The Taiwan Water Park Inferno

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Today’s Objectives

• Understand the magnitude of the Formosa waterpark explosion disaster
• Discuss the challenges faced by the Taiwanese health care system in responding to the disaster
• Become familiar with current burn surge capacity in the U.S.
• Describe evolving strategic plans to create burn surge capacity
• Discuss the importance of training and education in dealing with burn mass casualties
Introduction: Case Study #1

Cocoanut Grove Nightclub fire (1942, Boston)
• 492 people killed, 166 injured
• Factors: over capacity; lack of sprinklers and smoke detectors; rapidly moving fire and toxic gasses; jammed revolving door at main exit; other exit doors locked, blocked or blacked out
• BCH received 300 victims in 1 hour and MGH received 114 victims in 2 hours
• Deadliest nightclub fire in the world
• Led to reformed safety standards and codes

www.Bostonfirehistory.org

Introduction: Case Study #2

Station Nightclub Fire (2003, Rhode Island)
- 100 dead, 230 injured
- Great White concert
- Factors: over capacity; illegal pyrotechnics; stampede; narrow primary exit and blocked emergency exits
- Resulted in revision of fire codes on sprinklers and crowd management in nightclub-type venues

https://medium.com/homeland-security/safety-in-numbers-38f97e6f6c7d
Case Study #3: Formosa Water Park Disaster, Taiwan, June 2015

Location

Formosa Fun Coast Water Park

www.Google.com/maps
The Event

Saturday night, June 27, 9 p.m.: Color Play Asia

www.facebook.com/colorplayasia/

Event Video

Warning: graphic, may be disturbing
Stage view
https://www.youtube.com/watch?v=qYtjlbh0xk
Audience side view
Aftermath
Initial Response

- Emergency calls began ~ 9:30 p.m.
- Pathways in park too narrow for rescue vehicles
- Participants carried victims to parking area
- Scene command was assumed by the Fire Service (EOC command later transferred to Ministry of Health and Welfare)
- Patients were put into ambos, private vehicles, taxis, etc., and sent to nearest hospital or designated hospital

Initial Response (cont.)

Sample ED:
Cheng Hsin General Hospital
(970 beds)
10:20 p.m., 14 cases
>80% TBSA-3 cases-3 ETT
>60% TBSA-2 cases-2 ETT
>50% TBSA-2 cases-1 ETT
>40% TBSA-1 case
>20% TBSA-2 cases
<10% TBSA-4 cases

Source: Drs. Chuan Hsun Chang, Tsai Shen Kou
Initial Response (cont.)

- ED resuscitation
  - Airway
  - Access
  - Ventilator management
  - Fluid resuscitation
  - Pain management
  - Emergent escharotomies
  - Initial burn wound management/dressings
- Distraught families, the press, etc.
Initial Response (cont.)

- 499 victims
- 128 total burn beds nationwide, 43 of which are burn ICU
- 393 admissions, and >200 patients need burn ICU care

...NOW WHAT??

http://www.taipeitimes.com/News/taiwan/archives/2015/07/03/2003622167

Initial Response (cont.)

Sample hospital #1: Tri-Service General Hospital (military hospital)
- 1700 beds; 14 burn beds (6 ICU, 8 stepdown)
- Received 52 patients from the disaster

Sample hospital #2: Shin Kong Wu Ho-Su Memorial Hospital
- 921 beds; 3 burn beds
- Received 31 patients
Our Delegation/Mission

Coordinated through the Ministry of Health and Welfare (MOHW) representative to Taiwan in Washington, D.C.

Report as of 7/6/15:
- 291 still in ICU with 235 in critical condition
- Of the inpatients:
  - Average TBSA burn 50%
  - 253 patients > 40% TBSA
  - 32 patients > 80% burns

Source: Dr. Daniel Lu
Our Delegation (cont.)

- Johns Hopkins Go Team
  - Deployable medical asset for Johns Hopkins Medicine
  - ~200 providers on the team; multidisciplinary
  - Tremendous amount of expertise and reachback capability
  - Requirements to deploy: formal request, well defined mission, logistics in place

Our Delegation (cont.)

Members of our “strike team”
- Director of the Johns Hopkins Burn Center (MD)
- Director of Critical Care Medicine (MD)
- Plastic surgery resident and burn researcher (MD)
- Burn unit nursing coordinator (RN)
- Director of burn rehab (PT)
- Emergency physician and disaster expert (me)
Our Delegation (cont.)

Mission
• International collaboration and support
• Subject matter expert exchange
• Needs assessment

Activities of Our Mission

• Picked up in California by the President of Taiwan on his plane and flown to Taipei
• Met with the MOHW, Taiwan’s CDC, and the Presidents of the Burn Association and Society of Plastic Surgeons
• Visited 12 hospitals across Taiwan in 6 days
• Subject matter expert exchange via case conferences, bedside rounds on the unit, and cases in the OR
Challenges in Mass Burn Critical Care Faced by the Taiwanese Health Care System

Massive ICU Needs

- Fluid resuscitation
- Coagulopathy
- Electrolyte imbalance
- Pulmonary injuries and complications
- Intensive wound care
- Burn wound sepsis

Source: Dr. Hao-Yu Chiao
Overwhelming Surgical Needs

Autograft vs. Allograft
Extensive Nursing Care Needs

Long Term Physical Therapy Needs
Psychosocial Support Needs

• Significant long-term mental health effects
• Cultural considerations
• Spectrum of effects
• ? Under-recognized vs. unacknowledged in staff
• Using proxy markers to identify needs

Burn Capacity in the United States
Current Burn Capacity in U.S.

As of 11/5/2014:
• 128 burn centers with 1917 beds across the United States
• 1 burn center for every 44 hospitals
• 1 “burn bed” for every 477 hospital beds
=LIMITED CAPACITY for a large scale event

Source: ABA and AHA statistics

Perspective

California
• ~12 times the size of Taiwan
• 14 burn centers
• 209 burn beds

Maryland
• Roughly the same size as Taiwan
• 2 burn centers
• 20 burn beds

REMINDER: 500 BURN CASUALTIES!!!
Hospital Surge Capacity

• What is hospital “surge capacity”? 
  – The amount of additional patient care (both inpatient and outpatient) a hospital can provide when pressed into extraordinary circumstances, such as during a disaster
• What is “burn surge capacity” per the ABA? 
  – Ability to manage a surge of 50% above the reported capacity of the burn unit

Hospital Surge Capacity (cont.)

Disaster resources include the “4 S’s”: 
• **Space** to care for patients 
• **Staff** to deliver medical care 
• **Stuff** to implement care: medication, supplies and equipment 
• **Systems** for coordination
Hospital Surge Capacity (cont.)

• 3 tiers defined by the literature (Hick et al, 2009):
  – Conventional
  – Contingency
  – Crisis
• In 2014, Kearns, Hubble et al adapted this for burn care

Surge Capacity: Space
Surge Capacity: Space (cont.)

- Elective admissions and procedures were cancelled
  - Especially elective plastic surgery cases
  - Loss of revenue
- SICUs (and in some cases MICUs) became BICUs and surgical floors were turned to burn wards
- Unstaffed licensed beds were opened

Surge Capacity: Staff

- Staff planning — ways to augment hospital staff
  - Staff in management positions
  - Physicians/nurses in independent practice
  - Staff in research positions
  - Retired staff
  - Use of volunteers
Burn Surge Capacity: Staff

- Many surgical subspecialties were recruited to do debridements, dressing changes, etc.
- Medical nurses became surgical nurses
- Plastic surgeons in private practice volunteered or were recruited to help
- Residents and others stayed in hospital for 5-6 days straight
- Retired burn nurses returned to practice to serve as nursing subject matter experts
- Use of just-in-time training

Surge Capacity: Stuff
Time to Plan!

Burn Surge Capacity Planning

- 2004: ABA framework for national burn disaster planning strategies
- New York Plan: first peer-reviewed burn surge plan for a city/state
- Southern Region Burn Disaster Plan: first peer-reviewed regional plan
- Others: LA County, MI, NJ, NC, etc.

http://www.zmescience.com/
Burn Surge Capacity Planning (cont.)

• Every hospital should be able to manage burn patients for 24 to 120 hours (based on the New York plan)
• “Bypass strategies have been replaced by absorption strategies” (Keams et al, 2014)
• Need to develop:
  – Policy/procedures document;
  – Annex or appendix to existing EOP; or
  – Stand alone plan

Planning Process

• Identify your planning team with key stakeholders (first responders, first receivers, etc.)
• Review your HVA
• Evaluate your current capacity and surge ability
• Develop the plan
• Implement, test and revise the plan
Planning Process (cont.)

- 3 important components to plan
  - Institutional
  - Interfacility
  - Interstate/regional
- Coordination with ESF-8 based on the NRF
- Requires MOUs, transfer agreements, EMACs, etc.

Sample Planning Tools Available

North Carolina Hospital Burn Surge Plan (BSP) Checklist
Sample Decision Tools Available

Triage decision tables

• Saffle (2005) used data from the ABA’s National Burn Registry to predict outcomes based on age and TBSA burned, then Yurt (2008) translated the data to level of care needed

<table>
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<th>Age</th>
<th>TBSA</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Exposed</th>
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<td>19+</td>
<td>Y</td>
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</tbody>
</table>

Saffle Yurt

Burn Surge Strategies

• Build cache of burn supplies at non-burn centers
• Use Trauma Centers that are not co-located with Burn Centers to care for less severe patients
• Proactive daily regional burn bed counts during critical events
A recent survey found that fewer than 50% of clinicians who work in either a hospital or as part of EMS felt either “comfortable” or “very comfortable” with their knowledge, skills, and abilities to manage one burn-injured patient with >20% TBSA involvement.

- Kearns, Holms and Cairns, 2013
Training and Education (cont.)

• For first responders/receivers, initial care and treatment
  – Burn triage
  – Airway management
  – Fluid resuscitation (e.g., Parkland formula, Brooke)
  – Escharotomies
  – Basic burn wound care and dressings
  – Estimating TBSA
  – Ventilator management
  – Pain management

Training and Education (cont.)

• ABLS (Advanced Burn Life Support)
  – 6-8 hour course (pre-hospital vs provider)
  – $225-350 for course
  – Worth CEU and CME = carrot!

• ABLS Now©
  – Online learning course and case studies
  – $100-300 for course
  – Worth CEU and CME = carrot!
Training and Education (cont.)

• Need to train providers not only in burn care but also in the Burn Surge Capacity Plan
• Tabletop exercises, disaster drills, etc.

Source: fema.gov

Conclusion

• Mass burn events are uncommon but can completely overwhelm the health care system
• Burn surge capacity in the United States is limited
• Planning has been underway in some parts of the U.S. for ~5-10 years but is largely untested
• Non-burn centers are ill prepared for caring for significant burn victims
• Training and education are critical
References


References

References


• Saffle JR, Gibran N, Jordan M. Defining the ratio of outcomes to resources for triage of burn patients in mass casualties. J Burn Care Rehabil 2005;26:478-482.


Questions?
Thank you

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