Burn Injury and Burn Mass Casualty Incidents

Overview and the Importance of EMS and the Community Hospital

Randy D. Kearns

DHA MSA FACHE FRSPH CEM

Assistant Professor for Healthcare Management

College of Business Administration

University of New Orleans

6TH MCSWAIN EMS TRAUMA INTERNATIONAL SYMPOSIUM

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Introduction

Area of research

- Surge Capacity – focused on Burn Care, Role of EMS and Community Hospital

Background

- EMS, Paramedic Instructor, Retired Asst Professor School of Medicine at the University of North Carolina

Author (17 articles past 6 years including Dr. Jeff Carter, Burn Center Medical Director UMCNO)

- Annals of Burns and Fire Disasters (1 Published)
- EMS World (5 Published)
- Burns (1 Published)
- Journal of Burn Care and Research (4 Published)
- Prehospital and Disaster Medicine (1 Published)
- Southern Medical Journal (3 Published)
- Biosecurity and Bioterrorism (1 Published)
- American Journal of Disaster Medicine (1 Published)

Key Components

History or Potential Disasters with a Thermal Component – prior events, what lessons have been learned, what is applicable, and what has been retained

Planning – includes general planning considerations for both burn center and local EMS and hospitals

- **Surge Planning** – important for both the burn center and local hospitals

Education – basic burn education, hospitals and EMS

Transportation **Resources** – distribution and redistribution of patients

Finance – how do you pay for a burn disaster

Quick Patient Review

Five patients

What would you do?

- Airway
- Breathing
  - Oxygen
- Circulation
  - Fluid Resuscitation
- Secondary Survey
- Pain Management
- Burn Center

Patient One

Patient Two

Patient Three

Patient Four

Patient Five

What will you do?

Your scene is one of those patients?

Your scene is all of those patients?

Your scene includes 20 more patients?

The Role of EMS and the Community Hospital is Vital

9-1-1 Caller

So, that's where we start.

Why Burn?

Burn – is a time sensitive injury/illness

Small – but manageable patient population

Data quality – small, easier troubleshoot, better to understand gaps and anomalies

Scalability – lessons learned have applicability in other specialties

Limited Supply of Critical Facilities

- *How limited you ask?*

National Capacity

Limited Supply of Critical Facilities

- **Change over the past six years (x)**

131 Burn Centers (**+8 or 15.4%**) 123 **(4 Burn Centers Louisiana)**

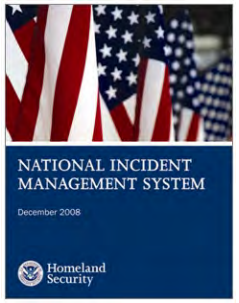
- **5534** Hospitals (**-71 or 1.24%**) (5795 in 2012)

- **2000** Burn Beds
- **894,574** Staffed Beds (**-49,703 or 5.26%**) (944,277 in 2012)

327,550,750 US Population (**+4.34%**) (313,914,040)

http://www.aha.org/research/rc/stat-studies/fast-facts.shtml
http://www.aha.org/aha/resource-center/Statistics-and-Studies/fast-facts.html

What is a Burn Disaster?



- **Type III Burn Disaster – Burn Care System Impact**
  - Isolated burn disaster such as the Station or Kiss Night Club Fires
  - Impact: Burn Care System
- **Type II Burn Disaster – Healthcare System Impact**
  - Multiple aspect disaster, such as an explosion with significant numbers of traumatic as well as burn injured patients such as the 2013 Boston, 2005 London or 2004 Madrid Bombings
  - Impact: Healthcare System

Type I Burn Disaster – Infrastructure Impact

- Catastrophic/wide spread event, multi-state such as 9/11 attacks or Earthquakes such as Northridge, Loma Prieta, Haiti*
- Impact: Critical Infrastructure

Kearns RD, Holmes 4th JH, Conlon KH, Valenta AL, Matherly AF, Cairns CB, Lord, G, Sawyer D, Johnson II DT, Skarote MB, Siler SM, Helminiak C, Cairns BA. Disaster Planning: The Basics of Creating a Burn Mass Casualty Disaster Plan for a Burn Center. *Journal Burn Care Research. Pub Ahead of Print JBCR:* Jul 2013.

Burn Center Planning

Disaster plans should reflect an extension of daily activities.

Planning from the burn center perspective should reflect (minimally) three levels;

Local: **Intrafacility (your hospital/system)**

State: **Interfacility/instrastate (burn and trauma centers) (state ESF-8)**

Regional: **Interstate (burn and trauma centers) NDMS or EMAC through state ESF-8**

Kearns RD, Conlon KH, Valenta AL, Matherly AF, Holmes 4th JH, Cairns CB, Lord, G, Sawyer D, Johnson II DT, Skarote MB, Siler SM, Helminiak C, Cairns BA. Disaster Planning: The Basics of Creating a Burn Mass Casualty Disaster Plan for a Burn Center. *Journal Burn Care Research. Pub Ahead of Print JBCR:* Jul 2013.

Governmental Planning

Planning from the governmental perspective should reflect:

Local: **First Responder (EMS system)**

First Receiver(s) (local hospital[s])

State: **Mutual Aid EMS, Intrastate regional response teams, burn and trauma centers**

Regional: **Interstate Burn Centers, Regional or Federal Response Teams through EMAC or NDMS**

State Plan

Kearns RD, Holmes 4th JH, Conlon KH, Valenta AL, Matherly AF, Cairns CB, Lord, G, Sawyer D, Johnson II DT, Skarote MB, Siler SM, Helminiak C, Cairns BA. Disaster Planning: The Basics of Creating a Burn Mass Casualty Disaster Plan for a Burn Center. *Journal Burn Care Research. Pub Ahead of Print JBCR:* Jul 2013.

Three Windows in Time, in a Burn Disaster

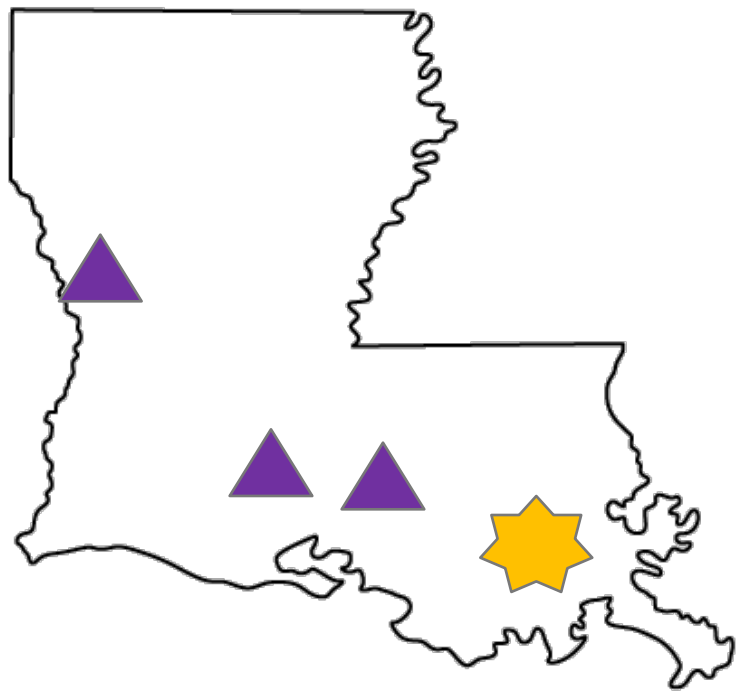
Immediate: best you can with what you have and know who to call for what you need (also referred to as a No-notice Event)

6-120 hrs: leaning forward with response teams, transport agencies, and push packs of equipment (***surge management***: staff, space, stuff) (special)

>72-120 hrs: high census but normal operation

Kearns RD, Conlon KH, Valenta AL, Matherly AF, Holmes 4th JH, Cairns CB, Lord, G, Sawyer D, Johnson II DT, Skarote MB, Siler SM, Helminiak C, Cairns BA. Disaster Planning: The Basics of Creating a Burn Mass Casualty Disaster Plan for a Burn Center. *Journal Burn Care Research. Pub Ahead of Print JBCR:* Jul 2013.

Burn Centers in Louisiana



Burn Center, Co-Located with a Level I Trauma Center

Designated Burn Center

Threat of Fire

Case study on **Fire** in a small space with limited fire protection

National Institute of Standards and Technology **(NIST)** Simulation

Concept

Process

Use

BURN SURGE CAPACITY IN THE SOUTH

WHAT IS THE CAPACITY OF BURN CENTERS WITHIN THE AMERICAN BURN ASSOCIATION SOUTHERN REGION TO ABSORB SIGNIFICANT NUMBERS OF BURN INJURED PATIENTS DURING A MEDICAL DISASTER?

BY

Randy Dermont Kearns

A doctoral project submitted to the faculty of the Medical University of South Carolina in partial fulfillment of the requirements for the degree

Doctor of Health Administration

In the College of Health Professions

Modeling

The Value of Modeling:

- Test multiple hypotheses
- Inject variability
- Increased frequency of exercise

Three Types of Simulation

- Discrete Event
- Continuous
- **Monte Carlo**

Plan Fatigue/Failure

- Plan vs. Framework

Methods

Descriptive analysis

- Self designated and self reported bed capacity
- Burn Center Surge capacity (50% above stated capacity)
- Trauma Center static capacity (temporary)

Monte Carlo Simulation (North Carolina Jaycee Burn Center 2009-10 to determine a distribution curve)

- Reported Staffed Capacity – Avg. Daily Census
  = Bed Availability
- Randomly perform 10,000 iterations using @Risk

Kearns RD. *Burn surge capacity in the south what is the capacity of burn centers within the American Burn Association southern region to absorb significant numbers of burn injured patients during a medical disaster?* Medical University of South Carolina: ProQuest Dissertations and Theses; 2011.

Findings and Regional Applications

Confirmed Trigger points for planning tools

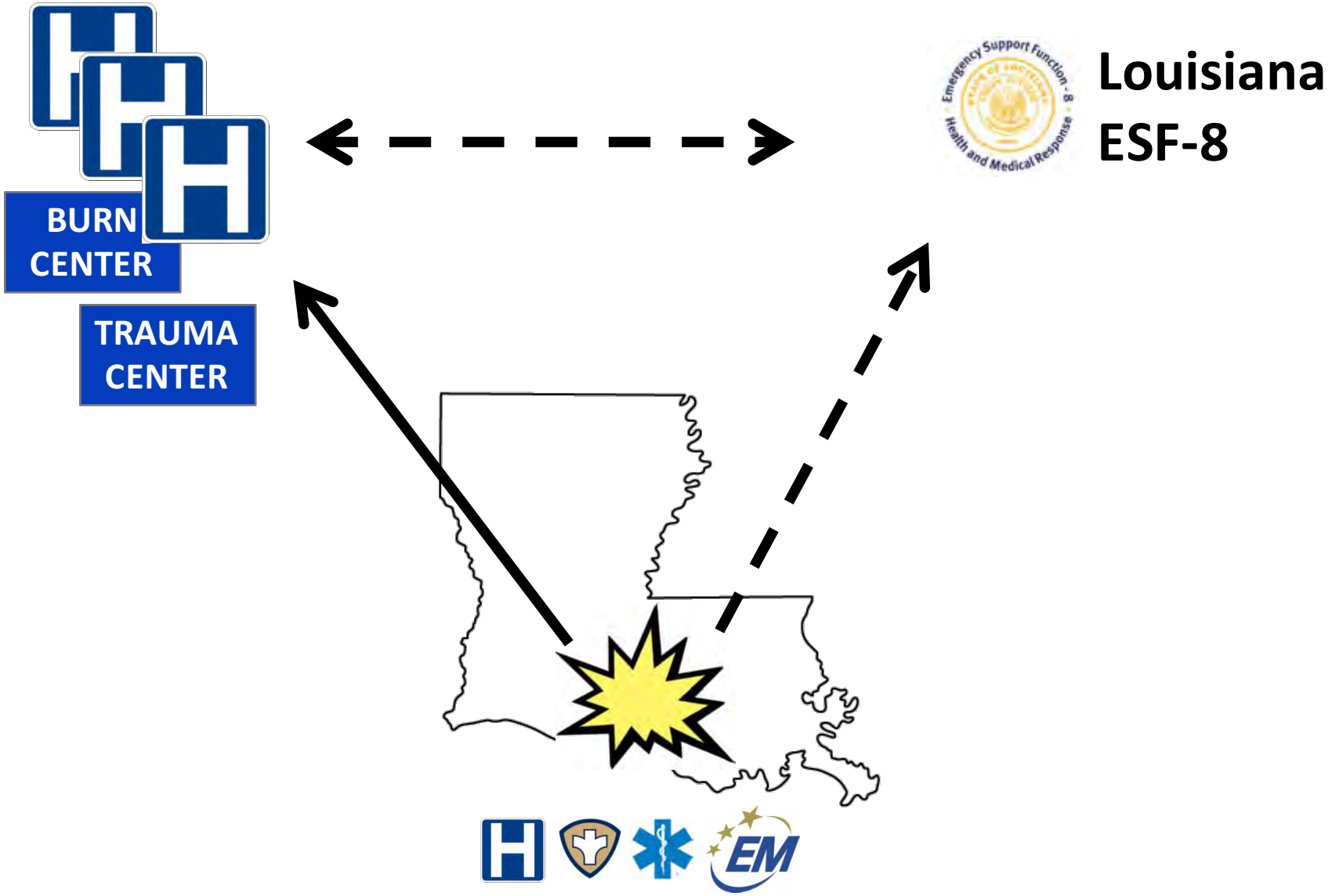
Activation points for transportation assets/resources

Better understanding of capacities and capabilities

6:5:6 Trigger to activate Plan

20-60 patients = Intrastate Plan Failure

425-450 patients = Interstate Plan Failure (Regional)



All Disasters are Local!

Key Steps at the Scene:

- Sufficient Resources
  - to the scene to care for and move patients to appropriate destinations
- Upstream notification
  - Receiving hospitals
  - Mutual aid ground/air ambulances

- Depending on your Destination and Triage plan will depend on your initial destination

Education (Past Experience)

Burn Prevention

- Elementary Schools (16,033 Students)

Statewide Protocols

- Common Approach to Care

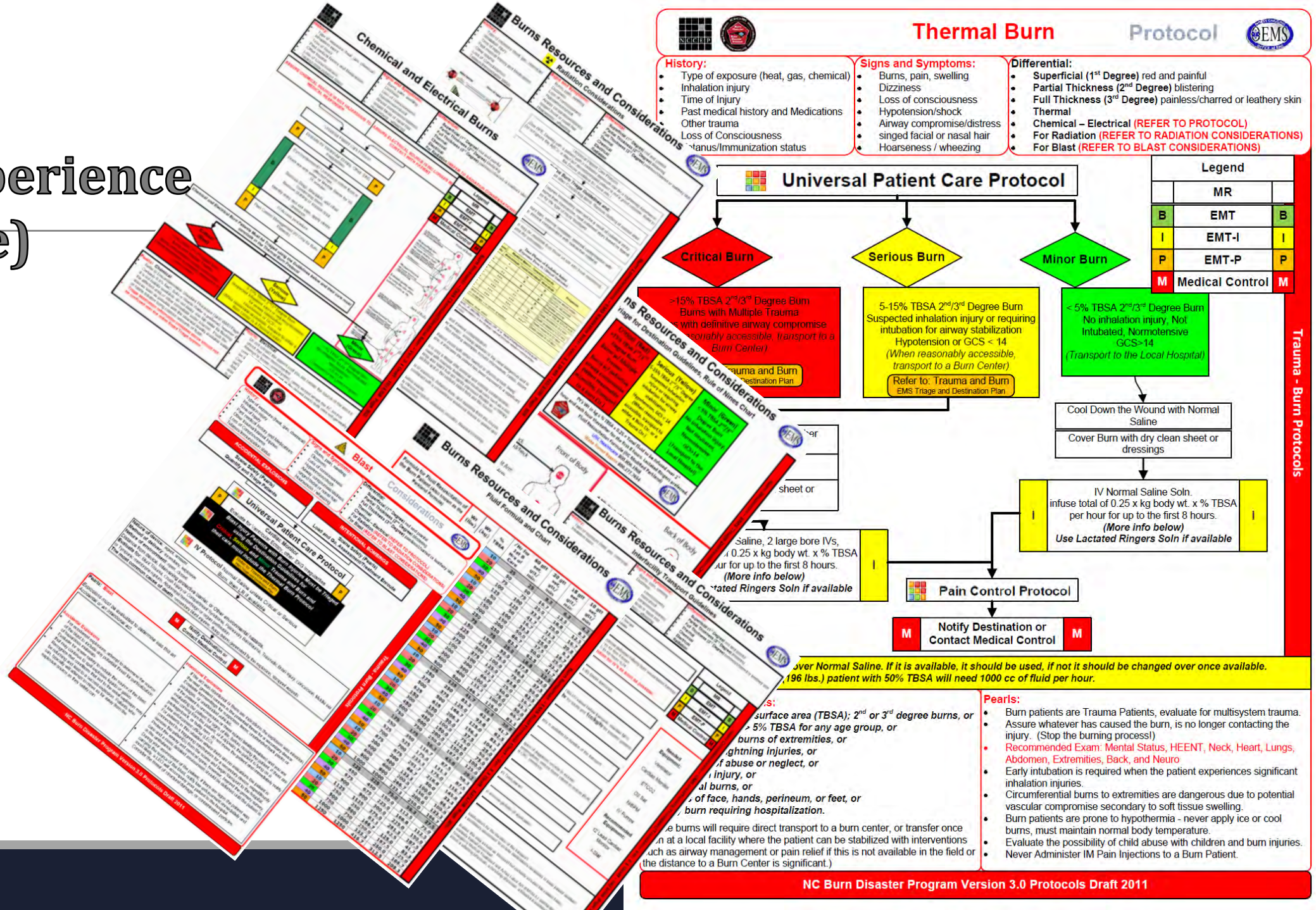
Local Delivery Burn Care Core Concepts

- Courses offered (154 courses)

Local and Regional Delivery, Advanced Burn Life Support

- Courses offered (93 courses)

(Past Experience Statewide)



(Past Experience National Journal)

EMS World Thermal

January 2013

By Randy D. Kearns, DHA, MSA, NREMT-P (ret.), Charles B. Cairns, MD, FACEP, FAHA, James H. Holmes, IV, MD, FACS, Preston B. Rich, MD, MBA, FACS, & Bruce A. Cairns, MD, FACS

THERMAL BURN CARE: A Review of BEST PRACTICES

What should prehospital providers do for these patients?

One of the greatest challenges in healthcare is the management of burn-injured patients. There are important, unique aspects that must be considered when managing this population. This the first in a series of articles on burn management during the first 60–90 minutes following injury. This article will examine the basics of thermal burn injury and address the role of prehospital providers in initial management of these patients.

Burn injury involves the largest body organ, the skin. The skin makes up the largest part of the integumentary system (skin, hair and nails). There are 450,000 burn injuries each year in the United States.[2] According to the American Hospital Association (AHA), there were 5,795 hospitals in the U.S. in 2011, with 944,277 staffed beds.[4] With 123 self-identified burn centers reporting 1,895 beds collectively,[5] this yields a ratio of approximately one burn center for every 47 hospitals and one "burn bed" for every 498 beds. Because burn injuries are relatively rare, there are very few locations where serious burn injuries are routinely managed. Regardless of prevalence, it is essential that patients with thermal injuries be managed in dedicated burn centers,[5,6] not unlike the need for trauma victims to be cared for at dedicated trauma centers.[7-9]

Thermal burn injury involving most of the right arm and the right lateral chest and abdominal area. The burn injury extends beyond the photo to the right thigh. This image is a mix of partial and full thickness burn injuries following an explosion. EMS care includes IV fluids; pain management; wound care to include slight elevation of burned extremity; close monitoring of distal neurocirculatory function for the arm; and evaluation for underlying traumatic injury, either from concussive wave or projectiles from the blast.

Thermal burn injury involving anterior of both legs, uninjured areas include where shorts, socks and shoes provided partial protection. This is a 15% TBSA burn. Each leg, including the foot, is 18%. For this burn, the anterior surface of each leg, minus the area of the foot and the upper leg shielded by clothing, is approximately 15%. The patient is pictured following debridement upon admission at a burn center.

Photos courtesy Dr. James H. Holmes IV, Burn Center Director Wake Forest University Baptist Health

EMS World Blast

May 2013

EMS World Chemical

May 2014

By Randy D. Kearns, DHA MSA NREMTP-ret., Charles B. Cairns, MD, FACEP, FAHA, James. H. Holmes IV, MD, FACS, Preston B. Rich, MD, MBA, FACS, & Bruce A. Cairns, MD, FACS

CHEMICAL BURN CARE: A Review of Best Practices

Great risk and potential for injury is present when dealing with chemical burns, for patients and providers

Chemical burns are produced when the skin is exposed to a corrosive material, such as an acidic or alkaline substance. Exposure to a variety of common substances can lead to an injury; this article will cover several of the more common chemicals that pose risks to the patient.

Caustic substances that have capacity to cause burns can range from non-lethal capsaicin-based sprays used by law enforcement to commonly available chemicals found in households, industrial settings and construction work sites. One critical aspect to always consider when responding to a patient with a known or suspected chemical burn is the risk of exposure to the responder by the same causative agent.

Several of the agents most closely associated with war and terrorism are caustic chemicals that result in burn injury. The prevention and management of chemical burns are prominent features in current efforts to curtail the impact of weapons of mass destruction (WMD).[3-6] In the aftermath of the 9/11 attacks,[7] WMD became and remains a central focus of the U.S. Department of Homeland Security (DHS) in its efforts to coordinate and develop overall disaster preparedness and planning. For medical disaster planning and preparedness, the U.S. Department of Health and Human Services' (DHHS) Office of the Assistant Secretary for Preparedness and Response (ASPR) and its Hospital Preparedness Program (HPP)[3,5,8-10] have also developed a focus to include weaponized chemical agents. Due to the widespread use of chemicals in households and industry,[11,12] and the capacity for their purposeful use to injure or instill fear,[13-16] exposure to caustic chemicals and the burns they create is an ongoing danger.[17]

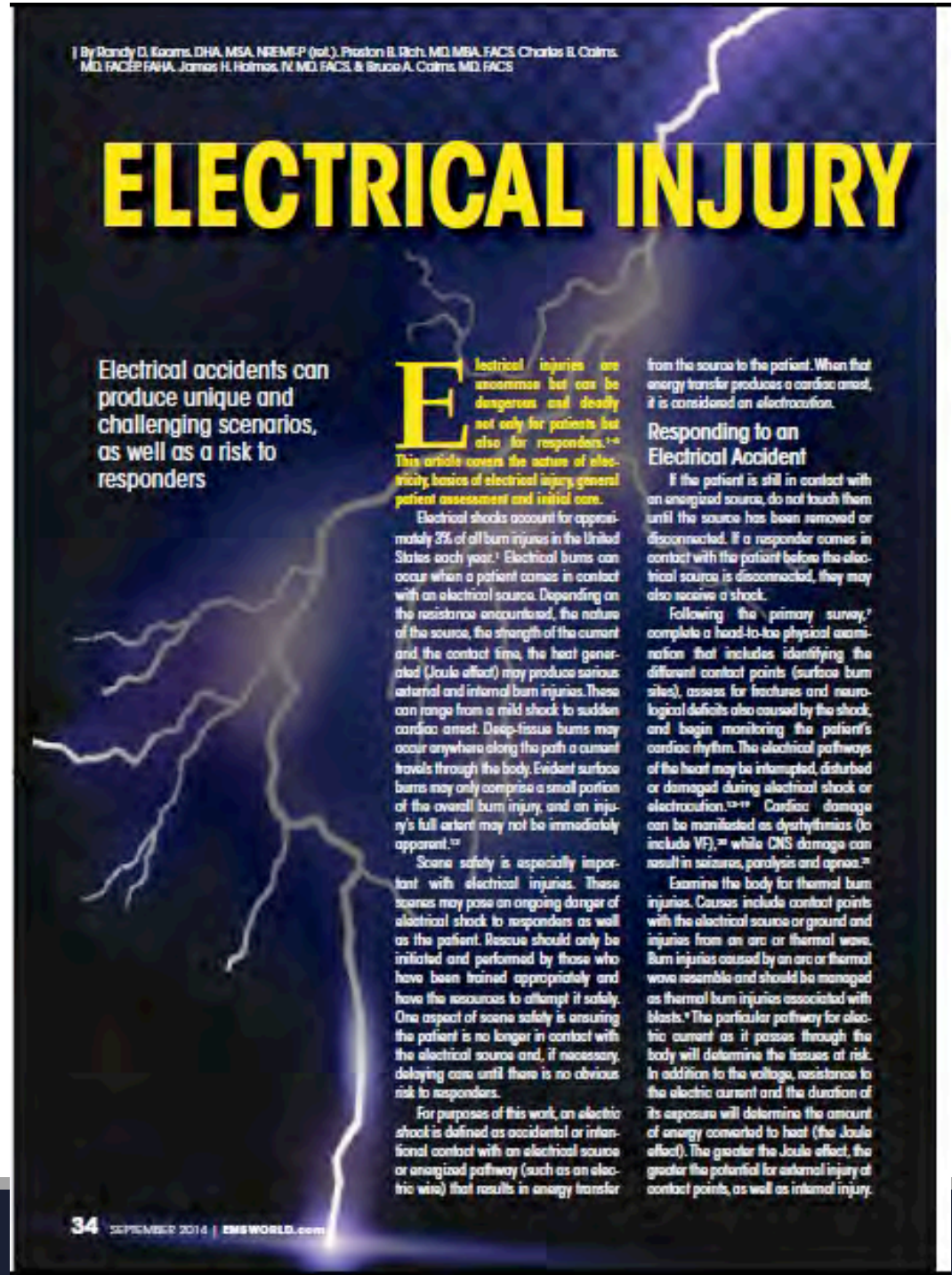
Assessment and Triage

The first steps of the assessment are to limit ongoing injury and determine the extent of exposure. These steps can be simplified to: strip, flush and cover the area. If it appears clothing is adhering to the injury site, then flush the area with water; wetting the clothing will facilitate its release from the wound.

Chlorine gas in a high concentration, saturated the clothing of this patient. Chemical burns were found in locations where the clothing was the thinnest and offered the least protection.

EMS World Electrical

September 2014



By Randy D. Kearns, DHA, MSA, NREMT-P (ret.), Preston B. Rich, MD, MBA, FACS, Charles B. Colms, MD, FACEP, FAHA, James H. Holmes, IV, MD, FACS, & Bruce A. Colms, MD, FACS

ELECTRICAL INJURY

Electrical accidents can produce unique and challenging scenarios, as well as a risk to responders

Electrical injuries are uncommon but can be dangerous and deadly not only for patients but also for responders.[1-4] This article covers the nature of electricity, basics of electrical injury, general patient assessment and initial care.

Electrical shocks account for approximately 3% of all burn injuries in the United States each year.[1] Electrical burns can occur when a patient comes in contact with an electrical source. Depending on the resistance encountered, the nature of the source, the strength of the current and the contact time, the heat generated (Joule effect) may produce serious external and internal burn injuries. These can range from a mild shock to sudden cardiac arrest. Deep-tissue burns may occur anywhere along the path a current travels through the body. Evident surface burns may only comprise a small portion of the overall burn injury, and an injury's full extent may not be immediately apparent.[1,2]

Scene safety is especially important with electrical injuries. These scenes may pose an ongoing danger of electrical shock to responders as well as the patient. Rescue should only be initiated and performed by those who have been trained appropriately and have the resources to attempt it safely. One aspect of scene safety is ensuring the patient is no longer in contact with the electrical source and, if necessary, delaying care until there is no obvious risk to responders.

For purposes of this work, an electric shock is defined as accidental or intentional contact with an electrical source or energized pathway (such as an electric wire) that results in energy transfer from the source to the patient. When that energy transfer produces a cardiac arrest, it is considered an electrocution.

Responding to an Electrical Accident

If the patient is still in contact with an energized source, do not touch them until the source has been removed or disconnected. If a responder comes in contact with the patient before the electrical source is disconnected, they may also receive a shock.

Following the primary survey,[3] complete a head-to-toe physical examination that includes identifying the different contact points (surface burn sites), assess for fractures and neurological deficits also caused by the shock, and begin monitoring the patient's cardiac rhythm. The electrical pathways of the heart may be interrupted, disturbed or damaged during electrical shock or electrocution.[12-17] Cardiac damage can be manifested as dysrhythmias (to include VF),[18] while CNS damage can result in seizures, paralysis and apnea.[19]

Examine the body for thermal burn injuries. Causes include contact points with the electrical source or ground and injuries from an arc or thermal wave. Burn injuries caused by an arc or thermal wave resemble and should be managed as thermal burn injuries associated with blasts.[4] The particular pathway for electric current as it passes through the body will determine the tissues at risk. In addition to the voltage, resistance to the electric current and the duration of its exposure will determine the amount of energy converted to heat (the Joule effect). The greater the Joule effect, the greater the potential for external injury at contact points, as well as internal injury.

EMS World Radiation

October 2016

Radiation Injury, Burns and Illness: A Review of Best Practices

Your approach should include identifying sources, determining exposure and managing resources

By Randy D. Kearns, DHA, MSA, NRP (ret.), Steve Sugarman, MS, CHP, CHCM, Charles B. Cairns, MD, FACEP, FAHA, James. H. Holmes IV, MD, FACS, Bruce A. Cairns, MD, FACS, & Preston B. Rich, MD, MBA, FACS

Injuries involving radiation sources and radioactive reactions are rare. Nevertheless, they can be catastrophic for the patient while simultaneously exposing the first responder to great risk.[1] This work will focus on radiation-related injuries as well as thermal burns produced by nuclear reactions. It will also address radiation injuries that may have burn injury characteristics.[2]

What Is Radiation?

Inherently unstable atomic structures are termed *radioactive* due to their natural tendency to release excess energy or mass to attain states of greater molecular stability. These emissions are called *radiation*. Radiation is emitted from its source and subsequently travels through substance, space or a combination of the two.

There are two classifications of radiation: ionizing and nonionizing. While ionizing radiation poses the greater danger, both ionizing and nonionizing radiation pose an injury risk. There are four subclassifications of ionizing radiation (see *Figure 1*).[3]

Radioactive forms of elements are called *radionuclides*. There are more than 60 radionuclides found naturally in the environment, while others are human-produced. Radionuclides are commonly grouped into three categories.[4] Although quantitatively the smallest category, the human-produced sources will be the focus of this work due to the significant role they play in determining radiation-associated injury.

The term *irradiation*, often referred to as *exposure*, is used to describe a situation where the human body is subjected to penetrating radiation emitted from radioactive materials or a radiation-generating device.[5] *Contamination* occurs when radioactive materials are deposited on body surfaces such as skin. This condition is specifically referred to as *external contamination*. If radioactive materials enter the body (e.g., through inhalation, ingestion, absorption or direct entry via wounds), *internal contamination* occurs.

Exposure to radioactive materials is not an absolute indication that an individual was also contaminated. For contamination to occur, the material must be physically present on or in the body. This is an important differentiation because the risk of contamination determines the need for personal protective equipment. The presence of contamination and identity of the contaminating radionuclide should be determined as soon as feasible, preferably prior to patient transport. However, lifesaving medical care should not be delayed due solely to contamination concerns.

Nonionizing radiation—Radiation is a general term that simply refers to the emission of energy in the form of waves or particles. Because radio waves, microwaves and ultraviolet radiation are all types of radiation, "radiation-emitting devices" include common sources of daily exposure such as cell phone towers and microwave ovens (*Figure 2*). These types of radiation, as well as others, are

A New Symbol

In February 2007, the United Nations introduced a supplemental symbol to augment the familiar yellow background symbol that warns of radiation hazards. The new symbol (with a red background) was created to help reduce accidental exposure to large radioactive sources. It will not be visible under normal use, but only if someone attempts to disassemble a device that is a source of dangerous radiation. It will not be located on building access doors, transportation packages or containers.

Figure 1: Universal symbols for radiation

EMSWORLD CE

This CE activity is approved by EMS World, an organization accredited by the Commission on Accreditation of Pre-Hospital Continuing Education (CAPCE), for 1 CEU upon successful completion of the post test available at EMSWorldCE.com. Test costs $6.95. Questions? E-mail editor@EMSWorld.com.

CAPCE

EMS World

Pending Articles and update previous articles

Key Considerations

- Know your limits, when do you need mutual aid and who do you call?
- Does the Burn Center have an “Always Open” philosophy?
- What are your regional or State Agency involvement?

Surge Capacity Definition:

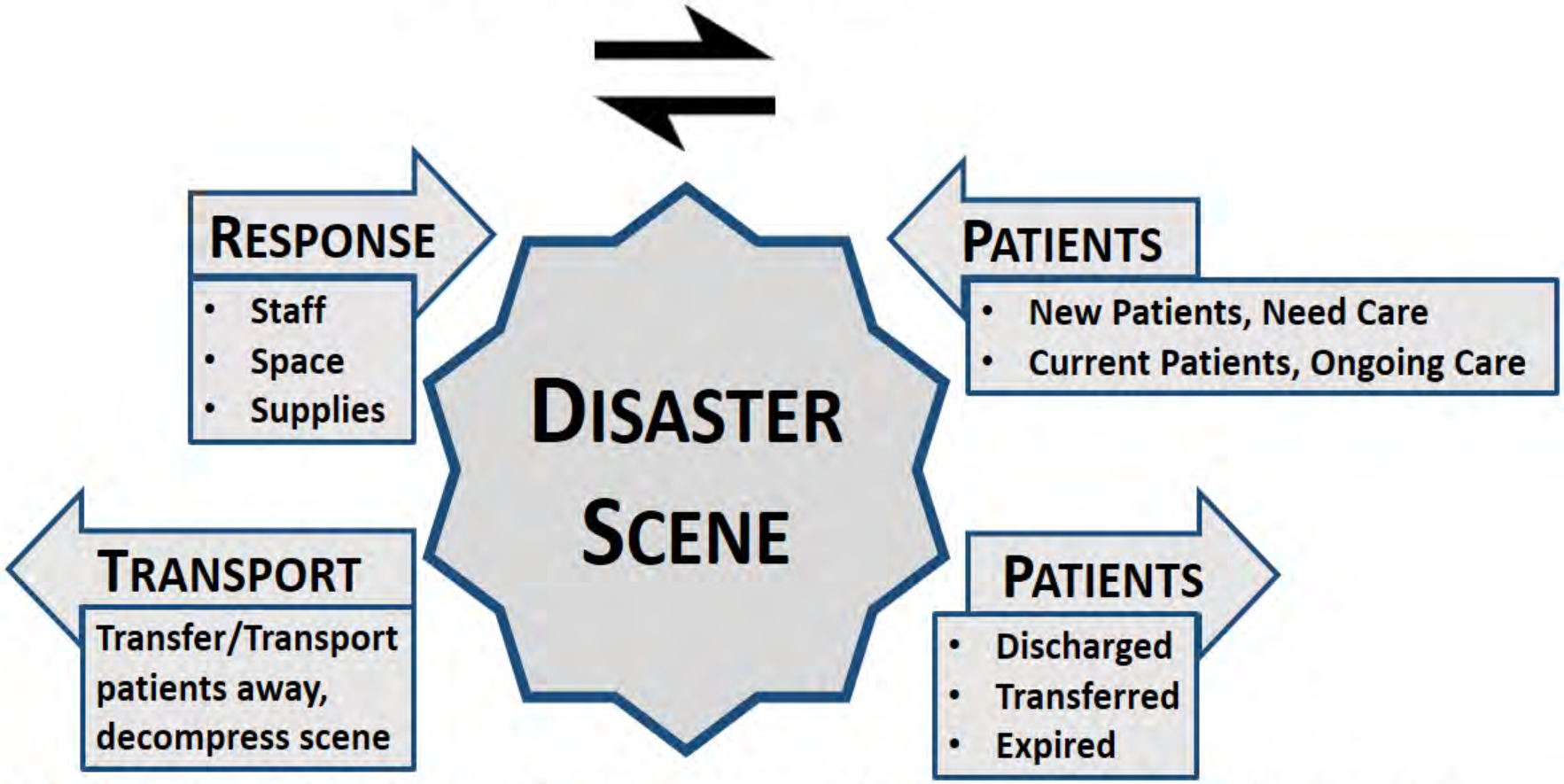
Surge Capacity (and Capability) includes the

- Staff
- Space
- Stuff (Supplies, Pharmaceuticals & Equipment) (Special)

required to meet the needs of the patients.

*The most important contributing factor outside of S3 is **medical transportation** resources.*

Surge Equilibrium



Surge Equilibrium: all competing influences of the disaster are balanced at the point of where the patients are being managed, disaster scene or at the hospital.

Kearns RD, Holmes 4th JH, Conlon KH, Valenta AL, Matherly AF, Cairns CB, Lord, G, Sawyer D, Johnson II DT, Skarote MB, Siler SM, Helminiak C, Cairns BA. Disaster Planning: The Basics of Creating a Burn Mass Casualty Disaster Plan for a Burn Center. *Journal Burn Care Research. Pub Ahead of Print JBCR:* Jul 2013.

Transportation Resources

Civilian

- **Ambulances –**
- **Ambulance Strike Teams –**
- **AmBuses Units –**
- **SCT/CCT Units –**
- **Helicopters –**
- **Fixed Wing –**

Governmental or Military

- National Guard vs. Reserves or Regular Air Force
- Coast Guard, Forest Service, Park Service

Conclusions

Plans – **Relationships**

- Local, State, Regional

Who to call and what can you bring?

- Staff, Space, Stuff – Transport resources

Plans – Scalability, Trigger Points, Activity, Failure

All disasters are local, so are all solutions

Education is a game changer

Thanks…Questions?

Randy D. Kearns, DHA

rkearns@uno.edu

Jeffrey E. Carter, MD FACS

jeffrey.carter@lcmchealth.org

Resources – Publications
PubMed: Kearns R

1. Kearns R, Holmes Jt, Cairns B. Burn disaster preparedness and the southern region of the United States. *South Med J.* Jan 2013;106(1):69-73.
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