Pediatric Patients: Bridging the Readiness Gaps

Lansing, June 18, 2019



Pediatric Burn Surge

Stewart C. Wang, MD PhD FACS

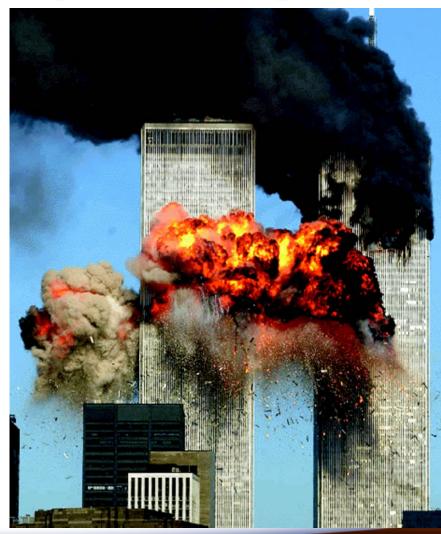


Burn Mass Casualty Planning

We think of...

New York 9/11/2001











MadridBus and Train Bombings









Civilian/Natural Disasters Persist





Civilian/Natural Disasters Persist





Just Imagine...









Preparing for a Mass Casualty Incident

Trauma # Burn



Penetrating Trauma







Blunt Trauma

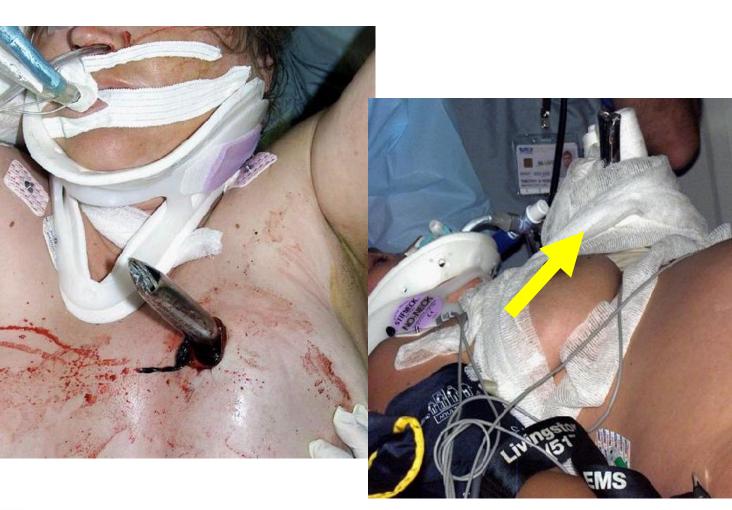




Blunt & Penetrating Trauma



Blunt & Penetrating Trauma

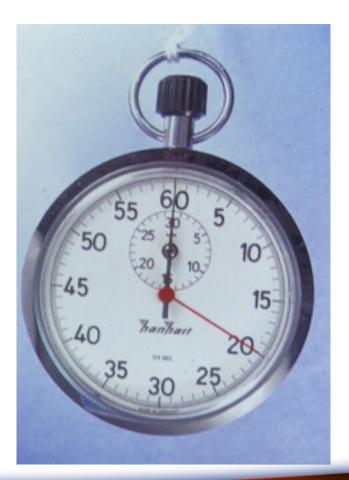




Trauma & Golden Hour

Multiple Waldo's, Extreme Time Pressure, High Stakes



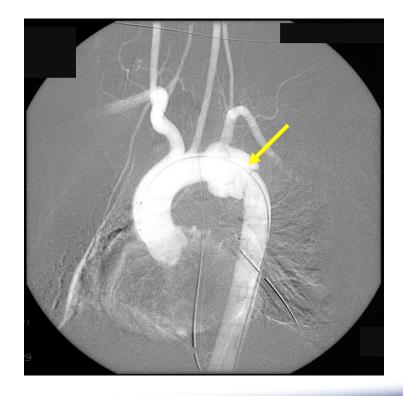




Why is it important to get trauma patients a treatment facility quickly?

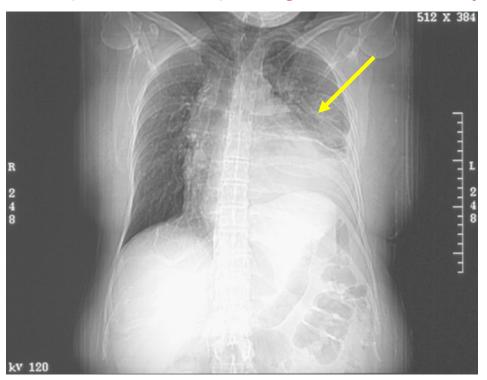
Torn Aorta with contained leak



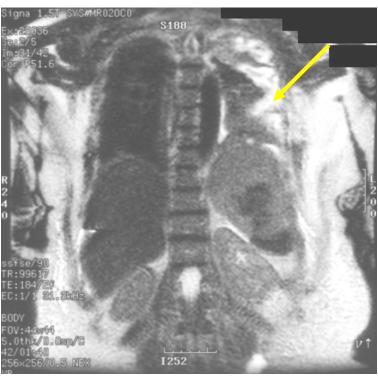




Ruptured Diaphragm = difficulty breathing and suffocation.



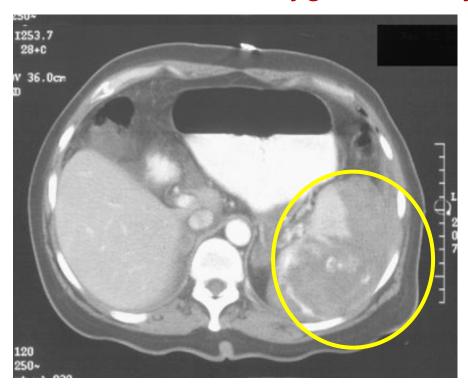
Chest Xray



Chest MRI



Blood Loss = Low oxygen delivery to tissues/organs (SHOCK)



Ruptured spleen on CT



Active bleeding on angiogram



Closed Head Injury leads to increased intra-cranial pressure and further brain injury



Subdural hematoma with shift



Epidural hematoma with shift



Top 3 Causes of Shock After Trauma

1. Bleeding

2. Bleeding

3. Bleeding

You need a surgeon!



Top 3 Causes of Shock After Burn

1. Salt water loss

2. Salt water loss

3. Salt water loss

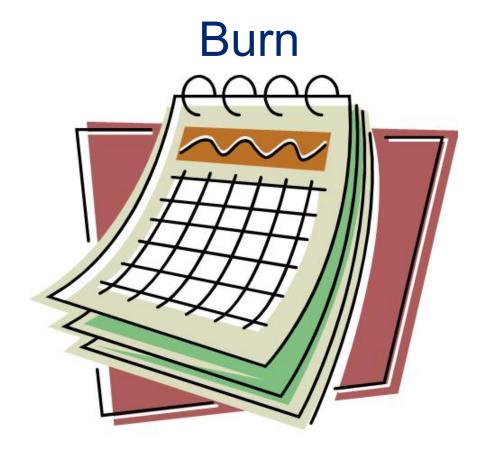
You don't need a surgeon to treat this!



From a Surgeon's Perspective....

Trauma







Past Lessons from Burn Disasters

- 1978 liquid petroleum gas tanker truck explosion in Spain.
 - 82 patients bussed (without medical care for many hours)
 150 miles south to Valencia.
 - 58 patients taken north, with enroute medical care, to Barcelona.
 - 4 day survival: 45% vs. 93%.
- Illustrates the importance of prompt medical resuscitation and stabilization.



Typical Burn Care Timeline

FIRST 6 HOURS

Triage, ABCs, wound assessment, resuscitation

Airway, Respiratory Insufficiency, Shock

6 – 24 HOURS

Wound care, monitor for complications, resuscitation

Compartment syndrome, Respiratory/Renal insufficiency

DAYS 2 – 6

Supportive Care (Analgesia, Nutrition, Prophylaxis)

Wound infections (day 5+)

DAYS 3 - 7

Decision for burn surgery or continued wound care

RARELY IS DEFINITIVE BURN SURGERY BEGUN IN FIRST 48-72 HRs



Treatment & Prevention of SHOCK Is the Key for Initial Burn Patient Care

SHOCK - Inadequate Tissue Perfusion

Perfusion requires intact A + B + C

- A upper airway: heat damage & swelling
- B lower airway: smoke, carbon monoxide
- · C hypovolemia, but NOT due to blood loss



Keep Everything WARM & COMFORTABLE

Burn injuries leak fluid, which evaporate...





- Shivering uses enormous energy
- Burns hurt



Keep Inside WET (hydrated)

- Patients leak (not bleed) everywhere
 - External wound
 - Internal lungs, tissues
- Establish IV access early (it ain't gonna get any easier)
- Give them what they're leaking:
 - salt water



Keep Inside WET (hydrated)

In mass casualty, consider ORAL hydration.





Medical Considerations in a Burn MCI

- Burns injuries rarely require immediate surgical intervention!
 - Take a breath....Think...Consider
- 100% O2, airway (resources)
- Keep everything WARM and COMFORTABLE
- Keep outside DRY
- Keep inside WET (hydrated)



U.S. Burn Bed Capacity

Number of BURN CENTERS →127

Number of BURN BEDS →as low as 1,500



Leaving the number of available beds as low as 300 on any given day



A Federal Mandate (and a good idea...)

- The US National Bioterrorism Hospital Preparedness Program, requires that states plan for the provision of care to burn patients based on a population ratio of <u>50 per million</u>.
- Michigan: population 10 Million \rightarrow 500 burn casualties
- 6 Michigan Burn Centers. 79 beds total.
 - Bronson Methodist Hospital
 - Children's Hospital of Michigan
 - Detroit Receiving
 - Hurley Medical Center
 - Spectrum Health
 - U of Michigan



Principles of Burn Mass Casualty Management*

- 1. Have a Plan
- 2. Command, Control and Communication
- 3. Triage
- 4. Transport
- 5. Treatment Strategies
- 6. Personnel Management
- 7. Supplies and Equipment
- 8. Transfer



^{*} Cancio LC & Pruitt BA, Int J Disaster Med 2005



General Concepts Underlying the Michigan Plan

- We should supplement (not replace) the American Burn Association's national preparedness efforts.
- We should build on and reinforce (but not re-invent) the infrastructure that has been built for major disasters: The National Incident Management System.
- We should prepare to rely only on ourselves (local/regional) for the initial post-incident period.



Time Distance Resources











Statewide Regional Organization

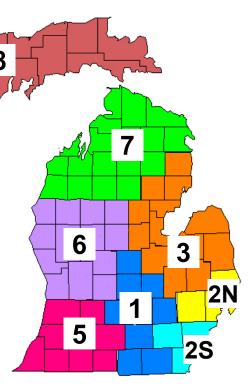
8 Healthcare Coalition Regions

- Medical Director
- Healthcare Coalition Coordinators
- Assistant Healthcare Coalition Coordinator

83 counties, 59 Medical Control Authorities, 45 Public Health Departments, and 12 Tribes

Each Region should plan to provide initial treatment and stabilization for burn victims triaged as meeting the criteria for a burn referral to a burn center

This administrative structure is also utilized for the statewide trauma system





Organization & Assignment of Responsibilities

Regional Medical Coordination Centers (MCC's)

- Activated when emergency medical care coordination is needed in response to a real or potential MCI.
- Functions
 - Support to hospitals, local EOC's, other RMCC's and the CHECC
 - Current availability of regional medical resources
 - Coordination of requests and receipt of intra and extra-regional medical resources
 - Casualty transportation system



Trauma Centers for Surge Capacity

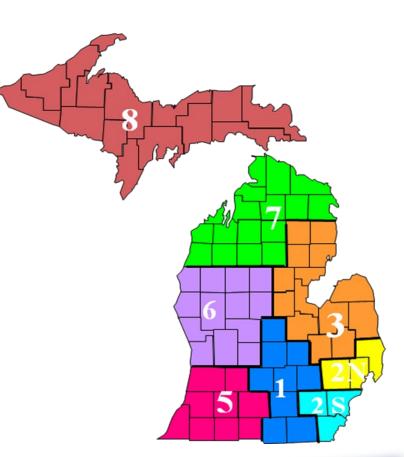
- 1. Typically the most capable medical centers in the more rural regions of Michigan
- 2. Already the center of local preparedness efforts
- 3. Working relationships with state/county agencies, medical control authorities and EMS
- 4. Preferred destination for combined burn/trauma injuries
- 5. Have ED physicians & surgeons on staff as well as manned ICUs
- 6. Currently function as via-point for transfer of rural burn patients to MI burn centers
- 7. Used to resuscitation of injured patients



Organization & Assignment of Responsibilities

Regional Burn Surge Facilities (2019)

- Region 1
 - Sparrow Hospital
 - Henry Ford Allegiance
- Region 2 North
 - William Beaumont Royal Oak
 - McLaren Oakland
- Region 2 South
 - Henry Ford Hospital
 - St. Joseph's Ann Arbor
- Region 3
 - St Mary's Saginaw

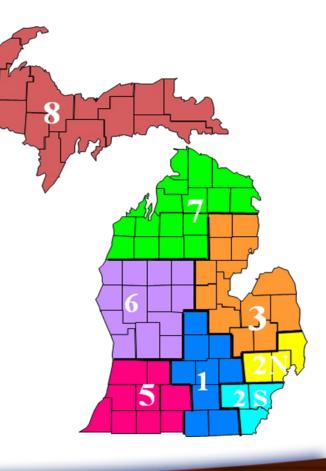




Organization & Assignment of Responsibilities

Regional Burn Surge Facilities (2019)

- Region 5
 - Borgess Medical Center
- Region 6
 - Mercy Health St. Mary's Grand Rapids
- Region 7
 - Munson Medical Center
 - McLaren Northern Michigan
 - MidMichigan Alpena
- Region 8
 - UP Health Systems Marquette
 - UP Health Systems Portage

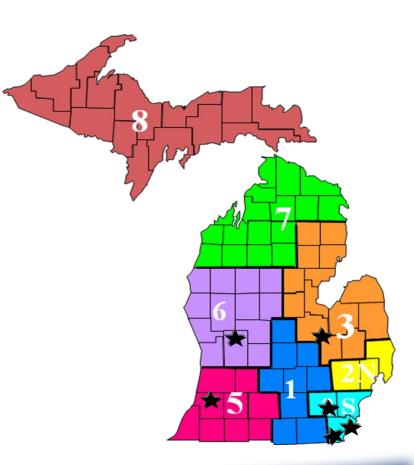




Organization & Assignment of Responsibilities

Michigan Burn Centers

- University of Michigan*
- Children's Hospital of Michigan*
- Detroit Receiving Hospital
- Hurley Medical Center
- Bronson Methodist Hospital
- Spectrum Health





^{*} ABA-verified Pediatric Burn Center

Michigan Burn Mass Casualty Tiered Triage

<u>AGE</u>	% Total Body Surface Area Burn + 10 for Inhalation Injury									
	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 +
<2	Very High	Very High	Very High	High	Medium	Medium	Medium	Low	Low	Very Low
2 - 5	Outpatient*	Very High	Very High	High	High	High	Medium	Medium	Low	Low
5 -19.9	Outpatient*	Very High	Very High	High	High	High	Medium	Medium	Low	Low
20 - 29.9	Outpatient*	Very High	Very High	High	High	Medium	Medium	Low	Low	Very Low
30 - 39.9	Outpatient*	Very High	Very High	High	Medium	Medium	Medium	Low	Very Low	Very Low
40 - 49.9	Outpatient*	Very High	Very High	Medium	Medium	Medium	Low	Very Low	Very Low	Expectant
50 - 59.9	Outpatient*	Very High	Very High	Medium	Medium	Low	Very Low	Very Low	Expectant	Expectant
60 - 69.9	Very High	Very High	Medium	Medium	Low	Very Low	Very Low	Expectant	Expectant	Expectant
70+	Very High	Medium	Medium	Low	Very Low	Expectant	Expectant	Expectant	Expectant	Expectant

^{*}Inhalation Injuries - consider admission for airway monitoring and respiratory support.

NOTE: Significant associated trauma and/or co-existing medical conditions WILL worsen prognosis.



State Burn Coordinating Center Roles, Responsibilities & Expectations



SBCC: Initial 24 Hours

- Activate SBCC emergency operations staff
- Coordinate with Community Health Emergency Command Center (CHECC) for activation of additional Burn Surge Facilities
- Monitor the triage and transport of burn casualties to MI Burn Centers and Burn Surge Facilities
- Notify SBCC in neighboring states or ABA as necessary
- Monitor the admission of burn casualties to MI Burn Centers and BSFs
- Monitor the response of BSF patients to resuscitation
- Consultation support for Burn Surge Facilities



Real-time Support

SBCC Emergency Command Center in UM Burn Center



...separate from UMHS ECC



Deployable Burn Triage & Support Teams

- Team:
 - Flight nurse for acute and critical care expertise
 - Burn nurse with special wound care expertise
 - Surgeon with burn experience
 - General and plastic surgery chief residents
 - Pilot/driver





- Equipment/Supplies:
 - Burn care reference materials, critical supplies
 - Video cameras and computers to record and report patient condition, enabling secondary triage at the State Burn Coordinating Center



SBCC: Days 2-4

- Send Burn Secondary Triage Teams to BSFs
- Monitor patient response in BSFs
- Continuous consultation support for BSFs
- Coordinate with CHECC for the transfer of burn casualties from BSFs to MI Burn Centers
- Coordinate with neighbor SBCCs and ABA for the transfer of burn casualties from BSFs and MI Burn Centers to regional/national Burn Centers
- Monitor walking wounded treated at BSFs around MI
- Coordinate the procurement and distribution of critical burn surgery supplies to MI Burn Centers



Burn Surge Facilities Roles, Responsibilities & Expectations





Burn Surge Facility – Priorities

- Triage
- Admit
- Resuscitate
- Pain relief
- Dressings
- Gather ID information
- Collaborating with CHECC & SBCC



Burn Surge Facility – Initial 96 Hours

- Supportive care: fluids, analgesia, nutrition
- Report patient response to resuscitation
 - Database entry
 - FAX
 - Call
 - Email
- Treating walking wounded
- Consultation with SBCC clinical staff
- Receive Burn Teams from SBCC
- Prepare patients for transfer to burn center







Website **Interface**

www. Michiganburn.org



The State of Michigan Burn Coordinating Center has developed these modules to

provide just-in-time training for pre-hospital and medical personnel caring for burn patients following a mass casualty event. This content is intended to support all levels of care for these patients as the triage and coordination of transfer is addressed.



734-936-BURN (936-2876)

DISASTER PLANS

MI Burn Mass Casualty Plan Michigan Burn Disaster Database EMResource (requires login) Google Maps of MI Burn Facilities

BURN ESSENTIALS

Fluid Resuscitation Protocol Peds Fluid Resuscitation (excel) Adult Fluid Resuscitation (excel) Difficult to Resuscitate Protocol Nutrition Algorithm for Burns Burn Injury FAQs Advanced Burn Life Support Burn Mass Casualty Links

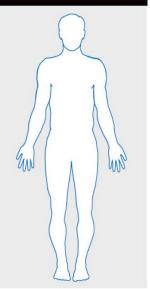
SELECT LEARNING MODULE

- Burn Assessment and Classification
- Debridement: Cleaning Wounds
- General Burn Care
- Adult Sedation and Pain Management
- Peds Sedation and Pain Management
- Medical Nutrition for Burns
- Care by Body Area
 - · Face, Neck and Ears
 - Upper Extremity Including Hand/Fingers
 - · Chest, Abdomen and Back
 - · Buttock, Groin, and Genitalia
 - · Lower Extremity Including Foot/Toes

SELECT TRAINING VIDEO

- Face and Ears: Burn Dressing
- Neck: Acticoat
- Neck: Silvadene
- Upper Extremity: Acticoat
- Upper Extremity: Silvadene
- Chest, Abdomen & Back (Mobile): Acticoat
- Chest, Abdomen & Back (Mobile): Silvadene
- Chest, Abdomen & Back (Immobile): - Chest, Abdomen & Back (Immobile):
- Groin & Genitalia: Silvadene
- Buttocks: Acticoat
- Buttocks: Silvadene
- Lower Extremity: Acticoat
- Lower Extremity: Silvadene

SELECT AREA BURNED

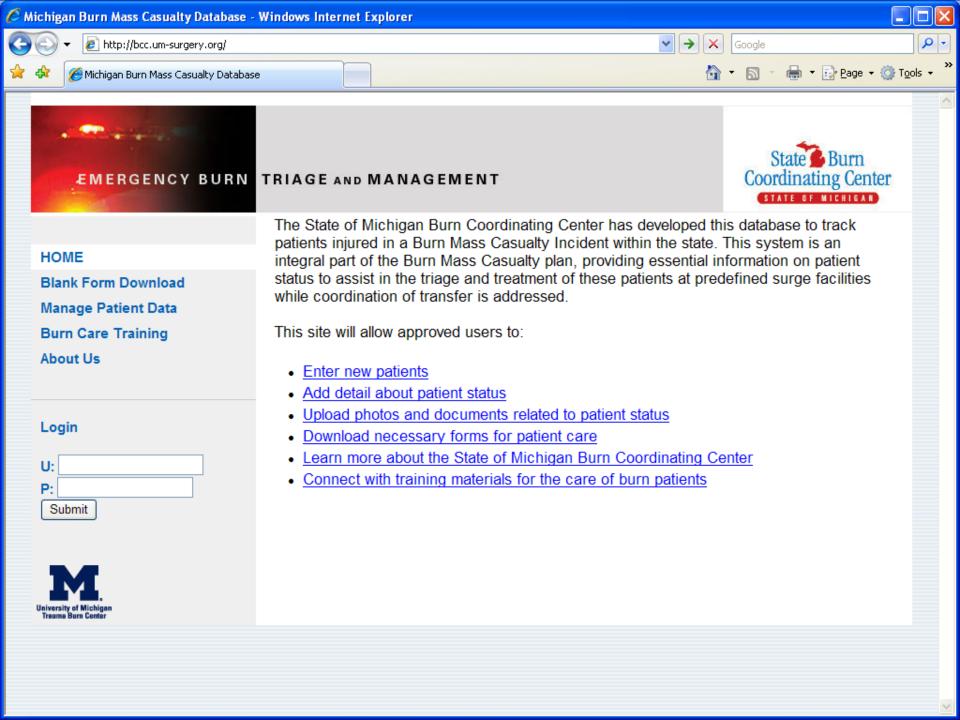




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Health Topics A-Z For Patients & Families For Health Providers

This website is part of a project that is being supported 56% with funding by the University of Michigan Health System, and 44% by the Michigan Department of Community Health with funding from the U.S. Department of Health and Human Services (HHS) Office of the Assistant Secretary for Preparedness and Response (ASPR) Hospital Preparedness Program Cooperative Agreement number 6U3REP090098-001.



Training and Reference Modules

www.michiganburn.org

Burn Care: Abdomen, Chest and Back

Presented by:
Sarah Taylor, BSN
University of Michigan Trauma Burn Center

Debridement/Cleansing of Burns

- Make sure all loose tissue is removed from the affected area.
- Open and drain any intact blisters over 1 inch diameter
- Debridement module





Assess the Wound

- Assess for compartment syndrome
- Bladder Pressure and Respiratory exam
- Burn Classification Module
- Emergency Procedure Module



Chest, Abdomen and Back Burns



Chest, Abdomen and Back Burns



Multimedia On-Demand Support

Combined with video and narration into interactive modules – cookbook reference





Resuscitation Protocols



BURN MCI: FLUID RESUSCITATION

I. Burn Resuscitation Protocol

- A. Document patient's TBSA burn using Lund-Browder diagram (Rule of Nines Diagram). Include only partial and full-thickness burns.
- B. Obtain weight or close estimate.
- II. First 24 Hours Post Burn
 - A. TBSA < 20%</p>
 Maintenance IVF only until taking adequate oral intake.
 - B. TBSA > 20% and Weight > 30kg
 - 1. Calculate estimated fluid needs:
 - a) 2-4cc of LR X kg of body weight X %TBSA burned:
 - administer half of calculated amount over the first 8
 - administer half of calculated amount over next 16 h
 - b) If urine output < ½ cc/kg/hour (goal is 30-50 cc/hour):
 - increase LR infusion by 1/3 of the hourly calculated
 - c) If urine output > 70 cc/hour:
 - dip urine to exclude glucosuria
 - decrease LR infusion by 1/3 of the hourly calculate
 - C. TBSA > 20% and Weight < 30kg
 - Calculate estimated fluid needs:

- Adult
- Pediatric
- Difficult to Resuscitate



Coordinating Center BURN MCI: DIFFICULT TO RESUSCITATE PROTOCOL

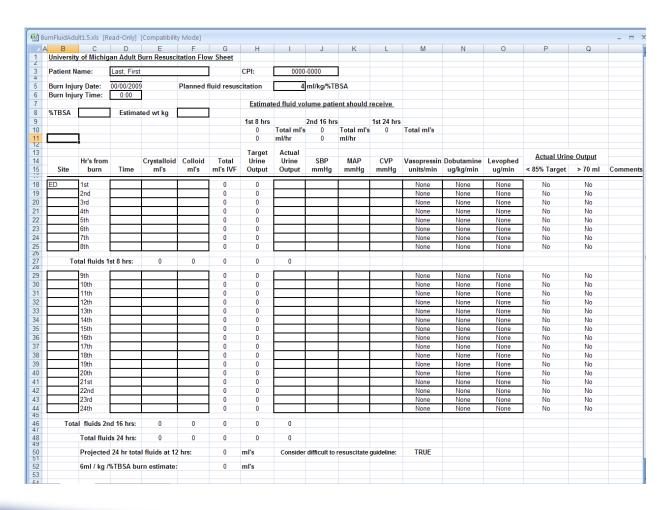
Recommendations for the difficult fluid resuscitation:

At 12 hours after burn injury, calculate the PROJECTED 24-hour resuscitation if fluid rates are kept constant. If the projected 24-hour resuscitation requirement exceeds 6ml/kg/%TBSA, then the following steps are recommended:

- Initiate 5% albumin (25gm/L) early as described previously in Emergency War Surgery Handbook.
- Check bladder pressures every 4 hours.
- If UOP <30ml/hr, strongly consider the placement of a PA catheter to guide resuscitation with specific PCWP and SvO₂ goals. (Goal PCWP 10-12, SvO₂ 65-70%). If PA catheter placement is not practical then consider monitoring CVP from a subclavian or IJ along with central venous saturations (goal CVP 8-10, ScvO₂ 60-65%).
 - a. If CVP or PCWP not at goal then increase fluid rate.
 - b. If CVP or PCWP at goal then consider levophed to augment mean arterial pressure (and thus UOP) or dobutamine 5mcg/kg/min (titrate until SvO₂ or ScvO₂ at goal). Max dose of dobutamine is 20mcg/kg/min.
 - c. If both CVP or PCWP and SvO₂ or ScvO₂ at goal, then stop increasing fluids (even if UOP<30ml/hr). The patient should be considered hemodynamically optimized and the oliguria is likely a result of established renal insult. Some degree of renal failure should be tolerated and expected. Continued increases in fluid administration despite</p>



Resuscitation Protocol



Excel Spreadsheet Formulas incorporated

Targets specified

Flags if desired outcome not observed

Clinical summary useful for secondary triage



BSF Training at SBCC

One day of classes and practical

- Evaluation of burn wounds and patients
- Hands on wound care training
- Surge Facility MCI Kit Development and Use
 - Role cards
 - Checklists
 - Protocols
- Mass casualty exercise Triage & resuscitation
- Resources what, where, how to use
- Communications what, where, how to use
- Team-building & networking





Michigan's Burn Centers Roles, Responsibilities & Expectations

Continue to provide great burn care just to many more people.



Michigan Burn Centers – 55,111 **Initial 24-48 Hours**

- Receive burn casualties
- **Activate surge capacity**
- Report capacity and capability to SBCC to coordinate the acceptance of transfers from Burn **Surge Facilities or other burn centers**
- Increase capability/capacity of outpatient burn care





Michigan Burn Centers – Day 3-7

- Accept transfers from BSFs or other burn centers
- Determine resources needed for definitive burn care of admitted burn patients
- Definitive burn care debridement/grafting, wound care
- Coordinate with SBCC for delivery of critical supplies (homograft, dressings, supplies)







MI Burn Centers - Day 8+

- Complete burn care of inpatient casualties
- Accept transfers of burn casualties treated outside MI

 Definitive burn care of those who self present (walking wounded)



MI Burn Centers – De-escalation

Rehab

Follow-up

- Scar management
- Support groups





Key Points

- Burn disasters will occur
- Local burn center resources and personnel will be overwhelmed.
- It will be impossible to immediately transport all burn casualties to definitive burn care facilities outside the regions (clogged roads, overtaxed ambulances & aircraft).
- The immediate clinical need is for resuscitation, which can be rendered by non-burn facilities.
- The burn care expected of these surge facilities should be simple and not overwhelm local medical personnel (Minimize wound care).
- Tremendous needs exist for practical burn care training to support preparedness efforts.



Michigan's Burn Plan

- Widespread acceptance & support
- Adopted by multiple states around US

....but



Pediatric Annex

Follow up discussion with Burn Surge Facilities as well as medical and emergency preparedness professionals determined there was insufficient Pediatric expertise and resources available to optimally care for a large number of burned pediatric patients.





Top Concerns

- Airway
- Resuscitation
- Pain Management

Solution

- Send expert teams AND supplies to the site to assist with the subtle nuances of the Pediatric patient
- Transfer the Pediatric patient as soon as possible (not day 2 or 3) to an appropriate center for definitive treatment.



Strike Teams

The configuration of the Team will be dependent on the incident and what will be required.

- Pilot/Driver and a Flight Nurse is the Primary Team.
- Additional members may include one or more of the following:
 - Additional flight nurse
 - Senior Burn Nurse
 - Pediatric Critical Care Nurse
 - Pediatric Emergency Medicine Fellow
 - Senior ER Resident
 - Senior Level Pediatric Surgical Resident

Strike team will provide support for: Triage, Treatment and Transport



Supplies

- The group started out with a "wish list" of supplies
- This was revised several times
- Input on packing and storing was gathered from flight services members
- Funds were provided through a grant from OPHP
- Glide Scopes were purchased
- These supplies have been assembled into the "GO BAGS" which have been distributed to 6 flight services throughout Michigan.
- OK to use for any pediatric MCI, not only burns.



Go Bag – Pediatric Burn Surge





What do you think? Need?

Current plan

Resources

Education/training





Questions?



www.michiganburn.org

