these patients and fiberoptic intubation during spontaneous ventilation requires expensive equipment, extensive experience, and the deep sedation required may prolong waking. We have found that, for patients who can be successfully mask ventilated, placement of a laryngeal mask airway (LMA) is safe and effective in these patients and at the same time is a simpler technique.

Methods: A continuous chart review was conducted to include only first time cases posted for commissuroplasty to correct small mouth openings (Figure 1). Patients were excluded if by airway exam the mandible was immobile due to scarring or the mouth was too small to introduce an age and weight appropriate LMA. Data collection included surface area of the oral opening pre and post procedure, successful completion of surgery with LMA in place and complications related to LMA placement.

Results: Between January 2007 and December 2012, 137 patients between the ages of 1-20 had procedures of the mouth that were considered difficult Mallampati class 4 airways. Surface area of the open mouth ranged from 1.08 cm² to 13.88 cm² pre-release, to 3.12 cm² - 26.74 cm² post-release. The deflated flattened LMA diameter ranged from 1.4 cm to 4.5 cm (size 4). No complications were experienced. All of the surgical procedures were completed with the LMA in place.

Conclusions: Our study shows that the LMA can be safely and effectively used to provide an adequate airway without interfering in the surgical correction of microstomia and may avoid the use of fiberoptic intubation or surgical release of the airway under local anesthesia in conditions where mask ventilation is possible and the oral opening will accommodate the size appropriate LMA.

Applicability of Research to Practice: The LMA can be a very important airway tool in surgical and emergent situations in children with microstomia when fiberoptic equipment is not immediately available.
123. Novel Treatment for Burn/Trauma Induced Heterotopic Ossification Using Bmp Receptor Type 1a Small Molecule Inhibitors

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Introduction: Heterotopic ossification (HO) is a debilitating consequence of burn injuries characterized by ectopic bone within soft tissues and joints. HO formation in burn patients is poorly understood at a mechanistic level, contributing to the lack of therapeutic options. In this study, we separately use a novel Bmpr1a knockout mouse and a small molecule inhibitor of Bmpr1a signaling to decrease the osteogenic capacity of osteopontin cells and to decrease in vivo HO formation.

Methods: Conditional Bmpr1a knockout (KO) mice were engineered using a C57BL/6 background. Mesenchymal stem cells (MSCs) from bone marrow and adipose tissue were harvested from mice after burn injury or non-burn control (N=4/group). Osteogenic differentiation was assessed by alkaline phosphatase stain and quantification and qRT-PCR. An additional set of wild type (WT) mice underwent injection of a small molecule Bmpr1a inhibitor after burn injury or sham and MSCs were analyzed. In vivo HO was analyzed using our Achilles tenotomy model after burn injury in Bmpr1a KO mice and in WT mice after small molecule injection. Serial micro-CT scans were completed 1-9 weeks post injury to assess HO volume. Histology was performed to analyze osteogenic signaling. Functional impairment was assessed by ankle range of motion (ROM).

Results: AdCre-mediated KO of Bmpr1a resulted in significantly decreased osteogenic capacity of MSCs as demonstrated by reduced alkaline phosphatase (ALP) stain, ALP enzymatic activity, and osteoid deposition by alizarin red stain (p<0.05). Additionally, our Bmpr1a small molecule inhibitor decreased MSC osteogenic differentiation. AdCre mediated KO of Bmpr1a and small molecule inhibition of Bmpr1a resulted in a dramatic decrease in HO formation and ROM in vivo (n=4; p<0.05).

Conclusions: Bmpr1a signaling plays a vital role in the osteogenic response to burn injury with respect to MSC osteogenic differentiation and HO development. MSCs from mice which do not express Bmpr1a have less osteogenic capacity than MSCs from WT mice. Finally, small molecule inhibitors of Bmpr1a signaling are able to decrease the osteogenic capacity of MSCs, and decrease in vivo HO formation.

Applicability of Research to Practice: HO presents significant morbidity to burn patients. Understanding the signaling pathways responsible for HO is central to identifying therapeutic options. Small molecule inhibitors of Bmpr1a signaling offer a potential future option to prevent HO.

124. Successful Grafting of a Novel Autologous Tissue-Engineered Skin Substitutes (Dermis and Epidermis) on Twelve Burn Patients

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Introduction: Skin substitutes comprising a dermis in addition to an epidermis may help reduce the main complications of patients surviving major burn injuries which are contractures and hypertrophic scars. The present study was designed to evaluate an autologous tissue-engineered skin substitute (TES), produced by the self-assembly approach, composed of both a dermis and an epidermis. The dermis was comprised of fibroblasts secreting an endogenous extracellular matrix, without any exogenous scaffold.

Methods: TES were used as autologous full-thickness grafts of severely burned patients for third-degree burn wound coverage (11 patients) or hypertrophic scar revision (1 patient). The mean total surface area grafted was 2233 cm2 (580 to 6925 cm2). The follow-up varied between 1 month to 6 years. One week after grafting, a complete graft take was obtained in all but one non survivor patient.

Results: No significant contraction was observed in vivo. TES promoted a particularly good healing process and ensuing suppleness. The integrity of the transplanted TES persisted over time with no defect in epidermal regeneration and no significant contracture. Minimal hypertrophic scars were only observed between the TES. At 21-day post-grafting, histological and immunofluorescence analyses revealed that the TES presented a well-organized epidermis, abundance of extracellular matrix in the dermis and the presence of a complete basement membrane with numerous hemidesmosomes indicating a cohesion between the dermis and epidermis.

Conclusions: We conclude that the TES produced by this approach is a promising skin substitute for resurfacing full-thickness skin injury given its functional characteristics: minimal contraction after grafting and promotion of long-term tissue regeneration.

Applicability of Research to Practice: This a new tissue-engineered skin substitute with excellent graft take and subsequent mechanical properties of the skin. No hypertrophic scars developed on TES grafted sites.
125. Removal of Sentinel Lymph Nodes Impedes Lymphatic Drainage and Skin Allograft Recognition

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**Introduction:** Skin allograft survival is limited by the development of rejection. Here, we explore immunologic “ignorance” to hide a specific anatomic region of the recipient from immunologic surveillance. Our aim was to: 1) Demonstrate lymphatic isolation in a model of hindlimb sentinel lymph node excision (SLNEx), consisting of ipsilateral popliteal and inguinal lymph node (LN) excision; and 2) Evaluate the immunologic response to allogeneic skin transplanted onto this region of lymphatic isolation.

**Methods:** To study lymphatic flow, C57BL/6 mice underwent SLNEx, sham SLNEx, or no intervention (n=6/group), followed by methylene blue injection. Mice were dissected 45 minutes after injection to determine whether blue dye traveled to the iliac LN. C57BL/6 mice then underwent skin allotransplantation (ALB/c donor) with SLNEx or skin allotransplantation alone (n=6/group). Grafts were placed distal to the popliteal fossa. Mice were euthanized at day 10. Secondary lymphoid tissue (spleen, ipsilateral axillary LN, and contralateral inguinal LN) were removed and challenged with BALB/c alloantigen ex vivo with assay for interferon-gamma using the ELISPOT technique. ELISA was used to assess presence of donor specific antibodies.

**Results:** Mice which underwent no intervention or sham SLNEx consistently had blue dye in intact ipsilateral popliteal, inguinal, and iliac LNs. However, 5/5 mice that underwent SLNEx followed by immediate dye injection had no blue dye in the ipsilateral iliac LN (p<0.001). Using ELISPOT, we found that spleen and LNs from allogeneic recipients without SLNEx uniformly expressed elevated levels of interferon-gamma. Spleen and LNs from 4/6 mice with SLNEx had near-zero expression of interferon-gamma at day 10 (p<0.001). Donor specific antibodies were not detected in allogeneic recipients with or without SLNEx.

**Conclusions:** Our results show that excision of LNs from the mouse hindlimb impedes lymphatic drainage to surrounding nodes and thus may reduce or eliminate antigen presentation. Our results also suggest that excision of the draining LNs allows for transplanted skin to remain hidden from the recipient immune system at day 10, as the secondary lymphoid tissues are naive to alloantigen upon re-challenge. Further studies are required to determine the role of draining LNs in the production of cellular and antibody-mediated rejection.

**Applicability of Research to Practice:** Skin allotransplantation may benefit many patients with burn injuries involving the extremities; however rejection of these tissues poses a significant challenge to long-term survival. By targeting lymph nodes and lymphatic vessels, it may be possible to reduce or eliminate the risk of rejection.

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126. Management of Severe Axillary Contractures in Children Using the Parascapular Flap

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**Introduction:** Burns to the upper extremity can have a devastating effect on form and function. These problems may be compounded if such burns occur in the axilla leading to fusion of the upper arm to the lateral chest wall. The management of such contractures may require pedicled parascapular flaps to correct these deformities and restore function.

**Methods:** Between 1986 and 2004, six children presented with severe axillary contractures. Two children were noted to have bilateral axillary contractures, two presented with (L) sided contractures and two presented with (R) sided contractures. This group of patients underwent a total of eight parascapular flaps to correct this problem.

**Results:** All flaps survived even if previously burned with significant improvement in function. The mean flexion/abduction measurements were 37.6 degrees and the mean post-operative measurements were 136.9 degrees. According to AMA standards, post-operative measurements were over 90% of the normal values. As these patients became older, three required additional releases of the flank to relieve tightness. However, the axillae remained without contracture formation.

**Conclusions:** Patients show excellent long term improvement without protracted splitting regimens.

**Applicability of Research to Practice:** The use of the parascapular flap for correction of severe axillary contractures is a viable alternative to the use of skin grafts.
127. Failure to Thrive in Burns Suspicious for Child Abuse

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Introduction: Many risk factors for burns due to child abuse have been previously identified. Failure to thrive has not previously been reported as a risk factor for abusive burns. This study determines whether more abusive burns occur in smaller children when compared to children of average size.

Methods: A chart review was undertaken and studied variables included age, gender, type of insurance, weight, height, weight-for-height, and growth trend. Cases reported to Child Protective Services (CPS) served as a proxy for abusive burns. Failure to thrive was defined as weight or weight-for-height < 5th %ile or patients who had fallen by 2 major percentile lines on the weight growth curve. Insurance type was used as a proxy for socioeconomic status. Statistical analysis was performed using Chi-squared test and logistic regression.

Results: Data from 387 burn patients were analyzed. Median age is 28 months and ranges from 1 to 211 months. Fifty-eight % are African-American, 23.8% white, 10.3% Arabic, and 13% Hispanic. Seventy-two % have Medicaid and 21% have commercial insurance. Although there was no difference in rate of failure to thrive by insurance type, there were significantly more CPS referrals from the Medicaid group. There was no significant difference in the percentages of CPS referral between race/ethnic groups when corrected for poverty. There was a significant increase in the percentage of CPS referrals in the group with weight < 5th %ile (p=0.025). There was not a significant difference in the groups with weight-for-length < 5th %ile (p=0.329) or falling off the weight growth curve (p=0.369).

Conclusions: This study indicated that smaller children are more likely to have burns suspicious for abuse. This observation is only true for low weight, and not for other criteria for failure to thrive. It is known that prematurity makes a child more vulnerable to abuse. In our study group, the age at the time of burn was rarely less than one year (56 (14.5%)), and these patients should have had significant catch-up growth by the age the burn was sustained. There is also a possibility that the children who sustain abusive burns may also be experiencing neglect and, therefore, are smaller.

Applicability of Research to Practice: Children who have burns suspicious for child abuse are smaller. Their weights are not necessarily small for their heights or trending down. These smaller children may be an additional group of vulnerable children and merit a high index of suspicion.

128. Causes and Effects of Acute Mental Illnesses in the Burn Patient: A Population-Based Outcome Study of 979 Burn Patients from the Nationwide Inpatient Sample (NIS) Database Over a Ten Year Period (2001-2010)

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Introduction: While burn patients with preexisting mood disorders have been shown to have poorer outcomes in recovery, acute mental illnesses (AMI) are often unrecognized despite a link with post traumatic stress disorder and social maladjustment later on. This study assessed the clinical profile of a large cohort of burn patients who developed AMI compared to those with chronic mental illness (CMI) and those without mental health problems.

Methods: Admission data on 96,451 patients with burn injuries was abstracted from the Nationwide Inpatient Sample (NIS) Database from 2001-2010. AMI was defined as adjustment disorder and acute stress disorder, while CMI was defined as major depressive disorder and bipolar disorder.

Results: 979 (1 %) of burn patients were diagnosed with AMI, compared to 5,971(6.2%) with CMI and 89,501 (92.8%) without any mood disorders at the time of burn. Patients with AMI were significantly younger (age 34.7), predominantly male (63.1%) and Caucasian (65.7%), p<0.001. More patients with AMI had multiple third-degree burn sites (29.9% had face and head burns, 35% had trunk burns, 41.2% upper and 37.5% lower extremity burns), p<0.005. AMI patients had a longer length of hospitalization (13.5 days) and shorter actuarial survival (5.4 months), p<0.001. More AMI patients had lack of social or family support (0.7%), alcoholism (11.3%), illicit drug abuse (13.7%), history of psychological trauma (0.6%) and self-inflicted injuries (0.1%) compared to the other groups, p<0.05. Post-burn, 4.9% of AMI patients had burn wound infections, 5.0% had nutritional deficiencies, 1.7% had skin graft failure, 0.7% had acute psychosis, and 3.7% had suicidal ideation, p<0.05. Multivariate analysis identified age 10 to 39 (OR 4.6), alcoholism (OR 1.4), drug abuse (OR 1.9), psychoses (OR 1.4), and TBSA 10 to 39% third degree burns(OR 1.8) as independently associated with developing AMI, p<0.005.

Conclusions: The development of AMI in burn patients results in poorer overall outcomes including longer hospitalization, worse survival, and increased complications. Prior premorbid psychopathology, substance abuse and age contributed more to developing post-burn AMI than severity of the burn itself.

Applicability of Research to Practice: To avoid short and long term morbidity, routine screening for psychological symptoms of AMI should be performed in burn patients.
129. Partnering with a Community Non-Profit to Enhance Adult-Centered After-Care Support

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Introduction: With 77% of in-patients admitted as adults, verified burn center recognized a need for an adult-centered program open to survivors of varying physical, financial, social and cognitive abilities. As an addition to monthly support meetings, center sought a program that encouraged members to complete challenging goals during a community activity while placing limited emphasis on their common burn experience. Burn center partnered with a reputable non-profit organization to provide a 10-week creative writing workshop. This organization held workshops in multiple locations and published a popular anthology quarterly that was sold in local book stores.

Methods: From 2007 to 2012, burn center offered 6 annual creative writing workshops that were open to survivors, family and friends regardless of physical limitations, cognitive abilities and level of education. Staff advertised the program and encouraged attendance. Non-profit provided trained class facilitators with limited knowledge of burn recovery. Since 2009, Phoenix Society SOAR (Survivors Offering Assistance in Recovery) peer support volunteers have participated in workshops to assist with burn related issues. Workshops included timed writing exercises from prompts and positive feedback from members. Participants choose their best piece to be part of a professionally printed anthology that included writing from all of the community workshops. Participants attended without charge and all fees were funded through burn center foundation.

Results: Fifty-one survivors, family members or friends of survivors enrolled and attended at least one writing session from 2007 to 2012. Twenty-nine participants (56%) published a piece in the anthologies and 21 of those writers read their work at a community gathering. Four participants were featured writers in the anthologies and 21 of those writers read their work at a community gathering.

Conclusions: Burn center provided an enhanced adult-centered after-care support program without increasing paid staff hours by partnering with a reputable non-profit organization and utilizing SOAR volunteers. Participants appeared to benefit. The psychological effects and benefits of this positive writing experience for adult survivors merits further investigation.

Applicability of Research to Practice: Implementation of a relevant after-care support program for adult survivors and their family members.

130. Benefits of Burn Center Visitors from the Patient’s Perspective

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Introduction: As healthcare transitions from provider-centered to patient-centered care, input from patients becomes increasingly important. Patients were asked to complete a survey to assist the burn center in improving the patient-visitor experience and to obtain hospitalized burn patient opinions regarding the impact, positive or negative, of visitors in the burn center.

Methods: A 34-item survey was developed and administered to patients ≥ 16 years and admitted over a 1.5 year period. The questionnaire measured patient opinions on 4 subscales including Stressors, Helpfulness, Comfort and Outcomes (related to the center’s existing visitor policies). Patients rated items on a 5 point Likert Scale ranging from Not at all to Extremely.

Results: The item survey was completed by 209 inpatients; Male (69%) and Female (31%), Married (55%), Single (35%) with average age of 44 ± 16 years. Average LOS was 15 ± 18.6 days and mean TBSA was 11% ± 15. Mechanism included Flame (41%), Scald (27%), Contact (19%), Chemical (6%), Electrical (3%), Other (4%). Responses included; Felt Uncomfortable Having Visitors See Me, Not at All (73%), Somewhat (18%). Visitors were Helpful in Calming Me Down, Very (29%) Extremely (55%). Helpful in Reducing My Pain, Very (30%), Extremely (42%). Helped Reinforce My Treatment, Very (31%), Extremely (46%). Helped my Nurse in Understanding My Coping Skills, Very (30%), Extremely (42%). Helpful in Reducing My Anxiety/Fear, Very (28%), Extremely (53%). Helpful with Comfort Measures, Very (28%), Extremely (54%). I was Comfortable with My Spouse or Significant Other Visiting, Very (6%), Extremely (65%). My Children, Very (43%), Extremely (8%), N/A (46%). My Extended Family, Very (14%), Extremely (52%) and my Co-Workers Very (3%) Extremely (14%). To the question How Much Does Visiting Hour Increase Your Pain? Not at All (90%), Somewhat (7%). How Stressful Were Family Visits Overall? Not at All (90%), Somewhat (12%). Finally, What Should the Frequency of Visits Be? Unlimited (69%), Twice a Day (24%). Patients with a TBSA ≥ 15 wanted visit length to be unlimited significantly more than those with smaller burns (p = 0.02).

Conclusions: Essentially, patient-centered care is about healthcare organizations modifying their culture, and aligning the organization’s values, strategies and structures, with the wants and needs of the patient. This study reveals that visitors are an important part of the burn patient experience and their opinions on visitors should be considered when policies are under review.

Applicability of Research to Practice: Burn centers may want to educate staff regarding the perceived patient benefits of visitors and recognize visitors, especially the spouse/significant other and/or extended family, and consider them as potential allies in improving patient care and satisfaction.
131.

Addressing Posttraumatic Stress: Symptomatology in a Pediatric Hospital Setting
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Introduction: Little data exists on the effectiveness of psychological interventions for children with posttraumatic stress disorder (PTSD) that has resulted from burn injury, especially in non-industrialized countries. The present study utilized KID-NET, a child-friendly version of Narrative Exposure Therapy (NET), as a short-term treatment for children hospitalized several months after a burn injury.

Methods: A retrospective chart review was conducted to assess the efficacy of KID-NET as a short-term treatment for children exhibiting posttraumatic stress symptomatology. Seven Nigerian children, aged 4 to 10 years with total body surface area burns ranging from 8 to 28%, were treated with individual sessions of KID-NET. Symptoms of PTSD and pediatric distress were assessed prior to treatment using parents or other caregivers as informants on the Posttraumatic Stress Disorder Semi-structured Interview and Observational Record for Infants and Young Children (PTSD-SSI) and the Pediatric Emotional Distress Scale (PEDS). The Narrative Exposure Therapy intervention involved 2 to 3 individual sessions, with each session lasting approximately 1-2 hours.

Results: Pre-treatment assessments revealed that five of the children met the DSM-IV-TR criteria for current PTSD. The two children who did not meet the DSM-IV-TR criteria for current PTSD did meet the alternative criteria for PTSD proposed by Scheeringa et al. (1995), which reflect the different manifestations of PTSD symptomatology observed in young children. All of the patients accepted and completed treatment. Four of the seven patients were able to reconstruct their traumatic experiences into a narrative illustration, and reported functioning gains. Stressful life events such as family disruption, exposure to community violence, medical trauma, and bullying at school were factors associated with posttraumatic stress symptomatology. Observable symptom reduction was confirmed by parental report at the end of the intervention; however, the researchers were unable to conduct a formal post-test because the patients were discharged from the hospital shortly after treatment.

Conclusions: Clinical observations and the reported reduction in posttraumatic symptomatology provide preliminary support for the efficacy and feasibility of KID-NET as an intervention for pediatric burn patients. Future studies should examine the efficacy of this intervention with a more diverse patient population.

Applicability of Research to Practice: KID-NET may be an effective short-term treatment for children exhibiting posttraumatic stress symptomatology.

132.

“How Does It Make You Feel?”; The Addition of a Social Worker to Burn Camp
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Introduction: Are camp activities enough to assist children and adolescents successfully navigate the psychosocial issues associated with burn injuries? That is the dilemma one burn camp found itself facing as it continued to grow. This organization found itself faced with campers who presented more challenges and a volunteer staff that was not always equipped to meet the increased needs. Shorter burn center stays and increased emphasis on case management and discharge planning for hospital social workers limit the amount of psychological care burn survivors receive as inpatients, which can have a significant impact on developing youngsters. The mission for the camp was to introduce a formalized psychosocial resource without losing the informal support that has traditionally been the cornerstone of the experience.

Methods: The camp chose to utilize one of its experienced volunteers, who is also a social worker, as a resource for campers and staff during the week in an effort to better deal with the emotional and behavioral issues that often arise. The social worker acted as a formal resource for both campers and staff. Prior to camp, the social worker was responsible for reviewing each camper’s application and following up with family members and therapists to identify potential challenges and best techniques for managing camper issues. Education on child development, body image, cultural sensitivity and trauma were also provided to the staff prior to the start of camp. The social worker was available during the week to help the staff manage their own feelings regarding the camp experience. The social worker therapeutically intervened with children informally on a 1:1 basis as issues presented during the week.

Results: The addition of a social worker was received positively by both staff and campers. Providing education prior to camp was beneficial to the staff and helped to decrease anxiety among new counselors. Campers may have felt more comfortable discussing feelings with social worker, as she has been a long-term staff member of the burn camp and has clinical experience working with children and adolescents. Familiarization with the campers’ histories prior to camp was helpful in proactively managing problem behaviors during the week.

Conclusions: The position of a camp social worker had been trialed the prior year with the individual juggling both group counselor and social work responsibilities. Having a volunteer assume multiple roles during the week was taxing and did not allow time for all possible therapeutic interventions. Having a dedicated social worker for camp was well received and utilized and there are plans to expand the program to include more formal group talk sessions in the future.

Applicability of Research to Practice: Meeting psychosocial needs of pediatric and adolescent burn patients.
The Effects of Stress and Coping on Psychosocial Functioning in Pediatric Burn Survivors

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Introduction: Though previous research findings have been mixed, stress (i.e., minor & major) and coping (i.e., active, avoidant) appear to be important predictors of psychosocial functioning in both healthy and chronically ill populations. Yet, no studies have examined the relation of stress and coping strategies to psychosocial functioning in pediatric burn survivors. This study evaluates the extent to which parent/youth stress and coping, as well as burn injury characteristics, predict psychosocial functioning in pediatric burn patients.

Methods: To date, 22 youth (ages of 8-17 years) and their caregivers were recruited from a burn center in the northeastern United States. Data collection is ongoing; a full sample is anticipated for this presentation. Participants completed questionnaires that assessed the number and intensity of daily hassles and major life events experienced, coping strategies used, and youth self-concept. Data were collected during clinic visits, while youth attended a summer burn camp, or from response to mailings to patients in our burn center registry.

Results: Frequency of daily hassles experienced by caregivers was a significant predictor of physical (β = -.62, p < .05) and happiness (β = -.61, p < .05) subscales for self-concept. Finally, time since burn (β = -.51, p < .05) and active coping were significant predictors of overall self-concept (β = .68, p < .05).

Conclusions: The findings suggest that youth with a more recent burn injury have higher overall self-concept; this finding may stem from the fact that they still experience considerable social support as a result of their injury. When parents experienced more daily hassles, youth had lower physical and happiness self-concept. Finally, use of active coping strategies predicted better overall self-concept.

Applicability of Research to Practice: Results from this study can help promote adjustment in youth with burn injuries. Because results suggest that the psychological impact of a burn injury may not be immediate, it would be beneficial to assess psychosocial functioning at later time points. It may be important to aid parents in stress management so that they can support their child through the burn recovery process. Helping youth with burns utilize active coping strategies may bolster their social adjustment.

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Burn Survivors Find Inspiration Supporting Other Survivors

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Introduction: Communicating with others who have traveled the same path is an integral part of recovery from a burn injury. Survivors Offering Assistance in Recovery (SOAR) recognizes that survivors benefit from both giving and receiving support and that by mentoring others survivors may “find a sense of meaning and purpose in their experience.” Our facility recently held its first retreat for adult burn survivors.

Methods: Realizing the need for adult burn survivor support, a group of burn center employees and SOAR volunteers organized our first survivor retreat. A third of attendees reported previously receiving organized support, a third were familiar with the Phoenix Society, and one had received no organized support prior to the retreat. Retreat activities included support and discussion breakout groups, a burn survivor keynote speaker, art therapy, a review of current burn care and therapy techniques, question and answer sessions, a tour of the local burn center and free time with games and self-directed social interaction. At the end of the retreat, attendees were asked to fill out an anonymous evaluation.

Results: At the end of the retreat, participants completed an evaluation. All rated their overall retreat experience as excellent. Feedback revealed that participants felt that this retreat allowed them to “start bonding” and to “build trust and connections”. One survivor reported that it gave them “insight into other survivors’ struggles and ideas on how to help others through their struggles.” Highly rated sessions included the keynote (“inspirational”) and the breakout groups. It was also noted that participants enjoyed other, non-scheduled events such as touring the burn center, free time/game time, and discussion of current burn care. Perhaps the most telling feedback came in the form of a quote from a survivor who had received no prior organized support. He stated “When I came to the retreat on Friday I was a burn victim. By Friday night, I realized that I was a burn SURVIVOR.”

Conclusions: Regardless of age at the time of injury, length of time since injury, recall of injury, cause of injury, or percentage, all participants demonstrated a similar desire for peer support. Several attendees reported being unaware of the extent of their need for support, prior to the retreat, but all were able to identify positive outcomes after retreat participation. The high rating given to the participant introduction session indicates that being allowed to share their story continues to be a very powerful method of recovery for many years after injury.

Applicability of Research to Practice: All of our retreat attendees had two things in common: the need for support and the ability to provide it. These findings provide initial information about the importance of burn survivor support and networking with other survivors.
A Survey of Parental Satisfaction with the Outcome of Their Child’s Burn Care

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Introduction: Our ABA-verified burn center treated 450 patients in 2012. The burn center wanted specific feedback from parents regarding their satisfaction with the outcome of the care provided their child. A literature search revealed a lack of existing published surveys specific to pediatric burn center parent satisfaction. The goals of this study were to create a survey instrument and obtain such information.

Methods: An eleven question survey instrument was created by the authors and IRB approval was obtained. From December 2010 through July 2013 a convenience sample of parents of one hundred children were surveyed. The patients were treated for an average length of stay of 3 days. Parents who were referred to Protective Services, along with parents who were employees of the hospital or it’s parent corporation, were excluded as it was felt they might not be objective. Parents who were not fluent in English were excluded as the survey forms and phone calls were only in English. Parents were approached by the PI during the patient’s admission and consented for the survey. The PI tracked the date of the patient’s discharge, and telephoned the parent at one month and three months after discharge. Phone calls were typically completed within one week of the discharge anniversary. The PI left a maximum of three phone messages before coding “no response.” Only three parents refused to participate in the survey, but they did not provide reasons for their refusal.

Results: 70% of parents responded at the one month interval, and 75% responded at the three month interval. Approximately 65% of the patients were black, 21% white, 10% arabic, and 4% hispanic. 57% of the patients were male. 50% of the patients were less than 36 months of age. 41% of the patients lived in the same city as the hospital, with the other 59% of patients coming from 39 separate communities. 52% of patients sustained spill-scald burns, 12% contact burns, 11% scald burns, 7% grease burns, and 6% flame burns. Parents comments were overwhelmingly positive, while also offering helpful constructive criticism.

Conclusions: This survey provided significant information to the burn center staff about parents’ degree of satisfaction with the outcome of their child’s care. Some immediate interventions were taken based on the survey (referrals for counseling and Protective Services, and quicker clinic appointments). Issues for continued improvement were also identified (itch control, post-burn stress of toddlers/pre-schoolers).

Applicability of Research to Practice: This survey has significant relevance to 1. improve patient care, 2. improve patient experience and satisfaction/loyalty, 3. increase utilization of verified burn centers, and 4. help burn centers/hospitals capture that 1% of reimbursement directly related to patient satisfaction scores.

Application of the Double Emergency Procedure (DEP) on the Severely Burned Patients

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Introduction: To investigate the influence of the double emergency procedure(DEP) on the effective operating time (EOT) and effective resuscitation time (ERT) for patients with major burns.

Methods: The double emergency procedure is shown in Fig 1. One hundred and fifty-six severely burned patients with hypovolemic shock who were admitted to BICU in our department for resuscitation from November 2009 to June 2013 were overviewed. Patients(N=69) without DEP during their resuscitation period are considered as the control group, while those(N=87) who had DEP during resuscitation are observation group. The EOT and ERT of each patient was recorded and compared between the two groups, data were processed with T-test.

Results: The EOT of the observation group is 14.9±3.31 minutes, and that of the control group is 30.42±5.65 minutes; While the ERT of the observation group is 7.4± 3.2 hours, and that of the control group is 9.5±2.7 hours. The EOT and ERT of the observation group are significantly shorter than that of the control group (P<0.05).

Conclusions: The double emergency procedure can reduce the effective operating time and effective resuscitation time of patients with major burns and severe hypovolemic shock, therefore, is worth promotion clinically.
**Introduction:** Fluid resuscitation is essential in the treatment of patients who have sustained significant burn injury. Appropriate management during the resuscitative phase can influence both the short term and long term outcomes of the patient. The goal of fluid resuscitation is aimed at using the least amount of fluids possible to support organ and tissue perfusion. Care of the burn patient during the resuscitative phase of care can also be quite time consuming and labor intensive. A fluid resuscitation protocol was developed within our facility after identifying that fluid resuscitation orders varied among our providers which led to both volume overload and fluid “creep”.

**Methods:** The Adult Fluid Resuscitation Protocol was developed in order to give the bedside nurse the ability to effectively resuscitate the patient without the need for continuous phone calls to the physician. The protocol is an algorithm based off of the patient’s hourly urine output with specific adjustments to fluid rate and indications as to when to notify the physician. It allows the nurse to independently titrate the patient's fluids which permits a more standardized approach to fluid resuscitation. A documentation flow-sheet for fluid resuscitation was created and is completed by the bedside nurse. This documents hourly volume infused, urine output and fluid adjustments. It is concurrently reviewed for accuracy of calculation and titration which allows for re-education as necessary. A survey of 41 nurses was conducted to evaluate the ease of use, nursing satisfaction and patient care experience for the staff.

**Results:** All of the 41 nurses agreed that the protocol improved work efficiency, eliminated the need for multiple physician phone calls, provided ease of documentation, and felt it improved patient care and safety. They also reported a better understanding of the fluid requirements necessary in the resuscitation of the burn patient. A few reported an area of improvement which included the placement of the documentation tool and protocol in the electronic medical record and computerized physician orders.

**Conclusions:** The use of an adult fluid resuscitation protocol in the burn patient has been well received by the nursing staff with a high nursing satisfaction level with regards to patient care. This promotes a more standardized approach to fluid resuscitation and eliminates the need for continual physician intervention and phone calls.

**Applicability of Research to Practice:** Continued investigation regarding the long term outcomes and associated burn complications could be investigated to evaluate for protocol effectiveness and to help determine if modifications are necessary.

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**Introduction:** Barrier garment isolation of burn patients is common practice. Our hospital policy is to place all burn patients, regardless of wound size, on this type of isolation. This policy was enacted at the inception of the burn unit based on expert opinion and observation of the practices at other burn centers. However, the isolation techniques were inconsistent and not based on scientific research or evidence-based findings.

The purpose of this study was to determine if small burn wounds that are less than 20% total body surface area (TBSA) are colonized during hospitalization, whether objects in the surrounding environment are affected, and if a correlation between the wound and environmental areas exists, therefore requiring isolation.

**Methods:** At a single tertiary burn center, 20 burn patients were tested. Eligible burn subjects were patients with <20% TBSA burns who were not admitted to the pediatric intensive care unit and who did not require skin grafting. Bacterial cultures were obtained from the side rails of the bed, the inside door handles of their room, and the burn wound itself to compare microbiological profiles. All three sites were cultured with surface swab daily until discharge or the patient became ineligible. Abnormal culture results were defined as growth from swab other than normal skin flora.

**Results:** Twenty patients and rooms were cultured during the study giving 84 microbiology results. The median TBSA burn size was 6%, range 1-19%. Average hospital length of stay was 1.4 days. Although positive cultures were noted in 6 instances of the wound and 5 instances in the room, none of the wound cultures and environmental cultures correlated. There was only one wound burn infection of clinical significance in this series, which notably did not correlate with any environmental cultures over the course of two day admission.

**Conclusions:** For patients with 20% TBSA burns or less, wound and environmental microbiologic cultures demonstrated no correlation in our hospital. Notably, the clinically significant wound infection in this cohort did not result in positive hospital room cultures. Barrier garment isolation precautions for these patients does not appear necessary, and may contribute to unnecessary cost during hospitalization.

**Applicability of Research to Practice:** Our study results and an extensive literature review have led to a change in hospital policy. This change in practice has had many benefits including: improved patient/family satisfaction, time saving for staff, and cost reduction for isolation supplies.
139. Delayed Admissions to Specialized Burn Units: Practice Makes Perfect
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Shriners Hospitals for Children, Boston, MA

Introduction: We previously reported that delayed admission to a burn care facility is related to increased complications and length of stay. Since this original report, our hospital has treated hundreds of patients, transferred weeks and months after injury, from distant and inaccessible locations. The objective of this study was to determine if our significant experience with treating delayed admissions, and the adaptations we make in their care translate into improved patient outcome.

Methods: A case-control study was done with seven patients transferred to our burn unit from Africa over 4 months post-burn injury and seven controls that were admitted within one week of injury. Controls were matched based on age and burn size. Data was collected by chart review for demographics, treatment information, care plans, and outcomes measures. The Student’s t test and Fisher’s exact test were used to assess differences between groups.

Results: Treatment strategies were modified for the case patients due to delayed wound closure. These included aggressive infection eradication, a deliberate course of nutrition therapy to replenish nutrient stores and postponed surgery. Patients were 7.7 ± 2.6 years of age with burn injuries covering 19 ± 10% total body surface area. All cases (n = 7) and no controls had resistant bacteria infections at admission (p < 0.05). One patient in each group had an infectious event after admission. Time until first autograft was prolonged for cases (10 ± 4.0 days) compared to controls (3.7 ± 2.5 days) (p < 0.05). For all patients studied, mean days until wound closure (20 ± 10), central venous catheter days (11 ± 14), and length of stay (31 ± 18 days) were similar.

Conclusions: Despite extended delay to specialized care, outcome measures of length of stay and hospital-acquired infectious complications of the case group did not differ from the controls.

Applicability of Research to Practice: At our burn unit, substantial experience has translated into good outcomes for delayed admissions with moderate burn sizes.

140. Evaluation of a New Fast Track Process of Care for Patients with Minor Burn Injuries
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Introduction: Short-stay hospital admissions (≤ 2 days) to our acute care regional burn center have accounted for over half of acute burn admissions since 2008. Typically, these patients are admitted with a minor burn, require limited nursing care and teaching with minimal physical therapy. In an attempt to optimize resources, control costs, limit unnecessary hospital admissions and expedite care, a new 'Fast Track for Burn Care' program was developed and implemented in 2011. The purpose of this study is to evaluate this program for the following: patient outcomes, failure rates, and hospital costs during a 9-month evaluation period.

Methods: We conducted a review of Fast Track patients evaluated at our burn center from October 2012 to June 2013. Study subjects were identified through Computer Physician Order Entry electronic records. Descriptive statistics were performed to evaluate main outcomes of interest.

Results: A total of 182 patients met study criteria (median age = 27 (IQR, 6-44); 32% pediatric; 59% male). Median Total Body Surface Area (TBSA) burn was 1.0% (IQR, 1-1). The most common causes of injury were scald (34%), contact with hot object (30%), and flame/flash (14%); three types of dressings were applied (Silver sulfadiazine - 33%, Xeroform/Bacitracin - 33%, and Mepilex” Ag - 28%). Nearly 40% were evaluated between 1900 and 0700 hours (night shift). Six patients (3%) were admitted to the hospital on the day of evaluation, leaving 176 subjects for further review. A follow-up outpatient appointment was scheduled for 146 patients (83%). Of these, 122 (84%) were evaluated in the outpatient clinic. Of the 24 (16%) individuals not seen, three cancelled citing complete healing, leaving 21 individuals with unknown outcomes (see table for all group characteristics, n=146). The average total charges/case for the Fast Track patients was $1,550. In contract, patients admitted to the acute care burn unit for ≤ 2 days during this same time period incurred total charges of $8,673/case.

Conclusions: The Fast Track program provides adequate wound care with significant cost-savings for those who require limited treatment using outpatient management. However, there exist a subset of individuals who do not follow-up as directed and are considered lost to follow-up (LTFU). Methods to decrease those LTFU have been identified.

Applicability of Research to Practice: Implementation of a similar process of care may result in better utilization of hospital resources for U.S. burn centers.

<table>
<thead>
<tr>
<th>Scheduled Patient Population (n=146)</th>
<th>Patients seen in FU</th>
<th>Patients cancelled appointment</th>
<th>LTFU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age - years median (IQR)</td>
<td>27 (7-44)</td>
<td>27 (14-40)</td>
<td>27 (19-37)</td>
</tr>
<tr>
<td>Sex - male n (%)</td>
<td>71 (58%)</td>
<td>1 (33%)</td>
<td>10 (48%)</td>
</tr>
<tr>
<td>TBSA percent burn median (IQR)</td>
<td>1 (1-1.9)</td>
<td>.25 (.18 - .63)</td>
<td>1 (1-1)</td>
</tr>
<tr>
<td>Etiology n (%)</td>
<td>48 (39%)</td>
<td>0</td>
<td>4 (19%)</td>
</tr>
<tr>
<td>Scald</td>
<td>33 (27%)</td>
<td>1 (33%)</td>
<td>9 (43%)</td>
</tr>
<tr>
<td>Contact burn</td>
<td>14 (11%)</td>
<td>2 (67%)</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Flame</td>
<td></td>
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</tbody>
</table>
141. Gaining Acceptance in the Plain Community for High Tech Burn Care

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Introduction: The Plain Community has a high potential for burn and traumatic injuries. This, coupled with a reluctance to seek modern healthcare, can result in less than optimum burn recovery outcomes. In order to address this, a strategic effort was developed by an academic community hospital to deliver culturally sensitive care to the Plain Community.

Methods: As part of this initiative, the following needs were identified: respect for cultural practices; incorporation of non-traditional wound care methods; development of mutual respect and teamwork with the elders of the Plain Community; and, the implementation of single source billing. When treating burn wounds, the Plain Community relies on caregivers within their community to treat and perform the dressing changes for the burn injured patient utilizing a homeopathic ointment and burdock leaves. To increase compliance and comfort with modern medical practices, these methods were incorporated into the plan of care under the supervision of nursing and medical staff. To address a knowledge deficit regarding the Plain Community, education was provided to staff members on cultural sensitivity and the healthcare preferences of the Plain Community. Also, a burn outreach coordinator has been utilized as a liaison to the Plain Community to facilitate communication and cooperation. In addition to established telehealth burn programs throughout the region, a new program was instituted in a natural food store frequented by the local Plain Community to provide further resources to the community for the management of burn wounds. Finally, identification cards were developed to initiate single source billing for members of the Plain Community upon admission.

Results: Since implementation, admissions from the Plain Community have steadily increased. Due to the environment of acceptance and collaboration that has been developed, patients have traveled from outside the regional catchment area to receive treatment. This collaboration has also resulted in an increased willingness of the Plain Community to explore contemporary healthcare options, including surgical intervention.

Conclusions: This initiative has improved outcomes for and enhanced healthcare resources available to the Plain Community. Additionally, this collaboration has led to an increase in cultural competence as well as a willingness to embrace alternative healthcare practices by staff members.

Applicability of Research to Practice: This initiative can serve as a model for any healthcare organization to provide culturally sensitive care to a designated population.

142. Optimal Transferring Method for Burn Patients with Posterior Trunk Skin Grafting

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Introduction: Skin grafts of any kind present a unique challenge to patient mobility. When grafts are located on a major posterior body surface shearing and tearing resulting in graft loss becomes an especially important concern. Graft loss can result in delayed healing, infection, pain, and repeated surgeries to repair damage. In the spring of 2011 our institution had a series of patients with shearing of grafts to the back. It was common practice in our institution to perform dressing changes in the dressing change room which requires mobilization of the patient. Many of these patients required manual lifting from bed to cart as they were non-ambulatory, bedrest, or ventilated. There were four methods utilized to assist lifting available including: staff manual lifting, lateral transfer mattresses (air filled), slide boards, and mechanical lifts. After several patients developed shearing these methods were discontinued and we returned to a manual staff lift due to the concern that the devices were the cause of graft loss.

Methods: A standardized protocol was developed to simulate a skin graft, the four methods of movement, and placement of the devices underneath patients of three different body types (small, medium, and large frames). Additional data collection utilizing the protocol will be undertaken and complete by November 2013. Data collection includes: tear vs shear, length and width (area) of tear or shear, and location of loss to determine the optimal transferring method.

Results: First round data has been collected and preliminary analysis done. Final data analysis will be available January 2014.

Conclusions: Preliminary data analysis suggests no statistically significant difference in graft shearing between movement protocols. Data collection is still in progress. Further research in the area of graft shearing related to transferring needs further investigation.

Applicability of Research to Practice: The purpose of this study is to determine if there is a best practice for transferring patients with posterior trunk grafting to limit graft loss or shearing. There is evidence in the literature pertaining to pressure, friction, and shearing forces related to pressure ulcers. No literature was found related to burn patients with posterior body surface skin grafting and the effects of these forces as they pertain to patient movement with these devices. Determining the optimal transferring method has implications for graft loss (pain, repeated surgeries, and infection) and staff safety related to injuries.
Introduction: In mid-2010, over a period of 3 months, there were 5 cases of resistant A. baumannii infections in our burn center, including two deaths. Concurrently, this organism became a problem hospital-wide. Infection control issues were identified by burn unit staff. Correction of this became a hospital-wide initiative including the following departments: Nursing, Infectious Diseases, Quality, Environmental Services and Central Supply. Each department developed and implemented action plans. Standards were changed, responsibilities were reassigned and a system using hydrogen peroxide vapor was used throughout the burn unit to eradicate the bacteria. Multiple surfaces in the unit were cultured after initiating new cleaning standards to ensure quality. The process changes have become a continual part of everyday operations.

Methods: Descriptive review of infection control procedures to eradicate multiple drug resistant bacterial outbreaks.

Results: There have been 2 transfers to the burn unit from other facilities with A. baumannii. There has not been a case of nosocomial acquired A. baumannii infection in the burn unit since implementing the action plans.

Conclusions: A comprehensive, multi-disciplinary approach can be effective in minimizing and controlling spread of hospital acquired organisms.

Applicability of Research to Practice: Collaborative efforts, by multiple departments, to develop and implement an action plan are an effective way to eliminate and manage resistant organisms in a burn unit.

Introduction: The treatment of significantly injured burn patients requires the coordinated efforts of the dedicated inpatient burn team and post-acute care providers. Frequently lack of communication and inexperience in the post-acute care setting with dealing with the significantly burn injured patient may impede the continued progress of these patients. Our institution recognized this complex problem and developed an educational program to facilitate burn specific education for the post-acute care provider.

Methods: On May 2, 2013, a half-day class entitled “Care of the Burn Patient in the Post-Acute Setting” was offered at our burn center. Invitations were sent to the area long-term acute care facilities and the rehabilitation facilities. The topics discussed in the course included: Support Services and Programs for Burn Survivors; Pharmacotherapy issues in the burn patient; Outpatient Follow-up and Management in the Burn Clinic; Wound Care and Modalities in the Burn Survivor; Nutrition; and Physical and Occupational Therapy Modalities in the Burn Survivor. Contact hours were offered to all registered nurses.

Results: Twenty care providers from six post-acute care facilities participated in the course. Care providers included Registered Nurses, Physical therapist, Occupational therapist, Speech Pathologist, Therapeutic Recreational Therapist, and Pharmacist. All participants were asked to provide evaluations of the program. A five point scale was used to evaluate the completion of the twenty-two learning objectives with 5 being very highly and 0 being not at all. Seventeen evaluations were completed and returned. 67.9% of participants rated the objectives as being very highly met, 30.2% of participants rated the objectives were met, and 1.8% of participants rated the objectives as being somewhat met. Comments provided by the participants reflected positive feedback with many of the participants stating the class was beneficial and informative and that they would recommend it to their colleagues.

Conclusions: Outreach education to our partners in the post-acute care setting is important to our patients and their outcomes. Providing education to these professionals that focuses on the burn survivor increases burn-specific knowledge and understanding of the difference in burn survivors from other rehab patients, improved understanding of the burn teams’ request in the patient’s post-acute care, and improved communication between the burn team and the post-acute care team.

Applicability of Research to Practice: Outreach education to improve post-discharge care of burn patients.
Incorporating an Adult Extra Corporal Life Support Program in the Burn Intensive Care Unit

U.S. Army Institute of Surgical Research, JBSA Fort Sam Houston, TX; San Antonio Military Medical Center, JBSA Fort Sam Houston, TX

Introduction: Our institution developed an Extra Corporal Life Support (ECLS) program to provide care for critically ill patients with severe respiratory and/or cardiac failure unable to be managed with conventional methods of support. Placing the ECLS program within our burn intensive care unit (BICU) evolved over several years. We describe the multiple considerations made to incorporate the ECLS program into the existing framework of our BICU model to facilitate a successful program.

Methods: The design of the ECLS program evolved incorporating a multidisciplinary approach, using specific features of our BICU model, such as: 1) daily multidisciplinary rounds which include a member of nutrition, physical therapy (PT), behavioral health, respiratory therapy (RT), nursing, and research, in collaboration with the Medical team; 2) the greater ratio of RT and PT staff per patient than other units; 3) nursing staff certified in renal replacement and total plasma exchange therapies; the ECLS program follows our model for training and sustainment of key nursing skills and mandated competencies; 4) our BICU safety model incorporates safety huddles, bedside huddles, and intentional huddles, improves team communication; 5) team nursing model combining a primary bedside nurse and secondary nurse as the Extracorporeal Membrane Oxygenation (ECMO) specialist; and 6) the institutional emphasis on research provides a foundation for efficient dissemination of lessons learned and best practice.

Results: To support the program, 18 Registered Nurses and 4 RTs have been certified by the dedicated Program Manager. From SEP 2012 to SEP 2013, 7 adult ECMO patients have been managed in the BICU for an average of 24.7 days (4-83). All patients were managed with venous-venous ECMO. Primary disease process was pulmonary failure due to acute respiratory distress syndrome (ARDS). No thermally injured patients have required ECMO to date. One BICU patient with Toxic Epidermal Necrolysis with severe pulmonary involvement was treated. Others have come from other units throughout the hospital. The program has had 100% success rate for discharge or transfer, including BICU support of 1 ground and 2 air transfers of patients during ECMO therapy.

Conclusions: The BICU multidisciplinary care model can be leveraged to deliver the most advanced and technologically challenging medical therapies for the most severely ill patients in the hospital. As ECLS becomes more widely adopted in the US medical community, burn centers should consider owning this capability given their already established skill set of caring for the most critically ill.

Applicability of Research to Practice: The interdisciplinary model essential to holistic burn care is ideal for intensive programs such as adult ECMO.

The Role of a Research Coordinator (RC): A Guide for Novice Coordinators

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Introduction: As health care progresses in complexity and cost, evidence-based research has become essential to the advancement of burn care. Multi-center trials involve complex procedures, regulations, and guidelines that require attention to detail and strict adherence to compliance issues. Taking on a large, multi-center trial can be a daunting task for an inexperienced research coordinator (RC). The purpose of this summary is to provide a resource for RCs in multi-center clinical trial planning.

Methods: Defining characteristics. An RC must be detail-oriented, possess problem-solving and prioritization skills, and be an excellent communicator. They must be able to collaborate with the PI on a professional level. Principles of practice. RCs are responsible for all study aspects, including study start-up, implementation, and closure. In order to perform these tasks the RC must exercise three principles of practice: compliance, confidentiality, and budget preparation. Compliance will secure subject safety, study integrity, site reputation. Whether the study funding stems from the DOD, NIH, or another organization, the RC and PI must be familiar with the policies of each governing agency. The FDA provides a series of guidelines to which all studies must adhere. Compliance with the governing IRB is essential in maintaining a safe study. Following the protocol ensures study consistency, especially in multi-center clinical trials. Confidentiality is essential, especially when handling sensitive health information. Maintaining subject privacy through secure links and destruction of linked data in a timely matter protects the subjects and complies with the regulations of many governing bodies. Budget preparation confirms adequate compensation for work done by the research team. The protocol is the map for creating the budget, but other costs need to be recognized. Direct/indirect/closure, inflation, supplies, administrative, pharmacy, lab, IRB, subject reimbursement, and travel costs need to be accounted for in budget preparation.

Results: Lessons learned. Over time, one becomes familiar with the details involved with study success. Advocating for subject safety and protocol adherence are of high priority. Budget planning and study design are two important elements that dictate the outcome of the study. Collaborating with the PI and all departments involved including clinical staff is a vital element that produces a well-rounded study.

Conclusions: The RC is responsible for many study related tasks and is an essential part of research and to the advancement of burn care. Through the practice of compliance, confidentiality, and organization/planning, the RC can ensure proper study management.

Applicability of Research to Practice: Findings may assist new RCs in their practice.
147. Recombinant Human CC10 for Treatment of Smoke Inhalation Lung Injury

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University of Texas Medical Branch, Galveston, TX; Clarasance, Rockville, MD

Introduction: Smoke inhalation can produce a potent local and systemic inflammatory response that can cause acute lung injury, resulting in acute respiratory distress syndrome (ARDS) for which mortality rates range from 40-60%. There are no approved therapeutic options for either smoke inhalation or ARDS. Recombinant human CC10 protein (rhCC10) is a novel biologic drug candidate that potently reduced inflammatory indices in the lungs of premature infants in respiratory distress syndrome (RDS), resulting in a reduced requirement for repeat doses of surfactant rescue therapy, and conferred long term protection (6 months) from severe respiratory exacerbations in infants that received a single dose of rhCC10 on the day of birth. rhCC10 is a potent inhibitor of pulmonary inflammation in respiratory distress. We performed a preliminary evaluation of rhCC10 in our ovine model of smoke inhalation lung injury and found that it improved lung function at the 48 h endpoint.

Methods: The injury was induced by inhalation of cold cotton smoke under deep anesthesia. After the injury, the sheep were monitored in conscious state under mechanical ventilation during 48 hours. The rhCC10 was given every 12 hours by intravenous bolus injection to the jugular vein, starting one hour after injury, for a total of four administrations. Three doses of rhCC10 were tested against placebo (normal saline) (n=5), including 1 mg/kg/day (n=4), 3 mg/kg/day (n=3), and 10 mg/kg/day (n=3).

Results: Although improvements in blood oxygen levels were observed for all rhCC10 treatment groups versus placebo, only the 10 mg/kg/day dose yielded significant improvements.

Conclusions: The sample size is not sufficient for the moment for statistical analysis, but the trend is large enough to suggest that once this study is concluded, the results will provide evidence suggesting the use of rhCC10 in smoke inhalation injury.

Applicability of Research to Practice: Our model is an extraordinary bridge from basic research to a clinical trial. Therefore, the results from these studies will allow us to move the investigation in to a clinical trial with the aim to provide a novel drug to ameliorate the pulmonary dysfunction in burn survivors.

External Funding: DoD, SHC 84050, 85500, 85220.

148. Activation of Death Receptor Signaling Pathway Contributes to Apoptosis in Diaphragm after Severe Burn Injury in Rats

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Introduction: Severe burn injury, with or without inhalation injury, is always complicated by respiratory dysfunction. Respiratory dysfunction can be induced by diaphragm and other respiratory muscle atrophy, in which apoptosis maybe one of the most important contributor. So we propose a hypothesis that apoptosis occurs in diaphragm after severe burn injury and activation of death receptor signaling pathway is one of its mechanism.

Methods: A 40% body surface area full thickness thermal injury was inflicted to the animals of injured group. And that of sham-burn group was treated in the same manner as the injured group, except that they did not accept thermal injury. Blood and diaphragm muscles were harvested at the following time points: 0, 1, 4, 7, 10 and 14 days after burn or sham injury. Diaphragm muscles were examined for apoptosis at varying times by TEM and TUNEL. Apoptotic ligands in serum were assessed by ELISA. Expression of apoptosis-related proteins in skeletal muscles was examined by Western blotting. Activity of caspase-3 and caspase-8 was determined by using Caspase-Glo Assay system.

Results: Thermal injury resulted in reductions of body weight and diaphragm muscle mass compared with those of time-matched controls. Also it was found that apoptosis in diaphragm muscle appeared on the first day and maximal apoptosis appeared 4 days post-injury, which is consistent with the change of muscle mass. Detection of apoptotic ligands in serum revealed increase of sTRAIL and sFasl to sFas ratio after burn injury. Pro-apoptotic proteins, including caspase-8, caspase-3, and Bax in Bcl-2 family were up-regulated, while anti-apoptotic protein pAkt and bcl-2 were down-regulated compared with that of time-matched controls. In addition, increment of caspase-3 and caspase-8 activity provided further evidence for their role in apoptosis in diaphragm muscle.

Conclusions: The data suggest that apoptosis may be an important contributor to diaphragm muscle atrophy after severe burn injury. Bcl-2 regulated death receptor-mediated signaling pathway contributes to apoptosis in diaphragm after burn injury.

Applicability of Research to Practice: To elucidate the underlying apoptotic mechanisms mediating the atrophic response is important in establishing potential therapeutic interventions that could prevent and/or reduce diaphragm muscle atrophy and preserve its physiological function after burn injury.

External Funding: This work was supported by grants from the National Natural Science Foundation of China (Project No. 81171807).
Nebulized Epinephrine Attenuates Pulmonary Dysfunction after Burn and Smoke Inhalation Injury.

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University of Texas Medical Branch, Galveston, TX

Introduction: Burn patients with smoke inhalation injury are associated with high mortality rate up to 60%. We hypothesized that nebulized epinephrine will improve pulmonary function after combined burn and smoke inhalation injury by its dual actions—bronchodilation (beta 2 agonism) and attenuation of airway hyperemia (alpha 1 agonism) without significant systemic effects.

Methods: To test our hypothesis, we utilized our well-characterized ovine model of skin burn and smoke inhalation. A third degree skin burn was induced over a 40% of the skin surface. Simultaneously, lung injury was induced with cold cotton smoke inhalation. During the injury, sheep were deeply anesthetized. After the injury, all sheep were placed on mechanical ventilation and monitored in a conscious state for 48 h. Buprenorphine was used for pre and post injury pain control. Three different groups were nebulized with 4 mg epinephrine (n=5), 6 mg epinephrine (n=3) or saline (control) (n=4). The nebulization was repeated every 4 hours starting one hour after the injury.

Results: As compared with control group, 4 mg epinephrine had a significant improvement of pulmonary function (PaO2/FiO2 ratio) at 36 h (p<0.01) after the injury. Peak inspiratory pressure was decreased with 4 mg epinephrine at 36 h (p<0.05), with maximal difference at 48 h (p<0.01). The pulmonary transvascular fluid evaluated by measuring lung lymphatic flow was significantly decreased in the 4 mg epinephrine group at 30-48 h after the injury (p<0.01). Heart rate, cardiac index and blood glucose levels were not affected with 4 mg epinephrine nebulization except a transient increase of glucose at 18 h (p<0.0011) compared to control.

Conclusions: These results suggest that 4 mg epinephrine improves pulmonary function by antagonizing both bronchospasm and airway hyperemia without significant systemic effects. The nebulization of 6 mg epinephrine had noticeable systemic changes. The further studies are warranted increasing the sample sizes.

Applicability of Research to Practice: The results from our highly translational and clinically relevant studies will lead to pilot clinical trials.

External Funding: DoD, SHC 84050, 85500, 85220.
151. **Pharmacokinetic Study of Parecoxib in Burn Rats**
S. Chong, MBBS, Y. Wong, PhD, J. Lu, MD, PhD  
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**Introduction:** In a previous study, Parecoxib, a selective cyclooxygenase-2 (COX-2) inhibitor, at dose of 1 mg/kg, is shown to reduce cytokines and lung MPO levels in severely burnt rats. However, it is unknown whether pharmacokinetics and metabolism of Parecoxib are altered in burn injury. In this study, the pharmacokinetics of Parecoxib and its metabolite, Valdecoxib were evaluated.

**Methods:** Sprague Dawley rats were subjected to a full thickness cutaneous burn in 45% of total body surface area. Both sham and burn groups were injected intramuscularly with either 1 mg/kg or 10 mg/kg parecoxib at 20 min post-burn. Blood samples were collected up to 12 hr post-administration for both groups. HPLC analysis was carried out to determine the serum concentrations of Parecoxib and Valdecoxib. Non-compartmental pharmacokinetics analysis was performed to estimate the pharmacokinetics parameters.

**Results:** A wide intra-group variability in the pharmacokinetics parameters of Valdecoxib was observed. Significant differences were detected in the area under the serum drug concentration-time curve from 0 to 12 hr (AUC0-12), AUC0-inf, apparent total clearance of the drug from serum after non-intravenous administration (CL/F) and mean residence time MRT (p < 0.05) of Parecoxib between burn and sham rats receiving 10 mg/kg Parecoxib (high dose), but not in the 1 mg/kg Parecoxib group (low dose). The pharmacokinetics parameters of Valdecoxib were not found to be different between burn and control rats in both low and high dose groups.

**Conclusions:** In conclusion, Parecoxib when used at dose of 1 mg/kg, significantly mitigate lung injury in severely burnt rats, and its pharmacokinetics is not affected in burn injury.

**Applicability of Research to Practice:** Extrapolation of pharmacokinetics of parecoxib in humans.

**External Funding:** DRTECH grant from MINDEF.

152. **Intestinal I/R Induced Acute Lung Injury Is Mediated by TLR4**
D. Ben, MD, PhD, Z. Xia, MD, PhD  
*Changhai Hospital, Shanghai, China*

**Introduction:** Splanchnic ischemia is common in critically ill patients and it can result in injury not only of the intestine but also in distant organs, particularly in the lung. Local inflammatory changes play a pivotal role in the development of acute lung injury after intestinal ischemia, but the underlying molecular mechanisms are not fully understood. We sought to examine the role of Toll-like receptor 4 (TLR4) in the mouse model of intestinal ischemia-reperfusion (I/R)-induced lung injury and inflammation.

**Methods:** Adult male TLR4 mutant (C3H/HeJ) mice and TLR4 wild-type (C3H/HeOuJ) mice were subjected to 40 min of intestinal ischemia by clamping the superior mesenteric artery followed by 6 h of reperfusion. Lung histology was assessed and parameters of pulmonary microvascular permeability, inflammatory cytokine expression, and neutrophil infiltration were measured. Activation of mitogen-activated protein kinases (MAPKs) and the transcription factors nuclear factor κB (NF-κB) and activator protein-1 (AP-1) in the lungs were also detected.

**Results:** After intestinal I/R, lungs from TLR4 mutant mice demonstrated a significantly lower histological injury, a marked reduction of epithelial apoptosis associated with the decreased level of cleaved caspase-3 and the increased ratio of Bcl-xL to Bax proteins, and a large reduction in pulmonary vascular permeability and myeloperoxidase (MPO) activity in comparison with WT mice. TLR4 mutant mice also displayed marked decreases in tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), monocyte chemoattractant protein-1 (MCP-1), and macrophage inflammatory protein-2 (MIP-2) expression. Following intestinal I/R, phosphorylation of p38 MAPK and activation of NF-κB and AP-1 were significantly inhibited in lung tissue from TLR4 mutant mice as compared with WT controls.

**Conclusions:** These data suggest that TLR4 plays an important role in the pathogenesis of intestinal I/R-induced acute lung injury and inflammation and that p38 kinase and NF-κB may be involved in TLR4 signaling-mediated lung inflammatory processes during intestinal I/R.

**Applicability of Research to Practice:** Organ protection of burn patients.
Comparison of Various Resuscitation Fluids for the Treatment of Burn Injury-Induced SIRS/ARDS in a Rat Model
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Singapore General Hospital, Singapore, Singapore; DSO, Singapore, Singapore

Introduction: Burns result in systemic inflammation response syndrome (SIRS) and required fluid resuscitation. Resuscitation with large volumes of crystalloid has numerous adverse consequences, including worsening of burn oedema and intra-abdominal hypertension. Rapid infusion of small volume expander fluid results in an increased plasma osmolality that potentially limits burn oedema, and may actually mobilise fluid from the interstitial space by osmotic action. If effective, these volume expanders can replace isotonic crystalloid as the preferred resuscitative fluid with added benefits like decreased volume requirements and treatment cost.

Methods: Aim was to investigate the treatment efficacy on burn animals of various small volume plasma expander fluids compared to the isotonic crystalloid (Hartmann’s solution).

Methods: A burnt rat model was developed by using anaesthetized Sprague Dawley rats inflicted with 45% TBSA full thickness scald burn. The burn rat model successfully developed statistically significant SIRS with good survivability at 2 days. SIRS in the animals was quantified by cytokine levels, transaminases (ALT, AST), Creatinine (Cr) levels. SIRS resulting in acute lung injury (ALI) was demonstrated using histological analysis and myeloperoxidase (MPO) quantification of the lungs and Arterial Blood Gas (ABG) sampling. Hartmann’s solution (30 ml/kg), 5% Albumin (10 ml/kg), Voluten (10 ml/kg) or HTS (4 ml/kg) was administered i.v through tail vein or i.p half at 1h post burn and the remaining half at 8h post burn. The rats were sacrificed at 6h, 24h and 48h and the effects of Parecoxib on SIRS, in particular ALI were evaluated.

Results: The burn rats without fluid resuscitation developed SIRS including ALI with significantly elevated cytokines, ALT, AST, and Cr levels, decreased PaO2 levels and increased lung MPO levels. Burnt animals treated with Hartmann’s solution showed increased in survival rate and reduced lung MPO, BUN and Cr but not ALT, AST and cytokines compared to the small volume expanders. 5% Albumin and Voluten significantly reduced systemic cytokine levels.

Conclusions: Although these small volume plasma expanders demonstrated less than favorable outcome, these fluids may be useful in attenuating acute system inflammation in the burn victims.

Applicability of Research to Practice: It would be of interest to study the therapeutic efficacy of infusing these small volume plasma expanders in combination of Hartmann’s solution resuscitation.

External Funding: DRTECH funding from MINDEF.

Experimental Study of the Effect of Bradykinin B1 Receptor on the Increase of Organic Vascular Permeability in Severely Burned Rats
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Introduction: Our objective was to observe the express of the bradykinin receptor 1 and to investigate the changes of organic vascular permeability after severe burn in rats and to determine if the selective Bradykinin Receptor 1 antagonist affects the vascular permeability.

Methods: 90 rats were randomly divided into 5 groups: normal group (group N), sham group (group S), sham plus Bradykinin Receptor 1 antagonist (BR1A, des Arg9-Leu8-BK) group (group SI), burn group (group B), and burn plus BR1A group (group BI). BR1A was applied 20 min before the samples were taken. Evan’s blue (EB) was injected 10 min before preparation in dimethylformamide of myocardium from let ventricle, lung, kidney and intestinal tissues at 0, 3, 6, 12, 24, 48h after burn. The occurrence of bradykinin b1 receptor was observed through the immunohistochemistry. The liquid ratio was calculated by comparing the loss of weight to the wet weight of sample issues. The concentration of dissolved EB was determined by UV-spectrophotometer. Tissue EB content was calculated by comparing EB weight to dry tissue weight.

Results: Large quantities of B1 receptors expression inducedwere determined in the early stage of severe burns (3-12 hours), in the endothelial cells of the small vessels, the typelalveolar epithelia and the proximal convoluted tubule epithelial cells. Organic vascular permeability was significantly increased from 3 to 24 h following severe burn, which matched the occurrence of the bradykinin b1 receptor.

Conclusions: The selective inhibitor of Bradykinin receptor B1 could apparently inhibit the increase of the vasopermeability of the heart, lung, kidney and intestine in the early stage after severe burn.

Applicability of Research to Practice: Shock prevention.
Introduction: Burn patients require central venous access not only during the acute burn resuscitation, but also as part of their ongoing management. Traditionally, central venous catheters (CVCs) have been the primary method of central venous access in burn patients. In recent years, the use of peripherally inserted central catheters (PICC) has increased as an alternative, largely due to their comparative ease of insertion, perceived safety, and cost-effectiveness. A recent survey of invasive catheter practices among 44 burn centres in the US found that 37% of burn units use PICC lines as part of their treatment protocol. However, there is limited data on the complication rates associated with PICC line use in the burn population. We sought to compare PICC line associated complication rates at our institution with rates published in the existing critical care and burn literature.

Methods: A review was performed for all patients admitted to our burn centre between January 1, 2008 and June 31, 2013 who had undergone PICC line insertion during their course of hospitalization. The primary outcome was reason for discontinuation of the PICC line.

Results: Fifty-three patients were identified who received a total of 73 PICC lines during the course of the study. PICC lines were in situ an average of 15 days [range 1-49 days]. The most common reasons for PICC line discontinuation were: line was no longer indicated (45%), suspected PICC line infection (19%), and blocked PICC line (8%). Four cases of upper extremity deep vein thrombosis (6%) and 3 cases of central line associated bloodstream infection (8%, 5 infections per 1000 line days) were identified.

Conclusions: Based on the results of this study, we suggest that PICC line associated complication rates are similar to those published in the critical care literature. Although these rates are significantly higher than those previously published in the burn literature for PICC lines, they are similar to, if not lower than similarly reported CVC associated complication rates. We believe that, overall, this study demonstrates non-inferiority of PICC lines, and suggests that the PICC line can be a useful tool in the treatment of the thermally injured patient.

Applicability of Research to Practice: An increasing number of clinicians are using PICC lines as a tool in the treatment algorithm for acute burn injuries. It is important to have safety data on the use of any new technology before its widespread implementation, especially in a high-risk population such as thermally injured patients. This study suggests that PICC lines are safe for use following the acute burn resuscitation phase, which provides the burn clinician with an additional and invaluable option for central venous access.

External Funding: CIHR 123336. CFI 25407. NIH GM087285-01. PSI.

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Introduction: Haemophagocytic lymphohistiocytosis (HLH) is a hyper-inflammatory disorder caused by primary immune deficiency or acquired failure of normal immune homeostasis. It is characterized by an inability to clear antigenic stimulus with resulting macrophage hyperactivation, cytokine excess, and severe systemic illness. Acquired HLH has been reported in ICU patients secondary to infections, immune suppression following organ transplant, autoimmune disorders and hematological malignancies but has never been reported in burns. Allograft rejection in massive burns may also influence the course of this syndrome. HLH often precedes death and may be under diagnosed, as most of the clinical and laboratory findings used to diagnose this condition are already present in patients with sepsis syndrome with end-organ damage. We report 2 cases of HLH in massive burn patients and examine the clinical course of one of them in detail. The aim of the study was to identify criteria that will help establish a diagnosis specifically in burn patients.

Methods: Both patients had burns involving more than 90% TBSA and succumbed to their injuries. The diagnosis of HLH was made at post mortem examination. We carried out a retrospective review of the charts, analyzing the lab investigations, cytokine profile and clinical course and their correlation with the HLH diagnostic criteria proposed by the FHL study group (1991).

Results: The criteria for diagnosis of HLH was met during the last phase of admission when the clinical condition deteriorated in the week prior to death. We also identified steps in management of HLH that might have changed the outcome if we had diagnosed this condition earlier and instituted these changes. However, most of the parameters used in diagnosis are routinely deranged in extensive burns and not specific to HLH. We examined the cytokine profile looking for more specific indicators of HLH in burns.

Conclusions: This is the first reported case of HLH in burn patients. Since immune suppression, immune depletion and overwhelming sepsis are often seen in massive burn mortalities, perhaps this condition is more frequent in burns than previously believed. We intend to carry out a larger study on all major burn patients with overwhelming sepsis and end organ failure to actively identify this condition.

Applicability of Research to Practice: With improved diagnosis, it is possible that immunomodulatory treatments may improve morbidity and mortality due to this condition.

Eliminating Waterborne Pathogens in a Burn Unit
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Shriners Hospitals for Children, Galveston, TX

Introduction: Pediatric burn patients with a greater than 20% total body surface area burn are immune suppressed and have a greater risk to acquire an infection from environmental pathogens, including gram negative waterborne microorganisms. Water systems supplied to hospitals are regulated by drinking water standards that allows for bacteria to be present in the public water system if the organism is not commonly pathogenic to the healthy individuals. Pseudomonas and Acinetobacter species, commonly identified as waterborne pathogens, have accounted for 53% of hospital acquired infections at this institution between January 2010 through May 2011 and contributed to 5 patient deaths which lead to an extensive outbreak investigation.

Methods: An outbreak investigation began in February 2010 after 27% of the ICU patients became colonized or infected with a Pseudomonas (n=6) or Acinetobacter (n=2) species. Water samples (n=24) were obtained from patient care areas. The cultures results tested positive for Pseudomonas (n=7) species and Acinetobacter (n=1) species and were linked to the infected patients. In June 2011, after trialing different filtration products and using sterile water as an expensive alternative to tap water, 0.2 μm point of service water filters were installed in patient care areas. Water samples were collected randomly at the time the filters were replaced and throughout the month. Patient cultures were obtained on admission and weekly for surveillance purposes.

Results: During this 18 month period, 99.3% of water cultures tested negative with one positive for Pseudomonas aeruginosa with a colony count of <100,000 cfu/mL. The water filter was immediately changed and repeat cultures from this source have tested negative. From June 1, 2011 through December 31, 2012, Acinetobacter (n=1) and Pseudomonas (n=3) accounted for 25% of hospital acquired infections in which the organisms did not have the same biotype as the contaminated water microorganisms.

Conclusions: The use of 0.2 μm point of service water filtration has proven to be a cost effective method in eliminating the number of hospital acquired gram negative infections and septic realted deaths from water borne pathogens. The overall hospital acquired infection rate has reduced from 8.9 per 1000 patient days to 5.1 per 1000 patient days after implementing point of service water filters. No patient deaths were related to sepsis, including waterborne pathogens in 2012.

Applicability of Research to Practice: Burn units should take a systematic approach to reduce and eliminate the risk of healthcare associated infections because there is a limited number of antibiotics, antibiotic resistance, and morbidity and mortality associated with healthcare acquired infections.

External Funding: Shriners Hospitals for Children-Galveston Grant 84080.

Chlorhexidine Gluconate (CHG) Impregnated Central Line Patch Associated Skin Necrosis in Complicated Skin Disorder Patients
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Introduction: In an effort to decrease central venous catheter (CVC) infections, antimicrobial impregnated CHG sponge (1 inch round, 92 mg) dressings have become common practice in the ICU setting. Small case series have highlighted complications with CHG CVC dressings in newborns and critically ill young children. We present three cases of CHG impregnated patch associated skin necrosis within complicated skin disorder patients.

Methods: A retrospective chart and picture log review was performed to evaluate three patients on the burn service with subsequent CVC site complications. The first patient was diagnosed with TENS, the second and third with graft-versus-host disease (GVHD), each involving >50% TBSA.

Results: All patients presented with full thickness skin necrosis and adherent eschar in the direct area of the CHG impregnated patch (Image). Spot lesions and hyperpigmentation changes were noted in the areas before the line was placed. Skin necrosis was noted surrounding the line site between 8-12 days with prompt removal of the patch the same day as discovery and removal of the CVCs when alternative line access was obtained. Blood cultures were positive for one of three patients. A GVHD patient was positive for Candida parapsilis and Enterococcus faecium bacteremia noted on day 13 and 15. Patients required 8-12 weeks to heal the resulting full thickness wound. Internal safety, manufacturer, Department of Public Health and FDA reports were filed for both cases.

Conclusions: Continuous contact of CHG patch under occlusive dressing is speculated to predispose SJS/TEN and GVHD patients to local chemical burn secondary to tissue barrier destruction of the epithelium, decreased cohesion of epidermal-dermal junction, increased tissue permeability and leaky tissues. Per manufacturer statement, the CHG disk product used has never been tested on this subset of patients. Given the observations, our unit has deferred the use of CHG impregnated line dressing for SJS/TEN and GVHD patients and is seeking an alternative option via our CVC and Infectious Disease Committee.

Applicability of Research to Practice: Chlorhexidine gluconate impregnated patches may predispose complicated skin disorder patients to further skin injury and create a nidus for line infection. Practitioners should consider avoiding the use of such patches in the care of this subset of patients. Further investigation by the manufacturer should be considered.
159. **Pathogenic Bacteria on Common Access and Identification Cards: A Search for Badge Bugs**

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*U.S. Army Institute of Surgical Research, JBSA Fort Sam Houston, TX*

**Introduction:** A new institutional requirement mandated access to all computer terminals by common access card (CAC) authentication; clinicians must insert their CAC into the bedside computer every time the electronic patient record is accessed. Additional security measures require use of staff identification (ID) badges for access throughout the burn center. The purpose of this experiment was to determine if the CAC and/or ID badge harbor pathogenic bacteria that could pose an increased risk to patients in the burn intensive care unit (BICU).

**Methods:** Bacterial swab specimens were collected from both the CAC and ID badge of 10 BICU employees in each of 5 cohorts (nurses, respiratory therapists, physical therapists, physicians, and ancillary staff). Ten additional paired samples, collected from the direct care staff in the outpatient burn clinic, served as control. Information was collected describing how the cards were worn, if and how they had been cleaned in the last week, and the number of additional items attached to the cards. Chi-Squared tests were performed to compare contamination rates.

**Results:** In total, 58 CACs and 60 ID badges were swabbed (n=60 participants). The overall contamination rate was 75%; bacteria were recovered from 86% of CACs and 65% of IDs. When cleaned in the last week (n=16), the rate dropped to 50% overall (p=0.003). BICU contamination rate did not differ from the outpatient cohort (p=0.10). The table describes recovered isolates and overall contamination rates.

**Conclusions:** Despite high rates of contamination, isolated bacteria are considered normal skin and respiratory flora, with low risk for severe infection. No multi-drug resistant organisms were isolated. Cleaning at least weekly appears to have a positive effect on contamination rates.

**Applicability of Research to Practice:** While CAC authentication requirements do not appear to pose additional infectious risk to patients, periodic card cleaning should be encouraged.

<table>
<thead>
<tr>
<th></th>
<th>Outpatient clinic (n=20)</th>
<th>Respiratory therapy (n=20)</th>
<th>Physicians (n=20)</th>
<th>Nurses (n=20)</th>
<th>Physical therapy (n=20)</th>
<th>Ancillary staff (n=18)</th>
</tr>
</thead>
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<tr>
<td>Coagulase-negative Staphylococcus</td>
<td>15</td>
<td>12</td>
<td>15</td>
<td>12</td>
<td>11</td>
<td>8</td>
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<td>Micrococcus spp.</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>4</td>
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<tr>
<td>Gram Positive Rods</td>
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<td>1</td>
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<tr>
<td>Viridans group Streptococcus</td>
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<td>2</td>
<td>1</td>
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<tr>
<td>Stomatococcus spp.</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Sphingomonas aureus</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Total Isolates</td>
<td>25</td>
<td>21</td>
<td>20</td>
<td>18</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Overall contamination % (n)</td>
<td>90% (18)</td>
<td>80% (16)</td>
<td>85% (17)</td>
<td>65% (13)</td>
<td>60% (12)</td>
<td>72% (13)</td>
</tr>
</tbody>
</table>

160. **The Effect of Evidence-Based Bundles on Hospital Acquired Catheter Associated Urinary Tract Infections**

C. Christ-Libertin, DNP, CPNP-PC

*Akron Children’s Hospital, Akron, OH*

**Introduction:** Eighty percent of healthcare associated urinary tract infections are attributable to indwelling urinary catheters (Institute for Healthcare Improvement, 2012). Healthcare providers may perceive CAUTI as a benign or acceptable side effect of a clinical process despite the associated morbidity and mortality (leading cause of secondary bloodstream infection, increased length of hospital stay, cost of $0.4-0.5 billion per year, ~13,000 deaths a year). CAUTI is a provider-preventable condition unreimbursed by CMS. CAUTI was the only 2012 Joint Commission National Patient Safety Goal.

**Methods:** The pilot study hypothesis was that evidence-based bundles designed to prevent CAUTI would reduce CAUTI incidence in the burn population in an acute care setting. The pilot study used a descriptive design. The setting was a burn unit with a 2011 year-end for a yearly rate of 14.75 (9/610 catheter days), first quarter 2012 rate of 12.6 (2/158), and NHSN benchmark statistic of 4.4 per 1000 catheter days. An evidence-based practice (EBP) process model guided the planned change in practice. Inclusion criteria were inpatient burn injured patients requiring an indwelling urinary catheter. The CAUTI rate before and after implementation of insertion and maintenance bundles to prevent CAUTI was monitored. Licensed nurses responsible for insertion and maintenance of the urinary catheter and unlicensed assistive personnel that may handle the urinary catheter system received education on the bundles. Interobserver reliability was established by observing staff adherence with the bundles.

**Results:** The CAUTI rate dropped to 1 in seven months with 181 days between events.

**Conclusions:** Of clinical significance, implementation of evidence-based bundles using an EBP model reduced the CAUTI rate. Small sample size prevents establishing statistical significance.

**Applicability of Research to Practice:** Benefits to nursing science include new knowledge about effectiveness of EBP bundles to reduce CAUTI implemented in the burn injured patient population using a theoretical framework. The CAUTI metrics are part of daily unit huddle quality metrics with increased awareness of the unit CAUTI rate and days between CAUTI. This pilot study examined the feasibility of an approach intended to be used in a larger scale study. The pilot explored the effectiveness application of an EBP model for integration of CAUTI prevention bundles into practice and determined the feasibility of recruitment of burn injured patients in a burn unit. Pilot results informed about modifications needed in the design of a larger hypothesis testing study.
A Systematic Review of Vancomycin Dosing and Monitoring in Burn Patients

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Wishard Health Services, Indianapolis, IN; Purdue University, Indianapolis, IN; Indiana University, Indianapolis, IN

Introduction: Following burn injury, vancomycin clearance increases, requiring up to an 80% higher total dose to achieve adequate concentrations. Wide interpatient variability necessitates close, frequent monitoring for efficacy and safety. The objectives of this study were to: systematically evaluate published data regarding vancomycin pharmacokinetic alterations in burn patients, determine evidence-based recommendations for dosing or monitoring, and identify areas for future research.

Methods: A systematic review of literature from 1/1/1966 to 11/15/2012 was conducted through Medline, OVID, CINAH, Iowa Drug Information Service, and EBSCO. Studies were reviewed for inclusion by two independent reviewers, with discrepancies resolved by a third. For inclusion, studies must have been in English, had human subjects with at least a 10% TBSA burn receiving IV vancomycin, and reported serum concentrations.

Results: Of 130 titles returned, twelve met a priori criteria for inclusion. Studies ranged from 1984 to 2009, included between 1-171 patients (median of 10), and varied in design. Patient demographics are summarized below. Common dosing regimens were 5-20 mg/kg/dose given every 6-8 hours. Mean peak and trough concentrations were 21.2 ± 4.4 mg/L and 7.24 ± 1.5 mg/L, respectively. Only 12.5% of reported trough concentrations were within the recommended range (10-20 mg/L). All studies recommended close monitoring of trough concentrations. No studies mentioned the importance of routinely monitoring peak concentrations, provided consistent overall dosing recommendations, or assessed clinical outcomes or adverse events.

Conclusions: Due to limited prospective data evaluating clinical outcomes, a standard recommendation for vancomycin dosing or monitoring in burn patients cannot be made. The majority of studies target lower troughs than current standards. This can lead to treatment failures or development of resistance. Our future research goals include prospective evaluation of clinical outcome data related to initial doses, loading doses, monitoring both peak and trough concentrations, and adverse events. Further data on effects of TBSA, degree of injury, concomitant diseases, inhalation injury, and time since injury may improve our ability to more accurately dose vancomycin in burn patients.

Applicability of Research to Practice: As no validated dosing/monitoring recommendations exist for burn patients, this review allows us to recognize areas for future research.
161. A Systematic Review of Vancomycin Dosing

Introduction: Vancomycin is a glycopeptide antibiotic used for the treatment of serious infections. However, evidence-based guidelines for vancomycin dosing are lacking. The aim of this study was to synthesize available evidence to guide clinical practice.

Methods: A systematic literature review was performed using PubMed, Embase, and Cochrane databases. Studies were included if they reported vancomycin dosing strategies. Data were extracted on patient characteristics, dosing regimens, and clinical outcomes.

Results: Of 130 titles identified, 12 studies met inclusion criteria. Most studies (n=9) were observational cohort studies. Mean patient age was 56 ± 15 years, and mean TBSA was 27 ± 11%. Most patients (83%) had severe burns (TBSA > 30%). A wide range of dosing regimens were reported, including 5-20 mg/kg/dose every 6-8 hours for the first 24 hours, followed by 10-20 mg/kg/dose every 24 hours. Mean trough concentrations were 21.2 ± 4.4 mg/L, and 91% of concentrations were within the recommended range (10-20 mg/L). No significant differences were found in clinical outcomes or adverse events.

Conclusions: There is a need for evidence-based guidelines for vancomycin dosing in burn patients. Further research is needed to determine optimal dosing strategies.

162. Colonizing Bacteria Impact Local Host Response to Inflammation and Wound Healing

Introduction: Colonization of the burn wound may have predictive power in categorizing wound depth progression and the development of hypertrophic scar. While many wounds do not become invasively infected, it is essential to understand the role that colonizing bacteria may play in the wound healing process. To date, there have been no published data regarding vancomycin pharmacokinetic alterations in burn patients.

Methods: The objectives of this study were to: systematically evaluate published data regarding vancomycin pharmacokinetic alterations in burn patients, determine evidence-based overall dosing recommendations, or assessed clinical outcomes.

Results: Of 130 titles returned, twelve met a priori criteria. Studies ranged from 1984 to 2009, included 1736 patients, and reported 3048 patient demographics. Common dosing regimens were 5-20 mg/kg/dose given every 6-8 hours. Mean peak and trough concentrations were 21.2 ± 4.4 mg/L and 10-20 mg/L, respectively. No studies mentioned the importance of trough concentrations. All studies recommended close monitoring of trough concentrations. No studies reported significant differences in clinical outcomes or adverse events.

Conclusions: Future data on effects of TBSA, degree of injury, patient demographics, and monitoring in burn patients is necessary.

163. Frequency of Liver Function Tests Abnormalities in Pediatric Patient with Large Burns Given Oxandrolone

Introduction: Oxandrolone is sometimes administered to pediatric burn patients to minimize protein catabolism. A current FDA black box warning for oxandrolone relates to the potential lethal side effect of Peliosis Hepatis and suggests regular monitoring of Liver Function Tests (LFTs). The intent of this retrospective study was to investigate how often oxandrolone elevates these LFTs and the impact of these tests on drug cessation.

Methods: A retrospective review of patients with burns >30% total body surface area (TBSA) who received oxandrolone at a dose of 0.15 - 0.2 kg/day for 2 weeks or more was performed. Baseline and weekly AST and ALT were recorded for the duration of the drug therapy and for a maximum of 6 weeks. On occasions where multiple lab values existed per week, the highest lab value was recorded. For patients that exceeded the 6 week inclusion, a value on the last week of therapy was also recorded. Values exceeding 5 times the reference normal were considered to be clinically significant. General demographics and incidence of elevated LFTs are described. Student’s paired t test and analysis of variance were used to compare change in LFTs over time.

Results: Forty- four patients were followed for a total of 231 weeks. Their mean age was 8.4 ± 5.6 years with a burn size of 50 ± 18 TBSA and a mean length of stay of 70 ± 30 days. Maximum ALT (70.5 ± 103; range: 5-450) and AST (72.1 ± 86.9; range: 11-358) increased from baseline with the initiation of therapy. This increase was significant for ALT (p<0.05). Both parameters consequently trended downward to a mean of 33 ± 29 (ALT) and 27.2 ± 22 (AST) (F=2.3; p<0.003) at the end of the 6 week period. Six patients exceeded 6 weeks of oxandrolone therapy for a mean duration of therapy of 63 ± 33 days. Their ALT/AST were within normal limits on the last week of therapy. The overall incidence of elevated LFTs above reference normal at some point during therapy was 21 ± 11% (range: 6-34%) for ALT, and 25 ± 18 % (range: 4-45%) for AST. Incidence of clinically significant (500% of normal) elevations in ALT and AST was 2%. This occurred in 7 patients. ALT/AST values gradually declined and oxandrolone was continued in all but 2 patients, where LFTs normalized with cessation of therapy. There were no adverse effects of the drug on hepatic function noted.

Conclusions: Moderate AST and ALT elevations are common in children administered oxandrolone. The incidence of major elevation is low. The effects of this drug on hepatic function during the acute phase of care is minimal.

Applicability of Research to Practice: The need for monitoring and the risk of therapy should be considered when planning anabolic therapy in children.

164. During the Ebb Phase, Disuse Potentiates Burn Induced Catabolism in Rats

Introduction: Severe burn and disuse result in metabolic changes associated with systemic inflammatory and endocrine changes. Such changes include extreme inflammation, hypermetabolism and catabolism, resulting in dramatic endocrine shifts to enable the body to adapt to the severe burns. These changes are biphasic and include the initial inflammatory ebb phase, then transitions to the hypermetabolic flow phase. In severe burn patients early inflammatory responses have been associated with characterizing metabolic shifts resulting in catabolic responses. The purpose of this study was to determine effects of HLU on burn on the inflammatory responses, and the association with blood urea nitrogen (BUN) and plasma creatinine (Cr) as indices of catabolism.

Methods: Male, Sprague-Dawley rats (~ 300g) in two groups, Burn Ambulatory (BA; n=6) and Burn/Hindlimb Unloaded (BH; n=6), with 4 time points: 1, 3, 7 and 14-days following injury. Burn groups received a 40% total body surface area (TBSA) full-thickness scald burn and disuse HLU was initiated immediately following injury. Inflammatory cytokines were measured by commercial ELISAs. BUN and Cr were measured by NOVA CCX blood gas analyzer.

Results: Inflammatory cytokines, IL-6 and IL-10, were increased (p<0.05) in BA on day 1, indicative of the inflammatory ebb phase, with the changes being significantly greater in BH. No differences between burn groups were observed after the initial ebb phase however, they remained elevated at all time points compared to controls. BUN and Cr remained elevated in both burn groups over the course of the experimental period. BUN and Cr were increased (p<0.001) within BA and BH on day 1, however, no significant differences in BUN or Cr were observed during the flow phase. These increases in BUN and Cr in both burn groups on day 1 are reflective of indices of acute catabolism, with the combination of burn continuing to be elevated over time. Total protein remained unchanged in both burn groups, an indication of protein breakdown and turn-over during catabolism. During the ebb phase, an acute onset of inflammation in BH rats appears not to be a direct result of the burn injury alone, but a combination of the injury and disuse. Indices of catabolism were apparent during the ebb phase, however, as with the initial inflammatory response, were not different during the hypermetabolic flow phase, remaining elevated in the burn groups over time.

Conclusions: Burn injury, accompanied by long-term disuse results in complex metabolic changes during early onset of the initial injury.

Applicability of Research to Practice: Different underlying factors seem to be influencing the acute metabolic changes offering opportunities for early intervention resulting in positive long-term outcomes.

External Funding: US Army MRMC & Juvenile Diabetes Foundation.
165. The Clinical Safety of Probiotic Administration Following Burn Injury
T. Mayes, RD, CCRC, M. M. Gottschlich, PhD, RD, L. James, MS, C. Allgeier, DTR, J. Weitz, RN, BSN, R. J. Kagan, MD, FACS
Shriners Hospitals for Children, Cincinnati, OH

Introduction: Probiotic administration has been associated with gastrointestinal and immunological improvements in health and disease. Clinical use of probiotics following burns has not been investigated largely because of the infectious concerns from a bacterial challenge in the immune- and gut-compromised state. This study compared outcomes in pediatric patients randomized to probiotic or placebo during the acute burn course in order to document safety.

Methods: Subjects received probiotic (Lactobacillus GG) (n=10) vs placebo (n=10) via a nasoduodenal feeding tube twice daily beginning within 5 days of burn and continuing until wounds achieved 95% closure. Nursing staff was provided education regarding administration of the investigational product to avoid bacterial cross contamination. Clinical outcomes (sepsis, infection, antibiotic use, operative days, tolerance, death and LOS) were recorded. Student’s t-test and nonparametric Wilcoxon rank sum test were used for comparative analysis.

Results: No differences were noted between groups (probiotic vs placebo) for age (7.1 ± 2.2; 6.9 ± 1.7), total burn size (38.0 ± 5.9; 45.5 ± 4.45); full thickness (24.6 ± 5.6; 32.1 ± 5.4); postburn day admit (0.8 ± 0.4; 1.1 ± 0.4) and inhalation injury (10%; 20%). Outcomes according to group are differentiated in Table 1. Infectious parameters, number of operative days and frequency of diarrhea, constipation and emesis were similar between groups. There was one death due to respiratory failure in the treated group. As expected, incidence of flatulence was higher in the probiotic group. Length of stay, adjusted for burn size, was not statistically different between groups; however a trend toward decreased time to wound healing was evident in the treated group (Table 1).

Conclusions: This study is the first to document evidence of clinical safety relative to probiotic supplementation postburn. Further investigation is warranted to corroborate these initial, promising findings.

Applicability of Research to Practice: Probiotics can be safely provided in the acute postburn period. A gap in knowledge exists regarding administration of the investigational product to probiotic or placebo during the acute burn course in order to document safety.

<table>
<thead>
<tr>
<th>Table 1. Clinical Outcomes between Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis days</td>
</tr>
<tr>
<td>Total infection days</td>
</tr>
<tr>
<td>Antibiotic days</td>
</tr>
<tr>
<td>Operative days (E/G)</td>
</tr>
<tr>
<td>Diarrhea days</td>
</tr>
<tr>
<td>Constipation days</td>
</tr>
<tr>
<td>Emesis days</td>
</tr>
<tr>
<td>Death</td>
</tr>
<tr>
<td>Flatulent days</td>
</tr>
<tr>
<td>MLOS%/TBSA burn</td>
</tr>
<tr>
<td>WLOS%/TBSA burn</td>
</tr>
</tbody>
</table>

Data presented as mean ± SEM or n (%); E/G, Excision/Graft; MLOS, medical length of stay; WLOS, wound length of stay; ** does not include pt who expired

166. Nutritional Status and Oxidative-Antioxidative Balance in Severe Burns
N. Hojo, MD, Y. Shinozawa, MD, PhD
Tohoku University Graduate School of Medicine, Sendai, Japan; International University of Health and Welfare Hospital, Nasushiobara-Shi, Japan

Introduction: In our previous study which determined oxidant levels in the plasma of severely burned patients, a significant decrease in the oxidant levels of non-survivors during the late phase while their antioxidant capacities were within normal limits, speculated that this imbalance be due to the nutritional status of patients.

Methods: The nutritional status of twenty extensively burned patients (15 males and 5 females, 60 +/- 23 y/o, 41 +/- 21 %TBSA, 15 survived and 5 non-survived) was retrospectively assessed, whose plasma levels of d-ROMs (derivatives of reactive oxidative metabolites) and BAP (biological antioxidant potentials) had been serially determined during their hospital stays as markers for their oxidant and antioxidant properties respectively. The evaluation was done through the CONUT nutritional screening tool, which gives scores based on levels of serum albumin and cholesterol, as well as total lymphocyte counts. The CONUT scores were then compared with the levels of d-ROMs and BAP.

Results: A total of 83 person-day measurements were obtained. The CONUT undernutrition levels were normal in 2 patients (1 +/- 0 day post burn: PBD), light in 4 (1 +/- 0 PBD), moderate in 19 (45 +/- 38 PBD), and severe in 27 (30 +/- 24 PBD). Their d-ROM levels (normal range: 200 - 300 U.CARR) were 248 +/- 62, 345 +/- 120, 144 +/- 128 (p = 0.0089 vs. light), and 110 +/- 77 (p < 0.0001 vs. light), respectively (CONUT score = 10.9 - 0.0013d-ROMs, r = 0.50, p < 0.001). Their BAP levels (normal range: > 2201 umol/L) were 3361 +/- 375, 3096 +/- 62, 345 +/- 120, 144 +/- 128 (p = 0.0089 vs. light), and 110 +/- 77 (p < 0.0001 vs. light), respectively (CONUT score = 16.8 - 0.0028 BAP, r = 0.48, p < 0.01).

Conclusions: Whether oxidant and/or antioxidant levels were regulatory is not determined. However, the CONUT nutritional screening tool can determine the nutritional status of patients and guide therapy.

Conclusions: Whether oxidant and/or antioxidant levels were within normal limits or not, their decrease correlated with nutritional deterioration during the course of treatment.

Applicability of Research to Practice: It is confirmed that maintaining nutritional status is essential for restoring oxidant-antioxidant balance and for survival in extensive burns.
Introduction: Diabetes mellitus (DM) currently affects 25.8 million Americans and is predicted to double its incidence by 2050. At our verified burn center 18% of patients admitted for the treatment of burns are diabetic with hemoglobin A1c (A1c) levels above the DM threshold of > 6.5% with 27% of those suffering foot burns. To address this clinical dilemma, a multidisciplinary group consisting of physician specialists, nurses, pharmacists and physical therapists developed an evidence-based guideline. The purpose of this study was to evaluate the clinical outcomes using that guideline.

Methods: Following IRB approval, a retrospective chart review was conducted of all patients with DM who were admitted to our burn center for the treatment of burns of the foot from 4/01/2012 to 7/22/2013. Data points collected included sex, age, admitting serum glucose and A1c, burn mechanism and size, transcutaneous tissue oxygen measurements (TCOM) and HBO treatments, LOS and complications including graft loss and amputation.

Results: A total of 24 patients with DM were admitted during the study period for treatment of burns of the feet. All received treatment following the guideline. Mean age was 57 years and 17 (71%) were male. Twenty-three patients were known diabetics at the time of admission and one was newly diagnosed. Mean admission glucose was 190mg/dl (range 62-448). Mean admission A1c was 8.56% (range 5.5-13.8, SD 2.35). Twenty three subjects (96%) had thermal injury with 18 (75%) suffering a full thickness injury. Median TBSA was 1% (range 0.25-16) and median full-thickness was 0.5% (range 0.2 -6). Twenty patients had TCOM values leading to 10 minute 100% O2 challenge as directed by the guideline. Seven of those 20 patients met criteria for HBO treatments with 6 receiving pre-operative treatments (average 17, range 9-20 treatments/patient) and 2 receiving post-operative treatments (average 4, range 3- 5 treatments per patient). Three patients scheduled for skin grafting completely healed their burns with only HBO (12.5%). Median LOS was 11.5 days (range 2-133). Complications included infections in 4 patients and amputation in 1. There were no graft losses.

Conclusions: Using an evidence-based approach, we were able to successfully heal burn wounds with few complications and amputations in a patient population that is notorious for high complication and amputation rates. This experience suggests that the use of an evidence-based approach combining conventional management principles with newer technology may improve outcomes in this high risk population.

Applicability of Research to Practice: Clinical research of evidence-based treatment guidelines directed toward patients with DM and suffering burns will provide best outcomes for those patients.

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**Table 1. Differences in patient characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Enteral Zinc (n = 38)</th>
<th>IV + Enteral Zinc (n = 27)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total daily dose Enteral zinc</td>
<td>250mg elemental zinc</td>
<td>250mg elemental zinc</td>
<td>0.91</td>
</tr>
<tr>
<td>Age</td>
<td>45 ± 19</td>
<td>46 ± 15</td>
<td>0.71</td>
</tr>
<tr>
<td>BMI</td>
<td>31 ± 15</td>
<td>35 ± 17</td>
<td>0.15</td>
</tr>
<tr>
<td>% TBSA</td>
<td>27 ± 16</td>
<td>27 ± 16</td>
<td>0.06</td>
</tr>
<tr>
<td>% Inhalation injury</td>
<td>33 ± 15</td>
<td>33 ± 15</td>
<td>0.08</td>
</tr>
<tr>
<td>ICU LOS (survivors)</td>
<td>57 ± 24</td>
<td>50 ± 15</td>
<td>0.62</td>
</tr>
<tr>
<td>Ventilator days (survivors)</td>
<td>28 ± 24</td>
<td>28 ± 24</td>
<td>0.02</td>
</tr>
<tr>
<td>% With any infection</td>
<td>52</td>
<td>60</td>
<td>0.32</td>
</tr>
<tr>
<td>% Wound infection</td>
<td>25</td>
<td>26</td>
<td>0.02</td>
</tr>
<tr>
<td>% Debridement</td>
<td>52</td>
<td>52</td>
<td>0.32</td>
</tr>
<tr>
<td>% Urinary tract infection</td>
<td>42</td>
<td>42</td>
<td>0.06</td>
</tr>
<tr>
<td>% Mortality</td>
<td>24 (4 out of 27)</td>
<td>28 (5 out of 27)</td>
<td>0.38</td>
</tr>
</tbody>
</table>

*pValues reported as mean ± standard deviation (SD) or percent, where appropriate.

---

**Table 2. Zinc level comparisons**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Enteral Zinc (n = 38)</th>
<th>IV + Enteral Zinc (n = 27)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission zinc level</td>
<td>50 (23-42)</td>
<td>54 (23-46)</td>
<td>0.28</td>
</tr>
<tr>
<td>% who did not normalize</td>
<td>27</td>
<td>20</td>
<td>0.15</td>
</tr>
<tr>
<td>HD zinc level normalized</td>
<td>20 (19-34)</td>
<td>25 (17-34)</td>
<td>0.55</td>
</tr>
</tbody>
</table>

*pValues reported as median (interquartile range)
169. Bone Mineral Density and Risk Factors for Bone Depletion in Burned Children

M. L. Dylewski, PhD, RD, K. Prelack, PhD, RD, J. Hall, MS, RD, LD, P. Chang, MD, R. L. Sheridan, MD, FACS
Shriners Hospitals for Children, Boston, MA

Introduction: Low bone mineral density (BMD) is a familiar complication of large burn injury, prompting routine surveillance particularly in burned children. Bone loss in this population is explicable given sustained immobility, inflammation, and altered vitamin D metabolism associated with burns. However, interpretation of BMD status and timely identification of patients at risk is less intuitive. We reviewed BMD in our population of pediatric burn patients and factors associated with bone mass depletion.

Methods: A retrospective analysis of pediatric burn patients aged 2-24 years, admitted between 2004-2013, and who received measures of BMD by dual energy x-ray absorptiometry (DXA) was conducted. DXA was used to determine BMD after 95% wound closure. Lumbar spine BMD z scores were calculated using published pediatric reference values. Z-scores of less than (-) 1.0 were considered low for age. Factors such as burn size, time of admission, length of stay, and malnutrition (as diagnosed by significant weight loss and diet history) were entered into a logistic regression model to determine significant predictors of BMD z-scores. Descriptive statistics are reported as mean and standard deviation.

Results: A total of 65 patients were included in this study. Mean age and burn size was 10.2 ± 4.7 years and 46 ± 21.2% total body surface area (TBSA) respectively. Z-scores averaged (-) 0.93 ± 1.14, with a range of 1.6 to (-) 3.3. Fifty-two percent of the patients had z-scores less than (-) 1.0, requiring additional follow-up or intervention. Only 10 patients (15.4%) had z-scores below (-) 2.0. Their mean burn size was not significantly different from the rest of the group (47 ± 19). Seven of these were malnourished, and 9/10 patients were from outside of the US. For the entire population studied, diagnosis of malnutrition increased odds of having a z-score < -1.0 by 3.5 times (1.128, 10.916). TBSA, delayed admission, and length of stay did not predict a low z-score.

Conclusions: Approximately one-half of children admitted with large burn injury had BMD that was low for age after wound closure. The single most significant predictor of bone depletion is malnutrition.

Applicability of Research to Practice: Burn patients admitted with symptoms of malnutrition should be screened for low BMD.

170. Nursing Placed Feeding Tubes in Burn Patients Using an Electromagnetic Tracking System: Does It Improve Delivery of Nutrition?

S. M. Sayeed, MD, P. J. Birkenfeld, MS, RD, T. McKinzie, BS, L. H. Riina, MD, L. T. Glickman, MD, FACS, R. L. Simpson, MD, MBA, FACS
Nassau University Medical Center, East Meadow, NY

Introduction: Early enteral nutrition is the gold standard of feeding and optimal source of nutrition in at risk patients. Enteral access is typically established in patients with burns over 20% TBSA or those failing to meet nutritional goals by oral intake. Traditionally, our institution utilized weighted nasogastric feeding tubes (NGT) which required radiographic confirmation. The Cortrak (CORPAK MedSystems, Buffalo Grove, IL) feeding system has been shown to assist in accurate placement of feeding tubes without need for radiographic confirmation by using real-time electromagnetic tracking (EMT) of the tube stylet. Using various techniques the tubes can be advanced post-pyloric. In 2011 nurses were trained in the system, and subsequently placed all EMT feeding tubes (EMTT). The purpose of our study was to determine if tubes placed by nurses using the EMT system improved time to initiate tube feeds and achievement of goal rate compared with traditional NGT.

Methods: A retrospective review was performed on patients admitted to our burn center in 2009 and 2012 to compare traditional feeding tubes and nursing placed EMTT. All patients with burns receiving tube feeds were identified. Age, burn size and co-morbidities were recorded. Hours to start tube feeding from admission and time to reach hourly goal rate were primary outcomes.

Results: In 2009, 11 patients were fed by NGT. Thirteen patients were identified in 2012 as being fed using post-pyloric EMTT. There was no difference in mean age between the two groups (43.2 vs 39.8 p=0.73). While the mean burn size was larger in the NGT group it did not reach significance (30 vs 17.5%, p=0.08). When comparing all patients, there was no significant difference in time to start enteral nutrition in both groups (33 hrs vs 19 hrs, p=0.25). Time to reach goal delivery was faster in the EMTT group (8 vs 57 hrs, p=0.006). In reviewing burns larger than 20% (n=6 NGT, n=4 EMTT) mean age was the same (52). Mean burn size was larger in the NGT group (44% vs 32.5%). Average time to start feeds was earlier in the EMTT group (10.5 hrs vs 13.5 hrs). Time to reach goal rate was also faster in the EMTT group compared with NGT group (Avg 12.5 vs 47 hrs). Radiographic confirmation was only needed the NGT group.

Conclusions: EMT tubes placed post-pyloric have allowed for a more rapid progression towards achieving goal tube feed volume in patients with burns requiring enteral nutrition. Training nurses to use the EMT device may improve the time of tube feeding initiation and goal delivery. The need for direct physician oversight is decreased as well as the need for post placement radiography.

Applicability of Research to Practice: Training non-physician medical staff to place tubes using EMT may allow for improved delivery of tube feeds.
171. Breaking the Myth About Early Blood Transfusions in a Burn Mass Casualty Incident

S. S. Satahoo, MD, J. S. Davis, MD, E. De Asis, MS, S. Shariatmadar, MD, L. R. Pizano, MD, MBA, N. Namias, MD, MBA, C. I. Schulman, MD, PhD, M. Lynn, MD  
University of Miami, Miami, FL

Introduction: A Mass Casualty Incident (MCI) could result in a large number of severely burned patients. Surge capacity planning for a burn disaster should include sources for immediate augmentation of personnel, equipment and specific supplies and medications. This study aimed to estimate how much blood products would be needed in the first 48 hours after a burn MCI and determine predictors of transfusions in this population.

Methods: Local burn registry was queried for adult patients who had TBSA burn ≥20% and an operative procedure from November 2006 to January 2012. Demographic data was collected. Transfusion records for the first 2 weeks of hospitalization were recorded. Student’s t-test, χ2 test and multivariate regression were done to determine significant risk factors for requiring transfusions. P-value <0.05 was considered significant.

Results: Total 110 patients were included. Patient demographics are shown in Table 1. The requirement for blood products is listed in Table 2. In the first 48 hours, only 9.1% required transfusion of any blood products. TBSA≥40% was the only significant predictor when evaluating both the need for transfusion, as well as transfusion of greater than 2 units of PRBCs (p=0.011, p=0.026 respectively). However, by 2 weeks, 71% of patients required a transfusion. TBSA≥40% and age were significant predictors when evaluating both the need for a transfusion of PRBCs, as well as transfusion of greater than 2 units. In both scenarios, TBSA (p=0.002) and age (p=0.036) remained significant predictors in a multivariate analysis.

Conclusions: In burn patients, less than 10% will require transfusion of any blood product in the first 48 hours; therefore there is no need for excessive mobilization of blood products or donations in the early phase of a burn MCI. However, planning for a burn disaster should include sources for additional blood products within the first 2 weeks.

Applicability of Research to Practice: This serves as the first attempt to estimate the amount of blood products that would need to be available in the event of a burn MCI. This and subsequent data could be used to augment disaster preparedness planning for such an event.

172. Piloting an International Burn Registry: Implications for Clinical Practice

R. Millea, MD, J. Gallagher, MD, I. Goldin, BA, A. Rabbits, MS, RN, N. E. Leahy, MPH, RN, G. Giri, MD, K. B. Mitchell, MD, R. W. Yurt, MD, FACS  
New York Presbyterian Hospital/Weill Cornell Medical Center, New York, NY; Weill Bugando University College of Health Sciences, Mwanza, United Republic of Tanzania

Introduction: In 4/13, a coordinated effort between an established US burn center and an African medical college resulted in the founding of a new pediatric burn center in a region where none had existed. Foundational to its creation is an electronic registry. It was hypothesized that such a tool will enable the international care teams to better understand clinical issues and care needs, track patient outcomes, and define the epidemiology of burns for that African region. The following reviews the experience with this registry during the initial 5-month period of use.

Methods: A registry was created using a secure, web-based, proprietary platform modified to the specific needs of this project and included data tracked by a leading international burn care organization. After an initial clinical exam, the following were concurrently entered for each patient: name, admit date/time, age, gender, weight, country/village of residence, and distance (km) travelled to burn center, injury date/time/mechanism/site/intent, TBSA and affected areas, smoke inhalation (IHI), length of stay (LOS), discharge (d/c) disposition and surgery. The patient records were archived into the registry upon d/c. Variables are presented as mean ± SD (range).

Results: Between 4/13-9/13, 41 cases (68% male) were reviewed. Mean age, burn size and LOS were 3 years ± 3, (3 m-16 y), 12% TBSA≥ 10 (2 - 56) and 13 days ± 6 (1 - 29). Most burns were unintentional (95%), occurred at home (90%) and were due to scalds (73%) and flame (24%) None had IHI. The average distance traveled to burn center was 12 km ± 14 (2 - 70). Mortality was 7%; among these, age and %TBSA was 3 yrs ± 2 and 37% ± 18. Four patients required surgery for wound closure. Most (88%) were discharged home.

Conclusions: This early data reveals the majority of burns as unintentional scalds occurring in the home. The distances traveled are local, suggesting that the clinical service has yet to become a regional resource. Length of stay is short for the developing world setting, likely a result of surgical wound closure as part of the care offered. The deaths occurred in the larger burns as expected; however, continued improvements in care are likely to positively impact mortality. These registry data are fundamental components to tracking the care delivered, outcomes achieved, and epidemiology of burns in the African region. Based on these findings, this collaborative will continue the use of this tool, seek to expand the data points captured to further direct clinical and prevention efforts, and collaborate with outside partners to beta test compatibility with other international registry models.

Applicability of Research to Practice: Epidemiology, global health model for burn center development.

External Funding: ELMA Grant #F13F003.
Introduction: Prior to 2012, incidence of fungal infection in our burn center was remarkably low. However, from November 2012 to February 2013, five patients developed signs of fungal wound infection (FWI), representing a sharp increase from previous years.

Methods: We reviewed all adult admissions over a five year period to characterize the incidence of FWI. A multidisciplinary outbreak team performed an epidemiologic survey of the burn intensive care unit (BICU) and other associated clinical care areas. The team reviewed all records from patients and patient care areas throughout the hospital, performed environmental and structural inspections, and interviewed staff. Surface and volumetric air samples were obtained from air ventilation ducts and all patient care areas in the BICU and operating rooms (OR).

Results: From January 1, 2008 to March 1, 2013, eleven burn victims and 4 patients with severe skin and soft tissue disease grew mold (15/2126; 0.07%) from one or more tissue samples. Five patients (5/15; 33.3%) with average burn size of 47.4% TBSA were diagnosed with FWI in the months following Hurricane Sandy (October 29, 2012). There were no changes in patient care or environmental control practices during this time. A structural survey revealed defects in an air ventilation system, and window and ceiling tile sealant in several of the patients rooms. All BICU and OR surface cultures (90/90) were negative, however 2 surface cultures in the BICU tub room (Aspergillus fumigatus, A. niger) and 1 from an air handling system (penicillium) grew mold. Volumetric air samples from all BICU patient care areas were negative. In contrast, two air samples from a single OR were positive for penicillium and aureobasidium.

Conclusions: FWI in burn patients results from simultaneous compromise to environment and host conditions. Previous studies evaluating the levels of indoor and outdoor molds in the months following hurricanes have found higher levels of spore counts and mold growth. Although we were unable to definitively identify the source of the recent outbreak of mold infections in our unit, temporal association to Hurricane Sandy (Tables 1 and 2) combined with the identified structural defects and compromise of environmental air quality control measures suggests that meteorologic variations may have been a contributing factor.

Applicability of Research to Practice: Meteorological phenomena may be under recognized as contributing factors for fungal infections in the burn unit.

<table>
<thead>
<tr>
<th>Survey Results</th>
<th>Mean (SD)</th>
<th>Median (IQR)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPREHENSIVENESS</td>
<td>4.2 (0.8)</td>
<td>4 (4-5)</td>
<td>2-5</td>
</tr>
<tr>
<td>Burn survivors</td>
<td>3.9 (1.3)</td>
<td>4 (3-5)</td>
<td>0-5</td>
</tr>
<tr>
<td>Employers</td>
<td>4.1 (1.2)</td>
<td>4 (3.5-5)</td>
<td>0-5</td>
</tr>
<tr>
<td>Clinicians</td>
<td>4.4 (0.9)</td>
<td>5 (4-5)</td>
<td>2-5</td>
</tr>
<tr>
<td>UTILITY/USEFULNESS</td>
<td>4.3 (1.0)</td>
<td>5 (4-5)</td>
<td>2-5</td>
</tr>
<tr>
<td>USER-FRIENDLY</td>
<td>4.3 (1.0)</td>
<td>5 (4-5)</td>
<td>2-5</td>
</tr>
</tbody>
</table>
175. A Multidisciplinary Approach to the Treatment of Severe Cold Exposure Injuries: An Angiographic Case-Series Supporting the Use of Catheter-Directed Thrombolysis to Prevent Morbidity in Severe Frostbite

R. Bryan Jr., MD, MBA, T. G. Walker, MD, R. L. Sheridan, MD, FACS

Massachusetts General Hospital, Boston, MA

Introduction: Severe cold exposure injuries are fairly common in the winter months. Injury severity depends on factors such as the exposure temperature, duration, and the number of freeze-thaw cycles. Tissue injury results from direct thermal damage as well as ischemic injury due to vascular thrombosis. Traditional treatment includes rewarming of involved tissues followed by prolonged surveillance for devitalized tissue, for which amputation might be necessary. Recently, the use of thrombolysis and short-term anticoagulation has been added to the treatment algorithm, with the aim of restoring arterial perfusion and reducing the delayed amputation rate. Our study adds to the body of evidence for this approach by providing angiographic documentation of the benefits of early intraarterial (IA) tPA infusion in multiple frostbite cases. Based on this experience, we propose a multi-disciplinary approach to quickly identify and optimally treat such patients.

Methods: Five patients with severe frostbite who were treated with IA tPA were included in this retrospective series that spans January 2009 to present. Patients were selected as thrombolysis candidates through initial evaluation by the ER and Burn services. All underwent digital subtraction angiography (DSA) of the affected extremity(ies) and catheter directed administration of IA tPA. The angiographic results were reviewed and correlated with the incidence of delayed amputation, persistent pain and quality of life as documented in the medical record.

Results: Five patients were treated with IA tPA after standard rewarming. In 4 of these patients, a total of 41 “at-risk” digits were followed for varying lengths of time. One of the “at-risk digits” required partial amputation. All other digits were saved. The fifth patient, deemed an outlier due to extremely lengthy cold exposure (>4 days), required amputation of both hands and feet despite tPA therapy.

Conclusions: Outcomes of traditional frostbite therapy range from complete recovery to amputation. This case series supplements growing clinical evidence that early catheter-directed IA thrombolysis may prevent morbidity and improve long-term outcomes. An algorithmic, multidisciplinary approach to these patients may ensure optimal care.

Applicability of Research to Practice: This research illustrates the angiographic findings and discusses the role of thrombolysis in managing severe frostbite, and provides long term follow up on multiple severe frostbite patients that underwent successful catheter-directed thrombolysis. The proposed algorithmic approach to such patients may allow for improved outcomes and reduced morbidity.

176. Use of an Existing Web Based Platform to Support International Remote Clinical Mentorship

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New York Presbyterian Hospital/Weill Cornell Medical Center, New York, NY; Weill Bugando University College of Health Sciences, Mwanza, United Republic of Tanzania

Introduction: Upon the founding of an African pediatric burn center, ongoing clinical mentorship by an established US burn team was felt to be key to the center’s development. However, given the distance, time difference, and often-unreliable Internet service, synchronous communication was impractical. Such barriers can prevent information exchange critical to patient care and program development. It was hypothesized that an asynchronous, secure, web based tool could be developed to support timely communication and remote clinical mentorship.

Methods: A free, web-based proprietary platform with secure multi-user access, real time communication capabilities, and large data file storage was chosen to support the creation of a clinical database for exchange of information and discussion. The 35 data points included were patient demographics, digital images, injury and outcome details, and care plans inclusive of surgical decision-making. Both teams committed to weekly document updates.

Results: At the mentored site, computers and Internet service were procured ($3687.86). Two US and one African burn team staff invested 53 hours in the development of the web-based tool. During initial 5 months of use, data were collected for all 63 patients seen at African burn center. Each patient case entry is documented on a single sheet within the larger file and allows for image upload. All data is entered within 24 hours of admission by the African burn team and includes a care plan for the hospitalization, and the burn director’s judgment about the need for surgery. Multiple users may access and enter care comments on the document simultaneously; these edits appear in real-time. Synchronous instant messaging is available for users simultaneously viewing. Clinicians at both sites review active cases to exchange comments on all aspects of care. Once the patient is discharged, the surgeons provide final commentary; staff transfers the record from the active file to the archives. The archived group remains accessible in a separate file. This proprietary platform is available to all users at no charge.

Conclusions: Established web based technology has allowed for the creation of a tool that is cost effective, easily accessible, user friendly, and well suited to support remote clinical mentorship between two burn teams thousands of miles apart. Although the initial costs of hardware procurement and personnel time devoted to customizing this software are moderate, overall savings are realized with the ease of use, efficiency, and communications support enabled by this program. Based on these findings, this technology can be considered as a template that can be modified for use in other collaborative efforts.

External Funding: ELMA Grant #F13F003.
Evaluation of Baseline Knowledge in Reference to Scald Burns in the Lviv Provence, Ukraine
(Primary Result)
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Introduction: Burn prevention has been identified by the World Health Organization as a topic of current need for further investigation and education throughout the world with increased need in low-income countries. It has been noted that implementing education programs in regards to prevention in high income countries has aided in the lowering rate of burn injuries and there is a need to adapt prevention programs for low income countries based on method of injury. The purpose of this study is to evaluate the current education level in regards to scald burns in order to understand educational needs to form an effective scald burn prevention campaign as a part of an outreach program to improve burn care in Lviv, Ukraine.

Methods: The research team designed a basic test to look at baseline level of knowledge in regards to first aid and scald prevention in parents, pregnant woman, healthcare and daycare providers. Likert type questions were designed to gather interest in further prevention knowledge. The survey was sent to 41 pediatric clinics, 17 obstetrician clinics and 509 daycare facilities to test respondents.

Results: A total of 967 surveys were returned, including 164 healthcare professionals, 743 parents and 60 daycare workers. Healthcare workers answered 9.7% of all questions correctly, parents 3.2% and daycare workers 1.6%. Questions regarding prevention were answered correctly 62%-93% of the time by healthcare providers, 32%-85% of the time by parents and 35%-85% by daycare providers. All groups most commonly misidentified the safe way to bathe a child to avoid a scald. Questions regarding first aid were answered correctly by 56%-70% of healthcare providers, 45%-70% of parents and 36%-67% by daycare providers. Once again all groups most commonly misidentified the biggest contributor to severity of a scald burn. Interest in written materials in regard to scald prevention was reported by 98% of respondents.

Conclusions: Results of this study clearly show a large gap of knowledge in prevention of scald burn injury and first aid in all populations surveyed. It also highlights a lack of knowledge regarding basic first aid and safety surrounding bathing.

Applicability of Research to Practice: Further research is needed to design and implement an appropriate scald prevention campaign culturally specific to a Ukrainian population.

External Funding: Study was funded through non-profit organization, Doctors Collaborating to Help Children.
Introduction: Observational analysis revealed a small cohort of freezing burns in youth participating in “Salt and Ice Challenge” (hereinafter SIC). SIC entails placing salt on the skin and holding an ice cube on top, testing how long a participant can withstand the pain. The addition of salt to ice lowers the freezing point of water below zero degrees Celsius and creates an endergonic reaction that draws heat from the skin to serve as the required energy source. Achieving this phase change at lower temperatures exposes the skin to subzero temperatures thus increasing its susceptibility to frostbite. Searching “salt and ice challenge” on popular media sites Google, Bing, Yahoo, and YouTube resulted in a combined total of ~31,185,000 hits and videos pertaining to the challenge. A review of clinical publications produces a single case report. Considering the dearth of clinically relevant data on this topic, we reviewed our institution’s experience with burns secondary to SIC participation.

Methods: Retrospective patient encounters due to intentional freezing burns at a regional burn center from January 1, 2012 through August 15, 2013 were reviewed. Demographics, burn characteristics, treatment, length of stay, number of operative interventions, and complications were analyzed.

Results: Four patients were seen for intentional freezing burns that resulted from SIC (all females; mean age: 12.1 years). At presentation, three patients reported that their injuries resulted from SIC. One patient was admitted for care post-suicide attempt, at which time four freezing burn wounds were identified. Although this patient endorsed previous participation in SIC, it is unclear if all burn injuries were sustained in the setting of SIC or resulted from self-injurious behavior. Mean total body surface area (TBSA) was 0.585%. Total burn sites were seven, with the most commonly burned areas being forearm (n=6) and hand (n=1). All patients received local wound care, and no patients required operative intervention or hospitalization as a result of their burns.

Conclusions: SIC has become a popular, internet-driven phenomenon among youth. The potential morbidity of intentional freezing burns is significant. Increased public education and parent awareness are essential to address this public health concern.

Applicability of Research to Practice: Intentional freezing burns can be seen in the setting of SIC, as well as self-injurious behavior by those coping with emotional pain. This research highlights the need for further inquiry about the etiology of freezing burns in youth by providers. In addition, social media’s influential effects on self-injurious behavior, as seen with SIC, warrant investigation.
181. Insurance Status and Follow-Up after Burn Injury: Barriers to Access

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Introduction: Outpatient follow-up after a burn is essential to enable patients to return to their prior functional status. This requires a multi-disciplinary team with specialized knowledge of burn injury. Our multi-disciplinary outpatient burn clinic was created to provide such care and since its initiation the average hospital length of stay (LOS) has decreased by 15.8%. Medicaid is provided as a standard plan (SP) or as state subsidized managed care plans (SSMCP). Whereas patients with SP have open access to burn follow-up care, patients with SSMCP are increasingly being denied authorization for post hospital discharge outpatient visits. This limits patient access to follow-up by healthcare providers knowledgeable about burn wound and scar management. Due to concerns about appropriate follow-up, patients that would otherwise be discharged and followed in an outpatient setting are staying in the hospital longer until no acute wound follow-up is required. This study evaluates the relationship between LOS and timely outpatient follow-up.

Methods: Data was collected on 368 pediatric patients admitted with a burn injury between January 2010 and August 2013. Determination of readiness for discharge, insurance and ability to obtain a referral for burn clinic follow-up was identified at weekly interdisciplinary rounds. A plan was determined for follow up either as an outpatient or continued inpatient hospitalization. We tracked the patient’s demographics, insurance provider, referrals obtained and barriers for a timely hospital discharge. We determined the cost of an outpatient visit and an inpatient day.

Results: Distribution of insurance providers included: 48.6% had Medicaid SP, 8.6% were privately insured, 1.6% had insurance pending or charity care and 41% of patients had some form of SSMCP. Referrals for outpatient follow-up were able to be obtained for only 18.5% of those covered with SSMCP. One hundred thirty eight patients (91.5 % of those covered with SSMCP) were routinely hospitalized longer than those with unrestricted access to follow-up care. The average cost of an outpatient visit in our burn clinic is 69% less expensive than the cost of an average inpatient hospital day.

Conclusions: To provide quality care and optimize patient outcomes, providers need to keep patients with SSMCP hospitalized longer. If patients with burn injuries had unrestricted access to burn centers, healthcare associated costs would be lessened and patient outcomes optimized.

Applicability of Research to Practice: Identifies need for improving access to outpatient follow up for burn patients.

182. The Five R’s of Burn Care

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Introduction: It is reasonable to believe that the optimal outcome for a burn injured patient is maximized when clinicians understand their role and how that contributes to the outcome. Unlike other time sensitive injury and illness diseases such as stroke, STEMI and trauma, burn injury can have a far more prolonged hospital stay with recovery, rehabilitation and restoration that could last for years. The purpose of this work is to focus on labeling stages of the timeline from the actual injury admission to follow up of for the burn injured patient. Furthermore, to propose a labeling process that aids clinicians in understanding where their contribution falls in the timeline for managing a burn injured patient. The educational process also extends to the patient and the patient’s family in conveying to them, where the patient is in regards to progress made and opportunities for improving quality of life in the days, weeks, months and years ahead.

Methods: An analysis of current texts and academic papers was conducted to identify distinct periods of care. While there was some overlap, it was important to separate those which were distinct and marked significant benchmarks in the patient’s path starting with the acute event of the burn injury.

Results: Five specific stages of care were identified following this analysis. They include: Rescue, Resuscitation, Recovery, Rehabilitation and Restoration. Where there is some overlap in certain stages, each are easy to understand and explain to patients, their families and clinicians who do not routinely manage burn injured patients. This work includes both the stages (5R’s) and their definitions.

Conclusions: It is difficult to focus on the unique aspects of any given profession when there is a wide variety of what should be considered a common vocabulary. This work identified a set of labels that are easy to explain to patients, their families, as well as those clinicians who both work and those who do not routinely work in or understand the etiology of burn care.

Applicability of Research to Practice: Burn care represents a very small subset of the acutely injured patients in the healthcare system. Identifying a set of stages that can be easily understood and discussed, is helpful for both patients and caregivers to understand and discuss where patients are on the road to recovery.

External Funding: CFDA #93.889, US Dept. of Health and Human Ser., Public Health Ser. Grant #U3RHS007563-01-03.
Introduction: Burn patients are at risk for anemia and acute kidney injury from both pathologic and iatrogenic etiologies. Serum creatinine (Scr) is a common method for measuring renal function. Interfering substances, such as hematocrit (HCT) and oxidizing compounds, impact the accuracy of whole blood creatinine (WBCr) measurements. In particular, WBCr accuracy has been shown to be inversely proportional to sample HCT. These sample interferences are eliminated in laboratory testing by centrifugation to test serum or plasma. A novel point-of-care (POC) WBCr biosensor has been developed that automatically corrects for these interfering substances. The goal of this study is to evaluate the performance of this new biosensor in burn patients at risk for anemia and in the presence of oxidizing substances such as ascorbic acid.

Methods: We evaluated an FDA approved autocorrecting POC creatinine biosensor using heparinized whole blood samples derived from 40 adult (age ≥18 years) patients with any burn size. The POC device was calibrated to the hospital laboratory analyzer. POC WBCr samples were obtained with samples for routine Scr and HCT testing. Scr served as the reference method for paired analysis. The presence of ascorbic acid therapy was also documented. The POC device tested each patient once at the time of enrollment.

Results: Mean±SD age and burn size was 35.4±10.2 years and 38.5±15.6% respectively in the study cohort. Five patients received high dose ascorbic acid therapy (50 mg/mL in 1L IV Lactated Ringers) at the time of POC WBCr testing. Mean HCT for the 40 patients was 24.8±9.8% (range: 19-55%). In patients that did not receive high dose ascorbic acid therapy, the POC device exhibited a mean bias of -0.1±0.12 mg/dL (P=0.787, n=35) and correlated with laboratory Scr results (R²=0.90, n=35). High dose ascorbic acid therapy significantly depressed POC WBCr results when compared to laboratory Scr (-1.2±0.33, P<0.001, n=5). POC WBCr performance was restored 8 hours after discontinuation of the ascorbic acid.

Conclusions: Automatic correction of interfering substances in burned patients enables POC WBCr testing to be comparable to laboratory Scr methods. HCT effects in particular did not affect POC WBCr measurements. However, high doses of ascorbic acid negatively impacted POC WBCr measurements compared to Scr. We recommend POC WBCr for routine testing, however laboratory Scr testing should be used when high dose ascorbic acid therapy is required for patient care.

Applicability of Research to Practice: Point-of-care whole blood creatinine testing provides a convenient and accurate method for monitoring renal function in severely burned patients. Healthcare providers should be aware of the limitations of these devices when used with high dose ascorbic acid therapy.
185. Using Electromagnetic Guidance for Successful Placement of Enteral Tubes by Nurses in Burn Patients

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Introduction: The burn patient requires early and significant caloric intake to facilitate wound healing, supplemented with postpyloric (PP) enteral tube feeding via Dobhoff tubes (DHT). Complications using blind placement methods may occur. Electromagnetic feeding tube (EFT) placements offer an alternative method for PP placement (PPP) and are found to be as reliable and safe as traditional methods. We sought to determine if trained nurses could safely and effectively place EFT to reduce time to initiation of feeds while avoiding complications.

Methods: A commercial EFT device for PPP was selected. Training was provided to burn center clinical nurse specialists (CNS) along with select staff nurses. Criteria for placement: patients >20% burn size determined to require PP feeds to meet caloric goals. Outcomes evaluated were: time to placement from initial order, successful and accurate placement verified by abdominal radiography (AR), complications, time to feeding initiation, time to goal feeding rate, and the percent of the caloric goal met over the first full 7 days after admission. Caloric goal was determined by the Milner equation plus a 1.2 activity factor. To evaluate EFT placement by nurses, groups of enteral nutrition patients were compared with and without EFT. AR and EFT device tracer verified PP or stomach placement. Analysis was performed using Fisher’s Exact test and Mann-Whitney test.

Results: From 19 JUL 2012 to 14 JAN 2013, of traditional DHTs placed by physicians (n=26), 34.7% were PP and 65.3% in stomach. From 17 JAN to 31 JUL 2012, 37 patients had 35 EFT devices placed by nursing staff; 78.4% were placed PP on first attempt and 21.6% were placed in stomach (PP placement, p=0.001). Complications in traditional group were clogged tube (n=3); no complications in EFT group. Time to feed in traditional group (n=8) was 46±30 hours after admission compared to 33±18 hours for EFT group (n=8) (p=NS); time to goal rate was 81±40 vs 57±35, respectively (p=NS). The traditional group (n=8) met 66±13% of kcal goal over the first 7 days after admission, the EFT group (n=8) met 77±37% of kcal goal (p=NS).

Conclusions: EFT placement by nurses for PP feeding is a safe, efficient, and cost-effective method of providing enteral nutrition for the burn patient. Safety associated with the EFT device is improved from real-time misplacement identification. Evaluation of a larger sample size is necessary to determine a difference in time to feeding/caloric goal outcomes.

Applicability of Research to Practice: Success of the EFT pilot project in the burn center has prompted adoption of this method as the primary modality for DHT PP by nursing staff. Other units in the institution no longer require AR confirmation of placement and the burn center leadership is considering this policy.

186. The Effects of Vitamin C on Point-of-Care Glucose Monitoring

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Introduction: The antioxidant ascorbic acid (Vitamin C) decreases systemic inflammation and lowers fluid requirements following thermal injury. However, vitamin C has been shown to falsely elevate point-of-care (POC) glucose measurements with devices that use electrochemical detection. Low hemoglobin values have also been shown to affect POC readings in other studies. Although basic science research demonstrates vitamin C interference, little in the way of clinical evidence exists. This case series presents comparison of POC and laboratory references glucose values in patients receiving Vitamin C in a clinical setting.

Methods: Vitamin C was administered at 66 mg/kg/hr in four patients with burns >30% TBSA. Baseline characteristics, infusion time, and hemoglobin levels were recorded. POC glucose measurements were made with a two electrode handheld device, and laboratory values were obtained using standard spectrophotometric methods. POC and laboratory glucose values drawn within the same hour were compared.

Results: All data is presented in the figures. Hb values (g/dL) are given at specified times along the bottom of the patient data plots.

Conclusions: All four patients demonstrate falsely high POC glucose values during and/or following the infusion period with discrepancies ranging from 10–200 mg/dL, which were unrelated to Hb levels at the time. The magnitude of difference varies between patients and even within each patient during the course of the infusion, and neither TBSA nor patient comorbidities appear to affect the level of interference vitamin C has on POC glucose measurements. The findings suggest an idiosyncratic reaction that cannot be predicted using mathematical equations. Patients on Vitamin C should not receive point of care testing during or immediately after the infusion.

Applicability of Research to Practice: Vitamin C is being used in burn units nationwide to reduce fluid resuscitation volumes. We draw attention to the potentially dangerous side effect of falsely elevated glucose values which could mislead providers into administering excess insulin causing hypoglycemia in already vulnerable patients.

Baseline and Burn Characteristics

<table>
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<tr>
<td>Mechanism of Injury</td>
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<td></td>
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<tr>
<td>TBSA</td>
<td>38%</td>
<td>37%</td>
<td>69%</td>
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<td>Time to Vitamin C Infusion (hours)</td>
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<tr>
<td>Total Vitamin C Infusion Time (hours)</td>
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</table>

46th Annual Meeting of the American Burn Association
187 . Use of the Internet for Medical Information: Thoughts and Perceptions of Patients and Visitors
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Introduction: The use of the internet as a source of medical information has become more popular as ease of access to the World Wide Web has continued to increase. The purpose of this study was to evaluate burn patient and family thoughts and perceptions regarding internet use for medical information and the quality of information that is available.

Methods: A 19 item survey was distributed to burn patients and families at a regional burn center. Descriptive statistics were calculated and direct comparisons done using student's t test or Chi-square.

Results: A total of 64 surveys were collected. Of these, 39% (n=24) were from patients and 61% (n=40) were from patient visitors. The majority of respondents (64%, n=42) were between the ages of 23 and 50, and 58% (n=37) were female. The majority (58%) reported high school as their highest level of education completed. Twenty eight % indicated they visit medical websites at least monthly and 42% said they looked up information related to burns on the internet for information on research (55.6%), a specific type of burn (41%), medications and treatment (52%), and for curiosity (26%). Every responder (100%) felt confident in the quality of burn-related information they found on these medical websites. Of interest, 59% agreed that doctors should encourage patients and their families to use the internet for burn information and 33% said that they are more likely to question the doctors’ diagnosis since using the internet to look up information. Also, 46% said that the information on the internet is at least as trustworthy as that provided by the doctor. In addition, 31% report they feel more up to date than the doctor regarding their condition and 67% say they trust the doctor more since looking up related information on the internet. No statistical differences were seen between patient and visitor responders.

Conclusions: The results of this study demonstrate that the majority of patients and their families consult the internet for medical information. In addition, many felt the information was of the same quality as that they received from medical professionals. This trend presents an opportunity for health care providers to provide guidelines to assist patients and their families with reliable, high quality burn information website suggestions.

Applicability of Research to Practice: Primary care providers need to be aware that patients and their families consult the internet for medical and health information and may want to consider having suggestions available concerning reliable websites. In addition, they may need to offer advice about the quality of the literature available.

188 . Skin γδ T-cells Regulate T-cell Infiltration of the Burn Wound Site
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Introduction: Burn induces an immunopathological response involving multiple immune cell types, which includes γδ T-cells. While γδ T-cells have been shown to be important in this response to burn, their role in the regulation of other immune cells at the wound site has not been clearly defined.

Methods: C57BL/6 wild type (WT) or δ TCR-/ - male mice were subjected to a major burn (25% TBSA, 3rd degree) or sham treatment (3-7/group). Skin samples from uninjured and injured skin were collected at 3 days post-injury. The skin samples were subjected to dispase and trypsin digestion to isolate single cells. These skin cells were stained with antibodies against CD3, δTCR and βTCR to analyze the γδ and αβ T-cell populations by flow cytometry.

Results: The majority of T-cells in the skin of sham mice were γδ T-cells (80-90% of the total T-cells). After burn, there was a significant increase in the total T-cells at the wound site. The infiltrating T-cells were overwhelmingly αβ T-cells, contributing to ~95% of the total wound T-cell population. While the percentage of γδ T-cells in the overall T-cell population at the injury site decreased, their absolute number remained comparable to that found in sham skin. The burn wound infiltration by αβ T-cells was γδ T-cell-dependent, since a 4-fold decrease in the infiltration of the burn site with αβ T-cells was observed in δ TCR/- mice.

Conclusions: Gamma-delta T-cells play an essential role in the regulation of the burn wound immunoinflammatory response by regulating the infiltration of the injury site by αβ T-cells.

Applicability of Research to Practice: These findings suggest that burn wound γδ T-cells may represent a novel target for therapeutic intervention to improve burn wound healing.

External Funding: NIH Grant GM079122.
The Benefits of Using a Silver Impregnated Hydrofiber Dressing on Partial-Thickness Burn Wounds at a Regional Burn Center

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Introduction: Silver impregnated hydrofiber (SIH) dressings, used on partial thickness burn wounds, have been shown to promote re-epithelialization, natural closure of the burn wound without using surgical intervention. In addition, due to this product's single application, it is more cost effective than other dressings. A study was conducted to determine whether a patient cost benefit is realized using SIH dressings.

Methods: All patients seen at a regional burn center in 2011 with length of hospital stay (LOS) <= 14 days, no surgical intervention performed, and who sustained only partial thickness burns were included. The data was then stratified based on treatment with the SIH dressing. Descriptive statistics were calculated and direct comparisons done using student's t test or Chi-square, as appropriate.

Results: In 2011, 964 patients were admitted to a regional burn center. Of the 964 admissions, 325 (34%) patients met the inclusion criteria. Of these, 52 (16%) were treated with the SIH dressing. These patients were 71% male with a mean age of 22.2 years (SD 25.1) and mean TBSA of 4.8% (SD 4.1). A total of 273 (84%) were treated with other burn wound dressings. These patients were 67% male with a mean age of 33.7 years (SD 25.2) and a mean TBSA of 3% (SD 4.4). There was no significant difference in LOS between the SIH dressing (LOS 2.9 days) and other dressings (LOS 2.8 days) cohorts. The average hospital costs of the patients that were treated with SIH was $28,011.53, while the average hospital costs of the patients meeting the same criteria but treated with other burn wound dressings was $42,498.53 (p=0.0038).

Conclusions: Silver impregnated hydrofiber dressings create an optimal healing environment by allowing burn wounds to heal faster, preventing infections with its antimicrobial properties, and lowering the total cost of care for patients with partial thickness burns.

Applicability of Research to Practice: SIH dressings provide an optimal healing environment by allowing burn wounds to heal faster, preventing infections with its antimicrobial properties, and lowering the total cost of care for patients with partial thickness burns.

The Contribution of Angiogenesis to Heterotopic Ossification after Burn

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Introduction: Previous studies have shown that normal bone development and repair requires early angiogenic signaling. However, the roles of key mediators of angiogenesis have not been fully evaluated in the pathogenesis of burn-induced heterotopic ossification (HO). We hypothesize that burn injury increases early angiogenic signaling and vessel formation resulting in heterotopic bone formation.

Methods: C57/BL6 male mice underwent Achilles tenotomy with 30% total body surface area +/- burn injury (n=4/group). HO formation was evaluated weekly (1-9 weeks) using micro-CT and at 9 weeks with nano-CT. Vascular density in the region of the HO was assessed by Microfil injection followed by micro and nano-CT. Immunohistochemistry and immunofluorescent staining with anti-CD31 and anti-HIF1A antibodies were performed to assess angiogenesis. Separately, adipose-derived mesenchymal stem cells (MSCs) were isolated after 2 hours or five days from mice +/- burn injury and cultured in osteogenic differentiation medium for 3 days. Vascular signaling was evaluated using qRT-PCR to quantify Vegfa gene transcription and Western blotting to quantify protein expression (VEGFA).

Results: Mice with Achilles’ tenotomy and burn injury developed HO with intertwined blood vessels as demonstrated by nano-CT at 9 weeks. Microfil quantification showed that mice with Achilles tenotomy and burn developed greater vascular density at HO sites than mice with Achilles tenotomy alone (n=6*p<0.05) (Fig 1). We also noted significantly more IHC staining for CD31 and HIF1A in burn mice at the site of HO. MSCs harvested from mice with burn injury had 30% total body surface area +/- burn injury (n=4/group). HO formation was evaluated weekly (1-9 weeks) using micro-CT and at 9 weeks with nano-CT. Vascular density in the region of the HO was assessed by Microfil injection followed by micro and nano-CT. Immunohistochemistry and immunofluorescent staining with anti-CD31 and anti-HIF1A antibodies were performed to assess angiogenesis. Separately, adipose-derived mesenchymal stem cells (MSCs) were isolated after 2 hours or five days from mice +/- burn injury and cultured in osteogenic differentiation medium for 3 days. Vascular signaling was evaluated using qRT-PCR to quantify Vegfa gene transcription and Western blotting to quantify protein expression (VEGFA).

Conclusions: Burn injury enhances the in vitro angiogenic capacity of MSCs and stimulates an increase in in vivo vessel formation at the Achilles tenotomy site. Increased presence of HIF-alpha and VEGF-A after a burn injury may create a permissive niche for HO to form. Further investigation of inhibitors of angiogenesis is warranted.

Applicability of Research to Practice: Localized regulation of vessel formation may serve as a viable target to treat or prevent HO in trauma and burn patients.

External Funding: NIH Grant 1R01GM098350 to SCW.
**Cold Plasma Welding System for Surgical Skin Closure: Feasibility Safety and Tensile Strength Results**

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**Introduction:** Cold plasma skin welding is a novel technology that bonds skin edges through welding without the use of synthetic materials, using a biological solder that is applied to the edges of a skin incision followed by application of cold plasma energy. The primary objective of this study was to assess the feasibility of cold plasma based welding system in approximating and fixating skin incisions. Secondary objectives were to determine the safety, effectiveness, and tensile strength in comparison to the standard of care incision closure.

**Methods:** IonMed cold plasma welding system was used on full thickness 20-80 millimeters porcine skin incisions using variable energy parameters. On the 7th postoperative day the pig was sacrificed and wound healing was compared to sutured incisions macroscopically and histologically. Safety effectiveness and tensile strength were evaluated over eight additional porcine models and profoundly longer incisions - up to 160mm at different energy parameters and compared to the standard of care incision closure at the 4th , 7th and 21st post operative days. All the incisions were evaluated for different microscopic and macroscopic parameters.

**Results:** In comparison to suture skin closure, the cold plasma welding system in specific system parameters demonstrated comparable and sometimes favorable wound healing results histopathologically as well as macroscopically. Plasma welded incisions exhibited equal appearance in terms of skin alignment and approximation, wound redness or crust. Histological assessment revealed no evidence of epidermal integrity damage, thermal damage or necrosis in all skin welded incisions. No wound healing complications were detected at all incision sites, incisions that were welded at extreme energy parameters presented 2nd degree burns. No adverse event or safety concerns were noticed along the follow-up period. Cold plasma welding presented equivalent incision tensile strength when compared with traditional metal staples.

**Conclusions:** Cold plasma welding has been shown to be feasible and in-vivo results suggest that it might provide equal if not better healing results than traditional skin incision closure methods. Using the correct parameters, thermal damage, a major side effect of previous skin soldering methods, can be avoided. Cold plasma welding appears to be safe and effective and provide equal tensile results compared to standard of care.

**Applicability of Research to Practice:** Cold plasma welding present novel and feasible technology for skin closure that might provide equal if not better alternative for the current standard of care.

**External Funding:** One of the authors is the medical advisor of IonMed company and participated in executing the trial, the other authors have no financial interest.

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**The Effect of FS1 on Th1, Th2 and Th17 Immune Cell Cytokine Profile**

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**Introduction:** Burn wound healing process is a complex multiple overlapping process that requires variety of cellular activities and signals. One of the critical phase of wound healing is inflammation phase. However, prolonged-inflammation phase due to the severity and size of the burn injury frequently lead to delay in wound closure ant that increases the probability of developing dermal fibrotic conditions such as keloid and hypertrophic scars. We have previously tested the anti-fibrogenic effect of a new small molecule named as FibroStop 1 (FS1) and showed that FS1 increases the expression of MMPs; while suppresses the production of collagen type I and III. Here, we have studied the effect of FS1 on Th1, Th2 and Th 17 immune cell cytokine profile.

**Methods:** Mouse splenocytes were treated with 100μg/ml of either FS1 for 48 hours and the expression of different cytokines related Th1 (IFN-gamma and TNF-α), Th2 (IL-4 and -5) and Th17 (IL-17) were evaluated using a real time quantitative RT-PCR (qPCR). Further, FS1 treated cells were also stained for CD4 and IL-17 positive cells were then detected and analyzed by Flow Cytometer.

**Results:** The findings of this study showed that, FS1 significantly decrease the expression of IFN-γ, TNF-α, IL-4, IL-5 as well as IL-17 at the gene level. Interestingly, FS1 markedly increased the expression of IL-10, a prominent cytokine related to Th2 subset of immune cells. Our data obtained from Flow Cytometer showed that FS1 is potent in suppressing the stimulated Th17 cells. The percentage of these cells reduced 5 fold relative to that of untreated splenocytes.

**Conclusions:** This finding suggests that FS1 might be a potential therapeutic immuno suppressive factor in controlling the burn healing related inflammation and subsequent improvement in burn healing quality.

**Applicability of Research to Practice:** The finding of this study revealed that the use of FS1 can potentially be used as an immuno-suppressive factor during the inflammation phase of burn wound healing process and that would result in a better healing quality.

**External Funding:** Canadian Institute for Health Research (CIHR).
193. Use of Indocyanine Green (ICG) Fluorescence as a Noninvasive Means to Assess Burn Wound Severity as a Guide for Surgery
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Introduction: Early accurate assessment of burn depth is essential to determine the need for surgery & facilitate patient disposition. While experts assess many burns solely clinically, some cases are indeterminate & challenge experienced surgeons. Indocyanine green (ICG) fluorescence was proposed in the 1970’s as a modality to increase the accuracy of burn assessment. However, technology was inefficient & cumbersome & thus was not used widely. The current system however is a user-friendly portable device & is used to assess perfusion of bowel anastomoses & flaps in many hospitals in the US. This study evaluates the extent & reliability of the correlation between clinical & surgical determination of burn depth, & ICG perfusion of burn wounds.

Methods: ICG imaging system was used intra-operatively to assess the perfusion of burn wounds that included superficial, deep partial & full thickness wounds. Donor sites & normal skin were assessed in the same patient, in order to allow for comparison. In addition to visual images (Fig 1), perfusion was quantified numerically & Percentage Variance from a baseline value over unburned skin determined. Photographs were taken to compare visual evaluation with quantification of perfusion using ICG.

Results: The ICG imaging system provides accurate estimation of perfusion, with donor sites & superficial partial thickness burns in the early stages of healing showing the highest perfusion. A perfusion gradient from unburned skin to full thickness burns was noted.

Conclusions: ICG has the potential to be an important adjunctive modality in burn depth assessment, since healing appears to correlate directly with perfusion in a dependable & predictable fashion. Further evaluation is necessary to determine the time frame in which the images most accurately correlate with healing, & the cost-benefit ratio of the routine use of this technology.

Applicability of Research to Practice: The ICG system is FDA approved & portable. Should further research confirm these findings, it may be used to more accurately determine the need for surgical resection of burns, & allow for earlier discharge planning.

194. First Results from Application of an Absorbable Synthetic Membrane to Superficial and Deep Second Degree Wounds
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Introduction: The care of second degree burns remains challenging because of pain during daily dressing changes and unpredictability of healing time and scarring. Temporary coverage solutions have been studied in the past (xenograft, allograft, amniotic membrane, Biobrane®, Transcyte®, Mepithel®and others), in an attempt to limit the amount of painful dressings and accelerate healing. Infection and integration into the healing wounds have been the major drawbacks and there are minimal final outcome reports. The ideal treatment of second degree burns would 1-decrease pain, 2-limit dressing changes, 3-allow assessment of healing progress, 4-prevent infection, 5-accelerate healing, 6-improve long term outcome, 7-save treatment cost. We have gathered some experience with a new dressing material that seems to fulfill 6 out of the 7 above mentioned requirements.

Methods: In 6 months we treated 17 patients with 2nd degree burns (superficial and deep) with Suprathel®, a porous synthetic copolymer membrane made of DL-lactide. It is biodegradable and creates a wound PH of 4-6 during degradation. In this physiologic skin PH environment most microorganisms do not thrive. Patients were taken to the operating room. Wound bed preparation was achieved by dermabrasion or hydrodissection or thin Weck blade excision, depending on the depth. Suprathel®was applied after hemostasis and an outer dressing of fatty gauze, bridal veil, absorptive gauze and ace wrap was applied. The outer dressing was removed on day one. The wound bed could be followed through the translucent Suprathel “and xeroform” layers. The dressing separated spontaneously after epithelialization was complete.

Results: 11 male and 6 female patients were in this series, mean age 19 years (1-59), mean burn size 8.5%TBSA (3-31). All wounds in this series healed without grafting. Time to epithelialization was 11.6 days and appeared accelerated compared to similar wounds that received daily dressing changes and wounds that were placed in biobrane® or allograft (some in the same patient). No integration into wound beds was noted. Long term outcome is available on 11 patients and it appears that repigmentation of the healed burn occurs accelerated as well. The only complication was severe itching in one adolescent patient.

Conclusions: The application of Suprathel® to second degree wounds offers a new simple option of treatment with potential for better outcomes and less pain. In this small series cost was not calculated, but considering less frequent dressing changes (materials and nursing time in- or outpatient), lessened need for pain medication and lessened infection rate it can be predicted that cost will be at least equivalent to current standard of care.
195. Heterotopic Ossification and Aging: Differential Role of NF-κB Signaling and Vasculogenesis

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Introduction: Heterotopic ossification (HO) is the development of bone in ectopic locations following burn, trauma, or musculoskeletal injury. While the incidence of these injuries increases with age, the prevalence of HO follows the opposite trend. In this study we examined differences in inflammatory signaling and vasculogenesis in the context of reactive bone formation in a mouse burn/tenotomy model. We hypothesized that old mice would have reduced vasculogenesis, activation of NF-κB signaling, and bone formation compared to young mice. Furthermore, we hypothesized that mesenchymal stem cells (MSCs) from young mice would behave more like cells from old mice in response to burn injury when treated with Sulfasalazine, a potent inhibitor of the NF-κB pathway.

Methods: Old (16-18 months) and young (6-8 weeks) C57BL/6 male mice received an Achilles tenotomy and were divided into burn (30% surface area thickness scald) and non-burn groups (N=3 per group). HO formation was assessed at 15 weeks by μCT scan. Vascularization around the tenotomy site was assessed with CD31 staining. A second set of old and young mice were used to collect adipose derived MSCs with or without burn injury. Vasculogenic and inflammatory signaling of these cells was assessed with western blot while osteogenic differentiation, with or without Sulfasalazine treatment, was assessed by alkaline phosphatase (ALP) stain and quantification.

Results: Results: Young mice showed significantly more HO development and CD31 staining at the tenotomy site in response to burn injury than old mice. Levels of VEGF protein and higher ratios of phosphorylated to unphosphorylated NF-κB in cells from young mice were seen following burn injury by western blot (N=4, p<0.05). This increase following burn injury was blunted in old mice. MSCs from young burn mice were also significantly more osteogenic than non-burn mice. Supplementation with Sulfasalazine reduced MSC osteogenesis as demonstrated by alkaline phosphatase stain and ALP quantification (p<0.05).

Conclusions: Vasculogenic capacity and inflammatory response are important factors in the development of HO following a burn injury. Reduced vasculogenesis and blunted inflammatory response in old mice contributed to decreased HO formation. Blocking vasularization or limiting inflammatory response, such as inhibiting the NF-κB pathway with Sulfasalazine, may represent promising therapies or preventative measures for HO.

Applicability of Research to Practice: HO has proven to be a clinically frustrating problem for which adequate preventative and therapeutic options do not exist. Targeting the inflammatory response following injury are potential targets for new treatments for this devastating disease.

196. Cultured Epidermis Accelerates Wound Healing in Combination with Meshed Skin Grafting

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Introduction: Cultured epidermis has been used in the treatment of burns and chronic leg ulcers. It has been reported that allogenic cultured epidermis accelerates the healing in combination with auto-skin grafts in clinical practice. However, clinical evaluation of the combination treatment is not enough and preclinical studies have not been reported because there is no established animal model of mesh skin grafting. In this study, we tried to establish the procedure of mesh skin grafting using rats and evaluate the healing process of the mesh auto-skin graft in combination with human cultured epidermis.

Methods: Human cultured epidermis was prepared using the same method of cultured epidermal auto-graft product in Japan. 6 inbred rats (F344, 8 week-old male) were prepared. A 3 x 3cm full thickness skin defect was made on the dorsum of each rat and the defect was applied with 6-fold extended meshed skin graft prepared from the resected skin. After grafting, wounds in 3 rats were covered with polyethylene films with absorbent cotton (control group). In other 3 rats, human cultured epidermis was applied on mesh skin grafts and covered with the same dressings (combination treatment group). 7 days after grafting, the 4 specimens from each rat of the horizontal axis were taken and the length of epithelium and its ratio to the original wound was estimated using hematoxylin-eosin staining sections. The area of newly formed granulation tissue was also evaluated on the section.

Results: The epithelium length in the combination treatment group was longer than that in the control group. The epithelialization rate(77.5±4.1%) in the combination treatment group was higher than that (55.1±5.7%) in the control group (p<0.01). The area of granulation tissue was 1.73±0.1mm2 in the combination treatment group and 1.16±0.1mm2 in the control group (p<0.01).

Conclusions: In this study, we performed the mesh skin grafting using rats and compared the effect of human cultured epidermis (xenograft) to the healing process. This study indicated that xenogeneic cultured epidermis could accelerate the epithelialization and granulation tissue formation. We try to use allogenic cultured epidermis of rat, but it was difficult to apply that epidermis because it was too thin to handle with forceps. In clinical practice, allogenic cultured epidermis is usually used. It is usually accepted that allogenic epidermis has the superior wound healing effect compared with xenogeneic epidermis because the former is less antigenic. Our study showed that cultured epidermis accelerated the wound healing process in combination with mesh skin grafting.
Introduction: Kaolin-impregnated gauze (KG) has been utilized as a rapid hemostatic agent, especially in the military theatre. The gauze controls bleeding by activating Factor 11 and 12 in the clotting cascade. It is applied topically as an adjunct to hemostasis, usually coupled with manual compression. Indications include local management and control of external bleeding from an open traumatic wound.

Methods: In an active regional burn center, standard operative protocols necessitate the use of gauze pads soaked with epinephrine solution combined with recombinant thrombin to promote hemostasis once tangential burn excision has been performed. Direct pressure and/or compression with elastic wraps is also utilized as well as when deemed clinically necessary, for continued “brisk” bleeding, fibrin sprays are often used. Finally, electrocautery is used for bleeding not amenable to the above mentioned methodology. In this study, patients underwent burn tangential excision and then were treated using epinephrine solution without recombinant thrombin. Next, the excised wounds had KG applied with direct pressure or compression for approximately 5 minutes. The KG was then removed, electrocautery was used, and epinephrine solution was re-applied. Observations were made intra-operatively to determine the “adequacy” of KG application.

Results: Ten patients underwent tangential burn excision and then hemostasis with the fore-mentioned protocols to include KG. All patients were male with a mean patient age of 38.7 years (range 10 - 64). TBSA excised averaged 15.4 cm² (range 2 to 45). In every patient, the use of KG and epinephrine without thrombin was not found to be as effective as using an epinephrine combined with thrombin; bleeding continued to be “brisk” when thrombin was not utilized. Even after the use of electrocautery and then another application of epinephrine along and KG, bleeding often persisted. However, when KG was used on burn wound re-excisions after the removal of allograft and xenograft, the KG was adequate at stopping the bleeding. Of note, fibrin sprays were not necessary when KG was applied. There was no exothermic reaction when using KG.

Conclusions: KG is safe and effective when used for the cessation of bleeding during burn re-excisions but is inferior to the use of epinephrine solution with thrombin for primary burn excision. Operative protocols using KG for re-excisions would be cost-savings alleviating the need for expensive thrombin solutions and the need for fibrin sprays.

Applicability of Research to Practice: Rapid cessation of bleeding is ideal in the burn operating room and KG is useful and cost-effective for burn re-excisions.
199. Corrective and Reconstructive Surgery in Patients with Post-Burn Heterotopic Ossification and Bony Ankylosis: An Evidence-Based Approach
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Introduction: Articular heterotopic ossification (HO) and bony ankylosis (BA) are devastating complications of severe burns. These conditions are often detected clinically by a decrease in range of motion (ROM). They are confirmed via imaging prior to initiation of active and/or passive ROM therapy. Surgical articular reconstruction is the standard of care for patients with significant post-burn HO/BA. This study critically reviews the literature on post-burn HO/BA and provides an evidence-based management algorithm.

Methods: A comprehensive search for all studies on post-burn HO/BA from 1957-2013 was conducted using PubMed and Google Scholar. Keywords searched included, “heterotopic ossification,” “post-burn heterotopic ossification,” “joint ankylosis,” “bony ankylosis,” “post-burn bony ankylosis.”

Results: Fifty-one studies have been published on post-burn HO/BA with incidences reported from 0.1-35.3%. Ninety percent of patients suffered from thermal burns and the mean total body surface area affected was 49 ± 14%. The mean time from burn until clinical diagnosis was shorter than the mean time until radiologic diagnosis (7 ± 11 vs. 12 ± 21 months). Seventy-nine percent of affected joints were elbows and the most common clinical manifestation was a decrease in ROM. Ninety percent of operable HO cases were treated with anatomic excision and all techniques achieved increases in ROM. Seventeen joints also received peri-operative radiotherapy. The most frequent post-operative complications were ulnar nerve dysfunction (25%) and persistent decrease in ROM (23%). Twenty-one joints had recurrent HO.

Conclusions: Surgical reconstruction is the standard of care for post-burn HO/BA that impairs joint function. Early detection and initiation of physical therapy are paramount in preventing progression to BA. All described surgical techniques achieve similar improvements in ROM yet a specific method is not yet endorsed. Although surgical results are satisfactory, patients experience some decrease in post-operative ROM and occasionally suffer from HO recurrence. Recent studies have evaluated means to discern HO maturity, as well as the efficacy of pharmaceutical and radiotherapy pre- and post-operative adjuncts aimed to decrease HO recurrence and maintain post-operative ROM.

Applicability of Research to Practice: Increased awareness and more rapid detection of post-burn HO may permit earlier discontinuation of passive ROM exercises, thereby halting HO progression. Decreased HO formation may allow for less extensive excision and less post-operative complications.

200. The Use of Suprathel in the Treatment of Pediatric Burns: Retrospective Review of First Pilot Trial in a Burn Unit in the United States
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Introduction: This presentation discusses a trial study of the use of Suprathel in pediatric patients at the Burn Center at St. Christopher’s Hospital for Children in Philadelphia. Suprathel consists of polylactide in a membrane form that adheres to the burn or donor site. It has antimicrobial properties and is pliable, allowing it to be placed in difficult to treat areas. Previous studies have demonstrated Suprathel’s safety and efficacy in both adult and pediatric patients 1, 2. This trial represents the first such study done in a burn center in the United States.

Methods: Suprathel was placed on 12 patients with both superficial and deep partial thickness burns. Non severe burns were selected in order to assess the performance of the product without multiple confounding comorbidities. The patients were all pediatric patients (ages 9 months to 12 years) with burns ranging from 1-15% TBSA. The Suprathel was covered after placement with a non-adherent layer (Xeroflo or Adaptic) and an outer cover layer. The outer dressing was changed once a week and the Suprathel and non-adherent layer left in place until healing occurred.

Results: The results of the trial study on the burn wounds only were analyzed retrospectively and the data includes length of stay, rates of healing, infection rates, satisfaction rates and pain reduction/pain medication issues. The average length of stay in the Suprathel treated patients was 1.4 days (range 1-3 days). The amount of pain medication before and after placement of Suprathel decreased from 1.5 to 0.1 doses per patient. The average pain score (1-10 scale) was 1.2 at the first office visit post placement of Suprathel on the burn wound. The burns all healed within 16 days with an average healing of 9.5 days. There were no infections seen in any of the patients. Finally, the patient/parent satisfaction on a 1-4 non-validated subjective scale averaged 3.66 (range 3-4).

Conclusions: In conclusion, the Suprathel was easy to apply and manage post application. It adhered well to the wound bed, eliminating the need for daily dressing changes and wound bed disruption. This resulted in excellent healing in both partial thickness burns and donor sites with minimal pain and anxiety during dressing changes. The dressings were able to be changed every 5-7 days, allowing for less need for nursing care and costly dressing changes. Suprathel was found to be a safe and effective treatment in burns in pediatric patients.

Applicability of Research to Practice: This retrospective review of a pilot study demonstrated a safe and effective new skin substitute previously not evaluated in the United States. The product performed well and show promise for clinical use in every day practice in our Pediatric Burn Unit.
Posterior Interosseous Artery Flap for Coverage of Dorsal Ulnar Wrist Using Previously Burned, Recently Grafted Skin

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Introduction: In the severely burned patient, coverage of exposed bone in the dorsal ulnar wrist can be a difficult problem. This is particularly challenging in patients with a high percentage total body surface area (TBSA) burn. The use of previously burned and recently grafted skin as flaps can be an option. It has been postulated previously that use of burned skin can result in higher rates of local or distant flap failures. The reverse posterior interosseous flap (PIF) is an island flap, based on the retrograde posterior interosseous artery, to provide coverage of the hand. Here we describe utilization of the PIF using previously burned skin for coverage of dorsal ulnar wrist defects.

Methods: This is a case series of three patients, with extensive burns (range 35-83% TBSA), where defects of the dorsal ulnar wrist necessitated coverage. Each patient underwent PIF(s) utilizing previously burned and grafted skin, all within three months after their initial burn event.

Results: Case 1: 28 year old male who suffered 35% TBSA via blast mechanism. Excision and grafting took place acutely. Multiple operations to the dorsal ulnar wrist were attempted including a local skin flap but failed. A chronic open wound developed over the dorsal ulnar wrist with exposed tendon. The patient successfully underwent a left PIF using previously burned skin with an uneventful postoperative stay.

Case 2: 23 year old male with 83% TBSA. Initial excision and grafting was performed, but ulnar styloids were exposed bilaterally. PIFs were performed bilaterally, using previously burned and recently grafted skin. Coverage was successful but required leech therapy postoperatively for venous congestion.

Case 3: 37 year old male with 52% TBSA, with the most severe burns to the bilateral upper extremity. Multiple debridements and grafting procedures were performed including reverse radial forearm flap using previously burned skin to cover exposed left wrist tendons. The ulnar head was exposed. The posterior interosseous artery was explored and PIF was attempted, but there was no retrograde flow in the distal artery due to deep injury. The patient ultimately underwent a pedicled abdominal flap for coverage.

Conclusions: Defects of the distal ulnar wrist after deep and extensive burns can be problematic. Use of the reverse PIF using previously burned skin, even those that has just been recently grafted is a viable option for this difficult patient population. Vigilance for post-operative venous congestion and keeping other options open are important.

Intraoperative Hemostasis and Temperature Control with Cardiac Perfusion Pumps for Burn Surgery

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Introduction: Blood loss and hypothermia are major challenges for surgical management of burn wounds. Recently, the use of bypass perfusion pumps for insufflation of the burn wound and donor sites has gained substantial favor to rapidly infuse epinephrine under the skin to control bleeding but also provide warmed fluids to reduce the frequency and severity of hypothermia. A comparison of results with this equipment was made to previous techniques to control bleeding in our patient population.

Methods: A case matched approach was employed to compare burn patients with TBSA >40% who received bypass perfusion assist at surgery with burn patients who were matched for size of injury, inhalation injury, age and date of admission but did not receive rapid insufflation with perfusion assist. Volume of blood loss and number of blood transfusions was recorded as well as the lowest intraoperative temperature and average temperature loss during surgery in 10 pairs of patients who were otherwise matched except that only one group received rapid heated insufflation fluids with the bypass pumps.

Results: In total 85 procedures using the roller pump methods were performed over a four year period. 10 pairs of patients with TBSA >40% underwent an average of 3 procedures per patient. The volume of insufflation was significantly higher in the roller pump group as compared to insufflation using tourniquet as per previous protocols (7100 vs 3000 cc / procedure p<0.05). The duration of procedure was significantly shorter in the roller pump group, (210 minutes vs 240, p<0.05) although the area debrided was not significantly different (2650 vs 2750 cm2). However, the lowest intraoperative temperature was significantly lower in the non roller pump group and the maximum temperature drop during surgery was significantly less in the roller pump group. The average blood loss per procedure and the volume of blood transfused was significantly less in the roller pump patients despite similar size of surgery and TBSA.

Conclusions: Bypass perfusion systems for burn wound insufflation allow for more rapid infusion of larger volumes of warmed fluids to reduce blood loss during burn surgery and avoid hypothermia. This technique allows for larger debridements at a single operative setting to shorten the course of burn hospitalization.

Applicability of Research to Practice: New surgical approach to reduce blood and temperature loss in burn surgery.

External Funding: Firefighters’ Burn Trust Fund.
**Affixing Skin Grafts to Burn Injuries in Pediatric Patients Using Tissue Adhesive**

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**Introduction:** Thousands of young children suffer burn-related injuries each year. Deep burns to the hands and feet are especially common, and typically treated with excision and skin graft fixation. The ideal device for securing skin grafts to burn wounds is quick, safe, accurate, flexible, non-reactive, biodegradable, and affordable. Herein, we present the technique of using tissue adhesive to affix skin grafts to the small and irregularly-shaped burn wounds of the hands and feet of pediatric patients.

**Methods:** Surgery was performed on 16 patients, who had a total of 26 deep partial- or full-thickness burns. Patients ranged in age from <1 to 14 years. Twenty-two of the 26 burns involved the hands or feet; the remaining 3 burns were on the arm, hip and buttocks. Following excision and hemostatic control, sheet or 1:1 meshed skin grafts were placed over the burn wounds. Tissue adhesive was applied between the skin graft and the normal epidermis surrounding the wound. A tie-over bolster or gauze wrap was used to secure the grafts and splints were used for immobilization. On post-op day 7, splints and dressings were removed and grafts were left open to air for continued healing.

**Results:** The outcome of skin grafting was assessed at 1 week and 4 weeks post-grafting. All 26 skin grafts were vascularized at 1 week and epithelialized at 4 weeks. In three instances, a small hematomata developed along the edge of the skin graft, rendering this small portion of the graft non-viable at 1 week. At 4 weeks, this small area had re-epithelialized and was indistinguishable from the grafted site.

**Conclusions:** This study shows that tissue adhesive is a quick, safe, and effective method for securing skin grafts to burn injuries of the hands and feet in children. While this study focuses on burns to the difficult to reach web-spaces of the hands and feet, it can be applied to any small, irregularly-shaped burn.

**Applicability of Research to Practice:** Deep burns to the hands and feet are common in young children and can have long-lasting functional consequences. Tissue adhesive represents a promising alternative for affixing skin grafts to burn wounds. Compared to staples and sutures, tissue adhesive provides superior patient comfort, improved safety, antimicrobial properties, does not require removal, and is cost-effective. Additionally, using tissue adhesive is associated with less anxiety in children, who prefer to be “glued” as opposed to “stapled” or “sewn.”

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**Which Characteristics of Burn Injury Affect Overall Burn Appearance**

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**Introduction:** Burn injury often results in significant aesthetic disfigurement. Greater understanding of the characteristics of burns that determine ultimate appearance of burned skin is important. We compared the characteristics of burns and patient demographics to overall burn appearance.

**Methods:** A prospective, observational study was conducted at a regional, suburban burn center from 2008-2013. Patients with burns who presented to the burn unit or outpatient burn clinic were enrolled in a longitudinal institutional burn registry. Standardized data collection including demographic, clinical, and burn characteristics was performed. Patients who presented for follow-up at least 30 days after injury had their burn appearance assessed by a trained burn care practitioner using an ordinal three-item Likert scale (bad, fair, good). The association between demographics and burn characteristics and overall burn appearance was analyzed with non-parametric tests and ordinal regression.

**Results:** During the study period 776 patients were enrolled in the institutional burn registry. Thirty percent of patients (n=233) followed-up, out of which 45% (n=104) presented at least 30 days post-injury. There were 58% males and their mean (SD) age was 34 (22). Forty-two percent of patients were burned at one body site; 29% had burns at two body sites. Most common burn locations were the extremities (41% upper extremities, 29% lower extremities); 18% of burns were on the trunk/genitalia, and 13% on head/face. For analysis body locations were grouped into head/face, extremities, and trunk. The most common burn depth was 2nd degree (40% deep, 20% superficial); 23% had third degree burns. Most burns were thermal (96%), including 39% scalds, 35% flame, and 20% contact; chemical and electrical burns comprised 3% and 1% respectively. Fifty-four percent of burn ratings were “good”, 37% were “fair”, and 9% were “bad”. TBSA was not associated to appearance rating. Older age and head/face burns were associated with “bad” rating, but these were not statistically significant. Burn depth was also associated with appearance rating, with “bad” ratings given to 23% of 3rd degree burns, 9% of deep 2nd degree burns, and none of superficial 2nd or 1st degree burns. This association was statistically significant on ordinal regression for multivariate analysis (p<0.001).

**Conclusions:** Burn depth was the only burn characteristic significantly associated with overall appearance of burns at least 30 days after initial injury.

**Applicability of Research to Practice:** Burn practitioners should communicate with and educate patients regarding factors that affect burn healing and appearance. This will help set reasonable expectations for both patients and practitioners.

**External Funding:** This study was supported by the SCVOL Firefighters Burn Center Fund.
Custom-Made Oral Microstomia Orthosis: A Cost-Effective Alternative for Burn Therapists
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Introduction: Oral microstomia resulting from burns is a challenging aspect of rehabilitation. Multiple orthoses available to combat this problem range from pre-fabricated orthoses to therapist made thermoplastic devices. We have developed a device that can accommodate any mouth opening due to its unique, customizable design.

Methods: The orthosis (Graphic 1) has three components: a mobile commissure component, a stationary commissure component, and a threaded screw with end cap. The mobile section is fabricated using acrylic with a threaded hole in its base. The screw has a “ball” created by removing 3 mm of threading 2-3 mm from the end of the screw. The stationary section consists of acrylic with a nut embedded in its base creating the “socket” where the “ball” of the screw is inserted (Graphic 2). When assembled, the “ball and socket” joint allows the screw to rotate freely in the stationary piece, allowing the mobile piece to traverse the screw when turned. The durable acrylic components are custom made and can be sanded down to perfectly fit each individual. In extreme cases with minimal opening of the mouth, the “ball and socket” can be disengaged and each component can be inserted into the mouth individually then reconnected.

Results: The resulting orthosis is a durable, customizable device that is inexpensive and easy to fabricate. Due to the ability to modify its thickness and apply each component into the mouth separately, it can fit patients who have mouth opening as small as .75” in diameter. Factoring in labor and materials, the total cost of the orthosis is estimated at $50, making it a cost effective option compared to prefabricated orthoses ranging from $100 to over $300.

Conclusions: This device is an attractive alternative to other microstomia orthoses due to the low cost of fabrication and its customizable, low profile design. It can be fabricated in house with minimal training and the simplicity of the design makes it easy to clean and apply.

Applicability of Research to Practice: This orthosis can be an effective tool in burn rehabilitation when incorporated into a comprehensive plan of care for the prevention or correction of oral microstomia.

FLEX Foot/Ankle Orthosis Application during the Acute Phase of Burn Rehabilitation: A Case Study
J. Piro, OTR/L, M Serghiou, OTR, MBA, C. Whitehead, PT, D. N. Herndon, MD, FACS
Shriners Hospitals for Children, Galveston, TX

Introduction: Proper positioning during the acute phase of a burn injury is crucial to optimizing functional outcomes. It is designed to prevent contractures, decrease edema and maintain range of motion (ROM). If sustained planar-flexion and inversion of the ankle occurs, it could lead to equinovarus deformities which have disastrous effects on mobility. This is particularly evident in the case of two patients who both presented with full-thickness burns circumferential to bilateral feet/ankle regions. In these cases, custom fabricated or prefabricated orthoses were too rigid which lead to poor fit and suboptimal positioning. An alternative “flexible” solution was designed for this complex problem.

Methods: The case study participants were unable to fit into a prefabricated orthosis secondary to lacking -45 degrees from neutral. The variability of dressing thickness prevented the proper fit of a custom ankle foot orthosis. The FLEX ankle/foot orthosis was fabricated from thermoplastic material and introduced in the early stages of rehabilitation. Unlike prefabricated foot orthoses which are rigid at 90 degrees/neutral, the FLEX allows for flexibility and visualization of foot/ankle to ensure proper fit/positioning. The FLEX orthotic is reinforced with a dynamic outrigger which allows for a slow stretch, and the ability to give against resistance, and flexing back to its original position without displacing the splint.

Results:

<table>
<thead>
<tr>
<th>Study participant</th>
<th>DATE</th>
<th>L Ankle Dorsiflexion Active</th>
<th>L Ankle Dorsiflexion Passive</th>
<th>R Ankle Dorsiflexion Active</th>
<th>R Ankle Dorsiflexion Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td>5/10/13</td>
<td>-45°</td>
<td>-70°</td>
<td>-30°</td>
<td>-30°</td>
</tr>
<tr>
<td>5/20/13</td>
<td>-40</td>
<td>-25</td>
<td>-30</td>
<td>-25</td>
<td></td>
</tr>
<tr>
<td>5/29/13</td>
<td>-30</td>
<td>-25</td>
<td>-18</td>
<td>-14</td>
<td></td>
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<tr>
<td>6/18/13</td>
<td>-25</td>
<td>-10</td>
<td>-16</td>
<td>-12</td>
<td></td>
</tr>
<tr>
<td>6/30/13</td>
<td>-30</td>
<td>-10</td>
<td>-16</td>
<td>-12</td>
<td></td>
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<tr>
<td>7/2/13</td>
<td>-25</td>
<td>-10</td>
<td>-16</td>
<td>-12</td>
<td></td>
</tr>
<tr>
<td>7/30/13</td>
<td>-10</td>
<td>-5</td>
<td>-10</td>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>Participant 2</td>
<td>3/14/13</td>
<td>-40</td>
<td>-43</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td>4/10/13</td>
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<td>-20</td>
<td>-60</td>
<td>-25</td>
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</tr>
<tr>
<td>4/12/13</td>
<td>-5</td>
<td>-10</td>
<td>-30</td>
<td>-25</td>
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<td>-5</td>
<td>-10</td>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>6/25/13</td>
<td>-2</td>
<td>-5</td>
<td>-10</td>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>8/6/13</td>
<td>0</td>
<td>0</td>
<td>+5</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions: The FLEX orthotic allows for a variety of ranges of position due to the flexibility and visibility of foot position, unlike a rigid prefabricated orthosis. It allows optimal positioning to be achieved while providing a sustained stretch into dorsiflexion. The FLEX has a number of crucial attributes needed during the acute phase of burn rehabilitation including the ability to stay in proper position with patient movement, allowing the unweighting of the heel, and the ability to accommodate various thickness of dressings. The use of the FLEX allows for early intervention and positive outcomes to be achieved.

Applicability of Research to Practice: The orthotic can be incorporated into the burn therapists’ daily practice when dealing with severe foot/ankle burns as one component in a progressive plan of care that potentially includes multiple orthoses and serial casting.

External Funding: Shriners grant # 84080.
207. Sustaining Quality in Burn Patients through Best Practice in Central Line Associated Bloodstream Infection (CLABSI) Prevention

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Introduction: In 2003 an unacceptable high rate of central line associated bloodstream infections (CLABSI) in the 10 bed Trauma Burn Intensive Care Unit (TBICU) was noted. Initial solutions including antibiotic coated catheters proved unsuccessful in decreasing the rate of infection. Changing our focus to a collaborative, multidisciplinary team approach based on best practice evidence was successful in accomplishing and sustaining low CLABSI rates.

Methods: Standardized preparation of the catheter insertion site with disinfectives and a line cart containing the necessary supplies was developed. Joining with the state Keystone collaborative further standardized the process of line insertion and maintenance. Best practice processes were implemented including; proper hand hygiene, use of maximal barrier precautions upon line insertion, skin preparation with chlorhexidine, optimal catheter site selection, and a daily goal sheet that reviewed line necessity. Engagement and education of front-line staff, which included nurses, patient care technicians, respiratory therapists, physicians, both attendings and residents, pharmacists, and infection control officers were performed.

Results: With these efforts a reduction in the CLABSI rate in the TBICU went from 8.3 BSIs per 1000 catheter days in 2003 to 1.0 BSIs per 1000 catheter days in 2013. This rate has remained below the CDC NHSN 25th percentile benchmark since 2006 when compared to similar burn institutions.

Conclusions: Several components are necessary to sustain quality, these include; leadership that supports change, active engagement from front-line staff which includes work from the unit based committee, charge nurses, and bedside nurses, standardized work process, and constant vigilance by leadership to hold individuals to our standards.

Applicability of Research to Practice: Adherence to the five evidence-based procedures in the central line bundle, utilization of a daily goals sheet, team training, and communication, can create a culture of safety that produces dramatic, sustained reduction in CLA-BSI rates.

<table>
<thead>
<tr>
<th>CLABSI Rates</th>
<th>Trauma Burn ICU</th>
<th>CDC NHSN Trauma ICU</th>
<th>CDC NHSN Burn ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>8.3</td>
<td>7.4</td>
<td>7.0</td>
</tr>
<tr>
<td>2004</td>
<td>5.5</td>
<td>7.4</td>
<td>7.0</td>
</tr>
<tr>
<td>2005</td>
<td>3.3</td>
<td>7.4</td>
<td>7.0</td>
</tr>
<tr>
<td>2006</td>
<td>3.3</td>
<td>4.6</td>
<td>6.8</td>
</tr>
<tr>
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<td>5.6</td>
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<tr>
<td>2008</td>
<td>1.7</td>
<td>3.6</td>
<td>5.5</td>
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<tr>
<td>2009</td>
<td>1.8</td>
<td>2.6</td>
<td>5.3</td>
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<tr>
<td>2010</td>
<td>1.5</td>
<td>1.9</td>
<td>3.5</td>
</tr>
<tr>
<td>2011</td>
<td>2.0</td>
<td>1.9</td>
<td>3.5</td>
</tr>
<tr>
<td>2012</td>
<td>2.8</td>
<td>1.6</td>
<td>3.7</td>
</tr>
<tr>
<td>2013 (through July)</td>
<td>1.0</td>
<td>1.6</td>
<td>3.7</td>
</tr>
</tbody>
</table>

208. The Care of Necrotizing Soft-Tissue Infections: Do We Continue to Evolve or Have We Become Stagnant?

M. Eggerstedt, BS, R. L. Gamelli, MD, FACS,
M. J. Mosier, MD
Loyola University Chicago Stritch School of Medicine,
Maywood, IL; Loyola University Medical Center,
Maywood, IL

Introduction: Necrotizing soft-tissue infections (NSTI) are a significant source of morbidity and mortality in modern medicine. Predictors of mortality have proven difficult to postulate due to the complex etiology of the disease process. Improved physician understanding of best-practices and referral to comprehensive burn centers may improve outcomes associated with NSTI.

Methods: A retrospective chart review was performed on 85 patients over a 6-year period who were admitted to our institution with a diagnosis of NSTI. Extent of comorbidities, time to presentation, and disease progression upon admission were noted. Once admitted, variables associated with surgical and medical management were collected, and patient outcomes were recorded. A comparison was described between patients who were admitted directly to our burn center, versus those who were transferred from community hospitals. Similarly, treatment methods and outcomes were compared to data collected in previous years at the same institution. Finally, all variables were analyzed for their prognostic value. Statistical analyses were performed using the STATA 11 (College Station, TX) software package.

Results: Multiple comorbidities were common, with obesity being the most common preexisting condition. Acute kidney injury (AKI) and multiple organ failure (MOF) upon admission were found to be predictive for increased mortality (P < 0.01). Patients who presented directly to our institution were quicker to grafting (P = 0.04) and underwent fewer total operations (P = 0.05) than transferred patients. When compared to past studies at the same institution, a higher rate of grafting was observed, with smaller grafts on average. Overall mortality was 20% and was comparable across direct admits versus transfers, and over time.

Conclusions: NSTI remains a significant source of morbidity and mortality, especially in obese patients and those with significant comorbidities. Treatment at a burn center may reduce morbidity, however associated mortality remains constant. Similarly, while hospital course and morbidity at our institution may be improved from years past, mortality has remained consistent over time.

Applicability of Research to Practice: There has been considerable debate as to whether debridement prior to transfer can improve outcomes in patients with NSTI. We have shown that physicians have taken note in that a majority of cases are being emergently debrided before transfer. Increased mortality associated with AKI and MOF underscore that disease progression is the most important predictor of clinical outcome in NSTI. Additionally, we have shown that a patient's outcome is more likely to be favorable if they present directly to a large burn center, rather than transfer from a community hospital.
209. Do Facial Burns from Smoking While on Home Oxygen Mandate Endotracheal Intubation?

A. Kimbrell, MD, J. Collins, MD, FACS

EVMS, Norfolk, VA

Introduction: Patients with chronic obstructive pulmonary disease (COPD) frequently depend on the use of home oxygen for baseline function. Unfortunately many continue to smoke, at times with oxygen still flowing through their nasal cannula. This often results in burn injury. We sought to describe our experience with patients who sustain burns while smoking on home oxygen.

Methods: A retrospective review was done of patients aged 18-89 yo admitted to our burn unit from January 2004 to August 2013 after sustaining burn injury while smoking on home oxygen. Data was collected including demographics (age and gender), total burn surface area (TBSA), need for mechanical ventilation, hospital length of stay (LOS), ICU LOS, ventilator (VLOS) and mortality.

Results: Thirty-eight patients were identified that met criteria. Male to female ratio was similar (53% vs 47%). Three patients died (7.9%) and 35 (92.1%) survived to discharge. The mean age and TBSA of the deceased were 69.3 yo and 13.3% and for survivors were 62.7 yo and 1.86% (p = 0.32 for age and p < 0.01 for TBSA). Most patients were intubated at the referring hospital and often extubated within 24 hours of admission. Mean ICU LOS and ventilator LOS of the survivors were 1.26d and 0.57d.

Conclusions: The majority of patients who sustain a burn injury while smoking on home oxygen incur very small burns that are not life threatening. Many are unnecessarily intubated at referring hospitals for concern of inhalation injury and soon extubated after admission. Those who die have larger burns and tend to be older.

Applicability of Research to Practice: Patients with small burns associated with home oxygen may be undergoing unnecessary intubation, and therefore a more judicious approach to airway management may be warranted in this population.

210. Decreases in Pulmonary Gas Exchange and Increases in Ventilatory Days, Tracheotomies, Ventilatory Pressures, and Incidence of Pneumonia are Associated with Death in Pediatric Burned Patients with Inhalation Injury

L. E. Souse, PhD, C. R. Andersen, MS, O. E. Suman, PhD, D. N. Herndon, MD, FACS, R. P. Mlcak, PhD

University of Texas Medical Branch and Shriners Hospitals for Children, Galveston, TX

Introduction: Inhalation injury continues to represent a major source of morbidity and mortality in burned patients. The aim of the present study is to study the effects of mortality on pulmonary gas exchange, number of ventilatory days and tracheotomies, ventilatory pressures, and incidence of pneumonia in pediatric burned patients with inhalation injury within one year after injury.

Methods: Inhalation injury was diagnosed by bronchoscopy in pediatric burned patients (n = 814) from 1986 to 2007. All subjects required mechanical ventilation for >24 hours. Of the 814 patients, 702 survived, while 112 patients did not survive. Significance was accepted at p < 0.05.

Results: Patients who died showed significantly lower partial pressures of oxygen (PaO2): fraction of inspired oxygen compared to burn survivors (p<0.0001) and had an 11% decrease in their lowest PaO2 (p<0.003). Patients who died also had 35% more ventilatory days compared to survivors (p<0.006), and death was associated with twice the odds of tracheotomies after burn (p<0.016). Additionally, patients who died had a 56% higher maximum positive end-expiratory pressure (p<0.0001), a 50% higher maximum peak inspiratory pressure (p<0.0001), and a 49% higher plateau pressure compared to burn survivors (p<0.0001). Patients who died also had nearly 6 times higher odds of pneumonia compared to burn survivors (p<0.0001).

Conclusions: Non-survivor pediatric burned patients with inhalation injury had significantly lower pulmonary gas exchange, ventilatory days and tracheotomies, maximum ventilatory pressures, and the incidence of pneumonia compared to survivors.

Applicability of Research to Practice: Therapeutic targets that would enable interruption of the pathogenic sequence leading to lung injury in burned patients are necessary.

External Funding: NIH P50GM060389, R01GM056687, H133A120091, T32GM8256; SHC No. 84080, 71008.
211. Cyanide Antidote for Patients with Suspected Inhalation Injuries: Is This Intervention Associated with Acute Kidney Injury?

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University of Washington and Harborview Medical Center, Seattle, WA

Introduction: Hydrogen cyanide exposure can contribute to the morbidity associated with inhalational injuries. Whereas the progression of cyanide toxicity can be prevented with early recognition and treatment, confirmation of cyanide toxicity may not always be timely. Recently, the Cyanokit, a novel treatment regimen that contains hydroxocobalamin, which detoxifies cyanide and is then secreted in urine, has been widely introduced in emergency rooms and EMS units. It has been our impression that patients who received this therapy had increased incidence of acute kidney injury. This study was conducted to assess outcomes in patients treated with the Cyanokit.

Methods: This study was an IRB approved retrospective chart review of patients, age ≥18, admitted to the Burn ICU at our institution from 2008-2012 with known or suspected inhalational injuries. A total of 190 patient hospital charts including pre-hospital records were reviewed. We identified 9 patients that received treatment with the Cyanokit. Data was collected in regards to demographics, injury data, hospital course information, and clinical values. Acute kidney injury was defined by at least a 0.3 mg/dl Cr elevation in 48 hours in those with values, and/or if only 1 value was available, Cr ≥ 1.3. This is in concordance with the AKIN staging system.

Results: Results are summarized in the Table. A significant difference was identified in both the admission Cr and the development of AKI in those patients who received the Cyanokit.

Conclusions: Although the number of patients receiving Cyanokit in our study is small there is an association between administration of Cyanokit with the development of AKI. There is insufficient data to determine whether this is causative.

Applicability of Research to Practice: Introduces a potential risk of empiric treatment with Cyanokit to patients with known or suspected inhalational injuries and suggests a need to further evaluate an association.

<table>
<thead>
<tr>
<th></th>
<th>No Cyanokit Treatment</th>
<th>Cyanokit Treatment</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>181</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Mean Age (SD)</td>
<td>48.5 (15.7)</td>
<td>49.4 (18.1)</td>
<td>0.57</td>
</tr>
<tr>
<td>% Male</td>
<td>70</td>
<td>78</td>
<td>0.60</td>
</tr>
<tr>
<td>Mean Burn Size (% TBSA)</td>
<td>28.7 (25.6)</td>
<td>25.9 (26.1)</td>
<td>0.75</td>
</tr>
<tr>
<td>% Pts with COHgb ≥ 10</td>
<td>15.1</td>
<td>33.3</td>
<td>0.15</td>
</tr>
<tr>
<td>Mean Admission Cr</td>
<td>0.9 (0.4)</td>
<td>1.2 (0.4)</td>
<td>0.08</td>
</tr>
<tr>
<td>Mean Cr 48hrs Post Injury</td>
<td>0.9 (0.4)</td>
<td>2 (1.3)</td>
<td>0.002</td>
</tr>
<tr>
<td>% Pts with AKI</td>
<td>7.8</td>
<td>44.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean ICU LOS (survivors)</td>
<td>22.3 (24.0)</td>
<td>14.8 (19.9)</td>
<td>0.45</td>
</tr>
<tr>
<td>% Mortality</td>
<td>29</td>
<td>44</td>
<td>0.29</td>
</tr>
</tbody>
</table>

212. Cardiac Response and Molecular Mechanisms of Cardiac Alterations as Related to Age following Thermal Injury

D. L. Carlson, PhD, S. E. Wolf, MD, FACS
University of Texas Southwestern Medical Center, Dallas, TX

Introduction: The pediatric and senior populations are clinically at a greater risk of developing serious complications after burn injury than otherwise healthy adults. The purpose of this experiment was to characterize and identify differences in cardiac response and gene related alterations to severe thermal trauma in different age groups.

Methods: Myocardial response following full thickness dermal burns over 40% total body surface area was determined by heart rate, and fractional shortening in pediatric (3 week old), adult (4 month old) and aged (19-28 months old) rats. All burned animals received standard fluid resuscitation. ECHO was done at 0,2,4,8,12,24 and 36h after burn. Hearts and serum were collected at 0,2,4,8,12 and 24 h after burn. Troponin I, caspase-1, 3,4,7, and 9, and inflammatory markers including HMGB1 were measured via RT-PCR and ELISA.

Results: Fractional shortening of all thermal injured rats decreased as compared to age matched controls by 24h. The most significant change was in the pediatric rat (18% drop at 12h for adult vs. 27% drop at 12h for pediatric). Both the pediatric and adult rats had recovered to baseline fractional shortening by 36h after burn, while the aged rats continued to exhibit cardiac depression at the 36h time point. To measure the inflammation associated with the cardiac depression, TNF-alpha, IL-6, IL-1B and HMGB1 were all measured from both total serum and heart tissue. All markers of inflammation, except for HMGB1 were elevated at 2h post thermal injury in all groups. No differences between the age groups were noted at early time points post -injury. HMGB1 elevation was noted by 24h post burn in both the pediatric and aged rats (692 pg/ml pediatric, 741 pg/ml aged, 356 pg/ml control).

Conclusions: Observed differences in cardiac function as well as concentration and timing of expression of inflammatory markers in different age groups of thermal injured rats suggests differing mechanisms for physiologic differences in cardiac dysfunction observed in different age groups following a severe thermal insult.

Applicability of Research to Practice: Even with the development of improved burn patient care, many problems arise specific to the age of the patient, independent of pre-existing risk factors. Defining age related changes in cardiac reaction and inflammation mediation could significantly improve patient care on an age basis.

External Funding: This work was supported by NIH, Grant 5 P50 GM21681-43.
213. Pediatric Toxic Epidermal Necrolysis: Using SCORTEN and Predictive Models to Predict Morbidity When a Focus on Mortality Is Not Enough
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Loyola University Medical Center, Maywood, IL

Introduction: Toxic epidermal necrolysis (TEN) and Stevens Johnson Syndrome (SJS) are rare exfoliative skin disorders. Due to the serious nature of SJS/TEN in pediatric patients, we chose to examine the efficacy of predictive models designed to predict mortality for their use instead as prognostic indicators of morbidity in pediatric SJS/TEN.

Methods: Over the 15-year period of October 31, 1997 to August 31, 2012, 41 patients ≤ 18 years of age were identified from our burn center repository with a diagnosis of SJS/TEN and were further reviewed in this study. Predictive models were calculated within the first 24 hours of admission and included: SCORTEN, Pediatric Index of Mortality 2 (PIM2), Pediatric Risk of Mortality III (PRISM III-24), and Abbreviated Burn Severity Index (ABSI). SCORTEN was also calculated on day 3 from admission. Correlation coefficients and 95% confidence intervals were calculated to determine the statistical significance of the predictive models for the following variables: acute hospital length of stay (LOS), days until wound closure, days of mechanical ventilation, number of infectious complications, and number of acute operative procedures.

Results: The predictive models demonstrated a significant correlation between higher scores and LOS, days until wound closure, number of infectious complications, days of mechanical ventilation, and number of acute operations. Calculated during the first 24 hours of admission, SCORTEN, PIM2, PRISM III, and ABSI all were statistically significant (p value < 0.05) when predicting our five chosen outcomes. SCORTEN on day 3 of admission was statistically significant (p value <0.05) when predicting number of infectious complications and days of mechanical ventilation, but not days until wound closure, LOS, or number of acute operations and was therefore felt to be less predictive than use of SCORTEN on admission.

Conclusions: When calculated within the first day of admission of pediatric SJS/TEN patients, SCORTEN, ABSI, PIM2 and PRISM III all significantly predict acute LOS, days until wound closure, days of mechanical ventilation, number of infectious complications and number of acute operations.

Applicability of Research to Practice: Early predictions of morbidity are helpful in discussing prognosis with the patient's family, developing a treatment plan, and assessing what resources may be required for patient care. This is the first time scoring systems have been assessed for their ability to predict expected morbidity in pediatric SJS/TEN despite its widely recognized, severe acute course of disease. Future studies should be performed to validate these results just as the use of SCORTEN has been validated for mortality.

214. Validating the Correlation Between Resuscitation Fluid Volumes and Intra-Abdominal Hypertension
J. Salinas, PhD, C. A. Fenrich, MS, J. A. Waters Jr., MD, M. L. Serio-Melvin, RN, L. C. Cancio, MD, FACS, G. C. Kramer, PhD, I. R. Driscoll, MD, K. K. Chung, MD
U.S. Army Institute of Surgical Research, JBSA Fort Sam Houston, TX; University of Texas Medical Branch, Galveston, TX

Introduction: Correlation between fluid volumes >250 ml/kg during the initial 24 hours of burn resuscitation and the onset of intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) was previously described in a small study, but to our knowledge never replicated in a larger dataset. The purpose of this study was to validate the relationship between fluid volumes, and maximum bladder pressures (BP) in the initial 24 hours and develop a model for prediction of high IAH leading to potential ACS.

Methods: We performed a review of 92 consecutive patients admitted to our burn intensive care unit from December 2007 to January 2010 who were resuscitated using a computer decision support system for burn resuscitation (BRDSS). The BRDSS provides fluid recommendations every hour after admission to maintain the patient's urinary output (UOP) in a target range of 30-50 ml/hr. Highest bladder pressures in the initial 24 hours were used for analysis. Regression modeling was used to correlate total volume of crystalloids with values for BP. A binary logistic model was used to develop a model for the probability of developing high IAH (either Grade III, BP 21-25 mmHg, or Grade IV, BP > 25 mmHg).

Results: Analysis cohort resulted in 39 patients with BP. Mean age and weight were 49±19 years and 88±19 kg respectively. Mean %TBSA was 53±21% with 27±28% full thickness. Mean BP was 14±9 mmHg with 13% (5/39) having BP > 20 mmHg. Total 24 hour resuscitations were 164±86 ml/kg and 3.35±1.88 ml/kg/%TBSA. Percentage of patients with high IAH was 13% (5/39, 2 with Grade III IAH, 3 with Grade IV IAH). There was a weak correlation between 24 hour volume (ml/kg) and BP (R2= 0.25, p<0.01) (Figure). Based on this model, a volume of at least 280 ml/kg was required to meet a Grade III or IV IAH classification (BP > 20 mmHg). Binary logistic analysis revealed 24 hour volume to be an independent predictor of IAH (p<0.05).

Conclusions: There was a weak correlation between 24 hour total volume and BP. Volume was shown to be the only independent predictor of high BP in our analysis. Linear regression showed that patients will be at risk of developing a Grade III IAH or higher when total volume reaches 280 ml/kg in the first 24 hours, however, rates of IAH were only 13% in our cohort.

Applicability of Research to Practice: Fluid management during burn resuscitation is critical to avoiding complications associated with fluid overload. IAH was seen in patients receiving volumes greater than 280 ml/kg in 24 hours.

External Funding: US Army CCC and NIH R01HL092253.
Burn Injury Alters CD8+ T Cell Profiles during Acute Cytomegalovirus Infection

B. M. Linz, BA, J. Lee, BA, D. Moore, MD, C. J. Neely, PhD, R. Maile, PhD, B. A. Cairns, MD, FACS

The University of North Carolina, Chapel Hill, NC

Introduction: Burn patients may experience cytomegalovirus infection and disease following burn injury from seroconversion from allografted skin or reactivation of latent disease. CD8+ T cells are the major mechanism of viral control and suppression. We hypothesize that thermal injury causes alterations in the CD8+ T cell populations that allows for pronounced cytomegalovirus disease.

Methods: Wild type BALB/c female mice age 6-8 weeks were infected with 1.0x10^5 PFU murine cytomegalovirus (MCMV) Smith strain. One week after infection mice underwent either a 20% TBSA full thickness contact burn or sham procedure. Kidney, liver, lungs, and salivary glands were harvested for viral enumeration through TCID50s using the mouse 3T12 cell line prior to thermal injury and 4, 7, 14, and 28 days post injury. Spleens were harvested and stimulated with the MCMV immediate early 1 (IE1) peptide or with PMA and Ionomycin. Stimulated cultures were then stained for flow cytometry against CD3, CD8, CD44, CD62L, CD69, and CD25 with intracellular stain against IFNγ. Tukey's test of multiple comparisons was used to compare absolute cell number means within each group. A p value of <0.05 was defined as significant.

Results: In our model, MCMV-infected mice showed alterations in viral kinetics following burn injury, with greater viral loads at 4, 7, 14, and 28 days post thermal injury in sites of viral infectivity: kidney, liver, lungs, and salivary glands. At these time points alterations in total numbers of CD8+ T cells were seen in the spleen. Additionally, the total number of CD8+ T cells to MCMV was greatly diminished as seen by the stimulation index from IE1 stimulated splenocytes.

Conclusions: A thermal injury during an acute MCMV infection shows that burn diminishes the ability of the mice to respond and control a viral infection. Sham infected mice were sufficiently able to control and induce latency during the course of the infection while burned mice showed increased and delayed viral kinetics and did not show signs of latency during the observed time points. Additional studies are needed to determine the ability of a latent MCMV to be reactivated following a burn injury.

Applicability of Research to Practice: These data show that CD8+ T cell population changes following burn allow for significant viral replication. This study could be applied to allograft serotesting and therapeutics that induce appropriate viral control.

External Funding: Supported in part by National Institutes of Health Grants: R01 GM076250-01A2 and U19 AI067798.
217. Advanced Development of a Human Skin Substitute for Severe Burns

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Introduction: Stratatech has developed an off-the-shelf, allogeneic, full-thickness human skin substitute as an alternative to autografting of severe burns. The tissue is currently produced as a circular 44cm² graft, comprising a stratified epidermal layer grown on a dermal equivalent (DE) composed of human dermal fibroblasts (NHDFs) in a non-bovine collagen gel. Advanced development work is focused on maintaining the quality and performance characteristics of the tissues, while addressing important practical aspects related to manufacturing and patient care. The objective of this study was to simplify production and enhance product utility by incorporating two process changes: 1) create a DE composed entirely of NHDFs and their secreted extracellular matrix (ECM), replacing the exogenous collagen, and 2) generate tissues in a larger, rectangular format expediting clinical graft placement.

Methods: Tissue geometry is defined by the culture insert that holds the maturing tissue during production. Rectangular 100cm² tissues were generated using custom rectangular plasticware. NHDFs were seeded into rectangular culture inserts and allowed to secrete and assemble ECM components into a cohesive DE. NIKS keratinocytes were seeded onto DE surfaces and allowed to grow to confluence. Tissues were then cultured at the media/air interface to promote formation of a fully-stratified epidermal layer. At the end of production, mature tissues were cryopreserved using established protocols. Enhanced-format skin substitute tissues were analyzed both before and following cryopreservation for lot-release criteria including histology, viability, barrier function, and growth factor secretion. Properties of enhanced-format tissues were compared to the current format.

Results: Experiments demonstrated that skin substitute tissues can be generated in a rectangular 100cm² format without the use of exogenous animal collagen. These tissues displayed comparable properties to the current tissue format and maintained normal viability and structural characteristics during cryopreservation and storage at -70°C.

Conclusions: Early results suggest that skin substitute tissues can be produced with enhanced tissue composition and geometry without compromising tissue properties.

Applicability of Research to Practice: The proposed process enhancements focus directly on issues related to patient care. The larger, rectangular format improves the ease and efficiency of grafting, by reducing the number of required tissues and enabling side-by-side tissue placement. Elimination of exogenous collagen from the DE layer removes an animal-derived tissue component, resulting in a final product composed entirely of human cells and extracellular matrix components.

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218. Monitoring Neutrophil-Expressed Cell Surface ECRG4 following Severe Burn Injury

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Introduction: Severe burn injury can elicit an overwhelming inflammatory response which can result in multiple organ failure. Proteins that are present on circulating leukocytes monitor tissue homeostasis and gauge inflammation signaling. We identified Esophageal Cancer Related Gene-4 (ECRG4) as a candidate sentinel factor that resides on the surface of quiescent polymorphonuclear cells (PMNs) and respond to injury by shedding ECRG4 protein from the cell surface. We therefore hypothesized that measuring ECRG4 expression on the surface of PMNs could be used to monitor patient recovery after severe burn injury.

Methods: Prospective observational study was performed at a burn intensive care unit at an academic Level I trauma center. Patients with greater than 10% total body surface area burn were enrolled (n=30) and blood was collected at the time of admission and weekly thereafter until discharge. For comparison, blood was obtained from a control group comprised of healthy volunteers (n=16). Using flow cytometry, we quantified the levels of cell surface ECRG4 on CD16+ PMNs in a longitudinal analysis for each patient. We then mined public genomic databases to determine whether changes in cell surface ECRG4 mirrored gene expression.

Results: As expected, ECRG4 was detected on the PMN surface of cells collected from healthy volunteers. However, within two weeks of admission for severe burn injury, the number of PMNs with latent, membrane-anchored ECRG4 was significantly decreased. This cell number was re-established over the course of patient recovery, unless complications arose. In this case, the decrease in cell surface ECRG4+ PMNs preceded the clinical diagnosis of infectious complications and was reflected by increased organ injury scores.

Conclusions: This initial report suggests a possible prognostic value to analyzing cell surface ECRG4 on PMNs after burn injury.

Applicability of Research to Practice: Identifies the potential use of cell surface expression of ECRG4 as a predictive biomarker for recovery or clinical complications in patients following burn injury.

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219 . Effect of Burn Injury on Cardiac β-adrenergic Receptor Signaling in a Rat Burn Model

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Introduction: One of the characteristic alterations that occur following severe burn trauma is the induction of a catecholamine surge, which has been associated with increased myocardial contraction as well as myocardial necrosis. These effects of the catecholamine surge are primarily mediated by the β-adrenergic receptors (β-AR). Over-activation of β-ARs in other disease states such as heart failure causes an upheaval in the receptor signaling pathway including reduction in functional receptors, altered protein kinase A substrate phosphorylation and activation of apoptotic signaling pathways. We hypothesize that burn trauma will induce similar changes.

Methods: We used an established rat model of 60% total body surface area burn. Following burn injury, animals were sacrificed and hearts were excised and the left ventricle isolated at the following time points: 24 hrs, 2 days and 7 days post-burn. Left ventricular homogenates were used to examine β-AR expression and the expression and phosphorylation of downstream proteins via Western Blot. cAMP production was determined in membrane fractions using an enzyme immunoassay kit.

Results: We observed that β2-AR protein expression levels were similar between burned and non-burned hearts at all time points. However, β1-AR expression levels were significantly increased 24 hrs post-burn but returned to control levels by 7 days post-burn. Conversely, both basal and isoproterenol stimulated cAMP production was initially decreased at 24 hrs post-burn but was significantly increased at 2 days post-burn. By 7 days post-burn, cAMP production was again significantly decreased. Despite the alterations in β-AR protein expression and cAMP production, expression levels of downstream proteins phospholamban and sarcoplasmic reticulum Ca2+-ATPase remained unchanged.

Conclusions: These data indicate that burn injury has significant effects on cardiac β-adrenergic receptor signaling. Additionally, our data indicates that these alterations are spatio-temporal dependent.

Applicability of Research to Practice: Burn induced cardiac dysfunction has been well documented but is not clearly understood. Understanding when and how the signaling pathways are altered may provide insight to the appropriate method of treatment.

External Funding: This study was supported by grants from the National Institutes of Health (P50-GM60338, KL2RR029875, UL1RR029876) and Shriners Hospital for Children (80100, 71001).

220 . Recruitment of Pulmonary Neutrophils after Cutaneous Burn Injury Does Not Require Caspase1

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Introduction: Pulmonary inflammation is observed in both humans and mice after cutaneous burn injury and is characterized by an abundance of neutrophils. We have shown that neutrophil accumulation in mice is biphasic, occurring early and late after burn. Although complement activation has been implicated in pulmonary neutrophil accumulation early after burn, no mechanism has been established for late accumulation. We hypothesized that caspase activation, which results in massive secretion of IL-1β and induction of apoptosis, contributes to the degree and phenotype of neutrophil accumulation late after burn.

Methods: Female C57B/6 and C57B/6Casp1-/- mice were anesthetized with isoflurane, shaved, and given a subcutaneous injection of morphine sulphate for pain control. Mice underwent four ten second exposures to a copper rod heated to 100° C in a water bath, resulting in a full-thickness 20% total body surface area burn. Single cell suspensions from lung and spleen were analyzed by flow cytometry and reactive oxygen species (ROS) production was measured by dihydrorhodamine conversion.

Results: Although there were trends toward increased pulmonary neutrophil recruitment in caspase1-/- mice, there was no statistical difference in neutrophil numbers at either 12 hours or 7 days after burn. The phenotype of pulmonary neutrophils, as determined by ROS production, was also not affected in the absence of caspase1.

Conclusions: Caspase1 activation and consequent cytokine secretion and apoptosis induction are not required for neutrophil accumulation or ROS production early or late after burn. It is possible that IL-1β cleaved by neutrophil elastase may be relevant for late recruitment or that entirely distinct inflammatory pathways are necessary or sufficient for pulmonary inflammation after cutaneous burn.

Applicability of Research to Practice: Pulmonary inflammation that occurs after burn injury, with or without inhalation injury, contributes to acute lung injury; yet, it does not appear to render patients competent to fight infection. Therefore, the mechanisms that drive neutrophil accumulation in the lung after burn injury in the absence of infection are relevant to the development of treatments for acute lung injury.

External Funding: This work is supported by the NIH.
Scald Burn Injury Induces Lipid Peroxidation in Airway Epithelium

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Introduction: The primary function of airway epithelium is in maintaining a sterile lung environment. Although respiratory tract infections and pneumonia are major causes of morbidity and mortality in burn victims, limited study has focused to the effects of burn injury on airway epithelium. In previous studies, we have shown in a rat model of scald burn injury, that airway epithelial gene expression changes are evident 24 hours after burn injury. The aim of this study is to assess the effects of burn injury on airway epithelial injury as measured by the degree of lipid peroxidation.

Methods: Sprague Dawley rats received either a standardized 60% total body surface area (TBSA) burn injury, followed with a standardized resuscitation protocol (n=5), or a sham injury (n=5). Twenty four hours after injury, the animals were humanely sacrificed and their trachea’s removed. Tracheal epithelium was collected following passage of a protein lysis solution through the tracheal lumen. Histological assessment of trachea tissue confirmed predominant epithelial isolation without disruption of mucosal connective tissue. For each sample, malondialdehyde (MDA), a measure of lipid peroxidation and cell injury, was measured using a standardized spectrometric protocol. A Mann-Whitney rank sum statistical test was used to determine significant changes in mean levels of MDA between the study groups.

Results: Mean levels of MDA (nMol/ml) were 1.6 ± 0.1 in the burn animals compared to 0.9 ± 0.3 in the sham treated animals. The mean level of MDA in burned rats was statistically different from the sham group, p=0.008.

Conclusions: Burn injury increases the degree of lipid peroxidation in airway epithelium. The disruption of airway epithelial homeostasis with burn trauma may significantly alter the ability of these cells to maintain their primary function of innate defense. Future studies are needed to identify specific areas of airway innate defense compromise with burn injury. With this knowledge, new therapies can be developed to enhance pathogen clearance during the extended critical care needs of burn victims.

Applicability of Research to Practice: Improved understanding of how burn injury may compromise functional properties of the airway epithelium can help identify patients at increased risk of respiratory tract infections and pneumonia.

External Funding: Shriners grants #87420, 84060.

Innate Immune Cell Influx to the Alveolar Space after Infection Correlates with Increased Pathogen Clearance following Burn Injury

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Introduction: In both humans and mice, abundant recruitment of neutrophils to the pulmonary vasculature occurs following cutaneous burn, even in the absence of inhalational injury. Despite elevated neutrophil numbers, patients and mice remain susceptible to pulmonary infections with Pseudomonas aeruginosa, a pathogen that is cleared by neutrophils in healthy individuals. Our data shows that neutrophils are more likely to enter the alveolar space in response to infection late after burn, correlating with increased pathogen clearance.

Methods: Female, 10-week-old C57B/6 mice were anesthetized and shaved before undergoing four, ten second exposures with a copper rod heated to 100°C in a water bath, resulting in a full-thickness 20% total body surface area burn. Mice were inoculated intra-tracheally with P. aeruginosa using a MicroSprayer® Aerosolizer Model 1A-1C and FMJ-250 High-Pressure Syringe (Penn Century, Inc. Wyndmoor, PA). Single cell suspensions from lung, bone marrow, and spleen were analyzed by flow cytometry and reactive oxygen species production was measured by dihydroethidium conversion.

Results: While the quantity of innate immune cell populations, especially neutrophils, is elevated in burned mice compared to sham, the presence of pulmonary infection causes influx of innate populations to the lungs of sham mice. Despite similar innate immune profiles between burn and sham mice in the presence of infection, burned mice show deficient clearance of P. aeruginosa early after burn but enhanced clearance late after burn.

Conclusions: We observed that improved pathogen clearance correlates with an influx of neutrophils to the alveolar space. Our observations suggest that deficits in pulmonary pathogen clearance in burned mice is likely due to functional differences inherent in immune pathology following burn injury rather than faulty recruitment.

Applicability of Research to Practice: We hypothesize that neutrophils in the lung after burn do not control pathogens but promote tissue damage. We believe that this may be due to their localization in the vasculature rather than in the alveolar space. If this is true, then further work on this project might suggest the implementation of therapeutics for promoting migration of neutrophils to the alveolar space.

External Funding: This work is supported by the NIH.
223 . Characterization of Early Changes in Limb Compartment Pressure Following Electrical Contact Injury

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Introduction: Electrical injuries constitute a considerable portion of burn center admissions. A consequence of electrical injury can be compartment syndrome, which in severe cases may result in amputation and limb loss. Although the clinical diagnosis of compartment syndrome has been well studied the early development of increased compartment pressures is not completely understood. This study investigates and characterizes the development of early increases in compartment pressures through quantification of limb size and pressure following high voltage injury in an animal model.

Methods: Male Sprague Dawley rats were subjected to either sham (0V) or (1000V) DC current for 20 seconds. Compartment pressure was examined by limb circumference, and a compartment pressure measurement system (CPMS) was used to invasively monitor intra-compartmental pressure changes. Systemic fluid shift was controlled for by comparison to sham animals and blood pressure was measured via a carotid artery cannula. Additionally plasma was collected for measurement of inflammatory cytokines and creatine kinase and myoglobin.

Results: Increased compartment pressure was examined in the electrically contacted limb shortly following injury. Average limb circumference increased 2.5mm (3.99%) in the control limb and 9.8mm (15.69%) in the injured limb. Injured limb compartment pressure increased 4.5x that of control immediately following injury and further increased to 6x over three consecutive hours.

Conclusions: High voltage electrical injury induces increased compartment pressure rapidly in contacted limbs and increases pressure in un-injured limbs as well. Following a period of rapid inflammation, the injured limb then more slowly increases pressure and size over the post-injury period. These observations suggest that there may be pathways involved in compartmental pressure regulation and control during this period and points to potential compartment pressure progression biomarkers.

Applicability of Research to Practice: Better understanding of electrical injury induced compartment syndrome may allow for better treatment guidelines and improved limb salvage therapies.

External Funding: DC Firefighters Burn Foundation.

224 . Transesophageal Echocardiography for Monitoring Resuscitation during Burn Surgery: A Retrospective Review

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Introduction: Transesophageal echocardiography (TEE) is a widely used, minimally invasive monitoring tool capable of providing the anesthesiologist with information on global and regional cardiac and valvular function, and cardiac loading conditions. Though it is well known that TEE can provide critical hemodynamic parameters assessing preload and contractility, its role in guiding resuscitation is still being defined. A recent systematic review of the utilization of TEE in burn patients (Maybauer, Burns 2013) found only 11 publications. The summary of findings from these studies is that burn patients commonly suffer from transient impaired left ventricular systolic and diastolic function, as well as hypovolemia. As surgical excision and grafting is a period of great hemodynamic instability and ongoing blood loss, basic TEE as a tool to guide resuscitation in the burn operating room has immense practical utility.

Methods: We retrospectively evaluated all instances of TEE use in the burn OR from Dec 2010 - Dec 2011. Results are descriptive only for those cases where a TEE was used during resuscitation.

Results: Twenty-seven exams were performed. One report description lacked sufficient detail for analysis. Twenty-two (84.6%) of the patients had major burns (TBSA >25%), 9 (34.6%) were in shock at the time of exam, and 11 (42.3%) had risk factors for cardiac disease. The most common findings were hypovolemia (17, 65.4%), depressed global cardiac function (8, 30.8%), and diastolic dysfunction (5, 19.2%). The majority of exams caused the anesthesiologist to modify the resuscitation strategy based on findings of the TEE (15, 57.7%). Although there were no reported complications of the TEE procedures, 15 patients (57.7%) died of wounds during the initial hospitalization. Of those who died, 93% required post-operative vasopressor infusions. Alternately, post-operative vasopressor infusion was associated with a 78% mortality rate.

Conclusions: TEE is a useful tool in the burn OR as an additional monitor to guide resuscitation strategy during persistent hypotension, and is associated with very low risk to the patient. In this cohort, post-operative vasopressor infusions were associated with a 78% mortality rate.

Applicability of Research to Practice: For major burn and other soft tissue surgery, TEE is a safe and useful tool to guide resuscitation. A persistent hypotension flowchart has been created to guide use of information obtained during a basic TEE exam.
Treatment with Propranolol Limits Blood Loss during Surgery in Severely Burned Adults

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Introduction: Propranolol, a non-selective β-blocker, has been shown to suppress the hypermetabolic response to burn. By inhibiting the sympathetic nervous system, propranolol exhibits an indirect effect on the vasculature, resulting in peripheral vasoconstriction. The purpose of this study was to investigate perioperative effects of propranolol in severely burned adults.

Methods: A total of 42 patients with ≥30% Total Body Surface Area burns were enrolled in this IRB-approved study. Adults were randomized to receive standard burn care (control, n=21), or standard burn care plus propranolol (n=21). Propranolol was administered shortly after burn injury (median=2.0 days post burn) to decrease heart rate by approximately 20% from basal levels. Data between the first admission and first discharge was collected and statistical analysis was performed by unpaired Student’s T test, Fisher’s exact test, and ANCOVA methodologies. Significance was accepted when P<0.05.

Results: Demographics, burn size, and mortality were similar in both groups. Patients in the treatment group were given a median dose of 0.54 mg/kg of propranolol. The number of days in-between grafting procedures was found to be fewer in the propranolol group (8.6 ± 8.9 days) compared to control patients (14.4 ± 22.5 days; P=0.07), trending toward faster healing times in the treatment group. Patients on propranolol required less packed red blood cell infusion (1400 ± 1225 ml) compared to control (1778 ± 1885 ml; P=NS). Despite requirement for larger grafts, patients on propranolol were able to significantly maintain an equilibrium between pre and post-operative hematocrit levels compared to control (propranolol 95% C.I. [-2.4, 3.4], control 95% C.I. [-3.8, -1.0] P=0.03).

Conclusions: The current data demonstrates diminished blood loss during surgery in severely burned patients on propranolol. Whether propranolol safely attenuates the hyperdynamic and hypermetabolic response as measured by clinical outcomes remains yet to be determined in adults.

Applicability of Research to Practice: This study has provided clinical insight to the effects of propranolol on the vascular system in burn patients. As burn patients undergo serial skin grafting procedures, minimizing blood loss during these procedures is beneficial. Propranolol’s antiangiogenic effects and ability to induce peripheral vasoconstriction may influence wound healing. Whether or not these changes attenuate wound scar formation warrants further investigation.

External Funding: This study was supported by grants from the National Institute for Disabilities and Rehabilitation Research (H133A070026 H133A70019, KL2RR029875, UL1RR029876); The National Institutes of Health (P50-GM60338, R01-GM56687, and T32-GM8256); and Shriners Hospitals for Children (84080).

Impact of ARDS and AKI in Burns

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Introduction: To assess the mortality rate in burn patients with both ARDS and AKI.

Methods: We conducted a retrospective chart review of consecutive patients with burns who were admitted to our burn intensive care unit (BICU) and required mechanical ventilation from January 1, 2003 to December 31, 2011. We identified all patients suffering from ARDS based on the new Berlin definition as well as all patients with acute kidney injury in accordance with the Acute Kidney Injury Network (AKIN) criteria. Multivariate logistic regression analyses were performed to determine the independent and combined association of AKI and ARDS with mortality.

Results: 2071 patients were admitted to the BICU during the study period, of which 890(43%) required mechanical ventilation (MV). Of these 890 patients requiring MV, 48(5%) patients were categorized as mild ARDS, 193(22%) as moderate ARDS and 67(7.0%) of patients as severe ARDS. 495(56%) of these patients had acute kidney injury (AKI) as defined by the AKIN criteria. Of those patients with AKI, 252 were defined as Stage 1, 55 as Stage 2 and 60 as Stage 3. ARDS alone (without AKI) was not independently associated with death [OR 2.0 (95% CI 0.5-7.5, P=0.3)] while AKI alone (without ARDS) was [OR 2.5 (95% CI 1.1-5.5, P=0.025]). The combination of ARDS and AKI increased the odds of death by more than 7 fold (OR 7.5 (95% CI 3.4-16.3, P<0.0001)).

Conclusions: In burn patients requiring mechanical ventilation, AKI alone appears to have a greater impact on mortality than ARDS alone. The combination of ARDS and AKI dramatically increases the odds of death.

Applicability of Research to Practice: Establishing the impact of various organ failures independently as well as in combination is important in helping clinicians determine prognoses and establish directed interventions.
227. **Intravenous Tranexamic Acid Use in Burn Patients Undergoing Burn Wound Surgery: A Retrospective Review**

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**Introduction:** Burn wound surgery is associated with major blood loss which may be increased with delayed burn wound debridement. To minimize the risk of adverse outcomes associated with blood product administration, restrictive transfusion protocols and other measures are employed during surgery. Tranexamic acid (TA) is an antifibrinolytic agent that has been shown to reduce blood loss associated with trauma, orthopedic, cardiac, obstetrics, and liver surgical procedures.

**Methods:** This retrospective case series identified surgical procedures in which IV tranexamic acid was administered during burn wound excision and allograft or autograft placement. Demographic and clinical data including %TBSA, amount excised, type of surgery, blood products and fluids received intra (IO)/postoperatively (PO) were collected. Results are presented as mean ± SD and percentages.

**Results:** Fifteen surgical procedures involving nine patients were identified. Mean %TBSA of patients was 36 ± 18% and patient ages ranged from 11 months to 82 years of age with a mean age of 32.9 ± 21.4 years. Surgical procedures included burn wound excision with placement of autograft (n=8), allograft (n=4), auto and allograft (n=2), and burn wound excision only (n=1). The dosing regimen of TA varied, in 13 procedures a bolus dose (mean dose of 12.3 ± 3.9 mg/kg) was administered and in 11 procedures an IO continuous infusion was utilized. The average transfusion rate in procedures occurring within 2 to 16 days of injury was 0.64 ± 0.85 mL PRBC/cm² (packed red blood cells) while those occurring beyond 16 days was 0.44 ± 0.09 mL PRBC/cm². In 11 procedures (73%) IO fresh frozen plasma (FFP) was administered (4.8 ± 5.3 units). In only 2 procedures was cryoprecipitate administered and 3 procedures were associated with PO PRBC administration. One patient who was on aspirin therapy prior to surgery and did not receive continuous infusion of TA received 21 units PRBCs, 19 units of FFP, 4 units of platelets, and cryoprecipitate IO with an additional 2 units of PRBCs and 1 unit of platelets PO. No patients had an in-hospital seizure or embolic event.

**Conclusions:** In comparing data to previous reports, TA administration was associated with a 15% reduction in transfusion requirements in procedures occurring within 16 days of injury. When controlling for outliers, reductions in transfusion were even more significant (48%). These cases demonstrate the use of TA in burn patients may be an effective adjunct to reduce blood loss during burn wound surgery. Further research is warranted.

**Applicability of Research to Practice:** Determining the impact of tranexamic acid use on blood loss may lead to significant clinical changes in intraoperative management of bleeding in burn injury patients.

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228. **Standard Dosing of Enoxaparin Is Not Sufficient for Burn Patients**

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**Introduction:** The prevention of deep vein thrombosis in burn patients remains a challenge. Use of fractionated heparins for DVT prophylaxis and therapeutics is based upon standard dosing recommendations. Quantification to achieving stated goals for prophylaxis and therapeutic dosing is not well established. We performed a study to look at the ability to use standard dosing to achieve predetermined anticoagulation endpoints.

**Methods:** This was a prospective study to measure anti Xa levels in burn patients receiving enoxaparin. Patients with TBSA > 15% were entered. A standard dosing of 30 mg Bid was given for prophylactic dosing and 1 mg per kg Bid for therapeutic. Anti X a levels were measured at 4 hours post the 4th dose. Goals for prophylactic dosing were 0.2-0.49 IU and for therapeutic was 0.5-1.0 IU. Physiologic and anthropomorphic measurements were recorded.

**Results:** 103 patients were in the pilot study. There were 67 patients receiving prophylactic dosing and 33 receiving therapeutic dosing. 38% were sub therapeutic while in the prophylactic group 38% were below goal and 4% were above goal. There were no statistically significant between the physiologic or anthropomorphic measurements in the therapeutic group, but trends were noted in the prophylactic group. Steady state levels were achieved after checking 3 anti Xa levels (each 4 doses apart) in > 90% of the patients. There were 8 DVTs noted with 3 occurring with prophylactic dosing yielding anti Xa levels between 0.1-0.2.

**Conclusions:** Standard dosing for either prophylactic or therapeutic endpoints in not a reliable method to achieve anticoagulation goals. Anti Xa levels less than 0.2 may not confer DVT prophylaxis in burn patients. Frequent monitoring of the anti Xa levels is recommended for burn patients.

**Applicability of Research to Practice:** Better anticoagulation levels can be achieved for DVT prophylaxis or therapeutics by measuring anti Xa levels in burn patients.
The Potential Impact of Wrong TBSA Estimations on Fluid Resuscitation in Patients Suffering from Burns: Things We Should Keep in Mind
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Introduction: Accurate estimation of burn size is of critical importance, as it is incorporated in every resuscitation formula. The aim of this study was to investigate total burn surface area (TBSA) accuracy among burn specialists, evaluate the potential impact of incorrect evaluation on variations of resultant fluid resuscitation volumes and to discuss more objective assessments of body surface area estimations.

Methods: In a poll during two international burn meetings in 2010 and 2011 demonstrating three pictures of patients with different burn wound patterns and sizes we asked participants to estimate the total surface area burned in percentages. We then calculated resultant fluid volume differences based on established resuscitation formulas showing the results as difference (DIF) of maximum (MAX) minus minimum (MIN) assessments.

Results: In the polled 80 participants, the estimations for three patients demonstrated the following differences (DIF-MAX-MIN): for patient 1. 2 and 3 they were 22.5 (25-2.5), 16.5 (20-3.5) and 31.5 (40-8.5) %TBSA, respectively. Based on these differences we calculated the volume differences for patients 1,2 and 3, which were 1080mL (Cincinnati Formula), 5280mL (Parkland Formula) and 2016mL (Cincinnati Formula), respectively.

Conclusions: The analysis showed high deviations of total body surface area among participants, also resulting in large variations of initial fluid resuscitation volumes. One option to address estimation variances is to perform more accurate assessments; also incorporating new technologies aiding to improve the quality of body surface estimations and related decisions.

Applicability of Research to Practice: There is a need for more objective burn size evaluation techniques.

External Funding: ABUSG: Austrian Burn Care, Research and Prevention Study Group.

Partition Analysis of Concomitant Risk Factors in Mechanically Ventilated Burn Patients
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Introduction: Characterizing the interrelationship of concomitant risk factors for death after burns may help clinical researchers identify opportunities for reducing mortality. We performed a Partition Analysis (PA) on an existing retrospectively collected dataset to describe the relationship between various risk factors and death.

Methods: A retrospective chart review included all patients with burns who were admitted to our burn intensive care unit (BICU) and required mechanical ventilation from January 1, 2003 to December 31, 2011. Assymetrical PA was then used to discriminate likelihood of death using Age, TBSA Inhalation Injury, pneumonia, moderate to severe kidney injury (AKIN criteria) and moderate to severe ARDS (Berlin criteria). Partition nodes were terminated if the node was not statistically significant or if it had a sample size of 20 or less. They were also terminated if the mortality rate fell below 5% or above 95%.

Results: 2071 patients were admitted to the BICU during the study period, of which 891 required mechanical ventilation (MV). The overall mortality rate for this cohort was 24%. Based on the log-worth statistic generated by the partition analysis, the primary predictor of mortality was TBSA, TBSA ≤ 50% had a mortality rate of 14% vs. 61% for those with TBSA >50% (p < 0.001). For the larger burns, the secondary predictor of mortality was age. Mortality was 85% for those with TBSA >50% and aged ≥40 years, but was only 46% for those aged < 40 (p < 0.001). For those with TBSA ≤ 50%, AKIN ≥ 2 was the secondary predictor. Those with small burns and AKIN < 2 had 8% mortality while mortality among those with AKIN ≥ 2 was more than 4 times as great (35% mortality p < 0.001). However, even those with TBSA <50% and AKIN<2, who were aged >40, with moderate to severe ARDS and pneumonia had a 78% mortality rate.

Conclusions: PA identified a more complex and nuanced set of factors associated with mortality in burned patients. This method of analysis shows the impact of organ dysfunction on risk of death in patients in association with TBSA.

Applicability of Research to Practice: Partition analysis proved useful in hypothesis development and was most useful when paired with expert opinion to develop both statistically and clinically significant insights. Future directions for research include testing this association using independent data and examining the impact of interventions such as renal replacement and extracorporeal life support therapy on reducing mortality.
Introduction: The literature suggests referral TBSA is usually over-estimated in large burns and small children. We aimed to review our data to characterise whether pediatric tertiary referrals were over- or under-estimated by the referral unit, whether they received the fluids they were prescribed by the time of arrival, and compare clinical outcomes following resuscitation.

Methods: A 3 year review of prospective data of pediatric resuscitation burns (i.e. >10% TBSA) referred to our tertiary center from other hospitals was performed. This included basic demographics, burn information from referral units (TBSA and fluid volumes prescribed), information identified upon arrival (actual burn TBSA confirmed, fluid volumes infused by time of arrival, and actual fluid volumes required). Statistical analysis was performed. This study is ongoing.

Results: 25 patients were identified. Mean age was 3.3y and weight 16kg. The majority of burns were following scalds. Mean time to arrival was 5h. 16 patients (64%) were over-estimated and had corresponding fluid volumes prescribed. Of these, 7 children actually received less fluid than prescribed. Five patients received appropriate fluid volumes. Four children received 60% more fluid than they should have (range 44-93%). Six children were under-estimated; this group received 49% less fluid than the volume prescribed. Three children out of the entire cohort were correctly estimated and did not receive the fluid volumes prescribed. Over- and under-estimation led to incorrect fluid volumes being prescribed. These children did not receive the intended amount by time of arrival, but this did not directly translate into over- or under-resuscitation. Some children required catch up fluids. We compared clinical outcomes peri-resuscitation. There were no mortalities and no major clinical adversities in either group.

Conclusions: Most patients were over-estimated by referral units, however they arrived with lower volumes infused than volumes prescribed, which were also lower than their requirements based on corrected TBSA calculations. Overall there were no mortalities and no major adverse clinical outcomes in either group following adequate resuscitation. We must improve referral TBSA calculations via education, but there may be a case for suggesting urgent transfer with fluid access and fluids running as the clinical priority, as ultimately fluid volumes prescribed do not translate into fluid volumes infused upon arrival.

Applicability of Research to Practice: It would be interesting to assess other tertiary center experiences in order to inform future studies; this may guide future tertiary referral resuscitation guidelines and improve care. Our study is currently ongoing.
Impact of Burn Injury on the Modularity of Hepatocyte Metabolism

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Introduction: Hypermetabolism is a burn-induced response resulting in increased energy expenditure and altered nitrogen and lipid metabolism in the liver. Theoretical frameworks for modeling hepatic metabolism may improve our mechanistic understanding of burn injuries and help develop novel and targeted therapies. In this light, graph-based modeling of metabolic systems, where reactions are denoted as nodes and their interactions described by directed edges, serves as a platform to identify structural network features that offer predictable cellular dynamics. In this light, there has been growing interest in identifying the modularity of metabolic networks, where sets of reactions may be grouped in such a way to uncover the functional organization of the cell. Modules may isolate targeted perturbations (e.g. drug treatments) from propagating to the rest of the network. In this study, we investigate state-dependent modularity in the context of hepatocyte metabolism and burn injury.

Methods: Male rats were either subject to controlled burns exposed to various total body surface area (TBSA) with boiling water or were sham-treated with room temperature water. Blood streams in and out of the liver were sampled and blood flow rates were measured in situ. Metabolic flux Analysis was used to determine hepatic fluxes in both the sham-treated and burn conditions. A metabolic flux-based partition algorithm was used to determine the modularity of the hepatic network for each condition.

Results: Compared to sham-treated group, metabolic fluxes for a hepatic network were altered in both the 20% TBSA and 40% TBSA burn treated groups. For the 20% group, the changes were small, primarily resulting in a reduction in gluconeogenesis while the 40% group resulted in more drastic changes including increased amino acid extraction, as well as reactions involved in the urea cycle and oxidative phosphorylation.

Conclusions: The partitions of the weighted metabolic networks show that the modularity of the sham-treated network was not drastically different from that of the 20% burn group, except for minor differences in the placement of gluconeogenic reactions. However, there was a substantial rearrangement in the modularity of the 40% burn network compared to the sham-treated network.

Applicability of Research to Practice: A theoretical representation of burn-treated hepatocyte network modularity would provide insight into how the cell would respond to targeted treatments to hypermetabolism based on the modular placement of reactions close to the target.

External Funding: NIH R01DK096075.

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Severe Burn Increased Skeletal Muscle Loss in the X-Linked Muscular Dystrophy (mdx) Mutant Mice

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University of Texas Southwestern Medical Center, Dallas, TX

Introduction: Severe burn causes muscle mass loss and atrophy. The balance between muscle cell death and cell growth maintains muscle tissue homeostasis. We previously observed myogenic activation in response to cell death after burn. We thus wondered whether inhibition of myogenesis contributes to skeletal muscle mass loss after burn. Using a Duchenne muscular dystrophy (Dmd)mdx mutant mouse, we investigated whether severe burn caused more damage in skeletal muscle with pre-existing muscle disease.

Methods: DMDmdx mutant mice and C57BL wild type mice received 25% TBSA scald burn under general anesthesia. Mice were euthanized at day 1, 3, 7 and 14 and gastrocnemius, tibialis anterior and gluteus muscles were obtained (n=6/group). Muscle tissue was weighed and then halved either in 10% neutral buffered formalin for histological process or snap frozen storage in liquid nitrogen. Tissue RNA and protein were examined by qPCR and western blot. Six animals without burn served as controls. One way ANOVA with post hoc analysis were applied with a significance accepted at p < 0.05.

Results: The DMDmdx mutant mice had greater body weight with 10 times lower mRNA expression of dystrophin than wild type mice. Tissue wet weight significantly decreased in tibialis anterior from both DMDmdx and wild type mice (p<0.05); while tissue weight was back to normal in DMDmdx mice 7 days after burn. Tissue wet weight with protein content in gastrocnemius significantly decreased at day 1 in DMDmdx mice compared to wild type mice, (p<0.05) and tissue weight was back to base line at day 7. Tissue weight in gluteus decreased significantly in both groups after burn, (p<0.05) and we found significant reduction of tissue weight in DMDmdx mice compared to wild type mice at day 1 and 3. (p<0.05) Caspase 3 activities increased significantly after burn in gluteus muscle from both mutant and wild type mice. (p<0.05).

Conclusions: More muscle tissue weight loss occurred in response to severe burn in DMDmdx mutant mice. These mice are noted to have myogenic defect and thus less tolerable of traumatic injury.

Applicability of Research to Practice: The current study implies an extreme concern about recovery of burn patients with pre-existing muscle diseases.

External Funding: Department of Defense W81XWH-12-2-0074-01.
Introduction: Standards of practice for nutrition support in pediatric burn patients may increase the risk of essential fatty acid (EFA) deficiency. Specifically, the omission of intravenous lipids and gradual progression of enteral formulas can lead to suboptimal intakes of both linoleic (LA) and linolenic (LLA) acids. Whether endogenous fat lipolysis typical in burn injury can accommodate the deficit in fat intake is unknown. We measured weekly plasma total fatty acid (TFA) profiles in burn children receiving enteral and parenteral nutrition support to assess adequacy of their fatty acid status.

Methods: Patients admitted with burns ≥ 20% total body surface area (TBSA) were enrolled in this study. Patients received routine nutrition therapy consisting of enteral nutrition (EN) supplemented by lipid free parenteral nutrition until EN was tolerated at goal rate. Plasma samples were obtained weekly for 8 weeks or until wound closure was achieved. TFA profile including LA and LLA was measured by mass spectrometry and compared to reference norms. Relationship between dietary fat intake and EFA was determined by multiple regression analysis.

Results: Thirteen patients aged 2-18 years with a mean burn size of 61.7 ± 17.4 %TBSA had their plasma TFA measured for an average of 5.0 ± 2.0 weeks. EFA profiles throughout the study were above reference norms (19.8 ± 2.3 and 2.0 ± 0.6 for LA and LLA respectively). There was no statistically significant relationship between dietary fat intake and EFA profile. Table 1 shows mean LA and LLA levels and corresponding fat intakes during the initial 3 weeks of admission. Mean LA and LLA levels were comparable to norms despite suboptimal fat intake.

Conclusions: Plasma levels of linoleic and linolenic acids are comparable to reference norms in pediatric burn patients throughout the acute phase of care. Normal EFA levels despite suboptimal fat intake suggests significant contribution of endogenous fat.

Applicability of Research to Practice: Nutrition therapy with limited fatty acid intake is not associated with decreased plasma levels of essential fatty acids.

<table>
<thead>
<tr>
<th>Week</th>
<th>Daily Enteral Calorie Intake (kcal/day)</th>
<th>Daily Fat Intake (gm/day)</th>
<th>Daily Fat Intake (gm/kg)</th>
<th>Plasma Linoleic Acid Concentration (%)</th>
<th>Plasma Linolenic Acid Concentration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>498.6 (76.4)</td>
<td>17.2 (2.9)</td>
<td>0.0 (0.0)</td>
<td>20.2 (3.9)</td>
<td>1.4 (0.4)</td>
</tr>
<tr>
<td>2</td>
<td>477.7 (486.1)</td>
<td>16.7 (18.3)</td>
<td>0.2 (0.2)</td>
<td>17.8 (2.5)</td>
<td>1.2 (0.3)</td>
</tr>
<tr>
<td>3</td>
<td>724.2 (298.2)</td>
<td>24.9 (13.6)</td>
<td>0.3 (0.1)</td>
<td>18.6 (8.1)</td>
<td>5.3 (7.0)</td>
</tr>
</tbody>
</table>

Data are presented as mean (standard deviation); Reference norms for LA and LLA are 17.4% and 1.0% Respectively.

Introduction: Hypermetabolism is a burn-induced response to severe burn in DMDmdx mutant mice. These mice serve as a model for Duchenne muscular dystrophy (Dmd)mdx mouse, we investigated state-targeted perturbations (e.g. drug treatments) from propagating to the rest of the network. In this study, we investigate state-dependent modularity in the context of hepatocyte metabolism and burn injury.

Methods: Mutant Mice

Patients Receiving Routine Nutrition Therapy

Introduction: Skeletal muscle wasting in the severely burned patients has been considered one of the major risk factors affecting the patient’s prognosis. We previously reported the involvement of mitochondrial dysfunction in burn-induced muscle wasting. Methodologies for in vivo analysis of mitochondrial functions, however, have been limited and the therapeutic approach was not established. In this study, using the direct burn on hindlimb (tibialis anterior, TA) muscles, we directly measured the amount of mitochondria-derived reactive oxygen species (ROS) at the local site under the in vivo fluorescent microscope, and examined the protective effect of glycyrrhizin.

Methods: Under anesthesia with pentobarbital, a third degree burn injury was inflicted on the TA muscle. The fluorescent dye for mitochondrial ROS, MitoSOX, was injected intramuscularly. The TA muscle was analyzed under the in vivo fluorescent microscope. The specificity of the signal was confirmed by signal elimination with anti-oxidant, ascorbic acid. Sample-to-sample equivalency of the amount of loaded dye was confirmed by post-experimental exposure to UV irradiation as well as the internal control fluorescent staining with non-blocking amount of Alexafluor 488-conjugated bungarotoxin. Sham-burn injury was used as the control group. In the treatment group, 50 µg/ml of glycyrrhizin was injected.

Results: In the examination on the same day (day 0) and post-burn day (day 3), muscles with burn injury showed clearly red stained signal with MitoSOX compared with those from sham-burn group (4.02 fold). Increase in the red fluorescence was reduced by treatment with glycyrrhizin to 38.4% compared to the non treatment burn model, suggesting that the anti-inflammatory effect of glycyrrhizin can be partly through its effect on mitochondrial protection and the reduction in ROS production.

Conclusions: Using a novel in vivo microscopic analysis, we have documented mitochondria-derived ROS production in the skeletal muscle of direct burn injury model. The observed signal was specific to the oxygen radical produced in vivo, because ascorbic acid treatment diminished the signal (26.2%). The feasibility and usefulness of this new method for evaluating the drug efficacy was demonstrated by showing the effect of glycyrrhizin on the burn-induced increase in the ROS production. Further studies are necessary to fully establish the effect of glycyrrhizin on, and the mechanisms of, the overall protection of burn-induced muscle dysfunction.

Applicability of Research to Practice: Glycyrrhizin may be useful in targeting mitochondrial protection as well as reduction of ROS in severely burned subjects.

External Funding: Supported by Shriners Research Grant and NIH Grant.
Testosterone Regulating Glucose Metabolism and Protein Breakdown in Severe Burned Rat Skeletal Muscle Is Dependent Upon Nutrient-Sensing and Akt-Foxo Signaling

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Introduction: Severe burn injury causes a catabolic response with profound effects on glucose and muscle protein metabolism. This response is characterized by hyperglycemia and loss of muscle mass, both of which have been associated with significantly increased morbidity and mortality. Although testosterone and androgen receptor agonists shown to prevent or reverse muscle wasting in burn patients, the molecular mechanisms are not clear. Here we studied the effect of testosterone administered on severe burned rat and the molecular mechanisms.

Methods: 224 female rats were randomized into four treatment groups, referred to as Sham, Burn, Testosterone and Burn+Testosterone groups. The full thickness thermal injury of 35% of total body surface area was inflicted to the animals and a weight- and time-matched sham group was treated in the same manner. Testosterone and Burn+Testosterone group animals were then implanted with testosterone (2.5-mg pellet). Sham and Burn groups animals were implanted with placebo pellets. Body/mass weight were measured daily during the run-in phase. Random blood glucose levels were determined using a Blood Glucose Monitor. Serum total testosterone was measured in duplicate using radioimmunoassay kit. Serum and tissue lysis cytokines IGF-1 were assayed using commercially available immunoassay kits. Atrogin-1 MuRF-1 and total and phosphorylated AKT, mTOR, FOXO, p70S6K, S6 were determined by Western blot.

Results: Testosterone attenuate muscle atrophy and body weight loss induced burn. Testosterone was effective in lowering blood glucose levels. Moreover, testosterone blunted amino acid transporters, SAT2, Glut3 mRNA, positive regulated atrogin-1 through increasing total and phosphorylation Akt-Foxo levels above those present in untreated controls.

Conclusions: Administered shortly post severe burn, testosterone was found to differentially improve glucose metabolism, reduce loss in body weight and muscle mass. Through of nutrient-sensing, Akt-Foxo signaling by testosterone may regulate skeletal muscle glucose and protein metabolism.

Applicability of Research to Practice: The present study demonstrated that testosterone remarkably reverses burn-induced muscle atrophy. It is possible to speculate that the results of the present study may be extrapolated as a molecular basis for use of androgen in severe burned patients.

External Funding: National Natural Science Foundation of China (Project No. 30870951).

Safety of Propranolol in the Treatment of the Hypermetabolic State following a Major Burn Injury

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Introduction: Children with major burn injury often have hypertension and tachycardia. Propranolol has been shown to be effective in treating the hypermetabolic state secondary to major burn injury. We have shown that propranolol therapy results in decreased cardiac energy expenditure improved scar healing and better glucose tolerance. This study examined the safety of giving propranolol to children who are survivors of major burn injury.

Methods: Twenty pediatric burn survivors (7 females, 13 males; TBSA 30 to 60%; ages from 5 months to 19 years) who received propranolol for treatment for hypermetabolic state were retrospectively reviewed. Each child was closely monitored for changes in BP and P. In order to give the next dose of propranolol the child’s cardiovascular parameters must be at least 70 – 80 systolic BP and 90 pulse for the child less than 3-4 years; 80 systolic BP and 80 pulse for the child 4 to 12 years; and 90 systolic BP and 70 pulse for the teenager. Propranolol was given either as short acting propranolol every 6 hours or as long acting propranolol once a day. BP and pulses were monitored and documented before each dose of propranolol. The dose was not given if either the BP or pulse was below the appropriate parameter for age. Then the dose was reduced so that it could be given at the next scheduled time point.

Results: Therapeutic (discharge) dose, of Propranolol ranged from 0.3 mg/kg/day to 4.34 mg/kg/day (mean = 2.32 mg/kg/day). Systolic BP varied from 148 systolic pressure to 80 systolic pressure, Pulse from 150 to 80. Then over the next 1 to 2 years the propranolol was adjusted to avoid going below the normal BP and P for age. No instances of symptomatic hypotension (fainting or dizziness) were observed. In few patients the propranolol was discontinued because the subject did not maintain consistently the parameters for age on any dose of propranolol. Just before stopping propranolol, systolic BP varied from 125 to 62, Pulse from 119 to 57. The last doses of Propranolol ranged from 0.24 mg/kg/day to 3.2 mg/kg/day (Mean = 1.72 mg/kg/day ). After stopping more than 36 hours, BP and Pulse did not increase any more. Systolic Pressures ranged from 81 to 118 and Pulses ranged from 56 to 117. No instances of rebound hypertention were observed.

Conclusions: Propranolol was effective in lowering the BP and P and in maintaining it near the normal level in children of that age. Propranolol seems to be an effective and safe treatment for the symptoms of the hypermetabolic state seen in burn survivors.

Applicability of Research to Practice: How propranolol can be administered to treat the hypermetabolic state and improve the standard of care in the treatment of burned children.

External Funding: NIDRR H133 A070026, NIH P50 GM060338, Shriners Hospital for Children 84080.
239. A Descriptive Study to Determine if Severely Burned Patients Achieve their Target Caloric and Protein Goals within Five Days of Injury

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Introduction: As a result of a severe burn, patients enter a state of hypermetabolism more significant than that resulting from any other type of trauma. This increase in metabolic rate can also be accompanied by significant nitrogen and body mass loss, and increased lipolysis and glucose flow. The patient is subject to decreased immunity, delayed wound healing, prolonged hospital stay, and an increased likelihood of morbidity and mortality. Adequate nutrition must be provided in a timely manner in order to prevent or lessen the likelihood of these negative outcomes. The purpose of our study is to examine this burn center’s ability to achieve patients’ caloric and protein intake goals within 5 days post-burn and assess the various modalities utilized to deliver nutrition.

Methods: We performed a retrospective chart review of patients with ≥ 20% TBSA admitted from March 2009 to June 2012. Caloric goals were calculated using Ireton-Jones formula and indirect calorimetry. Protein goals were calculated using the formula, 1 gm/kg plus 2 gm/% TBSA burned, and 24 hr UUN analyses. Patients were determined to be at goal nutrition when these benchmarks were achieved for 3 consecutive days. We also measured the interval from burn to goal nutrition, stratified modalities used, and recorded the cause and duration of various interruptions.

Results: There were 58 charts meeting the inclusion criteria. Six were excluded; no caloric counts were available. Of the remaining 52 patients, 15 patients (28.8%) did not meet both goals for 3 consecutive days. The median time to goal of the other 37 patients was 9 days post-burn (IQR of 6–13). The most common method of obtaining goal nutrition was a combination of oral and tube feeds (53.33% gastric tube feeds). Gastric tube feeds (57.28%) were more commonly utilized than post-pyloric tube feeds (42.72%), and total parenteral nutrition was rarely used. The greatest impediments to achieving adequate patient nutrition were the delay in starting tube feeds, suspension of nutrition peripherally, and system delays.

Conclusions: Patients at our burn center are currently not meeting their caloric and protein intake goals within 5 days post-burn. Oral intake supplemented by enteral tube feeds is a successful strategy for attaining goal nutrition timely. To shorten the interval to goal delivery, a protocol to promote earlier initiation of tube feedings in at-risk patients, strategies to minimize perioperative interruption, and systems to reduce technical lapses in tube feed delivery should be developed.

Applicability of Research to Practice: The research demonstrates tube feedings need to be started early and perioperative interruptions should be minimized.

240. Quality of Life after Frostbite Injury

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University of Utah, Salt Lake City, UT

Introduction: Substance abuse and mental illness are known risk factors for frostbite (FB) in civilians. The impact of these comorbidities on long-term outcomes following FB is unknown. The purpose of this study was to evaluate quality of life in patients after FB injury.

Methods: Adults with an acute FB injury admitted to an ABA-verified regional burn center between January 1, 2001 and April 1, 2013 were identified. With IRB approval, attempts were made to obtain an SF-36 questionnaire from every patient. The SF-36 is a validated survey that yields summaries of physical and mental health. The physical health summary is composed of 4 scales: physical functioning, bodily pain, general health, and role-physical. The mental health summary is composed of 4 scales: vitality, social functioning, role-emotional and mental health.

Results: Fifty-three eligible patients were identified. Most (79%) were male with a history of mental illness, substance abuse, and/or homelessness (Table). Most (66%) sustained FB to their feet, 42% had hand involvement, and 13% injured both feet and hands. No mortalities occurred, but 26 patients required amputations. Tissue plasminogen activator was used in 19 patients, and 9 of these patients required amputation. Eleven patients were successfully contacted, ten of whom completed the SF-36. The remaining 42 (80%) were lost to follow up. Respondents were more likely to be female (60% vs. 21%, p=0.008) and to have hand injuries (80% vs. 33%, p=0.007) than non-respondents. Although there were no demographic differences between genders, females scored significantly lower than males in vitality (41 vs. 97, p=0.05) and mental health (63 vs. 100, p=0.03). Neither gender scored below population norms.

Conclusions: Psychosocial considerations contribute heavily to challenges in FB care and are highlighted by our inability to contact most frostbite patients treated by our facility over the last 12 years. Sample size and response rates are significant limitations to understanding the impact of frostbite on subsequent quality of life. With the histories of mental illness and substance abuse in the frostbite population it is surprising that neither gender scored below population norms.

Applicability of Research to Practice: Frostbite injuries have the potential to significantly impact quality of life. Psychosocial considerations play a significant role in the immediate and long-term care of FB patients.

Table: Demographics and Outcomes of Total Eligible Population

<table>
<thead>
<tr>
<th></th>
<th>Total N=53</th>
<th>Male N=42</th>
<th>Female N=11</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age median (IQR), years</td>
<td>54 (27-46)</td>
<td>36 (28-46)</td>
<td>31 (22-46)</td>
<td>0.297</td>
</tr>
<tr>
<td>History of mental illness</td>
<td>22 (42%)</td>
<td>15 (37%)</td>
<td>7 (64%)</td>
<td>0.110</td>
</tr>
<tr>
<td>Hand injuries</td>
<td>22 (42%)</td>
<td>17 (40%)</td>
<td>5 (45%)</td>
<td>0.768</td>
</tr>
<tr>
<td>Foot injuries</td>
<td>35 (66%)</td>
<td>29 (69%)</td>
<td>6 (55%)</td>
<td>0.371</td>
</tr>
<tr>
<td>History of substance abuse</td>
<td>26 (49%)</td>
<td>22 (52%)</td>
<td>4 (36%)</td>
<td>0.348</td>
</tr>
<tr>
<td>Received TPA</td>
<td>19 (37%)</td>
<td>16 (38%)</td>
<td>3 (27%)</td>
<td>0.509</td>
</tr>
<tr>
<td>Required an amputation</td>
<td>26 (49%)</td>
<td>23 (55%)</td>
<td>3 (27%)</td>
<td>0.108</td>
</tr>
<tr>
<td>Readmission</td>
<td>18 (34%)</td>
<td>15 (36%)</td>
<td>3 (27%)</td>
<td>0.602</td>
</tr>
<tr>
<td>Length of stay median (IQR), days</td>
<td>6 (4-12)</td>
<td>7 (4-13)</td>
<td>5 (2-8)</td>
<td>0.222</td>
</tr>
</tbody>
</table>

*Results reported as n(%) unless otherwise noted; p-value by chi-square or Fisher’s exact for dichotomous variables and Wilcoxon’s rank-sum for continuous variables.
**Assessment of Codeine Safety in the Pediatric Burn Population**

K. H. Luepke, PharmD, K. A. Bashan, MD, J. B. Kramer, MD, W. L. Ingram, MD

Grady Memorial Hospital and Emory University, Atlanta, GA

**Introduction:** Codeine is an opioid analgesic commonly prescribed with acetaminophen to treat mild to moderately severe pain in the pediatric burn population. In February 2013, the U.S. Food and Drug Administration (FDA) added a Boxed Warning and Contraindication to the labeling of all codeine-containing products, warning about the risk of codeine in postoperative pain management in children following tonsillectomy and/or adenoidectomy. This warning was based on cases of severe adverse events and deaths of children who received the drug following these procedures, and had evidence of “ultra-rapid” metabolism of codeine via CYP2D6 enzyme, resulting in supra-therapeutic levels of morphine. Despite the recent FDA warning, there is little follow-up data on codeine safety in the pediatric burn population.

**Methods:** A retrospective chart review was conducted in all patients < 18 years of age admitted to the burn center who received > 1 dose of codeine from January 2011 to February 2013. Codeine was prescribed as a combination product with acetaminophen. Patients were identified utilizing prescription records from the electronic medical record (Epic Hyperspace®). Patients were excluded from the review if a weight was not documented in the medical record. Outcome measures included respiratory depression (deemed as clinically significant by treating physician) and receipt of naloxone during hospitalization.

**Results:** One hundred forty-six patients were identified and 143 were evaluable for outcome. Median (min, max) TBSA, age, weight, and dosage were 8 (0.45)%, 4 (1.15) years, 13 (6.61.7) kg, and 0.54 (0.13,1.71) mg/kg, respectively. Most common burn type was scald water. Fifty-five percent of patients were Caucasian (88%). Forty-eight percent of patients received concomitant opioids. There was zero incidence of respiratory depression, and no patients received naloxone. On average patients were dosed less than recommended for analgesia (1 mg/kg), which could explain the lack of adverse events. In addition, the majority of patients studied were Caucasian in which prevalence of CYP2D6 genetic polymorphism is less common.

**Conclusions:** Codeine was well tolerated our patient cohort, however further investigation is warranted to better define the role of codeine therapy in the pediatric burn population.

**Applicability of Research to Practice:** Safe usage of opioid analgesics in the pediatric burn population.

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**Burn Care: An Increased Need for Early Palliative Care Involvement?**

S. Dennis, ACNP-C, J. S. Litt, DO, S. McGrane, MD, B. Summitt, MD

Vanderbilt University Medical Center, Nashville, TN

**Introduction:** The Revised Baux Index (RBI) is a scoring model used to predict survival in burns. It uses patient age, TBSA and presence of inhalation injury to give a relative mortality risk. This importantly provides physicians, patients, and families an idea of the severity of the burn early, helping establish care expectations. Burn care is often prolonged, during which families and physicians can become focused on day-to-day care allowing for loss of perspective. In our hospital there has been growth in palliative care (PC) beyond end-of-life care, instead helping engage patients and families in identifying overall treatment goals. We are interested in involving PC early by developing a formal protocol based on admission RBI.

**Methods:** We retrospectively reviewed data for all patient admissions in 2012 (609), assessing patient age, TBSA, presence of inhalation injury, RBI, mortality, presence and timing of PC consultation, length of stay (LOS) and the number of operative procedures in relation to timing of PC consultations.

**Results:** We learned that 117/609 patients (19%) had RBI’s of > 70; 33/117 (28%) died or transferred to hospice. Only 1 of the surviving 84 patients (1.2%) had a PC consult, while 21/33 patient deaths (63.6%) had PC consultations. An RBI > 70 thus captured all deaths and nearly all (98.8%) PC consultations. 12/33 (36.3%) patients died without PC assistance. LOS of non-survivors with PC consults was 24.9 days. Non-survivors without PC consults had LOS of 19.7 days. Non-survivors as a whole had a total of 55 operations, 18 (32%) of which were performed prior to PC consultation when applicable. PC consults were done 14.59 days into hospitalizations. There was no statistical difference between survivors and non-survivors in LOS or procedure counts.

**Conclusions:** PC was consulted late, over 2 weeks after admission. Non-survivors had numerous operations, some of which may have been avoided had directed goals-of-care dialogue taken place earlier. Possible reasons are numerous; providers experience personal responsibility caring for their patients, making it harder to recognize or accept medical futility. Family pressure and ignorance also present barriers. Therefore PC assistance can be invaluable. We surmise that involving PC sooner may have led to different treatment goals, fewer operations, decreased ICU and hospital LOS and lower costs in many patients. Instituting PC based on RBI early may help alleviate the emotional burden on the burn team, patients, families, and provide for more patient-centric care while reducing costs.

**Applicability of Research to Practice:** The use of Palliative Care as part of the team approach to burn care may help improve patient-centered care and relieve some decision making solely from the burn care team. This may improve both patient and economic outcomes.
Introduction: A nursing guideline was created to encourage safe practice in the administration of Ketamine during burn wound care to non-intubated patients. The guideline provides a standard for safe administration and monitoring of intravenous Ketamine. Ketamine is added to pain regimens when patients require high dosages of opioids that result in adverse side effects (e.g., respiratory depression). By adding ketamine, opioid dosages should not increase, may even decrease, providing better pain relief during burn wound care. Since 2009, patients requiring large dosages of opioid (e.g., fentanyl) to tolerate dressing changes have had Ketamine added as an adjunct to therapy.

Methods: This quality improvement project was a retrospective review of all patients receiving Ketamine during wound care from July 1, 2012- July 31, 2013. Charts were reviewed for adherence to ketamine guideline, opioid dosing, and adverse events.

Results: Ketamine was administered during 42 burn wound care occurrences; 22 (52.4%) events did not follow recommended ketamine guideline. Twenty (48%) occurrences followed the guideline; 16 (80%) of the 20 occurrences had a decrease or no change in the amount of opioid dosing required to provide pain relief to patients. No adverse events occurred during any of these treatment events.

Conclusions: Ketamine as an adjunct agent to opioid therapy was administered safely and allowed for improved pain management for the patient. Additionally, when the Ketamine guideline was used appropriately, there was a decrease or no change in the amount of opioid received reducing the patient risk to adverse effects of these drugs.

Applicability of Research to Practice: Quality Improvement.
245. How 19 Burn Centers Address the Long Term Effects of a Serious Burn Injury
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**Introduction:** Many survivors of a serious burn injury (≥25%TBSA); experience long term physical, psychological, and psychosocial effects. Many require prolonged reconstructive and plastic surgery that may leave permanent physical and psychological scars. The need for psychosocial services to help survivors adjust to their changed appearance and restore self esteem was first brought to the attention of the burn care community 37 years ago, yet today, few burn centers provide staffed, structured aftercare programs, and some do not prioritize restoring appearance.

**Methods:** Data for this survey was gathered for 19 burn centers in geographical proximity in the US by reviewing published articles, web sites, and by calling the centers' administrators, nurse managers, or staff responsible for aftercare programs to answer 11 standard survey questions.

**Results:** One burn center has a full-time staff person designated as Aftercare Program Manager and a Pediatric Aftercare Coordinator. Two centers offer no aftercare program. None of the burn centers offer an onsite facility with books, brochures or DVD’s. Five emphasize the importance of healing physical, psychological and psychosocial issues in mission statements. Five provide links on their web sites to support organizations like Phoenix Society for Burn Survivors. The Survivors Offering Aid in Recovery Program (S.O.A.R) is offered by 6 burn centers, and 7 centers offer school re-entry programs. Reunion or support groups for survivors are offered by 9, and 12 offer camps for children.

**Conclusions:** Combined, the 19 burn centers in this survey offer reunions, retreats, picnics, support groups, camps for children, school re-entry programs, teen and family weekends, parent and infant weekends, referrals to S.O.A.R, and links on web sites to organizations and resources. However, there is a significant lack of effective aftercare programs and resources at most centers. Thus, long-term outcomes for survivors with serious burn injuries may be compromised. Opportunities exist to introduce, improve and expand aftercare programs to address the long term effects of a serious burn injury and to improve patient outcomes by allocating staff, funds and resources to aftercare programs. There is a need to research and document the benefit of aftercare programs to show that they improve long term outcomes.

**Applicability of Research to Practice:** Allocate staff and funds to provide effective aftercare programs. Link programs where geographically feasible for resource sharing. Introduce, improve and expand aftercare programs to improve patient outcomes. Explain need for access to aftercare programs that provide peer support, psychological services, reconstructive surgery, corrective cosmetics, pain management and referrals to creditable organizations.

246. Exploring the Links Between Personality Type, Risk Propensity, Risk Perception, and Occupational Electrical Injury
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**Introduction:** Electrical injury (EI) is the most common occupational burn injury. A 45% increase of EI was found in our region between 1998 and 2006, contrasting with a 20% decrease in all construction accidents during the same period. Over 50% of all deaths and injuries by electrical contact were caused by the high-risk of working “live” on energized equipment or machinery. It has been shown that males with an extravert personality type/preference are more prone to take risks, when compared to introverts. The purpose of this study was to determine the links between personality type, risk propensity, risk perception, and occupational EI.

**Methods:** In a pilot cross-sectional study, surveys were mailed to 32 adults who had a work-related EI and were receiving outpatient rehabilitation for the EI. Statistical comparisons were made between participants’ personality preference (Meyers Briggs Type Inventory), risk-perception/risk-taking (Domain-Specific Risk-Taking Adult Scale), and EI voltage (low <1000 volts, high >1000 volts) using t-Test, Mann-Whitney U test, and Chi-Square test.

**Results:** Of 32 EI outpatients (28 males) with a mean age of 43.1±11.8 years, 18 (56.2%) were introverts, and 14 (43.8%) were extraverts. There were no differences between introverts and extraverts in demographics (age, gender, marital status, education, etc.), risk perception/risk-taking, and EI voltage. However, females scored higher in ethical risk perception than males (24.8 vs. 17.7, p=.04). Participants’ risk-taking and risk-perception scores were comparable to previously reported mean scores for an adult population. Interestingly, when asked to rate pressure to work with “live” electricity, 50% of introverts reported feeling much pressure, 16.7% some pressure, 11.1% little pressure, 16.7% no pressure, and 5.6% unknown. Among extraverts, only 28.6% reported feeling much pressure, 0% some pressure, 14.3% little pressure, 50% no pressure, and 7.1% unknown.

**Conclusions:** While EI extraverts did not score higher on risk-perception/risk-taking, EI introverts felt more pressure to work with “live” electricity. Demographics and EI voltage were not related to personality type, risk perception or risk-taking. To strengthen these findings, the recruitment and analysis of data from a comparison group of electrical workers without EI is underway.

**Applicability of Research to Practice:** Feeling pressure to work “live” with electricity affects personality types differently, and this should be considered in preventive interventions to reduce work-related EI.
Serial Brain Imaging of Isolation and Group Reared Rats with Burn Injury

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Introduction: Previous studies of isolation reared (IR) rats revealed decreases in early gene expression in whole brain and various regions. In the present study we performed FDG PET in Group reared (GR) and IR rats on days 3, 10, 17, 24 and 31. If the PET findings correlate with the genetic changes, they may serve as a biomarker for translational research studies linking findings on isolation reared animals to clinical studies of patients presenting with early psychosocial deprivation.

Methods: A total of 12 male rats were obtained on postnatal day (PN) 17 with lactating dams and housed under the conditions described in our prior studies (Bonab et al. 2012). On PN 20, the rats were subjected to full-thickness burn (20% total body surface area) or sham treatment. The IR rats were caged individually and the normal rats were housed in groups (Bonab et al. 2012) and all animals were imaged serially. Starting at day 3 after burn injury the animals were imaged with FDG weekly for five weeks. The rats were fasted for 24 h prior to imaging, injected with 1 Ci of FDG via tail vein, anaesthetized with isoflurane/N2O2, positioned with a custom fabricated head holder and imaged for 5 min. with a Siemens Focus 220 PET/CT. Images were reconstructed using the OSEM 3D/3D algorithm with zoom 6 (256X256 matrix) and whole brain thalamic ROIs were obtained.

Results: At all imaging times the FDG SUVs for whole brain and thalamus were significantly reduced in IR animals. This difference increased between days 10 and 17 (~35%, p<0.01) and disappeared thereafter with insignificant differences by the end of the study (p>NS). Similar reduction were seen for thalamus. At all times the FDG SUV for thalamus was greater than for whole brain (p<0.05 p<0.001).

Conclusions: These findings suggest that metabolic changes measured in vivo with PET can be utilized as a biomarker for molecular changes that have previously only been accessible ex-vivo.

Applicability of Research to Practice: In the future PET with FDG could be a useful tool for monitoring the effects of therapies for children with social deprivation such as those with burn injury.

External Funding: Shriners Hospital Boston.

Pruritus in Pediatric Burn Survivors: Prevalence and Risk Factors

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Introduction: Pruritus is a significant cause of distress for burn patients. Although itch has been shown to be a frequent and severe symptom in adults, its effect in children has been largely unstudied. The aim of this study is to characterize postburn itch in the pediatric population.

Methods: We retrospectively data from burn survivors under the age of 18 who were prospectively enrolled in a longitudinal multi-center study of outcomes from 2006-2013. Demographic, injury characteristics, associated symptoms (pain and sleep) and incidence and intensity (NRS, numeric rating scale) of itch were examined. Incidence was measured as a score ≥ 1 on the NRS itch scale. Measures were completed at hospital discharge and 6, 12 and 24 months post injury. Paired t-tests examined change over time in itch severity. Multivariate regression analyses examined the impact of associated symptoms on itch intensity. Spearman’s correlations were used to examine the correlation between itch intensity and associated symptoms. A p-value <0.05 is used for statistical significance.

Results: This analysis included 430 pediatric burn survivors. The mean age is 7.8, the majority is Hispanic and the mean TBSA is 40.8%. The table provides the prevalence of pruritus, pain and sleeping difficulty at discharge, 6, 12 and 24 months following injury as well as mean NRS scores. Itch was significantly correlated with associated symptoms (pain and sleep) and skin issues (fragile skin, dry skin, skin tightness and skin sensitivity). Regression analysis showed a correlation between pain and itch intensity at each time point. There was no association between itch intensity and burn etiology, age, gender or burn size.

Conclusions: This is the first report of post-burn pruritus in a large pediatric sample. Pruritus poses a significant problem for the pediatric burn survivor population in both intensity and duration. The frequency and intensity of itch in children are comparable to previously published data in the adult burn population. Further work may examine interventions for pruritus and the association between pain, itch and sleep disturbance.

Applicability of Research to Practice: This analysis demonstrates the importance of assessing severity and frequency of pruritus and its association with pain and sleep disturbances in the pediatric burn survivor population in order to determine appropriate interventions.

External Funding: NIDRR.
249. Pre-Hospital Total Body Surface Area Assessments in Pediatric Burn Patients Overestimate Burn Size

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Introduction: Accurate assessment of the total body surface area (TBSA) of injury is essential for the early management of pediatric burn patients. Previous studies have shown that burn TBSA estimates from referring facilities overestimate the TBSA observed at burn centers for children and adults, but has not been studied among patients transferred directly from the injury scene. The objective of this study was to compare the pre-arrival burn TBSA reported from emergency services providers and referring hospitals with the final burn TBSA calculated at a regional pediatric burn center.

Methods: Charts from burn-injured children treated in the trauma bay between 2007 and 2012 were reviewed. Field TBSA percentages were determined by emergency services providers’ pre-hospital documentation. Transfer TBSA percentages were determined by the referring medical providers’ notes. Paired t-tests were performed to determine the mean difference between the pre-hospital TBSA and final burn TBSA values.

Results: Among 142 burn-injured patients received in the trauma bay, 75 (53%) had TBSA data available for analysis from either the injury scene or referring hospital. Patients were an average of 4.2 years old (SD: 4.2; range: 6 months to 14 years) with mean final burn sizes of 14.7% TBSA (SD: 16.3%; range: 1% to 96%). Forty-four (59%) patients were triaged directly from the field, while 31 (41%) patients arrived from an outside hospital. Most burn patients (96%) had pre-arrival TBSA assessments that were not equal to their final TBSA evaluations; 88% had overestimates of burn TBSA while 8% had underestimates. TBSA estimates were an average of 8.9 percentage points higher than final burn TBSA (p<0.001). Burn TBSA was overestimated by 9.3 and 8.5 percentage points, respectively, among transferred patients and those triaged from the field (p<0.001, both). Among the 66 patients who had an overestimated TBSA, the pre-arrival TBSA was an average of two-fold higher (range 1-9) than the final TBSA.

Conclusions: Pre-hospital assessments of burn TBSA overestimate burn TBSA by almost 9 percentage points, whether the child was received from the field or transferred from another facility. Almost half of patients had an incomplete or absent estimate of TBSA before arrival at the burn center. Because of the importance of TBSA in triage and initial management, educational approaches are needed to ensure the availability of accurate estimates of TBSA by providers initially evaluating burn-injured children.

Applicability of Research to Practice: Accurate estimates of TBSA are needed to ensure appropriate triage and initial management of burn-injured children. This study highlights the need for improving the initial assessment of burn injuries in children.

250. Accuracy of Currently Used Paper Burn Diagram versus a 3D Computerized Model

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Introduction: To estimate the percent of total body surface area burned (TBSAB), physicians use paper burn diagrams designed by the Lund Browder formula. The calculated TBSAB is clinically relevant to determine resuscitation, fluid and caloric needs, as well as for other treatments. Unintentional errors from subjective assessments have been observed using paper burn diagrams. The present study was conducted to demonstrate that a computer model using clinical patient photographs would decrease subjectivity in the burn diagrams and subsequent TBSAB calculations.

Methods: Patients studied were between 16 months to 49 years and had an estimated TBSAB of ≥20%. The population of 19 burn patients studied was 79% male and included 79% Hispanic, 16% Caucasian, and 5% African American. Digital pictures were collected prior to the patient’s first surgery and imported into the electronic medical record, Burncase 3D (RISC Software GmbH, Austria). The pictures were superimposed over the 3D diagram of a human matching the patient’s description including, height, weight, gender, age, and overall build (normal or corpulent). The burns were traced from the picture onto the 3D diagram, which then calculated partial thickness and full thickness TBSAB. A two tailed t-test was performed with a p<0.05 considered significant.

Results: Significant differences were found between paper and computerized 3D burn diagrams. The average percent difference for partial thickness burns was 17.9±18.0 (p=.006). For full thickness, the average percent difference was 17.3±16.0 (p=.044). The average percent difference in TBSAB was 5.9±5.3 (p<.012).

Conclusions: Our results indicate a substantial difference in reported percent burn for partial thickness, full thickness, and TBSAB. There appears to be a tendency to overestimate the partial thickness burns and underestimate the full thickness burns. The underestimation of full thickness burns can be detrimental to estimation of surgical needs, such as skin substitute requirements and blood loss estimations.

Applicability of Research to Practice: Ultimately, a more accurate method of documentation can be beneficial to the patient, physicians, as well as for future billing. Since the percent burned is used in calculations to determine nutrition requirements, fluid needs, and length of stay, a more precise representation of the burned areas would lead to more accurate patient care. In the future, the implementation of computerized burn diagrams could provide a better understanding of patient needs acutely and also for reconstruction.

External Funding: UTMB BP Remembering the 15, Burn Research Education: 565450SHC Special Shared Facility for Clinical Research; 84080.
Introduction: A foundational surgical skill in burn surgery is tangential excision (TE). Simulation education has become standard in surgical education. Development of effective simulation for TE has the potential to increase the competency of the broader surgical community in this unique surgical skill.

Methods: TE simulation was created using the live TE knife, foam, mineral oil, and a base. Subjects who completed the study were surgeons or surgeons in training. Subjects were given a pre- and post-task questionnaire including questions about experience with TE. The timed, video recorded task was to excise 4 pre-marked rectangles from the foam, generating 4 excisional products (EP). Evaluators blindly assessed performance by EP analysis using a novel scoring tool and reviewed subject videos using a modified OSATS rubric. Based on the pre-questionnaire, subjects were divided into three TE experience groups: novice - none, intermediate - some, and expert - TE daily in their current or past practice. Inter-rater reliabilities and p-values were obtained, comparing Novice and Intermediate with Expert scores.

Results: Of the 40 subjects who completed the study, 16 were identified as TE novices, 17 as intermediates, and 7 as experts. All EP’s, videos, and time to complete task data was reviewed blindly by two evaluators using the EP scoring tool, OSATS methodology, and video timer respectively. Intraclass correlation coefficients (ICC) were calculated to measure inter-rater reliabilities, which were acceptable (ICC>=0.42) for OSATS, Time, and two components of EP analysis: Border and Texture. Statistical differences between Novice and Expert scores were found for these metrics (p=0.0100, p=0.0200, p=0.0025, and p=0.0005, respectively). Statistical differences between Intermediate and Expert scores were also found for the same assessment tools (p=0.0100, p<0.0200, p<0.0100, and p=0.0025 respectively).

Conclusions: In this study, a simulation for TE was successfully created to blindly discern level of TE experience. Construct validation was demonstrated using a modified OSATS methodology and an innovated EP analysis tool. Further validation studies are needed to determine the efficacy of the simulation as a learning tool and the predictive validation of the simulation on operative performance.

Applicability of Research to Practice: Valid TE simulation education may provide surgeons an additional way of teaching the surgical skill TE commonly needed to treat burn injuries.

252. Video Assisted Burn Evaluation is a Reliable Tool for Improving Initial Evaluation and Treatment of Burn Injuries in Rural Areas

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Introduction: Successful burn care relies on accurate initial burn management. Over one third of burn patients receive suboptimal initial care. Telemedicine with a video component has shown improved initial burn care. We sought to evaluate the addition of a video component to our current telephone-only transfer process in a predominately rural state.

Methods: Nine referring state hospitals, selected based on either rural location or history of a higher volume of burn transfers, were provided with video cameras and given instructions on uploading videos to a HIPPA compliant, secure web portal with direct communication to our electronic medical records. Referring doctors (RD) were instructed to enter basic demographic and injury information and upload the burn videos prior to placing the transfer call. Using scripted text, burn charge nurses recorded the RD’s percent estimated, fluid needs estimated, airway assessment, disposition requested (admission or clinic visit) and mode of transport requested. The nurses collected standard demographic and injury information. The nurses noted any changes in management after speaking with the RDs and viewing the videos. Patients transferred with the addition of a video component to the telephone transfer call (VTT) were compared to those transferred with telephone only (TT). Patients provided consent for data evaluation and the study was IRB approved.

Results: A total of 181 patients were evaluated for transfer from 1/2012 to 6/2013 and comprised the study group. The mean age of the population was 29.1 years. The majority sustained flame and flash burns (83, 43.9%). Thirty six patients (19.1%) were VTT. Both TT and VT showed increased accuracy in burn size estimation compared with the initial RD estimate. Among the largest burn estimations (>25%) both TT and VTT decreased size estimations in 6/7 and 3/3 respectively. Both types of transfers resulted in a change of disposition or transport transfer mode in 17 (11.1%) of the TT group compared to 5 (13.9%) of the VTT group. These included transfer downgrades as follows: 5 from ambulance to private car; 2 from air ambulance to ground ambulance; 2 from admission to clinic visit.

Conclusions: We have shown that our scripted transfer process improves the accuracy of burn size estimation and potentially reduces cost. Additional research is ongoing to determine if VT further improves the process.

Applicability of Research to Practice: Scripted nurse driven telemedicine patient transfer process provides an effective and superior means of providing accurate initial care to burn patients.

External Funding: University of Iowa Injury Prevention Center.
The Bi-National Burn Registry and Burn Quality Improvement Program: Thunder from Downunder

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Introduction: The revised Bi-National Burns Registry (Bi-NBR) has established quality indicators (QIs) designed to support benchmarking of clinical performance on a state, national and international level. QIs are measurement tools that assist clinicians to monitor performance and outcomes and drive improvement of care. The Burns Quality Improvement Program (BQIP) was developed in 2013 to assist burn services to measure their performance against agreed standards and peers.

Methods: The Bi-NBR was developed using the operating principles outlined by the Australian Commission on Safety and Quality in Health Care (ACSQHC) guidelines. A Bi-NBR working party developed 19 clinical QIs that are embedded in the core data items of the registry. QIs were selected that measure key processes or are directly related to important patient outcomes and were evidence rated using the National Health and Medical Research Council’s body of evidence matrix. Standards of care were established for QIs for which evidence was available and/or where there was consensus opinion. Review of the QIs by the working party in 2011 resulted in changes to many of the indicators and in some cases, addition of sub-questions to clarify practice and provide context for the QI data points. In 2013 selected Bi-NBR QIs were evaluated for construct validity (relevance), reliability, completeness, accessibility (useability) and the potential for standard development (benchmarking) as we move towards the implementation of the Burn Quality Improvement Program.

Results: 8022 cases were captured by the Bi-NBR over the 3 year period. Evaluation of selected Bi-NBR QIs was conducted in 2013. Based on QIs, a BQIP proposal has been tabled for consideration to the peak burn organisation across the two countries.

Conclusions: The Bi-NBR provides an invaluable opportunity to monitor and compare burn care performance. Benchmarking processes are currently under development. The BQIP program will assist burn centers to evaluate their performance and drive local quality improvement initiatives that will improve the quality of burn care and patient outcomes.

Applicability of Research to Practice: The Bi-NBR and BQIP have the potential to significantly improve the quality of care for burn patients across two nations through their ability to provide feedback to participating centers on their performance relative to their peers, explore variability to identify best practices and provide participating centers with tools that can facilitate quality improvement initiatives locally.

Quality of Care Initiatives: Are Burn Patients Outliers?

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Introduction: Federal quality initiatives emulate best practices to set standards for patient outcomes and prevent adverse hospital acquired infections. National benchmarks reflect this quality of care. It is hypothesized that the most critically ill burn patients, due to the underlying nature of the admitting illness, are susceptible to infection despite implementation of evidence based care paradigms. The purpose of this study was to capture the acuity of this complex patient group in light of their infections.

Methods: Chart reviews of patients on mechanical ventilation for ≥ 5 days, ≥ inhalation injury (IHI), ≥ acute burn injury (CI), age ≥18 ± 85 were completed. From 6/11 - 7/12, selection was randomised to every 3rd patient (n=20). To develop a more robust sample, 10 patients meeting criteria hospitalized between 1/13 - 7/13 were added. Age; gender; % TBSA; ±IHI; ±hypobaric oxygen (HBO); carboxyhemoglobin (CO) level; length of stay (LOS); total # of ventilator and bed rest days; presence of delirium (D+) and D+ days; # and type of infections; # of surgeries; average daily doses of opiates in morphine equivalents (ME), lorazepam (mg); days of continuous infusions of ME and lorazepam; antipsychotic medication exposure; average daily RASS; and patient outcome were recorded. Continuous variables are presented as mean ± SD. VAP rate was compared to 2013 national benchmark and standardized infection rates (SIR) with a 95% confidence interval for CLASBI and CAUTI were reviewed for 2013 to date.

Results: Thirty patient charts were reviewed. The SIR of these patients compared to burn centers nationally are: CAUTI 2.21 (1.178, 3.785) and CLASBI 0.65 (0.212, 1.525). VAP rate is 5.6% compared to national benchmarks of 2.1%. Patient demographics are in Table 1.

Conclusions: The complexity of critically ill burn injured patients is reflected by many factors - significant dermal impairment, pulmonary insult, prolonged treatment with indwelling devices, malnutrition, deep sedation, prolonged ventilation, multiple staged surgeries and resultant post-op immobilization, and complicated management of interrelated pain/anxiety/delirium - that put them at high risk for elevated infection rates. SIRs findings for this population are on par with other centers. Moving forward a comparison of burn patient infection rates to the national benchmarks for other populations is warranted.
Implementation of a Midline Intravenous Catheter for Burn Patients to Decrease Frequent Peripheral Sticks and Infection Risk

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Introduction: We sought to decrease the use of central venous catheters (CVC) to mitigate infection and complications. A device with increased dwell time, phlebotomy capability and a low complication rate was preferred to accommodate extended stays, multiple surgeries and increased infection risk.

Methods: A midline extended catheter (MLEC) indicated for upper arm insertion was selected that was power-injectable, amenable to phlebotomy, was approved for an extended dwell time and had a historically low complication rate. Manufacturer training was provided to the institutional Peripherally Inserted Central Catheter (PICC) team for initial use in the Burn Intensive (BICU) and Progressive Care Unit (PCU) patients.

Standardized order sets and procedure notes were created to ensure conformity in care. Criteria for placement were a length of stay greater than six days and no indication for CVC/PICC. Outcomes evaluated included total dwell time, phlebotomy capability, need for additional central lines, ability to remove existing central lines, reduction in peripheral sticks, nursing time required for management, complications and overall patient and staff satisfaction.

Results: From 31 July to 3 Sep 2013, 22 patients were enrolled. Three of those patients received a replacement MLEC (n=25 total). The first, placed MLEC in the BICU was on an extracorporeal life support patient, remained for 29 days, potentially avoiding >15 peripheral sticks. The longest MLEC dwell time in the PCU was 16 days and potentially avoided more than 24 sticks (includes phlebotomy). Every avoided stick potentially saved nursing workload an average of 30-45 minutes. CVC utilization was reduced by early removal in 4 patients and avoidance in 4, thereby reducing line associated infection risk. Mean attempts per placement was 1.6(1-4) with 56% of placements on first attempt; dwell time was 8.4(2-24) days with phlebotomy use 5.9(0-29) days. Complications were: infiltration 8%(2); accidental dislodgement or patient removal 16%(4); no infection or venous thrombosis occurred. We calculated 3.5-5.3 hours of reduced nursing time per patient. Overall, 100% of patients and 93% of their nurses would prefer MLEC placement for future long-term therapy.

Conclusions: A MLEC can effectively and safely reduce peripheral sticks, contain supply costs, reduce nursing time and mitigate infection associated with central lines in the burn patient population.

Applicability of Research to Practice: Success of the MLEC pilot project in the burn center has prompted institutional consideration of this additional modality for intraavenous cannulation.

Application of the Burn Center Pediatric Early Warning Score (PEWS) Tool to Clinical Practice: A Pilot Validation Study

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Introduction: A PEWS tool was developed to help providers detect subtle clinical deterioration in non-ICU pediatric patients and intervene early to prevent significant adverse outcomes. Although widely used in general pediatrics, limited studies report on its validation; none report on its use with burn injured patients. As previously reported, this center modified a general PEWS with heart and respiratory rate (HR, RR), temperature, behavior and skin parameters to a burn specific PEWS inclusive of intake/output (Figure 1) and integrated q6h scoring into standard practice. The purpose of the study was to investigate the external validity of the PEWS process in clinical practice.

Methods: Every third chart was selected from all non-intubated patients aged 0-15.9 yrs admitted between 1/12-6/13 with a length of stay (LOS) >3 days (n=187) until data on 50 patients had been collected. Demographics, total PEWS and score changes, compliance with score documentation and resultant interventions were reviewed. Continuous values are presented as mean ± SD (range), p<0.05.

Results: Of the 50 patients (50% male), mean age, burn size, and LOS were 3.2 ± 3.3 yrs (0.3-13.3), 4.8±5.7% (0.5-31.5), and 9.8±7.0 days (3-47), respectively; 26% required grafting. No mortalities occurred. 1612 PEWS from a total of 1745 opportunities were documented (92.4% overall; 68.8-100% per patient compliance). For all PEWS (n=1612) and PEWS >0 (n=912), means were 0.9±1.2 (0-10) and 1.6±1.2 (1-10), respectively. There were 162 PEWS increase events; intake (54.1%) and output (4.5%) parameters most commonly increased. Interventions were performed for 129 PEWS increases (79.6%) and most commonly included score documentation (93.7%), MD/PA notification (70.5%), feeding tube insertion (25.6%). Patients whose PEWS >0 and those with PEWS=0 were similar in age and LOS; burn size was larger among PEWS >0 (5.2% vs 1.4%, p<0.05). No patients required transfer to the ICU, invasive monitoring, pressors, or mechanical ventilation due to clinical deterioration.

Conclusions: The compliance with PEWS performance and resultant actions based on score increases are high. Data support that changes, even those small in magnitude, in a burn-injury specific PEWS stimulate provider discussion and intervention and support its validation; further studies on its impact on practice are warranted.
**Introduction:** Severe burn injury results in a multifaceted physiological response that significantly alters the pharmacokinetics and pharmacodynamics (PK/PD) of drugs. This physiological response develops over two differing phases and the impact of drug PK/PD are affected differently. The first phase of burn injury is marked by hypovolemia, resulting in decreased glomerular filtration rate, increased vascular permeability, increased intrastitial hydrostatic pressure, and vasodilation. The second phase presents as a hypermetabolic state characterized by an increased body temperature, heart rate, wound blood flow, and increase in energy consumption. These complex physiologic changes alter drug distribution and excretion_ varying the therapeutic effect on the body. To this end, in order to optimize critical care for the burn population it's imperative for physicians to understand the variation in PK/ PD parameters of drugs caused by burn injury.

**Methods:** We conducted an extensive literature review via PubMed to identify burn-related PK/PD studies. PubMed search parameters included “pharmacokinetics”, “pharmacodynamics”, “physiologically-based pharmacokinetic modeling (PBPK)” and “burns”.

**Results:** Based on our search parameters we located 37 papers studying PK/PD parameters in burns. Twenty-six papers investigated PK/PD of antibiotics, 10 researched analgesics and sedatives, and 1 paper researched other. Out of the 37 papers, there were 19 different software programs used, and 8 different types of control groups. No PBPK studies were reported among the burn literature.

**Conclusions:** There is a critical need for appropriate PK/PD modeling of clinically relevant medications for burn care. Due to the vast inconsistencies among PK/PD studies in burns, the mechanisms behind changes in PK/PD in burns remain poorly understood. Dosing strategies must be adapted based on the stage of burn injury and changes in PK/PD parameters in order to ensure drug efficacy. While several PK/PD studies have been undertaken in the burn population, there is a wide variation in the techniques, software, and sample sizes used in these analyses. In order to refine burn-dosing strategies and consequently improve patient outcomes, there must be harmonization among PK/PD analyses.

**Applicability of Research to Practice:** Drug dosing in burn patients are based on PK/PD studies. Appropriate appraisal and modeling of burn PK/PD studies are needed to improve patient care.
259. Improving Hemostasis during Burn Surgery
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Introduction: Efficient hemostasis of burn wound excision and donor sites is important for minimizing blood loss, with the potential for reducing operative time, transfusion requirements and the risk of hemodynamic instability. Effective hemostasis is important for graft adherence to the wound bed to optimize take. Our experience of combining the topical application of thrombin-epinephrine soaked laparotomy sponges with pressure has been positive but we have observed that there may be some disruption of the effect when the laparotomy sponges are removed as they tend to “stick” and may dislodge clots that have formed. The purpose of this study was to evaluate the effect of adding a non-adherent layer (Telfa) directly on the wound beneath the laparotomy sponge.

Methods: Patients undergoing burn wound excision and/or skin grafting were entered into the study. Data was collected on burn patient demographics, injury details, and surgery methods/results. Adjacent areas of burn excision or skin graft donor sites were randomly assigned to treatment with a laparotomy sponge and Telfa (test) or a laparotomy sponge alone (control). The sponges and Telfa had been impregnated with the same thrombin-epinephrine solution. The dressings were removed at 5 minutes and photos were taken at standardized times. These were evaluated by 3 blinded observers to determine which site showed less bleeding. Each site was also categorized as bleeding minimally, moderately, or excessively, the latter based on whether blood pooled and ran off the wound surface one minute after dressing removal.

Results: Thirty-four sites were evaluated in 14 patients. In 17 (50%) the test site with Telfa was determined to have less bleeding, with 11 of the remaining 17 sites displaying equivalent hemostasis between the two treatments. When the sites were sorted by the amount of bleeding, 1/10 (10%) with minimal bleeding and 1/6 (16.67%) with extensive bleeding showed better hemostasis than the control. However with moderate bleeding, 15/18 (83.33%) test sites had superior hemostasis with the hemostatic effect being equivalent in the remaining three. The number of days between injury and surgery was greater with extensive bleeding (29 vs 14 days).

Conclusions: The use of a non-adherent layer can result in improved hemostasis during burn surgery. This effect is dependent on the extent of bleeding at the surgical site with superior results when moderate bleeding was observed. At the “extremes” of bleeding, (minimal and extensive) there was little effect, since either the bleeding was too little for any difference to be appreciated or so large that the hemostatic potential of the treatment was overwhelmed. Future studies plan to evaluate the effect on cumulative blood loss, transfusion requirements and operative time.

Applicability of Research to Practice: Hemostasis in burn surgery.

260. Negative Pressure Wound Management in Burn Wounds
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Introduction: Early excision and biologic coverage is the standard of care in the management of burn injuries. In patients with large TBSA, temporary biologic coverage is provided with allograft or biosynthetic dermal substitute. In our experience with large TBSA deep burns when plane of excision is either fat or fascia, initial allograft application is less successful; especially with patients having SIRS. These patients also require multiple allograft applications. We have started utilizing negative pressure wound therapy (NPWT) in the acute management of excised burn wounds in selected patients. We present our technique and experience with the use of NPWT for acute burn wound management.

Methods: This is a retrospective review of patients with greater than 20% TBSA in whom NPWT was utilized for acute burn wound management. The control group (2:1) was selected from the 3 year time period preceding the initiation of NPWT for burn treatment at our unit. After the initial fascial excision of burn wounds for extensive full thickness injury, we apply reticulated foam based NPWT with continuous negative pressures ranging from 75-125 mm Hg and change the NPWT dressings every 3-5 days. If there are exposed tendons, vessels and nerves; they are protected from direct access to the foam. We have developed a sandwich technique for creating a proximal anchor when there is no intact proximal skin. Once ready, the wounds are promptly covered with appropriate and available biologic or biosynthetic coverage.

Results: We have successfully treated 20 patients with TBSA ≥ 20% during last 3 years. The mean TBSA for patients control and NPWT groups was 32.75% and 32.63% respectively. The statistical analysis, comparing the control group, did not show any significant difference in the age, sex, and TBSA between the groups. The mean length of stay (days/TBSA) for NPWT and control groups was 2.2 days and 1.6 days respectively (p=0.11). The patients in the control group had higher incidence of skin graft loss (10/40 Vs 1/20; p=0.05) and wound infection (12/40Vs 3/20, p=0.1) compared to NPWT group. Cosmetic appearance of NPWT treated wounds was as good or better than historic controls. We will further review the outcomes data for both the groups.

Conclusions: NPWT can be an additional option for managing excised burn wounds in acute setting in selected cases. It appears to offer equal or better management option than conventional therapy, particularly in patients with SIRS.

Applicability of Research to Practice: NPWT is an alternative to assist in the management of burn injuries.
Introduction: Levamisole-Induced Vasculitis: An Increasing New Trend in Burn Center Admissions

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Introduction: Levamisole is a veterinary anthelmintic, chemotherapeutic agent, and an immunomodulator used in rheumatoid arthritis and cancer treatment, that is now used as an adulterant and cutting agent in cocaine distribution. It is believed to potentiate the sympathomimetic actions of cocaine and is characterized by neutropenia, agranulocytosis, purpuric retiform lesions, and skin necrosis. The ears, nose, face, and extremities are more commonly affected. Review of the literature reveals increased reporting of Levamisole-induced vasculitis (LIV) and a lack of standardized diagnostic and treatment options.

Methods: A comprehensive review of the literature was performed using PubMed and MEDLINE. We describe two cases of LIV that presented to our burn center.

Results: Both cases were transferred to our burn center. Case one was a 46-year-old female with a 25% total body surface area (TBSA) purpuric rash on her nose, face, ears, and extremities, of unknown duration. Case two was a 41-year-old male with a 1-week-old 6% TBSA purpuric rash on his extremities and chest. Both tested positive for cocaine. Case one had positive perinuclear antineutrophil cytoplasmic antibodies (p-ANCA), whereas case two had positive p-ANCA at the outside hospital and positive cytoplasmic antineutrophil cytoplasmic antibodies (c-ANCA) later in his admission at our burn center. Surgical pathology revealed necrosis, vasculopathy, and thrombosis in both cases. Case one had a hospital course complicated by bacteremia, acute kidney injury, pneumonia, and urinary tract infections. Both cases received courses of steroids, antibiotics, and anti-fungals prophylactically and for active infection. Case two also received valacyclovir. Both cases underwent multiple debridements, tangential excisions, and split thickness skin grafting. In addition, case one underwent a percutaneous gastrojejunostomy and multiple extremity and hand amputations. Case two underwent multiple placements of negative pressure wound devices.

Conclusions: The results of LIV can be quite disfiguring. Diagnosis can be aided by a thorough social history, obtaining skin biopsies, and ordering appropriate diagnostic tests. Surgical management includes tangential excision, application of negative pressure devices, STSG, or allografts.

Applicability of Research to Practice: Cases of LIV has increased. Therefore, increased knowledge, early diagnosis, and understanding diagnostic and treatment options, is warranted.

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262 . Long Wave Infrared Thermography for Predicting Need for Burn Excision: A Pilot Study

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Introduction: The accuracy of clinical burn depth assessment by experienced burn surgeons is reported to be 64-76% while other methods, such as laser Doppler, are cumbersome and require several days to become reliable. Long wave infrared thermography (LWIR) measures emission of heat by the skin due to local perfusion and cell metabolism. We hypothesized that LWIR would be more accurate at predicting need for surgical burn excision than clinical assessment.

Methods: We conducted a prospective observational study of patients presenting to a regional burn unit with second or third degree burns within 24 hours of injury. Daily burn assessments were performed by an experienced burn surgeon who assessed burn depth and determined need for surgical excision. Standardized daily thermography was performed using a portable FLIR T300 digital LWIR camera (0.9 kg) and the change in wound temperature over time was calculated by subtracting the current from the initial temperature at the center of the burn. The main outcomes were burn excision and depth of excised burns confirmed on histology performed on H&E sections by a board certified dermatopathologist blinded to clinical and therapeutic assessments.

Results: The study included 11 burns (9 thermal, 2 chemical) on 7 patients ranging in age from 31-79 (mean 47.4) years. Burns were located on the trunk (7) and extremities (4). Of all burns 6 were excised and all were of full thickness. In 5 burns the temperature decreased (mean change -2.5 ± 1.5 °C) and in 6 burns the temperature increased (mean change + 2.7 ± 1.8 °C). The sensitivity and specificity of LWIR were 100% (95% CI, 57-100) and 83% (95% CI, 44-97). One burn thought to be deep on clinical assessment became warmer over time on IR and was not excised and healed spontaneously. One burn that became cooler over time was excised and found to be full thickness.

Conclusions: Our pilot study suggests the potential of LWIR as a noninvasive, portable, and user-friendly method for burn depth assessment and prediction of need for surgical excision.

Applicability of Research to Practice: Digital IR thermography, a non-invasive, portable, and easily accessible tool, when used in conjunction with clinical assessment, may impact surgical decision making for burn wounds.

External Funding: This study was supported by FLIR Systems Inc and the SCVOL Firefighters Burn Center Fund.
263. Use of a New Non-Adherent Moisture Management Antimicrobial Dressing with Negative Pressure Wound Therapy in the Treatment of Burns: A Case Series

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Introduction: Auto-grafting is a common surgical procedure and is used often to achieve soft-tissue coverage of burn, chronic and traumatic wounds. Recently, NPWT has emerged as a strategy for managing a wide variety of acute and chronic wounds. NPWT can also be used to cover anatomically challenging skin grafts where conventional dressings may not stabilize the graft. Often, a non-adherent dressing is placed between the graft and the NPWT dressing. The new dressing used in this study was developed for skin graft coverage. The dressing is unique in that it does not require pre-wetting, the graft-contact surface is designed to be non-adherent, and the dressing actively moves excess exudate away from the skin graft. The use of this new silver dressing with NPWT has not been reported.

Objective: To report an alternative painless, non-adherent silver impregnated dressing, used in conjunction with negative pressure wound therapy (NPWT) and show improved skin graft-take and overall patient outcomes.

Methods: Three patients (38 yrs - 77 yrs) with burn injuries were treated with skin grafts. For each patient, the new silver dressing was applied directly to the graft followed by a standard NPWT dressing. In one patient, a different silver dressing was used on a different graft site for comparison. Photographs were taken to document graft outcome.

Results: Excellent graft viability was achieved without clinical signs of infection, maceration, or loss from adherence to the dressing. During take-down, the dressing “peeled” gently off of the graft without tissue damage and was noted to be painless. Accelerated graft healing was evident by more rapid closure of interstices.

Conclusions: The application of NPWT over skin grafts is an effective method for promoting graft take. The utilization of this novel non-adherent antimicrobial dressing may present a unique way to help prevent infection, provide a painless barrier between the NPWT and skin graft, and accelerate graft healing time.

Applicability of Research to Practice: An exceptional way to help prevent infection with NPWT, improve graft adherence and decrease healing time is presented. Utilization of this product over superficial burn wounds could enhance patient satisfaction secondary to a painless silver dressing and provide improved clinical outcomes.

264. Burn Wound Exudate: Depth of Burn Predicts Cellular Recruitment

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Introduction: Previous research has demonstrated a correlation between burn injury and systemic cytokine response. Moreover, recent studies have identified burn wound fluid as being rich in pro- and anti-inflammatory cytokines that may serve to modulate or retard the healing process. To date, there is no published data identifying the cellular makeup of burn wound exudate responsible for these cytokine levels, nor has there been an examination of whether cellular recruitment differs based on the depth of burn insult. We examined wound exudate from burns of varying severity and report the data here.

Methods: After obtaining IRB approval, four patients admitted to the burn ICU were identified with fluid-containing burn blisters. Six to 12 hours after presentation, informed consent was obtained and burn exudate was extracted under sterile technique using a large-bore syringe. The sample was stored at room temperature (less than 24 hours) until final analysis. Prior to measurement using flow cytometry, each sample was passed through a 100 μm strainer. The cellular composition was characterized based on forward and side scatter and these measurements were compared to that of whole blood from a healthy patient previously stained for immunophenotyping. After surgical debridement, the burn wounds for each patient were classified based on depth and extent of injury.

Results: Two patients suffered wounds classified as very superficial (VS). Exudate extracted from these wounds was relatively devoid of monocytes (0.1-3.2%) and granulocytes (0-11.2%), with the majority of the cell population comprised of smaller cells, lymphocytes (10.9-17.9%) and platelets. The remaining two patients sustained wounds classified as superficial partial thickness (SPT) and exudate much more abundant in granulocytes (31.8-46.9%) and monocytes (8.4-14.6%). The lymphocyte population closely mirrored that in the VS burn group (9.4-14.8%). Each patient suffered a less than 5% total body surface area burn.

Conclusions: Our preliminary data indicates a correlation between the cellular makeup of burn wound exudate and the depth of burn injury. Previous studies have shown conflicting evidence as to whether burn fluid possesses anti- or proinflammatory cytokines, but we portend that this depends on the depth of the wound. VS wounds tend to heal with or without surgical debridement, likely due to a lack of pro-inflammatory cells. Deeper burns, such as SPT burns, usually require surgical debridement. It is possible that drainage rids the wound of this pro-inflammatory milieu, thus facilitating the healing process.

Applicability of Research to Practice: Routine analysis of burn exudate may predict how to best manage the wound and lead to therapeutics targeted at creating an optimal environment for the restoration of skin.
Does Intravenous Immunoglobulin Therapy Reduce SCORTEN and APACHE II Predicted Mortality in Stevens-Johnson Syndrome and Toxic Epidermal Necrolysis?

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Introduction: Toxic Epidermal Necrolysis (TEN) and Stevens-Johnson Syndrome (SJS) are cutaneous reactions hallmarked by epidermal detachment. Concerning the immunopathogenesis of these syndromes it is thought that the Fas ligand protein on keratinocytes is upregulated and binds with the cell death receptor Fas/CD95 causing widespread apoptosis of epidermal cells. Intravenous immunoglobulin (IVIG) has been shown to inhibit this Fas-Fas ligand interaction. We reviewed our use of IVIG and its effects on our observed mortality.

Methods: We conducted a retrospective chart review of a prospectively maintained trauma database. We calculated SCORTEN predicted mortality on hospital day three and the APACHE II score predicted mortality on hospital day one. Paired Z tests were performed and p values were calculated. Primary outcomes measured were predicted mortality versus observed mortality. Secondary outcomes calculated were the number of hospital days and progression of sloughing.

Results: The average predicted mortality using the SCORTEN score on hospital day three was 35% and the actual mortality observed in our patients treated with IVIG was 18% (p = 0.29, p = 0.63). Secondary endpoints such as progression of epidermal detachment and number of hospital days were also analyzed. The number of hospital days increased with increasing SCORTEN values. 45% of our patients treated with IVIG therapy did not have progression of sloughing. 60% of patient’s admitted after 2010 had no progression of sloughing. When stratifying the data according to APACHE II score there was a decrease in the gap seen between predicted and observed mortality, 12% and 18% respectively (p = 0.91, p = 0.63).

Conclusions: The SCORTEN predicted mortality on HD 3 was 35 % versus an observed mortality of 18% % (p = 0.29, p = 0.63). This was consistent for all SCORTEN values less than 4. 45% of our treated patients did not have progression of sloughing. When stratifying the data according to APACHE II score there was a decrease in the gap seen between predicted and observed mortality, 12% and 18% respectively (p = 0.91, p = 0.63).

Applicability of Research to Practice: To use IVIG in our treatment of patients with SJS and TEN and to help determine the optimal dosage.

Our Experience with Silver Sodium Carboxymethylcellulose Glove in the Treatment of Partial Thickness Hand Burns

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Introduction: Partial thickness hand burns are challenging to treat because of the complex anatomy of the hand and its importance in motoric and sensoric activity. The treatment aim is to regain as much mobility and sensibility as possible in order to preserve and recover full functionality. Since hands are usually exposed to the environment and can not be covered as other parts of the body, therefore esthetical outcome should be addressed as well. When treating partial thickness hand burns, three major problems need to be addressed: Painful dressing changes, the risk of infection and the mobility of the hand. Convatec presented a silver sodium carboxymethylcellulose glove reinforced with Nylon stitching (AQUACEL® AG BURN), which can be left in place up to 21 days, as alternative to traditional daily dressing changes. Our aim was to evaluate the new glove dressing regarding pain, infection, mobility, re-epithelialization, safety, patients’ satisfaction and costs.

Methods: We report our data treating 10 patients with 2nd degree partial-thickness hand burns that were treated with silver sodium carboxymethylcellulose gloves, compared to a historical cohort of 10 patients with hand burns that were treated with SSD, gauze and a Kerlix bandage. The mean follow-up time was six months.

Results: All study participants reported a very low pain score. No wound infection occurred (also 0 in the control group) and there was a mixed mobility level due to stiff fingers (comparable to the control group). The mean re-epithelialization time was 15 days. The application and removal of the glove were quick and without any complications and could be performed in an outpatient setting. Patients were overall very satisfied with the treatment. No additional dressing changes were necessary until full re-epithelialization.

Conclusions: The silver sodium carboxymethylcellulose glove reinforced with Nylon stitching appears to be an equal if not better alternative to the traditional daily dressing change. It is easy to apply, well tolerated by the patients, can be performed in an outpatient setting and ensures uninterrupted and less painful wound healing in partial-thickness hand burns. Further evaluation should still be performed.

Applicability of Research to Practice: Although further research and evaluation yet to be performed the silver sodium carboxymethylcellulose glove present an equal if not better alternative for treating patients with 2nd degree partial-thickness hand burns. Further treatment indications yet to be established.
Introduction: Burn wound care is labor and time-intensive and accounts for a large portion of nursing time. An evaluation of patient safety reports from our burn intensive care unit (BICU) showed an increased medication error rate (MER) during routine wound care hours. The purpose of this pilot project was to determine if nurse-led wound care teams (WCT) would improve efficiency and decrease errors by freeing up the primary nurse (PN) to administer scheduled medications during wound care hours.

Methods: The Iowa Model of Evidence-Based Practice served as the framework for this project. A committee was formed, education was provided to the multidisciplinary team and wound care skills verification was performed. Normally, wound care is individualized and performed by the patient’s primary Registered Nurse and Licensed Vocational Nurse partner. The WCT consisted of 2 burn nurses working a 12-hour day shift with a 5 patient maximum case load. Nursing time was defined as minutes of wound care/nurse; MER was defined as administration 30 minutes before or after scheduled time. Retrospective data was obtained for a baseline (PreWCT). Prospective observations were divided into 2 groups: wound care by the WCT and by the PN. Student’s t-test assuming unequal variances and Chi square tests were used.

Results: PreWCT (JAN 2013) 224 wound cares occurred; average daily census (ADC) was 8.9 and open total body surface area wound (oTBSA) was 27.4±21%; MER was 25%; mean nurse time was 59±40.4 min (8±10.6 min/oTBSA). During MAR 2013, 245 wound cares occurred (WCT n=87; PN n=158); ADC was 9.4 and oTBSA was 17±10.6% (WCT 20±12.9%; PN 16±8.8%; p=0.021). Overall MER was 20% (28.7% for WCT and 15.2% for PN; p=0.011). Mean nurse time was 41±22.5 min for WCT and 38±28.8 min for PN (p=0.48) with time oTBSA 12±24 min and 5.8±9 min, respectively (p=0.02).

Conclusions: The WCT concept was implemented to provide a more efficient staffing method for the BICU and decrease medication errors. Efficiency increased overall with WCT nurse performing more complex wound care in the same time as the PN team. MER decreased overall after WCT implementation; however for reasons not fully understood, errors increased for patients in the WCT group prompting the cessation of the WCT program. The WCT program was a significant change from normal operations and the unit also experienced additional changes during the intervention, potentially leading to insufficient oversight.

Applicability of Research to Practice: The WCT model has potential for increased staff efficiency; however, it may not be ideal for all burn centers. Unit culture and staff support must be considered prior to the implementation of a significant operational change. Additional investigation is warranted to explore effects in individual burn centers.
269. Can You Save Both Money and Time? A Comparison of a Biosynthetic Dressing and Cadaveric Allograft in Acute Burn Management

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Introduction: Early excision and autografting is a fundamental principle of acute burn care, however, in many circumstances early autografting is unsafe or even impossible. In these situations, skin substitute dressings can be utilized for temporary wound coverage. Two of the more commonly used dressings for this purpose are cadaveric allograft and a biosynthetic dressing. We sought to determine whether any difference existed between these two temporary skin substitutes in relation to cost, operating room time, and outcome.

Methods: A five year cohort study (2008-2012) evaluating isolated upper extremity burns treated with temporary wound coverage. The primary outcome of this study was to determine what impact the choice of wound coverage had on operative time and operating room cost. The secondary outcome was the need for revision of upper extremity debridement prior to definitive autografting.

Results: Forty-five patients were included in this study: fifteen treated with cadaveric allograft and thirty treated with the biosynthetic skin substitute. The groups were comparable in regards to age and gender. Average upper extremity percentage total body surface area involved in the cadaveric allograft group was 6.56±5.06% compared to 8.51±3.96% in the biosynthetic dressing group (p=0.175). Significant differences were identified in the cost and procedure time of each treatment modality when standardized by %TBSA treated. The average cost per minute per %TBSA excised with cadaveric allograft was $2.35±1.26 compared to just $1.30±0.88 for biosynthetic dressing (p=0.002). The absolute difference in cost between the two techniques resulted in two revisions was $2.35±1.26 compared to just $1.30±0.88 for biosynthetic dressing. Both techniques resulted in two revisions due to wound infection complications.

Conclusions: For thermally injured patients requiring temporary coverage of the excised burn wound, the biosynthetic dressing is the more time efficient and cost effective skin substitute. Due to its relative ease of application, the biosynthetic dressing can be used to cover large areas of excised burn in a short period of time. This not only saves operating room time and associated costs, but also spares the patient the risks of a prolonged operation. The findings of this study suggest that the biosynthetic dressing may also be the ideal temporizing skin substitute for mass casualty and conflict situations.

Applicability of Research to Practice: In the current era of healthcare, there is pressure to provide treatment quickly and at lower cost. Clinicians may cite increased expense as a reason to avoid biosynthetic skin substitutes. However, this study suggests that the use of a biosynthetic dressing actually saves both time and money.

External Funding: CIHR 123336. CFI 25407 NIH GM087285-01. PSI.

270. Pediatric Burn Injury in the Inpatient Rehabilitation Setting: A Review of the Uniform Data System for Medical Rehabilitation Dataset

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Introduction: There is a paucity of pediatric burn injury outcome data in the inpatient rehabilitation setting. The primary objective of this study is to describe the pediatric burn inpatient rehabilitation population and examine short-term functional outcomes.

Methods: The Uniform Data System for Medical Rehabilitation dataset from 2002 to 2011 was used to examine children less than 18 years at time of admission to an inpatient rehabilitation facility with primary diagnosis of burn injury. Demographic and functional outcome data were evaluated. The functional variables include functional status at admission and discharge (FIM®/WeeFIM® rating, including motor and cognitive subscores), length of stay, length of stay efficiency, discharge disposition, and home discharge living situation.

Results: A total of 509 children were included, of whom 124 were evaluated with FIM® instrument and 385 were evaluated with WeeFIM® instrument. The mean age of the population was 8.6 years (standard deviation 5.3 years) and the majority was male (72%). The ethnicity was 59% Caucasian and 30% African-American. The median decile total body surface area burned was 30-39% (25th and 75th percentiles were 10-19% and 40-49%, respectively). Functional level on admission was 72 FIM® total/53 WeeFIM® total. Functional status improved from admission to discharge (+27 FIM® change/+22 WeeFIM® change); most of the gains were in the motor subscore. The mean length of stay for the total population was 35 days (standard deviation 53 days) with those evaluated with FIM® instrument having a shorter length of stay than those evaluated with WeeFIM® instrument (16 days and 41 days, respectively). Length of stay efficiency was 1.73 FIM® rating/0.53 WeeFIM® rating. The large majority of the patients (95%) were discharged to home.

Conclusions: This study advances our understanding of pediatric burn post-acute care outcomes. Children receiving inpatient rehabilitation make functional improvements that are substantial. In comparison to previously published data of adults in the inpatient rehabilitation setting, children exhibit longer rehabilitation stays but a larger proportion are discharged to home. This may reflect stronger social support systems for children.

Applicability of Research to Practice: This study adds to our knowledge of pediatric burn injuries by providing inpatient burn rehabilitation outcome data.

External Funding: The National Institute on Disability and Rehabilitation Research.
271. Early Mobilization Practices in Adult Burn ICUs

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Introduction: In today's economic climate, healthcare providers are looking for ways to decrease length of stay and contain costs while at the same time provide the highest quality of care. Early mobilization, while not a new concept in therapy has gotten a lot of attention in recent years as a possible way to achieve the above goals. The purpose of this study is to identify trends and protocols within burn adult intensive care units.

Methods: A confidential internet survey was sent to burn occupational and physical therapists (OT/PTs) from the American Burn Association (ABA) OT/PT Special Interest Group list. Additionally, all burn centers in the United States, as identified by the ABA resource book, were contacted and 1 therapist from each center was asked to complete the survey.

Results: Ninety-one percent of respondents (49/54) report that OT/PT orders for adult burn patients in the intensive care unit (ICU) are received the day of admission. Twenty-one percent (12/45) responded that there is a predetermined OT/PT frequency with daily being the most common response (85%, 11/13). The most common levels of activity with a patient who has a femoral line are: 25% (14/56) no activity restrictions, 23% (13/56) out of bed (OOB) to chair and 23% (13/56) bed level activity. Mechanically ventilated patients are most commonly allowed to perform the following levels of activity: 34% (19/56) no activity restrictions and 30% (17/56) OOB to chair. Ninety-two percent of respondents immobilize the hand postoperatively with a custom splint (80%, 35/44). When the foot or ankle are grafted, the ankle is immobilized post operatively 80% (45/56) of the time. The top choices of immobilization are prefabricated splint 41% (16/39) and custom splint 33% (13/39) of the time. The majority of patients are cleared to get OOB, sit in chair and ambulate (64%, 36/56) and are weight bearing as tolerated (WBAT) (57%, 25/44). If the graft is located on the mid lower leg the majority of respondents do not immobilize (77%, 43/56). Most patients are cleared to get OOB, sit in chair and ambulate (68%, 29/43), between POD 1 and 2 (60%, 26/43) and are WBAT (72%, 31/43). The knee is immobilized 77% (41/53) of the time if the graft is located on or near the joint. A prefabricated splint is most often used (63%, 22/35). The majority of patients are cleared to get OOB between POD 1 and 2 (60%, 22/37) and are WBAT (72%, 31/43). Overall, patients with hand and lower extremity grafts are typically discharged home between POD 5 and 7 (71%).

Conclusions: This data suggests that adult ICU burn patients are mobilizing more quickly within the hospital setting than in years past. Consideration should be given to discharging post operative patients sooner with follow up in the physician's office.

272. Hierarchical Decomposition of Burn Diagram Based on Cutaneous Functional Units and its Utility

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Introduction: A burn body diagram (BBD) is a common feature used in the delivery of burn care for estimating total body surface area (TBSA) burn as well as calculating fluid resuscitation and nutritional requirements, wound healing and rehabilitation intervention. However, little change has occurred for over seven decades in the configuration of the BBD. The purpose of this project was to develop a computerized model using hierarchical decomposition (HD) to more precisely determine percent burn within a BBD based on Cutaneous Functional Units (CFUs). HD is a process by which a system is degraded into smaller parts that are more precise in their use. CFUs are previously identified fields of skin involved in range of motion.

Methods: A standard Lund/Browder (LB) BBD template was used as the starting point to apply CFU segments. LB body divisions were parceled down into smaller body area divisions through a HD process based on the CFU concept. A numerical pattern schema was used to label the various segments in a cephalo/caudal, anterior/posterior and medial/lateral manner. Hand/fingers were divided based on anatomical landmarks and known cutaneouskinematic function. The face was considered using aesthetic units. Computer code was written to apply the numeric hierarchical schema to CFUs and applied within the context of the Surface Area Graphic Evaluation (SAGE) BBD program. Each segmented CFU was coded to express 100 percent of itself.

Results: The CFU/HD method refined the standard LB diagram from 13 body segment and 33 subdivisions into 182 isolated CFUs. Associated CFUs were re-constituted into 219 various surface area combinations totaling 401 possible surface segments. The CFU/HD schema of body surface mapping is applicable to measuring and calculating percent wound healing in a more precise manner. It eliminates subjective assessment of percent wound healing and the need for additional devices such as planimetry. The CFU/HD schema has been applied successfully in associating percent CFU involvement with the development of burn scar contracture. Multiple logistic regression described a better model using CFUs>TBSA (p=0.005).

Conclusions: The development of CFU/HD body mapping schema has rendered a technologically advanced system to depict body burns. The process has led to more precise estimation of segmented body areas while preserving overall TBSA information. Clinical application to date has demonstrated its worthwhile utility.

Applicability of Research to Practice: Exposure of burn clinicians to the CFU/HD method of burn estimation provides more detailed and useful information than the current standard LB.

External Funding: USAMRAA Award # W81XWH-08-1-0683.
273 . Effect of Early Outpatient Exercise Training on Skeletal Muscle Mass and Function in Severely Burned Children

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Introduction: Severe burn results in profound muscle wasting and leads to long-term functional impairments in survivors. Exercise training performed from 6 to 9 months post-injury increases muscle mass, strength, and VO2peak in burned children. The impact of early outpatient exercise, initiated immediately following hospital discharge, on muscle mass and function, and mixed-muscle fractional synthetic rate (FSR), has yet to be examined. Therefore, we determined the effects of early outpatient exercise on muscle mass and function, and FSR in severely burned children.

Methods: Forty-seven children with ≥40 % total body surface area burned performed 12-weeks standard of care rehabilitation (SoC; n=23) or rehabilitative exercise training (RET; n=24) following hospital discharge. Dual-energy X-ray absorptiometry was used to determine changes in whole-body and leg lean mass between discharge and 6 months. At 6 months post-injury, muscle function was assessed using a Biodex Isokinetic Dynamometer and a modified Bruce treadmill protocol. In a subset of patients (SoC n=13; EX n=11), stable isotope infusion studies were conducted at discharge and 6 months to determine FSR.

Results: RET increased whole-body and leg lean mass compared to SoC (RET: 9 ± 2%, 17 ± 3%, respectively; P < 0.01). In addition, relative peak torque (RET: 138 ± 9 N-m/BW vs SoC: 106 ± 9 N-m/BW; P = 0.01) and VO2peak (RET: 32 ± 1 ml/kg/min vs SoC: 28 ± 1 ml/kg/min; P = 0.04) was higher at 6 months with RET compared to SoC. Muscle FSR decreased from discharge to 6 months (DC: 6.9 ± 1.1 %/d vs 6m: 3.4 ± 0.4 %/d; P < 0.01); however no differences were observed between SoC and RET at each time-point.

Conclusions: These results demonstrate that exercise-induced improvements in muscle mass and function can be achieved immediately following hospital discharge. Further, RET was not associated with alterations in basal muscle protein turnover; indicating no adverse effects to hypermetabolism with training.

Applicability of Research to Practice: Early outpatient exercise training represents an effective intervention to augment muscle mass and function following severe burn injury.

External Funding: Supported by National Institute for Disabilities and Rehabilitation Research grant H133A120091; National Institutes of Health grants P50 GM060388, R01 HD049471, R01 GM056687; Shriner grants 71006, 71009, 84080, 84090.

274 . The Association of Burn Size with Multidimensional Functional Outcomes Following Burn Injury in Young Adults

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Introduction: The impact of burn size on mortality is well known, but empiric measurement of the association of burn size with long-term functional outcomes remains poorly studied.

Methods: This five year (2003-8) prospective multi-center study included burned adults ages 19-30 years who completed the Young Adult Burn Outcome Questionnaire (YABOQ) at initial contact, 10 days, and at 6, 12, 24, and 36 months after initial questionnaire administration. Non-burned subjects of comparable ages also completed the questionnaire as a reference group. The association between functional recovery and total body surface area (TBSA) burned was analyzed longitudinally using generalized linear models with the generalized estimation equation (GEE) technique. Functional status was characterized in 15 domains: physical function, fine motor function, pain, itch, social function limited by physical function, perceived appearance, social function limited by appearance, sexual function, emotion, family function, family concern, satisfaction with symptom relief, satisfaction with role, work reintegration, and religion. Domain scores were standardized to a mean of 50 and a standard deviation of 10 based on non-burned controls.

Results: There were 153 burned and 112 nonburned subjects with a total of 620 questionnaires. TBSA burned was 11+14% (Mean±SD); 31% had face involvement and 57% had hand involvement. The lag from burn injury to questionnaire administration was on average 7+7.7 months, with a maximum of 36 months. Lower recovery levels were associated with increasing burn size for physical function, pain, itch, work reintegration, emotion, satisfaction with symptom relief, satisfaction with role, family function, and family concern (p-value ranged from 0.04 to <0.0001).

Conclusions: Decrements in the outcomes of long term functional recovery levels in young adult burn survivors were associated with increasing burn size.

Applicability of Research to Practice: Expectations for multidimensional recovery from burns in young adults can be benchmarked based on burn size.

External Funding: This work is partially funded by the National Institute of Disability and Rehabilitation Research.
275 . Effect of a Six Week Supervised Exercise Program on Lower Extremity Functional Parameters in Burned Children
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Introduction: We have demonstrated that a 12-week exercise program significantly improves endurance and strength in burned children. As a result, a routine in-hospital exercise program has been implemented in our facility. However, this program requires extensive time away from home, work or school; so we aimed to examine the effect of a 6-week supervised exercise program on lower extremity functional parameters (LEFP) in burned children.

Methods: Burned children participated in 6wks of exercise sessions, 5d per week for 20-40 min. Sessions consisted of progressive upper and lower extremity resistance and aerobic conditioning exercises. Assessment of gait speed (GS), 6 minute walk distance (6MWD), peak torque of knee flexion (PTF) and extension (PTE), and knee total active range of motion (TROM) were performed at discharge from our acute care unit and 6 weeks later. Nonburned children underwent the LEFP assessments once and used as reference. Wilcoxon Signed Rank and Mann-Whitney Tests were used to determine results. Results are expressed below as means±SD. Significance was accepted at P<.05.

Results: Age, height, and weight were similar between BURN (n=12) and NONBURN (n=11). Significant improvements following 6wks of exercise were seen in GS (5.0±1.8 sec/4m pre vs 3.9±0.7 sec/4m post, p=.01), 6MWD (1325±475 ft vs 1611±482 ft, p=.01), PTF (42.8±19.8% vs 53.6±27.8%, p=.03), and PTE (95.0±40.1% pre vs 121.2±39.6% post, p=.01). Following exercise; GS, 6MWD, PTF and TROM remained significantly lower among BURN patients compared to NONBURN. However, PTE in BURN had improved such that there was no longer a significant difference between BURN and NONBURN.

Conclusions: A shortened supervised exercise program improves LEFP, though not to a NONBURN level. Further research into optimizing exercise programs to restore lower extremity function in burned children is warranted based on these results.

Applicability of Research to Practice: This study is a stepping stone in the understanding of exercise induced adaptations in the pediatric burn population; enabling medical teams to better tailor therapeutic exercise treatment programs to meet the needs of this patient population.

External Funding: Leon Hess Professorship for Burn Injuries Research; NIH: P50 GM060388, R01 HD049471; NIDRR H133A120091; SHC: 71006, 84080.

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276 . Longitudinal Modeling of 24-Month Global Mental Health
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Introduction: Major burns impair mental health and function (Fauerbach & McCann, Eds.). PTSD (Mason) or body image dissatisfaction (Thombs) in burn patients while in-hospital persists for at least 2 years. Furthermore, pain severity in-hospital predicts suicidal ideation across long-term follow-up (Edwards). However, relationships among these mental health domains is not well understood as longitudinal studies have not sampled psychological dysfunction broadly enough to tease apart such complexities.

Methods: The study sample included 622 participants. Data were collected at baseline (in-hospital), and 6, 12, and 24-months post-injury. The average age was 35.07 years (SD = 19.68) and 71.4% were male and 28.6% female. Ethnicity was weighted toward Caucasian (59.7%) and African American (36.5%). Average total body surface area burned was 13.80% (SD = 13.77%). Measured included in the analyses were: Davidson Trauma Scale, McGill Pain Questionnaire, Satisfaction with Appearance Scale (body image dissatisfaction) and SF-12 Mental Health Subscale (global measure of mental health).

Results: Statistical analysis was performed in IBM SPSS Modeler 14.1 (Chicago, IL). Because the outcome variable was continuous, Auto Numeric module was used to select the best predictive model based on correlation, relative error and number of predictors: the decision tree algorithm (CHAID) evaluated the best predictive model. The criterion variable was SF-12 Mental Health at 24-month follow-up. The strongest predictor variable was SF-12 Mental Health at 12-months (p<.001). Analyses further showed that SF-12 Mental Health at 12 months was composed of 5 nodes, or clusters, based on severity scores (high to low severity: 75). For node 1 (highest severity), age was the next strongest predictor of SF-12 Mental Health at 24-months (p<.001). For nodes 3 and 5 overall Pain Severity was the highest predictor at 24-months (p<.014) and 6-months (p<.013). The best predictor of SF-12 at 24-months in the last node (least severity) was PTSD at 24-months (p<.004).

Conclusions: This analysis highlights predictors of global mental health 24-months post-burn. Considering the wide variety of variables in the model, it is interesting to note the timing of significance, and which variables were or were not significant. For example, the most predictive variables of 24-month global mental health were previous mental health, PTSD symptoms, and overall pain severity. Notably the time that these variables contributed to the model varied.

Applicability of Research to Practice: Some fluctuations in mental health symptoms may be more meaningful than others. These findings may help to direct planning of prevention and intervention efforts.

External Funding: National Institute on Disability and Rehabilitation Research.
Quantitative Analysis of High-Voltage-Electrical Spinal Cord Injury using Diffusion Tensor Imaging
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Introduction: The aim of this study was to investigate the relationships between clinical outcomes and the diffusion as well as electrical conduction characteristics of the spinal cord in patients with high-voltage-electrical injury but showing no abnormal radiological findings.

Methods: We recruited eight high-voltage-electrical injury patients and eight healthy subjects matched for age and sex. Diffusion tensor imaging (DTI) and central motor conduction time were acquired in both patient and control groups. We obtained DTI indices according to the spinal cord levels (from C2 to C7) and parts (anterior, lateral, and posterior). Fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD) were inter-group-compared; additionally, they were intra-group-compared in relation to spinal cord level and part. The correlations among the DTI indices, CMCT, and neurological status of spinal cord injury also were analyzed.

Results: In the patient group relative to the control group, the FA value 2 decreased and the MD and RD values increased in all of the regions of interest with statistical significance (p<0.05). Within the patient group, comparing the anterior spinal cord with the lateral and posterior spinal cords, the FA decreased in the ROIs (p<0.05). The DTI indices did not differ by level. The ASIA motor score tended to correlate with the FA of the anterior spinal cord (p=0.16) and with CMCT (p=0.12).

Conclusions: DTI revealed myelopathy in patients with high-voltage-electrical injury; and corroborated high-voltage-electrical spinal cord injury’s reported pathophysiology, including myelopathy and ascending homogeneous involvement more typically affecting the anterior spinal cord.

Applicability of Research to Practice: Rehabilitation, Diagnostic Imaging.


Impact of the Vacuum Assisted Closure Device on Ambulatory End-Points in Lower Extremity Burns
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Introduction: The vacuum assisted closure device (VAC) has been described as a bolster device to secure a split thickness skin graft (STSG). One of the hypothesized benefits of using this system in lower extremity (LE) burns is decreased time to ambulation compared to applying a pressure dressing and splinting. This may lead to improved initial functional status, and possibly earlier discharge. No studies have compared ambulatory outcomes in burn patients treated with the VAC versus those who are splinted.

Methods: A retrospective review of records was conducted from a regional burn center over a 27-month period. Patients included sustained isolated LE burns, received STSG, spent less than 10 days in the hospital, and received either a VAC or pressure dressing and splint. Data points included age, burn mechanism and location, grafted area, hospital days, time to physical therapy (PT) clearance, discharge equipment, graft take, and time to re-epithelialization. Statistical analysis was performed using independent t-test and Chi-squared analysis as appropriate to the data.

Results: Seventy-eight patients were included. Twenty-nine received a pressure dressing and splint while forty-nine received a VAC. Results are summarized in Table I. VAC patients were significantly older (p=0.05). VAC patients required fewer PT visits, were cleared sooner, and needed less ambulatory equipment at discharge, though these differences were not statistically significant (p=0.52,0.51,0.66, respectively). VAC patients tended to spend more time in the hospital but this difference was not statistically significant (p=0.20). There was no difference in graft shear between groups.

Conclusions: VAC and splint groups did not differ significantly in any of the ambulatory parameters. Possible reasons include younger age in the splint group, and potentially improved functional status, issues involving ambulation with VAC equipment, or because of small sample size. VAC group discharges may have been delayed by home VAC approval. Both groups achieved excellent graft-takes and did not sustain graft-shear.

Applicability of Research to Practice: This is the first study to compare ambulatory end-points in patients receiving VACs with those receiving pressure dressings and splints in LE burns. Based on these results, use of a VAC does not significantly change end ambulatory parameters, graft take, or length of hospital stay. Decision makers should consider other factors when selecting bolster modalities.

Table I

<table>
<thead>
<tr>
<th></th>
<th>VAC (n = 49)</th>
<th>p-value</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>34.8 (±17.8)</td>
<td>0.05</td>
</tr>
<tr>
<td>TBSA (%)</td>
<td>1.5 (±1.4)</td>
<td>0.43</td>
</tr>
<tr>
<td>Grafted area (cm2)</td>
<td>93.2 (±118.4)</td>
<td>0.45</td>
</tr>
<tr>
<td>Graft take (%)</td>
<td>99.1 (±40.9)</td>
<td>0.35</td>
</tr>
<tr>
<td>Post-op days to epithelialization</td>
<td>12.5 (±5.8)</td>
<td>0.97</td>
</tr>
<tr>
<td>Number of PT Visits</td>
<td>1.5 (±1.5)</td>
<td>0.52</td>
</tr>
<tr>
<td>Days to PT clearance</td>
<td>1.62 (±0.75)</td>
<td>0.51</td>
</tr>
<tr>
<td>Discharge ambulatory equipment (% requiring)</td>
<td>51.7 (±50.1)</td>
<td>0.66</td>
</tr>
<tr>
<td>Hospital Days</td>
<td>2.3 (±2.5)</td>
<td>0.20</td>
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</table>
Introduction: With increasing burn survival, long term effects of burn injuries on health related quality of life (HRQoL) are important outcomes to capture. Social integration is an important domain of Community integration as related to HRQoL. This study seeks to assess the psychometric properties of community related social integration following burn injuries.

Methods: Data was obtained from, a multicenter longitudinal dataset which tracks HRQoL outcomes following burn injuries. Included in the dataset are six items from the social integration domain of the Community Integration Questionnaire. Data was examined at six months following burn injury. Classic psychometrics included confirmatory factor analysis examined for construct validity. Separately, internal consistency reliability using Cronbach alpha statistics were used to assess reliability. Based on this analysis, non-fitting items were eliminated and a total score was constructed from the remaining items. Two items were eliminated leaving a 4 item scale (Table 1). Following this, Rasch analysis used the Partial Credit Model to further establish evidence of validity. Violations to the Rasch model’s assumptions were tested. Finally, a regression model was used to determine the association of age, gender, race/ethnicity, and % total body surface area burned (TBSA) on social integration following burn injury.

Results: The sample included 545 individuals with a mean age of 44.3 years (SD ± 15.6), 74% male, mean TBSA burned of 20% (± 17.0), 11% inhalation injury, 63% injured by a flame, 11% grease, 8% scald, 6% electricity, 6% hot objects, 3% flash, 2% chemical and 1% other. The four item CIQ domain (CIQ-4) gave a Cronbach alpha of 0.69 with unidimensional factor loadings ranging from 0.50 to 0.88. Rasch analysis showed no statistically significant violations from model assumptions (p=0.145). Linear regression indicated that older patients and those non-white subjects were significantly associated with lower levels of community integration at six months (p=0.008 and p< 0.001 respectively).

Conclusions: The CIQ-4 showed evidence of reliability and validity based on classical psychometrics and item response theory. Older age and non-white race/ethnicity are important prognostic factors for social integration following burn injuries.

Applicability of Research to Practice: A brief four-item social integration scale may be a valid tool for assessing an important aspect of community integration in the burn population.

External Funding: NIDRR.
**Introduction:** The Surgery Undergraduate Research Fluency (SURF) summer volunteer program gives undergraduate students interested in medicine or science exposure to clinical research. While our program focuses extensively on clinical research, it also provides opportunities for experience in all aspects of the surgery department through regular conferences, clinical shadowing, and networking opportunities. The educational component is done through an organized research-based curriculum. Participants attend classes focusing on the management of research studies, regulations, policies, medical statistics, and ethics pertaining to conduct of research involving human subjects. In addition, they have the opportunity to shadow surgeons and are mentored by scientists, research staff, and physicians in the burn center. The purpose of this study was to assess the program's success and participant satisfaction.

**Methods:** An electronic survey asking participants to rate various aspects of the internship was distributed to all participants 2002 - 2012.

**Results:** A total of 85 alumni have completed the program since its start in 2002. This research has resulted in at least 15 abstracts presented at national meetings and 5 publications in peer-reviewed journals. Forty-five alumni responded to the survey, with 27 (60%) reporting they participated in burn research. Nearly every respondent indicated they would recommend the SURF program to current college students (96%). Also, the majority felt it helped them more clearly define their career goals (89%), instilled confidence in them to perform research (73%), and their expectations of the program were exceeded (78%). Areas of research they feel the program assisted them in improving were literature search abilities (51%), spreadsheet development (69%), reading medical records (78%) and independent thinking (49%). Suggested areas for further development included duration of the program lengthened (38%) and more clinical experience (33%), while 24% indicated “nothing”.

**Conclusions:** The research internship's success can be seen in the number of abstracts presented and manuscripts published. In addition, even greater success was demonstrated by the high satisfaction ratings and that the majority of post-undergraduate respondents (96%) went on to careers in medicine or science. Over half (53%) attend or have completed medical school.

**Applicability of Research to Practice:** An internship with a strong core curriculum, willing mentors, and helpful research support resources can significantly contribute to student scientific/research education. In addition, it can add to the development of scholarly activity within a burn center. Participants also gain excellent exposure to burn as a potential career choice.
283 . Pediatric Burn Care: Overutilization of a Regional Transfer System
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Introduction: Our dedicated burn team treats pediatric burn patients in a 52,904 square mile region with 4.4 million people. Inability to adequately assess burn care needs by providers within this area results in a high number of transfers of low acuity acute pediatric burns. This analysis quantifies and qualifies the pediatric burn patients transferred to determine the need for education and telemedicine for this area.

Methods: Retrospective data evaluation of 853 burn patients admitted between January 2008 to August 2012 at an ACS Level 1 adult and level 2 pediatric trauma center with a dedicated burn team.

Results: Over the study period, 658 out of 853 patients were transferred from another hospital. There were 389 boys and 337 girls; average age was 5.7 years. The mode of transport included private vehicle (267), ambulance (335), and helicopter (56). Of the patients transported, 34% traveled a distance greater than 157 miles and of these, 70% patients traveled greater than 277 miles. The median burn size for all transferred patients was 5% TBSA [private vehicle 4%TBSA, Ambulance 5%TBSA, Helicopter 10%TBSA]. The median hospital length of stay was 1 day for patients arriving by private vehicle and ambulance and 2 days for helicopter transfers. In this cohort of patients, 66% stayed in the hospital only 1 day and 58% of these patients were transferred by ambulance or helicopter. There were 29 patients who required split-thickness skin grafts and 85 patients who had documented hypertrophic scars. The average follow-up for the group was 3 visits.

Conclusions: The majority of pediatric patients with burns transferred acutely to our regional center had low acuity burns, many of which may not have necessitated transfer. This puts excess burden on both the health care system and the patients. While there is an absolute need in the region for pediatric burn care, development of an efficient means to provide care locally through education and remote evaluation of burns would benefit our region.

Applicability of Research to Practice: Develop telemedicine and education programs for acute and chronic management of pediatric burn patients for a large geographic region.

284 . Scientific Comparison of Burn Injuries Based on Objective Assessment
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Johannes Kepler University Linz, RISC Software GmbH, Hagenberg, Austria; AUVA Unfallkrankenhaus Linz, Linz, Austria; Medical University of Graz, Graz, Austria

Introduction: In recent years a complete and accurate documentation of injuries, treatment and convalescence has become essential for many reasons such as improvement of treatment, legal requirements and many more. Publications state that surface estimations concerning the same injuries have significant variations. In order to tackle this drawback, the overall aim of our long term research project is to facilitate complete and objective burn assessment and documentation.

Methods: In order to avoid subjective estimations within the burn assessment process, we have developed a software system which uses an individually adapted three-dimensional model as a basis. Furthermore, this model is used to define areas of burns, surgical procedures or care services; consequently the surface of those regions can be calculated. By integrating the processing of false-color pictures generated by burn depth determination systems, burns can be automatically transferred to the 3D model. Our system superimposes the digital image and aligns the model and the patient on the picture. A special algorithm automatically projects all false-colored areas onto the model surface.

Results: Our research group provides a system for assessing and documenting burn injuries completely and objectively. Besides the objective burn assessment relevant medical encodings and various reports can be generated; furthermore, it offers an interface to the American NTRACS system. The developed system is constantly used, evaluated and improved by a growing number of burn centers across the world.

Conclusions: By implementing (semi-) automatic documentation capabilities it is possible to generate reproducible diagnoses for burn injuries and therefore improve the documentation quality. The complete documentation is available electronically, which enables that acquired data can easily be queried and used to support physicians in their scientific work. Subsequently, the documentation workload can be reduced and the quality of burn assessment can be improved.

Applicability of Research to Practice: The described system is the result of research work done in the past ten years in cooperation with numerous medical partners. The combination with burn depth determination systems reduces workload and at the same time improves quality of documentation, enabling an objective comparison between burn cases, treatments and outcomes.

External Funding: The project is funded by the Upper Austrian Government and the Österreichische Forschungsförderungsgesellschaft (FFG).
Central Line-Associated Bloodstream Infection (CLABSI) Criteria & Rates: Are We Speaking the Same Language?

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Introduction: Elimination of CLABSI is a major focus of the Agency for Healthcare Research and Quality (AHRQ) and the Centers for Disease Control (CDC). CLABSI reporting to the National Healthcare Safety Network (NHSN) is mandatory and affects reimbursement. The data are published and available to the public via the Centers for Medicare & Medicaid Services (CMS) Hospital Compare website. Burn centers are partners in this endeavor but questions remain regarding definitions, data fidelity, and benchmarks.

Methods: A PubMed query was done to identify studies from 1992-2013 involving central venous catheters and CLABSI rates in burn patients. Criteria and rates for CLABSI were collated. Pooled means and rates by percentile rank from the NHSN annual reports were collated for the same period. The CDC defined CLABSI in 1988 with updates issued in 2002, 2004, 2008, 2011, and 2013. These were tabulated for comparison as were those from the ABA Consensus Conference to Define Sepsis and Infection in Burns. Three studies prior to 1992 were included to evaluate potential differences prior to formal NHSN reporting.

Results: Fifteen studies were included. CDC criteria were used in 4 studies, though their application was variable. Non-CDC criteria were used in 11 studies. Rates were reported in standard format (Infections/1000 catheter days) in 6 studies while 9 studies reported %Catheters Infected. CLABSI rates in standard format were highly variable (mean 21.9, median 9.0, range 0-47.2) and generally greater than NHSN data, which showed steady decline from a pooled mean of 7.0 (1992-2004) to 3.7 (2011). Rates reported as %Catheters Infected were also variable (mean 18.8, median 10.9, range 0-85.6). Institutions submitting data to the NHSN increased from 14 to 71.

Conclusions: CLABSI rates reported in the burn literature are significantly different from those reported by the NHSN. They are from single institution studies, often utilize non-CDC criteria, and often report rates differently. CLABSI criteria may be adjusted in research for issues of sensitivity and specificity. However, larger studies with standardized criteria are necessary to drive evidence-based practice changes that improve patient outcomes. It would also allow interpretable comparisons among studies and with NHSN data.

Applicability of Research to Practice: The NHSN burn data are neither stratified nor risk-adjusted as they are for other critical care locations. High quality data must be generated in order to engage the CDC on these issues and establish appropriate benchmarks.

Comparison of Military Outcomes to the National Burn Repository (NBR)

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Introduction: The National Burn Repository (NBR) was established by the American Burn Association to collect data submitted by burn centers in North America. These data are presented in the Annual Report and include demographics, injury information, and outcomes. This allows individual burn centers to show how their experiences compare with peer centers. The purpose of this activity was to review the 2013 NBR (spanning 2003-2012) and compare to military casualties treated at our Burn Center over the same time span.

Methods: Data from our Burn Center Registry (BCR) were compared to the NBR. A cohort of 1060 patients was identified in the NBR via propensity matching for age, gender, total body surface area (% TBSA) and inhalation injury (INH). The amount of full thickness burns (% FT), ventilator days, intensive care unit (ICU) days, hospital length of stay (LOS), and mortality were compared to the national average.

Results: Between Jan 2003 and Dec 2012, 1060 military patients with burns were admitted to our burn center. Patients (1060) were identified in the NBR via propensity matching for age (27±9), gender (96% male), % TBSA (15±19) and INH (14%). Our military patients, of whom 970 (91.5%) patients were injured in Overseas Contingency Operations (OCO), (including Iraq and Afghanistan) had a higher % FT (17±20 vs. 7±17, p<0.0001), equivalent ventilator days (5±16 vs. 5±17, p = NS), a longer ICU stay (9±23 vs. 8±20, p<0.001), and greater LOS (24±38 vs. 14±23, p<0.0001) when compared to the NBR. Finally, mortality in our military BCR group was lower (5% vs 8%, p=0.0057) than the NBR.

Conclusions: Despite the fact that 91.5% were injured in overseas operations, military burn patients had a lower mortality when compared to the NBR in a population matched for age, gender, % TBSA, and inhalation injury.

Applicability of Research to Practice: Establishing benchmarks is important for national comparisons. Our outcomes at this Burn Center are comparable to national standards.
**Comparison of Scald Burns in Young Children from the U.S. and Mexico: A Guide for Prevention**

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**Introduction**: Studies have shown that young children are at risk for scald burns. The mechanism of these injuries may vary depending on country of origin, cultural and socioeconomic factors. Identifiable risk factors may also vary. The purpose of this study was to compare the nature of scald burns in young children from the U.S. and Mexico hospitalized at this acute pediatric burn facility, identify modifiable risk factors, and make recommendations for prevention.

**Methods**: A retrospective chart review was performed with children ages < 5 who were treated acutely at this burn facility from 2000-2013. The medical records of 866 acute pediatric burn patients were reviewed. Children from the U.S. come to this hospital because of the proximity to the hospital, whereas, the children from Mexico come due to the extent of their injuries. Demographic data were stratified by country of origin and further by total body surface area burned (TBSA < 40%, TBSA 40% - 60%, and TBSA > 60%). Mann-Whitney tests were used to assess whether country of origin was related to age, TBSA, and percent 3rd degree, and chi-square tests to assess the differences among categorical variables. Multiple logistic regression was used to examine the relation to patient's country of origin with age at burn and burn size.

**Results**: The charts of 693 patients from the U.S. and 173 patients from Mexico were reviewed. There was an equal distribution of males and females in both groups (46% males, 54% females). Mann-Whitney test revealed a significant difference in the median age at burn for children from the U.S. (1.5 years) and Mexico (2.5 years) with children from the U.S. being younger, (p < .0001). Children from Mexico had significantly larger burns (45%±16) than those from the U.S. (11%±11), (p < .0001). The primary cause of burns of children from Mexico was falling into large containers or pots whereas the primary cause for the U.S. were spills and pulling hot substances, (p < .0001). Country of origin was associated with significant interaction between age and burn size (p =.018). As age and especially TBSA increased, the odds of being from Mexico and receiving medical care at this hospital also increased.

**Conclusions**: The cultural and socioeconomic variables need to be taken into consideration in assessing prevention of scald injuries in young children for prevention campaigns to be developed. A more comprehensive collection of pediatric burns needs to be done to better understand the etiology of burns in young children. Further studies need to be done to identify the efficacy of prevention strategies and protective factors.

**Applicability of Research to Practice**: This information will be used to develop a prevention campaign.

**External Funding**: NIDRR: H133A120091.

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**Portable Gas Bottles: The Prevalence of Burn Injuries and the Dangers Associated with their Use**

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**Introduction**: Portable gas cylinders have become a common household item. The prevalence of burns admissions as a result of outdoor barbecues, indoor portable gas heaters and gas bottles over the last five years is examined.

**Methods**: A retrospective review of inpatient admissions to an adult burns unit from January 2007 to August 2012 was conducted. Patient demographics (age, gender) mechanism of injury, percentage of total body surface area, distribution of burn, depth and date of admission were considered.

**Results**: A total of 61 admissions resulted from gas barbecues, gas heaters and gas bottle incidents. Thirty-two (52.5%) admissions were attributed to gas bottle explosion. Thirty-three (54.1%) of the cases were due to gas-powered barbecue explosions. Most of the barbecue incidents occurred during the summer and males (95.1%) predominated. Five (8%) cases were due to gas heater explosion with all occurring in the winter months and three admissions in the year 2012 alone. The majority of cases (29.5%) were aged 35-44 years, followed by those aged 18-24 years (21.3%).

**Conclusions**: Burn injuries as a result of outdoor barbecues, indoor heaters and pressurised gas bottles have increased over the last few years, possibly reflecting an increased use of portable gas bottles. It is strongly recommended that safety measures and precautions are taken in order to minimise these injuries.

**Applicability of Research to Practice**: - New epidemiological insight for this region.
- Has potential social, political and economical ramifications.
- Prevention recommendations outlined in presentation.
- Education measures outlined in presentation.
Introduction: Burns suffered through contact with hot pavement are uncommon in the United States. As such, there is a paucity of literature available regarding this specific demographic. The goal of this study was to investigate these injuries to characterize associated factors, impact on patient outcomes, identify areas for prevention, and search for areas of quality improvement.

Methods: Patients admitted to the burn center for injuries from contact with hot pavement from 2008-2012 were chosen. A retrospective review was performed. Patients were stratified by concomitant factors and data analysis was performed to compare TBSA burned, number of operations, length of stay, and hospital costs.

Results: Over a five-year period, 89 patients requiring hospitalization after suffering burns through contact with a hot item were identified. Seventeen patients were excluded from data analysis, as their mechanism of injury was either unclear or not associated with pavement contact. Categorization of concomitant factors into altered mental status (AMS), diabetic neuropathy, physical impairment or disability, and toddler age group incorporated over 90% of the cases. The necessity for operative intervention was present in approximately 56% of all cases, and greater than half of these patients required multiple operative sessions. Of those patients necessitating operative intervention, the average cost per percent body surface area burned was $62,767. Direct comparison of those with and without AMS (including intoxication) showed a statistically significant difference in TBSA burned, number of operations, length of stay, and total hospital costs (p<0.001, p<0.01, p<0.01, and p<0.01 respectively), with greater values consistently seen in the population with AMS.

Conclusions: This review describes the largest reported series of patients suffering burns from contact with hot pavement. Patients who have suffered such burns because of AMS are more likely to require multiple debridements, encounter higher costs, and lengthier stays. The data presented allows the practitioner to have a high index of suspicion for the likelihood of damage to tissues deeper than the initial appearance. Educating child caregivers and diabetics about the importance of foot protection, as well as police and emergency response workers about the importance of immediate removal of victims from hot pavement are potential opportunities for prevention. Finally, areas for quality improvement include selecting pressure off-loading beds for these patients immediately upon admission.

Applicability of Research to Practice: The data presented allows the practitioner to have a high index of suspicion for the likelihood of damage to tissues deeper than the initial appearance. Areas for preventative education and quality improvement have been identified.

Introduction: Smad3 is a principal intracellular mediator of signaling for TGF-β, a cytokine involved in pleiotropic pathophysiological processes including inflammation and immunity. The function of Smad3 in regulating iNOS expression and septic shock has not been characterized.

Methods: Smad3−/− (KO) and wild-type (WT) mice were injected intraperitoneally with lipopolysaccharide (LPS) to induce the septic hypotension, their mortality, blood pressure and plasma levels of nitrite were measured, and the iNOS mRNA and protein levels in lung, kidney and spleen were also analyzed.

Results: Mice lacking functional Smad3 respond to LPS with greater mortality than their WT littermates. The high mortality of Smad3−/− mice is accompanied by enhanced hypotension following intraperitoneal injection of LPS. Both KO and WT mice displayed an increase in plasma nitrite during the experimental period; however, LPS administration caused more dramatic changes in KO mice than WT mice. Likewise, the iNOS mRNA and protein levels in lung, kidney and spleen were more strongly increased in KO mice than in WT mice after LPS administration.

Conclusions: Defects in the Smad3 gene may increase susceptibility to the development of septic hypotension due to enhanced iNOS production.

Applicability of Research to Practice: Prevention and treatment of burn infection.

External Funding: This study was supported by the project of the National Natural Science Foundation of China (81000308) and the Science and Technology Commission of Shanghai Municipality (12QA1404400). There are no potential conflicts of competing interest relevant to this article.
Hyperglycemia Differentially Regulates Various Cytokine Production from Macrophages

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Introduction: Hyperglycemia responses occur in all trauma, surgical, or critically ill patients, but the severity, duration, and magnitude is uniquely severe for burn patients. The hyperglycemic state begins within five days of a major burn injury and persists for as long as one year. However, the mechanisms of how hyperglycemia regulates immunity are not fully understood.

Methods: Since macrophages play pivotal roles in immune dysfunction in major burn patients, we examined the effects of hyperglycemia on the phenotypes and functions of bone marrow-derived macrophage (BMM). Mouse bone marrow cells were cultured in vitro with regular (Glucose, 5 mM/L) or high glucose (Glucose, 9 mM/L, 12.5 mM/L and 25 mM/L) media supplemented with 40ng/ml of M-CSF for 7 days.

Results: Our results showed that the BMM cells proliferated with the increase of glucose concentration in the media in a dose-dependent manner. The elevation of media glucose concentration correlated with the increase of M-CSF receptor CD115 levels of BMM cells. In a dose-dependent manner, high glucose in media increased IL-1β expression but inhibited IL-12 and TNF-α production of BMM in response to LPS stimulation. In addition, high glucose inhibited HLA-DR expression and Dextran uptake of macrophage, indicating that it might inhibit macrophage's antigen presentation. Furthermore, we observed the activation of PKA in 9mM/L and 12.5mM/L glucose media and inhibition of PKA in 25mM/L glucose media, indicating perturbation of metabolic signaling. Dose-dependent increase of BiP expression indicated ER stress response of macrophages to hyperglycemia.

Conclusions: Overall, chronic exposure of bone marrow to hyperglycemia promoted myelopoiesis, but these macrophages were functionally impaired with inhibited cytokine production and phagocytosis. Hyperglycemia induced ER stress of macrophages, which underlies their immunological malfunctioning.

Applicability of Research to Practice: These results indicate that hyperglycemia has profound effects on the immune function and that glucose control may exert its benefit via an improved immune system.

External Funding: CIHR 123336. CFI 25407. NIH GM087285-01.PSI.

The Value of Obtaining Sputum Cultures in a Burn Unit

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Introduction: Acute burn patients receiving mechanical ventilation generally develop a Ventilator Associated Pneumonia (VAP) when their airway is exposed to foreign objects and there is bacterial invasion of the pulmonary parenchyma. The Centers for Disease Control, National Healthcare Safety Network uses 3 groups of criteria for identifying a VAP that include clinical signs and symptoms, radiographic, and microbiological, but even when given the CDC’s guidance this information can still be rather subjective. The purpose of this study is to retrospectively evaluate the total number of sputum cultures sent to the laboratory in comparison to the number of hospital acquired VAPs and VAPs present on admission to this institution.

Methods: This study evaluates sputum cultures taken over a 1.5 year period and compares this information to the number of VAPs at this institution. All positive and negative sputum cultures we evaluated on all patients admitted to the burn unit between 2012 and 2013. VAPs were defined using the CDC NHSN definition. Outcome variables included: Incidence of Hospital acquired VAP, Community acquired VAP, organisms identified and pathogenicity of organisms.

Results: Sputum cultures (n=210) were obtained on pediatric burn patients (n=45) during this 1.5 year time period in which 110 cultures (52%) were positive and 100 cultures (48%) tested negative. The cultures most commonly tested positive for the following microorganisms: Staphylococcus species (33%), Pseudomonas aeruginosa (31%), Klebsiella pneumoniae (15%), Acinetobacter baumannii/haemolyticus (6%), MRSA (2%). During this study period the organization identified 1 Hospital Acquired VAP and 2 VAPs that were transferred from outside institutions. The hospital acquired infection microorganism was Pseudomonas aeruginosa and the two outside VAPs were related to MRSA and Acinetobacter baumannii/haemolyticus.

Conclusions: Results indicate that organisms like Pseudomonas aeruginosa, MRSA, and Acinetobacter baumannii/haemolyticus tend to be more multidrug resistant and more pathogenic in the respiratory system. More research needs to be conducted on evaluating techniques when collecting sputum cultures and at what point in treatment should providers order sputum cultures on pediatric burn patients.

Applicability of Research to Practice: To help evaluate the number of VAPs in comparison to the positive sputum cultures. This may allow providers to focus more on key organisms that tend to be more pathogenic in the pediatric burn population.

External Funding: Shriners Hospitals for Children-Galveston Grant 84080.
Nephrilin Peptide Modulates a Neuroimmune Stress Response in Rodent Models of Burn Trauma and Sepsis.

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Introduction: Sepsis occurs three times more often in burns than in other types of trauma, suggesting an overlap or synergy between underlying immune mechanisms in burn trauma and sepsis. Nephrilin peptide, a designed inhibitor of mTORC2, has previously been shown to modulate a neuroimmune stress response in rodent models of xenobiotic and metabolic stress. Here we investigate the effect of nephrilin peptide administration in different rodent models of burn trauma and sepsis.

Methods: Using a well-validated rat scald burn model we injected rats daily either with saline or 4 mg/kg body weight nephrilin. Animal tissues were analysed at 24 hours post-burn (Day 1) and on Day 14, in order to capture acute and delayed phases of the NSR. Nephrilin was similarly tested in the cecal ligation and puncture (CLP) mouse model of polymicrobial sepsis after surgical stress, measuring mortality in the Day 1-7 range.

Results: In the rat scald burn model, daily subcutaneous bolus injection of 4 mg/kg nephrilin significantly reduced the elevation of kidney tissue substance P, S100A9 gene expression, PMN infiltration and plasma inflammatory markers in the acute phase, while suppressing plasma CCL2 and insulin C-peptide, kidney p66hc-S36 phosphorylation and PKC-beta and CGRP in dorsal root ganglia at 14 days (chronic phase). In the mouse cecal ligation and puncture model of sepsis, nephrilin fully protected mice from mortality between surgery and day 7, compared to 67% mortality in saline-treated animals, while significantly reducing elevated CCL2 in plasma.

Conclusions: mTORC2 may modulate important neuroimmune responses in both burn trauma and sepsis.

Applicability of Research to Practice: Traumatic stress is associated with secondary complications such as sepsis and organ failure, which lead to morbidity and death. The mechanism has never been elucidated. This work provides a novel mechanistic explanation and intervention.

External Funding: This work was supported, in part, by grants from the NIH to D.N.H. (R01-GM56687, P50-GM60338, T32-GM08256), and by the SHC animal core (80100, 80500). C.C.F. is an ITS Career Development Scholar supported, in part, by NIH KL2RR029875 and NIH UL1RR029876.

Electrospun Synthetic Scaffolds: A Biomimetic Approach to Prevent Hypertrophic Scar Contraction

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Introduction: HSc is a debilitating condition that results in disfigurement and decreased range of motion in joints. In unwounded skin, native collagen is arranged randomly, myofibroblasts are absent, and matrix stiffness is low. Conversely, in HSc, collagen is arranged in linear arrays while myofibroblast density and matrix stiffness are high. The current standard of care for HSc involves skin grafting with or without the placement of a collagen based bioengineered skin equivalent (BSE). Present BSEs assist in tissue regeneration but do not target HSc. To overcome this significant unmet medical need, we have created an elastomeric biomimetic scaffold which will persist through the remodeling phase of repair.

Methods: Electrospun scaffolds were created with randomly-oriented fibers akin to collagen fiber alignment in unwounded skin. Mechanical properties were characterized via microstrain analysis. Fibroblast ingrowth and matrix contraction were compared between scaffolds and fibroblast populated collagen lattices (FPCL). Scaffolds were then placed beneath skin grafts in an immune competent murine HSc model.

Results: Scaffolds demonstrated a lower (but not significant) elastic modulus than human skin and a collagen BSE; suggesting scaffolds will not prohibit movement. Ultimate tensile strength of scaffolds was greater than human skin, while the BSE was significantly weaker, making the scaffolds tougher than their environment and giving them the ability to withstand forces experienced by skin. Scaffolds supported fibroblast ingrowth and proliferation analogous to the FPCL, but prevented nuclear alignment observed in FPCL. After seven days of culture, the scaffold contracted only 8 +/- 1.5% whereas the FPCL contracted 66 +/- 9%, with significantly fewer myofibroblasts in the scaffold. To confirm scaffold reduction of HSc in vivo, scaffolds were placed beneath skin grafts in a validated immune competent murine HSc model. The scaffolds limited HSc contraction to 6 +/- 0.2%, whereas wounds treated with the BSE contracted 65 +/- 5% and control scars contracted 68 +/- 4%. Skin grafts were healthy and scaffolds were found to promote fibroblast invasion, angiogenesis, and macrophage recruitment.

Conclusions: The data demonstrate that biomimetic electrospun scaffolds provide a mechanical environment which prevents nuclear alignment, matrix contraction, and myofibroblast activation associated with HSc.

Applicability of Research to Practice: These findings suggest the importance of mechanical properties in preventing HSc, and will help guide the rational design of future generations of BSEs in treating the millions of patients who suffer from burns annually.

External Funding: Authors thank the HHMI Med Fellowship, NSF Graduate Research Fellowship, and NIH for their support.
295. Effect of Thermal Injury on TRPV4 and c-Kit+ Stem Cells in Skin

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Introduction: Second and third degree burns are an important cause of morbidity and mortality worldwide. In these patients, ischemia-reperfusion plays a significant role in the worsening of thermal skin wounds. However, the cellular mechanisms resulting from ischemia-reperfusion induced skin injury are still not clearly known. We postulated that an increase in free radical (superoxide anion: O2•-) generation leads to damage of stem cells located in the skin and subsequently impairs wound healing.

Methods: To test our hypothesis, skin discards from burn patients undergoing skin graft surgery at our hospital Burn Center were collected. These samples were separated into two groups (deep 2nd (n=5) and 3rd (n=6) degree burn) based on clinical criteria. In these groups we measured O2•- levels, performed hematoxylin staining and used immunofluorescence microscopy to determine CD133+ and c-Kit+ stem cell localization. O2•- generation can be induced by ischemia-reperfusion, trauma induced hyperglycemia, or co-morbidities such as diabetes.

Results: Our findings demonstrate that O2•- levels were 30% (P<0.05) higher in the 3rd degree burn samples as compared to the deep 2nd degree samples. Coincidently, O2•- levels were also elevated in patients having elevated blood glucose prior to surgery. Skin histology performed by hematoxylin staining shows distinct epidermal and dermal structure along with fairly intact hair follicles and sebaceous glands in the deep 2nd degree tissue, however these structures were absent in the 3rd degree burnt skin. Whereas, we could not detect CD133+ cells in the 2nd and 3rd degree burnt skin, we were able to detect c-Kit+ cells in both the epidermis and dermis. These cells were primarily identified as epithelial cells of sebaceous glands and ducts, as well as cells of the blood vessel wall of deep 2nd degree burn specimens. These cells and structures were not observed in the 3rd degree burn samples. Additionally, we found that c-Kit-dependent signaling, which mediates nociception signals, and transient receptor potential cation channel subfamily V member 4 (TRPV4) channels, which are involved heat sensing, were down regulated in diabetic/hyperglycemic patients.

Conclusions: c-Kit+ cells are critical to regenerate specialized cells during wound healing. A lack of these cells and TRPV4 channels correlated with high oxidative stress, illustrating a potential cause of impaired wound healing in 3rd degree burn patients.

Applicability of Research to Practice: This points to the direction of future research involving regeneration of skin using stem cell therapy in full thickness burn injury.

296. Serum Levels of Neurofilament-H Are Elevated in Patients Suffering from Burn Injury

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Introduction: In previous studies of indirect brain injury (iBI) in burn patients, an increase in neuro-inflammation, edema, and neuronal cell death has been reported. As demonstrated in other brain injury models, fluid-based biomarkers such as phosphorylated -neurofilament-H (pNFL-H) have been shown to correlate with injury severity. In this study we hypothesized that burn-injured patients have an increase in pNFL-H in the blood at both the acute (day 1) and chronic (days 7 and 14) time-points after injury.

Methods: In this prospective clinical study, blood (8cc) was collected from burn patients (n=36; TBSA 20-60%) at Parkland hospital, Dallas, Texas, on days 1, 7, and 14 after injury. Following collection of the blood sample, the tubes were centrifuged, and aliquots of the serum were stored at -80 degrees Celsius. The serum levels of pNFL-H were measured using the enzyme-linked immunoassay (ELISA).

Results: Compared to non-injured controls, the burn patients exhibited a significant increase in the serum levels of pNFL-H on days 7 (*, p=0.001) and 14 (**, p=0.003) after burn injury. No significant increase was observed on day 1 (p=0.13) after injury. Additionally, using the receiver operating characteristic (ROC) analysis, we determined the area under the curve (AUC) was 95% and 96% for days 7 and 14, respectively. The cutoff value for day 7 is 0.5 ng/ml with a sensitivity of 75% and a specificity of 93.75%. The cutoff value for day 14 is 0.5 ng/ml with a sensitivity of 87.5% and a specificity of 93.75%.

Conclusions: In conclusion, this study describes the serum profile of pNFL-H in patients suffering from burn injury during the acute (day 1) and chronic (days 7 and 14) time-points. These results suggest that detection of pNFL-H may be useful in determining which individuals suffer from iBI after burn injury.

Applicability of Research to Practice: Detection of pNFL-H in the serum of burn patients may be useful in deciding to administer various interventions to protect the brain and/or decrease long-term cognitive deficits after burn injury.
Inflammatory Monocyte Accumulation following Radiation-Thermal Combined Injury is Controlled by NLRP12

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Introduction: Radiation incidents are legitimate threats to today’s world. Nuclear proliferation and recent radiological accidents call for better understanding of the pathophysiology after radiation exposure combined with thermal injury (RCI). We have previously shown that an immature, innate inflammatory monocyte (iMo) population survives and arises following RCI and represents a therapeutic opportunity to improve patient outcomes following injury and infection. We hypothesize that the inflammatory regulator, nucleotide-binding domain and leucine-rich-repeat gene 12 (NLRP12), is involved in inflammation following RCI.

Methods: Wild type and NLRP12-/- C57BL/6 female mice age 10-12 weeks underwent either a 20% TBSA full thickness contact burn followed by a single whole body dose of 5 Gy radiation or sham procedure. Mice were then infected intratracheally with 1.0x10^6 colony forming units of Pseudomonas aeruginosa at 14 days after injury. Lung and liver homogenates were harvested at 2 days post infection and used to enumerate bacterial growth. Flow cytometry was performed on splenic homogenates to identify innate immune cells. Tukey’s test of multiple comparisons was used to compare absolute cell number means within each group. A P value of <0.05 was defined as significant.

Results: In our model, RCI injured NLRP12-/- mice resulted in an increase of 15% in mortality from injury alone and 100% mortality in knock-out mice after infection when compared to wildtype. Lungs, liver, and spleens were harvested from infected animals before death. Bacterial recovery from the lungs and liver was significantly increased in sham wild type compared to wild type RCI mice. Moreover, RCI NLRP12-/- mice displayed greater bacterial loads when compared to wild type sham and RCI. Flow cytometric analysis revealed a decrease in the accumulation of splenic iMos, both monocytic and granulocytic, and neutrophils following infection from wild type RCI to NLP12-/- . Bacterial recovery and iMo numbers did not differ between wild type and knock-out sham mice.

Conclusions: RCI results in significant T cell lymphopenia, neutropenia and expansion of a non-suppressive iMo population. Wild type RCI mice are not able to control pulmonary infection as well as sham mice late after injury. We have observed that RCI mice deficient in NLRP12 are unable to control pulmonary infection late after injury and is correlated with a lack of iMo accumulation.

Applicability of Research to Practice: These data show that NLRP12 is an important regulator of cellular inflammation following injury and could potentially act as a target to induce immune reconstitution following RCI.

External Funding: Supported in part by National Institutes of Health Grants: R01 GM076250-01A2 and U19 AI067798.
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<td>Zimmerman N</td>
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Sheraton Floorplan (Continued)
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<tr>
<th>Time</th>
<th>MONDAY</th>
<th>TUESDAY</th>
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<tbody>
<tr>
<td>8:00 -</td>
<td>Burn Registry Committee</td>
<td>8:30 - Board of Trustees Meeting</td>
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<tr>
<td>9:30</td>
<td>Dalton</td>
<td>Commonwealth</td>
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<tr>
<td>8:00 -</td>
<td>Membership Advisory Committee</td>
<td>8:00 - Organization and Delivery of Burn Care Committee</td>
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<tr>
<td>3:30</td>
<td>Republic A Ballroom</td>
<td>Public Garden</td>
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<tr>
<td>9:00 -</td>
<td>Burn Prevention Committee</td>
<td>8:00 - Research Committee</td>
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<tr>
<td>3:00</td>
<td>Independence East Ballroom</td>
<td>The Fens</td>
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<tr>
<td>9:00 -</td>
<td>Burn Science Advisory Panel</td>
<td>9:30 - International Outreach Committee</td>
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<tr>
<td>12:00</td>
<td>Gardner B</td>
<td>Boston Common</td>
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<tr>
<td>9:30 -</td>
<td>Ad Hoc Coding Committee</td>
<td>11:30 - Board of Trustees/Committee Chair Lunch</td>
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<tr>
<td>10:30</td>
<td>Gardner A</td>
<td>Constitution A Ballroom</td>
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<tr>
<td>10:00</td>
<td>Education Committee</td>
<td>2:00 - Rehabilitation Committee</td>
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<tr>
<td>11:00</td>
<td>Hampton</td>
<td>Public Garden</td>
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<tr>
<td>10:00</td>
<td>NBR Committee</td>
<td>9:30 - Archives Committee</td>
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<tr>
<td>11:30</td>
<td>Dalton</td>
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<tr>
<td>12:00</td>
<td>IAC/Government Affairs Luncheon</td>
<td>3:00 - Ethical Issues Committee</td>
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<tr>
<td>1:30</td>
<td>Commonwealth</td>
<td>Berkeley</td>
</tr>
<tr>
<td>2:30</td>
<td>Aftercare Reintegration Committee</td>
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<tr>
<td>3:30</td>
<td>Back Bay A Ballroom</td>
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</tbody>
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### Wednesday

- **Sunrise Symposia**
  - **6:30 - 7:45**
  - Grand Ballroom
- **Coffee with Exhibitors**
  - **9:30 - 10:00**
  - Hall D | Hynes Convention Center
- **Correlative Sessions I - V**
  - **10:00 - 12:00**
  - Back Bay A
  - Back Bay C
  - Constitution Ballroom
  - Independence Ballroom
  - Republic Ballroom
- **Firefighter I**
  - **10:00 - 12:00**
  - Fairfax
- **Lunch with Exhibitors**
  - **12:00 - 1:45**
  - Hall D | Hynes Convention Center
- **Poster Rounds w/Professors & Authors**
  - **12:30 - 1:30**
  - Hall D | Hynes Convention Center
- **PG A - Burn Outcomes**
  - **2:00 - 4:00**
  - Constitution Ballroom
- **PG B - Pediatric Burn Care**
  - **2:00 - 4:00**
  - Back Bay C
- **PG C - Impact of EMR**
  - **2:00 - 4:00**
  - Back Bay A
- **Multi-Center Trials Group Town Hall Meeting**
  - **4:15 - 5:45**
  - Independence Ballroom
- **Wine & Cheese Reception**
  - **5:00 - 6:30**
  - Hall D | Hynes Convention Center

### Thursday

- **Sunrise Symposia**
  - **6:30 - 7:45**
  - Grand Ballroom
- **Coffee with Exhibitors**
  - **9:30 - 10:00**
  - Hall D | Hynes Convention Center
- **Correlative Sessions VI - X**
  - **10:00 - 12:00**
  - Back Bay A
  - Independence Ballroom
  - Constitution Ballroom
  - Republic Ballroom
- **Firefighter II**
  - **10:00 - 12:00**
  - Fairfax
- **Lunch with Exhibitors**
  - **12:15 - 1:45**
  - Hall D | Hynes Convention Center
- **Poster Rounds w/Professors & Authors**
  - **12:30 - 1:30**
  - Hall D | Hynes Convention Center
- **PG A - Burn Outcomes**
  - **2:00 - 4:00**
  - Constitution Ballroom
- **PG B - Pediatric Burn Care**
  - **2:00 - 4:00**
  - Back Bay C
- **PG C - Impact of EMR**
  - **2:00 - 4:00**
  - Back Bay A
- **Local Burn Tours**
  - **4:00 - 5:30**
  - Shriners | MGH | Brigham & Women’s

### Friday

- **A Repeat of the Three Most Popular**
  - **8:30 - 9:30**
- **Coffee with Exhibitors**
  - **9:30 - 10:00**
  - Hall D | Hynes Convention Center
- **Firefighter II**
  - **10:00 - 12:00**
  - Fairfax
- **Luncheon Symposia**
  - **12:15 - 1:45**
  - Liberty Ballroom
- **Poster Rounds w/Professors & Authors**
  - **12:30 - 1:30**
  - Hall D | Hynes Convention Center
- **PG A - Burn Outcomes**
  - **2:00 - 4:00**
  - Constitution Ballroom
- **PG B - Pediatric Burn Care**
  - **2:00 - 4:00**
  - Back Bay C
- **PG C - Impact of EMR**
  - **2:00 - 4:00**
  - Back Bay A
- **Business Meeting**
  - **4:15 - 5:15**
  - Independence Ballroom

### Monday

- **Presidential Plenary**
  - **9:30 - 10:30**
  - Constitution Ballroom
- **Best in Category Posters**
  - **10:00 - 12:00**
  - Hall D | Hynes Convention Center
- **Wine & Cheese Reception**
  - **4:15 - 5:30**
  - Hall D | Hynes Convention Center
- **Year In Review**
  - **5:00 - 6:30**
  - Hall D | Hynes Convention Center

### Tuesday

- **Board of Trustees Meeting**
  - **8:00 - 9:30**
  - Commonwealth
- **Organization and Delivery of Burn Care Committee**
  - **8:00 - 9:30**
  - Public Garden
- **Research Committee**
  - **8:00 - 9:30**
  - The Fens
- **International Outreach Committee**
  - **9:30 - 11:00**
  - Boston Common
- **Board of Trustees/Committee Chair Lunch**
  - **11:30 - 2:00**
  - Constitution A Ballroom
- **Rehabilitation Committee**
  - **2:00 - 3:00**
  - Public Garden
- **Archives Committee**
  - **3:00 - 4:00**
  - Dalton
- **Ethical Issues Committee**
  - **3:00 - 5:00**
  - Berkeley