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THESIS

STRENGTHENING HOSPITAL SURGE CAPACITY IN THE EVENT OF EXPLOSIVE OR CHEMICAL TERRORIST ATTACKS

by

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13. ABSTRACT (maximum 200 words)

Medical Care is a Public Trust. Americans expect that hospitals and healthcare providers will be available and prepared to care for their every medical need. Yet the medical community is severely challenged daily to care for the influx of patients to its Emergency Departments with current resources. Healthcare is ill-prepared to meet community needs in the event of a mass casualty event from a terrorist attack using weapons of mass destruction.

This research explores the premise that clinicians have skills either current or remote that can be renewed and enhanced to provide an immediate life-saving response team in the event of explosive or chemical events. The research identified that the medical community has the building blocks available awaiting the guidance, organization and direction to orient them into a disaster medical capability that will improve preparedness and response. This thesis proposes a strategy to leverage the clinician personnel assets already in place to improve preparedness.

A transformational approach is necessary to insure healthcare preparedness. Government planners must understand the challenges and current limitations of emergency medical response and partner with the healthcare to enhance preparedness. The United States medical community must understand the realities of terrorism and war at home.

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STRENGTHENING HOSPITAL SURGE CAPACITY IN THE EVENT OF EXPLOSIVE OR CHEMICAL TERRORIST ATTACKS

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ABSTRACT

Medical Care is a Public Trust. Americans expect that hospitals and healthcare providers will be available and prepared to care for their every medical need. Yet the medical community is severely challenged daily to care for the influx of patients to its Emergency Departments with current resources. Healthcare is ill-prepared to meet community needs in the event of a mass casualty event from a terrorist attack using weapons of mass destruction.

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LIST OF ABBREVIATIONS

AAMC	American Association of Medical Colleges
AAP	American Academy of Pediatrics
ABMS	American Board of Medical Specialties
ACGME	American College of Graduate Medical Education
ACLS	Advanced Cardiac Life Support
ACEP	American College of Emergency Physicians
ACS	American College of Surgeons
ADC	Average Daily Census
AHA	American Hospital Association
AHRQ	Agency for Healthcare Research and Quality
AIC	Akaike's Information Criteria
AIDS	Acquired Immunodeficiency Syndrome
AMA	American Medical Association
AMA	Against Medical Advice
ATLS	Advanced Trauma Life Support
ATT	Attending
BIC	Bayesian Information Criteria
BLS	Basic Life Support
BT	Bioterrorism
BTCDP	BioTerrorism Training and Curriculum Development Program
CBRNE	Chemical, Biological, Radiological, Nuclear, Explosive
CDC	Centers for Disease Control
CLIA	Clinical Laboratory Improvement Amendments
CME	Continuing Medical Education
CMS	Center for Medicare and Medicare Services
CONOPS	Concept of Operations
CPHP	Center for Public Health Preparedness
CT	Computerized Tomography
DERM	Dermatology
DHHS	Department of Health and Human Services
DHS	Department of Homeland Security
DMAT	Disaster Medical Assistance Teams
DOD	Department of Defense
DOW	Died of Wounds

ED	Emergency Department
EKG	Electrocardiogram
EM	Emergency Medicine
EMS	Emergency Medical Services
EMTALA	Emergency Medicine Treatment and Labor Act
ENT	Ear, Nose & Throat
ESAR VHP	Emergency System for Advanced Registration of Volunteer Health Professionals
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FRSS	Forward Resuscitative Surgical System
FT	Full Time
FY	Fiscal Year
GAO	General Accounting Office
GDP	Gross Domestic Product
GS	General Surgery
GWOT	Global War on Terror
HANYS	Hospital Association of New York State
HCS	Healthcare System
HCW	Health Care Worker
HEICS	Hospital Emergency Incident Command System
HIPAA	Health Insurance Portability and Accountability Act
HOSP	Hospital
HRSA	Health Resources and Services Administration
HSBC	Hong Kong Shanghai Bank Corporation
HSPD	Homeland Security Presidential Directive
ICU	Intensive Care Unit
IED	Improvised Explosive Device
IOM	Institute of Medicine
IRB	Institutional Review Board
ISS	Injury Severity Score
JCAHO	Joint Commission for the Accreditation of Healthcare Organizations
JMTF	Joint Medical Task Force
KIA	Killed in Action
LWOBS	Left Without Being Seen

MCI	Multi Casualty Incident
MD	Medical Doctor
MDA	Magen David Odem-Israeli EMS
MMRS	Metropolitan Medical Response System
MRC	Medical Reserve Corps
NBHPP	National Bioterrorism Hospital Preparedness Program
NBMS	National Board of Medical Specialties
NCDP	National Center for Disaster Preparedness
NDLS-D	National Disaster Life Support-Decontamination
NDMS	National Disaster Medical System
NEURO	Neurology
NHPF	National Health Policy Reform
NICU	Neonatal Intensive Care Unit
NIMS	National Incident Management System
NORTHCOM	U.S. Northern Command
NP	Nurse Practitioner
NRF	National Response Framework
NRP	National Response Plan
OB	Obstetrics
OB-GYN	Obstetrics-Gynecology
OPHTHO	Ophthalmology
OR	Operating Room
ORTHO	Orthopedics
OSHA	Occupational Safety and Health Organization
PA	Physician Assistant
PALS	Pediatric Advanced Life Support
PDD	Presidential Decision Directive
PEDS	Pediatrics
PGY	Post Graduate Year
PHTLS	Pre-hospital Trauma Life Support
PICU	Pediatric Intensive Care Unit
PMR	Physical Medicine & Rehabilitation
POD	Point of Distribution
PSYCH	Psychiatry
PT	Part Time
RBC	Red Blood Cells
RES	Resident
RVU	Relative Value Unit

SARA	Superfund Amendment and Reauthorization Act
SARS	Sudden Acute Respiratory Syndrome
SNS	Strategic National Stockpile
TCL	Target Capabilities List
TJC	The Joint Commission
USMC	United States Marine Corps
USPHS	United States Public Health Service
UTL	Universal Task List
VA	Veterans Administration
WMD	Weapons of Mass Destruction

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I. INTRODUCTION

> Ask not what your country can do for you, ask what you can do for your country.[1]

The new millennium dawned spectacular and bright as the world watched the excited throngs of people celebrating at fireworks displays at major monuments in Paris, Australia and New York. Less than two years later, the world watched horrified at another spectacular blaze at a major monument. The world changed dramatically on September 11, 2001. Suddenly, the world looked very different. Terrorism had moved to our shores and our heartland. We had to refocus.

As the nation has successfully strategized and taken action to prevent other spectacular events, terrorists search for simpler, more accessible means and targets to strike fear in the citizens. As Thomas Friedman wrote in his best-seller The World is Flat, the Internet has allowed small, well-positioned attacks to instill fear in the hearts and minds of millions throughout the world.[2] It has opened possibilities and technical information to the devious and disaffected around the world.

The 9/11 Commission concluded, "…a rededication to preparedness is perhaps the best way to honor the memories of those we lost that day."[3]

This thesis offers a challenge to the healthcare community to rededicate themselves to their Hippocratic Oath and to the people of the United States.

A. PROBLEM STATEMENT

Hospitals and physicians share a public trust with the community to care for the citizens in their time of need. Fulfilling this function requires that hospitals and physicians create a surge capacity (a term used in Homeland Security and healthcare that

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[1] John Fitzgerald Kennedy, 35th President of the United States, Inaugural Address, January 20, 1960.

[2] Thomas Friedman, *The World Is Flat, Farrar* (Straus and Giroux, New York 2006), 430.

[3] The 9/11 Commission Report, *Final Report of the National Commission on Terrorist Attacks upon the United States* (WW Norton and Company: New York), 323.

means to improve and expand resources in the event of a major healthcare crisis). Much has been written and plans have been developed for improving surge capacity by hospitals and public health in the event of a bioterrorism event such as smallpox or pandemic flu. In these scenarios, the surge capacity can be developed over hours to days.

However, little has been written and less has been studied on improving surge capacity in the event of a chemical or explosive event in which many victims may require immediate life saving or limb-sparing medical care within the "Golden Hour" (defined by the American College of Surgeons as the critical time in which intervention and stabilization will significantly impact a patient's outcome[4]) long before the Disaster Medical Assistance Team (DMAT) or Medical Reserve Corps (MRC) will arrive.

The Institute of Medicine concludes that Emergency Departments are not prepared to handle surges from terrorist and other events.[5] The public is indicating concern about the preparedness of healthcare.[6]

Advances have been made in trauma management and lessons have been learned from the United States Military Medical Departments as well as Israeli military and medical units and from professionals from other countries from battles or attacks fought abroad. Few of these advances have yet to be translated to civilian medicine because the possibility is remote and the challenge is great. Most U.S physicians have received little training to prepare them to manage victims of terrorist weapons such as explosive or chemical agents especially under mass casualty scenarios.

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[4] L. S. McGinnis, and B. Cebuhar, "The Quality Imperative, New Tools and Expanded Responsibilities of Surgeons," *Bulletin of the American College of Surgeons* 88, no. 3 (March 2003): 1.

[5] Institute of Medicine, *Hospital-Based Emergency Care, At the Breaking Point, Future of Emergency Care Series, Report of the Committee on the Future of Emergency Care in the United States* (Institute of Medicine of the National Academies, The National Academies Press, Washington, DC, June 2006), Executive Summary, 6-7.

[6] I. Redlener, MD, R. Grant. D. A. Berman, D. Johnson, and D. Abramson, Annual Survey of the American Public by the National Center for Disaster Preparedness at Columbia University, Mailman School of Public Health and The Children's Health Fund, "Where the American Public Stands on Terrorism, Security and Disaster Preparedness, Five Years after September 11, One-Year after Hurricane Katrina," September 2006, 2-5, http://www.ncdmailman.columbia.edu/files/2006_white_paper.pdf (accessed May 19, 2007).

The threats are now on our shores and are predicted to continue for many years. Strengthening the national preparedness and response capability requires that the major Homeland Security agencies, especially the Department of Homeland Security (DHS) and the Department of Health and Human Services (DHHS), look carefully at the scenarios they have defined[7] and examine carefully the timeline for adequate response. They need to strategize collaboratively with the medical community and the hospital community to improve local preparedness and response capability to maximize the care given to the largest number of victims in a time appropriate to the injury.

DHHS calls for preemptive action. It emphasizes that health care and public health systems, individual hospitals and health care personnel must collaborate to ensure that plans are in place to effectively receive, evaluate and treat large numbers of injured patients, to rapidly identify and stabilize the most critically injured, to evaluate those efforts and to strategically plan for future incidents.[8] Medical communities must develop and implement new strategies in the medical communities to maximize the medical response and to minimize the morbidity and mortality within the walls of the hospital.

B. ARGUMENT

1. Main Claim

Current preparedness plans do not adequately address the scenarios of explosive and chemical events in which the timeline for effective response requires immediate intervention. Most hospitals would be severely challenged to provide several response teams in the immediate timeframe. Physicians expect that response will be the responsibility of the emergency physician, the trauma surgeon, the Disaster Medical Assistance Teams (DMAT) or the federal government. Yet Emergency Department

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[7] The United States Department of Justice, Office of Justice Programs, Fact Sheet, Homeland Security, "A Nation Prepared, The Target Capabilities List," www.ojusdoj.gov/odp/docs/Target_Capabilities_List_041405.pdf (accessed February 7, 2008), 1.

[8] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 2- 3.

physicians are struggling with the overcrowding crisis and the number of trauma surgeons is diminishing evidenced by the fact that only 58% of trauma fellowships were filled in 2002.[9] Since they are engaged in their own specialty, other physicians do not really think about their participation in a response effort. Many physicians who participated in the research for this thesis expressed surprise that they were being included. Clinicians do not cross-political barriers of specialty credentialing and, even more importantly, no one has asked them to participate and prepare. Many expect that someone else is coming to assist in the response.

Governmental agencies have focused attention on building federal DMAT teams, adding local Medical Reserve Corps (MRC) teams and credentialing more physicians to respond from afar but these resources have limitations. At the end of the day, hospitals will have to respond from within due to the urgency of these scenarios. Instead of building more of the same, which will not address the scenarios, an alternative solution is sought. The best value-added approach may be to invest scarce resources in educating and training all physicians so that hospitals can develop internal response teams and regional teams that work together, practice together and are available to respond together.

This research seeks to determine if hospitals can effectively maximize the emergent clinical care, they provide utilizing the clinician resources present within their facility at the moment a time-sensitive mass casualty event occurs. Optimizing the clinical resources immediately present in the hospital will provide victims, the best chance of a successful outcome. The research of this thesis explores the premise that clinicians have knowledge or skills either current or remote that can be leveraged and enhanced to provide an immediate life-saving response team in the event of explosive or chemical events.

The reality is that hospitals must improve preparedness. More clinicians (Physicians, Physician Assistants or Nurse Practitioners) must prepare and train to a level sufficient to intervene initially. Training a wider community of physicians strengthens hospital response. They would be available in-hospital during chemical, biological,

[9] Joshua Brown, "The Need for Transformation: A Challenge for Trauma Surgery," *Journal of the University of Rochester* 3, no. 2 (Spring 2005): 19.

radiological, nuclear and explosive (CBRNE) events. Teaming together in a tiered-response model under the expertise and supervision of an ED or trauma physician, they might be the professional support needed immediately to provide an expanded response capability at any hospital in the nation in the "Golden Hour."

Clinical skills that a physician might not routinely employ in an elective situation might be sufficient and life saving in a disaster situation. Physicians and other medical personnel have training, whether recent or remote, that allows them to manage such victims. They have training and skills that might be expanded to strengthen their ability to function in a tiered-response model. The advantage of such a team is that they are used to working together utilizing hospital policies and systems, and they have professional relationships and trust. Organizing the medical response system into a coordinated, integrated, cooperative structure that can interact effectively and operate efficiently will leverage response and save lives and help minimize damage.

The United States medical community has the intelligence and expertise to improve its ability to prepare for and respond to all nature of mass casualty events. Engaging physicians educated in relevant principles throughout their training can accomplish this goal. These physicians are present in every hospital in the United States.

When a disaster occurs in a region, and Hospital Emergency Incident Command System (HEICS) is implemented, all elective Operating Room (OR) cases are cancelled, freeing up scheduled surgeons.[10] Those surgically-trained physicians, such as general surgeons, orthopedists, plastic surgeons, Obstetrician-Gynecologists and other surgical sub-specialists, are immediately available within the hospital to provide care that could potentially be life or limb sparing. Other, non-surgical physicians potentially have skills and abilities that might enhance a timely and effective response. While non-ED and non-Trauma physicians are even included in some hospital response plans, most are not specifically educated or trained for this response. In real emergencies, many clinicians do respond. It would be most effective if they were trained.

[10] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 11.

Traditionally, physicians have trained under a model of graduated responsibility whereby a resident in Postgraduate Year I (PGY I) is supervised by a more senior, more experienced PGY II or PGY III who answers to the responsible attending physician. Physicians are familiar and comfortable with this model. Its success could apply to a disaster response model. The Emergency Medicine Attending and/or the Trauma Surgeon directs, supervises, guides and supports several other clinicians as they assess and stabilize victims. This model provides a force multiplier such that those clinicians with the most clinical experience and judgment can direct the care while others with technical skills but less clinical acumen and experience can provide the care.

Whether more clinicians can train to adequate levels, whether they are willing to be trained, whether the regulators will allow them to function outside of their specialty, whether their already-trained colleagues believe in the value of training more clinicians, is all open to speculation and study.

2. Warrants

Intuitively, many readers will assume that all physicians have the ability to intervene to save lives and no new approaches are necessary.

However, many physicians completed medical school years before terrorism and weapons of mass destruction, and they were not formally taught these topics. Traditional medical school teaching with some relevance to CBRNE agents includes courses in patho-physiology, toxicology, infectious disease, emergency preparedness/disaster response, biostatistics, and epidemiology. However, the context was different and the importance attached to the learning was in a different framework. The CBRNE agents were discussed as rare agents and dismissed as having little day-to-day relevance. Agents of mass destruction are weapons precisely because they are not part of everyday life. Physicians who will be directly involved with physically injured or exposed must have more information and knowledge of treatment protocols.

Many have specialized to such a significant degree that they are far removed from their Emergency Medicine or general surgery/trauma rotations in medical school. The Emergency Medicine and Trauma disciplines have evolved as well, making many physicians uncomfortable with their training of many years ago.

Some physicians will not accept the need for a new approach. They believe they already have the skills. Some will assert that they are already trained by virtue of their license or board certification status. They will not look for any additional educational requirements or opportunities.

Some physicians will reject the need for a new approach since they deny any risk in their community. Some will be concerned for their own well-being. Some will say that response is not their responsibility. Some will be concerned about the costs in terms of time and cost of training. Some will raise a valid question about liability insurance coverage should they respond. The respondents in this research raised all these points.

Some officials may reject the need for a new approach since there are federal teams in place and governmental plans verify credentials of other clinicians. However, no external response will be rapid enough to have an impact. Little hard evidence suggests that these clinicians are adequately trained in CBRNE agents or response to make a difference despite their willingness.

Physician certification boards might reject the need for a new approach as they see an expanded, multi-specialty physician response as encroaching on their professional domain and a threat to their autonomy. The pressure to breach specialty walls may be viewed as unneeded competition that threatens financial viability. These specialty barriers can be serious impediments to physician response. Other barriers are hospital delineation of medical privileges, medical staff rules, and liability coverage terms that limit a physician's scope of practice to that defined by the specialty board. Response could be improved if specialty Boards each included relevant CBRNE response requirements for certification, and hospitals added an addendum to hospital privileges for

disaster response. However, the discipline of disaster medicine must be more clearly defined and the American Board of Medical Specialties must encourage their members to examine their role in a disaster response.

3. Evidence that the Proposal would be Effective

Despite all of the challenges, the majority of physicians go into medicine for altruistic reasons. If given the proper tools that expand on their already solid medical knowledge and technical skills, many more will accept the challenge and responsibility to improve preparedness.

For years, the United States military has trained many types of physicians to respond to trauma injuries on the battlefield.[11] Physician teams include career surgeons, as well as physicians at various levels of training and from multiple specialties, who are trained and practice together to make a comprehensive response team. This blended medical response crosses all the services and all specialties.

The New York University School of Medicine and its College of Dentistry, as part of a Department of Homeland Security grant, preliminarily explored the potential role of dentists in a disaster response. The study developed a summary expert/ leadership report on an expansion of role of dentists for the enhancement of medical surge response by conducting a survey of experts including Deans of Medical Schools, Deans of Dental Schools, Presidents of State Dental and Medical Societies.[12] In a report to the Department of Justice, the survey concludes that the medical and dental academic community and the dental profession's organized leadership envision a response role and perhaps an obligation for dentists to meet surge manpower requirements in response to catastrophic events. They assert that dental training and skills provide solid background for response.

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[11] Joseph DeFeo, *Joint Medical Readiness*, *Are We Ready to Answer the WMD Threat*? (U.S. Army War College, Carlisle Barracks, PA, March 2006), 3.

[12] W. Psoter, and D. Glotzer, *Enhancing Medical and Public Health Capabilities during Times of Crisis: A Summary Report on the Expansion of the Role of Dentists and Their Enhancement of the Medical Surge Response,* A Report to the Department of Justice (New York: New York University School of Medicine, New York University School of Dentistry, 2002), 2.

It was agreed that this role required additional training.[13] Research aimed to explore the development of training and training content for dentists and other possible responders. They heightened their knowledge of WMD and other catastrophic events and explored their potential roles in events such as complementing emergency department staff, in the areas of triage, certain basic hands-on skills and possibly decontamination. As result of heightened awareness and new needs assessment associated with emergency response, new requirements have been proposed for the dental profession to help meet the special needs of society in the event of a disaster.[14] However, the survey did not query potential participants and no strong consensus that dentists are receptive to additional training, that medical professionals would recommend training, or be receptive to assistance by dentists during a surge environment. This may suggest the existence of real political and professional pressures that would proscribe involvement of others in response to a catastrophic event. The authors conclude that it is early in surge response development and planning and that the healthcare infrastructure has not yet envisioned that the response systems could utilize this potential manpower pool.[15]

Researchers are now examining practitioner willingness and barriers to response. Qureshi et al studied the ability of the health care system to meet surge capacity needs at 47 centers. The investigators looked at the physical ability and willingness of healthcare workers to respond in several scenarios. They identified barriers to response including fear, concern for family and self and personal health issues. Respondents were most able to respond for a multi-casualty incident and least able for an infectious outbreak or a snowstorm. They were most willing to respond for a snowstorm or Mass Casualty Event but least willing for a biological or chemical event. Physicians represented 10% of the

[13] W. Psoter, and D. Glotzer, *Enhancing Medical and Public Health Capabilities during Times of Crisis: A Summary Report on the Expansion of the Role of Dentists and Their Enhancement of the Medical Surge Response,* A Report to the Department of Justice (New York: New York University School of Medicine, New York University School of Dentistry, 2002), 11.

[14] Ibid., 1.

[15] Ibid., 10.

study sample.[16] Schechter looked at the willingness and barriers to response for a county volunteer Medical Reserve Corps, including a wide spectrum of professionals, and concluded that volunteers may have more motivational intent, but barriers to response such as primary job commitment (34.5%) and lack of training (42.4%) still remain.[17] This study suggests the need for a more robust strategy for hospital preparedness.

Evidence for consensus on the appropriate education and training of clinicians is weak. The AHRQ promotes training clinicians for Public Health events relevant to bioterrorism preparedness.[18],[19] AHRQ found only modest evidence about effective ways to train clinicians to detect and manage an infectious disease outbreak. Very little evidence exists about how to train clinicians effectively to respond to other types of public health events deemed relevant to bioterrorism preparedness such as explosive or chemical events. Development of the curriculum, the courses, and the competencies is at an early stage as different organizations try different approaches. Some institutions do nothing as they await the consensus. AHRQ found that almost no evidence exists on training clinicians in aspects of response such as using central information resources, communicating with other professionals and reporting events to a central agency. They conclude that this lack of evidence demands an increased commitment to developing and evaluating educational programs relevant to Bio Terrorism preparedness.[20]

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[16] K. Qureshi, R. R. M. Gershon, M. F. Sherman, T. Straub, E. Gebbie, M. McCollum, M. J. Erwin, and S. S. Morse, "Health Care Worker's Ability and Willingness to Report to Duty during Catastrophic Disasters," *Journal of Urban Health*: *Bulletin of the New York Academy of Medicine, Oxford University Press* (2005): 6.

[17] S. Schechter, *Medical Reserve Corps Volunteers' Ability and Willingness to Report to Work for the Department of Health during Catastrophic Disasters* (Master's Thesis, Naval Postgraduate School, Monterey, CA, March 2007), 45.

[18] "AHRQ Training Clinicians for Public Health Events Relevant to Bioterrorism Preparedness," www.ahrq.gov/clinic/tp/biotrthtm (accessed May 19, 2007), 1.

[19] "AHRQ Disaster Plannings Drills and Readiness Assessment, Bioterrorism and Health System Preparedness," Issue Paper # 2, http://www.ahrq.gov/news/ulp/btbriefs/btbrief2.htm#training (accessed May 19, 2007), 1.

[20] Training of Clinicians for Public Health Events Relevant to Bioterrorism Preparedness, Prepared by Johns Hopkins Evidence-Based Practice Center, Christina Catlett, MD et al., Prepared for AHRQ, DHHS, SPHS, Rockville, MD AHRQ Evidence Reports and Summaries No 51, Publication No 02-E011, January 2002, 4, http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hstat1.chapter.76478 (accessed May 30, 2007).

Other studies point to weak clinician preparation. One review reveals that three-quarters of hospitals have disaster plans that address explosives but only one-fifth have conducted drills involving the imagined use of explosives. Many problematic areas stand between the current reality of emergency care in the United States and effective management of a Madrid-like event.[21] Hospitals with The Joint Commission (TJC) accreditation are more likely to provide terrorism preparedness training to all types of clinical staff. Teaching hospitals that are medical school affiliated as well as hospitals with larger bed capacity and an urban location are also likely to provide CBRNE training for staff physicians, residents, NP and PAs.[22] In the National Hospital Ambulatory Medical Care Survey conducted by CDC, 88.4% of nurses, 75.1% of attending physicians and 39.3% of residents reported receiving training in terrorism response,[23] although it is unclear if this training is didactics or disaster drill practice. There is a distinct difference.

Preparing clinicians to strategize and adapt may be as important as didactics and more important than traditional disaster drill practice. Burstein wrote of the "Five Myths of Disaster Education." The myths are, "…people need to know special things;" that "…professionals are smart and hearing the information once is enough;" "…a drill now and then is enough;" "…the government will take care of it" and finally, "…it is impossible to be prepared." He wrote that with all the money and effort spent to date, it is not clear that we have achieved an appropriate benefit in disaster readiness. He encourages teaching professionals how to think, communicate and coordinate. He promotes local training, frequents drills and incorporating realistic disaster training into residency and medical and nursing school curriculum, and incorporating it into daily life.[24]

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[21] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 2- 3.

[22] Richard Niska, MD and Catharine Burt, EdD, U.S. Department of Health & Human Services, Centers for Disease Control and Prevention, "Training for Terrorism-Related Conditions in Hospitals: United States, 2003-04," *Advance Data from Vital and Health Statistics* no. 380 (December 11, 2006): 3.

[23] Ibid., 2-3.

[24] Jonathan Burstein, "The Myths of Disaster Education," *Ann Emerg Med* 47 (2006): 50-52.

No study has evaluated whether non-ED or non-Trauma physicians or physician assistants believe they are qualified and competent or could be sufficiently trained to assist ED or Trauma physicians in the critical "Golden Hour" of assessment and resuscitation.

4. Challenges

Since 2001, considerable effort has been made to assess the capabilities of systems and individuals that are expected to prevent, detect and respond to terror incidents involving WMD. However, challenges still exist in defining a clear operational structure, a relevant curriculum, educational methods and competencies for physicians and mobilizing experienced faculty and integration across the continuum of healthcare. A consistent vision of where healthcare needs to move and how it will get there has not been articulated. First, the response and educational structure must be developed. Then the discussion about dissolving operational barriers, including specialty certification, credential and licensure restrictions and liability limitations can ensue.

Issues regarding physician understanding of their professional obligation to treat; their right to protect their personal safety; their responsibility and rights as a volunteer; and the professional liability issues in the context of a WMD event are other challenges that merit further discussion and resolution.

Additional challenges to insuring a robust physician response include integrating specialty divisions despite conflicting professional, financial and political constraints. Appropriate training that engages the participant in a relevant way must be developed. It must be easily accessible and affordable, and respect physician time. Credible faculty must be identified. Consideration must be given to augmenting knowledge retention.

Another challenge in response is accepting the concept of minimally acceptable care. One author has commented that the concept of minimally acceptable care is the key to a staged management approach during a mass-casualty incident.[25] Concerns about

[25] A. Hirshberg, J. B. Holcomb, and K. L. Mattox, "Hospital Trauma Care in Multiple Casualty Incidents: A Critical Review," *Ann Emerg Med* 37 (June 2001): 647-652.

declaring and delivering altered standards of care for patients in a mass casualty situation in order to provide basic care to the most patients rather than highly specialized care to a few has yet to be fully examined or addressed. This ethical issue requires discussion both within as well as beyond the discipline of medicine.

Significant concerns exist about liability coverage since some physician liability coverage ceases if the physician acts outside of their specialty, outside of their hospital, their state or their usual scope of practice, or when employing altered standards of care such as might occur during a disaster. Indemnity under Good Samaritan Acts varies by state. The Federal Government does not indemnify for liability unless the clinician is federalized such as when a DMAT team is activated or for a federal employee.[26]

C. RESEARCH QUESTIONS

This thesis aims to identify a superior strategy to insure preparedness and adequate immediate response, to assess the preparedness and willingness of physicians to participate in a response team, to stimulate discussion and to challenge the medical community to improve and maximize preparedness.

The research question studied is whether professional personnel resources already exist, such that when configured differently, could improve medical response to victims of chemical or blast events. The research conducted for this thesis aims to understand the perceived current preparedness of medical professionals and their ability to be part of the response team for explosive as well as chemical events. The timeframe of response for these two scenarios will require hospitals to look to other clinicians immediately available in the hospital during the event in addition to their Emergency Medicine and Trauma physicians.

[26] G. L. Foltin, C. Lucky, I. Portelli, L.R. Goldfrank, B. S. Fertel, B. Lackey, M. Marr, and B. P. Dreyer, "Overcoming Legal Obstacles Involving the Voluntary Care of Children who are Separated from their Legal Guardians during a Disaster," *Pediatric Emergency Care* 24, no. 6 (June 2008): 392-398.

The thesis explores the following.

- What is the perception by the physician of their own qualifications and competencies to assess and stabilize victims of a chemical or explosive event?
- What is the ability of the physician community to participate within their own hospital in the evaluation and management of patients involved in a chemical or explosive event?
- What types of steps do hospitals and others need to develop and strengthen clinician surge capability?
- How should a hospital medical staff best prepare to play an integral role in increasing a hospital's surge capacity and how is this best accomplished?

This thesis tests several hypotheses.

- Non-ED or Trauma physicians have an ability to participate (and their level of ability).
- Non-ED or Trauma physicians know and can indicate what is necessary to allow them to become part of a hospital response team.
- Non-ED and non-Trauma physicians reject the belief that they have no ability and responsibility in a catastrophic event.

D. SIGNIFICANCE OF THIS RESEARCH FOR HOMELAND SECURITY

The significance of this research is crucial to understand the current limitations of the healthcare community in this age of clinician specialization and tight healthcare dollars. It is meant to establish a baseline from which the hospitals and the medical community can strive to improve their preparedness. It is intended to determine the preparedness and willingness of clinicians to participate in a patient evaluation and resuscitation effort. It is intended to explore the potential for alternative models of response to meet the requirements of new world scenarios. It is intended to open a dialogue within the healthcare and homeland security community to realize that much remains to be done to achieve medical preparedness. Strategies and incentives to leverage existing resources to meet these challenges must be explored.

This research also has significance for the following.

- The Literature - Little has been written about developing surge capacity for the specific scenarios of explosive and chemical exposures. This research opens a discussion about the potential role of all physicians and physician assistants in these scenarios and whether non-EM or Trauma physicians could or would be willing and able to train and participate. The thesis aims to cause professionals to examine this important topic separate from surge capacity for biologic events. Using regression analysis, the thesis offers a model of characteristic findings for clinicians who perceive themselves qualified and competent for these scenarios.
- Public Policy - It generates a discussion and challenges diverse agencies and disciplines with laws, policies and guidelines to envision the possibilities for crafting a new strategy and paradigm. It should cause Homeland Security agencies to analyze current preparedness for the explosive and chemical scenarios. It also raises the discussion level in Homeland Security and Health and Human Services and perhaps among the public to realize the limitations of the Emergency Department.
- Emergency Medicine - It gives ED physicians a voice to support the Institute of Medicine's (IOM) finding that Emergency Medicine is not prepared to handle surges from terrorist and other events.[27] Some have asserted this view before, but it is not in other physicians' day to day interest to extend their scope of practice and training for skills they may never use, will not be compensated, and could jeopardize their health and safety.
- Medicine - The House of Medicine must examine its rules, regulations, traditions and practice barriers with the goal of increasing the integration of specialties, departments and practitioners to improve medical surge capability. This thesis supports and encourages developing a new discipline of disaster medicine.

E. THE IMMEDIATE CONSUMER

The immediate audience for this thesis is those professionals responsible for providing medical care to the public, including the following.

- The Department of Homeland Security, the Department of Health and Human Services and its Centers for Disease Control as well as the state and local commissioners of health;

[27] Institute of Medicine, *Hospital-Based Emergency Care, At the Breaking Point, Future of Emergency Care Series, Report of the Committee on the Future of Emergency Care in the United States* (Institute of Medicine of the National Academies, The National Academies Press, Washington, DC, June 2006), Executive Summary, 6-7.

- ED physicians, trauma surgeons, other physicians and physician assistants, hospital administrators, and the organizations that represent them such as the American College of Emergency Physicians, the American College of Surgeons and the American Hospital Association, and local leaders such as the Greater New York Hospital Association;
- The American Association of Medical Colleges (medical student training), The American College of Graduate Medical Education (resident physician and fellow training) and the American Board of Medical Specialties (attending physician board certification, recertification and credentialing) as well as hospital accreditation agencies such as The Joint Commission. These agencies may have to change first to address the basic structural issues associated with response.
- The Institute of Medicine (part of the National Academy of Medicine) and other think tanks as well as researchers at the U.S. Schools of Public Health who are studying these issues in Homeland Security;
- Homeland Security Practitioners and Government and political leaders nationally.

As studies since 9/11 conducted by the Mailman School of Public Health at Columbia University with the Marist Poll reveal, the public is more acutely aware that healthcare is not prepared for a major event.[28] Homeland Security leaders as well as national, state and local leaders are at risk if they fail to provide for the public.

[28] I. Redlener, MD, R. Grant. D. A. Berman, D. Johnson, and D. Abramson, Annual Survey of the American Public by the National Center for Disaster Preparedness at Columbia University, Mailman School of Public Health and The Children's Health Fund, "Where the American Public Stands on Terrorism, Security and Disaster Preparedness, Five Years after September 11, One-Year after Hurricane Katrina," September 2006, 2-5, http://www.ncdmailman.columbia.edu/files/2006_white_paper.pdf (accessed May 19, 2007).

II. LITERATURE REVIEW

A. HISTORY AND ANALYSIS OF THE PROBLEM

1. Background

Terrorism is the war of the new millennium. The media and the Internet have vastly increased the ability of terrorists to recruit members and extend fear throughout the world. Non-state actors, attempting to engender fear, intimidation and perhaps coercion as they seek to promote political, religious or ideological goals through violence or the threat of violence, use traditional or non-traditional weapons of mass destruction.

A Weapon of Mass Destruction (WMD) is defined as any explosive, incendiary or poison gas, bomb, grenade or rocket having a propellant charge of more than 4 ounces, or a missile having an explosive or incendiary charge of more than one-quarter ounce, as well as any mine or device similar to the above; any weapon involving a disease organism; or any weapon designed to release radiation or radioactivity at a level dangerous to human life.[29]

Experience in the U.S. with these agents is unknown to most physicians. Yet terrorist bombings in the U.S. would be a foreseeable disruption. Despite the potential for biological, chemical or radiological threats, bombings using conventional explosives remain the terrorists' method of choice. They can inflict multi-system injuries on numerous patients. Recent patterns of terrorist activity have demonstrated the devastating civilian casualties from explosives. Terrorist bombings in Egypt, Iraq, India, Israel, Mumbai (2006 and 2008), Spain (2004) and the United Kingdom (2005) highlight that bombing civilian populations are an ever-present danger worldwide.[30]

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[29] U.S. Code 18, Section 2332a, http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+18USC2332a (accessed July 31, 2008), 1.

[30] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 1.

A critical step in understanding terrorism and its implications is to identify potential terrorist scenarios and the "Magnitude of Impact."[31] This planning concept permits analysis of a potential terrorist incident by applying knowledge of the different agents, their characteristics, their behaviors and the timeline for inflicting injury and response.

2. Status of Current Disaster Response

Disaster response in America traditionally has been the responsibility of state and local governments with the federal government playing a supportive role. State and local governments know the unique requirements of their citizens and their geography. As such, they are best positioned to respond to incidents in their own jurisdictions and will always play a large role in disaster response.[32]

The background for disaster response is supported by several directives and laws and more recently the National Strategy for Homeland Security.[33]

The centerpiece legislation for providing federal aid in disasters, The Robert T. Stafford Disaster Relief and Emergency Assistance Act[34] of 1974, establishes a process and structure for the systematic coordinated and effective delivery of assistance to address the consequences of any major disaster or emergency declared under the act. It reinforces the principal that response efforts should first utilize state and local resources.

Presidential Decision Directive (PDD) 39, issued in June 1995, establishes the national framework on federal response to WMD terrorism. The framework provides for military assistance to civilian health and medical personnel. Congress passed Public Law

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[31] Robert Bass, and Georges C. Benjamin, "The Maryland Strategic Plan to Improve the Health and Medical Response to Terrorism," *Maryland Institute for Emergency Medical Services Systems (MIEMSS) and Maryland Department of Health & Mental Hygiene* (February 23, 2000): 5.

[32] Office of the President of the United States, *The Federal Response to Hurricane Katrina: Lessons Learned* (Washington, DC, February 2006), 11.

[33] United States Department of Homeland Security, *National Strategy for Homeland Security* (Washington, DC: U.S. Government Printing Office, 2002), 41.

[34] Office of the President of the United States, *The Federal Response to Hurricane Katrina: Lessons Learned* (Washington, DC, February 2006), 13.

104-201[35] in 1997 establishing mechanisms and policies known as the Domestic Preparedness Program in Defense against WMD and outlining the status of programs and initiatives to enhance federal, state and local capabilities. In 1998, President Clinton issued two additional directives, PDD-62 and PDD-63, to improve coordination of Federal WMD counterterrorism and WMD response respectively.[36]

In the post 9/11 United States, strengthening preparedness took on heightened significance.

The National Strategy for Homeland Security was issued in July 2002. One of the strategic objectives is to minimize the damage and recover from attacks that do occur. One of the six critical mission areas within that objective is emergency preparedness and response. The stated initiatives under this critical mission area include preparing for chemical, biological, radiological and nuclear decontamination, as well as preparing health care providers for catastrophic terrorism.[37] It also calls for strengthening the protection of critical infrastructure,[38] which includes healthcare facilities.

The National Strategy for Homeland Security calls for a major initiative to build a national system for incident management and to integrate separate federal response plans into a single all-discipline incident management plan. In creating the Department of Homeland Security (DHS) in November 2002, Congress included this initiative as one of the responsibilities of the Secretary of DHS.

To improve response, the President issued Homeland Security Presidential Directive (HSPD) #5, "Management of Domestic Incidents," in February 2003.[39] He directed the Secretary of DHS to create the National Incident Management System

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[35] U.S. Public Law 104-201, National Defense Authorization Act for FY 1997, Title XIV, Section 1416, September 23, 1996, 301.

[36] Robert Bass, and Georges C. Benjamin, "The Maryland Strategic Plan to Improve the Health and Medical Response to Terrorism," *Maryland Institute for Emergency Medical Services Systems (MIEMSS) and Maryland Department of Health & Mental Hygiene* (February 23, 2000): 1.

[37] United States Department of Homeland Security, *National Strategy for Homeland Security* (Washington, DC: U.S. Government Printing Office, 2002), vii-x.

[38] Ibid., 32.

[39] The White House, http://www.whitehouse.gov/news/releases/2003/02/20030228-9.html (accessed June 6, 2008), 1.

(NIMS) to provide a consistent nationwide approach to work effectively to prepare for, respond to, and recover from disasters. In addition, DHS had to use NIMS to develop and administer an integrated National Response Plan (NRP) to provide structure and mechanisms for national level policy and operational direction for federal support to state and local incident managers.[40]

In December 2004, the NRP issued an all-hazards plan that establishes a single comprehensive framework for managing domestic incidents across all levels of government and across a spectrum of activities that include prevention, preparedness response and recovery. The NRP defines a catastrophic incident as any natural or man-made incident including terrorism that results in extraordinary levels of mass casualties, damage or disruption severely affecting the population, infrastructure, environment, economy, and national morale and/or government functions. A catastrophic event could result in a sustained national impact over a prolonged period of time.[41]

While it is built on the premise that incidents are generally handled at the lowest jurisdictional level possible,[42] the National Response Plan organizes the type of Federal response assistance into 15 Emergency Support Functions (ESF), each with a primary agency. Emergency Support Function (ESF) #8 of the NRP addresses Public Health and Medical Services. According to this function, the Department of Health and Human Services (DHHS) is the operational leadership. The Federal Emergency Management Agency (FEMA), an agency within the Department of Homeland Security, manages operational response. FEMA has operational teams including the Metropolitan Medical Response System (MMRS) and the Disaster Medical Assistance Team (DMAT), consisting of state and local first responders who volunteer to be activated, deployed and reimbursed. FEMA reinforces standards, certifications and qualification for participation in such programs and provides funding for equipment and training.[43]

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[40] Office of the President of the United States, *The Federal Response to Hurricane Katrina: Lessons Learned* (Washington, DC, February 2006), 12.

[41] Ibid., 18.

[42] Ibid., 14.

[43] Ibid., 17.

The National Response Framework issued in March 2008 is a more advanced iteration of the NRP that takes the integration of all levels of government in a common incident management framework to a new level. It presents the key response principles, participants, roles and structures that guide the nation's operational response. The NRF establishes mechanisms for improved delivery of federal preparedness assistance to state and local governments and outlines actions to strengthen preparedness capabilities of federal, states and local entities.[44] The goal is to align the right people with the right training and the right equipment and supplies at the right place at the right time to ensure an effective response.[45]

To build a vision for the future, President Bush issued Homeland Security Presidential Directive (HSPD) #8, *National Preparedness,* in December 2003. This directive establishes policies to strengthen the preparedness of the U.S. to prevent and respond to threatened or actual domestic terrorist attacks, major disasters and other emergencies. HSPD-8 directs the development of a national domestic all-hazards preparedness goal establishing measurable priorities and balancing the potential threat and magnitude of terrorist attacks, major disasters and other emergencies with the resources required to respond to and recover from them.[46]

The Interim National Preparedness Goal issued in 2005[47] strives to establish a common, consistent approach to developing needed capabilities identified in the Target Capabilities List (TCL) and to perform functions identified in the Universal Task List (UTL) that link strategies to prevention, protection, response and recovery tasks for the National Planning Scenarios.[48] The Universal Task List as it relates to response for health

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[44] The U.S. Department of Homeland Security, *National Response Framework* (Washington, DC, January 2008), 2.

[45] Joseph DeFeo, *Joint Medical Readiness: Are We Ready to Answer the WMD Threat*? (USAWC Strategy Research Project, U.S. Army War College, Carlisle Barracks, PA, March 2006), 7.

[46] Office of the President of the United States, Homeland Security Presidential Directive HSPD 8, National Preparedness, December 17, 2003, http://www.whitehouse.gov/news/releases/2003/12/20031217-6.html (accessed July 31, 2008).

[47] The United States Department of Homeland Security, *Interim National Preparedness Goal,* Homeland Security Presidential Directive HSPD 8: National Preparedness, Washington, DC, March 2005.

[48] The U.S. Department of Homeland Security, *National Response Framework* (Washington, DC, January 2008), 72.

care includes Coordination of Public Health and Medical Services. Medical Surge capacity is one of 37 topics on the Target Capabilities List (TCL) of the National Preparedness Guidelines.[49] National surge targets include surge guidelines of 500 beds/million residents for Infectious Disease outbreaks; 50 beds/million residents for noninfectious injury such as chemical or explosive events.[50]

Capability, as defined in the TCL, is the ability to prioritize needs, update preparedness strategies, allocate resources and deliver preparedness programs that help entities develop resiliency. Performance as defined in the UTL and the Homeland Security Exercise Evaluation Program aims to evaluate operations, training and exercises, identify lessons learned, share best practices and update improvement plans. [51] It provides common planning factors in terms of potential scope, magnitude and complexity of major events that will help to determine the target levels of capability required and apportion responsibility among all potential partners. Development of appropriate capabilities to address these scenarios is designed to prepare the nation for terrorist attacks, major disasters and other emergencies.[52]

The National Planning Scenarios, the TCL and the UTL, revisited and revised after Hurricane Katrina, were released by DHS as part of the National Preparedness Guidelines in September 2007 fulfilling components of HSPD # 8 and the National Preparedness Goal.[53] The National Planning Scenarios include five that address explosive and chemical events. These scenarios form the focus of this thesis.

Homeland Security Presidential Directive #21, issued in 2007, establishes a National Strategy for Public Health and Medical Preparedness to transform our national

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[49] U.S. Department of Homeland Security, *National Preparedness Guidelines* (Washington, DC, September 2007), 19.

[50] Target Capabilities List, *A Companion to National Preparedness Guidelines* (U.S. Department of Homeland Security, Washington, DC, September 2007), 450.

[51] The U.S. Department of Homeland Security, *National Preparedness Goal* (Washington, DC, December 2005), Appendix D, D1-D2.

[52] The U.S. Department of Homeland Security, *National Response Framework* (Washington, DC, January 2008) 75.

[53] The U.S. Department of Homeland Security, *National Preparedness Guidelines* (Washington, DC, September 2007), 1-11.

approach to protecting the health of the American people against all disasters. It calls for an end-to-end system redesign through a critical and formal process in which public health and medical preparedness and response are integrated vertically through all levels of government and horizontally across all sectors of the community. It engages the private sector, academia and other non-governmental entities in preparedness and response efforts. Toward that end it calls for the nation to collectively support and facilitate the establishment of a discipline of disaster medicine, providing a foundation for doctrine, education, training and research and integrating preparedness into public health and medical communities. It calls for development of a robust disaster health capability that requires development of an operational concept for medical response to catastrophic events that is substantively distinct from and broader than that which guides day to day operations.[54]

3. Conclusions on Status of Current Response

Current health care response is based upon providing care to individual patients with management oriented to caring for one patient at a time. Thus, it cannot be assumed that the health and medical system can effectively handle even small mass casualty events of 25 or fewer victims. In the Topoff II 2003 drill, the ED staff rapidly became overwhelmed and many people died.[55] The drill was designed to exercise and test the coordination of public health and medical response to multiple geographically dispersed disaster events including a radiological dispersion in Seattle and a biological event in Chicago. It demonstratess that a significant deficiency in public health and medical response to catastrophes persisted. Performance prompted the White House to direct DHHS to develop a strategy for improving the nation's medical and public health surge capacity to deal with the medical consequences of a terrorist attack. This directive supports the need for a more comprehensive approach. The DHHS strategy to improve

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[54] Office of the President of the United States, The White House, HSPD 21, Public Health and Medical Preparedness, October 18, 2007, http://www.whitehouse.gov/news/releases/2007/10/print/20071018-10.html (accessed October 31, 2008), 2-4.

[55] United States General Accounting Office, "Hospital Preparedness: Most Urban Hospitals Have Emergency Plans but Lack Certain Capacities for Bioterrorism Response," *GAO 03-924* (2003): 3-4.

this national health surge capacity consists of five priorities including identifying ways to augment hospital bed capacity; assuring a sufficient number of trained medical personnel to support a crisis; ensuring the availability of pharmaceuticals and supplies; evaluating and expanding the NDMS capabilities; and using models to set surge requirements.[56]

Current strategies do not adequately address the ability of the medical community to respond effectively to victims of chemical or explosive events when the response timeline is short. Most surge literature does not address where to obtain trained personnel in the immediate time frame.

Positively impacting a victim's chance of survival depends on mobilizing trained clinicians–MDs, PAs and others within moments of hospital notification of an event. The more knowledgeable and trained clinicians that hospitals can mobilize from within their staff can determine the success of the response to the mass-casualty incident. This strategy is expected to translate into improved outcome for the greatest number of patients. Yet physicians and physician assistants may have little, if any, formal training either in professional school or during the postgraduate period, in the mechanism of action of the CBRNE weapons and management of the victims of terrorism. Thankfully, most have no real world experience.

The current healthcare strategy presupposes a preparedness that is not real for explosive and chemical events and jeopardizes the nation's ability to provide timely emergency medical care in response to a major mass casualty disaster.

4. What to Expect in a Mass Casualty Event

A mass/multi casualty incident has two distinct stages. The first phase is while the event is still evolving, casualties are still arriving and information is incomplete. The

[56] Sumner Bossler, "Surge Capacity and Health System Preparedness: Surge Capacity National Bioterrorism Hospital Preparedness Program (NBHPP)," Department of Health & Human Services, Hospital Preparedness Program, http://www.ahrq.gov/news/ulp/btsurgefacil/bossltxt.htm (accessed July 31, 2008), slide 3.

second phase is when the patient volume, scope and severity are completely defined. Only during the second phase can the event be appropriately staged and resources appropriately distributed to victims.

Blast victims would require emergent intervention because of the potential for serious injury and would necessitate a trauma team. Inhalation victims would be emergent as well under ACLS and ATLS guidelines since airways could be rapidly compromised and would demand a resuscitation team. Both imply the availability of certain personnel resources.

Explosive events such as occurred in London or Madrid or chemical events such as occurred in Tokyo caused a surge that is dramatically different from an outbreak of an infectious disease in which the patient population increases slowly as the outbreak spreads and then gradually decreases over days to weeks. Until all the victims are identified and medically assessed in an explosive or chemical mass casualty event, it is very difficult and challenging to comprehend the scope of the disaster and the necessary response and to pair the victims and the corresponding resources appropriately. Injuries or exposure of response workers add to a second surge. The worried well add a third surge.

Careful analysis of the agents, of the potential scenarios and of the impact of a potential terrorist attack on a community and healthcare facilities requires the professional to delineate further the tasks to be accomplished. There are low probability and high probability events, resulting in low multi-casualty (< 25 victims), mass casualty (26-hundreds of victims), or catastrophic casualty (>1000 victims) events.[57]

A multi casualty incident that taxes a department or community resources must be distinguished from a major medical disaster or mass casualty incident that destroys organized community support mechanisms and results in overwhelming numbers of casualties. Complicating the situation, patients requiring immediate care present simultaneously with a mix of other patients or may present after non-urgent arrivals since

[57] Robert Bass, and Georges C. Benjamin, "The Maryland Strategic Plan to Improve the Health and Medical Response to Terrorism," *Maryland Institute for Emergency Medical Services Systems (MIEMSS) and Maryland Department of Health & Mental Hygiene* (February 23, 2000): 7.

it is often easier to move less urgent patients or they get to the hospital on their own. It is vital to rapidly sort out or triage those patients who will most benefit from optimal immediate care. In a mass casualty event, the ability to assemble an effective medical response is crucial to insure that care for the severely ill or injured is not jeopardized. In a mass casualty situation, conventional standards of medical care may not reach all casualties. In reality, the quality of trauma care in mass casualty events is inversely proportional to the caseload simply because the number of trauma trained staff and trauma related resources are limited.[58]

In a typical mass casualty event in which all injuries are simultaneous, the principles of trauma indicate that 10 to 15% of survivors are severely injured and necessitate immediate assessment and care.[59] The rest have mild to moderate trauma that can safely wait some time or be moved out of the ED for treatment. Therefore, using the data as a model and extrapolating backwards, if a trauma center could immediately assemble 4 trauma teams, consisting of a trauma or ED attending physician and a critical care nurse and others, to work simultaneously to assess and stabilize patients determined at triage to be severely injured and those four severely injured patients comprise 10-15% of the casualty load, then a realistic estimate of ED capacity over the immediate 1-2 hours during a typical urban mass casualty event would be 25-40 patients with 3-4 of them being severely injured. Beyond that number, the quality of care suffers because experienced trauma care providers and critical resources are not immediately available. Hirshberg posits that even in a large urban trauma center, staff could respond to only three or four severely injured patients arriving simultaneously.[60] After the Madrid bombings, one hospital received 272 victims in 2.5 hours. Of the total 243, seriously injured patients received, 91 were admitted and 29 were admitted to critical care for a critical care rate of 12%, a number consistent with previously published data.[61]

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[58] A. Hirshberg, J. B. Holcolmb, K. L. Mattox, "Hospital Trauma Care in Multiple-Casualty Incidents: A Critical View," *Ann Emerg Med* 37, no. 6 (June 2001): 648.

[59] Ibid.

[60] Ibid.

[61] J. P. Gutierrez de Cebllos, F. Turegano Fuentes, D. Perez Diaz, M. Sanz Sanchez, C. Martin Llorente, J. E. Guerrero Sanz, "Casualties Treated at Closest Hospital in the Madrid March 11 Terrorist Bombings," *Critical Care Medicine* 1 Suppl:S107-12 (January 31, 2005): 107.

Experience in London, Madrid, Tokyo and Oklahoma City shows hospitals receive far more than the number of injured patients able to be treated in the model and not all hospitals would be able to assemble multiple trauma teams concurrently. Conversely, during the Tokyo sarin release, a non trauma chemical event, one hospital describes receiving 640 victims of which of which one died on arrival, 0.62% were critical, 16.7% were moderately affected and 82.5% had mild symptoms. The outcome of the other 3000+ victims is less clear.[62]

The timeline of patient arrival to the hospital may also impact the numbers of severely ill who can be treated by one facility. The remote location, the difficulty extricating victims and poor weather that did initially not allow for helicopter transport following the Avianca plane crash in suburban Long Island, NY in 1990 allowed for a controlled arrival at the hospital. These circumstances allowed the hospitals to prepare and clinician staff to respond. However, the effort did not meet the guideline of medical care within the "Golden Hour" in all cases. In summary, while a hospital may be able to provide a surge capacity of many beds for severely injured victims, they do not currently have sufficient trained physician staff or surge capability immediately available to assess and stabilize the patients upon arrival.[63] Clinical staff that are not emergency medicine or trauma specialists but who have significant patient assessment and technical skills could be extremely useful.

5. Surge

Hospitals must be able to increase their ability to care for the additional critical patients as well as their regular patients in the immediate time frame. This concept defines surge capacity.

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[62] Tetsu Okumura, MD, Kouichiro Suzuki, MD, Atsuhiro Fukuda, MD, Akitsugu Kohama, MD, Nobukatsu Takasu, MD, Shinichiis Himatsu, MD, Shigeakih Inohara, MD, "The Tokyo Subway Sarin Attack: Disaster Management, Part 2**:** Hospital Response*, *Academic Emergency Medicine* 5 (1998): 618-620.

[63] A. Hirshberg, J. Holcomb, and K. Mattox, "Hospital Trauma Care in Multi-Casualty Incidents, A Critical View," *Ann EM Med* 37 (June 2001): 650.

Catastrophic disasters create surge capacity needs for the health care system. This scenario is especially true in urban areas because of high population density and reliance on complex and concentrated urban infrastructure (mass transit, tunnels and bridges and high rise buildings). Large numbers of victims could adversely affect the ability of a hospital to meet surge capacity needs. A surge manpower capacity must be built drawing on and training other professionals to complement the traditional medical and public health workforce.

As defined by the Agency for Healthcare Research and Quality (AHRQ), Bioterrorism and Health System Preparedness division, surge capacity is a health care system's ability to expand quickly beyond normal services to meet an increased demand for medical care in the event of bioterrorism or other large-scale public health emergency."[64] The American College of Emergency Physician (ACEP) Policy Statement on Health Care System Surge Capacity Recognition, Preparedness and Response states, "…surge capacity is a measurable representation of a health system's ability to manage sudden or rapidly progressive influx of patients within the currently available resources at a given point in time."[65]

Surge involves an increased volume of patients over the usual baseline census over a defined time course. Surge capacity involves space, beds, staff and supplies. A newer concept is surge response capability which is the extent to which surge capacity can accommodate the surge and respond effectively.[66] Extraordinary surge is also described as critical event surge, catastrophic surge and disaster surge.[67]

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[64] Robert Claypool, MD and Nathaniel Hupert MD, Agency for Healthcare Research & Quality Division of Bioterrorism and Health Systems Preparedness, "Addressing Surge Capacity in a Mass Casualty Event," Rockville, Maryland, Web conference presented October 26, 2004, 1.

[65] "Policy Statement: Health Care System Surge Capacity Recognition, Preparedness and Response," *Ann Emerg Med* 45 (2005): 239. Approved American College of Emergency Physicians Board of Directors, August 2004.

[66] Gabor Kelen, MD, and Melissa McCarthy, MD, "The Science of Surge, Proceedings of the 2006 AEM Consensus Conference: The Science of Surge," David Cone, MD, Guest Editor, *Academic Emergency Medicine* 13, no. 11 (November 2006): 1090.

[67] Ibid., 1089.

Surge response capability is affected by many variables including: the type of injury; the severity of injuries; the number of injuries; the rate at which patients arrive to the hospital; the need for decontamination; and the number of hospitals in the immediate area to which the victims can be distributed. These variables all impact the ability of a facility or community to adequately respond. Also of importance is the census of the ED and inpatient services at the time of the event as well as the hour of the day since patient loads vary over a 24-hour cycle and hospitals staff to their usual volumes.

Many agencies have addressed the issue of surge capacity for events such as biological attacks, pandemics or natural events. For example, in the event of biologic events, such as pandemic influenza, policies address the establishment of alternative care sites both in hospitals and in other community locations that encourage the diversion of the walking wounded to other parts of the hospital. These protocols and locations would not be adequate for critically injured victims of blast or chemical agent injuries who require immediate medical intervention, advanced interventions, trained professionals and specific equipment and monitoring.

TJC's "Surge Hospitals Providing Safe Care in Emergencies" highlights the types of surge hospitals and staffing of these hospitals used during Hurricane Katrina.[68] This example is a different problem. While the hospitals had days to prepare, the review of what happened in New Orleans gives a glimpse of what happens when the entire community, including the hospital and its clinicians, are the victims of the disaster, and the facility has sustained too much damage to be able to surge in place and may have to relocate. Supplies may take hours to days to obtain. Clinicians may not be able to physically get to the hospital and for disasters that last days, clinicians will need replacements and a place to rest and reinvigorate.

The Centers for Disease Control (CDC) has written resource guides for Emergency Medicine whose purpose is to promote activation of additional emergency department resources needed within four hours of an explosion. According to the guidelines, the resources should be capable of triaging, registering, evaluating and

68 "Surge Hospitals: Providing Safe Care in Emergencies," *Joint Commission for the Accreditation of Healthcare Organizations* (2006): 14.

treating up to 300 patients in the first four hours after an event and includes mobilization of additional staff, equipment, supplies and beds. The CDC specifically says that Federal Resources (including personnel) should be expected no sooner than 72 hours from the event. Hence hospitals must become self-sufficient. The CDC recommends that hospitals identify potential institutional surge staffing from employees with clinical training but not currently tasked with clinical responsibility.[69] Available staff will vary by facility and time of day.

a. Current State of Surge Response

One identified challenge for healthcare to provide adequate capacity requires identification of necessary treatment space, equipment including beds, monitors and ventilators, supplies and medication. Emergency Preparedness planners should not pre-suppose, however, that beds are the solution. Equipment is useless if there is insufficient trained staff to use it. Data published on twelve terrorist bombing incidents in Israel showed that the capacity of a hospital was determined by the number of surgeons and the number of resuscitation rooms and CT availability—not the number of beds or operating rooms.[70]

The far more crucial challenge for healthcare is to provide adequate capability to provide a seamless response to escalating health care demands for surge capacity. This task requires development of the vision and strategies that support response and, most importantly, provide appropriately trained staff in adequate numbers in the appropriate time frame. Once the structure is in place, it can be solidified by developing the policies to coordinate and operationalize the process. The structure can balance activity across all domains, training and educating to standards and seamlessly

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[69] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 26-27.

[70] A. Hirshberg, M. Stein, and R. Walden, "Surgical Resource Utilization in Urban Terrorist Bombing: a Computer Simulation," *Journal of Trauma* 47 (1999): 545-550.

responding to escalating health care demands for surge capacity.[71] Yet current emergency preparedness and response plans do not adequately address immediate physician response. Plans that do not address the immediate time frame of response and response options may not be realistic.

Typical clinician response options include many organized and unorganized teams and responders, some trained, some not. They include the federal DMAT and MMRS volunteer teams, the federally employed teams including the U.S. Public Health Service (USPHS), the Veteran's Administration, and the military. In addition, the local volunteer MRC and the state sponsored program for licensed practitioners Emergency System for Advanced Registration of Volunteer Health Professionals (ESAR-VHP) offer some potential help. However, each of these options has limitations or challenges. These teams will not activate in the "Golden Hour." As a result, these options may not be solutions at all in light of the need for immediate qualified response.

Sources of Federal support include the National Disaster Medical System (NDMS), which was formed in 1984 as part of the Public Health Service and is currently part of DHHS. Its original mission was to support state and local health agencies during natural disasters and to provide backup support to the Department of Defense and Veterans Administration medical systems during times of overseas conflicts. In recent years its mission has expanded to include providing the national medical response to a terrorist attack and pre-staging for National Security Special Events such as political party conventions and the Olympics. It is a partnership between federal, state and local governments and health care providers. It has the primary responsibility for providing emergency medical care after a national disaster. At the core of NDMS are the Disaster Medical Assistance Teams (DMAT) that are regional teams of approximately 7,000 doctors, nurses and other health professionals sponsored by local entities such as hospitals and universities. They are paid by the federal government and are covered for liability during the time they are federally deployed, but they must find their own funding

[71] Donna Barbisch, and Kristi, Koenig, "Understanding Surge Capacity: Essential Elements," *Academic Emergency Medicine* 13, no. 11 (November 2006): 1101.

to train, prepare, purchase and store equipment as well as maintain readiness. According to testimony before Congress, the NDMS cannot respond rapidly or effectively to major disasters as currently constituted. In 2002, a DHHS report estimated that of the 70 DMATs nationwide, only 29 were found operational. Only 16 could supply a fully staffed and equipped team.[72] Their level of training is not defined.

Current response and preparedness capabilities at the regional and national level involve a medical response that includes the Metropolitan Medical Response System (MMRS). MMRS is a division of FEMA and is located in 124 major cities as of FY 2003.[73] Other potential medical resources to homeland emergencies include the U.S. Public Health Service Commissioned Corps. The U.S. Surgeon General heads this service that currently has approximately 6000 members. The Department of Veteran's Affairs and ultimately the military (NORTHCOM),[74] are the ultimate resources, depending on the need. These intermediate term solutions will take 36-96 hours or more to be fully operational. They will not respond to civilian hospitals in a timeframe realistic to manage and resuscitate these blast or chemical victims. Practically, all disasters are local and in the case of chemical and explosive devices, the personnel response must be local and immediate to be effective and real.

One source of local professional response is the Medical Reserve Corps (MRC), founded by President Bush in 2002 in cooperation with the USA Freedom Corps, to identify, train and organize volunteers throughout the United States. Currently, 27,000 practicing and retired physicians, nurses and other professionals plus ordinary citizens participate in teams organized within localities.[75] While they are willing volunteers, many have primary responsibility at their place of employment and may not be available.

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[72] "The Decline of the National Disaster Medical System," U.S. House of Representatives Committee on Government Reform-Minority Staff, Special Investigations Division, Washington, DC, December 2005, 4.

[73] U.S. Department of Homeland Security, Federal Emergency Management Agency, Washington, DC, http://www.fema.gov/mmrs/ (accessed November 6, 2007).

[74] U.S. Public Law 104-201, National Defense Authorization Act for FY 1997, Title XIV, Section 1416, September 23, 1996, 301.

[75] "Surge Hospitals: Providing Safe Care in Emergencies," *Joint Commission for the Accreditation of Healthcare Organizations* (2006): 6.

Literature has borne out other challenges to their response.[76] Most have no recent emergency experience.[77] Their clinical expertise is not verified and there is no current integration of these professionals into hospitals. The premise is based on protocols and just-in-time training making them very useful for mass immunization and prophylaxis in pandemic scenarios but less useful when patient assessment and management is required.

The concept of and plans for rapid mobilization of community volunteer physicians may not be realistic for explosive and chemical events. The Joint Commission (TJC) (formerly the Joint Commission on the Accreditation of Healthcare Organizations) is a private organization that hospitals use most often to accredit their facilities and programs in order to maintain their Medicare provider status. TJC requires accredited hospitals to have a surge capacity protocol[78] and a method to credential licensed independent health care providers to work within the hospital in an emergency situation.[79] State authorized Emergency Systems for Advanced Registration of Volunteer Health Professionals (ESAR-VHP) reflects TJC's requirements and provides a standardized set of verified credentials for volunteers who may be called upon to assist hospitals during emergency situations.[80] Challenges to this plan for response could be clinician unavailability due to responsibility at their primary place of employment, delay in arrival to the hospital due to travel time, closed roads or transportation or other barriers to participation.

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[76] K. Qureshi, R. R. M. Gershon, M. F. Sherman, T. Straub, E. Gebbie, M. McCollum, M. J. Erwin, and S. S. Morse, "Health Care Worker's Ability and Willingness to Report to Duty during Catastrophic Disasters," *Journal of Urban Health*: *Bulletin of the New York Academy of Medicine, Oxford University Press* (2005): 4.

[77] Shelly Schechter, *Medical Reserve Corps Volunteers' Ability and Willingness to Report to Work for the Department of Health during Catastrophic Disasters* (Naval Postgraduate School, Monterey CA, March 2007), 28-29.

[78] The Joint Commission formerly the Joint Commission for the Accreditation of Healthcare Organizations, "Surge Hospitals: Providing Safe Care in Emergencies," Oakbrook, IL, 2006, 1.

[79] Joint Commission for the Accreditation of Healthcare Organizations, JCAHO Standard HR 4, 35, Credentialing of Volunteer Licensed Independent Practitioners during a Disaster, http://www.jointcommission.org/NR/rdonlyres/6F82C0BE-7A8A-4DE5-8616-73E19DF7E172/0/LTC2008HRChapter.pdf (accessed June 15, 2008), 21.

[80] Marc Roberts, et al., ed. Sally J. Phillips, and Ann Knebel, Agency for Healthcare Research & Quality, AHRQ Publication No. 07-001, *Mass Medical Care with Scarce Resources* (Rockville, Maryland, February 2007), 65.

These credentialing plans and proposals are resource intensive and time consuming for the hospital. They detract from the response effort and will not rapidly provide trained clinicians who are oriented to all the intricacies and systems of a particular institution, rendering them less effective. Upon arrival to the hospital, the clinician would still have to be registered and verified, assigned to a responsibility and guided about how to get things done at that hospital. In 2008, volunteer clinicians may require password access to enter orders for pain medication, prescribe modalities, write prescriptions, order and review laboratory and radiology tests and document care using electronic medical record systems.[81] All these challenges add up to a time delay before being fully operational. This plan has not been established at most hospitals and is not as simple as suggested.

The ACEP Policy Statement on Hospital Disaster Privileging states that all hospitals should have a process in place that allows for emergency privileging of additional physician staff in the event of activation of the hospital disaster plan. Privileges requested should be consistent with those currently in place at the appropriate department and specialty in the physician's home hospital. This policy does not address where to obtain these trained professionals in the immediate time frame. It also calls for all hospitals to provide professional liability coverage for those physicians providing assistance during the disaster.[82]

The challenge for healthcare remains putting the trained clinicians in the ED within minutes of activation with the right skills and equipment to insure an effective response for the victims of explosive and chemical scenarios.

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[81] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 17-20.

[82] American College of Emergency Physicians, "Hospital Disaster Privileging," ACEP Policy Statement, *Ann Emerg Med* 42 (2003): 607-608.

b. Scenarios

Patients exposed to biological agents, whether of natural or terrorist etiology such as anthrax or pandemic influenza, will evolve symptoms for the most part over hours to days as the infection spreads throughout the community. Radiological injuries also develop over hours to weeks. The symptoms may be slow to be recognized initially and the presentation will depend on the scope and nature of the exposure. Hospital Emergency Departments (ED) will receive and evaluate patient victims for days to months. In this scenario, hospitals will have time to mobilize resources including professional personnel to manage those patients. Just-in-time training will improve response in these scenarios. Surge plans for such a scenario often involve alternate care sites, Points of Distribution (POD), use of Medical Reserve Corps or other volunteers utilizing alternate credentialing. They are all useful for the protracted health crisis when time to mobilize is not a significant issue. Current surge plans may work well here. Additionally, treatment for many victims of these scenarios will be simply supportive, not requiring specialty staff or equipment.

On the other end of the spectrum, concern exists about chemical weapons and conventional weapons such as Improvised Explosive Devices (IEDs) of the suicide or other bomber. These agents impact the victim immediately and over the ensuing several minutes and hours. Experiences in London and Madrid bombings support the urgency of required response. Survival outcomes depend on prompt medical intervention and stabilization. Hospitals must be able to respond within seconds to minutes. Response may also involve deploying and suiting up a decontamination team and certainly providing sufficient trained staff in the ED to care for large numbers of patients.

(1) The Clinical Scenarios. Two scenarios should cause particular concern in the medical community. The scenarios of an explosive event from an Improvised Explosive Device (IED) of a suicide bomber or a toxic chemical release in a public place may be the most likely method of terrorists in view of recent efforts to harden much of the rest of the nation's major critical infrastructure. These events may be

the most challenging to manage. For explosive and chemical events, many patients will require more rapid intervention and stabilization to prevent death or significant morbidity than is currently planned.

(2) Explosive Devices. The FBI confirmed 324 incidents of terrorist bombings in the U.S. between 1980 and 2001.[83] Recent events in Egypt, India, Iraq, Israel, Spain and the United Kingdom indicate that bombing civilian populations is an ever present danger. Bombings with conventional explosives remain the terrorists' method of choice. Explosions, particularly in confined spaces, can inflict multi-system injuries on numerous patients and produce unique management challenges to health care providers. They can rapidly overwhelm hospital resources and may limit the ability to care for large numbers of critically injured victims

Explosives from a suicide bomber on a train or other confined space as in the 2004 Madrid or 2005 London bombings[84] or from a carefully positioned car or truck bomb such as occurred in Oklahoma City or the Khyber Towers bombings in 1996[85] caused massive injuries resulting from the blast effect, from fire, from smoke or toxic chemicals that are inhaled, from falling debris or from shrapnel. The bombing of the USS Cole in Yemen points to terrorist determination. The potential for multi-organ or multi-system injury is greater the closer the victim is to the epicenter of the explosion or if the device is detonated in a closed-space environment.[86]

Critical to victim survival in explosive events is immediate medical attention including assessment, resuscitation and stabilization. The timeline to stabilize such victims is short. Upwards of ninety percent of those killed in a suicide

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[83] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): (April 2007): 3.

[84] Ibid., 1.

[85] B. Hoffman, D. W. Brannan, E. Herren, and R. Matthiessen, "Preparing for Suicide Terrorism, A Primer for American Law Enforcement Agencies and Officers," *Rand National Security Division*, xi.

[86] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 1.

attack typically die immediately.[87] Studies have shown a 5.3% death rate in hospital for victims of explosive events.[88] Survival of the remaining victims is absolutely dependent upon the wounded receiving medical attention within minutes of their injuries, being stabilized (air passages opened, bleeding controlled, vital signs maintained) and then being moved to a hospital immediately.

(3) The Chemical Agents. Chemical agents include the toxic nerve agents such as Sarin, Tabun and VX, and chlorine or phosgene gas among other agents.

The nerve agents are readily inhaled as well as absorbed through the skin. They are acetylcholinesterase inhibitors. Acetylcholine is the most common neurotransmitter in the body. Acetylcholinesterase is the enzyme that degrades the acetylcholine after it has attached to the post-synaptic receptor at the neuromuscular junction and an impulse has been generated. Acetylcholinesterase removes the acetylcholine, thus ending the impulse. The nerve agents inhibit that enzyme so the acetylcholine continues to fire nerve impulses causing seizures and producing hyper-secretions, including excess bronchial secretions that threaten a patient's airway or ability to breathe. Patients may require immediate airway intubation and use of a ventilator as well as continuous monitoring, frequent suctioning and timely dosing of medications to control seizures and reduce secretions. Response must be immediate to stabilize the patient.

Chlorine and Phosgene are pulmonary asphyxiates that cause irritation, increase secretions and bronchospasm of the airways. They interfere with a victim's ability to obtain oxygen. Immediate stabilization of the airway is necessary with these agents as well.

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[87] B. Hoffman, D. W. Brannan, E. Herren, and R. Matthiessen, "Preparing for Suicide Terrorism, A Primer for American Law Enforcement Agencies and Officers," *Rand National Security Division*, 6.

[88] K. Peleg, L. Aharonson-Daniel, M. Stein, M. Michaelson, Y. Kluger, D. Simon, Israeli Trauma Group, and E. Noji, "Gunshot and Explosion Injuries, Characteristics, Outcomes and Implications for Care of Terror-Related Injuries in Israel," *Annals of Surgery* 239, no. 3 (March 2004): 316.

The significance of these agents is that they can be weaponized, and are easily transported and surreptitiously released.

(4) Scenario Conclusion. Hospital preparedness and response for a low probability, high consequence event such as a chemical or explosive release where time is of the essence depend on efficient and effective coordination, planning, exercises and practice.[89] Preparedness and response cannot be merely thought of as expanding capacity of the existing system for handling non-terrorist multi casualty incidents. Preparedness and response for terrorist events may well depend on the development of new strategies to increase capability.

A paradigm shift in healthcare may be required to establish the sources and potential roles for a reserve pool of catastrophic event responders. Identifying a source of immediately available, trained professionals capable of providing patient care requires some familiarity with health and public health principles and practice. A broad consensus must be established on the utility of the concept of non-traditional medical and public health professions as a surge manpower resource.[90] Models of graduated responsibility within a department exist in current physician residency training. A senior physician supervises a junior physician. Models across specialties are less common, although trauma teams consisting of trauma and EM physicians are successful. Expanding on such models requires altered delineation of privileges, challenging traditional board certification, licensing, hospital credentialing requirements, and liability coverage issues as well as legal and medical staff policies that define current activity.

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[89] Robert Bass, and Georges C. Benjamin, "The Maryland Strategic Plan to Improve the Health and Medical Response to Terrorism," *Maryland Institute for Emergency Medical Services Systems (MIEMSS) and Maryland Department of Health & Mental Hygiene*, (February 23, 2000): 16.

[90] Walter Psoter, and David Glotzer, *Enhancing Medical and Public Health Capabilities During Times of Crisis: A Summary Report on the Expansion of the Role of Dentists and Their Enhancement of the Medical Surge Response,* A Report to the Department of Justice (New York: New York University School of Medicine, New York University School of Dentistry, 2002), 10.

c. Discipline Specific Challenges for Surge

When the continuum of care reaches the hospital entrance, the assumption is that doctors and hospitals are prepared to assume the care of these victims and that all resources are available and will be mobilized for the care of each patient as an individual. However, in many of these catastrophic events, the emergency medical system itself may be overwhelmed and/or totally crippled. Many uncontrolled or difficult-to-predict elements may have substantial effects on true hospital surge capacity.

(1) Pre-Hospital Care. Current preparedness and response plans may not be consistent with reality. In a typical multi-casualty incident involving several victims from the same event, the pre-hospital Emergency Medical Response personnel will assess the scene, prioritize the most injured and distribute the victims to several neighboring hospitals, with the most injured victims transported to the regional Level I Trauma Center.

By contrast, mass casualty management is more complicated than multi-casualty management, which a physician might handle during a multi-car accident or a bus accident. The concept of diverting critically injured patients to a Trauma Center may be lost in the time of a mass casualty event as has been demonstrated in previous international terrorist events.[91] In a mass casualty event, it would be difficult to prioritize all patients at the scene. It may be impossible to transport many critical victims to a Level I Trauma center for lack of sufficient EMS teams and ambulances and for fear of overwhelming those centers. Even hospitals without trauma designation may be forced to participate in a community response.

Experience in Madrid and Tokyo has shown that patient distribution was independent of plans and best judgment.[92] The experience after the Sarin nerve agent release by Aum Shrinkyo on the Tokyo subway in 1995 reveals that the

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[91] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 1.

[92] Ibid.

pre-hospital providers or Emergency Medical System (EMS) were overwhelmed and many victims self- selected themselves to the nearest hospital via cars (13.5%), taxi (24%) and on foot (35%) adding chaos to attempts to organize the response at the scene. Only 11% of the 4000 victims were transported via EMS.[93] Of the 7,364 patients treated at hospitals after the 2001 terrorist attack at the World Trade Center in New York City, only 6.8% were transported by ambulance.[94] This data emphasizes the inability to conduct field triage and the inability to control the distribution of patients during a disaster.

In the Virginia Tech Massacre in April 2007, the closest Level I trauma center was 42 miles from Blacksburg. The next closest was 149 miles away, and weather precluded air transport. All patients went to level III or non classified EDs.[95]

(2) Emergency Department Response. The ED is the front door to most hospitals. Emergency medical care is provided at most of the nation's hospitals. Emergency Medicine is a relatively new specialty that first offered formal training and certification in 1975. Currently about 60% of the 32,000 physicians employed in the ED are Emergency Medicine Specialists. The other physicians are for the most part trained and certified in Internal Medicine (28%), Surgery, Pediatrics and Family Practice (32%).[96] EM physicians are largely represented by the trade group The American College of Emergency Physicians. The American Board of Emergency Medicine, a member of the American Board of Medical Specialties (ABMS), certifies them. Physicians are licensed by the state in which they work. Employment arrangements vary. They can be hospital employees, or employees of affiliated medical schools. They

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[93] T. Okumura, and K. Suzuki, et al., "The Tokyo Subway Sarin Attack: Disaster Management, Part 2: Hospital Response," *Academic Emergency Medicine* 5, no. 6 (June 1998): 618-624.

[94] E. Auf der Heide, "The Importance of Evidence-Based Disaster Planning," *Annals of Emergency Medicine* 47, no. 1 (January 2006): 41.

[95] Lisa Kaplowitz, and Morris Reece et al., "Regional Health System Response to the Virginia Tech Mass Casualty Incident," *Disaster Medicine & Public Health Preparedness* I (Suppl I) (2007): S9-S13.

[96] J. Waeckerle, MD, S. Seamans, MA, and M. Whiteside, PhD, et al., "Executive Summary: Developing Objectives, Content and Competencies for the Training of Emergency Medical Technicians, Emergency Physicians and Emergency Nurses to Care for Casualties Resulting from Nuclear, Biological or Chemical (NBC) Incidents," Irving, TX, *Annals of Emergency Medicine* 37, no. 6 (June 2001): 588.

can be licensed independent practitioners who contract with the hospital independently or through a recruitment firm or large independent group. They can be part of a small Professional Corporation or a large EM staffing group.

Some EDs, especially in rural areas, evaluate small numbers of patients each year and are staffed by only one physician at a time. Other EDs at larger tertiary hospitals or university centers with or without residency training programs may have many more physicians present at any time in the ED. Emergency Departments staff their physician and nursing shifts according to the usual volume at any hour based on years of historical data.

Immediately after an attack, initial information will be shared by EMS, law enforcement and Emergency Management. The quality, quantity and timing of the information are crucial for determining a successful response.

Response algorithms may change throughout the course of the incident and must remain fluid throughout. Preliminary decisions will be made about appropriate institutional response based on imperfect information. Predicting resource needs can be difficult. Despite the magnitude of the 9/11 terrorist attack, relatively few wounded people presented to hospitals. Other less overpowering disasters result in surges of the worried well. The expected implications for victims as well as the ED are based on characteristics of the event including proximity, closed space or open space, smoke or fume release and complicating multi-trauma from structural collapse.[97] Response will also vary depending on the time of day or the day of the week.

To mobilize for a disaster, hospitals develop policies, procedures and protocols to reduce routine hospital activities rapidly in a safe, sensible, ethical manner to maximize resources. Upon activating the hospital wide disaster plan, the ED will either admit or discharge all current patients to free up beds and ED staff for arriving victims. The hospital may initiate diversion; cancel elective surgeries, procedures and clinics; call in backup staff; lock down the facility; and/or mobilize the decontamination

[97] P. Halpern, M. C. Tsai, J. L. Arnold, E. Stok, and G. Ersoy, et al., "Mass Casualty Terrorist Bombings-Implications for ED and Hospital Emergency Response Part II," *Prehospital and Disaster Medicine* 18, no. 3 (September 2003): 235-41, 236.

team and equipment. Disaster carts with extra procedure sets are brought to the ED. Certain clinical staff such as surgeons and anesthesiologists may be assigned to the ED. A staging plan specific for the described event will be drawn up by senior ED leadership present at the moment and shared with all ED and related staff such as registration, security, social work, and housekeeping. All departmental needs will be communicated to the hospital incident command center, which is located apart from the ED.

In a large-scale event, each hospital must have the capability to increase staffing, rapidly assess its available bed status and make occupied beds available in the ED, Operating Rooms (OR), and Intensive Care Units (ICU). This task may require discharge or transfer of patients or the opening of alternative care sites. All of these activities take time and engage valuable personnel resources that detract from the response. None of these decisions are taken lightly since the impact on a hospital to mobilize or not can be financially and operationally devastating. The impact of these decisions was evident several days into the SARS event in Toronto when, as a result of curtailment of services and fear, hospitalization rates decreased by 12 percent.[98]

To complicate matters, experience has shown that the walking wounded often arrive at the hospital even before the critically ill.[99] This practice creates a logistical and resource allocation problem for hospitals that initially rely on incomplete verbal reports to visualize and understand the scope of the disaster. Initially hospital staff may assign resources to the patients with minor injuries, only to find that they have to reassign resources when the critical patient arrives.

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[98] M. Schull, MD, "Hospital Surge Capacity: If You can't Always Get What You Want, can You Get What You Need?" Editorial, *Ann Emerg Med* 48 (2006): 389-390.

[99] Michael Schull, Therese Stukel, Marian Vermeule, Merrick Zwarenstein, David Alter, Douglas Manuel, Astrid Guttman, Andreas Laupacis, and Brian Schwartz, "Effects of Widespread Restrictions on the Use of Hospital Services during the Outbreak of Severe Acute Respiratory Syndrome," *Canadian Medical Association Journal* 176, no. 13 (June 19, 2007): 1830.

Over-assessing a patient's condition and under-assessing a patient's condition upon arrival, known as over-triage or under-triage, has been reported in the trauma literature by Askenazi[100] and Frykberg.[101] Mis-triage causes a patient/resource mismatch, complicates the ED response and jeopardizes patient care. Hence in a disaster, triage is often done by an experienced surgeon who can estimate the ultimate management plan for each patient. The critical mortality rate or the mortality rate in critical patients is the barometer of comparison so that the mortality rate is not diluted by large numbers of minor injuries. In the Virginia Tech shootings, the critical mortality rate was 20%, which was higher than the London bombing (15%) but lower than several other traumatic mass casualty events, which were about 30%. An elevated critical mortality rate is associated with over-triage, but the Virginia Tech over-triage rate was 69%, slightly lower than other traumatic mass casualty events.[102] This difference may explain the lower critical mortality rate.

(3) Trauma Surgery. Multiple factors affect the preparedness and response of hospitals to a bombing event. Immediate availability of a surgeon can be crucial. The realistic admitting capacity of the hospital is determined primarily by the number of trauma teams that the hospital can recruit. A trauma team consists of a surgeon, an ED physician, a critical care nurse and others, including perhaps an anesthesiologist. Trauma surgeons train as general surgeons and then specialize. They are certified by the American Board of Surgery, also a member of the ABMS and are represented by the American College of Surgeons. Others involved in trauma surgery include orthopedists, neurosurgeons, pediatric surgeons, anesthesiologists, and critical care intensivists. Other specialists may be consulted after initial assessment and stabilization of the patient.

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[100] I. Askenazi, B. Kessel, T. Khasan, J. Haspel, M. Oren, O. Olsha, and R. Alfici, "Precision of In-hospital Triage in Mass Casualty Incidents after Terror Attacks," *Prehospital Disaster Medicine* 21, no. 1 (2006): 20-23.

[101] E. Frykberg, and J. Tepas, "Terrorist Bombings, Lessons Learned from Belfast to Beirut," *Annals of Surgery* 208, no. 5 (November 2008): 569.

[102] Lisa Kaplowitz, and Morris Reece et al., "Regional Health System Response to the Virginia Tech Mass Casualty Incident," *Disaster Medicine & Public Health Preparedness* I (Suppl I) (2007): S9-S13.

Yet hospitals that are not designated Level I Trauma centers have no requirement to have a surgeon in-house around the clock. Alternatively, a surgeon could be in the OR committed to another patient. Trauma knowledge base and skills set are concentrated at fewer hospitals because of the trauma designations. The recent increased interest in disaster response capabilities is in contrast to the general surgery community's decreased interest in managing emergency surgery.[103] Many trauma fellowship positions go unfilled. In the past decade, physicians, particularly surgeons and surgical sub-specialists, have refused to participate in hospital on-call lists due to the decreased number of practitioners available to share on-call responsibilities, the increased litigation costs, and Emergency Medical Treatment and Labor Act (EMTALA) requirements which may result in no reimbursement. Additional challenges to hospital response are the fact that some hospital ORs are not routinely staffed at night and ICU beds are limited and not easily vacated.

Many trauma care providers view disaster preparedness as a field in which they are obliged to take part but that they do not find very stimulating. Some perceive a mass casualty event primarily as a logistical and organizational problem rather than a trauma care problem. The prevalent view is, "…good standards of medical care are the best guidelines in responding to disasters."[104] This view implies that trauma care remains essentially similar to normal daily practice and is therefore not an issue. From a current trauma care perspective, the goal of the hospital emergency plan is to provide severely injured patients with a level of care that approximates the care given to a similar single patient under normal conditions. However, experiences from an increasing number of incidents in recent years have shown that this complacency is ill-advised.[105] The

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[103] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 12.

[104] *ACS Committee on Trauma Resources for Optimal Care of the Injured Patient, Mass Casualties* (Chicago, IL: American College of Surgeons, 1993), 87-91.

[105] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 6.

delivery of quality trauma care during mass casualty event events differs in many respects from the daily routine. During a mass casualty event, the volume and severity of casualties and their erratic flow into the ED adversely affect the quality of trauma care given to individual patients. Effective triage of these casualties is often not straightforward.

d. What Professionals Say about Healthcare Preparedness and Current U.S. Medical Surge

(1) View from the Executive Level. The Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, also known as the Gilmore Commission, was legislated in 1998. In its first report in 1999, the commission concluded that a terrorist attack was likely and that it was not possible to describe the type of attack or the agent most likely to be used. They warned that the nation must be prepared for the entire spectrum of potential terrorist threats.[106] In its second report in 2000, they found major weaknesses in response capabilities.[107] The third report in 2001 includes a brief review of the nation's health and medical systems, which were found to be under-prepared to address the full scope of potential terrorist attacks. They list several recommendations involving training and exercises, planning, public health infrastructure support programs, investing and evaluation of appropriate stockpiles.[108] The fifth and final report in 2003 notes that states

[106] Gilmore Commission First Annual Report, Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, "Assessing the Threat," First Annual Report to the President and Congress, Washington, DC, December 1999, vi.

[107] Gilmore Commission Second Annual Report, Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, "Toward a National Strategy to Combating Terrorism," Second Annual Report to the President and Congress, Washington, DC, December 2000, 32.

[108] Gilmore Commission Third Annual Report Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, "For Ray Downey," Third Annual Report to the President and Congress, Washington, DC, December 2001, 14.

and local entities are not tightly linked with the federal government, they lack coordination in their planning, and are frustrated about response planning.[109]

The 9/11 Commission states that the nation must manage risk by developing capabilities that are suitable for a wide range of threats and hazards while working within an economic framework that necessitates prioritization and choice.[110]

In his book, *Americans at Risk*, Irwin Redlener, M.D., concludes, "…the nation remains decidedly unprepared," and he challenges the reader to look at response capabilities of countries such as Cuba, Canada, China and Israel, which he reports have all done a better job than the U.S. in similar situations.[111]

In a consensus panel convened by *Academic Emergency Medicine,* the Journal of the Society of Academic Emergency Medicine, in November 2006, then United States Surgeon General, Vice Admiral Richard H. Carmona, MD, MPH of the U.S. Public Health Service, notes, "There is a vital need to assess critically the current state of surge capacity and develop methods to study and augment it to improve our nation's all-hazard preparedness.[112]

DHHS asks, "Can hospitals meet the challenge?" The current health system, especially the emergency care system, is already severely strained by its routine volume of daily care and the financial strains on the hospital system. Health care and public health specialists anticipate profound problems in adequately caring for a

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[109] Gilmore Commission Fifth Annual Report Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, "Forging America's New Normalcy: Securing our Homeland, Preserving Our Liberty," Fifth Annual Report to the President and Congress, Washington, DC, 5-7.

[110] *The 9/11 Commission Report, Final report of the National Commission on Terrorist Attacks Upon the United States* (Washington, DC: U.S. Government Printing Office, July 2004), 391.

[111] Irwin Redlener, MD, *Americans at Risk, Why We are Not Prepared for Megadisasters and What We can do Now* (New York: Alfred A, Knopf, 2006), xxiii, 201-215.

[112] Richard H. Carmona, MD, MPH, "The Science of Surge: An All-hazard Approach is Critical to Improving Public Health Preparedness, Proceedings of the 2006 AEM Consensus Conference: The Science of Surge," David Cone, MD, Guest Editor, *Academic Emergency Medicine* 13, no. 11 (November 2006): 1097.

surge of victims. The Health Care System, EDs, and Intensive Care Units (ICUs) of acute care hospitals are chronically overcrowded and are resource constrained. Each hospital and unit differs substantially in capacity, training and level of coordination.[113]

An Institute of Medicine report released in June 2006 identifies the lack of surge capacity as a "…major challenge for the future of emergency care."[114] The Institute of Medicine argues that EMS and Emergency Medicine are very poorly prepared to handle natural disasters, a disease outbreak or a terrorist attack.[115] It called on Congress to increase funding in FY 2007 for hospital emergency preparedness in specific areas. They include strengthening and sustaining trauma care systems, enhancing ED trauma center and inpatient surge capacity, improving EMS response to explosives and designing evidence-based training programs.

In accordance with recommendations in the Institute of Medicine's "Future of Emergency Care" report series, "…all health profession schools, institutions and entities responsible for the training, continuing education, credentialing and certification of healthcare professionals should define and incorporate adult and pediatric domestic preparedness and emergency care competencies into discipline specific educational curriculum and competency criteria."[116]

The National Report Card issued by the American College of Emergency Physicians in 2006 gave the nation's EDs an overall score of C- on issues not specifically related to preparedness for terrorist or natural disasters but related to

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[113] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 1.

[114] Institute of Medicine of the National Academy of Sciences, Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), Executive Summary, 6.

[115] Institute of Medicine of the National Academy of Sciences, Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), 1.

[116] Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), Executive Summary, 7.

overcrowding, staffing, etc., yet issues that affect the ability to surge. No state received an A or an F but some populous states received poor scores. New York received a C-. More than 80% of states received poor or near failing grades of C- to D.[117] The most recent 2009 edition of the National Report Card gives the nation's emergency care system an overall grade of C-, unchanged from 2006 on issues such as Access, Quality and Patient Safety Environment, Medical Liability Environment, Public Health and Injury Prevention and Disaster Preparedness. The 2009 national grade for Disaster Preparedness is C+.[118]

In their publication, "Ambulances to Nowhere," Barbera and Macintyre call for a public policy debate at the local, state and national level "…to establish…remedies to resolve this critical healthcare funding issue." Without prompt action, the nation faces the risk that victims of mass casualty disasters might end up in "ambulances to nowhere."[119]

Governmental agencies have also identified the need to improve surge capability. The General Accounting Office released a report in August 2003 titled "Hospital Preparedness: Must Urban Hospitals Have Emergency Plans but Lack Certain Capacities for Bioterrorism Response," documenting that most hospitals have emergency plans but they do not work. The written preparedness plans provide a false sense of security. Few have integrated community plans.[120] Few hospitals have actual experience. A CDC survey shows that only 46% of hospitals have Memoranda of Understanding with other hospitals in the community for sharing resources.[121]

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[117] American College of Emergency Physicians, *The National Report Card on the State of Emergency Preparedness 2006* (Irving, TX: American College of Emergency Physicians, 2006), http://myaceorg/PageServer (accessed July 2, 2006), 1.

[118] American College of Emergency Physicians, *The National Report Card on the State of Emergency Preparedness 2009* (Irving, TX: American College of Emergency Physicians 2009), http://www.emreportcard.org/overview.aspx?id=386 (accessed December 21, 2008), 2.

[119] J. Barbera, A. Macintyre, and C. DeAtley, *Ambulances to Nowhere: America's Critical Shortfall in Medical Preparedness for Catastrophic Terrorism*, BCSIA Discussion Paper 2001-15, ESDP Discussion Paper ESDP2001-07 (Cambridge, MA: Harvard University Press, 2001), 14.

[120] United States General Accounting Office, *Hospital Preparedness: Most Urban Hospitals Have Emergency Plans but Lack Certain Capacities for Bioterrorism Response*, GAO 03-924 (Washington, DC: GAO, 2003), 13.

[121] Ibid.

In a 2005 DHS internal report on medical readiness, Dr. Jeffrey Lowell, the senior medical advisor to former DHS Secretary Tom Ridge, evaluates medical preparedness within the DHS and focuses specifically on NDMS. He found that the national medical leadership works in isolation; its medical response capability is fragmented and ill-prepared to deal with a mass-casualty event; and DHS lacks an adequate medical support capability for its field operating units. He calls for a "radical transformation" of NDMS, including the immediate appointment of strong medical leadership, development of clear mission objectives and substantial investment in the medical resources.[122] A second 2005 report prepared by DHHS concludes that NDMS suffers from poor coordination with other federal agencies. It concludes that the U.S. does not have an effective national capacity to provide emergency medical services after a major disaster. Both agencies have recognized the need for fundamental reforms, including an increase in funding, establishment of strong medical leadership and clear internal control over assets.[123] Evidence for these reports was that NDMS had trouble responding to the Florida hurricanes in 2004 and had major lapses in response to Hurricane Katrina in 2005.[124] When housed in DHHS, NDMS was headed by an Assistant Secretary for Public Health Emergency Preparedness. In DHS, it was part of FEMA and as such its lead official is four levels below the Secretary, making it more difficult to be heard. The report quotes an unnamed DHS person as saying that most of DHS is law enforcement. "The right thing to do for medical support and operations is not understood. It is just lost."[125] Subsequently, NDMS has been returned to DHHS. The continual shifting of responsible agencies detracts from the development of a coherent response.

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[122] U.S. House of Representatives Committee on Government Reform-Minority Staff, Special Investigations Division, "The Decline of the National Disaster Medical System," Washington, DC, December 2005, 10.

[123] Monica Giovachino, Elizabeth Myrus, Dawn Nebelkopf, and Eric Trabert, *Hurricanes Frances and Ivan: Improving Delivery of HHS and ESF #8 Support* (The CNA Corporation: Alexandria, VA (February 2005), 25.

[124] U.S. House of Representatives Committee on Government Reform-Minority Staff, Special Investigations Division, "The Decline of the National Disaster Medical System," Washington, DC, December 2005, 2.

[125] Ibid., 1.

Several professional study groups have examined surge capability and made recommendations.

The American College of Emergency Physicians' position is that every healthcare worker should be able to respond to acts of terror.[126] The Committee on Trauma of the American College of Surgery outlines similar advice to their members.[127] The American Academy of Pediatrics (AAP) Task Force on Terror aims to help prepare practitioners for disaster response. They note that these physicians should adopt a life-long learning perspective with regard to this subject.[128]

In February 2006, recognizing that the American College of Emergency Physicians must play a leadership role in obtaining government funding and do the necessary analysis and training to prepare our nation's frontline EM personnel to respond to a disaster, David Seaberg, MD, a member of the Board of Directors of ACEP, outlined a 10-point plan before a joint hearing of subcommittees of the U.S. House Committee on Homeland Security to increase capacity, alleviate overcrowding and improve surge capacity at the nation's emergency departments. It lists a wide range of initiatives to improve preparedness and calls for Congressional funding for them. None of its proposals directly addresses increasing the pool of trained clinicians.[129] While he

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[126] ACEP Disaster Planning & Response Policy, http://www.aceorg/practres.aspx?id=40342 (accessed August 15, 2008).

[127] "ACS Disaster from Biological and Chemical Terrorism-What Should Individual Surgeon do?-Committee on Trauma," 2001, http://www.facs.org/civiliandisasters/trauma.html (accessed May 19, 2007).

[128] "The Pediatrician and Disaster Preparedness," 117, no. 2 (February 2006): 560-5, http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22American%20Academy%20of%20Pediatrics%20Committee%20on%20Medical%20Liability%22%5BCorporate%20Author%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DiscoveryPanel.Pubmed_RVAbstractPlus (accessed May 19, 2007).

[129] American College of Emergency Physicians, *Disaster Preparedness: Key Messages* (Irving, TX: American College of Emergency Physicians, 2006), 1, http://www.aceorg/webportal/templates (accessed July 2, 2007).

called for funding for hospitals and EDs to compensate for non-reimbursed care and to bring physicians and nurses into any first responder funding, the plan did not call for strengthening the clinician participation in hospital response.[130]

Among its goals, the ACEP Strategic Plan for FY 2006-07 aimed to work to eliminate ED crowding and boarding of patients, achieve meaningful medical liability reform and promote emergency medical preparedness for disasters. They sought to prepare frontline EM personnel for disasters through specialized conferences, curriculum and training. They sought grant funding to subsidize National Disaster Life Support (NDLS) courses, to offer disaster preparedness courses at ACEP educational meetings and to create core competencies for healthcare workers (HCW) involved in disasters and to fund them. They aimed to aggressively seek grants and promote research funding in an effort to identify and promote solutions to ensure adequate U.S. healthcare response and surge capacity during disasters. They requested and were awarded an Executive DHS grant. With that grant, they surveyed and trained hospital staff in 18 states in disaster preparedness; and supported and assisted up to 10 of 53 state and affiliated chapters in organizing and hosting town hall meetings to attract the attention of the media to increase public awareness of the role of Emergency Physicians in responding to disasters and mobilize support for the need for adequate surge capacity. They advanced a research agenda and increased the overall availability of research funding for Emergency Medicine Disaster Preparedness.[131]

Acknowledging the terrorist threat to the United States and the potential weapons which present relatively new challenges to the U.S., the CDC's National Center for Injury Prevention and Control convened an expert panel in October 2005 and January 2006 to identify creative strategies that could be adopted in a timely

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[130] American College of Emergency Physicians, Nations's Emergency Physicians 10-point Plan for Avoiding Mass Casualties From Pandemic Flu Outbreak or Other Disaster, Testimony of David Seaberg, MD,,Board Member, American College of Emergency Physicians, Joint Hearing of Subcommittees of the U.S. House Committee on Homeland Security titled "Protecting the Homeland: Fighting Pandemic Flu From the Front Lines," February 8, 2006, http://www.aceorg/webportal/Template/Default_Primary_Print.aspx?NRNODEGUID= (accessed May 19, 2007).

[131] American College of Emergency Physicians, "Ensure Access to Emergency Medical Care," Strategic Plan FY 2006-07, 1-7.

manner to address surge issues from terrorism and recommend strategies for rapid management of a large number of bombing casualties. Objectives were to increase collaboration between the CDC and federal agencies, external partners and other experts on issues of surge capacity for injuries from conventional weapons and WMD. They examined the related challenges that would confront not only the general emergency medical response of the healthcare system but would affect select medical disciplines. Their conclusions, released in April 2007, notes that without immediate federal assistance, many if not most communities would have difficulty caring for a surge of victims because each hospital and EMS system differs dramatically in capacity, training and level of coordination. The CDC cites several surge capacity challenges.[132] Crowded Emergency Departments, increased volume, frequent diversion, and hospital closures are identified as some of the many problematic areas that stand between the current reality of emergency care in the United States and the effective management of a Madrid-like event. Other CDC-identified challenges and conclusions facing health care facilities and providers include:

- Organization and leadership—effective preparedness and response demand an established functional leadership structure with clear organizational responsibilities. Such preparation has not occurred, particularly at the local operational level. Consequently, confusion and redundant efforts and gaps exist.
- Education—disaster preparedness and response education is not included in most medical or nursing school curricula. With the exception of EM, it is not a requirement in residency training programs. Thus, most health care providers are unprepared to provide the clinical care required during a disaster.
- Infrastructure and Capacity—patients may seek care at facilities not part of the existing response plans so all hospitals must prepare and drill.
- Hospital capabilities and staffing offer significant challenges—shortages of nurses and specialized technicians exist every day. This situation could be catastrophic during a mass casualty event due to the large number of patients, or the hesitation of staff to report to work for fear for their own health and safety or that of their own families. Estimating available staff

[132] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 1.

may be difficult since many clinicians work at multiple facilities and may be over-counted. Conversely, screening, managing and credentialing well-intentioned volunteers can be challenging if not impossible during a disaster.[133]

- Information Technology, cost and interoperability offer other challenges.
- Potential bottlenecks include triage, the response and capability of Radiology, limited critical care beds and limited transportation. Many hospitals have adopted just-in-time inventory for supplies and equipment including ventilators and pharmaceuticals. Many rely on the same regional suppliers who may be unable to surge these items to several hospitals in a timely way. Access for delivery may be blocked.
- Legal Issues.
    - Alteration in Standard of Medical Care. Altering or reducing the standard of care provided to do the greatest good for the community is a concept that is fraught with ethical, societal and legal issues making it difficult to surmount. It will require public discussion and legislation to support a protocol for determining who will have the authority to order the transition from usual to altered standard of care and when it will occur.[134]
    - Verification of volunteer providers' identity and credentialing, standards for clinical documentation, liability, EMTALA, HIPAA and CLIA.[135]

In 2003, TJC issued a white paper. Its intent was to frame the issues that must be addressed in developing community-wide preparedness and to delineate federal and state responsibilities for eliminating barriers and for facilitating and sustaining community-based preparedness across the United States through leadership and funding.[136] While it does demand that direct medical caregivers be given the highest priority for training and receipt of equipment, vaccinations, antidotes and other protective measures, it does not call upon the medical community itself to organize to prepare nor

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[133] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 19.

[134] Ibid.

[135] Ibid., 21.

[136] "Health Care at the Crossroads, Strategies for Creating and Sustaining Community-wide Emergency Preparedness Systems," *Joint Commission on the Accreditation of HealthCare Organizations* (2003): 4.

does it call upon the hospital community to take a leadership role. It calls on the federal and state governments. It prescribes a top down approach from agencies that may not appreciate all the issues at the lowest level. While it has been a force for change in the past, it is often reticent to tell hospitals how to do certain things. Several years ago, TJC retracted under pressure some standards that would have improved patient care and ED organizational and logistical operations. ACEP has called for those standards to be reapplied.[137]

The AMA, which represents roughly 244,500 of the estimated 850,000 licensed physicians, or 28% in the United States,[138] released a Policy Statement titled, "Physician Obligation in Disaster Preparedness and Response," which was adopted June 2004 and issued in December 2004. "In preparing for epidemics, terrorist attacks and other disasters, physicians as a profession must provide medical expertise and work with others to develop public health policies that are designed to improve the effectiveness and availability of medical care during such events. …individual physicians should take appropriate advance measures to ensure their ability to provide medical services at the time of disasters, including the acquisition and maintenance of relevant knowledge."[139] The Policy Statement is silent on how best to accomplish this goal. In July 2007, the AMA issued a statement by then AMA-President Nelson asserting that all public health and healthcare personnel as well as professors have a responsibility to continually prepare themselves to respond to the health and medical needs of the public during disasters and concluding that a coordinated and integrated response requires that all clinicians are trained in multiple disciplines.[140] They offer no guidelines on physician

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[137] "Health Care at the Crossroads, Strategies for Creating and Sustaining Community-wide Emergency Preparedness Systems," *Joint Commission on the Accreditation of HealthCare Organizations* (2003): 8.

[138] David Boddinger, "AMA Hopes Streamlined Agenda Will Boost Membership," *The Lancet* 366 (September 17, 2005)*:* 971.

[139] American Medical Association, "Physician Obligation in Disaster Preparedness and Response," Policy of American Medical Association, E-9,067 Issued December 2004, Adopted June 2004, 1, http://www.ama-assn.org/apps/pf_new/pf_online?f_n=resultLinkanddoc=policyfiles/HnE/E- (accessed June 23, 2007).

[140] American Medical Association/American Public Health Association Linkages Leadership Summit Consensus Report, Georges Benjamin, and Michael Maves, "Improving Health System Preparedness for Terrorism and Mass Casualty Events," (July 2007): 11.

preparation. However, the National Disaster Life Support Foundation, a 501C3 nonprofit foundation in partnership with AMA, has developed a family of courses to address the need for standardized disaster medicine education.[141] They sponsor courses like the Core Disaster Life Support Course. The Basic Disaster Life Support covers traumatic and explosive events and chemical events over 60 minutes each. The Advanced Disaster Life Support covers the basic disaster paradigm, mass triage, medical decontamination, legal issues of disaster response, media and communications, healthcare facility and community disaster Planning and Mass Fatality management. It does not specifically cover the medical response.[142]

In a report by the National Health Policy Forum (NHPF) titled *Medical Response for Terrorism and Public Health Threats: One Region's Experience*, the authors summarize the comments from emergency preparedness and medical specialists resulting from a site visit to Pittsburgh, Pennsylvania in 2003. Feedback from these meetings, along with guidance from the Forum's Bioterrorism Preparedness Workgroup and Steering Committee, suggests that NHPF should focus more explicitly on how hospitals and other health care providers were preparing for mass casualty events. The Pittsburgh visit revealed that planning was bottom up and had a long ramp-up phase. Some participants questioned whether designated federal and state agencies had the resident substantive expertise to oversee medical and hospital preparedness efforts. They criticized the limited regional preparedness efforts, adding that hospitals and hospital systems plan independently. Planning is often not guided by threat assessments. Individual hospital systems have attempted to define their own preparedness needs. Confounding the problem, these activities appear to have been conducted in isolation with little or no consideration of regional plans or priorities.[143]

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[141] Jack Horner, "A Call for Standardized Training," Disaster *Medicine & Public Health Preparedness* 2007; I (Suppl I) S3; I (Suppl I) S9-S13.

[142] Advanced Disaster Life Support, http://www.ama-assn.org/ama/pub/category/12608.html (accessed May 11, 2008).

[143] NHPF Site Visit Report, "Medical Response for Terrorism and Public Health Threats: One Region's Experience," Pittsburgh PA, September 22-23, 2003, National Health Policy Forum, The George Washington University, Washington, DC, 6.

(2) The View at Street Level-Public Expectations. Health Care is a public trust. The general public, segments of the emergency response community and policy makers demonstrate a limited understanding of mass casualty medical care issues faced by hospitals. Data on ED visits shows that one in seven Americans are patients in an ED each year, but since some patients with acute exacerbations of chronic diseases visit more frequently, many Americans have no concept of the current crisis in emergency medicine. Everyone assumes that the ED is ready when they need it but that circumstance may not be always true.

The general public expects adequate preparedness for consequence management by the emergency response community. A key component to those expectations is timely and appropriate medical care for victims of a mass casualty incident. Emergency Medicine is a major component of this trust. It is thus presumed by the public that even if a large number of patients are brought simultaneously to a hospital, they would receive the same high-quality care as the individual patient does under optimal hospital conditions. These assumptions about existing medical capabilities to treat mass casualties may not be correct in all cases.

Many things underlie the public's expectation of the best care possible and provide the basis for this trust. The Hippocratic oath, the EMTALA law, the high esteem in which society holds physicians and nurses and other medical personnel, daily media reports of breakthroughs in research, and the severity of judicial malpractice remedies for breach of medical standards are all evidence of the public's medical care expectations.

This public trust in part results from community financing of healthcare from taxes and public funds; fee-for-service billing for medical care; the government guarantee of emergency care and stabilization under EMTALA; and the obligation of hospitals toward community preparedness incorporated into public policy.

Title III of the Superfund Amendment and Reauthorization Act (SARA) of 1986[144] establishes local Emergency Planning Committees to designate a local hospital as receiving facilities for hazmat events. As part of CMS' Medicare Condition of Participation, any hospital with an ED must have sufficient physicians and nurses to meet patient needs. TJC accreditation implies certain assurances.[145]

This confidence in today's health care system, however, may, at times, be unfounded and may be eroding. Public surveys in 2006 by the Mailman School of Public Health at Columbia University reveals that just 28% of the public surveyed are confident that the health care system is ready to respond effectively to a biological, chemical or nuclear attack, a decrease from 39% in 2005 and 2004 and down from 46% in 2003 and 53% in 2002. Less than a quarter of the American public (23%) is confident that the health care system is ready to respond effectively to a bird flu pandemic.[146] Fewer respondents expressed confidence when the survey was analyzed for New York City resident responses.[147]

(3) The View from the Ground Floor

- The Emergency Department Emergency Medicine and Hospital Landscape-Current Healthcare System Status. While the public and the political communities assume that the healthcare systems are adequately

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[144] J A. Barbera, A. G. MacIntyre, and C. A. DeAtley, "Ambulances to Nowhere: America's Critical Shortfall in Medical Preparedness for Catastrophic Terrorism," BCSIA Discussion Paper 2001-15, ESDP Discussion Paper ESDP 2001-07, John F, Kennedy School of Government, Harvard University, October 2001, 3.

[145] United States Center for Medicare Services, § 482.22 Conditions of Participation for Hospitals, Medical Staff, (1994); § 482.23 Condition of Participation: Nursing Services (2002), http://edocket.access.gpo.gov/cfr_2004/octqtr/pdf/42cfr482.22.pdf (accessed November 13, 2007).

[146] I. Redlener, MD, R. Grant. D. A. Berman, D. Johnson, and D. Abramson, Annual Survey of the American Public by the National Center for Disaster Preparedness at Columbia University, Mailman School of Public Health and The Children's Health Fund, "Where the American Public Stands on Terrorism, Security and Disaster Preparedness, Five Years after September 11, One-Year after Hurricane Katrina," September 2006, http://www.ncdmailman.columbia.edu/files/2006_white_paper.pdf (accessed May 19, 2007).

[147] Columbia University, Mailman School of Public Health, *Snapshot 2005: Where the American Public Stands on Terrorism and Preparedness Four Years after September 11, Confusion, Loss of Confidence and Unmet Challenge* (New York: Columbia University Press, 2005), l; Irwin Redlener, *The 2005 Annual Survey of the American Public by the National Center for Domestic Preparedness* (New York: Columbia University Press, 2005), 6.

> preparing for terrorism incidents that would generate catastrophic casualty loads, the medical community is struggling just to maintain its everyday operations.

Emergency physicians recognize that if a mass casualty event happens, they will be rapidly overwhelmed and people will die. A survey conducted by the American College of Emergency Physicians of their members in October 2003 reveals that 80% of the respondents said their hospital emergency department does not have the surge capacity to handle an epidemic or act of terrorism. Barriers to surge include the overcrowding found in the EDs, where over 60% of the respondents work, as well as a shortage of on-call physicians, jeopardizing patient safety and causing delays and backup. Additional barriers include lack of resources and lack of political will.[148]

ED physicians cannot do it all. One state chapter of ACEP, the Arizona College of Emergency Physicians (AzCEP) took a stand on the crisis in Emergency Medicine and issued a formal position statement. In December 2000, they declared that AzCEP, "…hereby goes on record as stating that the emergency physician community has lost confidence in the emergency healthcare infrastructure in Arizona and that current resources supporting emergency care are inadequate to meet the needs of all patients at all times."[149]

A key component of consequence management is timely and appropriate medical care for victims of mass casualty incidents. In reality, hospital surge capacity and specialized medical capability across the United States has never been more restricted. Hospitals currently do not have enough trained staff in place at any given time to handle large numbers of patients with injuries from chemical or conventional weapon injuries such as might occur after a subway bombing or the release of chemical agents at a sports arena.

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[148] American College of Emergency Physicians, "Eighty Percent of Emergency Physicians Surveyed Say Emergency Departments Lack Surge Capacity," Irving, TX, October 2003, http://www.aceorg/webportal/Template/Default_Primary_Print.aspx?NRNODEGUID= (accessed May 19, 2007).

[149] Arizona College of Emergency Physicians, *Position Statement on the Critical State of Emergency Care in Arizona* (Phoenix, AZ: Arizona College of Emergency Physicians, 2000), http://www.azceorg/er_crowding/position.pdf (accessed January 12, 2007).

Hospitals are facing severe financial challenges in 2008. Thirty percent of U.S. hospitals operated at a deficit in 2003.[150] Those in the black have very narrow margins of surplus. In 2007, the Healthcare Association of New York State (HANYS) reported that 56% of New York State hospitals were either in the red or were operating with a financial margin of 1% or less.[151] Hospitals are struggling daily to provide increasingly complex medical care to a growing and aging population with multiple medical problems, as well as 47 million uninsured Americans and a large illegal immigrant population. In addition, professional staff personnel salaries, new and costly technology and equipment, pricey medications, exorbitant liability costs, costly regulatory compliance, and capital dollars needed for the replacement of aging physical plants all drive up the cost of healthcare. The Balanced Budget Act of 1997[152] restricts access to capital dollars, making it difficult to replace outdated facilities.

This situation occurs at a time when reimbursement is low due to the failure of managed care, to reduction of payments from insurance companies, to reduction in payments from Medicare and Medicaid, and to the requirement to treat the uninsured. Hospitals are closing beds, merging into health care systems or networks and curtailing services where possible to control costs.[153] As a result of new and safer technologies, new medications, advanced therapies and evidence-based medicine which challenges the validity of old assumptions, the paradigms of hospitals have shifted from large inpatient services with much supportive staff to smaller inpatient units with greater emphasis on same-day surgery and outpatient procedures and interventions. The hospital industry has contracted its staff and downsized its operations and become more specialized and efficient over the past decade in order to survive in the tight financial markets.

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150 American Hospital Association, http://www.aha.org/aha/content/2005/pdf/05fragilehosps.pdf (accessed November 9, 2007).

151 "Falling Behind, Medicare Hospital Payment Policy in New York," *Healthcare Association of New York State (HANYS)* (June 2007): 1.

152 J. K. Iglehart, "Support for Academic Medical Centers-Revisiting the 1997 Balanced Budget Act," *NEJM* 341, no. 4 (July 1990): 299-300.

153 "Falling Behind, Medicare Hospital Payment Policy in New York," *Healthcare Association of New York State (HANYS)* (June 2007): 2.

Capacity is not keeping pace with the increased demand for care, however. Hospital closures and bed reductions were largely a response to massive transformation in the delivery of patient care. Medicare's prospective payment systems and managed care controls created incentives to increase efficiency by lowering length of stay. Hospital length of stay initially decreased over the past decade but has more recently flattened out as the efficiencies reach their limits. This situation occurs as baby boomers enter the high health care use period. The managed care backlash shows that Americans are unwilling to have restrictions placed on choice and access to care.

A particular crisis exists in emergency care. The Institute of Medicine's report in June 2006 titled, "Hospital-Based Emergency Care: At the Breaking Point," brought this crisis to light.[154] There are 4,017 EDs nationwide[155] of which 1,414 are certified trauma centers.[156] Two thirds are urban, one-third are rural. Seven-hundred three hospitals and 425 Emergency Departments (14%) have closed throughout the country from 1993 to 2003 while the population has increased 12%. Hospital admissions have increased 13% despite a loss of 198,000 beds (17%) including 103,000 staffed medical/surgical beds and 7,800 ICU beds during the same period, accommodated largely through a decreased length of stay. The annual volume of ED visits has increased 26% from 90.3 million in 1993 to 113.9 million in 2003. By 2001, 60% of hospitals were operating at or over capacity.[157],[158]

Trend analysis from the American Hospital Association reveals that about 1/3 of the increased demand for hospital care can be attributed to population

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[154] Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), 1.

[155] Health Forum an American Hospital Assn Co., Chicago, IL, AHA, AHA Hospitals Statistics 2006 Edition, "The Rising Demand for Hospital Care: Can We Meet the Challenge," *Caroline Rossi Steinberg VP Trends Analysis AHA*, 159.

[156] Ibid., 166.

[157] Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), 1.

[158] Robert Wood Johnson Foundation and the George Washington University School of Public Health, Urgent Matters, "About ED Crowding," http://urgentmatters,org/318725 (accessed November 3, 2008), 1.

growth. Two-thirds is due to increased consumption of health care services. Outpatient visits per thousand persons are up 61% since 1990. Health care consumes a greater portion of Gross Domestic Product each year, raising questions about future affordability. Americans spent $1.7 trillion on health care amounting to 16% of the GDP in 2007, up from 9% in 1980.[159] The United States spends more per capita on health care than any other industrialized nation. The aging population is leading to increased demand for hospital care. The CDC found that the greatest increase in ED visits is occurring among those 65 and older—a trend that is likely to continue.[160] Between 1990 and 2002, the population grew 16%. During same period, people over age 75 increased by 33%. In 2002, people over 75 used nearly four times as many hospital days per thousand than the general population. The health profile of the aged and their health care needs are dramatically different now than in the past. A 75-year old today has different health care needs than a decade ago. While advances in medicine improve longevity and the quality of life for the elderly population, these advances are accompanied by increased demand for health services. The aging of the population results in patients with chronic and acute serious illness requiring more time-consuming and complex workups and treatment.

Healthcare restrictions come at a time when advances in treatment for once-killer diseases such as AIDSs, cancer, renal and cardiac disease result in survivors with serious ongoing healthcare needs. The rising burden of chronic disease is driving up the use of hospital services. Increased incidence of obesity, hypertension and diabetes contribute to costly health complications. Advances in medicine provide more treatment options.[161]

These resource challenges impact the flow of patients from the ED to an inpatient bed resulting in overcrowding in many EDs. In some EDs, patients wait

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[159] National Coalition on Healthcare, http://www.nchc.org/facts/cost.shtml (accessed August 18, 2008).

[160] Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), 42.

[161] Health Forum an American Hospital Assn Co., Chicago, IL, AHA, AHA Hospitals Statistics, 2006 Edition, "The Rising Demand for Hospital Care: Can We Meet the Challenge?" *Caroline Rossi Steinberg VP Trends Analysis AHA*, ix-x.

days for an inpatient bed, clogging up ED rooms and hallways and challenging the already overstretched staff. Consequently, 1.7% of ED patients left without being seen (LWOBS) and 1% left Against Medical Advice (AMA). Sixty-nine per cent of urban hospitals reported periods of time when they had to divert ambulances due to the lack of critical care beds and acute care beds, ED overcrowding and staff shortages.[162] According to the IOM, 501,000 ambulances were diverted in 2003, an average of once every 11 minutes.[163] Redirection becomes a moot point if all hospitals in a region are on diversion at the same time, and patients are brought to hospitals whether they can care or not. By 2004, the AHA reported that half of all hospitals and 70% of urban hospitals went on diversion.[164] Georges Benjamin, MD, Executive Director American Public Health Association stated, "Everyday in the hospital emergency departments around this country, we face a smoldering mass casualty scenario."[165]

The uninsured Americans and immigrant population may have no healthcare until arriving at the ED. Emergency Departments fall under the purview of the Emergency Medical Treatment and Labor Act (EMTALA) of 1986,[166] which requires hospitals to perform a medical screening examination and to provide stabilization of all unstable medical conditions for all patients who present to the ED requesting help regardless of their ability to pay. Thus, the ED becomes the health care provider of choice for the 47 million uninsured citizens in the United States, as well the entire immigrant population. Stabilization may require extensive evaluation involving costly equipment and procedures including CT scan, surgery and ICU care for which the hospital and doctor may receive no payment.

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[162] The American Hospital Association, *The State of America's Hospitals: Taking the Pulse* (Chicago, IL, 2005), 2.

[163] Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, *Future of Emergency Care, Hospital-Based Emergency Care: At the Breaking Point* (Washington, DC: The National Academies Press, June 2006), 21.

[164] The American Hospital Association, *The State of America's Hospitals: Taking the Pulse* (Chicago, IL, 2005), 2.

[165] Georges Benjamin, *American Medical News*, February 24, 2003, http://www.ph.ucla.edu/epi/bioter/surgecapacity.html (accessed October 5, 2007).

[166] U.S. Congress 42 USC, 1395dd, Emergency Medicine Treatment and Labor Act, 1986.

The appeal of the modern ED is becoming problematic in terms of volumes, costs, staffing, facilities etc. It is all things to all people. To the uninsured, it is their only access to healthcare. To the community physician, it is a valuable practice benefit that provides coverage for patients in the off hours when the office is closed. This practice is especially true in the managed care era when there is little financial incentive to have extended hours. To the patient, it is a convenient one-stop, no appointment necessary, fast solution to many problems. To the hospital, the ED is an escape valve for a strained inpatient capacity. The result overwhelms the ED, creating a national crisis. As a result, Emergency Department overcrowding and diversion are realities in many communities on a daily basis.

- The Healthcare Continuum-Regionalization and Community Organization

Physician training has evolved in response to the increasing body of knowledge, the evolving principles of education and the changing healthcare model of specialization. The medical school curriculum is so voluminous that few schools train specifically or sufficiently for the new reality of terrorism. The agents may be covered within other lectures on trauma, infectious disease and pharmacology. Students need to know merely the basics unless they choose to specialize in these areas. Few programs address these agents as weapons of terrorism.

Postgraduate training including the Emergency Medicine residency has minimal, if any, requirements to study these weapons. After residency, continuing Medical Education (CME) offerings encourage the clinician to study changing patterns of disease emergence, altered response and new therapies, cutting edge advances in knowledge and technology, new medications and new practice guidelines. Physicians rarely seek out WMD training given other choices. Requirements of eight hours of Continuing Medical Education per year for physicians on a stroke team recently unleashed comments in the Emergency Medicine community that ED physicians must know the evaluation and management of at least 30 life-or-limb threatening emergency conditions. If required to have eight hours of training for each diagnosis, it would require six full weeks of school annually that no physician has the time, the backup physician coverage or the funding to complete. This training is in addition to hospital mandated

training in infection control, child abuse, HIPPA, corporate compliance, risk management, customer satisfaction and computer system training etc. Additionally, training in WMD is not widely offered or pursued.

Healthcare and the medical profession have been moving to physician specialization for the past several decades. Physician specialization is a result of the rapidly expanding body of knowledge in medicine. Physicians know a lot about a little but do not focus on community needs outside of their specialty. The general practitioner is a clinician of the past. The current healthcare model centers about a Primary Care Provider, usually an Internist, Family Practitioner or Pediatrician, who evaluates the new patient and then refers the complicated patient to a specialist. Fewer physicians are trained in the U.S. in 2008 than in decades past.

Regionalization of certain hospital services such as trauma, stroke, cardiac catheterization, interventional radiology is the result of literature that supports improved patient outcomes in centers that deal with these problems in large numbers on a regular basis. In some cases, it is also a function of centralizing costly equipment and specialists in one location to prevent a mismatch of resources.

Regionalization and specialization in health care has resulted in Trauma Center designations. For major trauma, Emergency Medical Services (EMS) divert to the most highly qualified Level I hospitals in the region where Emergency Department (ED) physicians and trauma physicians are present around the clock and where residents are trained and research is conducted. The current Trauma System in place across the United States designates only a limited number of hospitals as Trauma Centers, with only 221 Level I trauma centers in the U.S. In San Antonio, Texas, the single Level I Trauma Center covers many cities and counties and covers millions of lives. The alternatives to a Level I Trauma Center are a Level II center with some trauma expertise and specialists who can respond within 30 minutes and Level III community hospitals with limited expertise.

Due to the specialization, many, if not most, hospitals would not be prepared to handle hundreds of victims from a bombing or chemical release at a football game or inside a mall in the time frame necessary to make a difference.

During the attacks on the World Trade Center Twin Towers in 2001, the trauma system in New York City was never tested. The borough of Manhattan is the hub of New York City. It is home to 1.53 million residents (2000 census)[167] and on weekdays, 581,000 additional people work in this borough (2004 data).[168] It is home to much critical infrastructure. As the recognized financial capital of the world, it is a prime target of terrorists. Particularly vulnerable are the trains, buses and tunnels that residents and workers use to enter and exit the city, as well as the tall office towers in which they work. An explosive event or the release of a nerve agent or other chemical agent could generate large numbers of victims requiring immediate medical attention. Manhattan is the site of four designated Level I Trauma Centers. In the first hour of a response effort, each patient requires significant resources including nurses, physicians, consultant physicians, space, supplies and equipment, and radiology capability. After initial evaluation and stabilization they would be moved to the Operating Room or an ICU. Critical patients each take an attending physician from 10 minutes to over one hour to evaluate and stabilize. On average, 2-8 physicians are on duty at a Level I trauma center. Non Level I hospitals would have fewer trained physicians on duty and would be even slower in their response. This scenario is hardly strong preparedness for the country given its expansive health care.

More than 60% of hospital revenues are used to pay salaries and benefits, and yet a serious shortage of health care workers exists. Demand for these workers exceeds supply, resulting in costly overtime, agency or incentive packages such as sign on bonus or tuition reimbursement to recruit staff. In December 2004, hospitals had an estimated 109,000 vacant positions for registered nurses, accounting for 8.1% of

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[167] The City of New York, Department of City Planning, Population Division, 2000 Census Summary, http://home2.nyc.gov/html/dcp/html/census/pop2000.shtml#contents (accessed June 3, 2007).

[168] J. J. Salvo, A. P. Lobo, and J. A. Alvare, "A Pre-and Post 9/11 (2000 to 2005) Look at Lower Manhattan," Paper prepared for the March 2007 Population Association Meetings in NYC, http://home2.nyc.gov/html/dcp/pdf/census/pre_post_911.pdf (accessed June 3, 2007).

part-time and full-time positions. Staff is aging and retiring. Other professional options for women in healthcare besides nursing are depleting those resources.[169] HRSA now projects a one million RN shortage by 2020 and predicts that only 64% of positions will be filled.[170]

Equally worrisome is that hospital personnel often have simultaneous commitments to multiple hospitals in any individual region resulting in over-estimation of available resources. This shortage could result in a serious shortfall of professional staff when surge capacity is needed in a region.

Due to the tight healthcare financial picture, dedicated hospital personnel resources needed to strategize and plan for disaster preparedness both within the hospital and within the regional emergency preparedness community rarely exist. Planning is often done by interested professionals who have other primary responsibilities. While they are able to draft the required response plans and complete the deliverables for HRSA grants or regulatory agencies, hospitals often do not have the resources to bring the necessary didactic or practical training to the entire staff.[171] Nor do they have the time or personnel to coordinate a regional, scenario-based response. The calculations of hospital reimbursement do not include reimbursement for domestic preparedness or to maintain surge capacity.

Since 2002, the U.S. government has distributed more than $7 billion to prepare for all types of disasters. Much of the money has gone to state and local health departments, emergency first responders, and hospitals. However, the distribution includes funds for decontamination showers and medication stockpiles but does not systematically address the lack of emergency and inpatient capacity. In addition, dollars are decreasing from $516 million in 2004 to $423 million for FY 2007 and projected to

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[169] Health Forum an American Hospital Assn Co, Chicago, IL, AHA, AHA Hospitals Statistics 2006 Edition, "The Rising Demand for Hospital Care: Can We Meet the Challenge?," *Caroline Rossi Steinberg VP Trends Analysis AHA*,xii.

[170] M. Biviano, M. Fritz, and W. Spencer, "What is Behind HRSA's Projected Supply and Demand and Shortage of Registered Nurses, National Center for Health Workforce Analysis," *Bureau of Health Professional, HRSA and T. Dail, The Lewin Group* (September 2004).

[171] General Accounting Office, *Most Urban Hospitals Have Emergency Plans but Lack Certain Capacities for Bioterrorism Response*, GAO 03 924, 5.

be $361 million for FY 2009.[172] While pre-hospital providers have received grants for preparedness including equipment and training, hospitals struggle with unfunded mandates. Individual hospital grants from HRSA in 2002 Round 1 fell between $10,000 and $40,000, depending on location. This amount is insufficient to equip one critical care room. Round II HRSA grants in 2003 ranged from $22,900 to $35,700. The Greater New York Hospital Association survey of hospital preparedness expenditures shows that NYC hospitals spent over $3 million on average for preparedness in 2003.[173]

Couple the troubled healthcare environment with the threat of terrorism on our shores and it is rapidly apparent that a new paradigm of hospital preparedness and response is necessary. The potential global threat of terrorism and the recent dramatic demonstrations of terrorist attacks in major European cities and natural disasters in the United States and their impact on healthcare have continued to stimulate much thought about available resources within the medical and public health communities. Designated dollars need to be carefully targeted to improve capability with the greatest return on investment.

Researching and modeling surge capacity reveals some interesting and disturbing findings but is helping discern the issues and debunking the old impressions. Hospital inpatient census data can give a misleading picture of a hospital's surge capability. While clearly the number of available beds is only one measure of capacity and it is no measure of surge capability, it does give some indirect insight into the challenges facing hospitals today. In a study published in October 2006, DeLia evaluates the annual bed statistics in New Jersey in 2003. When using licensed beds as the denominator, the occupancy across the state varied from 60-68%, with zero days above the threshold occupancy rate of 85% (a rate associated with delayed inpatient bed availability). A 90% occupancy rate represents a bed crisis. When using average daily maintained beds (i.e., set up and staffed) instead of licensed beds as the denominator, 58% of the time the state in-patient census was above the threshold occupancy rate of

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[172] J. Greene, "Post 9/11 Federal Disaster Funds, where did the $7 Billion Trickle Down?" *News and Perspectives, Annals of Emergency Medicine* 52, no. 3 (September 2008): 264.

[173] Kenneth Raske, "Hospital Preparedness and Public Health Infrastructure Funding," *Greater NY Hospital Association Bulletin* (July 3, 2003): 2-3.

85%. One-quarter of the time, the state in-patient census is over 90%. About 75% of the time, bed availability decreased below the federal standard of 500 unoccupied beds available per million residents in the event of a mass casualty event.[174]

An editorial[175] accompanying the DeLia article takes the question beyond beds and asks whether one could get what is really needed i.e., personnel, treatment space, operating rooms, sophisticated equipment and supplies.

A study in Maryland shows that entire state total available surge capacity would be 1299 beds in the fourth quarter of 1998. This statistic includes a 20% increase above the average daily census of acute care hospitals. Most hospitals are not trauma receiving hospitals. The estimated ambulance capacity was 246 ambulances as of March 1999. This number is for a population of 5,219,125 (projected for 2000 by the Maryland Office of Planning.)[176] This study determined that there was no hospital ED in Maryland or any grouping of hospitals that could handle a Mass Casualty Incident with a patient casualty surge in the hundreds. Most hospitals would try to go on diversion with a relatively small surge expanding the stress on other facilities.[177] Diversion may be unrealistic in a disaster. As of 2000 when the State of Maryland released its "Strategic Plan to Improve the Health and Medical Response to Bioterrorism," the authors conclude that no Emergency Department in Maryland had the available surge capacity to handle a Mass Casualty Incident involving hundreds of victims.[178]

The U.S. House of Representatives Chairman of the Committee on Oversight and Governmental Reform, Rep. Henry A. Waxman, held a hearing on "The Lack of Hospital Emergency Surge Capacity" and the impact of Medicaid Regulations on surge capacity on May 5 and 6, 2008. He concluded that the emergency care systems

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[174] C. W. DeLia, "Annual Bed Statistics Give a Misleading Picture of Hospital Surge Capacity," *Annals of Emergency Medicine* 48 (2006): 384-388.

[175] Michael Schull, MD, "Hospital Surge Capacity: If You can't Always Get What You Want, can You Get What You Need?" Editorial, *Ann Emerg Med* 48, no. 4 (2006): 389.

[176] Robert Bass, and Georges Benjamin, "The Maryland Strategic Plan to Improve the Health and Medical Response to Terrorism," *Maryland Institute for Emergency Medical Services Systems (MIEMSS) and Maryland Department of Health & Mental Hygiene* (February 23, 2000): 11.

[177] Ibid., 31-33.

[178] Ibid., 33.

were stretched to the breaking point and had no capacity to respond to a surge of victims.[179] In preparation for the hearing, the committee staffers conducted a one-point-in-time survey on Tuesday, March 25, 2008 at 4:30 PM. The result is a paper, "Hospital Emergency Surge Capacity: Not Ready for the "Predictable Surprise." Surveyors contacted 34 Level I Trauma Centers in seven cities—New York City, Los Angeles, Denver, Washington, DC, Houston, Chicago and Minneapolis. They found that three of the five Level I Trauma Centers in Los Angeles were on diversion. Los Angeles and Washington DC had no available space in their EDs and patients were being treated in hallways and waiting rooms. One facility in Washington was operating at 286% capacity. In NYC, the site of previous terror attacks, ten of the 16 trauma centers surveyed had no available treatment spaces in their EDs. The other six facilities had a total of 56 available spaces. On the day of the Madrid bombing, 966 casualties were taken to hospitals, more than eight times the total number of standard treatment spaces available in all 34 surveyed Level I trauma centers in seven cities. Fifty-nine percent of the 34 centers were operating over capacity and the average ED was operating at 115% capacity. None of the hospitals had enough critical care beds to handle a Madrid-like event. In Madrid, 29 patients arriving at one hospital required ICU care. On average, the trauma centers had only five intensive care beds available and six hospitals (18%) had no available ICU beds. None of the Level I centers surveyed had sufficient inpatient bed capacity to absorb casualties from a Madrid-like event. In Madrid, one hospital received 89 patients requiring admission. No Level I Trauma center had this bed availability. On average the Level I trauma centers had only 24 beds available.[180] While beds are not the sole limiting factor for response for a disaster, hospitals staff for the usual volume and staff would be stretched thin for this excess volume. The time to move these patients out of the ED to

[179] Congress of the United States, House of Representatives, Committee on Oversight and Government Reform, Henry A, Waxman, Chairman, Opening Statement, "The Lack of Hospital Emergency Surge Capacity; Will the Administration's Medicaid Regulations Make It Worse?" May 5, 2008, http://oversight.house.gov/story.asp?ID=1931 (accessed October 5, 2008), 2.

[180] Congress of the United States, House of Representatives, Committee on Oversight and Government Reform, A. Henry Waxman, Chairman, Report prepared for Chairman, "Hospital Emergency Surge Capacity: Not Ready for the "Predictable Surprise,"" 3-4.

prepare for the sudden influx of victims when the pre-event volume is so high and the inpatient and ICU beds are so limited portends a major bottleneck. Having trained staff to absorb this volume is crucial.

- Conclusion on Current Healthcare State

Emergency Medicine Physicians have concerns that if a mass casualty event happens, they will be rapidly overwhelmed. Many are overwhelmed on a daily basis. Study group reports on surge illustrate no consensus on improving surge capability. Some talk of needing more beds. Some talk of clinician responses from afar; some cannot get past hospital financial constraints to preparedness. While some agencies understand part of the challenge, they still come up short on the solution.

Increased efforts are needed at the highest level of medicine to establish and promulgate a baseline set of knowledge and competencies complemented with discipline and specialty specific targeted training modules. Jerome Hauer, the former Acting Assistant Secretary of Public Health Emergency Preparedness at DHHS, testifying before Congress concluded, "At the end of the day, it is medical care that will be needed."[181]

6. Healthcare Participation-What Has Been Done to Date

The Centers for Disease Control and Prevention (CDC), is a division of the Department of Health and Human Services. One of its top strategic imperatives is to build a competent and sustainable public health workforce that can respond to bioterrorism events or other public health emergencies. They aim to improve education and training in a three-pronged attack. They have mandated education and training at the state and local level through the Division of State and Local Readiness (DSLR). They have entered into partnerships with agencies to disseminate information through the

[181] "Health Care at the Crossroads, Strategies for Creating and Sustaining Community-wide Emergency Preparedness Systems," *Joint Commission on the Accreditation of HealthCare Organizations* (2003): 4.

Centers for Public Health Preparedness Program (CPHP). Finally, they have their own direct providers of education and training within their Office of Terrorism Preparedness and Emergency Preparedness.[182]

The CDC has established cooperative agreements on Public Health Preparedness and Response for Bioterrorism at the state and local levels. Grants have been funded to conduct needs assessment, to develop training plans, and to maintain data on who has been trained.

The CDC has also partnered with the Center for Public Health Preparedness (CPHP), including 23 schools of Public Health, 13 specialty centers including Schools of Medicine, Nursing, Veterinary Medicine, and independent laboratories to identify community needs and strategize for solutions. The CPHP is part of a national system of Academic Centers for Public Health Preparedness created by the CDC. It is a unique partnership between public health, medical and dental schools and state and local health departments. Its mission is to prepare and strengthen frontline public health, health professionals and first responders. The Center for Public Health Preparedness (CPHP) has taken leadership in addressing the complex public health threats posed by terrorism. It designs and implements bioterrorism response programs for its diverse public health partners and conducts competency based training of the public health workforce. The Center for Public Health Preparedness aims to facilitate faculty development by establishing month long faculty-in-residence programs that allow faculty to observe and study at institutions with a robust WMD curriculum.[183] It seeks to establish year-long fellowship programs in WMD preparedness and response for faculty. It offers a free emergency preparedness and response National Public Health Preparedness Referral Center to match preparedness needs of state and local health agencies and national

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[182] U.S. Department of Health & Human Services, Centers for Disease Control, Coordinating Office for Terrorism Preparedness and Emergency Response, http://www.cdc.gov/about/organization/cotper.htm (accessed April 13, 2008).

[183] "Practical Implications, Approaches, Opportunities and Challenges of a Preparedness Core Curricula in Accredited Schools of Public Health," September 2008, http://www.asph.org/UserFiles/finalcorecurriculawhitepaper1.pdf (accessed March 7, 2009), 3.

organizations and available expertise, trainings and other services.[184] It has received grant funding to measure medical response preparedness. It does not define who will respond.[185] Despite all of this apparent activity, most hospitals and clinicians have not heard of this center.

Additionally, the CDC has established relationships with the Association of American Medical Colleges (AAMC) and eight of the 30 medical specialty societies.[186] They are working collaboratively to develop relevant information for the 300,000 clinicians and health care professionals who are represented by these organizations. In April 2003, Jordan Cohen, MD, President of the Association of American Medical Colleges (AAMC), testified before Congress that 23 of the 126 medical schools had identifiable courses or sessions directly related to the potential effects of biological, chemical or radiological agents. This number had increased from 10 schools just two years before.[187] This increase seems underwhelming in light of the events of 9/11 more than 18 months before. The cause of the slow response is open to speculation. Curriculum changes and development are slow, faculty may not be available, the expanding body of medical knowledge is difficult to compress into four years. Perhaps there is myopia when evaluating how a particular specialty can contribute to preparedness for a variety of reasons. For example, the Uniformed Services University Health School offered 28 hours

[184] Centers for Public Health Preparedness, http://emergency.cdc.gov/training/cphp/network_activities.asp (accessed May 11, 2008), 1.

[185] Columbia University Mailman School of Public Health, *Snapshot 2005: Where the American Public Stands on Terrorism and Preparedness Four Years after September 11, Confusion, Loss of Confidence and Unmet Challenge* (New York: Columbia University Press, 2005); Irwin Redlener, *The 2005 Annual Survey of the American Public by the National Center for Domestic Preparedness* (New York: Columbia University Press, 2005), 6.

[186] Department of Health and Human Services, Agency for Healthcare Research and Quality, Bioterrorism and Health System Preparedness Issue Brief, "Surge Capacity-Education and Training for a Qualified Workforce," *AHRQ* Pub No, 04-P028, October 2004, 2.

[187] J. Cohen, Development of Medical Education Programs to Respond to Biological, Chemical and Radiological Threats, Testimony before the Committee on Veteran's Affairs, Subcommittee on Oversight and Investigations, United States House of Representatives, April 10, 2003, 2.

of training in 2003 for its medical students over four years.[188] The Medical College of Ohio offered an eight-hour Basic Anti-Terrorism Emergency Life saving skills course for their students.[189]

In its Health Systems Preparedness writings, the National Center for Disaster Preparedness (NCDP) at the Mailman School of Public Health, Columbia University reports that in order to bolster the medical and public health preparedness of the nation's healthcare delivery systems, clinicians and health professionals need to be trained to function across their traditional professional roles. To promote a multi-disciplinary approach to the medical management of a disaster or public health emergency, NCDP is working to ensure that core topics related to disaster preparedness including bioterrorism become an integral part of the basic and continuing education of all health care professionals. The initiative includes the HRSA Bioterrorism Training and Curriculum Development Program (BTCDP). NCDP is reviewing the graduate health curricula at each Columbia University School, including the College of Physicians and Surgeons, the Mailman School of Public Health, and the Schools of Dentistry and Nursing. They are creating disaster-related content and competencies that are essential for all graduating health care professionals. Future anticipated training includes distance-based learning, online interactive simulations and creation of a clinical hands-on learning lab for clinical and public health students.[190]

Besides the CDC, other agencies of DHHS such as Agency for Healthcare Research and Quality (AHRQ) and HRSA are involved in preparedness and response as well.

The Agency for Healthcare Research and Quality (AHRQ), the measurement arm of the Department of Health and Human Services (DHHS), is the lead federal agency

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[188] Association of American Medical Colleges, Training Future Physicians about Weapons of Mass Destruction: Report of the Expert Panel on Bioterrorism Education for Medical Students, Funded by a grant U36/CCU 319276 through cooperation with the Centers for Disease Control and Prevention, U.S. DHHS, 2003, 9.

[189] Ibid., 9-10.

[190] Health System Preparedness, The National Center for Disaster Preparedness, http://www.ncdmailman.columbia.edu/print_health.htm (accessed May 19, 2007).

charged with supporting research designed to improve the quality of health care, reduce its cost, address patient safety and medical errors and broaden access to essential services. It is charged with preparing models and promoting practices including competency based drills that enhance the national, state and local preparedness through the development and assessment of alternative measures that ensure health surge capacity for mass casualty events. AHRQ has outlined four strategic objectives, which fit into the DHHS department-wide strategic plan for bioterrorism and public health emergency preparedness. These strategic objectives are to develop and assess (1) alternative approaches to ensuring healthcare surge capacity; (2) models that address training and information needs; (3) alternative uses of information technology and electronic communication networks; (4) protocols and technologies to enhance interoperability among healthcare systems.[191]

The Health Resources and Services Administration (HRSA), also an agency of DHHS, has developed a National Bioterrorism Hospital Preparedness Program, NBHPP. This program readies hospitals and supporting health care systems to deliver coordinated and effective care to victims of terrorism and other public health emergencies. Through a grants process, hospitals determine the training with strong emphasis on competency-based training rather than content. Progress has been slow for a variety of reasons.

States have been encouraged to develop initiatives and imperatives to improve healthcare preparedness that engage practitioners, hospitals and all stakeholders using federally supported grants and local monies. The Maryland Strategic Plan examines the current response and preparedness. It defines some strategic priorities that include improving awareness within the health and medical community with regard to terrorism and the potential impacts of explosives chemical, biological and radiological agents; improving surveillance; improving the response to all Mass Casualty Incidents by building on the response capability and improving coordination along the continuum of care from EMS, Public Health, Office of Emergency Management, law enforcement and public safety and health and medical resources in preparation for a WMD event; and

[191] Sally Phillips, "Current Status of Surge Research," *Academic Emergency Medicine* 13, no. 11 (November 2006): 1103.

improving coordination to assure adequate levels of preparation and readiness for an incident.[192] They establish priorities for investment of time, money and energies and identify a process of engagement of stakeholders to assure that priority goals are achieved. They improve existing Mass Casualty Disaster Plans to handle a WMD Mass casualty event numbering in the hundreds of victims and a WMD Catastrophic Mass Casualty Incident at the 1000 live victim level.[193] It concludes that awareness and education of health and medical communities are essential if improved preparedness, knowledge and response are to be achieved. A new understanding of terrorism, its weapons, its motivations, strategies, implications are necessary to develop responsible, measured and effective plans and responses.[194]

7. Importance of Problem for Homeland Security

A terrorist attack in the United States would be one example of a "predictable surprise" as characterized by Bazerman and Watkins. A characteristic of predictable surprises is that leaders know a problem or threat exists and that the problem will not solve itself. Resolving the problem would incur significant costs in the present, while the benefits of action would be delayed and ambiguous. Limited resources and pressure for near term results challenge the leader in view of competing needs. The natural tendency is to maintain the status quo. Some may actually benefit from inaction and will be motivated to subvert the actions of leaders. Leaders can expect little credit for prevention of predictable surprises.[195]

While relying on traditional disaster management and trauma life support training is far easier and less expensive than learning and practicing new skills, planners cannot

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[192] Robert Bass, and Georges C. Benjamin, "The Maryland Strategic Plan to Improve the Health and Medical Response to Terrorism," *Maryland Institute for Emergency Medical Services Systems (MIEMSS) and Maryland Department of Health & Mental Hygiene* (February 23, 2000): 35.

[193] Ibid., 36.

[194] Ibid., 5.

[195] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, Atlanta Georgia, "in A Moment's Notice: Surge Capacity for Terrorist Bombings," (April 2007): 5.

assume that we can provide the usual standard of care for large numbers of victims from terrorist bombings as we do for victims of a smaller multi-casualty event.[196] Successful models have been developed from the military in Iraq and the Israeli experience.[197]

Concerning improving surge and preparedness, many disciplines and agencies have opinions and goals, but a long road still stretches ahead to achieve preparedness. The progress to develop a model for healthcare that increases the number of clinicians available for surge capability for a WMD catastrophic mass casualty event is exquisitely slow due to competing interests, differing priorities, limited resources and, most importantly, lack of vision and clear, mutually agreed upon goals. Information from military and international colleagues shows that we cannot just provide more of the same.

A strategy that aligns the goals and objectives of all who are charged with protecting the health of people with the realities of healthcare capabilities requires stakeholders to zoom out and take a look at the problem from the 40,000 foot level. The executive level and the ground level are far apart and the public is in the middle, expressing their lack of confidence and at risk.

B. ALTERNATIVE SOLUTIONS STEMMING FROM THE EXPERIENCE OF OTHER COUNTRIES AND THE UNITED STATES MILITARY

1. Learning from Others

From 2001 to 2003, more than 500 international terrorist bombings caused more than 4600 deaths. In 2005 alone, according to the Terrorist Attack Archives Terrorism Research center, there were 741 terrorist events in 45 countries and more than half were

[196] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 6.

[197] S. Einav, Z. Feigenberg, C. Weissman, D. Zolchik, G. Caspi, D. Kotler, and H. Feund, "Evacuation Priorities in Multi-casualty Terror RelatedEvents, Implication for Contingency Planning," *Annals of Surgery* 239, no. 3 (March 2004): 304-310.

bombings. There were 8015 victims resulting in 3049 deaths. September 11 was an example of flying bombs that killed over 3000 victims.[198] The threat continues.

Experience in other countries gives a glimpse of what U.S. healthcare can expect should there be more on-shore terrorist attacks. Experience from other countries has shown that other constructs in the delivery of trauma care have produced consistent or improved outcomes. This knowledge can provide a basis on which to plan and train for these new realities and to incorporate lessons learned and best practices in our plans.

New practice models need to challenge traditional trauma teaching and integrate newer methodologies to address newer threats. As the U.S. healthcare industry develops its plans, it would be wise to study and consider the operational aspects of other systems and review the clinical results in an effort to improve patient outcomes. It is a misconception that disaster management is just managing more patients in the usual way. We have learned from experiences of the U.S. and Israeli military and international colleagues in London and Madrid that clinical management of casualties from terrorist bombings differs considerably from that seen daily in trauma centers.[199] Successful models have developed from the U.S. military in Iraq and the Israeli experience.[200] Tokyo gave us a glimpse of chemical events with secondary casualties in EMS and hospital workers.[201]

a. Israel

Israel has had a long, violent history during its existence. The response to that violence gives the U.S. a preview of what healthcare should expect in the future. Particularly interesting is their real world experience with the limited pre-hospital control

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[198] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 8.

[199] Ibid., 18.

[200] S. Einav, Z. Feigenberg, C. Weissman, D. Zolchik, G. Caspi, D. Kotler, and H. Feund, "Evacuation Priorities in Multi-casualty Terror Related Events, Implication for Contingency Planning," *Annals of Surgery* 239, no. 3 (March 2004): 304-310.

[201] T. Okumura, and K. Suzuki et al., "The Tokyo Subway Sarin Attack: Disaster Management, Part 2: Hospital Response," *Academic Emergency Medicine* 5, no. 6 (June 1998): 618-624.

of the distribution of patients resulting in the participation of all hospitals in the response effort; their military experience with implementation of the evacuation hospital concept; their commitment of personnel; their evaluation of triage; and their clinical findings.

In Israel, preparedness is ensured by central governance. It is recommended that all hospitals achieve an appropriate degree of surgical capability, be well-disciplined in trauma care and that all personnel (medical, nursing, and ancillary) participate in periodic training programs and hospital drills.

The Israeli experience traditionally adheres to Pre Hospital Trauma Life Support and Advanced Trauma Life Support guidelines, which deal with the single patient. Israel has a system that tightly integrates the EMS system, hospitals, civilian and military agencies at the state level. In the recent terror related mass casualty incidents, Einav and colleagues determine that during recent bombings the integration came undone. The Emergency Medical Service in Israel (MDA) is a nationwide network with a central command allowing for a coordinated, centralized on-scene organization. The choice of hospital is made by the most senior medical personnel accompanying the victim in consultation with central control. In this study, the tremendous speed with which the Israeli EMS system responded to an urban mass casualty event virtually precluded central control of the EMS response. By the time the system was activated in several bombings, all casualties had already been transported to hospitals. Consequently, many wounded patients ended up in hospitals that routinely see little or no trauma but were close to the bombing site.[202] Hirshberg, in an editorial accompanying a series of disaster response articles in the Annals of Surgery, concludes, "The lesson is clear: if a hospital happens to be located in proximity of a Mass Casualty Event, lack of trauma designation or experience will not shield it from incoming casualties."[203]

All Israeli EDs are required to prepare for casualties numbering 15-20% of the total number of beds in their hospital. In a study by Einav, a review of mass casualty

[202] S. Einav, Z. Feigenberg, C. Weissman, D. Zolchik, G. Caspi, D. Kotler, and H. Feund, "Evacuation Priorities in Multi-casualty Terror Related Events, Implication for Contingency Planning," *Annals of Surgery* 239, no. 3 (March 2004): 306.

[203] A. Hirshberg, MD, "Multiple-casualty Incidents Lessons from the Front Line," Editorial, *Annals of Surgery* 239, no. 3 (March 2004): 322.

events yields data on casualties from September 2000 to September 2002. In the 33 incidents, 230 died at the scene and a total of 1156 injured were evacuated to hospitals, providing a dead to wounded ratio of 1:5. This number corresponds to the ratio typical for military combat in conventional wars.[204] Trauma victims were taken to hospitals near mass casualty events whether the hospitals were designated as trauma facilities or not. In large urban areas with rapid access to trauma centers, only 48% of urgent/emergent victims went to trauma centers. The numbers were 9% and 34% respectively for urban and rural areas. The remaining victims went to local hospitals. Twenty-seven patients who were taken to local hospitals were then transferred to trauma centers within two hours of the event. Thus, the author concludes that all hospitals should be included in contingency planning for mass casualty events.[205]

In the Israel emergency response, the concept of "minimally acceptable care" is applied in the initial phase until all patients have arrived at the hospital and have been preliminarily screened and initially stabilized.[206] At this point, the determination of the total scope of the hospital challenge will be known and resources can be assigned appropriately. There were 315 mass casualty events in Israel that utilized minimal acceptable care, yet it has never been formally adopted by civilian hospitals for a mass casualty event. Currently, no guidelines exist as to what exactly constitutes minimally acceptable trauma care at a hospital during a mass casualty event.

An article by Almogy et al describes a large Israeli university teaching hospital coping with the consequences of a bombing incident. In Israel, all hospital staff demonstrates a total commitment to the Mass Casualty Event. Every hospital employee is

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[204] S. Einav, Z. Feigenberg, C. Weissman, D. Zaichik, G. Caspi, D. Kotler, and H. Freund, "Evacuation Priorities in Multi-casualty Terror-Related Events, Implication for Contingency Planning," *Annals of Surgery* 239, no. 3 (March 2004): 306.

[205] Ibid.

[206] K. Peleg, L. Aharonson-Daniel, M. Stein, M. Michaelson, Y. Kluger, D. Simon, Israeli Trauma Group, and E. Noji, "Gunshot and Explosion Injuries, Characteristics, Outcomes and Implications for Care of Terror-Related Injuries in Israel," *Annals of Surgery* 239, no. 3 (March 2004): 315.

mobilized for the hospital effort. They have pre-defined roles and regularly participate in disaster drills. Israeli medical students are trained and are part of the response efforts of their affiliated hospitals.[207]

Hirshberg claims that in North America despite 9/11, emergency preparedness is not engrained in hospital culture and remains the province of a select group of dedicated health care providers and administrators. The major obstacle in preparing for large scale or WMD is this institutional culture of selective participation, not the lack of sophisticated protective gear or decontamination equipment. He notes that such a posture will never be good enough for a large-scale event. He concludes that commitment, not technology, is the key to a robust emergency response.[208]

Hirshberg suggests that we should practice discrete event simulation.[209] Hirshberg encourages that discrete event simulation be used to study the emergency plans of a large university hospital. Plans can be analyzed and optimized based on a casualty profile from a real life urban terrorist bombing.[210] Handling a mass casualty event demands different organization of the hospital and response to prevent bottlenecks caused by scarce resources including personnel, radiology, ICU beds and operating rooms. [211] Physicians will be increasingly required to treat victims of mass casualty incidents requiring a broadening of their existing skills and knowledge of various mechanisms of injuries.[212]

Hirshberg suggests that emergency plans be made more relevant by designating a core of critical decision makers. While the ED is full of health care

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[207] G. Almogy, H. Belzberg, Y. Mintz, A. Pikarsky, G, Zamir, and A. I. Rivkind, "Suicide Bombing Attacks, Update and Modifications to the Protocol," *Annals of Surgery* 239, no. 3 (March 2004): 299.

[208] A. Hirshberg, MD, "Multiple-casualty Incidents Lessons from the Front Line, Editorial," *Annals of Surgery* 239, no. 3 (March 2004): 323.

[209] Ibid.

[210] A. Hirshberg, J. B. Holcomb, K. L. Mattox, "Hospital Trauma Care in Multiple-casualty Incidents: A Critical View," *Annals of Emergency Medicine* 37, no. 6 (June 2001): 650.

[211] K. Peleg, L. Aharonson-Daniel, M. Stein, M. Michaelson, Y. Kluger, D. Simon, Israeli Trauma Group, and E. Noji, "Gunshot and Explosion Injuries, Characteristics, Outcomes and Implications for Care of Terror-Related Injuries in Israel," *Annals of Surgery* 239, no. 3 (March 2004): 315.

[212] Ibid., 311.

providers, only 3-4 senior clinicians should be making decisions: the triage officer, surgeon-in-charge and the charge nurse. He says the North American experience trains providers where to go, not how to think and strategize especially when their decisions are crucial. He says the crux of a successful mass casualty event is to separate the severely ill but salvageable patients from those who need minimally acceptable care and can wait for definitive procedures.[213] This viewpoint supports the concept of evacuation hospitals.

While most studies describe injury patterns and casualty profiles, a few look at the quality of care, which can have serious implications for disaster planning in the United States. Effective triage contributes greatly to the success of a mass casualty event resulting in quick pairings of patients in need and appropriate resources. Many authors emphasize the importance of triage by an experienced trauma surgeon. Mis-triage presents its own set of problems, including misappropriation of scarce resources and patient death. A study of terrorist bombings in Israel reports that as many as 53% of the severely injured victims were under-triaged by experienced trauma surgeons.[214] In a review article by Frykberg and Tepas of 220 incidents worldwide, the authors conclude that 59% of the patients were over-triaged.[215] Over-triage is considered by some to be merely an administrative problem. Yet the inundation of hospitals with large numbers of non-critical casualties may very well interfere with the capability of limited medical resources. In fact, the authors use linear regression to show a direct linear relationship between over-triage and increased mortality.[216]

Either way, any mis-triage complicates the ED response and negatively impacts the care of the patient by the misallocation of scarce resources including clinicians and space. Assets may be wasted on the wrong patients and may be exhausted by the time a real patient in need presents.

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[213] A. Hirshberg, MD, "Multiple-casualty Incidents Lessons from the Front Line, Editorial," *Annals of Surgery* 239, no. 3 (March 2004): 322-324.

[214] I. Ashkenazi, B. Kessel, T. Khashan, J. Haspel, M. Oren, O. Olsha, R. Alfici, "Precision of in-Hospital Triage in Mass Casualty Incidents after Terror Attacks," *PreHospital and Disaster Medicine* 21, no. 1 (February 2006): 21.

[215] E. Frykberg, and J. Tepas, "Terrorist Bombings, Lessons Learned from Belfast to Beirut," *Annals of Surgery* (November 1988): 569.

[216] Ibid., 572.

Terrorist bombings bring with them a host of new clinical problems. The Israeli experience with civilian bombings provides a glimpse of what clinical challenges other nations, including the United States, may face. Authorities can use each event or attack to prepare for the different clinical outcomes.

Israel has 23 Trauma Centers of which six are major Level I trauma centers. Clinical data obtained from the review of the Israeli trauma registry data from 2000 to 2002 reveals 1033 victims of penetrating injury, of which 60.3% were victims of explosions and 62% of those explosive victims had injuries to multiple body regions. Of all the explosion victims, 9.1% had an Injury Severity Score greater than 16, which is associated with severe injury, and an additional 17.3% had Injury Severity Scores (ISS) greater than 25. Patients with an ISS greater than 16 rose to 63%, and those with an ISS greater than 25 rose to 46.4% respectively if the patient had internal injuries which would be more likely with closed space explosions or secondary injuries. Forty-six percent of the explosive victims underwent surgery. Of the explosive victims, 53.6% required ICU care and 14.9% of those with internal injuries died. All 5.3% of explosive victims died after hospitalization. Of these, 58% died within one day of the explosion.[217] This data has tremendous implications for planning because U.S. physicians will use the lessons learned to guide patient assessment and management. The significant experience will also guide staffing arrangements.

Another author reviewed several real Israeli scenarios. In one closed space event with 52 injured survivors, 42% of the patients were intubated and 19% received chest tube thoracostomies. In an open-air attack with 190 survivors, only 7% were intubated and only 3% received a chest tube thoracostomy.[218] Those findings are in comparison to the Oklahoma City bombing with its structural collapse where only 2% of 388 survivors sent to 13 EDs underwent endotracheal intubation; one received a surgical

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[217] K. Peleg, L. Aharonson-Daniel, M. Stein, M. Michaelson, Y. Kluger, D. Simon, Israeli Trauma Group, and E. Noji, "Gunshot and Explosion Injuries, Characteristics, Outcomes and Implications for Care of Terror-Related Injuries in Israel," *Annals of Surgery* 239, no. 3 (March 2004): 315.

[218] Ralph G. DePalma, MD, David G. Burris, MD, Howard R. Champion, FRCS, and Michael J, Hodgson, MD, MPH, "Blast Injuries," *New England Journal of Medicine* 352, no. 13 (2005): 1335-1342.

airway; and 1% received a chest tube thoracostomy.[219] A major trauma center may not be overly taxed with an average of six intubations and three chest thoracostomies as suggested by the Oklahoma data, but patients are not distributed equitably and many community or rural hospitals would be challenged to provide that level of care in a short time span. Therefore, an attack that targets the individual instead of the infrastructure, whether in an enclosed or open environment, can have a noticeably different medical needs profile.

The challenges posed by terror-induced mass casualty events require consideration of a major reorganization of trauma care from the trauma center concept to preparing all hospitals to be the evaluation/evacuation hospital. Research on the implications of evacuating the most severely injured victims to the nearest hospital is needed. However, real experience in Israel and Iraq support the concept. The evacuation hospital concept has emerged from accumulated experience of Israeli Defense Force Medical Corps during combat and has been highly successful in the American Military experience in Iraq as well. In this model, a Front Line Medical Facility performs primary triage and resuscitation and prompt life and limb saving surgery. Victims are later evacuated to appropriate civilian medical centers. Evacuation of the critically injured to the nearest hospital is predicated on that facility possessing the means to deal with such a situation. Military experience in the 1973 War in Sinai Peninsula and the 1982 conflict in Lebanon suggested that civilians should follow this model. Initial civilian implementation of this study in Israel began in the early 1990's with a wave of terrorist bombings against public transportation buses as suicide bombings or automatic weapons fired into crowds became more frequent and occurred on a large scale. Scoop and run to an evacuation hospital became the model. Bi-directional secondary wave coordination followed.[220] The

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[219] P. Halpern, MD, M-C. Tsai, MD, MPH, J. L. Arnold, MD, E. Stok, MD, and G. Ersoy, MD, "Mass Casualty, Terrorist Bombings:Implications for Emergency Department and Hospital Emergency Response (Part II)," *Prehospital and Disaster Medicine* 18, no. 3 (July-September 2003): 237.

[220] S. Einav, Z. Feigenberg, C. Weissman, D. Zaichik, G. Caspi, D. Kotler, and H. Freund, "Evacuation Priorities in Multi-casualty Terror-Related Events, Implication for Contingency Planning," *Annals of Surgery* 239, no. 3 (March 2004): 308-309.

Surgeons of the International Committee of the Red Cross triage according to immediate or delayed operative intervention, also supporting the concept of the evacuation hospital.[221]

In an editorial in the Annals of Surgery, Frykberg states, it is "…past time that we begin taking to heart the critical need to learn the basic principles of mass casualty management from terrorist disasters from decades of published experiences. We must develop the necessary expertise that we now tend to lack in the history of explosive injury and the unique principles of mass casualty management that are so different from our routine approaches to trauma."[222]

Mass casualty disasters require a major paradigm change from our routine approach to ED care. We have the opportunity to review the experiences of those unfortunate enough to have experience with terrorist events and open a dialogue that will allow the United States to review and decide how best to respond to these events when so much is out of our control.

b. European and Other Experience

Explosive devices and high velocity firearms are the terrorists' weapons of choice. Bombings and shootings are the most common forms of terrorist violence and the easiest and least costly methods of achieving the terrorist goals of large scale casualties. This reality explains why surgeons and other acute care trauma specialists must be integrally involved as leaders in the field of disaster management and in local hospital and community disaster planning.[223]

Devastation in two European capitals demonstrates the impact of detonating explosives among densely packed civilians. Terrorist weapons can wreak havoc, producing numerous casualties with complex, technically challenging injuries.

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[221] A. Hirshberg, J. B. Holcomb, K. L. Mattox, "Hospital Trauma Care in Multiple-casualty Incidents: A Critical View," *Annals of Emergency Medicine* 37, no. 6 (June 2001): 648.

[222] E. Frykberg, "Editorial Principles of Multi-casualty Incident Management following Terrorist Disasters," *Annals of Surgery* 239, no. 3 (March 2004): 320.

[223] Ibid., 319-321.

Hospitals can expect to receive a large influx of surge of victims after a terrorist attack. The rapid surge of victims typically occurs over minutes, reaching a peak and then decreasing over a few hours.[224]

In the Madrid 2004 and London 2005 bombings, many patients self-evacuated from the scene. Analysis of the response to the Madrid subway bombings in March 2004 provides a real life scenario of what U.S. hospitals and physicians must prepare to handle. The ten bombs killed 177 people and injured more than 2000, with over 300 going to the nearest hospital. Of those victims, 272 arrived in the first 2.5 hours creating a massive surge.[225] The others were distributed to 15 public community hospitals.[226] The multiple logistical and operational challenges included field triage and transportation of injured persons from the scene of the event; hospital discharge of inpatients where possible; transfer of the current ED and ICU patients to prepare for arrival of victims; and facilitation of multiple surgical procedures and tests, including hundreds of radiographs, CTs and ultrasounds.[227]

The experience in Istanbul, Turkey in November 2003 with two truck bombings of city synagogues[228] resulted in 30 deaths and 300 survivors who were reportedly maldistributed to 16 medical facilities. Thirteen percent of the survivors were admitted. Five days later, simultaneous bombings in Istanbul at the British Consulate and Hong Kong Shanghai Bank Corporation (HSBC) headquarters resulted in 33 deaths and an estimated 450 injured, leading to 15% admissions.[229] In both events, the authors posit that the maldistribution to 16 hospitals was a function of proximity to the bombing site, the type of medical facility (government versus private) and the personal preference of

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[224] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 1.

[225] Ibid.

[226] Ibid., 5.

[227] Ibid.

[228] U. Rodoplu, J. L. Arnold, R. Tokyay, G. Ersoy, S. Cetiner, and T. Yucel, "Mass Casualty Terrorist Bombings in Istanbul, Turkey," *Prehospital and Disaster Medicine* 19, no. 2 (April-June 2004): 133-45.

[229] Ibid., 137.

survivors. However, EMS experienced difficulty coordinating the scene, resulting in little field triage and communication with the hospitals. The police lacked control at the scene.

A March 2004 bombing of a religious procession in Quetta, Pakistan, attacked in three phases. Three hand grenades were thrown into the crowd, followed by automatic rifle fire on the crowd, followed by suicide by explosion by all the attackers. The mass casualty event involved 161 casualties taken to one hospital, including 20 dead on arrival. Priority I cases accounted for 22.7% of the total. Priority II cases accounted for 14.72%, Priority III accounted for 50.31% and Priority IV accounted for 12.27%. Four percent died after initial hospital survival. The maximum number of cases had arrived by two hours. The response involved 31 doctors and 135 paramedical staff. One hundred forty-five surgical procedures were performed within two days.[230] This example provides evidence for rural U.S. hospitals that are the only resource in town and supports the concept of evacuation hospitals.

c. The U.S. Military Experience

Military literature abounds with articles praising as well as criticizing the logistics of surge capacity in the theater of combat from the Civil War, through Vietnam to Iraq. Push packs of supplies and mobile hospitals are all part of their current surge plan.[231] More recent experiences in other countries, both in the civilian and military sectors, have given evidence to potential strategies to improve U.S. hospital preparedness and response. The U.S. military in Iraq has successfully demonstrated concepts in surgical surge capacity management that should be assessed for adoption by civilian medicine. Several aspects of current military experience should be of particular interest to the civilian U.S. medical community as they analyze and strive to improve their ability to provide a successful response. They include the concept of the Forward Resuscitative Surgical Systems, with its reported improved outcomes, as well as the ongoing training of

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[230] Z. U. Malik, M. S.Hanif, M. Tariq, R. Aslam, A. J. Munir, H. Zaidi, and M. Akmal, "Mass Casualty Management after a Suicide Terrorist Attack on a Religious Process in Quetta, Pakistan," *Journal of College of Physicians and Surgeons of Pakistan* 16, no. 4 (2006): 253-256.

[231] R. Thomas, *Ensuring Good Medicine in Bad Places: Utilization of Forward Surgical Teams on the Battlefield* (Carlisle Barracks, PA: U.S. Army War College, 2006), 2.

teams who will be deployed together. The principles are universal and concepts can be abstracted by civilian medicine to meet surge capacity demands and improve disaster response.

The initial, dynamic combat phase of Operation Iraqi Freedom employed the Forward Resuscitative Surgical System (FRSS) in close proximity to the site of battle. The ability to provide stabilizing emergency surgery has shown that more patient lives can be saved through temporizing surgery and transfer than if the patient received time-consuming definitive surgery at the initial receiving hospital.[232] The initial experience of the U.S. Marine Corps FRSS during Operation Iraqi Freedom prevented delays in surgical intervention of USMC combat casualties with beneficial effects on patient outcomes.[233] Tactical surgical intervention consisted of selectively applied damage control or definitive trauma surgical procedures.[234] In a study of 90 combat casualties with 170 injuries requiring 149 procedures by six FRSS teams, the authors contend that at least eight critically injured soldiers survived as a result of the FRSS. They doubtfully would have survived the longer transport time to surgery in the older model. The killed-in-action (KIA) rate of 13.5% and Died of Wounds (DOW) rate of 0.8% compares favorably to 20% KIA for the wars in the 20th century and 8% DOW in World War I and 3% DOW in Vietnam. Additionally, the infection rate for patients with severe extremity injury including open fractures and amputation was 9%, which compares favorably to the 20-40% reported during the Vietnam War and the 1973 Arab-Israeli War.[235] While a small sample, this data provides support to the success of the concept of FRSS and suggests that there might be a small percentage of those who would have died in the past who could have been saved if they had received immediate, stabilizing treatment.

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[232] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Environmental Health and Injury Prevention, National Center for Injury Prevention and Control, "A Moment's Notice: Surge Capacity for Terrorist Bombings," Atlanta, Georgia, (April 2007): 12.

[233] L. W. Chambers, MD, P. Rhee,, MD, B. C. Baker, MD, and J. Perciballi, MD et al., "Initial Experience of U.S. Marine Corps Forward Resuscitative Surgical System during Operation Iraqi Freedom," *Arch Surg* 140 (January 2005): 26, www.archsurg.com (accessed May 3, 2007).

[234] Ibid.

[235] Ibid., 8.

For civilian medical agencies, the results support the concept of regional hospital preparation, whereby all hospitals prepare to do the initial resuscitation, stabilization and temporizing and life saving surgery. Then patients could be secondarily transferred to other more appropriate facilities for definitive surgery. In fact, this process happens daily when a trauma patient inadvertently arrives at a non-trauma facility. They are stabilized and transferred. This military model shows that the concept works and is advantageous in large-scale events.

Training military and the reserves in combat medicine is difficult in time of peace since most stateside military hospitals are not trauma facilities. At the outbreak of war, relatively few active duty military personnel are prepared for managing combat casualties. Reservists working in the civilian sector may have more recent trauma experience. The need to provide sources of qualified military medical corps personnel in times of conflict or natural disasters to meet surge demands is challenging. To offset this severe limitation in trauma exposure, FRSS teams train at the Navy Trauma Training Center at Los Angeles County Medical Center. FRSS members attend retraining every 1-2 years including an intensive 29-day inner-city experience and tactical combat casualty care instruction.[236] Frequent and extensive refresher courses and simulations retrain and update military professionals and active-duty and reserve surgeons in the care of injured. Military clinicians are deployed to civilian trauma centers for experience and retraining. Similar rotations for the Army at Brooke Army Medical Center in San Antonio and the Air Force at Maryland Institute for Emergency Medical Services in Baltimore train both active-duty military, reserves and pre-assembled trauma teams. The military has also expanded forward shock and resuscitation training to include the use of PAs and nurses.[237]

The military has identified the need for immediately available appropriately trained clinicians. The military has called for a Joint Training requirement to be established across the services so that all medical personnel can carry out any

[236] Ben Eiseman, MD, and James G. Chandler, MD, "Military Medical Surge Capacity in Times of War and Natural Disaster," *Journal of Trauma, Injury, Infection and Critical Care* 60, no. 1 (January 2006): 238.

[237] Ibid., 237-239.

mission handed to them on any platform in DOD and in any location.[238] The blending of the services for integrated medical response is believed to be cost effective and necessary in this time of an all-volunteer service. One author states, "…the unique physical, toxicological, destructive and other properties of each type of CBRNE threat requires that operational and technological responses be tailored to the threat," and he defines medical readiness using the five Rs of readiness: having the right people with the right training in the right place at the right time with the right equipment and supplies. The author points out that the critical specialists that would be needed to treat injuries from a WMD attack are sorely lacking from current military medical units.[239]

C. ANALYSIS OF RELEVANT POLICY OPTION

The preparedness of the United States for time sensitive mass casualty scenarios such as explosive and chemical events requires an intensification of discussion and a strategy to align goals. The planners, the public, and the healthcare industry are planning along three skew lines, and they are not meeting the objective. Resources are expended but do not meet their intended goal to provide surge capability. The healthcare community must lead the discussion with the planners listening and trying to facilitate solutions to the roadblocks. The trauma experts, in consultation with the military, must build a response model for these events. Then the Boards of Medical Specialties, the AAMC, and the ACGME must take the lead to build a training model to prepare all physicians. Hospitals, together with their licensing and regulatory agencies, as well as DHS and DHHS, must integrate these trained physicians into a local response model. DHS and DHHS must address some of the critical issues facing physicians such as altered standards of care and liability coverage. DHS and DHHS should promote technological development of computer simulations to allow physicians to learn procedures as well as event simulation to practice how to respond and how to think about the response scenario.

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[238] Joseph DeFeo, *Joint Medical Readiness, Are We Ready to Answer the WMD Threat*? (U.S. Army War College: Carlisle Barracks, PA, March 2006), 2.

[239] Ibid., 7.

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III. RESEARCH METHODS AND RESULTS CHAPTER

A. RESEARCH METHODOLOGY

This research assesses the availability of physician resources in the immediate aftermath of a disaster and determines ways to improve hospital preparedness and the number of physician responders. To situate this research, preliminary interviews were conducted with one Emergency Department physician chairman, one physician trauma director and one hospital association professional working in the field of bioterrorism. Interviews focused on determining their perception of hospital preparedness and their thoughts on developing and implementing improved preparedness to understand what they believe are the best ways to improve preparedness. The interview questions include whether they believe strengthening preparedness can or should be done; where they would like to see the policy implementation for the program; what barriers to implementation they would predict both from within and from outside the medical community; whether participation should be voluntary or mandated; and whether to include all clinicians or some. All the respondents agreed that there is a need for improving immediate preparedness and that preparedness can and should be improved. However, the hospital association representative felt that preparedness efforts should not be required if it becomes another unfunded mandate for hospitals since hospitals already operate on thin margins.

Following these interviews, a survey was developed to explore the self-perceived readiness of physicians to respond to disasters. The survey is designed to determine whether additional physician resources (other than Emergency Department physicians who are present in limited numbers at any point in time or trauma surgeons who are present in a limited number of designated centers) are immediately available in a hospital to respond to an explosive or chemical event. The survey asks hospital physicians and physician assistants whose primary specialty is not Emergency Medicine or Trauma to assess their perception of their current preparedness to participate in an explosive or

chemical mass casualty event during the initial hour of response; to determine their willingness to prepare; and to understand the type of training they would need to prepare and assess perceived barriers to preparedness.

The research survey, titled "Strengthening Hospital Preparedness for Explosive and Chemical Mass Casualty Events," was presented to the Institutional Review Boards (IRBs) of two public hospitals, one urban and one suburban. Both are Level I Trauma Centers in the New York Metropolitan Area, and both IRBs approved the research.

Hospital A, is a 530-bed hospital, Level I Trauma Center located in a suburb of New York City. It is an academic affiliate of the State University of New York at Stony Brook School of Medicine.

Hospital B is a 342-bed acute care hospital, Level I Trauma Center located in New York City. It is an academic affiliate of the Weill Cornell School of Medicine in New York City.

These Level I Trauma Centers have large numbers of service patients cared for by physicians employed as faculty, rather than private physicians. Both hospitals have extensive graduate medical education residency training programs. At the time of the survey, Hospital A had 190 full-time attending physicians, 25 part-time Attending Physicians, 280 resident physicians and 25 Physician Assistants. Hospital B had 179 full-time attending physicians, 47 part-time attending physicians, 201 residents and 39 Physician Assistants.

During disaster drills, it has been apparent that most clinicians believe that disaster response is the responsibility of Emergency Department and trauma physicians. Yet the crash response during the 1990 Avianca Plane crash in Long Island, New York, proved that many other clinicians were willing and able to participate in hospital response. Emergency Department physicians know how quickly a surge event can overwhelm and would welcome additional manpower resources. The survey is developed around two scenarios with sensitive response times. It divides the response into finite, scenario-relevant skills that could be leveraged under supervision by an Emergency Department or trauma physician to multiply the number of patients who could be cared

for in a short time. It seeks to determine demographic differences in ability and willingness to help other hospitals estimate how many of their non-trauma physicians might be able to respond in a disaster. In addition, it explores the clinician's vision for how best to reach that level of preparedness and what incentives might encourage participation. Prior to distribution, several Emergency Department physicians, one surgeon and several nurses involved in domestic preparedness reviewed the survey.

After obtaining approval from the departmental Chairmen, research assistants distributed the survey to all attending physicians, resident physicians and fellows, as well as physician assistants, at both hospitals from April 2007 to June 2007. An introductory letter regarding the purpose of the study was provided. Most surveys were distributed during the beginning or end of conference time. The research assistants collected the surveys anonymously.

The clinicians surveyed represent the full spectrum of experience, from physicians in training to senior physicians, as well as many specialties including, but not limited to, General Surgery, Internal Medicine, Pediatrics, Anesthesiology, Plastic Surgery, Orthopedics, Ophthalmology, Psychiatry, Physical Medicine and Rehabilitation, Pathology, Obstetrics and Gynecology. The survey aimed to reach all physicians and physician assistants at both hospitals.

B. THE SURVEY

1. Design

The survey (attached) seeks demographic information including sex, practice specialty, board certification status, year of medical school graduation and whether the respondent ever received additional training in Life Support or CBRNE agents. Two scenarios are provided. One is an explosive event, and the other is a chemical event. To eliminate concerns about personal safety from the responses, there is no mention of a dirty bomb in the explosive scenario. The chemical scenario states that decontamination has been completed.

- The first scenario describes an explosive event. Questions were posed about the current qualifications and competencies of the respondent to work alongside Emergency Department and Trauma surgeons in two types of circumstances.
    - The survey first questions their ability to assess and stabilize victims with unstable vital signs or an unstable airway. For the unstable patient, the survey asks about the respondent's current ability to perform certain procedures such as manage an airway, intubate, manage resuscitation fluids, assess the need for blood products, transfuse packed red blood cells and control external hemorrhage.
    - Next, it questions their ability to assess and manage urgent but stable victims. For the stable but urgent patient, the survey asks whether the respondent can perform such potentially necessary skills such as triage, clean and dress a wound, repair simple lacerations, order and interpret x-rays and splint.
    - For those who indicate that they are not qualified and competent to care for the unstable or the stable victim, the survey asks the respondents if additional advanced training can help them learn to perform assessment and stabilization. The respondents are then questioned about what training they would require.
- The second scenario involves a chemical event. Two questions were posed about the current qualifications and competencies of the respondent to work alongside Emergency Department and Trauma surgeons in two types of circumstances.
    - The survey first queries the ability to assess and stabilize victims with unstable vital signs or an unstable airway. For the unstable patient, the survey asks about the current ability to perform certain procedures including the ability to manage an airway, intubate, and manage seizures.
    - Next, it questions their ability to assess and manage urgent but stable victims.
    - For those who indicate that they do not think they are qualified and competent to care for either the unstable or the stable victim, the survey asks if they thought that with additional advanced training, they could learn to perform assessment and stabilization. The respondents are then questioned about what training they would require.
    - Finally, the clinicians are asked whether they would be willing to respond to a request to assess and stabilize victims with unstable vital signs or unstable airway.

The scenarios are followed by a series of statements that the respondents are asked to rate on a 5-point Likert scale of "strongly agree," "agree," "neutral," "disagree" and "strongly disagree." They include four broad categories including the role of the clinician in a disaster, concerns or barriers to CBRNE training, voluntary or mandatory conditions of participation, and which entity should offer training.

The survey ends with a series of open-ended questions regarding training choices and barriers to participate in preparedness training.

2. Response Demographics

Four hundred twenty five (425) surveys were completed in total. Given the total number of 986 physicians and physician assistants at the two hospitals, the response rate is 43.10% for both hospitals combined. Hospital A returned 229 surveys out of 520 Physicians/PAs for a response rate of 44.03%. Hospital B had returned 196 out of 466 Physicians/PAs for a response rate of 42.06%. Some departments or chief residents were verbally contacted a second time if they had promised to collect the surveys and did not respond in a timely fashion.

Some physicians were observed throwing the blank survey out immediately, perhaps indicating that they did not see a role for themselves in response, did not have an interest or were too busy to complete it. Completion was higher in Departments where the Chairman or Department Head upon initial contact had indicated their willingness to have their department participate.

The respondents include 401 physicians and 24 Physician Assistants. Of the 401 who indicate that they are physicians, 179 (44.63%) are attending physicians and 222 (55.37%) are resident physicians. Two hundred sixteen of the 401 physicians (53.86%) are from Hospital A including 108 attendings and 108 residents. One hundred eighty-five of the 401 physicians (46.13%) are from Hospital B including 71 attendings and 114 residents. Thirteen and 11 Physician Assistants from each institution responded, respectively. Of the 422 who indicate their sex, 257 or 60.90% are male and 165 or 39.10% are female.

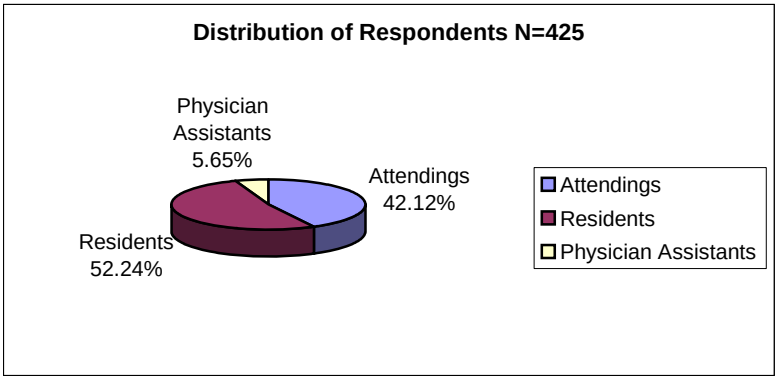

Figure 1. Distribution of Respondents

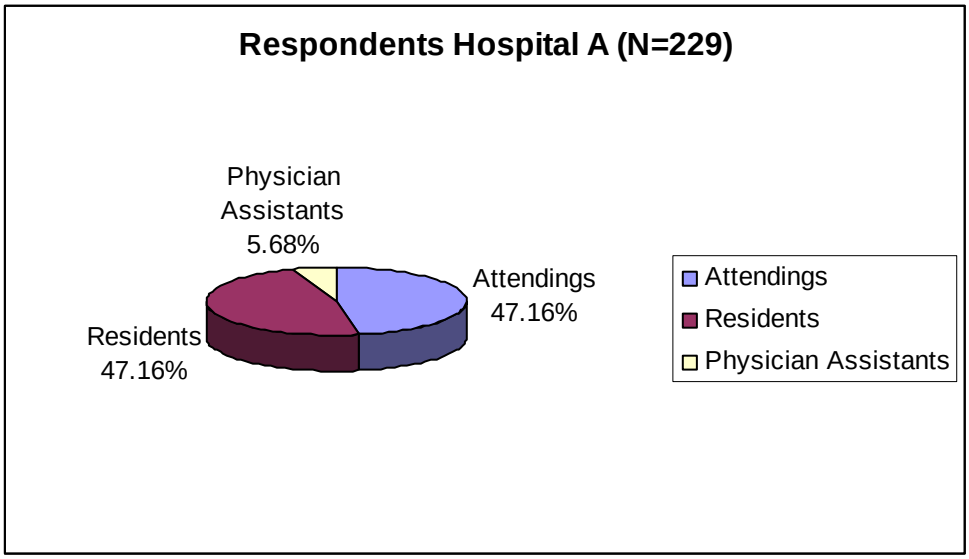

Figure 2. Respondents Hospital A

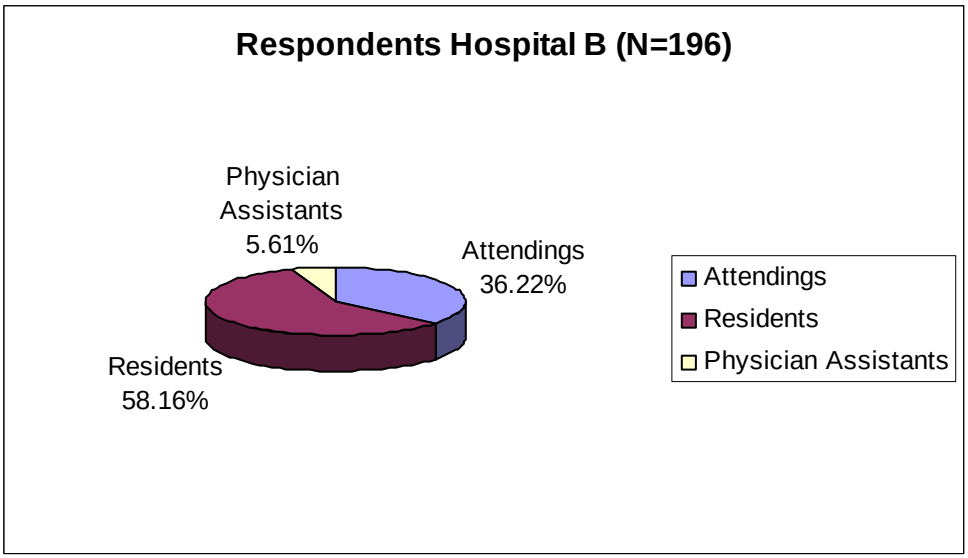

Figure 3. Respondents Hospital B

A primary specialty is indicated by 411 of the 425 respondents. They are distributed as follows.

Primary specialty indicated by 411 of 425:		
Internal Medicine	140	34.06%
Pediatrics	46	11.19%
General Surgery	37	9.00%
Psychiatry	29	5.60%
Physician Assistant	29	5.60%
Physical Medicine and Rehabilitation	21	5.11%
Pathology	20	4.87%
Obstetrics and Gynecology	18	4.38%
Ophthalmology	13	3.16%
Radiology	12	2.92%
Dermatology	11	2.68%
Anesthesia	9	2.19%
Orthopedics	8	1.95%
Emergency Medicine	7	1.70%
Ear, Nose, and Throat	7	1.70%
Urology	5	1.22%
Dental	5	1.22%
Neurology	4	0.97%
Podiatry	1	0.24%
Plastic Surgery	1	0.24%

Table 1. Primary Specialty

Of the 179 attending physicians, 143 of the 179 or 79.89 % are board certified; the remaining 22 respondents of the 179 or 12.29 % are board eligible. Fourteen or 7.82% do not respond to the question.

The disciplines of 174 attending physicians (five do not indicate) are distributed as follows.

Disciplines indicated by 174 Attending Physicians:		
Internal Medicine	68	39.08%
General surgery	18	10.34%
Psychiatry	9	5.17%
Pediatrics	9	5.17%
Pathology	9	5.17%
Physical Medicine and Rehabilitation	9	5.17%
Radiology	8	4.60%
Dermatology	8	4.60%
Obstetrics and Gynecology	7	4.02%
Anesthesia	7	4.02%
Orthopedics	7	4.02%
Emergency Medicine	4	2.30%
Urology	4	2.30%
Neurology	2	1.15%
Ear, Nose, and Throat	2	1.15%
Ophthalmology	1	0.57%
Podiatry	1	0.57%
Plastic Surgery	1	0.57%

Table 2. Disciplines of Attending Physicians

This distribution is important to preparedness research because it gives a snapshot of which specialties are present in a teaching hospital and allows for targeted emphasis for training and resource distribution. Community hospitals and tertiary care centers or specialty centers may have a different distribution of physician specialties and different number of physicians present at any given time. Preparedness implies assessing these resources both at the hospital and community level. The results seen in this research are more likely comparable to hospitals with similar demographics.

Of the 222 residents, 213 (95.95%) indicate a discipline. Nine do not indicate. They are distributed as follows.

Of 222 Residents, 213 (95.95%) indicated a discipline.		
Internal Medicine	71	33.33%
Pediatrics	37	17.37%
General Surgery	19	8.92%
Psychiatry	14	6.57%
Ophthalmology	12	5.63%
Physical Medicine and Rehabilitation	12	5.63%
Obstetrics and Gynecology	11	5.16%
Pathology	11	5.16%
Ear, Nose, and Throat	5	2.35%
Dental	5	2.35%
Radiology	4	1.88%
Emergency Medicine	3	1.41%
Dermatology	3	1.41%
Anesthesia	2	0.94%
Neurology	2	0.94%
Orthopedics	1	0.47%
Urology	1	0.47%

Table 3. Disciplines of Resident Physicians

It is important to understand which specialties are training at a teaching hospital and to understand their relative potential impact on improving surge capacity.

I also examine medical specialties as compared to surgical specialties. Medical specialties are defined as internal medicine, internal medicine specialty, psychiatry, pediatrics, anesthesia, radiology, pathology, physical medicine–rehabilitation, emergency medicine, dermatology, and neurology. Surgical specialties are defined as general surgery, general surgery specialty, obstetrics-gynecology, ophthalmology, podiatry, plastics, orthopedics, urology, ear-nose-throat, and dentistry. A total of 293 respondents are identified as having medical specialties and 95 are identified as having surgical specialties. The remainder are identified as physician assistants or do not provide a primary specialty code. This breakdown may prove to be important as it is frequently hypothesized that surgical specialties would be better able to respond to disaster scenarios. Those professionals with surgical background have advantage in assessing and managing explosive trauma victims. Medical specialties may have an advantage in managing chemical victims since the primary complications involve airway management and seizure management. There may be some overlap in abilities between medical and

surgical specialties, especially Emergency Medicine. Some weakness in ability to respond may appear among those who are highly specialized. The analysis tests this potential.

Medical Specialties represent 68.94% and surgical specialties represent 22.35%. The distribution of attendings, residents across medical and surgical specialties is not statistically significant at (P=0.729).

	Residents	Attendings	PA	Total
Medical	156	133	1	293
Surgical	54	4	0	95
PA	0	0	23	23
Missing	9	5	0	14
Total	222	179	24	42

Table 4. Distribution of Attendings, Residents & PAs Across Specialties

Three hundred forty-six indicate their year of graduation.

346 indicated their year of graduation of Medical or PA School		
Past 10 years	173	50.00%
10 - 19 years ago	78	22.54%
20 - 29 years ago	64	18.50%
30 - 39 years ago	23	6.65%
40 - 49 years ago	4	1.16%
50 - 59 years ago	4	1.16%

Table 5. Year of Graduation

Fully 50% of these hospital-based clinicians trained in the past decade with an additional 22.54% trained in the previous decade. The falloff between the decades is the result of more experienced clinicians leaving the teaching setting in pursuit of private practice, administrative, non-hospital based settings and perhaps attrition from

the field of medicine or retirement. This statistic might indicate that training should be focused on the beginning of a physician career such as during medical school or residency to successfully strengthen hospital preparedness.

a. Characteristics of Current Position

Physicians can be employed at a hospital in a full-time or in a part-time capacity. Many of those physicians who are part-time at a hospital are likely to have multiple appointments in different hospitals. Since they can only respond to one hospital, part-time physicians may skew the numbers of physicians a hospital will rely upon to respond.

	Part-Time	**Full Time**	**Total**
Voluntary	23	13	36
Paid	20	369	389
Total	43	382	425

Table 6. Physician Distribution by Full Time, Part Time, Paid or Voluntary

A statistically significant difference exists in this distribution between full-time or part-time and voluntary or paid (P=0.000). Roughly half of the part-time physicians are voluntary whereas only 3% of full-time physicians are voluntary.

There is no statistical significance between full-time and part-time physicians and whether they indicate they have any CBRNE training (P=0.919). No statistical significance appears whether they are full-time or part-time and whether they have training in BLS (P=0.098), ACLS (P=0.111), PALS (0.504), ATLS (P=0.970).

The time from medical school graduation shows a statistically significant difference whether full-time or part-time (P=0.023), with the full-time being the more recent graduates. This difference may represent that they are in full-time residency programs or in full-time hospital, academic or administrative positions. It is more likely that part-time clinicians work at more than one hospital and are expected to be the more senior physicians.

When asked about their extra-clinical duties, four physicians respond that their position is a combination of clinical, academic, and administrative roles. Sixty-five have a combination of clinical and academic roles and eight have a combination of clinical and administrative roles. The remaining 348 have strictly clinical roles. This data supports the premise that clinical resources are present in the hospital to form a response surge team. When assessing hospital clinical resources, it is important to delineate if hospitals self-report that they have 425 physicians when 77 are not purely clinical, since that discrepancy may affect surge capability.

b. Comparison of Hospitals

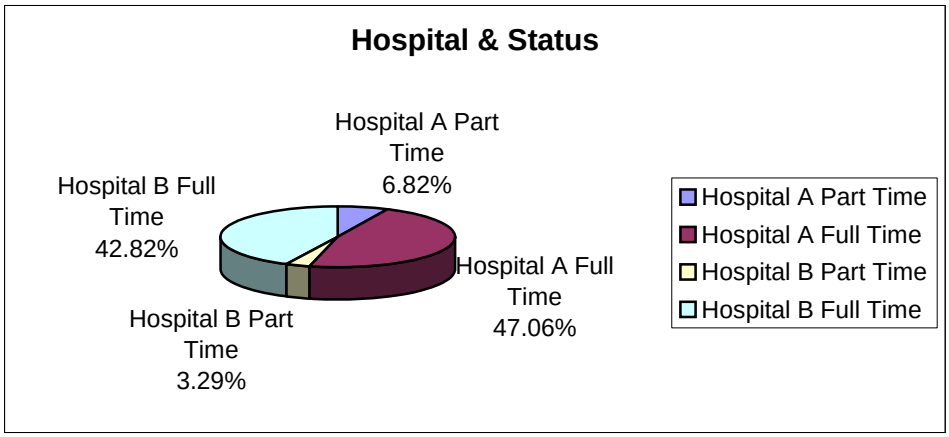

Figure 4. Hospital & Status

Comparing hospital A and B shows that Hospital A has statistically significantly more surgical specialists than Hospital B ($P<0.05$) and Hospital A has a greater percentage of volunteers than Hospital B ($P<0.000$). The difference between the percentage of residents and attendings at Hospital A and Hospital B tends toward statistical significance ($P=0.066$) with Hospital A having more attendings than Hospital B. Similarly, the difference between full time and part time at Hospital A and Hospital B tends toward statistical significance ($P=0.060$) with Hospital A having higher rate of part-time than Hospital B. While the number of male/female physicians is not statistically different between the two hospitals, the age difference is statistically significantly

different ($P<0.05$) with Hospital A having a greater percentage of physicians in the 10-30 years since graduation range and Hospital B having a greater percentage of physicians in the 30+ years since graduation range.

This fact is important and interesting because part-time physicians tend to have responsibility at other facilities, which could impact the size of the response team. Attendings are farther from their training and may have less confidence with required procedures, yet they would have more experience and stronger clinical acumen. A larger surgical staff would support a response team to an explosive event. The research explores these differences in their ability to respond.

c. Life Support Training

Current Life Support certification statistics between hospitals and specialties vary for a number of reasons. Hospital Medical Boards differ on whether they require training for their Attending Physicians. For example, Hospital A does not require ACLS for credentialing, but Hospital B does. Where training is required for credentialing, clinicians are credentialed by their Medical Board as long as they are current with life support training requirements on the day of credentialing. However, this training may expire before the physician is re-credentialed, affecting the percent currently certified. In addition to Medical Boards, specialties have differing training requirements. Emergency Medicine physicians may be required to have current certification in life support, but pathologists do not.

Residents in Radiology (who administer potentially allergenic IV contrast dye, which can precipitate allergic reaction) and Oro-Maxillofacial Surgery (who administer anesthetic agents) are required by their Residency Review Committees to obtain ACLS certification. Internal Medicine (whose physicians compose most hospital cardiac arrest response teams) has no requirements. Graduate Medical Education requirements for residents may differ by hospital. In addition, resident physicians rotating from affiliated institutions may have different requirements than these two hospitals. Resident physicians may still have current certification from classes taken in Medical

School. The diversity of regulatory agencies impacting clinicians' practice affects the mix of Life Support trained and certified clinicians at any institution at any point in time.

This survey queries respondents about certification in each of four life support courses: Basic Life Support, Advanced Cardiac Life Support, Advanced Trauma Life Support, and Pediatric Advanced Life Support.

Basic Life Support (BLS) is an American Heart Association defined and sponsored 4.5-hour course. It teaches the basics of recognizing cardio-respiratory compromise and initiating airway positioning and chest compressions or other external maneuvers to open an airway or provide cardiac compressions until more advanced practitioners arrive. Current certification requires retraining and testing biennially.

BLS		
All Respondents N=425		
Currently certified	297	69.88%
Previously certified	50	11.76%
Never certified	78	18.35%
Attending Physicians N=179		
Currently certified	134	74.86%
Previously certified	25	13.95%
Never certified	20	11.17%
Resident Physicians N=222		
Currently certified	142	63.96%
Previously certified	25	11.26%
Never certified	55	24.77%
PAs N=24		
Currently certified	21	87.50%
Previously certified	0	0.00%
Never certified	3	12.50%
Hospital A N=229		
Currently certified	135	58.95%
Previously certified	45	19.65%
Never certified	49	21.40%
Hospital B N=196		
Currently certified	162	82.65%
Previously certified	5	2.60%
Never certified	29	14.80%

Table 7. BLS

It is interesting that respondents from Hospital B have a statistically significantly higher current certification rates in BLS than respondents from Hospital A (P< 0.000). In addition, statistically significantly more Attendings are currently BLS certified (75%) than Residents (64%) (P<0.01). However, no significant difference appears between medical and surgical specialties, paid or volunteer staff, full-time or part-time staff, or duration since graduation. Hospitals and residency requirements for Life Support training differ. Hospital B has strict requirements for Basic Life Support certification for clinician credentialing. Residents may have less time and money available for training or may be rotating from another affiliated hospital with different requirements or the course may not be readily available.

Advanced Cardiac Life Support (ACLS) is an American Heart Association defined and sponsored 13.5 hour course. It teaches an algorithmic approach to cardiac dysrhythmias and their treatment, advanced airway management including intubation, and modifications to the algorithms for special situations including trauma, drug exposure and others. Current certification requires retraining and testing biennially. Both hospitals offer regular ACLS courses on site.

ACLS		
All Respondents N=425		
Currently certified	210	49.41%
Previously certified	60	14.12%
Never certified	155	36.47%
Attending Physicians N=179		
Currently certified	96	53.63%
Previously certified	28	15.64%
Never certified	55	30.73%
Resident Physicians N=222		
Currently certified	98	44.14%
Previously certified	29	13.06%
Never certified	95	42.79%
PAs N=24		
Currently certified	15	62.50%
Previously certified	3	12.50%
Never certified	6	25.00%
Hospital A N=229		
Currently certified	101	44.10%
Previously certified	44	19.21%
Never certified	84	36.68%

ACLS		
Hospital B N=196		
Currently certified	109	55.61%
Previously certified	16	8.16%
Never certified	71	36.22%

Table 8. ACLS

It is interesting that respondents from Hospital B have a statistically significantly higher current certification rates in ACLS than respondents from Hospital A ($P< 0.01$). In addition, statistically significantly more Attendings are currently ACLS certified (54%) than Residents (44%) and more Residents have never been certified (43%) than Attendings (31%) ($P<0.05$). However, there is no significant difference between medical and surgical specialties, paid or volunteer staff, full-time or part-time staff, or duration since graduation. Again, different hospital medical staff requirements are evident here. The difference is by hospital. Hence, there is no difference between specialties or full-time or part-time status. Additionally, residents may have less time to take training or may be rotating from hospitals that do not require Advanced Life Support training.

Advanced Trauma Life Support (ATLS) is an American College of Surgery defined and sponsored 16-hour course that teaches a logical algorithmic approach to the assessment, stabilization and management of the trauma patient in the initial "Golden Hour." It includes establishing a definitive airway, life-saving interventions and stabilization procedures, monitoring, fluid and blood management, etc. Current certification implies retraining and testing every four years. Both hospitals offer ATLS classes regularly on site.

ATLS		
All Respondents N=425		
Currently certified	64	15.06%
Previously certified	29	6.85%
Never certified	332	78.12%
Attending Physicians N=179		
Currently certified	52	29.05%
Previously certified	16	8.93%
Never certified	111	64.16%
Resident Physicians N=222		

ATLS		
Currently certified	10	4.50%
Previously certified	11	4.95%
Never certified	201	90.54%
PAs N=24		
Currently certified	2	8.33%
Previously certified	2	8.33%
Never certified	20	83.33%
Hospital A N=229		
Currently certified	40	17.47%
Previously certified	18	7.86%
Never certified	171	74.67%
Hospital B N=196		
Currently certified	24	12.24%
Previously certified	11	5.61%
Never certified	161	82.14%

Table 9. ATLS

It is interesting but not unexpected that respondents with a surgical specialty have a statistically significantly higher current certification rates in ATLS (24%) than respondents from medical specialties (12%) ($P< 0.01$). In addition, statistically significantly more Attendings are currently ATLS certified (29%) than Residents (5%) ($P<0.000$). Time since graduation from medical school is also statistically significant with physicians in the 10 to 30-year range having the highest ATLS certification rates ($P<0.000$). However, there is no significant difference between the hospitals, paid or volunteer staff, or full-time or part-time staff.

ATLS is designed for physicians who are first responders to trauma victims. These responders are usually attendings in surgery, trauma, and emergency medicine. The course is costly in both dollars and time requirements and residents might not have had the opportunity to take the course. Due to the money required, it is not widely offered. That there is no difference between hospitals is probably because the requirements for Life Support training are set by the State Department of Health, which designates trauma centers and sets requirements for Emergency Department physicians.

The number of clinicians currently or previously certified in ATLS is considerably lower than for ACLS or BLS. ATLS is usually only taken by those clinicians who have primary responsibility for trauma victims such as Emergency Department or Surgery physicians. Overall, the requirements for ATLS in New York are for Emergency Department physicians who are not residency trained or Board Certified. A larger percentage of Emergency Department physicians in Hospital B are Emergency Medicine residency trained, and hence do not require ATLS. In addition, Hospital A has a General Surgery residency program, so the investment of time and money for these residents to take ATLS is sensible. Hospital B does not have a General Surgery residency but utilizes General Surgery residents who rotate from other centers that may not offer ATLS training. It is interesting that two PAs indicate that they are currently certified and two were previously certified since this course only certifies physicians. However, many courses allow PAs to audit the course, which may be the circumstance here.

Pediatric Advanced Life Support (PALS) is an American Heart Association sponsored course that teaches the advanced approach to the pediatric patient. It considers different primary diagnoses, different normal values, different size and medication dosing of the pediatric population. The course is 14 hours in duration. Current certification implies retraining and testing on a biannual basis. Both hospitals offer PALS courses on site.

PALS		
All Respondents N=425		
Currently certified	89	20.94%
Previously certified	18	4.24%
Never certified	318	74.82%
Attending Physicians N=179		
Currently certified	53	29.61%
Previously certified	11	6.14%
Never certified	115	64.25%
Resident Physicians N=222		
Currently certified	33	14.86%
Previously certified	5	2.25%
Never certified	184	82.88%
PAs N=24		
Currently certified	3	12.50%
Previously certified	2	8.33%

PALS		
Never certified	19	79.17%
Hospital A N=229		
Currently certified	41	17.90%
Previously certified	16	6.99%
Never certified	172	75.11%
Hospital B N=196		
Currently certified	48	24.49%
Previously certified	2	1.02%
Never certified	146	74.49%

Table 10. PALS

It is interesting that respondents from Hospital B have statistically significantly higher current certification rates in PALS than respondents from Hospital A ($P< 0.01$). In addition, statistically significantly more Attendings are currently PALS certified (30%) than Residents (15%) ($P=0.000$) and more Residents have never been certified (83%) than Attendings (64%) ($P<0.000$). There is also a statistically significant difference in PALS certification rates between paid (22%) or volunteer (14%) staff ($P<0.01$). Time since graduation from medical school is also statistically significant with physicians in the 10+ year range having approximately twice the PALS certification rates than those in the <10 year range ($P<0.05$). However, there is no significant difference between medical and surgical specialties or between full-time and part-time staff.

Both hospitals have Pediatric Emergency Departments, pediatric inpatient services including Neonatal Intensive Care Units (NICU) and Pediatric Intensive Care Units (PICU), as well as pediatric clinics. The differences may be a result of Graduate Medical Education and Medical Board expectations and requirements and the availability of courses and the financial subsidization of the course by the hospital. The number of clinicians currently or previously certified is also low since certification is sought primarily by Emergency Department physicians caring for pediatric patients and pediatricians. Yet, not all Emergency Department physicians care for pediatric patients. Neonatologists take a separate certification course for neonatal advanced life support. Paid physicians can often take the courses during the workday while voluntary attendings come to the hospital for a specific responsibility and leave to manage their practice. Dedicating hours to these courses may interfere with their practice and their earnings.

Challenges to resident training include cost and time commitments. Since attendings are ultimately responsible for patients, it is more likely that they will be certified. The large percentage of clinicians who have never been certified supports the 2006 IOM Report highlighting the weaknesses in Pediatric Emergency Care[240] across the United States.

d. CBRNE Training

Neither hospital has a requirement for CBRNE training. Trauma centers have no requirement for specific CBRNE training. Emergency Medicine has some specific requirements for CBRNE training, but other residencies do not require specific CBRNE training. However, the residents in other programs may study penetrating or concussive injuries such as occur in explosive events or study airway and seizure management such as occur in chemical events.

Only 181 of 425 or 42.59% respondents state that they have any training in CBRNE. At Hospital A, 100 of 229 or 43.67% indicate they have any CBRNE training. At hospital B, 81 of 196 or 41.33% say they have any CBRNE training. Eighty-five of 179 attending physicians or 47.49% indicate that they have any CBRNE training. Eighty-five of 222 or 38.29% of residents indicate that they have CBRNE training. Nine of 24 Physician Assistants or 37.5% indicate that they have received training. None of these differences is statistically significantly different.

CBRNE Training	# Who Received Training	#Respondents	% Who Received Training
All Respondents	181	425	42.59%
Attendings	85	179	47.49%
Residents	85	222	38.29%
Pas	9	24	37.50%
Hospital A	100	229	43.67%
Hospital B	81	196	41.33%

Table 11. CBRNE Training

[240] Institute of Medicine, "The Future of Emergency Care in the United States, Emergency Care for Children: Growing Pains," June 2006, http://www.iom.edu/Object.File/Master/35/014/Emergency%20Care.pdf (acessed July 3, 2008), 5.

Examining the 181 who reported some CBRNE training in greater detail, only 31% have all five types of training (chemical, biological, radiological, nuclear and explosive). Approximately 60% have three or fewer of the trainings (Table 12).

CBRNE each as separate training N=181	N	% of those with training
One type of training	35	19.34%
Two types of training	38	20.99%
Three types of training	35	19.34%
Four types of training	16	8.84%
Five types of training	57	31.49%

Table 12. CBRNE Types of Training

Chemical and biological training are the two most popular trainings. Approximately one-third of the population has each of these. There has been interest and education about biological agents after the anthrax incidents and concerns about smallpox and pandemic influenza. Chemical training is similar to managing organophosphate poisoning so education may have been given in other contexts. Interestingly, only 17% have had explosives training even though explosives are the most likely disaster scenario. While experts report that explosives are a major threat, there may be less training on explosives since most clinicians feel the trauma team will deal with those victims and no new body of knowledge exists.

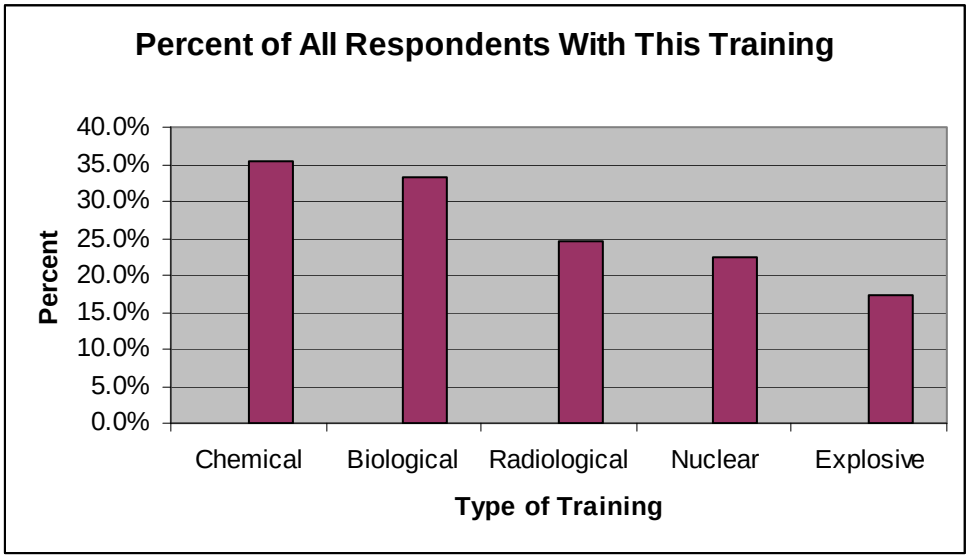

Table 13. Types of Training

Of the 151 who have chemical agent training, 66 received it in medical school, 23 in residency, 10 in the military, 35 in continuing medical education classes, 18 at Grand Rounds, 22 at in-services and 9 indicate other training but do not elaborate.

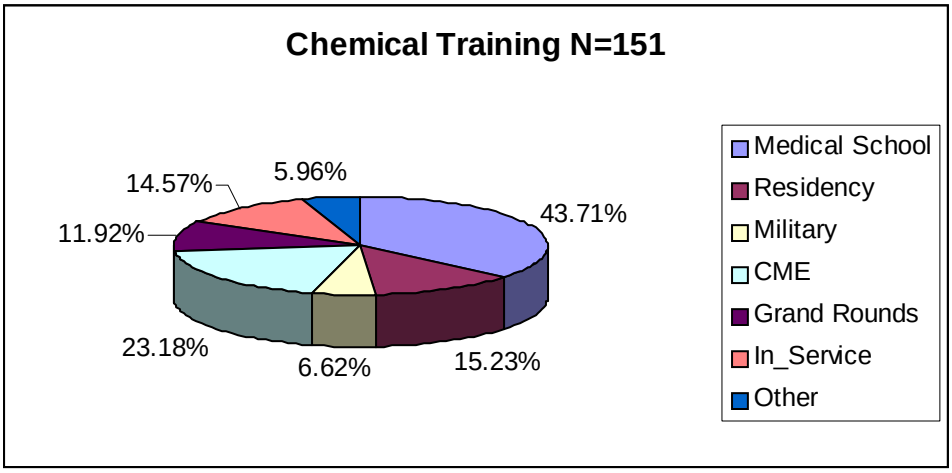

Figure 5. Chemical Training Sources

Of the 141 who have some biological agent training, 55 trained in medical school, 21 in residency, 7 in military, 26 at CME, 25 at Grand Rounds, 22 at in-services and 6 indicate other training but do not elaborate.

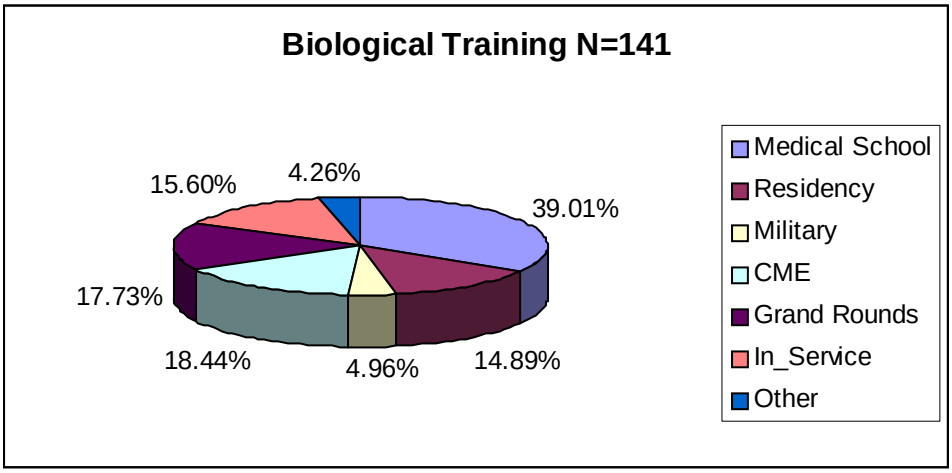

Figure 6. Biological Training Sources

Of the 104 who have radiological agent training, 45 trained in medical school, 23 in residency, 7 in the military, 17 through CME, 8 at Grand Rounds, 12 had in-services and 8 indicate other training but do not elaborate.

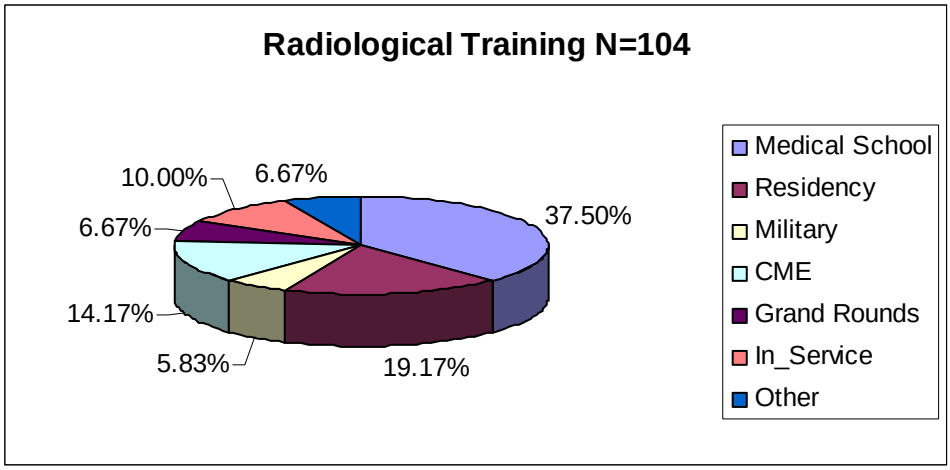

Figure 7. Radiological Training Sources

Of the 95 who have nuclear agent training, 37 trained in medical school, 17 in residency, 7 in the military, 15 had CME, 11 had training at Grand Rounds, 11 had in-services and 9 indicate other training but do not elaborate.

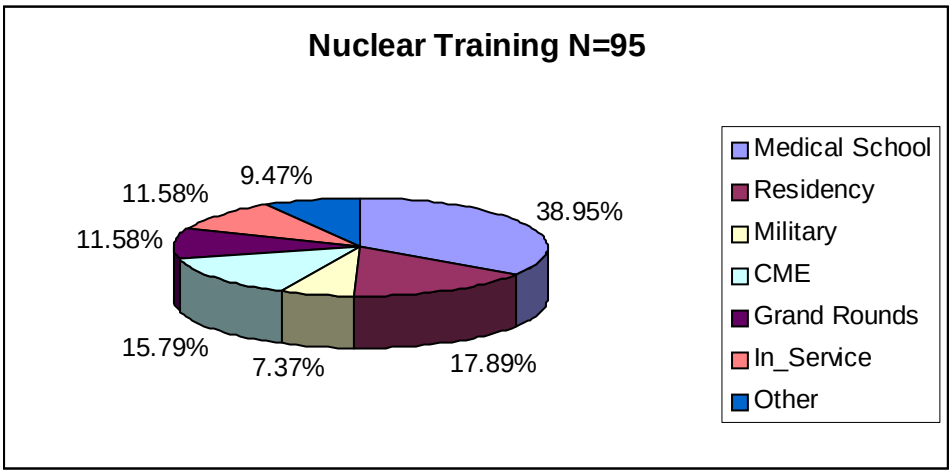

Figure 8. Nuclear Training Sources

Of the 74 who have training to deal with explosive agents, 30 trained in medical school, 12 in residency, 8 in the military, 12 at CME, 6 at Grand Rounds, 8 at in-services and 6 indicate other training but do not elaborate.

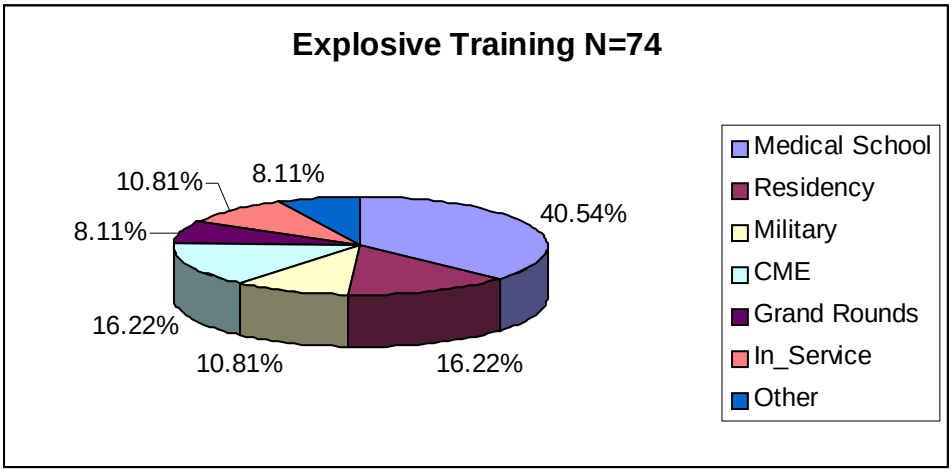

Figure 9. Explosive Training Sources

It is interesting that CBRNE training is not statistically significantly different between hospitals, medical or surgical specialty, residents, attendings or PAs, full-time and part-time staff, or paid or voluntary staff. The time since graduation from medical school tends toward statistical significance (P=0.057) but demonstrates no clear pattern of increasing or decreasing training over the decades. It seems counterintuitive that there is no statistical difference. This may be due to the total lack of designated, formal CBRNE training as well as a lack of trend toward increasing training options or requirements. There are no requirements for training by either hospital, state licensing or regulatory authority or specialty. For those who say they have had training, it is not clear how extensive that training is. It could range from reading an article, which another clinician who read the same article might not consider training, all the way up to extensive didactic and practical training in the military. The research reveals that only 42.59% identify any training in CBRNE. Of those, approximately 40% received training in medical school with less than 20% indicating any training in residency. When looking

at the entire 425 respondents only about 17% of the entire sample identify training in medical school and less than 8% identify training in residency. Respondents identify even less exposure in other choices such as in-services, Grand Rounds, or CME.

3. Perception of Preparedness

The survey's main focus determines whether physicians feel qualified and competent to respond in an emergency situation. Since the physicians are self-rating, it explores whether the physician rating matched a specific skill set needed to successfully respond to victims of an explosive or chemical event. It provides an assessment of internal validity–so the physicians who report that they are qualified and competent have the needed skills. At the same time, does the physician who reports that they are not qualified and competent truly not possess the necessary skills? These results are presented in the section on internal validity. The results from the individual question analysis are then presented. The results of the logistic regression analyses to determine the overall determinates of response are reported in Section 4 (Logit Analysis).

a. Internal Validity

To test the internal validity of the questions, the survey evaluates the physician's response on whether they feel qualified and competent to respond compared to their ability to perform a given set of skills, which would likely be necessary to manage patients in the scenarios described.

(1) Unstable Victims of Explosion. All two-way tables comparing physicians' self assessment with their skill sets are statistically significantly different ($P<0.000$), implying that the distribution among the columns is not due to randomness.

- Manage an airway

Table 14 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of an explosion and whether or not they could manage and airway.

Manage an Airway		
	Qualified/Competent	**Not qualified/competent**
Can Manage Airway	63.25%	13.37%
Cannot Manage Airway	2.38%	23.39%

Table 14. Manage an Airway

This question shows physicians are self-assessing properly since only 2.38% say they are qualified and competent, yet they lack one of the most crucial abilities in managing these patients. Of those who say they are that they are not qualified or competent, 13.37% can manage an airway but they do not feel that that skill is sufficient to manage these patients. It has a statistical significance of (P=0.000).

- Intubate

Table 15 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of an explosion and whether or not they could intubate.

Intubate		
	Qualified/Competent	**Not qualified/competent**
Can Intubate	49.88%	6.92%
Cannot Intubate	13.37%	29.38%

Table 15. Intubate

This question shows physicians are self-assessing properly since the majority of respondents judge themselves to be qualified and competent and can intubate, or not qualified nor competent and cannot intubate. The 13.37% who judge themselves qualified and competent but cannot intubate may think they can rely on an anesthesia consult to intubate since this service is available in-house in these two hospitals 24/7. Anesthesia consult is not available in many hospitals around the clock.

- Manage resuscitation fluids

Table 16 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of an explosion and whether or not they could manage resuscitation fluids.

Manage Resuscitation Fluids		
	Qualified/Competent	**Not qualified/competent**
Can Manage Resuscitation Fluids	60.19%	13.19%
Cannot Manage Resuscitation Fluids	3.18%	23.50%

Table 16. Manage Resuscitation Fluids

This question shows physicians are self-assessing properly since the majority of respondents either judge themselves qualified and competent and can manage resuscitation fluids or judge themselves neither qualified nor competent and cannot manage resuscitation fluids. The 13.19% who judge themselves neither qualified nor competent but can manage resuscitation fluids recognize that this knowledge alone is not sufficient to manage these patients.

- Assess need for blood

Table 17 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of an explosion and whether or not they could assess the need for blood.

Assess Need For Blood		
	Qualified/Competent	**Not qualified/competent**
Can Assess Need for Blood	61.00%	17.94%
Cannot Assess Need for Blood	2.15%	18.66%

Table 17. Assess Need for Blood

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can assess the need for blood or judge themselves neither qualified nor competent and cannot assess the need for blood. The 17.94% who judge themselves neither qualified nor competent but can assess the need for blood may recognize that this ability is not sufficient to manage these patients.

- Transfuse Red Blood Cells (RBC)

Table 18 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of an explosion and whether or not they could transfuse RBCs.

Transfuse RBCs		
	Qualified/Competent	**Not qualified/competent**
Can Transfuse RBCs	55.50%	12.68%
Cannot Transfuse RBCs	7.60%	24.16%

Table 18. Transfuse RBCs

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can transfuse RBCs or judge themselves neither qualified nor competent and cannot transfuse RBCs. The 12.68% who judge themselves neither qualified nor competent but transfuse blood may recognize that this ability is not sufficient to manage these patients.

- Control external hemorrhage

Table 19 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of an explosion and whether or not they could control external hemorrhage.

Control External Hemorrhage		
	Qualified/Competent	**Not qualified/competent**
Can Control External Hemorrhage	57.66%	16.75%
Cannot Control External Hemorrhage	5.50%	20.10%

Table 19. Control External Hemorrhage

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can control external hemorrhage or judge themselves neither qualified nor competent and cannot control external hemorrhage. The 16.75% who judge themselves neither qualified nor competent but can control external hemorrhage may recognize that this ability is not sufficient to manage these patients.

- Overall

The physician's overall skill set for managing unstable victims of an explosion in terms of the number of the six total vital skills they possess and how they self-rate their competency and qualifications are also examined.

	Number of Skills Possessed by Physician							
Physician's Rating	0	1	2	3	4	5	6	Total
Qualified/Competent	2	1	7	10	21	44	181	266
Not qualified/Not competent	50	21	25	22	15	12	12	157
Total	52	22	32	32	36	56	193	423

Table 20. Number of Skills Possessed by Physician for Unstable Explosive Victim

This table shows the overall physicians self rating of qualifications and competency is excellent. Of those who felt they are qualified and competent, 96% have three or more of the skills that are required for a response to an unstable victim. Of those who feel they are not qualified and competent, 75% possess only three or fewer of the skills that are required for a response. Therefore, we conclude that the physician's self-rating is valid for this question.

(2) Stable Victims of an Explosion. All two-way tables comparing physicians' self assessment with their skill sets are statistically significantly different ($P<0.000$) implying that the distribution among the columns is not due to randomness.

- Triage

Table 21 shows the physicians' rating on whether they are qualified and competent to respond to stable victims of an explosion and whether or not they could triage.

Triage		
	Qualified/Competent	**Not qualified/competent**
Can Triage	64.69%	5.43%
Cannot Triage	13.83%	16.05%

Table 21. Triage

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can triage or judge themselves neither qualified nor competent and cannot triage. The 13.83% who judge themselves qualified and competent to handle stable patients but who cannot

triage may have no experience since this is not a traditional MD/PA role and they have not been trained or they do not want to do triage. However, they may still feel they have enough other skills to be helpful. The 5.43% who judge themselves neither qualified nor competent but can triage may recognize that this ability is not sufficient to manage these patients.

- Clean and dress a wound

Table 22 shows the physicians' rating on whether they are qualified and competent to respond to stable victims of an explosion and whether or not they could clean and dress a wound.

Clean and Dress A Wound		
	Qualified/Competent	**Not qualified/competent**
Can Clean and Dress A Wound	77.03%	10.37%
Cannot Clean and Dress A Wound	1.48%	11.11%

Table 22. Clean and Dress a Wound

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can clean and dress a wound or judge themselves neither qualified nor competent and cannot clean or dress a wound. The 10.37% who judge themselves neither qualified nor competent but can clean and dress a wound may recognize that this ability is not sufficient to manage these patients.

- Repair simple lacerations

Table 23 shows the physicians' rating on whether they are qualified and competent to respond to stable victims of an explosion and whether or not they could repair simple lacerations.

Repair Simple Lacerations		
	Qualified/Competent	**Not qualified/competent**
Can Repair Simple Lacerations	65.93%	8.89%
Cannot Repair Simple Lacerations	12.59%	12.59%

Table 23. Repair Simple Lacerations

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can repair simple lacerations or judge themselves neither qualified nor competent and cannot repair simple lacerations. The 12.59% who judge themselves qualified and competent but cannot repair a simple laceration may be many years away from performing these procedures since it is usually relegated to a junior clinician. However, they may feel that their other skills will make up for this lack and they will be useful in other ways. The 8.89%% who judge themselves neither qualified nor competent but can repair simple lacerations may recognize that this ability is not sufficient to manage these patients.

- Order and Interpret x-rays

Table 24 shows the physicians' rating on whether they are qualified and competent to respond to stable victims of an explosion and whether or not they could order and interpret x-rays.

Order and Interpret x-rays		
	Qualified/Competent	**Not qualified/competent**
Can Order and Interpret x-rays	67.41%	6.91%
Cannot Order and Interpret x-rays	11.11%	14.57%

Table 24. Order and Interpret X-rays

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can order and interpret x-rays or judge themselves neither qualified nor competent and cannot order and interpret x-rays. The 11.11% who cannot order and interpret x-rays but judge themselves qualified and competent may rely on radiologist interpretation. The 6.91% who judge themselves neither qualified nor competent but can order and interpret x-rays may recognize that this ability is not sufficient to manage these patients.

- Splint

Table 25 shows the physicians' rating on whether they are qualified and competent to respond to stable victims of an explosion and whether or not they could splint.

Splint		
	Qualified/Competent	**Not qualified/competent**
Can Splint	52.72%	4.46%
Cannot Splint	25.74%	17.08%

Table 25. Splint

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can splint or judge themselves neither qualified nor competent and cannot splint. The 25.74% who are qualified and competent for managing stable explosive victims but cannot splint may be a function of the fact that both hospitals have orthopedics consult on site 24/7 who can splint so they feel it is unnecessary for them to possess this skill to be an asset. The 4.46% of the physicians who judge themselves neither qualified nor competent but can splint may recognize that this ability is not sufficient to manage these patients.

- Overall

The physician's overall skill set for managing stable victims of an explosion in terms of the number of the five total vital skills they possess and how they self-rate their competency and qualifications is also examined.

	Number of Skills Possessed by Physician						
Physician's Rating	0	1	2	3	4	5	Total
Qualified/Competent	3	7	18	37	92	161	318
Not qualified/Not competent	38	6	15	13	9	7	88
Total	41	13	33	50	101	168	406

Table 26. Number of Skills Possessed by Physician for Stable Victims of Explosive Events

This table shows the overall physicians self rating of qualifications and competency is excellent. Of those who feel they are qualified and competent, 91% have three or more of the skills that are required for a response to an unstable victim and 97% have two or more of the required skills. Of those who feel they are not qualified and competent, 67% possess only three or fewer of the skills that are required for a response. Therefore, the conclusion is that the physician's self-rating is valid for this question.

(3) Unstable Victim of a Chemical Attack. All two-way tables comparing physicians' self assessment with their skill sets are statistically significantly different (P<0.000), implying that the distribution among the columns is not due to randomness.

- Manage an airway

Table 27 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of a chemical attack and whether or not they could manage and airway.

Manage Airway		
	Qualified/Competent	**Not qualified/competent**
Can Manage Airway	59.66%	14.25%
Cannot Manage Airway	1.93%	23.91%

Table 27. Manage an Airway

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can manage an airway or judge themselves neither qualified nor competent and cannot manage an airway. The 14.25% who judge themselves neither qualified nor competent but can manage an airway may recognize that this ability is not sufficient to manage these patients.

It is interesting to note that more clinicians are qualified and competent to manage an airway in an explosive victim (62.25%) than can manage an airway in a chemical event (59.66%), but those that judge themselves not to be qualified or competent and cannot manage an airway are similar in the in the explosive event (23.39%) and the chemical scenario (24.15%). This difference may be a function of the nature of the event since chemical implies some threat to the clinician, although the victims were presumed to be decontaminated. It may be a function of the knowledge of the extreme oropharyngeal secretions requiring medications administered in doses with which the clinicians may not be familiar.

- Intubate

Table 28 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of a chemical attack and whether or not they could intubate.

Intubate		
	Qualified/Competent	**Not qualified/competent**
Can Intubate	49.51%	6.28%
Cannot Intubate	12.08%	31.88%

Table 28. Intubate

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can intubate or judge themselves neither qualified nor competent and cannot intubate. The 12.08% who judge themselves to be qualified and competent for unstable chemical but cannot intubate may believe that they can call the anesthesia consultant to intubate since anesthesia is available in both hospitals 24/7. Anesthesia is not available 24/7 in all hospitals. The 6.28% who judge themselves neither qualified nor competent but can intubate may recognize that this ability is not sufficient to manage these patients.

It is interesting to note of those who judge themselves neither qualified nor competent, 29.38% could not intubate an unstable explosive event, and 31.88% could not intubate an unstable chemical victim. Intubation in a victim of an explosive event may be complicated by an injured airway, distortion of anatomy, swelling after inhalation of hot gases in a closed space or facial deformities. Airway management may require a surgical airway. Intubation of a victim of a chemical event can be difficult due to the copious oral-pharyngeal secretions, which can decrease visualization and can limit oxygenation. Therefore, it is not surprising that the results of those who can or cannot intubate in an explosive event differs from the results in a chemical event. The difference may reflect concern for personal safety or may be illustrative of the recognized differences in the clinical complications of each scenario.

- Manage seizures

Table 29 shows the physicians' rating on whether they are qualified and competent to respond to unstable victims of a chemical attack and whether or not they could manage seizures.

Manage Seizures		
	Qualified/Competent	**Not qualified/competent**
Can Manage Seizures	55.56%	11.84%
Cannot Manage Seizures	6.04%	26.32%

Table 29. Manage Seizures

This question shows physicians are self-assessing properly since the majority of the respondents either judge themselves qualified and competent and can manage seizures or judge themselves neither qualified nor competent and cannot manage seizures. The 11.84% who judge themselves neither qualified nor competent but can manage seizures may recognize that this ability is not sufficient to manage these patients.

- Overall

The physician's overall skill set for managing unstable victims of a chemical event in terms of the number of the three total vital skills they possess and how they self-rate their competency and qualifications are also examined.

	Number of Skills Possessed by Physician				
Physician's Rating	0	1	2	3	Total
Qualified/Competent	4	9	56	187	256
Not qualified/Not competent	80	39	28	13	160
Total	41	13	33	50	406

Table 30. Number of Skills Possessed by Physician for Unstable Chemical Victims

This table shows the overall physicians self-rating of qualifications and competency is excellent. Of those who feel they are qualified and competent, 95% have at least two of the three skills that are required for a response to an unstable victim.

Of those who feel they are not qualified and competent, 74% possess at most one of the three skills that are required for a response. Therefore, it can be concluded that the physician's self-rating is valid for this question.

A set of internal validity questions for the stable chemical patient are not included. However, since the prior three questions demonstrate internal validity, there is no reason to presume that it suddenly would no longer hold with the fourth. The space on the questionnaire is used instead to ask physicians about their willingness to respond to an event (as distinct from the perception of whether or not they feel qualified and competent).

(4) Conclusion. The internal validity analysis shows a consistency of response by the respondents that indicates most understand the importance of the skills required to manage these patients as highlighted by the associated questions in each scenario. Clinicians who possess the skill most often feel qualified and competent to manage victims of these scenarios. Clinicians who lack the skill most often judge themselves neither qualified nor competent to manage victims of these scenarios. A few have the skills but judge themselves neither qualified nor competent to manage victims of the scenarios. This point may be a result of having the skills but remaining insecure about the mechanism of the chemical or explosive agents or not understanding how the skills fit together in a resuscitation effort. In the end, there are a few clinicians who lack the skill but still feel qualified and competent to manage these victims. They may not appreciate that these skills may be necessary for a successful response. However, it is more likely the result of working in a Level I Trauma center teaching hospital where a wealth of resources is available around the clock. For example, while a clinician might not have the skill to intubate, they could call an anesthesiologist to perform that skill for their patient. Resources would be different in a community hospital and perhaps in a different teaching hospital.

b. Explosive Scenario Result

(1) Unstable Patient. In analyzing the results of the explosive scenario, 266 or 62.88% of 423 respondents indicate they are qualified and competent to

initially assess and stabilize unstable victims of explosive events. This data includes 107 of 178 or 60.11% of the attendings and 145 of 221 or 65.61% of the residents and 13 of 24 or 54.1% of the physician assistants. At Hospital A 136/229 or 59.38% and at Hospital B130/194 or 67.01% indicate they are qualified and competent to handle unstable victims of an explosive event.

Explosive Event, Unstable Victims			
Category	**#Qualified/Competent**	**#Respondents**	**%Qualified/competent**
Attendings	107	178	60.11%
Residents	145	221	65.61%
PA	13	24	54.17%
Hospital A	136	229	59.39%
Hospital B	130	194	67.01%

Table 31. Qualified/Competent for Unstable Victims of Explosive Events

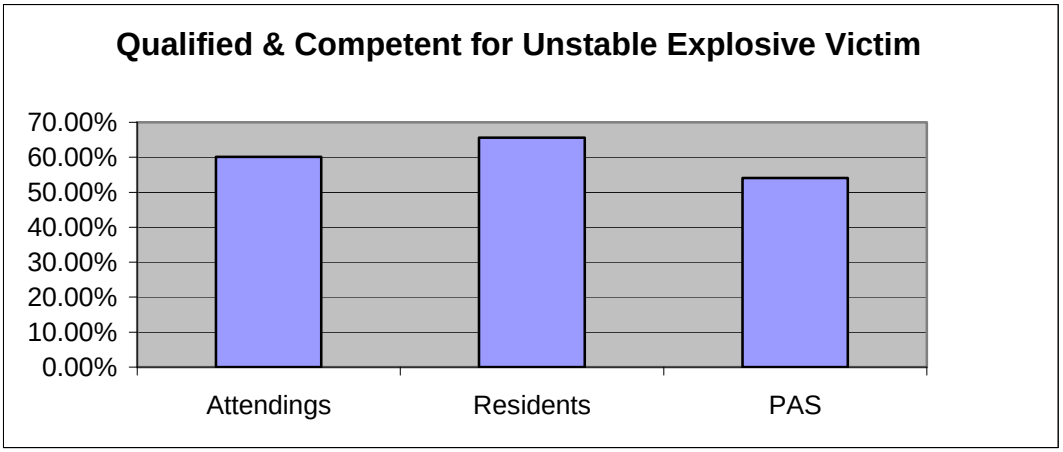

Figure 10. Qualified & Competent for Unstable Explosive Victims by Title

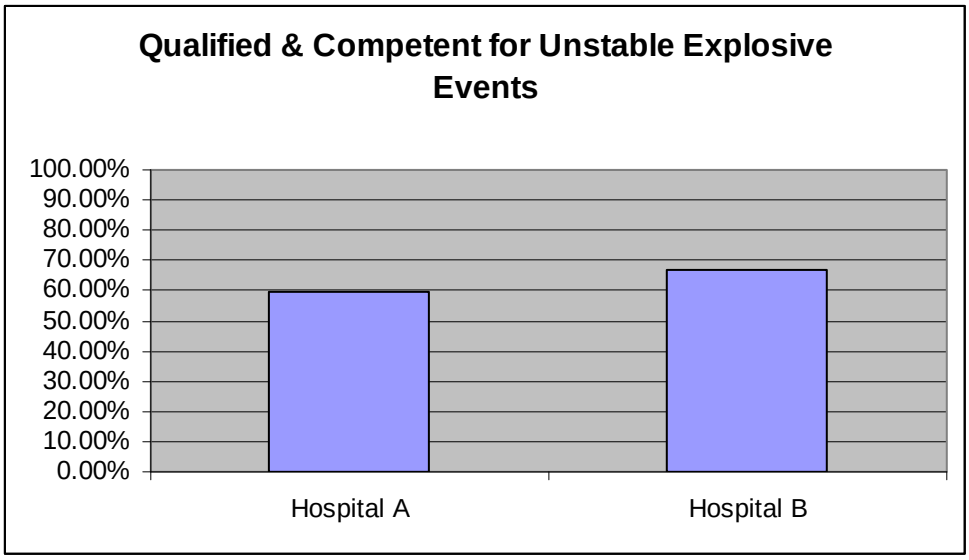

Figure 11. Qualified & Competent for Unstable Explosive Victims by Hospital

When examining those who indicate a specialty (n=409), we see a wide range of percentages among the specialties who feel qualified and competent to respond to unstable victims of an explosive event. However, since numerous specialties are only represented by a small number of physicians this result does not lend itself to robust statistical analysis.

	#Qualified/Competent	#Respondents	%Competent
Anesthesia	9	9	100.00%
EM	7	7	100.00%
GS	34	37	91.89%
Peds	33	46	71.74%
Optho	9	13	69.23%
IM	94	139	67.63%
OBGYN	11	17	64.71%
Psych	14	23	60.87%
Urology	3	5	60.00%
PA	13	23	56.52%
Ortho	4	8	50.00%
PMR	9	21	42.86%
Pathology	8	20	40.00%
ENT	2	7	28.57%
Radiology	3	12	25.00%
Neuro	1	4	25.00%
Dental	1	5	20.00%
Derm	1	11	9.09%

	#Qualified/Competent	#Respondents	%Competent
Podiatry	0	1	0.00%
Plastics	0	1	0.00%

Table 32. Qualified/Competent for Unstable Victims of Explosive Events by Specialty

In the explosive scenario, of those qualified and competent to assess and manage unstable explosive victims, there is no significant difference between attendings, resident or PAs (P= 0.472), nor between those identified as having a medical or surgical specialty (P=0.524), nor by decade from graduation (P=0.164), nor by sex (P=0.372), nor by paid or voluntary status (P=0.094), nor by hospital (P=0.106). There is a significant difference in those currently certified in BLS (P=0.000), those currently certified in ACLS (P=0.000), those currently certified in ATLS (P=0.000) and those who have some CBRNE training (P=0.000). In addition, there is a statistically significant difference depending on whether physicians are full-time or part-time (P=0.007). There is no significant difference between the ability of a board-certified attending and other clinicians (P=0.433).

Of the 105 respondents who answer "No" or do not respond to the question about their current qualifications and competency to care for unstable explosive patients, 92 or 87.62% indicate their willingness to learn. Thirteen or 12.38% indicate that they are unwilling to learn. Examining respondents willingness to learn to treat unstable patients from an explosive event in detail, there are statistically significant differences by resident, attending, or PA (P=0.015), by whether or not an attending was board-certified (p=0.001), by decade from graduation (P = 0.005), and by part-time or full-time status (P=0.000). There was no statistically significant different between medical or surgical specialties (P=0.475), nor by gender (P = 0.161), nor by BLS training (P=0.234), nor by ACLS training (P=0.854), by ATLS training (P=0.178), nor by CBRNE training (P=0.834), nor by paid or voluntary status (P = 0.904).

Of the 157 who judge themselves neither qualified nor competent for unstable explosive victims, 92 indicate a willingness to learn to manage unstable victims of explosive events. Of those 92, ninety indicate a specialty (see Table 33) and there is a wide range of percentages among the specialties who are willing to learn.

Encouragingly, all specialties have at least 50% of their physicians who are willing to learn to care for unstable victims of an explosive scenario. Since numerous specialties are only represented by a small number of physicians, this data does not lend itself to robust statistical analysis.

Not qualified nor competent but willing to learn to manage unstable explosive events			
Specialty	**#Willing**	**#Respondents**	**%Willing**
Podiatry	1	1	100.00%
Radiology	4	4	100.00%
Plastics	1	1	100.00%
Ortho	2	2	100.00%
Dental	3	3	100.00%
Surgery	1	1	100.00%
OBGYN	4	4	100.00%
Peds	11	11	100.00%
Ophtho	1	1	100.00%
Internal Medicine	29	32	90.63%
Physician Assistant	7	8	87.50%
PMR	10	12	83.33%
Psych	5	6	83.33%
Pathology	6	8	75.00%
Neuro	2	3	66.67%
Derm	3	6	50.00%

Table 33. Not Qualified/Competent for Unstable Victims of Explosive Events by Specialty

(2) Stable Victims of Explosive Event. In analyzing the results of the explosive scenario, 318 of 406 or 78.33% respondents indicate they are qualified and competent to initially assess and stabilize stable victims of explosive events. This includes 132 of 168 or 78.57% of the attendings and 167 of 216 or 77.31% of the residents and 18 of 22 or 81.82 % of the physician assistants. At Hospital A 155 of 212 or 73.11% and at Hospital B 163 of 194 or 84% indicate they are qualified and competent to handle stable victims of an explosive event. This difference is statistically significant (P=0.008) and may be due to the fact that Hospital B (inner city) treats more penetrating trauma than Hospital A (suburban), which handles more blunt trauma on a daily basis.

For Explosive Event, qualified and competent for stable victims			
Category	**#qualified/competent**	**#Respondents**	**%Qualified/competent**
Attendings	132	168	78.57%
Residents	167	216	77.31%
PA	18	22	81.82%
Hospital A	155	212	73.11%
Hospital B	163	194	84.02%

Table 34. Not Qualified/Competent for Unstable Victims of Explosive Events by Specialty but Willing

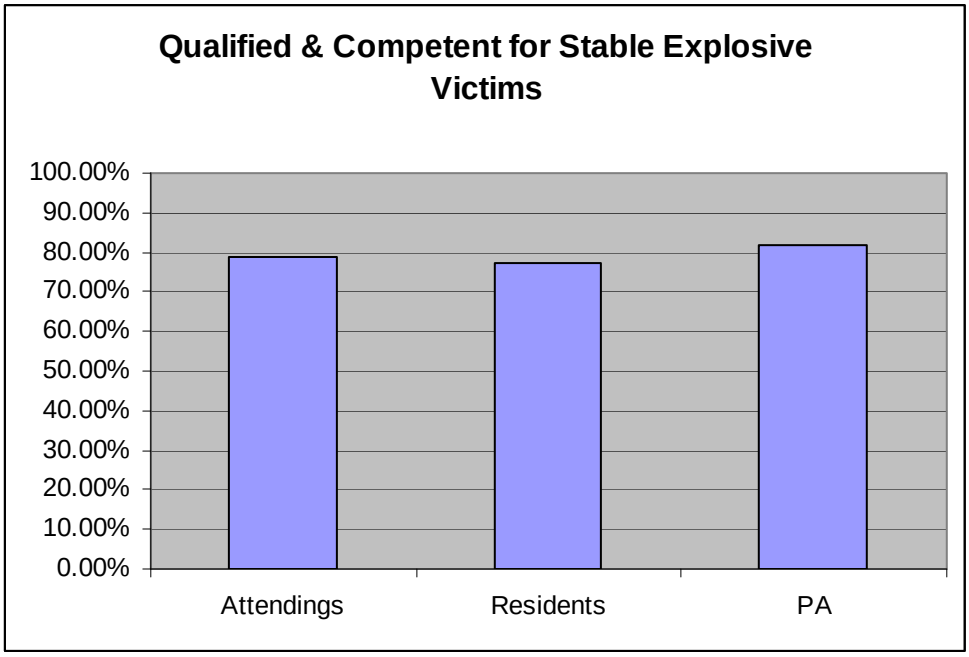

Figure 12. Qualified & Competent for Stable Explosive Victims by Title

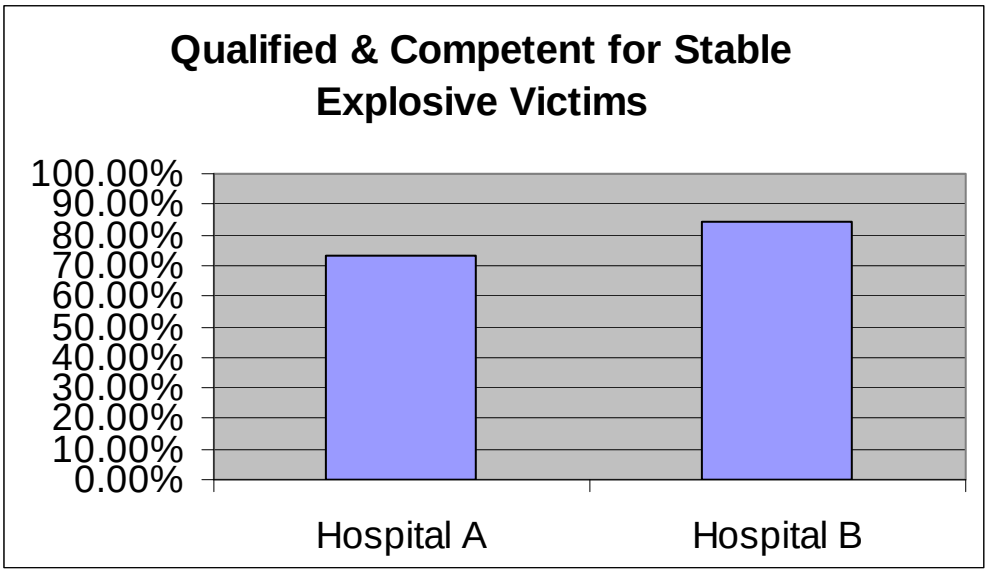

Figure 13. Qualified & Competent for Stable Explosive Victims by Hospital

When examining those who indicate a specialty (n=392), there is a wide range of percentages amongst the specialties who feel qualified and competent to respond to stable victims of an explosive event. However, since numerous specialties are only represented by a small number of physicians, this data does not lend itself to robust statistical analysis.

Specialty	# Qualified/Competent	# Respondents	%Qualified/ Competent
Plastics	1	1	100.00%
Orthopedics	7	7	100.00%
EM	6	6	100.00%
Neuro	4	4	100.00%
Anesthesia	8	8	100.00%
Surgery	32	35	91.43%
Peds	40	45	88.89%
Physician Assistant	18	21	85.71%
Internal Medicine	112	135	82.96%
PMR	17	21	80.95%
Psych	18	23	78.26%
OBGYN	12	17	70.59%
Ophtho	8	13	61.54%
Urology	3	5	60.00%
Radiology	6	11	54.55%
ENT	3	6	50.00%
Derm	5	11	45.45%
Dental	2	5	40.00%

Specialty	# Qualified/Competent	# Respondents	%Qualified/ Competent
Pathology	6	17	35.29%
Podiatry	0	1	0.00%

Table 35. Explosive Event-Comparison between Qualified & Competent for Stable & Unstable

In the explosive scenario, of those qualified and competent to assess and manage stable victims, there is no statistically significant difference between resident, attending or PA (P= 0.615), nor by medical or surgical specialty (P=0.671), nor by gender (P=0.884), nor by paid or voluntary status (P=0.709). There is a tendency towards statistical significance by decade from graduation (P=0.067). There is a statistically significant difference between those who have BLS (P=0.000), have ACLS (P=0.000), have ATLS (P=0.000) and have some CBRNE training (P=0.000). In addition, there is a statistically significant difference depending on whether or not physicians are full-time or part-time (P=0.041). There is no statistically significant difference between board certified and non-board certified attendings (p=0.755).

For stable explosive patients, of the 57 who answer that they are not qualified or competent, 47 or 82.46% indicate a willingness to learn. Examining respondents' willingness to learn to treat stable patients from an explosive event in detail, there are statistically significant differences by resident, attending, or PA (P=0.027), by whether or not an attending is board certified (P=0.012), and by decade from graduation (P = 0.043). There is a tendency toward statistical significance between whether a physician is full-time or part-time (P=0.60). There is no statistically significant different between medical or surgical specialties (P=0.809), nor by gender (P = 0.325), nor by BLS training (P=0.479), nor by ACLS training (P=0.344), nor by ATLS training (P=0.894), nor by CBRNE training (P=0.580), nor by paid or voluntary status (P = 0.219).

Of the 47 who indicate a willingness to learn to manage stable victims of explosive events, 44 indicate a specialty (see Table 36), and there is a wide range of percentages among the specialties who are willing to learn. Encouragingly, all specialties have at least 33% of their physicians who are willing to learn to care for stable

victims of an explosive scenario. Since numerous specialties are only represented by a small number of physicians this data does not lend itself to robust statistical analysis.

Specialty	#Willing	#Respondents	%Willing
Podiatry	1	1	100.00%
Radiology	3	3	100.00%
PMR	2	2	100.00%
Physician Assistant	2	2	100.00%
Urology	1	1	100.00%
Surgery	2	2	100.00%
Peds	5	5	100.00%
Ophtho	3	3	100.00%
Internal Medicine	16	18	88.89%
Psych	2	3	66.67%
OB-GYN	2	3	66.67%
Pathology	4	7	57.14%
Dental	1	2	50.00%
Derm	1	3	33.33%

Table 36. Explosive Event-Not Qualified/Competent but Willing To Learn

(3) Comparison between Stable and Unstable Explosive Patients. Physicians feel more qualified and competent responding to stable patients rather than to unstable victims of an explosive event (78% as compared to 63%). This result is expected because a stable patient allows time for clinicians to assess the patient and plan a management strategy. An unstable patient requires rapid troubleshooting and intervention, and the clinician must be much sharper in their ability to assess, sort out the priorities and intervene. They must know indications for medication and doses, indications for procedures, size of tubes etc. immediately. Stable patients may allow the clinician time to research information and time to consult.

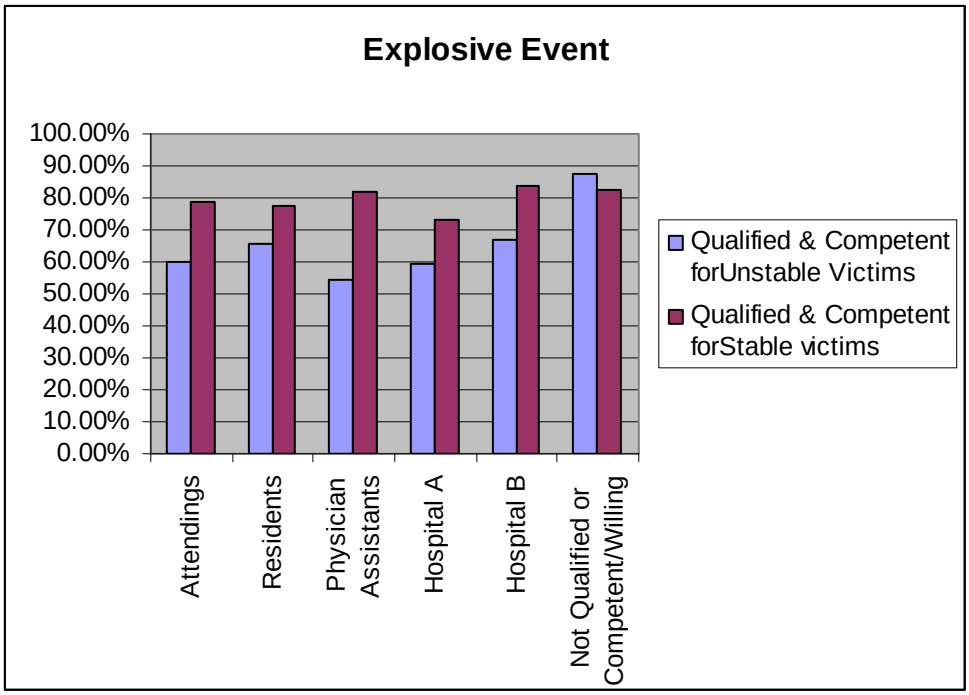

Figure 14. Explosive Event-Comparison between Qualified & Competent for Stable & Unstable

As is to be expected physicians feel more qualified and competent responding to stable patients rather than unstable patients (Table 37). The residents differentiate less between the stable and the unstable patients than the attendings. The differences are most notable in the physician's assistants. Physician assistants practice under the oversight of an attending physician. Their ability to manage critical patients without oversight will be less and they will be more comfortable managing stable patients.

Interestingly, respondents are more willing to learn the skills to treat the unstable victims than the stable victims. This mindset speaks to an ethical quality of professionals in that they will do what is necessary to assist a patient when there is no one else to care. They may defer to other more qualified clinicians for stable patients.

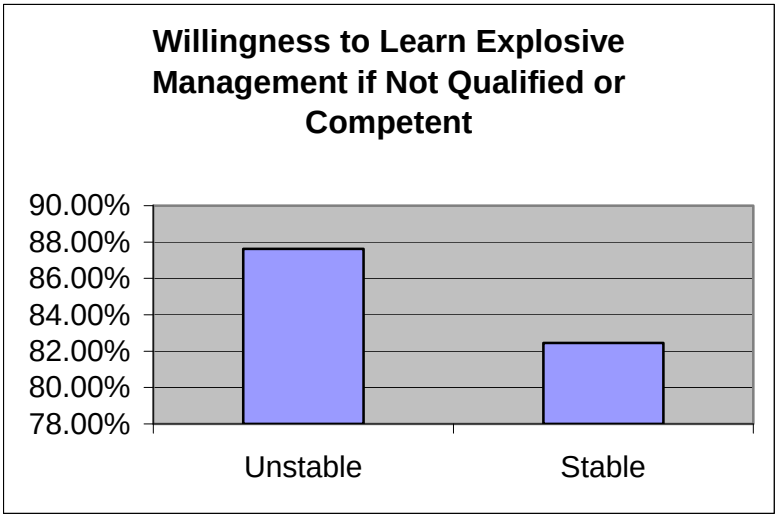

Figure 15. Explosive Event-Not Qualified/Competent but Willing To Learn

c. Chemical Event Scenario Results

(1) Unstable Victims. In analyzing the results of the chemical scenario, 256 of 416 or 61.54% of all respondents indicate their ability to initially assess and stabilize unstable victims of chemical events. This includes 106 or 173 or 61.27% of the attendings and 137 of 220 or 62.27% of the residents and 12 of 23 or 52.17% of the physician assistants. At Hospital A, 133/ 226 or 58.85% and at Hospital B, 123/190 or 64.74% indicate they are competent to handle unstable victims of a chemical event.

Qualified/Competent for unstable victims of Chemical Event			
Category	**#Qualified/competent**	**#Respondents**	**%Qualified/competent**
Attending	106	173	61.27%
Residents	137	220	62.27%
PAs	12	23	52.17%
Hospital A	133	226	58.85%
Hospital B	123	190	64.74%

Table 37. Qualified/Competent for Stable Victims of Explosive Events

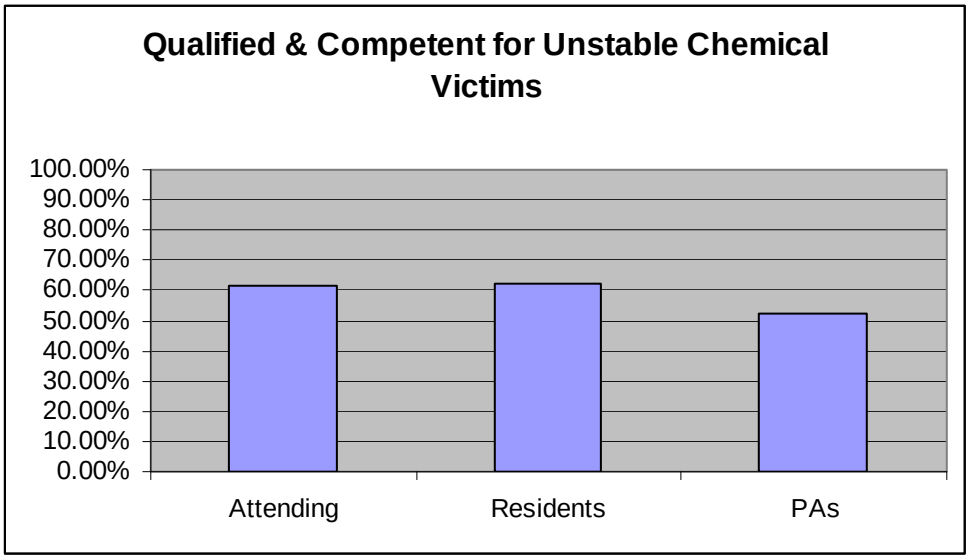

Figure 16. Chemical Event-Qualified/Competent for Unstable Victims by Category

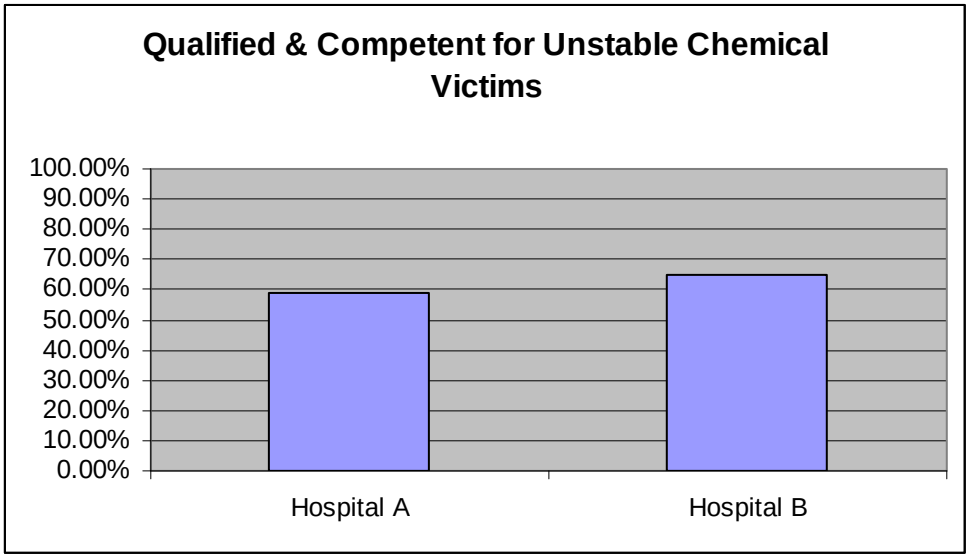

Figure 17. Chemical Events -Qualified/Competent for Unstable Victims by Hospital

When examining those who indicate a specialty (n=402), there is a wide range of percentages among the specialties who feel qualified and competent to respond to unstable victims of a chemical event. However, since numerous specialties are only represented by a small number of physicians, this data does not lend itself to robust statistical analysis.

Qualified/Competent for unstable victims of chemical event:			
Specialty	**#Qualified/competent**	**#Respondents**	**%Qualified/competent**
Plastics	1	1	100.00%
Surgery	33	36	91.67%
Anesthesia	8	9	88.89%
EM	6	7	85.71%
Peds	38	46	82.61%
Ophtho	10	13	76.92%
Ortho	5	7	71.43%
IM	88	139	63.31%
GU	3	5	60.00%
PA	12	22	54.55%
Psych	12	22	54.55%
OBGYN	9	17	52.94%
PMR	9	21	42.86%
Path	6	18	33.33%
ENT	2	7	28.57%
Neuro	1	4	25.00%
Dental	1	5	20.00%
Rad	2	11	18.18%
Derm	1	11	9.09%
Pod	0	1	0.00%

Table 38. Not Qualified/Competent for Unstable Victims of Explosive Events by Specialty but Willing

In the chemical scenario, of those qualified and competent to assess and manage unstable chemical victims, there is no significant difference between attendings, resident or PAs (P= 0.861), nor between those identified as having a medical or surgical specialty (P=0.311), nor by decade from graduation (P=0.321), nor by sex (P=0.568), nor by paid or voluntary status (P=0.258), nor by hospital (P=0.219). There is a significant difference in those currently certified in BLS (P=0.000), those currently certified in ACLS (P=0.000), those currently certified in ATLS (P=0.000) and those who have some CBRNE training (p=0.000). In addition, there is a statistically significant difference depending on whether physicians are full-time or part-time (P=0.032). There is no significant difference between the ability of a board certified attending and other clinicians (p=0.696).

For the 115 who indicate that they are not qualified or currently competent to manage unstable victims of chemical events, 88 or 76.52 % indicate their willingness to learn. Examining respondents willingness to learn to treat unstable patients from a chemical event in detail, there are statistically significant differences by decade from graduation (P = 0.002) and by part-time or full-time status (P=0.006). There is no statistically significant difference between medical or surgical specialties (P=0.315), nor by resident, attending, or PA (P=0.394), nor by gender (P = 0.117), nor by BLS training (P=0.521), nor by ACLS training (P=0.345), by ATLS training (P=0.494), nor by CBRNE training (P=0.463), nor by paid or voluntary status (P = 0.448), nor by whether or not an attending was Board Certified (P=0.251).

Of the 88 who indicate a willingness to learn to manage unstable victims of chemical events, 87 indicate a specialty (see Table 38). There is a wide range of percentages among the specialties who are willing to learn. Since numerous specialties are only represented by a small number of physicians, this data does not lend itself to robust statistical analysis. Physicians seem to be less willing to learn skills required to respond to a chemical event than to learn those required to respond to an explosive event. This research does not explain why this case may be, but numerous hypotheses are possible.

Not Qualified nor competent but willing to learn to manage unstable chemical victims			
Specialty	**#Willing to Learn**	**#Respondents**	**%Willing to Learn**
Podiatry	1	1	100.00%
Radiology	4	4	100.00%
Ortho	2	2	100.00%
EM	1	1	100.00%
Surgery	1	1	100.00%
Peds	7	7	100.00%
Ophtho	1	1	100.00%
Anesthesia	1	1	100.00%
Internal Medicine	34	39	87.18%
Physician Assistant	6	7	85.71%
OBGYN	5	6	83.33%
PMR	8	12	66.67%
Dental	2	3	66.67%
Psych	6	9	66.67%

Not Qualified nor competent but willing to learn to manage unstable chemical victims			
Pathology	5	8	62.50%
Neuro	1	2	50.00%
Derm	2	7	28.57%
Urology	0	1	0.00%

Table 39. Not Qualified/Competent for Unstable Victims of Explosive Events by Specialty but Willing

(2) Stable Chemical Victims. In analyzing the results of the chemical scenario, 317 of 396 or 80.05% respondents indicate they are qualified and competent to initially assess and manage stable victims of chemical events. This includes 127 of 160 or 79.38% of the attendings and 171 of 214 or 79.91% of the residents and 19 of 23 or 82.61 % of the physician assistants. At Hospital A, 156 of 205 or 76.10% and at Hospital B, 161 of 191 or 84.29% indicate they are qualified and competent to handle stable victims of a chemical event. This difference is statistically significant (P=0.041) and may be due to past training, subtle differences between urban and suburban hospitals, or the fact that Hospital B had a higher percentage of residents. Their more recent training, while not specifically CBRNE but perhaps organophosphate poisoning management, may explain the finding.

Qualified/Competent for stable victims of Chemical Event			
Category	**#Qualified/competent**	**#Respondents**	**%Qualified/competent**
Attending	127	160	79.38%
Residents	171	214	79.91%
PAs	19	23	82.61%
Hospital A	156	205	76.10%
Hospital B	161	191	84.29%

Table 40. Qualified/Competent for Stable Victims of Chemical Events

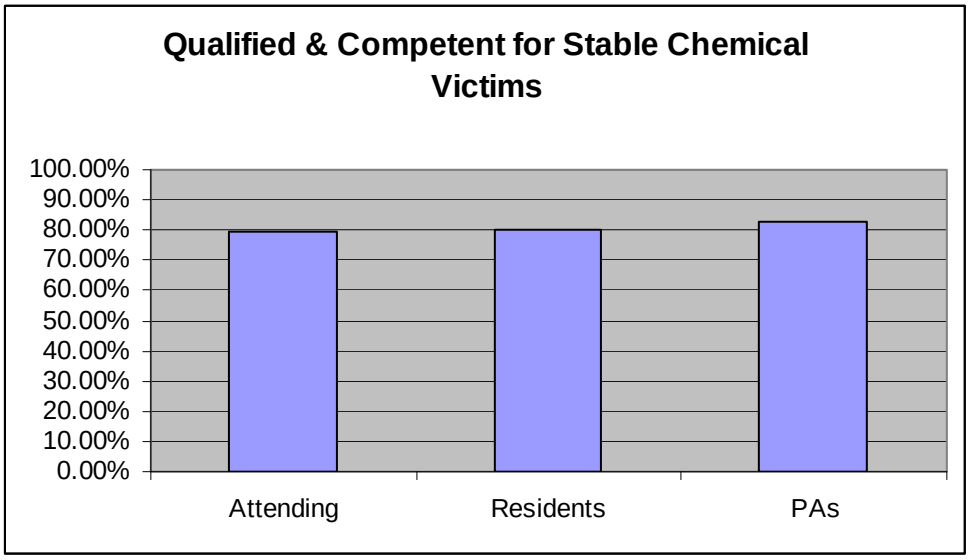

Figure 18. Chemical Events -Qualified/Competent for Stable Victims by Category

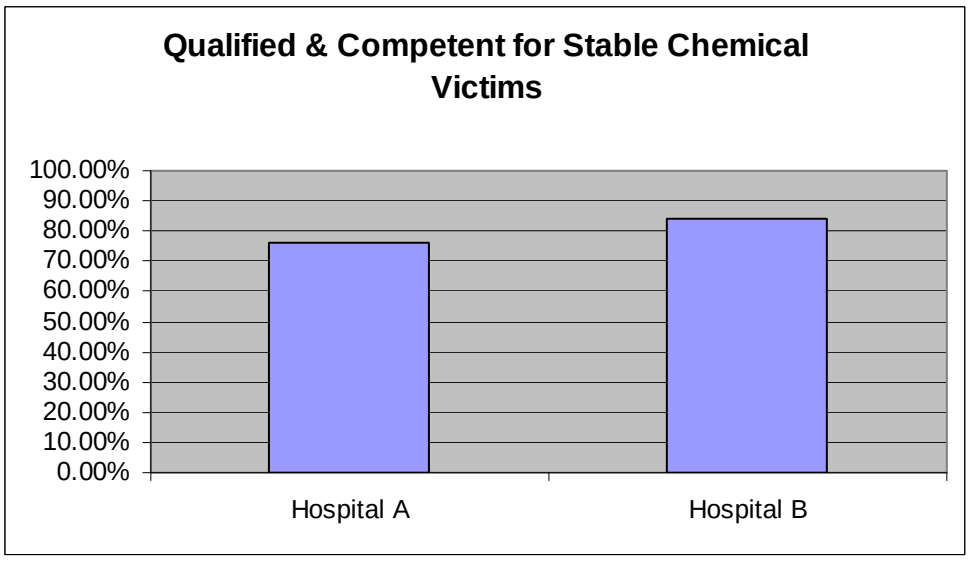

Figure 19. Chemical Events -Qualified/Competent for Stable Victims by Hospital

When examining those who indicate a specialty (n=382), there is a wide range of percentages among the specialties who feel qualified and competent to respond to stable victims of a chemical event. However, since numerous specialties are only represented by a small number of physicians, this data does not lend itself to robust statistical analysis.

Qualified/Competent for Stable Victims of Chemical Event			
Specialty	#Qualified/Competent	#Respondents	%Qualified/Competent
Plastics	1	1	100.00%
Neuro	4	4	100.00%
Anesthesia	9	9	100.00%
Peds	41	44	93.18%
Surgery	30	33	90.91%
Physician Assistant	19	22	86.36%
Ortho	6	7	85.71%
Ophtho	11	13	84.62%
EM	5	6	83.33%
Psych	19	23	82.61%
PMR	17	21	80.95%
Internal Medicine	100	131	76.34%
OBGYN	11	15	73.33%
Dental	3	5	60.00%
Derm	6	11	54.55%
Urology	2	4	50.00%
ENT	3	6	50.00%
Radiology	4	9	44.44%
Pathology	7	17	41.18%
Podiatry	0	1	0.00%

Table 41. Qualified/Competent for Stable Victims of Chemical Events by Specialty

In the chemical scenario, of those qualified and competent to assess and manage stable victims, there is no statistically significant difference between resident, attending or PA (P= 0.742), nor by medical or surgical specialty (P=0.409), nor by gender (P=0.950), nor by paid or voluntary status (P=0.917), nor by decade from graduation (P=0.103), nor by whether or not physicians were full-time or part-time (P=0.144). There is a statistically significant difference between those who have BLS (P=0.000), have ACLS (P=0.000), or have ATLS (P=0.000) and some CBRNE training (P=0.006). There is a tendency towards statistical significance between board certified and non board certified attendings (p=0.070).

Of the 50 who indicate that they are not qualified or competent to manage stable victims of a chemical event, 36 or 72% indicate a willingness to learn. Fourteen or 28% indicate that they are not willing to learn. Examining respondents' willingness to learn to treat stable patients from a chemical event in detail, there was

statistically significant differences by decade from graduation (P = 0.022). There is no statistically significant different between medical or surgical specialties (P=0.767), nor by resident, attending, or PA (P=0.408), nor by gender (P = 0.496), nor by BLS training (P=0.235), nor by ACLS training (P=0.962), nor by ATLS training (P=0.889), nor by CBRNE training (P=0.178), nor by whether or not an attending is Board Certified (P=0.218), nor by paid or voluntary status (P = 0.889), nor by part-time or full-time status (P=0.514).

Of the 36 who indicate a willingness to learn to manage stable victims of chemical events, 35 indicate a specialty (see Table 41). There is a wide range of percentages amongst the specialties who are willing to learn. Since numerous specialties are only represented by a small number of physicians, this data does not lend itself to robust statistical analysis.

Physicians seem to be less willing to learn skills required to respond to a chemical event than those required to respond to an explosive event. This research does not explain why this case may be, but numerous hypotheses are possible. Perhaps this reluctance is due to concerns about their own health, but this theory is pure speculation and a topic for future research.

Not Qualified Nor Competent But Willing To Learn to manage stable victims of chemical events			
By specialty	**#Willing To Learn**	**#Respondents**	**%Willing To Learn**
Radiology	3	3	100.00%
Physician Assistant	1	1	100.00%
EM	1	1	100.00%
Urology	1	1	100.00%
ENT	1	1	100.00%
Surgery	2	2	100.00%
Peds	3	3	100.00%
Internal Medicine	13	16	81.25%
Pathology	6	8	75.00%
OBGYN	1	2	50.00%
Psych	1	2	50.00%
Derm	1	3	33.33%
PMR	1	4	25.00%
Podiatry	0	1	0.00%
Dental	0	1	0.00%

Table 42. Not Qualified/Competent for Stable Victims of Chemical Events but Willing to Learn

(3) Comparison between Stable and Unstable Chemical Patients. Physicians feel more qualified and competent responding to stable chemical patients rather than unstable patients (80% as compared to 62%). This result is expected because stable patients allow clinicians to approach each patient methodically and there is time to research answers. Unstable patients require stronger clinical acumen and experience to deal with rapidly fluctuating signs and symptoms in an immediate time frame and require strong knowledge of medication dosing, effects, procedures and familiarity with equipment.

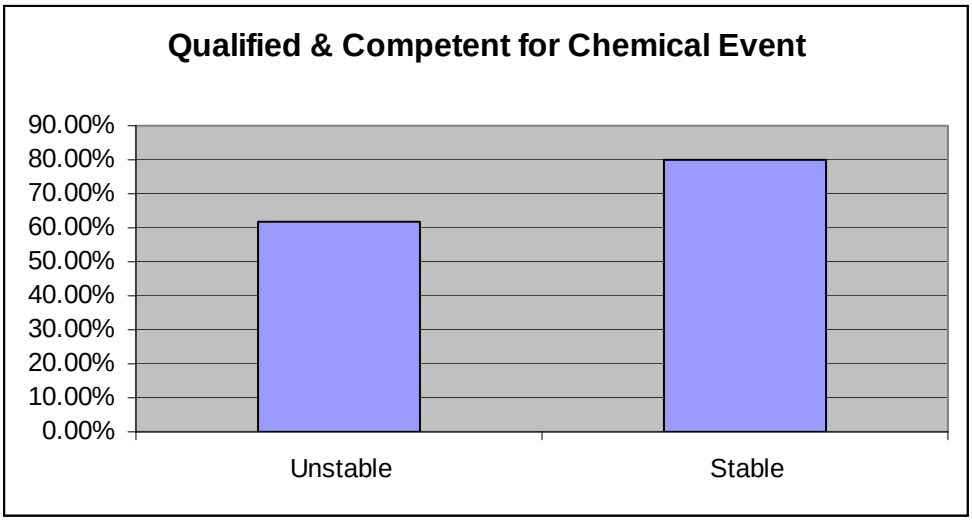

Figure 20. Chemical Events -Qualified & Competent

As is to be expected, physicians feel more qualified and competent responding to stable patients rather than unstable patients (Table 42). The residents differentiate less between the stable and the unstable patients than the attendings did. The differences are most notable in the physician's assistants.

Attendings may be less confident in their skills since they are farther from their Emergency Medicine training and may have been focused on specialized knowledge. Physician Assistants usually work under the supervision of an attending and would feel uncomfortable with an unstable patient without supervision.

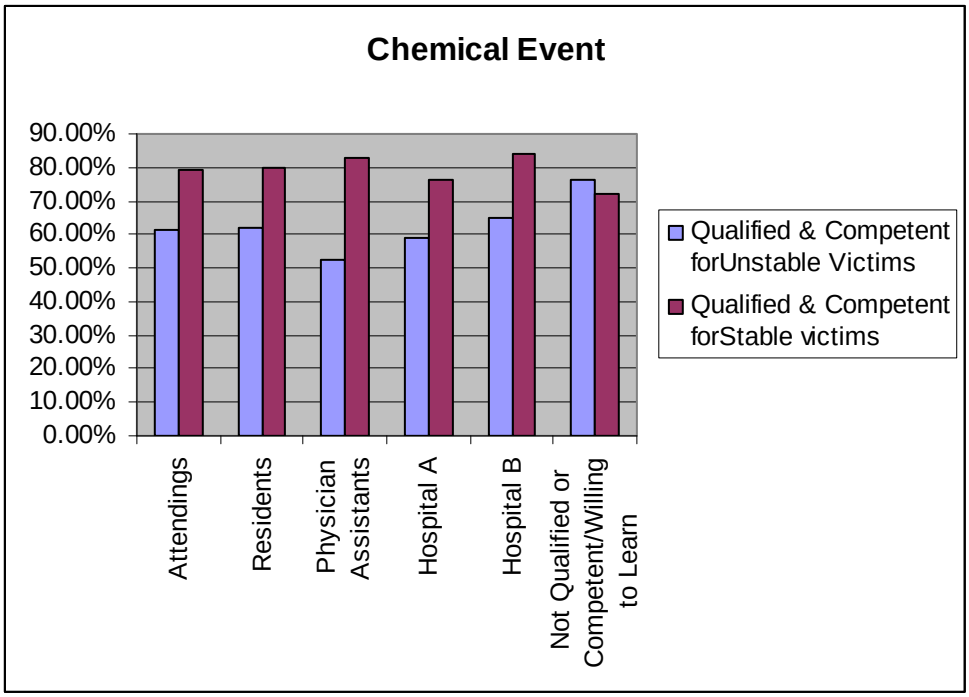

Figure 21. Chemical Events –Qualified & Competent by Title & Hospital

Interestingly, respondents are more willing to learn the skills to treat the unstable victims than the stable victims. Again, physicians would recognize the imperative to help the unstable patient to the best of their ability but would feel that the stable patient could wait until a relevant, more experienced practitioner arrived.

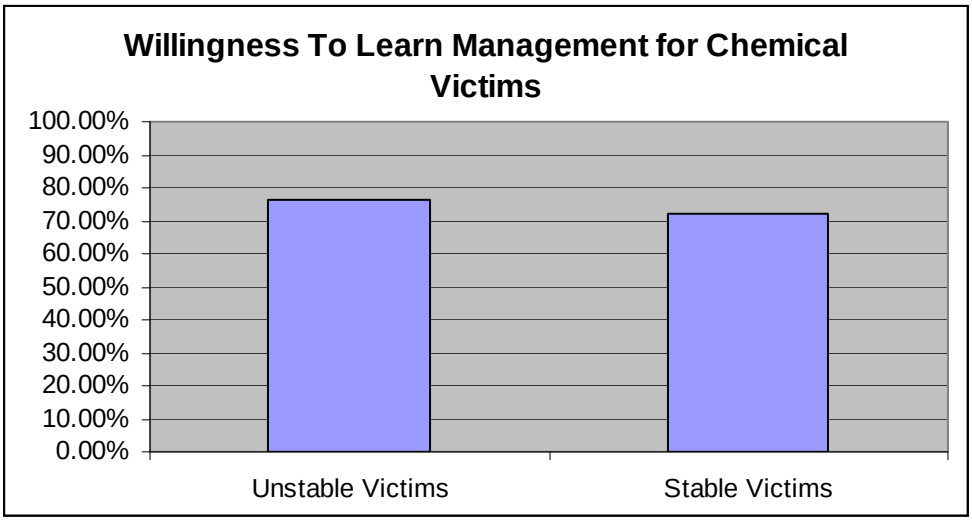

Figure 22. Chemical Events-Willingness To Learn for Stable and Unstable

(4) Physician Willingness to Respond. In assessing a physician's willingness to respond to unstable patients from a chemical attack, only 231 physicians (out of 425) respond to this question giving only a 54.4% response rate for this question. As half of the sample refuse to answer this question, the results are suspect. Of those who do answer the question, 76.62% respond that they would be willing to respond. Table 43 shows that of the 177 who indicate their willingness to respond, 131 judge themselves qualified and competent. Presumably the remaining 46 are eager to learn. All but one person who feels qualified and competent to respond was willing to respond. Of those who do not feel qualified and competent to respond, roughly half would be willing to help by whatever means they could offer. Of the 54 who are not willing to respond, 53 judge themselves not qualified and competent. It is unclear if they are willing to learn.

Examining physicians' willingness to respond to treat unstable patients from a chemical event in detail, there is no statistically significant difference between resident, attending or PA (P= 0.332), nor by medical or surgical specialty (P=0.695), nor by gender (P=0.635), nor by paid or voluntary status (P=0.401), nor by decade from graduation (P=0.174), nor by whether or not physicians are full-time or part-time (P=0.994), nor by whether or not an attending is board certified (P=0.159). There is a statistically significant difference between those who have BLS (P=0.000), have ACLS

(P=0.000), or have ATLS (P=0.000) and some CBRNE training (P=0.014). These results highlight the need to distinguish between physician willingness to respond and physician ability to respond as they do seem to capture two very different facets of the question.

	Willing to Respond		
Qualified and Competent to Respond	No	Yes	Total
No	53	46	99
Yes	1	131	132
Total	54	177	231

Table 43. Willing to Respond vs. Qualified/Competent to Respond

d. Comparison between Explosive and Chemical Responses

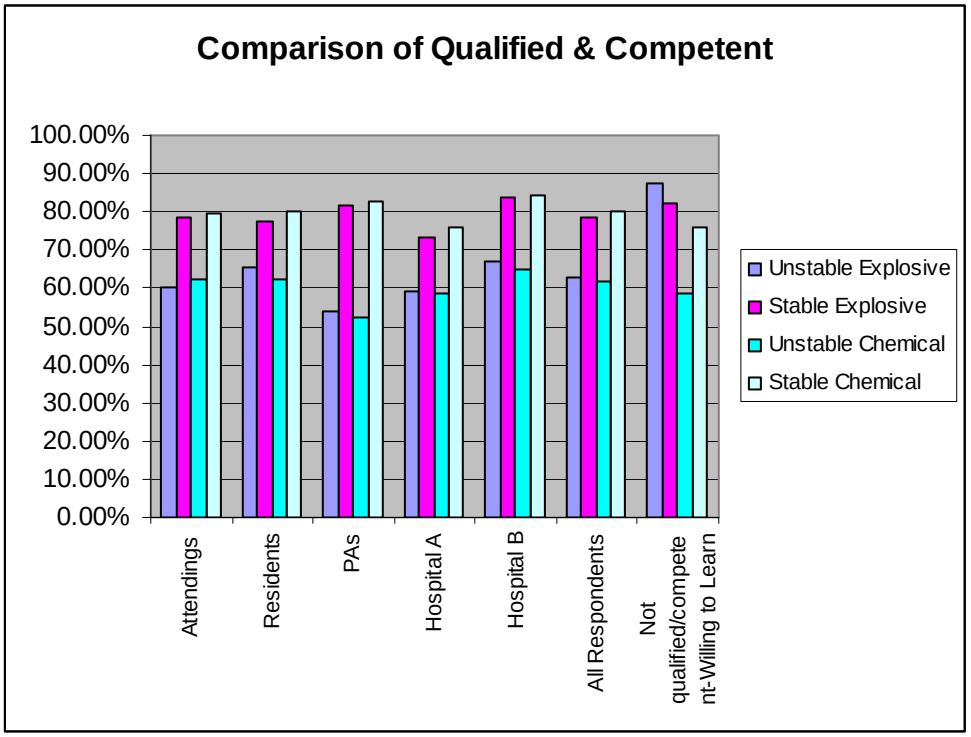

Figure 23. Chemical Events –Qualified & Competent by Title & Hospital

Within their individual category, Residents and PAs judge themselves to be more qualified and competent to handle unstable explosive victims than unstable chemical victims, and least qualified and competent for unstable chemical victims of all the scenarios. Attendings are almost equally qualified and competent for either unstable scenario, perhaps reflecting more confidence and clinical acumen. Respondents at both hospitals self-assess themselves to be more qualified and competent for unstable explosive victims than unstable chemical victims. These findings perhaps reveal concern for clinicians' own health.

Across groups, the residents are more qualified and competent than attendings for the victims of the unstable explosive scenario, but equally qualified and competent as the attendings for the unstable chemical scenario. The PAs self-assess themselves to be decidedly less qualified and competent for both unstable scenarios but judge themselves more qualified and competent than both attendings and residents for the stable scenarios. Hospital B respondents feel more qualified and competent for all scenarios than Hospital A, perhaps reflecting a difference in their patient population and clinical experience and the higher percentage of residents.

Willingness to learn is highest for unstable explosive where the need is great and the personal risk to the practitioner is low. There is less willingness for stable explosive victims where the clinician response time could be slower and patients could safely await the arrival of experienced clinicians. There is least willingness for unstable chemical patients, perhaps reflecting concern for their personal safety. Also, blunt and penetrating trauma is more common in trauma centers, and may be less intimidating than the chemical exposures which are much less frequent particularly in the urban environment.

4. Logit Analysis

Having explored which potential explanatory variables are statistically different between individuals who answered yes or no to the ability to respond in various scenarios, this paper now examines whether it is possible to develop a predictive model for these responses. Since the independent variable is binary, a logistic (logit) model is

most appropriate. The best model is developed for each question and then the best overall model for all four response scenarios is developed. To measure and compare the logit models, this research examines the goodness of fit test using Pearson's chi-squared test, the Akaike's information criterion (AIC) and the Schwarz's Bayesian information criterion (BIC), the area under the ROC curve (which provides a measure of predictive power), and the percent correctly classified. Models that failed the goodness of fit test were eliminated. To choose the best individual model I choose the model that has the lowest AIC score (tolerance ≤ 1.0) and for those where I judge the AIC to be equivalent, I choose the model with the lowest BIC score. To choose the best overall model, I choose the model with the lowest BIC score to choose the most parsimonious model.

Throughout this section, I use the following explanatory variables.

- ACLS–a yes/no indicator for whether physicians have had ACLS training
- ATLS–a yes/no indicator for whether physicians have had ATLS training
- BLS–a yes/no indicator for whether physicians have had BLS training
- duration–the number of years since graduation from medical school
- FTorPT–a yes/no indicator for whether physicians are full-time or part-time
- Hosp–an indicator for Hospital A and Hospital B
    - HospStand–an indicator that is the cross product of whether the physician is a resident, attending, or physician's assistant and whether the physician is at Hospital A or Hospital B
    - NoCBRNE–a yes/no indicator for whether physicians have had any CBRNE training
    - ResAttPA–an indicator variable for whether the physician is a resident, attending, or physician's assistant
    - Status–an indicator that is the cross product of whether the physician is a resident, attending, or physician's assistant and whether the physician is full-time or part-time.

a. Explosive Scenario

(1) Unstable Explosive Patients. There are several models that are almost equivalent in performance to the best model as can be seen in Table 44. Using

our decision criteria, the model that best fit the responses to physician's assessment of whether they feel qualified and competent to respond to an unstable victim is based on whether or not the physician has any CBRNE training, has BLS training, has ACLS training, has ATLS training, is a resident, attending or physician's assistant, and the duration since medical school graduation.

Explanatory variables included in the model	**Goodness of Fit Test (Pearson's Chi-squared)**	**ROC**	**Percentage Correctly Classified**	**AIC**	**BIC**
NoCBRNE; BLS; ACLS; ATLS; duration; ResAttPA	0.25	.81	75.9%	371.5	413.8
Status; NoCBRNE; BLS; ACLS; ATLS; duration	0.11	.81	74.5%	373.8	423.8
FTorPT; NoCBRNE; BLS; ACLS; ATLS; duration; Hosp	0.25	.80	73.6%	374.5	416.8
NoCBRNE; BLS; ACLS; ATLS; duration **	0.25	.80	74.2%	377.1	411.6
NoCBRNE; BLS; ACLS; ATLS; duration; Hosp	.013	.81	72.5%	376.3	414.7

(note: highlighted model is the best one for unstable, explosive patients,
** model is the best performing model across all four response scenarios)

Table 44. Model Comparison Question 1-Unstable Explosive

- Statistics

```
xi: logit  Q1ans  NoCBRNE i.BLS i.ACLS i.ATLS  duration i.ResAttPA
Logistic regression                       Number of obs   =       345
                                          LR chi2(10)     =    106.60
                                          Prob > chi2     =    0.0000
Log likelihood =  -174.7467               Pseudo R2       =    0.2337
------------------------------------------------------------------------------
       Q1ans |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   NoCBRNE |  -.4074708   .2770702    -1.47   0.141    -.9505184    .1355768
```

_IBLS_2	-.1706457	.3920403	-0.44	0.663	-.9390306	.5977391
_IBLS_3	-.7571116	.4562252	-1.66	0.097	-1.651296	.1370734
_IACLS_2	-1.674533	.3623407	-4.62	0.000	-2.384707	-.9643579
_IACLS_3	-.2900811	.4410639	-0.66	0.511	-1.15455	.5743882
_IATLS_2	-2.169537	.6518303	-3.33	0.001	-3.447101	-.891973
_IATLS_3	-1.185525	.8148265	-1.45	0.146	-2.782556	.4115052
duration	.0011589	.0155252	0.07	0.940	-.02927	.0315878
_IResAttPA_2	-.831605	.3668091	-2.27	0.023	-1.550538	-.1126725
_IResAttPA_3	-1.314766	.5312608	-2.47	0.013	-2.356018	-.2735144
_cons	3.896427	.6783945	5.74	0.000	2.566798	5.226056

Table 45. Logistic Regression Question 1- Unstable Explosive Patients

Q1ans	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
NoCBRNE	.6653309	.1843434	-1.47	0.141	.3865406	1.145197
_IBLS_2	.8431202	.3305371	-0.44	0.663	.3910067	1.818004
_IBLS_3	.4690192	.2139784	-1.66	0.097	.1918011	1.146912
_IACLS_2	.1873957	.0679011	-4.62	0.000	.0921159	.3812279
_IACLS_3	.7482029	.3300053	-0.66	0.511	.3151992	1.776044
_IATLS_2	.1142305	.0744589	-3.33	0.001	.0318378	.4098463
_IATLS_3	.3055856	.2489992	-1.45	0.146	.0618801	1.509088
duration	1.00116	.0155432	0.07	0.940	.9711542	1.032092
_IResAttPA_2	.43535	.1596903	-2.27	0.023	.2121339	.8934432
_IResAttPA_3	.2685371	.1426632	-2.47	0.013	.0947969	.7607014

Table 46. Logistic Odds Ratios Question 1- Unstable Explosive Patients

NoCBRNE = 0 have had some CBRNE training, NoCBRNE = 1 have not had any CBRNE training. Therefore, someone who has had some CBRNE training is more likely to respond than someone who has not had any training. The odds of responding are 1.5 (1/.665) times greater for those who have had some training. This variable is not statistically significant.

BLS = 1 currently certified, BLS = 2 never certified, BLS = 3 once certified
Therefore, someone who was once certified is much less likely to respond than someone who is currently certified. The odds of responding are 2.1 (1/.469) times greater for those who have had current training over those whose training is not current and it is not statistically significant. The odds of responding are 1.2 (1/.843) times greater for those who have had current training over those who have never had and it is not statistically significant response.

ACLS = 1 currently certified, ACLS = 2 never certified, ACLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 5.3 (1/.187) times greater for those who have had current training and it is statistically significant. In addition, those who were once certified are also less likely to respond than someone who is currently certified. The odds of responding are 1.3 (1/.7480) times greater for those who have had current training and but this variable is not statistically significant.

ATLS = 1 currently certified, ATLS = 2 never certified, ATLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 8.8 (1/.114) times greater for those who have had current training and it is statistically significant. In addition, those who were once certified are also less likely to respond than someone who is currently certified. The odds of responding are 3.3 (1/.306) times greater for those who have had current training and but this variable is not statistically significant.
Duration = number of years out of medical school. This variable is not significant and the odds ratio is approximately one.

ResAttPA = 1 Resident, ResAttPA = 2 Attending, ResAttPA = 3 Physician's Assistant
Therefore, an attending physician is less likely to respond than a resident. The odds of responding are 2.3 (1/.435) times greater for residents and it is statistically significant. A physician's assistant is less likely to respond than a resident. The odds of responding are 3.7 (1/.269) times greater for residents and it is statistically significant.

- Classification Ability of the Logistic Model

I next calculated how well the model was able to classify physicians as to whether or not they would feel qualified and competent to respond to unstable victims of an explosive event. I compare the model predictions with the actual results obtained from the survey to calculate the model's sensitivity, specificity, positive and negative predictive value, and the percent correctly classified.

	True		
Classified	D	~D	Total
+	179	46	225
-	37	83	120
Total	216	129	345

Classified + if predicted Pr(D) >= .5
True D defined as Q1ans != 0

Sensitivity	Pr(+| D)	82.87%
Specificity	Pr(-|~D)	64.34%
Positive predictive value	Pr(D| +)	79.56%
Negative predictive value	Pr(~D| -)	69.17%
False + rate for true ~D	Pr(+|~D)	35.66%
False - rate for true D	Pr(-| D)	17.13%
False + rate for classified +	Pr(~D| +)	20.44%

False - rate for classified - Pr(D| -) 30.83%

Correctly classified 75.94%

Table 47. Model Fit Question 1- Unstable Explosive Patients

(2) Stable Explosive Patients. There are several models that are almost equivalent in performance to the best model as can be seen in Table 48. Using our decision criteria, the model that best fit the responses to physician's assessment of whether they feel qualified and competent to respond to a stable victim is based on whether or not the physician has any CBRNE training, has BLS training, has ACLS training, has ATLS training, is located at hospital A or hospital B, and the duration since medical school graduation

Explanatory variables included in the model	Goodness of Fit Test (Pearson's Chi-squared)	ROC	Percentage Correctly Classified	AIC	BIC
NoCBRNE; BLS; ACLS; ATLS; duration **	0.10	.79	78.7%	279.0	308.7
FTorPT; NoCBRNE; BLS; ACLS; ATLS; duration; Hosp	0.18	.79	81.4%	279.1	316.2
NoCBRNE; BLS; ACLS; ATLS; duration; Hosp	0.12	.79	81.4%	277.3	310.7
NoCBRNE; BLS; ACLS; ATLS; duration; HospStand	0.15	.80	81.2%	276.9	321.0

(note: highlighted model is the best one for stable, explosive patients,
** model is the best performing model across all four response scenarios)

Table 48. Model Comparison Question 3- Stable Explosive Patients

- Statistics

xi:logit Q3ans NoCBRNE i.BLS i.ACLS i.ATLS duration i.Hosp

Logistic regression Number of obs = 301

LR chi2(8) = 62.35

Prob > chi2 = 0.0000

Log likelihood = -129.64705 Pseudo R2 = 0.1938

Q3ans	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
NoCBRNE	-.9103098	.3509841	-2.59	0.009	-1.598226	-.2223936
_IBLS_2	-.58465	.4240387	-1.38	0.168	-1.415751	.2464505
_IBLS_3	.0047276	.5181053	0.01	0.993	-1.01074	1.020195
_IACLS_2	-1.288383	.4620783	-2.79	0.005	-2.19404	-.3827257
_IACLS_3	-.7764694	.5554945	-1.40	0.162	-1.865219	.3122797
_IATLS_2	-1.404883	.8116718	-1.73	0.083	-2.99573	.1859646
duration	-.0325341	.0139682	-2.33	0.020	-.0599113	-.005157
_IHosp_2	.6714362	.3491302	1.92	0.054	-.0128464	1.355719
_cons	4.11553	.8130802	5.06	0.000	2.521923	5.709138

Table 49. Logistic Regression Question 3 - Stable Explosive Patients 63

Q3ans	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
NoCBRNE	.4023995	.1412358	-2.59	0.009	.202255	.8006002
_IBLS_2	.5573009	.2363171	-1.38	0.168	.2427433	1.279476
_IBLS_3	1.004739	.5205605	0.01	0.993	.3639495	2.773736
_IACLS_2	.2757164	.1274026	-2.79	0.005	.1114656	.6819999
_IACLS_3	.4600273	.2555426	-1.40	0.162	.1548624	1.366537
_IATLS_2	.2453958	.1991808	-1.73	0.083	.0500001	1.20438
duration	.9679894	.0135211	-2.33	0.020	.9418481	.9948563
_IHosp_2	1.957046	.6832638	1.92	0.054	.9872357	3.879548

Table 50. Logistic Odds Ratios Question 3 - Stable Explosive Patients

NoCBRNE = 0 have had some CBRNE training, NoCBRNE = 1 have not had any CBRNE training. Therefore, someone who has had some CBRNE training is more likely to respond than someone who has not had any training. The odds of responding are 2.5 (1/.402) times greater for those who have had some training. This variable is statistically significant.

BLS = 1 currently certified, BLS = 2 never certified, BLS = 3 once certified
Therefore, someone who was never certified is less likely to respond than someone who is currently certified. The odds of responding are 1.7 (1/.557) times greater for those who have had current training but this variable is not statistically significant. In addition, there is no difference in likelihood of response between those who were once certified and those who are currently certified (OR~1) and this variable is not statistically significant.

ACLS = 1 currently certified, ACLS = 2 never certified, ACLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 3.6 (1/.276) times greater for those who have had current training and it is statistically significant. In addition, those who were once certified are also less likely to respond than someone who is currently certified. The odds of responding are 2.2(1/.460) times greater for those who have had current training and but this variable is not statistically significant.

ATLS = 1 currently certified, ATLS = 2 never certified, ATLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 4.07 (1/.245) times greater for those who have had current training and this variable is not statistically significant. Note: IATLS = 3 predicts success perfectly (i.e., all who were once certified feel qualified and competent to respond to stable victims) so this variable was dropped and 27 observations were not used.

Duration = number of years out of medical school. This variable is significant (P=0.020) and every year further removed from medical graduation makes the person less likely to respond.

Hosp_1 = Hospital A, Hosp_2 = Hospital B

Therefore, physicians at hospital A are half (0.51) as likely as physicians from Hospital B to respond.. These odds of response are tending towards statistical significance (P=0.54).

- Classification Ability of the Logistic Model

I next calculate how well the model is able to classify physicians as to whether or not they would feel qualified and competent to respond to stable victims of an explosive event. I compare the model predictions with the actual results obtained from the survey to calculate the model's sensitivity, specificity, positive and negative predictive value, and the percent correctly classified.

```
          -------- True --------
Classified |         D          ~D  |      Total
-----------+--------------------------+-----------
    +      |       222           45  |        267
    -      |        11           23  |         34
-----------+--------------------------+-----------
   Total   |       233           68  |        301
Classified + if predicted Pr(D) >= .5
True D defined as Q3ans != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   95.28%
Specificity                     Pr( -|~D)   33.82%
Positive predictive value       Pr( D| +)   83.15%
Negative predictive value       Pr(~D| -)   67.65%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)   66.18%
False - rate for true D         Pr( -| D)    4.72%
False + rate for classified +   Pr(~D| +)   16.85%
```

False - rate for classified - Pr(D| -) 32.35%

Correctly classified 81.40%

Table 51. Model Fit Question 3 - Stable Explosive Patients

b. Chemical Scenario

(1) Unstable Chemical Patients. There are several models that are almost equivalent in performance to the best model as can be seen in Table 52. Using our decision criteria, the model that best fit the responses to physician's assessment of whether they feel qualified and competent to respond to an unstable victim is based on whether or not the physician has any CBRNE training, has BLS training, has ACLS training, has ATLS training, is a resident, attending or physician's assistant, and the duration since medical school graduation.

Explanatory variables included in the model	**Goodness of Fit Test (Pearson's Chi-squared)**	**ROC**	**Percentage Correctly Classified**	**AIC**	**BIC**
FTorPT; NoCBRNE; BLS; ACLS; ATLS; duration	0.08	.80	72.8%	371.0	409.3
NoCBRNE; BLS; ACLS; ATLS; duration **	0.09	.80	72.5%	372.3	406.8
NoCBRNE; BLS; ACLS; ATLS; duration; ResAttPA	0.09	.81	75.2%	367.5	409.5
FTorPT; NoCBRNE; BLS; ACLS; ATLS; duration; ResAttPA	0.06	.81	74.0%	368.8	414.7

(note: highlighted model is the best one for unstable, chemical patients,
** model is the best performing model across all four response scenarios)

Table 52. Model Comparison Question 5–Unstable Chemical Patients

- Statistics

```
xi: logit  Q5ans  NoCBRNE i.BLS i.ACLS i.ATLS  duration i.ResAttPA
Logistic regression                             Number of obs   =        338
                                                LR chi2(10)     =     102.98
                                                Prob > chi2     =     0.0000
Log likelihood = -172.74528                     Pseudo R2       =     0.2296
------------------------------------------------------------------------------
       Q5ans |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    NoCBRNE |  -.5531956   .2780881    -1.99   0.047    -1.098238   -.0081529
      _IBLS_2 |  -.3935312   .3984343    -0.99   0.323    -1.174448    .3873857
      _IBLS_3 |  -.7334209   .4585733    -1.60   0.110    -1.632208    .1653662
    _IACLS_2 | -1.396097    .3621947    -3.85   0.000    -2.105986   -.6862085
    _IACLS_3 |   -.1473394   .4413449    -0.33   0.738    -1.01236     .7176808
    _IATLS_2 |  -2.259406    .6535209    -3.46   0.001    -3.540283   -.9785281
    _IATLS_3 |  -.9907545   .8388342    -1.18   0.238    -2.634839    .6533302
    duration |   .0168683   .0159718     1.06   0.291    -.0144358    .0481724
_IResAttPA_2 |  -.9758841   .3745638    -2.61   0.009    -1.710016   -.2417526
_IResAttPA_3 |  -.9647497   .5362553    -1.80   0.072    -2.015791    .0862913
       _cons |   3.744164   .6802093     5.50   0.000     2.410979     5.07735
------------------------------------------------------------------------------
```

Table 53. Logistic Regression Question 5 - Unstable Chemical Patients

```
------------------------------------------------------------------------------
       Q5ans | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    NoCBRNE |   .5751091    .159931    -1.99   0.047      .333458    .9918803
      _IBLS_2 |   .6746703   .2688118    -0.99   0.323     .3089894    1.473125
      _IBLS_3 |   .4802633   .2202359    -1.60   0.110     .1954974    1.179825
    _IACLS_2 |   .2475613   .0896654    -3.85   0.000     .1217256    .5034814
    _IACLS_3 |   .8630011   .3808811    -0.33   0.738     .3633606    2.049674
```

_IATLS_2	.1044125	.0682358	-3.46	0.001	.0290051	.3758639
_IATLS_3	.3712964	.3114561	-1.18	0.238	.0717305	1.921931
duration	1.017011	.0162435	1.06	0.291	.9856679	1.049352
_IResAttPA_2	.376859	.1411577	-2.61	0.009	.180863	.7852504
_IResAttPA_3	.3810786	.2043554	1.80	0.072	.133215	1.090124

Table 54. Logistic Odds Ratios Question 5 - Unstable Chemical Patients

NoCBRNE = 0 have had some CBRNE training, NoCBRNE = 1 have not had any CBRNE training. Therefore, someone who has had some CBRNE training is more likely to respond than someone who has not had any training. The odds of responding are 1.7 (1/.575) times greater for those who have had some training. This result is statistically significant.

BLS = 1 currently certified, BLS = 2 never certified, BLS = 3 once certified
Therefore, someone who was once certified is much less likely to respond than someone who is currently certified. The odds of responding are 1.5 (1/.675) times greater for those who have had current training over those who have never had training but this variable is not statistically significant. The odds of responding are 2.1 (1/.480) times greater for those who have had current training over those whose training is not current but this variable is also not statistically significant.

ACLS = 1 currently certified, ACLS = 2 never certified, ACLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 4.0 (1/.248) times greater for those who have had current training and it is statistically significant. In addition, those who were once certified are also less likely to respond than someone who is currently certified. The odds of responding are 1.2 (1/.863) times greater for those who have had current training and but this variable is not statistically significant.
ATLS = 1 currently certified, ATLS = 2 never certified, ATLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 9.6 (1/.104) times greater for those

who have had current training and it is statistically significant. In addition, those who were once certified are also less likely to respond than someone who is currently certified. The odds of responding are 2.7 (1/.371) times greater for those who have had current training and but this variable is not statistically significant.

Duration = number of years out of medical school. This variable is not significant and the odds ratio is approximately one.

ResAttPA = 1 Resident, ResAttPA = 2 Attending, ResAttPA = 3 Physician's Assistant
Therefore, an attending physician is less likely to respond than a resident. The odds of responding are 2.7 (1/.377) times greater for residents and it is statistically significant. A physician's assistant is less likely to respond than a resident. The odds of responding are 2.6 (1/.381) times greater for residents and this result is tending towards statistical significance (P=0.072).

- Classification Ability of the Logistic Model

I next calculate how well the model is able to classify physicians as to whether or not they would feel qualified and competent to respond to unstable victims of a chemical event. I compare the model predictions with the actual results obtained from the survey to calculate the model's sensitivity, specificity, positive and negative predictive value, and the percent correctly classified.

	True		
Classified	D	~D	Total
+	176	50	226
-	34	78	112
Total	210	128	338

Classified + if predicted Pr(D) >= .5
True D defined as Q5ans != 0

Sensitivity Pr(+| D) 83.81%

Specificity Pr(-|~D) 60.94%

Positive predictive value Pr(D| +) 77.88%

Negative predictive value Pr(~D| -) 69.64%

False + rate for true ~D Pr(+|~D) 39.06%

False - rate for true D Pr(-| D) 16.19%

False + rate for classified + Pr(~D| +) 22.12%

False - rate for classified - Pr(D| -) 30.36%

Correctly classified 75.15%

Table 55. Model Fit Question 5 - Unstable Chemical Patients

(2) Stable Chemical Patients. There are several models that are almost equivalent in performance to the best model as can be seen in Table 56. Using our decision criteria, the model that best fit the responses to physician's assessment of whether they feel qualified and competent to respond to an stable victim is based on whether or not the physician has BLS training, has ACLS training, has ATLS training, and the duration since medical school graduation.

Explanatory variables included in the model	**Goodness of Fit Test (Pearson's Chi-squared)**	**ROC**	**Percentage Correctly Classified**	**AIC**	**BIC**
No CBRNE; BLS; ACLS; ATLS; duration **	0.35	.80	80.1%	261.3	290.9
No CBRNE; BLS; ACLS; ATLS; duration; Hosp	0.15	.80	83.8%	260.2	293.4
BLS; ACLS; ATLS; duration	0.20	.79	81.1%	260.8	286.7
BLS; ACLS; ATLS; duration; Hosp	0.11	.80	81.8%	260.1	289.6

(note: highlighted model is the best one for stable, chemical patients,
** model is the best performing model across all four response scenarios)

Table 56. Model Fit Question 5 - Unstable Chemical Patients

- Statistics

Logistic regression — Number of obs = 297
LR chi2(6) = 57.48
Prob > chi2 = 0.0000
Log likelihood = -123.41345 — Pseudo R2 = 0.1889

Q7ans	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_IBLS_2	-1.063144	.4125407	-2.58	0.010	-1.871709	-.2545789
_IBLS_3	-.2803167	.5008941	-0.56	0.576	-1.262051	.7014176
_IACLS_2	-1.569371	.5010724	-3.13	0.002	-2.551455	-.5872868
_IACLS_3	-1.241896	.6014198	-2.06	0.039	-2.420657	-.0631349
_IATLS_2	-.9735121	.8312102	-1.17	0.242	-2.602654	.65563
duration	-.0347304	.0142954	-2.43	0.015	-.0627488	-.006712
_cons	3.987253	.7928104	5.03	0.000	2.433373	5.541133

Table 57. Logistic Regression Question 7 - Stable Chemical Patients

Q7ans	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_IBLS_2	.3453683	.1424785	-2.58	0.010	.1538605	.7752429
_IBLS_3	.7555444	.3784477	-0.56	0.576	.2830728	2.016609
_IACLS_2	.2081762	.1043113	-3.13	0.002	.0779682	.5558333
_IACLS_3	.2888361	.1737117	-2.06	0.039	.0888632	.9388168
_IATLS_2	.377754	.313993	-1.17	0.242	.0740767	1.926356
duration	.9658658	.0138074	-2.43	0.015	.9391793	.9933105

Table 58. Logistic Odds Ratios Question 7 - Stable Chemical Patients

BLS = 1 currently certified, BLS = 2 never certified, BLS = 3 once certified
Therefore, someone who was never certified is less likely to respond than someone who is currently certified. The odds of responding are 2.9 (1/.345) times greater for those who have had current training and this result is statistically significant. The odds of responding are 1.3 (1/.756) times greater for those who have had current training over those whose training is not current but this variable is not statistically significant.

ACLS = 1 currently certified, ACLS = 2 never certified, ACLS = 3 once certified
Therefore, someone who was never certified is much less likely to respond than someone who is currently certified. The odds of responding are 4.8 (1/.208) times greater for those who have had current training and it is statistically significant. In addition, those who were once certified are also less likely to respond than someone who is currently certified. The odds of responding are 3.5 (1/.288) times greater for those who have had current training and this variable is statistically significant as well.

ATLS = 1 currently certified, ATLS = 2 never certified, ATLS = 3 once certified
Therefore, someone who was never certified is less likely to respond than someone who is currently certified. The odds of responding are 2.6 (1/.378) times greater for those who have current training but this variable is not statistically significant. Note: IATLS = 3 predicts success perfectly (i.e., all who were once certified felt qualified and competent to respond to stable victims) so this variable was dropped and 25 observations were not used.
Duration = number of years out of medical school. This variable is significant (P=0.015) and every year further removed from medical graduation make the person less likely to respond.

- Classification Ability of the Logistic Model

I next calculate how well the model is able to classify physicians as to whether or not they would feel qualified and competent to respond to stable victims of a chemical event. I compare the model predictions with the actual results obtained from the survey to calculate the model's sensitivity, specificity, positive and negative predictive value, and the percent correctly classified.

Classified	D	~D	Total
+	226	47	273
-	9	15	24
Total	235	62	297

Classified + if predicted Pr(D) >= .5
True D defined as Q7ans != 0

Sensitivity	Pr(+| D)	96.17%
Specificity	Pr(-|~D)	24.19%
Positive predictive value	Pr(D| +)	82.78%
Negative predictive value	Pr(~D| -)	62.50%
False + rate for true ~D	Pr(+|~D)	75.81%
False - rate for true D	Pr(-| D)	3.83%
False + rate for classified +	Pr(~D| +)	17.22%
False - rate for classified -	Pr(D| -)	37.50%
Correctly classified		81.14%

Table 59. Model Fit Question 7 - Stable Chemical Patients

c. Overall Model and Summary

In looking for a global model that works well for all four questions, I focus on the most parsimonious model as determined by the BIC score. Every question could obtain better AIC scores by including an additional variable in the model (though not the same variable). However, one model provides the best BIC score in three out of

the four questions (Questions 1, 3, and 5). In the fourth question (Question 7) a simpler model is better; however, the chosen model scored third in BIC and is close in absolute terms of BIC value.

The overall predictor model that best fits the responses to physician's assessment of whether they feel qualified and competent to respond in each of the four cases is based on whether or not the physician has any CBRNE training, has BLS training, has ACLS training, has ATLS training, and the duration since medical school graduation.

For the individual questions, additional information relating either to the hospital of service or the physician's standing as a resident, attending or physician's assistant could provide additional accuracy. This finding is most likely related to the fact that in the crosstab assessments, the number of full-time and part-time individuals is statistically different between those who judge themselves qualified and competent and those who do not. However, when creating the models, those that include the variable FT or PT have higher (worse) AIC and BIC values than those that do not. Therefore, this variable is not included in the final models. Further analysis shows that the number of full-time and part-time employees tend toward statistically significant differences between the hospitals ($p=0.06$) and is statistically different between residents, attendings, and Physician's assistants ($p=0.000$). Neither of these latter two variables is individually significantly different between those who judge themselves qualified and competent and those who do not. Additionally, the number of residents, attendings, and physician's assistants tend toward statistically significant differences between the hospitals ($p=0.066$). Additional interaction variables are developed and tested in the logit models– the first, a classification by full-time or part-time and standing (resident, attending, or PA); the second, a classification by hospital and standing; and the third, a classification of hospital and fulltime or part-time, and the fourth, a classification by hospital, full-time or part-time, and standing–but none of these variables improve all of the logit models. The cross between hospital and standing produces a good model for Question 3 and the cross between standing and fulltime/part-time produces a good model for Question 1. I tested

for multicollinearity in Stata between the variables (FTorPT, Hosp, ResAttPA) and did not find any using *collin*. Therefore, while there is likely confounding between these variables, the exact nature of the relationship is unclear.

Finally, even though duration (time since graduation) is not statistically significant in all of the logistic regressions, its inclusion did greatly improve model goodness of fit, AIC, BIC, and the percent correctly classified.

The overall results show that the information needed to best predict physician's self-reported assessment of qualification and competency for all four scenarios is based on their training histories (BLS, ACLS, ATLS, and CBRNE) and time since graduation.

5. Summary Results of the Likert Questions

Several statements are presented and the respondents are asked to rate their beliefs about the statement on a scale from 1 to 5 where score 1 was "Strongly Agree" and score 5 was "Strongly Disagree." There were four broad categories of statements, including the roles of the clinician in disaster response, barriers to participating in either a response or in training for a response, how training should be implemented and who should implement it. Summaries of the results are presented below. For more detail on the exact responses, please see Appendix D.

a. The Role of the Clinician in a Disaster

There were five questions relating to physician's perception as to their role and responsibilities in responding to a natural disaster.

- "Medical Specialists Have Skills Applicable to a Catastrophic Response Team." The average score for all respondents is 2.18 (Std. Dev.0 .94). Residents, Hospital B and female respondents and those who graduated between 1980 and 1989 agree with this statement more than their counterparts.
- "Medical Professionals Have an Ethical Responsibility to Respond." The average score for all respondents is 1.72 (Std. Dev. 0 .78). Residents and PAs, Hospital B and those who graduated before 1980 agree with this statement more than their counterparts.

- "Medical Professionals are Receptive to Additional Training that Enables them to Provide Additional Assistance during Catastrophic Events." The average score for all respondents is 1.88 (Std. Dev. 0 .76). Residents and PAs, Hospital B, female and those who graduated between 1990 and 1999 agree with this statement more than their counterparts.
- "Medical Specialists are Receptive to Assistance from Other Professionals during a Catastrophic Event." The average score for all respondents is 1.76 (Std. Dev. 0.69) with residents, Hospital B, female and those who graduated from 1990-1999 agree with this statement more than their counterparts.
- "Training in CBRNE Should be Mandated for all Physician's/Pas." The average score is 2.48 (Std Dev. 1.16) with Residents, PAs, females, Hospital B respondents and those who graduated between 2000 and 2008 being more agreeable than their counterparts.

In conclusion, respondents feel that they have clinical skills that could be useful in a catastrophic response effort. They feel that they have an ethical responsibility to respond and that other clinicians would be receptive to their assistance. They are receptive to additional training to enable them to respond. Respondents are neutral about whether this training should be mandated.

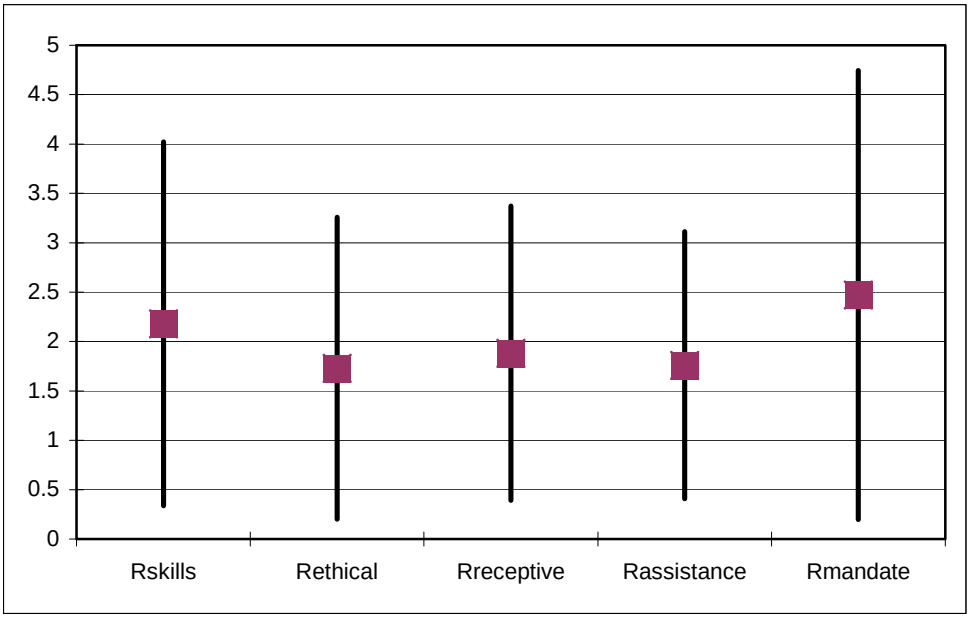

Figure 24. Likert Graph for Role of the Clinician in a Disaster

b. Concerns or Barriers to Participation

There are six questions designed to assess why physicians may not feel comfortable responding to disasters or taking part in trainings to respond to disasters.

- "I Have Concerns about Risk and Malpractice." The average score for all respondents is 2.25 (Std. Dev. 0.94) with Attendings, Hospital A, female and those who graduated between 1990 and 1999 and those who graduated before 1980 being more concerned than their counterparts.
- "Training Costs are a Concern." The average score for all respondents is 2.44 (Std. Dev. 0.95) with Attendings, Hospital A, female and graduates from 2000-2008 being more concerned than their counterparts. Reimbursement for education may be inconsistent at facilities and between attendings and residents.
- "Amount of Training Time is a Concern." The average score for all respondents is 2.28 (Std. Dev. 0.90) Attendings, Hospital A, female and those who graduated before 1980 have greater concerns than their counterparts. This concern may be the result of attendings having to generate revenue and demonstrate productivity and RVUs. Females may have increased family responsibilities.
- "The Cost of My Time for Training is a Concern." The average score for all respondents is 2.25 (Std. Dev. 0.95). Females and those who graduated between 1990 and 1999 and before 1980 have more concern than their counterparts. PAs and Hospital B respondents show considerably less concern than their counterparts.
- "I Have Concerns that I Can Learn These Skills." The average score for all respondents is 3.21 (Std. Dev. 1.12). Attendings, PAs, Hospital A, female and graduates before 1980 have greater concerns than their counterparts.
- "I Have Concerns about Retention of These Skills." The average score for all respondents is 2.88 (Std. Dev. 1.14). PAs, females and those who graduated before 1980 and between 2000 and 2008 have greater concerns than their counterparts.

In conclusion, respondents have mild concerns about risk and malpractice. They show some concern for the cost of training, the time involved in training and the cost for the time in training (lost revenue, CME time). Respondents have fewer concerns about whether they can learn and retain these skills.

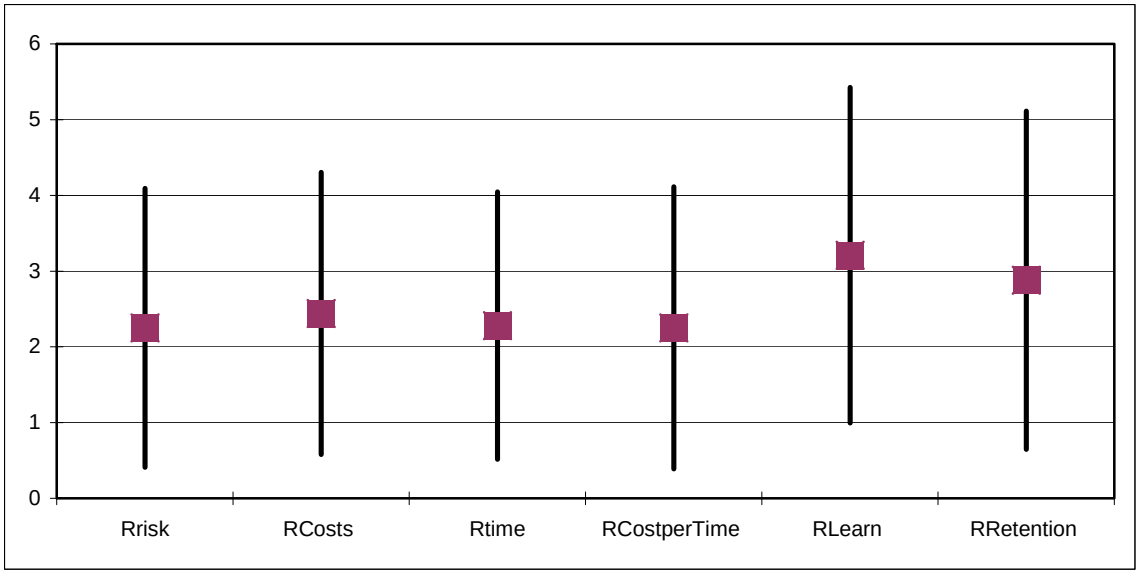

Figure 25. Likert Graph for Concerns and Barriers to Participation

c. Conditions of Participation

There are six questions to assess how physicians feel that a training program would best be implemented.

- "Training in CBRNE Should be Mandated for all Physicians/PAs." The average score for all respondents is 2.72 (Std Dev. 1.20). Residents, PAS, Hospital B, and females agree more strongly than their counterparts.
- "CBRNE Training Should be Standardized across all Disciplines." The average score for all respondents is 2.35 (Std. Dev. 1.12) with Residents, PAs, Hospital B, females agreeing more strongly than their counterparts.
- "Retraining in CBRNE Should Occur at Regular Intervals." The average score for all respondents is 2.16 (Std. Dev. 0.95) Residents, PAs, Hospital B, females and those who graduated since 1990 feel more strongly than their counterparts.
- "CBRNE Training Should be a Requirement for Medical Board Credentialing/Re-credentialing." The average score for all respondents is 3.12 (Std. Dev. 1.23).Residents, PAS, Hospital B, and females agree more strongly than their counterparts.
- "CBRNE Training Should be a Requirement for a State Medical License." The average score for all respondents is 3.22 (Std. Dev. 1.22). Hospital B and females agree more strongly than their counterparts. Those who graduated before 1999 disagree.

- "CBRNE Training Should be a Requirement for Board Certification/Recertification." The average response for all respondents is 3.19 (Std. Dev. 1.23). Attendings and PAs, Hospital A, males and those who graduated before 1999 disagree more than their counterparts.

In conclusion, while clinicians tend to agreed that CBRNE training should be standardized and offered on a regular basis, they tend to disagree that CBRNE should be mandated or made a requirement for state medical licensure, for Medical Board credentials, for Board Certification or Recertification.

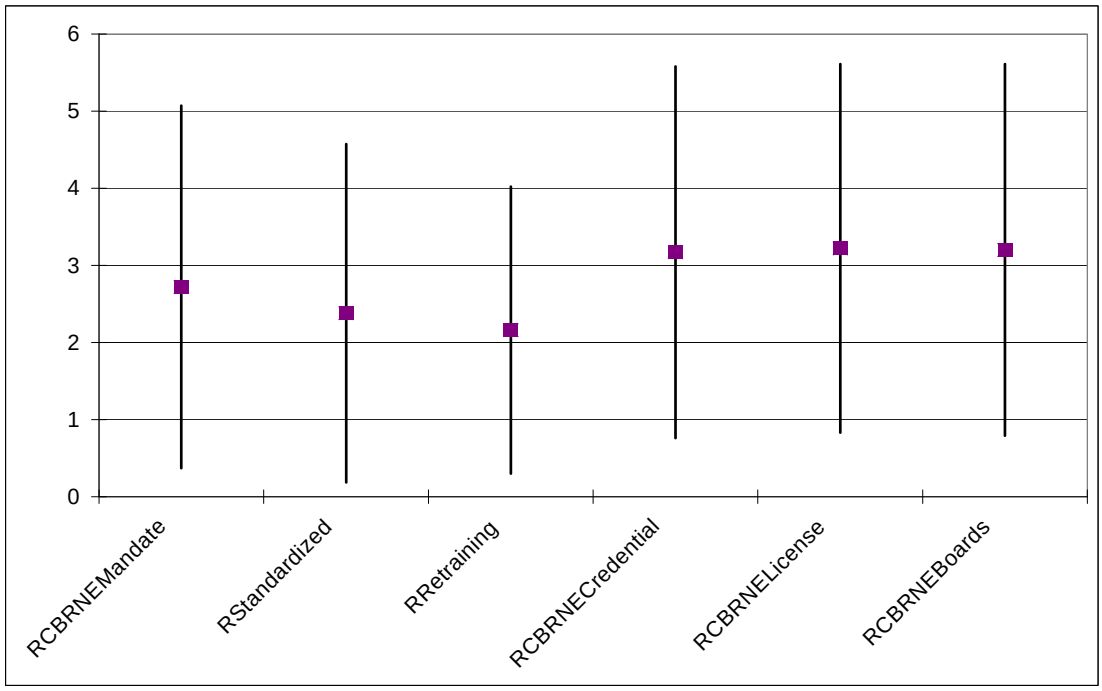

Figure 26. Likert Graph for Conditions for Participation

d. Training Preferences

There are seven questions to assess whom physicians thought should best conduct training programs.

- "Postgraduate CBRNE Response Training Should be Conducted by the Hospital." The average score for all respondents is 2.18 (Std. Dev. 0.93). Residents and PAs, Hospital B, females and those who graduated between 2000 and 2008 agree more strongly than their counterparts.

- "Postgraduate CBRNE Response Training Should be Conducted by the Department of Health." The average score for all respondents is 2.49 (Std. Dev. 0.97). Residents, Hospital B, females and those who graduated between 2000 and 2008 agree more strongly than their counterparts.
- "Postgraduate CBRNE Response Training Should be Conducted by the Medical Society." The average score for all respondents is 2.78 (Std. Dev. 0.98). Hospital B and females feel more strongly than their counterparts.
- "Postgraduate CBRNE Response Training Should be Conducted by the CDC." The average response for all respondents is 2.54 (Std. Dev. 0.96). Hospital B, females and those who graduated from 2000-2008 feel more strongly than their counterparts.
- "Postgraduate CBRNE Response Training Should be Conducted by Private Organizations such as the American Heart Association." The average score is 2.68 (Std. Dev. 0.96). Those who graduated before 1980 disagree the most with their counterparts
- "Postgraduate CBRNE Response Training Should be Conducted by a National Specialty Society such as the American College of Physicians." The average score for all respondents is 2.69 (Std. Dev. 0.95). Those who graduated before 1980 disagree more than their counterparts.
- "Postgraduate CBRNE Response Training should be Conducted by the U.S. military." The average score for all respondents is 2.48 (Std. Dev. 0.99). Those who graduated before 1980 disagree more than their counterparts with this statement.

In conclusion, clinicians tend to prefer that training be conducted by their hospital. They tend to less agreement with the Medical Society, private organization and National Societies. They are neutral about the Department of Health, CDC and the military.

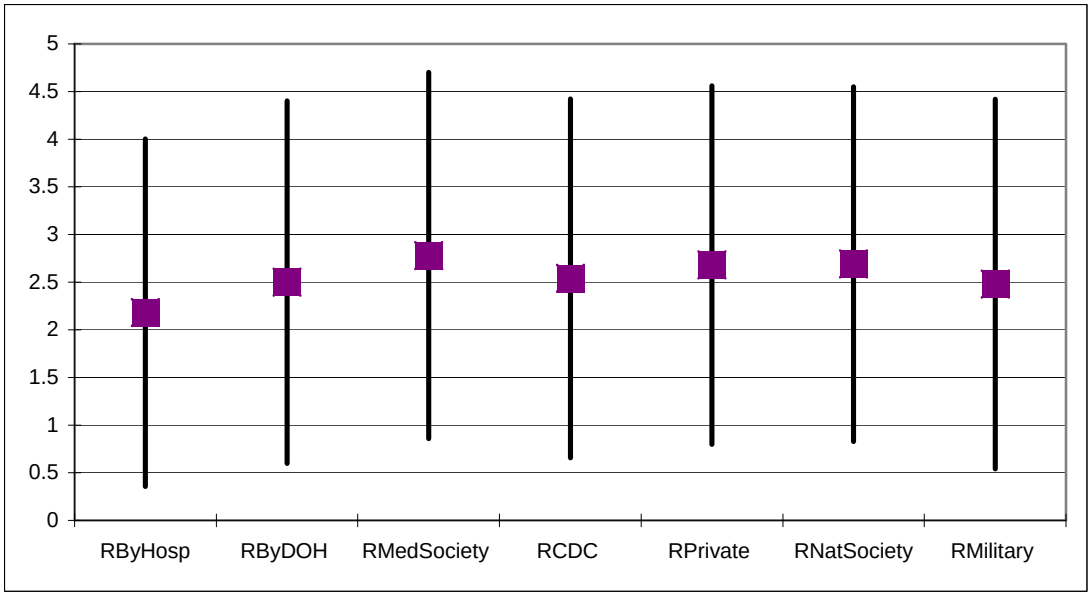

Figure 27. Likert Graph for Training Preferences

e. Open Ended Questions

At the end of the survey, physicians and physician assistants are asked a series of open-ended questions where they could provide additional input if they so desired. Approximately half of the physicians chose to respond.

Physicians are asked what subject matter for CBRNE training they would like to receive. The responses are centered on structured algorithmic training such as courses similar to ACLS and ATLS. Many respond with various combinations of the subject matter (i.e., Chemical, Biological, Radiological, Nuclear or Explosive) or all of them. Responses include, "all that is available," "ACLS," "ATLS," "emergency medicine residency," and "emergency care management." Many physicians indicate that they would be very interested in additional training. Several indicate that this topic is very interesting to them. They want to participate and would like to learn more. A few indicate that they are not interested.

The physicians are asked specifically what type of training they feel they would want to prepare to assess and manage victims of explosive and chemical events. The responses cover a wide range of opinions. Scenarios, simulations, drills, and

practical, hands-on course similar to the life support courses are the most common responses. Some indicate that the practice aspect of this response should be incorporated into regular hospital disaster drills and simulations as well as during regular Continuing Medical Education (CME) or Grand Rounds. Others speak to the need to standardize training while others call for the development of guidelines and manuals. More than half of those who give an opinion indicate that field training and simulations or drills would be valuable. Approximately one-third indicate that classroom training is valuable. Less than a quarter indicate that they want on-line or tele-conferencing training. In summary, those who respond have very differing ideas and there is no consensus. This question represents an area for further research.

Physicians are also asked to provide ideas for what they feel would be conditions for the training to be successful. The main themes from these responses are that the training should be voluntary, should be started early in medical school and should be conducted in the hospital where it could begin at orientation and continue on a regular basis at conferences and drills. Some suggest that this education needs to be promoted to gain greater acceptance by the medical community. Several speak to the need for enthusiastic, effective and qualified instructors.

Participants at both hospitals were asked what barriers to CBRNE training they envision. Many say training should be voluntary; not mandated. A few are concerned that specialists and non-ED physicians would be able to learn the material and required skills. Some speak about sustainability and retention of this knowledge and the skills. However, the majority of respondents voice concerns about time for training and express concerns about the cost of training both in money (absolute cost, lost revenue) and time (personal time vs. hospital time, using or losing dedicated CME hours to this training, convenient scheduling and location, arranging coverage for patients during these activities). Several indicate that time should be provided during the workday by the hospital and that the hospital should absorb the costs of training. A few respondents indicate concerns about having malpractice liability should they be called to respond. In summary, the main concerns seem to center around the logistical issues surrounding time and money.

6. Chapter Summary and Discussion

At the outset, this thesis sought to determine if non-EM and Trauma clinicians had knowledge and procedural skills from current or previous experience that could be enhanced to allow these clinicians to assist EM and Trauma clinicians under a tiered supervision system in the assessment and stabilization of victims of explosive or chemical events in the initial "Golden Hour" when rapid intervention may positively affect patient outcome and may enhance the hospital response to a mass casualty event. This tiered supervision system is already familiar to most physician graduates of training programs and especially Emergency Medicine physicians. One of the hallmarks of the Emergency Medicine Residency Training program is graduated responsibility, whereby the Post Graduate Year I resident (PGYI) is supervised by the PGY II resident, who takes direction from the chief resident, who in turn is supervised by an Attending Physician. This model allows the attendings management and procedural skill expertise to extend to many patients at once and serves as a force multiplier. The attending steps in to assist if they detect any difficulty or delay.

This thesis identifies a limited exposure in two hospitals to the didactics of CBRNE. When each scenario is presented and each piece of the resuscitation is explored, clinicians have skills or familiarity with skills that could be exploited in the early management of these victims. Clinicians who indicate that they do not have the skills but still feel qualified and competent may be thinking that in their hospital, other resources are at hand to assist them. For example, intubation may be a crucial procedure for these patients. Clinicians who cannot intubate may know that they can ventilate and get an immediate anesthesia consult in their hospital.

Skills that might be crucial in the short-term assessment and stabilization of victims of explosive or chemical events are airway management (including positioning, use of adjuncts, suctioning, use of medications to control secretions and definitive intubation.) Also crucial are patient assessment and stabilization, including interpretation of vital signs and monitoring, and management of resuscitation fluids for both types of victims. For the explosive victim, assessment of internal hemorrhage and the need for and

administration of blood and blood products and control of external hemorrhage are important skills. Also crucial in a chemical event are the management of seizures. Less crucial but helpful skills in any scenario might be the ability to triage at secondary sites, the ability to clean and dress a wound, splint, and suture simple lacerations. This plan will provide timely assessment of large numbers of patients and management of wounds to improve outcome, stabilize fractures, manage pain, and expedite transfer to other facilities or alternate care sites. Clinicians with these skills are helpful to move patients safely and promptly through the ED and minimize the distraction of these patients from the major resuscitation efforts.

For the unstable victim of the explosive event, at least one CBRNE training made the clinician 1.5 times more likely to respond than someone who is not trained. This variable was not statistically significant. Current BLS certification makes the clinician 2.1 times more likely to respond than someone who has remote BLS training. This variable was not statistically significant. The difference between those who are currently trained versus those who were never trained is not statistically significant. Those who have had training know it is harder than those who have never had training. Current ACLS training makes the clinician 5.3 times more likely to respond than those who have never been certified, and this variable is statistically significant. Current ACLS certification makes the clinician 1.3 times more likely than someone who was once certified, and this variable is not statistically significant. Current ATLS certification makes the clinician 8.8 times more likely to respond than someone who was never certified in ATLS, and this variable is statistically significant. Current ATLS certification makes the clinician 3.3 times more likely to respond than someone who was once certified, and this variable is not statistically significant. Years from medical school graduation is not statistically significant. Resident physicians are 2.3 times more likely to respond than attendings and 3.7 times more likely to respond than Pas. Both findings are statistically significant.

For stable explosive victims, any CBRNE training makes the clinician 2.5 times more likely to respond that those who receive no training. This variable is statistically significant. Current BLS training makes the clinician 1.7 times more likely to respond

than someone who was never certified and there is no difference in likelihood to respond than someone with remote training. Neither variable were statistically significant. Current ACLS training makes the clinician 3.6 times more likely to respond than someone who was never certified. This variable is statistically significant. Current ACLS training makes the clinician 2.2 times more likely to respond than someone who was once certified. This variable is not statistically significant. ATLS certification makes the clinician equally likely to respond than someone who was once certified, and this variable is not statistically significant. ATLS certification makes the clinician 4.03 times more likely to respond than someone who was never certified, and this variable is not statistically significant. More recent medical school graduates are more likely to respond and this variable is statistically significant. Hospital B clinicians are 1.9 times more likely to respond and this tends toward significance (P=0.054).

For unstable chemical event victims, any CBRNE training makes the clinician 1.7 times more likely to respond, and this variable is statistically significant. Current BLS certification makes the clinician 1.5 times more likely to respond than someone who was never certified and 2.1 times more likely than someone who was once certified. Neither is statistically significant. Current ACLS makes the clinician 4.0 times more likely to respond than someone who was never certified, and this variable is statistically significant. Current ACLS certification makes the clinician 1.2 times more likely to respond than someone who was once certified, and this variable is not statistically significant. Current ATLS certification makes the clinician 9.6 times more likely to respond than someone who was never certified, and this variable is statistically significant. However, current ATLS certification makes the clinician only 2.7 times more likely than someone who was once certified, and this variable is not statistically significant. Number of years since medical school is not statistically significant. Residents are 2.7 times more likely to respond than attendings and this variable is statistically significant. Residents are 2.64 times more likely than PAs to respond, and this variable tends toward statistical significance (P=0.072).

For stable chemical victims, current BLS certification makes the clinician 2.9 times more likely to respond than someone who was never certified, and this variable is

statistically significant. Current BLS certification makes the clinician 1.3 times more likely to respond than someone who was once certified, and this variable is not statistically significant. Current ACLS certification makes the clinician 4.8 times more likely to respond than someone who was never certified, and 3.5 times more likely than someone who was once certified. Both results are statistically significant. Current ATLS certification makes the clinician 2.6 times more likely to respond than someone who was never certified, but this variable is not statistically significant. Years from medical school graduation is statistically significant. For each year away from medical school graduation, the clinician is less likely to respond.

Conclusion Model Summary		
Unstable Victim of Explosive Event		
More likely to respond if:		P=
Current ACLS Certification compared to never certified	5.3x	0.000
Current ATLS Certification compared to never certified	8.8x	0.001
Residents compared to attending	2.3x	0.023
Residents compared to Physician Assistant	3.7x	0.013
Stable Victim of Explosive Event		
More likely to respond if:		
Any CBRNE compared to none	2.5x	0.009
Current ACLS certification compared to never certified	3.6x	0.005
More recent medical school graduates	**	0.020
Hospital B respondents	1.9x	0.054
Unstable Victim of Chemical Event		
More likely to respond if:		
Any CBRNE training compared to none	1.7x	0.047
Current ACLS certification compared to never certified	4.0x	0.000
Current ATLS certification compared to never certified	9.6x	0.001
Residents compared to attending	2.7x	0.009
Residents compared to Physician Assistant	2.64x	0.072
Stable Victims of Chemical Event		
More likely to respond if:		
Current BLS certification compared to never certified	2.9x	0.010
Current ACLS certification compared to never certified	4.8x	0.002
Current ACLS certified compared to once certified	3.5x	0.039
More recent medical school graduates	*	0.015

* This decreases incrementally each year.

Table 60. Conclusion Model Summary

In an overall sense, the best model to predict the number of physicians who are likely to self-assess themselves as being qualified and competent to respond to victims in each of the four scenarios-unstable explosive victims, stable explosive victims, unstable chemical victims, stable chemical victims is based on whether or not the physician has current Life Support training (BLS, ACLS, ATLS), some CBRNE training and the duration since medical school graduation. While duration (time since graduation) is not statistically significant in all of the logistic regressions, its inclusion does greatly improve goodness-of-fit and the percent of physicians who are correctly classified as to whether they feel they are qualified and competent. This result is important because it highlights the fact that the best predictor of a physician's response in an emergency event is their training history, far outweighing all other considerations.

Many clinicians resist, delay and reason against required Life Support training. They use arguments against "cookbook medicine." They indicate that they do not need the training/retraining, that they already have the training by virtue of their Board certification, and that these courses are just money-making enterprises sponsored by organizations that operate outside of the hospital arena and do not relate to them. Yet these qualifications are the exact trainings that are present in those who self-assess themselves qualified and competent.

The model offers challenges to the healthcare community to encourage and motivate training in Life Support. The house of medicine must decide if this training can be done with modifications for special situations of the current widely-available courses to provide a framework for approaching and managing the victims of scenarios such as are studied in this thesis. Alternatives may include promotion of the newer but less available Basic Disaster Life Support Course, and/or the Advanced Disaster Life Support Course developed by the University of Georgia in conjunction with the American Medical Association.

Alternatively, each Board of Medical Specialty could offer training and competency testing and certification in the management of victims of CBRNE events and perhaps offer an added qualification to Board certification as an incentive. This proposal could provide powerful motivation for physicians, and leverage for improving the

preparedness of all physicians. The ABMS would have to actively participate to ensure that the individual boards are not stove-piped and integration between specialties. Integration is needed in a hospital for a successfully prepared team to administer an effective response.

The model supports that those qualified and competent have some CBRNE training although there are more variations in training for these subjects and less availability and less requirements for training. Training currently exists for all responders. Some training is quite basic and some is quite technical and specialized. Choosing relevant and physician-specific training will be crucial to ensure physician interest and participation. In addition, the model shows that the qualified and competent are the more recent medical school graduates. That data suggests that exposure to the didactics of the CBRNE agents and the overview of response should begin in medical school and continue into residency.

This information is useful to planning and oversight agencies responsible for improving healthcare preparedness and response especially as it relates to curriculum development and to federal funding agencies to allocate scarce preparedness dollars most appropriately.

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IV. DISCUSSION

A. INTRODUCTION

Healthcare response is one crucial step in the continuum of emergency response. All hospitals are required to have well-rehearsed disaster response plans. The plans are often based on traditional responders performing traditional response one patient at a time supplementing staff from a distance. These plans are insufficient for a mass casualty event such as an explosive or chemical event where time of response is a crucial factor in a successful response. Barbera and McIntyre,[241] the Arizona Chapter of the American College of Emergency Physicians[242] and others have identified the lack of capacity. The Society of Academic Emergency Medicine has questioned the adequacy of surge capability.[243]

The medical community must take preparedness for victims of explosive and chemical events to a new level as suggested by the AMA.[244] All practitioners should be able to care for CBRNE victims. The medical community must look at the scenarios and the time frame of response. They must strategize together to build alliances and foster willingness on the part of practitioners in a horizontally and vertically integrated response plan. Integration in healthcare response involves all the steps that take the victim to definitive care as safely and expeditiously as possible. The continuum begins with first responders–especially EMS–moves to the ED, the OR and the ICU, and perhaps transfers to tertiary care hospitals. Integration between departments and providers within a hospital

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[241] J. Barbera, A. Macintyre, and C. DeAtley, *Ambulances to Nowhere: America's Critical Shortfall in Medical Preparedness for Catastrophic Terrorism* (BCSIA Discussion Paper 2001-15, ESDP Discussion Paper ESDP2001-07 (Cambridge, MA: Harvard University Press, 2001), 14.

[242] Arizona College of Emergency Physicians, *Position Statement on the Critical State of Emergency Care in Arizona* (Phoenix, AZ: Arizona College of Emergency Physicians, 2000), http://www.azceorg/er_crowding/position.pdf (accessed January 12, 2007).

[243] Sally Phillips, "Current Status of Surge Research," *Academic Emergency Medicine* 13, no. 11 (November 2006): 1103.

[244] American Medical Association, Physician Obligation in Disaster Preparedness and Response, Policy of American Medical Association, E-9,067 Issued December 2004, Adopted June 2004, 1, http://www.ama-assn.org/apps/pf_new/pf_online?f_n=resultLinkanddoc=policyfiles/HnE/E- (accessed June 23, 2007).

is equally important for a well-timed escalation of surge capability. Enhanced integration may require that providers step out of traditional roles. They must incorporate their talents in an improved, coordinated response that is appropriate for the realities of this decade, and give consideration to lessons learned and best practices developed from the experience of other countries and the United States military.

This research explores whether there are qualified and competent physician resources within a hospital that, when configured differently, could make this happen. Rather than building a response effort that relies on outside professional assistance that may never respond in the appropriate time frame, and rather than committing precious federal dollars to many projects that may never provide an improved response capability, this research looks at the current capabilities in terms of numbers of clinicians and abilities present within two hospitals. It provides a snapshot view of clinician background, training, abilities, willingness to learn and comments. It assesses clinician-perceived preparedness and willingness to learn to participate in a response effort for the two scenarios of explosive and chemical events. By deconstructing the response effort for these two scenarios into individual required tasks and querying clinicians about ability for each task, it is clear that organization of these clinicians around these tasks and rethinking the response framework along different lines of authority could improve a hospital response for the scenarios of an explosive or chemical event where time of response is a crucial factor in a successful outcome for the greatest number of patients.

Medical leadership must take a step back and create a transformation of healthcare preparedness and response such that physicians are educated and trained.

B. REVIEW OF SURVEY FINDINGS

1. Demographics

The survey was completed by 401 physicians representing 19 specialties and 24 physician assistants at two hospitals. There was a response rate of 43.10%. Males represent 60.90%. Resident physicians represent 52.24%, attending physicians 42.12% and PAs 5.65% of the total. Of the 179 attending physicians, 79.89% are board certified,

12.29 % are board eligible, and 7.82% do not respond to the question. Fifty percent graduated within the past 10 years. Two hundred ninety-three respondents identify themselves as trained in medical specialties and 95 identify themselves as trained in surgical specialties. The remainder identify themselves as physician assistants or do not provide a primary specialty code. Ninety percent of the physicians are employed in full-time positions; 10% in part-time positions. Many of those physicians who are part-time at a hospital are likely to have multiple appointments in different hospitals.

2. Training

The results of training are interesting in that 18.35% have never been certified in Basic Life Support, 36.47% have never been certified in Advanced Cardiac Life Support and 78.12% have never been certified in Advanced Trauma Life Support. Yet, these courses provide a framework of rapid emergency response, including teaching procedures necessary to manage victims of these two scenarios and many respondents indicate that they want additional similar training. Only 42.59% have any training in CBRNE.

3. Scenarios

a. Explosive Scenario

For the unstable victim of an explosive, 62.88% indicate that they are qualified and competent to evaluate and stabilize them. There is a statistically significant difference in perception of qualified and competent if the respondent is BLS, ACLS or ATLS certified or have any CBRNE training. For those who judge themselves neither qualified nor competent for an unstable explosive victim, 87.62% indicate that they are willing to learn. There is a statistically significant difference in willingness between resident, attending and PA; year of graduation; board certification status; and part- or full-time employment.

For stable victims of explosive events, 78.33% indicate that they are qualified and competent to manage stable explosive victims. Of the 57 who indicate that they are neither qualified nor competent, 82.46% indicate a willingness to learn. There is

a tendency toward statistical significance by year of graduation and a statistical difference exists for those with current BLS, ACLS, ATLS certification or any CBRNE training. For those who are neither qualified nor competent for stable victims but willing to learn to manage victims of explosive events, there is a statistically significant difference between resident, attending and PA; by decade of graduation; by attending board certification status; and a tendency for statistical significance for full-time as compared to part-time physicians.

b. Chemical Scenario

For unstable victims of chemical events, 61.54% indicate that they are qualified and competent for unstable victims of a chemical event. There is a statistical significance for those who are qualified and competent if they are currently BLS, ACLS, ATLS certified and have some CBRNE training. For those who are neither qualified nor competent, 76.52% indicate a willingness to learn. There is statistical significance if they are more recent graduates or full-time.

For stable chemical victims, 80.05% indicate that they are qualified and competent to manage these victims. There is statistical significance for those who are currently certified in BLS, ACLS, ATLS and have any CBRNE training. For those who are neither qualified nor competent, 72% indicate a willingness to learn. There is statistical significance for more recent graduates.

In a multivariate logit analysis, the explanatory variables included in the best model to predict the likelihood of physician's perceived ability to respond in any/all of these four scenarios are: whether or not physicians had BLS, ACLS., ATLS, CBRNE training and the number of years since medical school graduation. This model has the best goodness of fit and predictive ability across all four scenarios. The most important factors affecting a physician's perceived ability to respond are their levels of training and the relative recentness of that training.

C. RISK PERCEPTION MODIFIERS

Physicians learn by training and develop confidence by experience. Yet there is no standardized curriculum and only 42.59% have some CBRNE training. Few U.S. physicians have practical experience with these types of events. Responses about needed training are very diverse, reflecting the different ways individuals learn. Some respondents express concern about their ability to learn the skills and to retain them. Many respondents do not respond to questions about what type of training they would like to have, perhaps reflecting their inexperience with the topics. Some want frequent retraining; one wants a specialty residency. Of those who voice a choice, many request algorithmic courses that they are familiar with such as ACLS, ATLS and CBRNE training.

When asked about the method of training, their choices are the following.

Field Training	75.50%
Classroom	37.40%
Simulation/Drill	70.07%
Online	24.40%
Teleconference	16.30%

Table 61. Physician Choices for Training

D. RESPONSE BARRIERS AND ENABLERS

Several clinicians express concerns about malpractice and liability coverage. Recent pediatric literature raises issues around these matters during Hurricane Katrina response.[245]

Respondents indicate that ease of access to training, the cost of training, the amount of time it takes to train, the ability to take the time, which would require alternate coverage for their position and patients, putting responsibilities on hold and the loss of revenue for that training period are all of concern. The regularity of the training is a

[245] Committee on Pediatric Emergency Medicine, Committee on Medical Liability and the Task Force on Terrorism, "The Pediatrician and Disaster Preparedness," *Pediatrics* 117 (2006): 563-564.

concern. They want convenient scheduling. Some are concerned that this training would interfere with their ability to take other continuing medical education. A few specifically request competent, credible faculty.

Respondents are less enthusiastic about mandated training or requiring training for hospital medical staff credentialing, for state medical licensure or for specialty board certification. As a group, they are more enthusiastic to have training given by their hospital than by any other outside or professional agency, perhaps reflecting their concerns about convenience and cost. Residents are more likely to want training than attendings or PAs. Since they are all graduates, they do not call for training in medical school, although some did have it in medical school.

E. MOTIVATORS AND COGNITIVE DISSONANCE

No respondents offer any solid comments about motivators. This shortcoming offers a challenge for future research. Yet many are clear that they do not want training mandated or required for any step along their career path such as licensure, medical board credentialing, and board certification. Most indicate that they want training integrated into their day-to-day lifelong learning.

Several clinicians voice surprise and intrigue at the survey. They never pictured themselves as part of an initial response team. They never sought any related training. They never thought that there would be a need for their skills outside of their specialty. They did not know if they would be allowed to help. Individual physicians and organizations representing physicians and hospitals have witnessed Oklahoma City, the collapse of the World Trade Towers and the London and Madrid bombings and know that physicians and hospitals have cared for all those mass casualty victims in a short period of time. However, cognitive dissonance prevents them from believing that they will ever need to respond.

There are limited organized efforts to improve individual hospital surge capability and regional hospital surge capability at a national or professional level. Successes in improving capability come from local grassroots communities of practices where like-minded professionals strategize to improve preparedness in their community. The rest of

the medical community is unaware of the imperative, have other priorities, are otherwise occupied, or are disturbingly disinterested. At the hospitals surveyed, some did not want to complete the survey. Some do not want any more information.

F. SUMMARY

This study in two hospitals shows interest and ability on the part of these clinicians. Many comment during the survey process that this topic is important and they would like to know more. A standardized, compact, inexpensive, well-publicized and easily accessible curriculum with some incentive to pursue education and training by clinicians of all specialties would go a long way to raising the level of discussion in the medical community. Disaster planning could then move to a more comprehensive, interdisciplinary approach that does not rely solely on Emergency Department and Trauma physicians. This strategy will improve hospital preparedness to handle mass-casualty events.

All hospitals can review this research in light of their own institution. While the numbers will be different for each institution, the research suggests that building blocks of a response effort are present in every hospital and in many departments to improve and ensure enhanced surge capability to manage terrorist or natural mass casualty events. These qualified and capable individuals, and those willing to be educated, need to integrate and leverage into a coordinated, multi-specialty framework to strengthen hospital preparedness and resiliency for improved patient outcomes.

Hospital preparedness and response can and must be strengthened, but it may not be in the control of the individual hospital to accomplish it. The impetus may have to come from the larger organized medical community of professional organizations that can improve and encourage training in WMD, beginning in medical school and continuing into residency and through life-long learning in the postgraduate years. It can empower specialties to cross traditional lines of authority to build a canvas across specialties that weaves a resiliency into our response effort. This survey indicates that

there is ability and willingness. While not currently structured or promoted, a new paradigm could leverage the strengths of our healthcare system to ensure an improved response.

V. RECOMMENDATIONS AND CONCLUSIONS

A. STRATEGY FOR IMPROVING HOSPITAL PREPAREDNESS AND RESPONSE

> The country needs and, unless I mistake its temper, the country demands bold, persistent experimentation. It is common sense to take a method and try it. If it fails, admit it frankly and try another.[246]
>
> FDR 1932

1. The Challenge

The challenge facing the U.S. medical community is to develop a mass-casualty surge capability and resiliency. Medical response capability is an important component of Homeland Security preparedness. The times demand a new strategy for improving surge capability to meet the needs of patient care in the event of an explosive or chemical event in which the timeline for intervention is a crucial parameter in the effectiveness of the response and the outcome of the victims. It is a component of a trust compact with the American public.

The U.S. medical community must accept that acts of terrorism are a new reality for their practice. The American College of Surgeons' Board of Governors states, "The threats posed by Acts of Civilian Terrorism (ACT) require a new level of preparedness and a new level of knowledge by surgeons."[247] This applies to all practitioners. HSPD 21 supports initiatives to develop disaster medical capability.[248] The U.S. medical community can initiate change by accepting studies that indicate a rate limiting factors in medical response is the number of trained clinicians. They can accept data that all

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[246] James MacGregor Burns, *Transforming Leadership* (Atlantic Monthly Press, New York, 2003), 22.

[247] Statement on Unconventional Acts of Civilian Terrorism: A Report from the Board of Governors, American College of Surgeons 2001, http://www.facs.org/civiliandisasters/statement.html (accessed December 9, 2006).

[248] Foundation of American Sciences, http://www.fas.org/irp/offdocs/nspd/hspd-21.htm (accessed October 30, 2008).

response is local, and that alternatives such as DMAT teams or Medical Reserve Corps will not be in place for hours to days. Acknowledging the serious consequences of these explosive or chemical agents, the U.S. medical community has a responsibility to strategize to build a framework that improves the ability of healthcare to respond.

Hospitals cannot drive preparedness initiatives since they face serious financial challenges and constraints, which cause them to re-organize, to right-size and to reinvent themselves. They are giving limited attention to preparedness. The leadership to develop this discipline must come from the physician community.

The medical community consists of professionals from many disciplines and specialties. This research demonstrates that these professionals, if given the appropriate challenge in the appropriate framework and opportunities for education, have indicated their ability to respond. It indicates a level of interest for participation by many physicians from a wide cross section of specialties.

Medical leadership must define the body of knowledge and then determine the most effective training methods to guarantee the competencies are achieved. Further study must determine how best to disseminate the information and maintain the skills. Building the framework of response can be done by developing and integrating communities of practice within the medicine community that will challenge traditional disaster planning and will motivate and encourage practitioners to participate.

The biggest challenge is transforming reluctant organizations to allow physicians to participate in cross specialty activities.

2. The Vision

In fulfillment of the trust embodied in the healthcare community by the public and in fulfillment of the physician's Hippocratic Oath, a new strategy is necessary to enable the healthcare community to care adequately for the population involved in a mass casualty event. Emergency Department and Trauma physicians are trained, but in insufficient numbers to manage a mass casualty event in the immediate time frame.

The vision is that each hospital would be able to call upon physicians immediately available within their institutions to mount a massive, effective, efficient and timely response to the scenarios of terrorism or other mass casualty events in their community whether the hospital is a designated trauma center or not; whether urban, suburban or rural.

Physicians cover these topics in medical school in some form and perhaps in rotations during medical school or residency and postgraduate training. Many of the management skills and procedures involved in response to WMD relate to others disease processes as well. However, physicians have limited knowledge about the intellectual as well as the operational aspects of terrorism response. These subjects are minimally addressed in some specialty literature. Most physicians have been comfortable expecting that the Emergency Department physician or surgeon will care for these victims, denying the massive response that might be necessary. Maybe no one has asked physicians to prepare or participate. Maybe it is expected that physicians are all-knowing and are prepared to handle any emergency. Perhaps they do not have sufficient insight to understand the challenges of a response effort of massive scope. Perhaps physicians believe that they are unable to participate since they are limited by their specialty, their credentials, their hospital, their department, their malpractice coverage or their regulatory agencies. Maybe leadership is denying that these events are possible in their community.

If dissected into the specific, individual skills necessary to stabilize these patients in the "Golden Hour," many respondents indicate that they have or had the skills. The challenge is to refresh these skills into competencies and organize these skills into a framework to support and supervise the individual clinician. The non–Emergency Department or trauma physician may not have the didactics of trauma and CBRNE agents and may not know how to assess these patients, but they may have used the skills in other situations. With some education and training, the individual clinician can easily learn how the skills fit together in the assessment and management of these victims. While assessment and management expertise can take years to develop, Emergency

Department and trauma physicians can guide and support less experienced physicians in a graduated responsibility model that will extend the expertise of Emergency Department and trauma physicians to many patients.

This survey of physicians and physician assistants reveals that the majority of respondents feel they are qualified and competent with the skills that may be required to manage these victims. Others have indicated their willingness to learn. With some education, reeducation and reframing, physicians can understand that much of what they know and the skills they once mastered can extend to this new imperative. Newer training methods such as procedure simulations and online training and interactive activities can be very engaging and productive and should be promoted to improve preparedness.

Why is a resilient system not in place? Whatever the cause, the medical community has the building blocks already available waiting for the guidance, organization and direction to orient them into a disaster medical capability that will improve preparedness and response. This challenge is relatively simple and solvable. It is analogous to the patient who has the right medication but does not take it for various reasons. He does not get the benefit and may suffer the consequences. Healthcare has the building blocks of physician resources, but they are not being applied effectively to ensure the benefit. We should not have to experience the consequences.

Actualization of this vision requires leadership; commitment of mind, money and time; standardization; and coordination.

B. THE VALUE PROPOSITION

To earn the trust of the American public, the House of Medicine must reorganize itself in a major way. This transformational change should result in a Blue Ocean Strategy,[249] a value proposition so innovative that it involves a major shift in strategy that crosses borders, changes rules and develops a new framework that aligns innovation with

[249] W. Chan Kim and Renee Mauborgne, *Blue Ocean Strategy* (Harvard Business School Press, Boston, MA, 2005), 4.

improved usefulness and reasonable cost.[250] Concerning disaster medical capability, the value is improved surge capability in the immediate time frame in all hospitals at all times and improved outcome for more victims as well as restoration of public trust. The cost is dollars in a time of limited Homeland Security dollars, time commitment, cost factors or the pain and uncertainty of change.

In this strategy model, other physicians present in the hospital who have been reeducated in the medicine and procedures that they once learned could assist in the Emergency Department in the initial hour under the supervision of Emergency Department and trauma physicians. The Trauma physician can direct triage and direct staging while the ED physician can direct stabilization. Each Emergency Department or trauma physician could supervise, mentor, and monitor several physicians or physician assistants, each of whom could care for a few patients at a time.

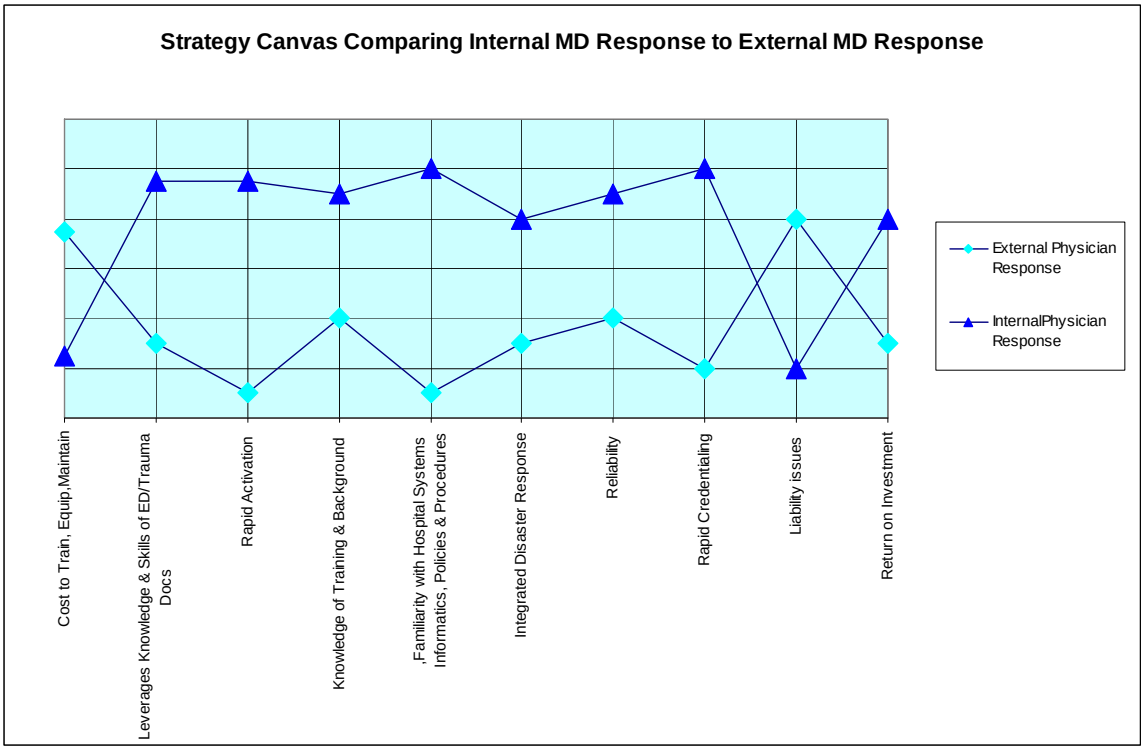

Figure 28. Strategy Canvas

[250] W. Chan Kim and Renee Mauborgne, *Blue Ocean Strategy* (Harvard Business School Press, Boston, MA, 2005), 13.

This strategy offers several significant and unique advantages to overall preparedness. This tiered response immediately leverages the abilities of the Emergency Department physicians and trauma surgeon allowing many more patients to be evaluated, stabilized and managed in the immediate time frame. It improves a hospital's self-sufficiency, which is important for both urban as well as rural hospitals. Hospitals can then integrate their trained physicians into their response model. It obviates concerns about diverting patients to trauma hospitals since experiences in Japan,[251] Madrid[252] and other countries show that the system of diversion becomes overwhelmed. It minimizes the cost of assembling, training, transporting and putting up response teams. It allows for integration of newer theories about trauma management such as the field forward hospitals of the military, which have yet to become part of civilian response. It is reliable, rapid, and well-rehearsed.

Current strategies for disaster planning exclude much talent. This research examines the decisive issue of whether non–Emergency Department or non-trauma physicians possess skills, abilities or experiences relevant to the assessment and stabilization of victims of chemical or explosive mass casualty events and whether they would be willing to train to participate in a response. The answer is that a majority feel qualified and competent. Others are willing to learn.

C. BUILDING A FRAMEWORK

This strategy to improve medical surge capability is rather simple and intuitive. The framework uses physicians immediately available in a tiered graduated response model with Emergency Department physicians and surgeons assessing and directing management that is carried out by other clinicians. Instead of building more DMATs or larger MRCs and metropolitan region response teams, this strategy relies on the

[251] T. Okumura, and K. Suzukiet al., "The Tokyo Subway Sarin Attack: Disaster Management, Part 2: Hospital Response," *Academic Emergency Medicine* 5, no. 6 (1998): 618-624.

[252] J. P. Gutierrez de Cebellos, F. Turegano Fuentes, D. Perez, D. Diaz, M. Sanz Sanchez, C. Martin Llorente, J. E. Guerrero Sanz, "Casualties Treated at Closest Hospital in the Madrid March 11 Terrorist Bombings," *Critical Care Medicine*, (1 Suppl) (January 31, 2005): S107-12, 107.

willingness and abilities of physicians immediately available. It requires the cross training of all willing participants. The U.S. military and the Israeli medical community have been cross training their medical corps for years.

The physician response to Hurricane Katrina, the World Trade Center bombings, Oklahoma City bombings, the Avianca Plane crash and other disasters speaks to the skills possessed by physicians, some of whom are specialists not involved in trauma, and their willingness to respond in an emergency. This research confirms that likelihood. For the immediate events, it would be most helpful if physicians have CBRNE training and disaster training regardless of their departments and specialties.

In disaster events, regulations, privileges and policies all go by the wayside in an attempt to save a life. As we seek to build a disaster medical capability, some of these artificial barriers must be reconsidered and redeveloped in advance. In terms of disaster response, policies should specifically allow and encourage clinicians to prepare in teams and respond in teams to save many lives. Such a new construct may shift organizational alliances and cross traditional lines of authority, affiliation and certification. In actuality, it simply requires a new mindset, and ongoing training and competencies for clinicians. Physician certification organizations, hospital regulatory agencies, specialty organizations, DHHS and DHS should authorize and encourage some paper changes in regulations, privileges and policies.

Constructing the framework starts with DHS and DHHS to provide leadership, direction and ownership. In consultation with the ABMS and with the support of its individual Boards, ACGME and its RRCs and the AAMC, they must develop a model that leverages those resources already present in a hospital along guidelines determined and promulgated by them. They must decide on the clinical and operational training requirements for physicians willing to participate in response efforts. They must determine who will provide education and training, how they will offer it, and determine what standards prepare a clinician to be a responder. They must strategize to provide the most complete, interesting and innovative educational methods that will not cause a

major disruption in the day-to-day practice of medicine. They must strategize to create a win-win situation for the practitioner and the hospital in an era of limited dollars and limited time availability.

Supported by their licensing and regulatory bodies, hospitals and networks must set the training and certification standards. They must build internally upon the model of a tiered response with Emergency Department and trauma physicians supervising other trained clinicians to be a force multiplier in increasing the number of patients that can be cared for in the immediate time frame. Fostering an interdepartmental, interdisciplinary, collaborative response team supported by policy accomplishes this goal. The licensing and regulatory bodies and the ABMS must support and promote a different construct that applies different privileges and credentials in a disaster response. Hospitals move into HEICS with its own table of organization during a disaster. The Chief Executive Officer is often not the Incident Commander. In this construct, clinicians may move into a different table of organization during a disaster so that all participants answer to one Chief.

Hospitals and networks must also support participation in the Regional Response Committees (RRC), which will leverage community resources in an integrated response model for the transfer of patients or resources. The RRC serves as a community of interest further encouraging practitioner participation and professional growth in emergency preparedness.

1. Funding and Manpower

Federal resources can best be spent developing and rolling out a curriculum for physicians that is flexible, frequent, relevant and inexpensive such as teleconference and on-line. The curriculum can start in medical school and continue through residency, and become part of lifelong learning. Homeland Security dollars can develop technology for computer and other simulations that will develop and enhance the technical, management and operational skills of the clinician. Incentives such as a certificate of added

qualification for the individual physician and Pay-for-Performance (P4P) financial incentives for hospitals can encourage participation. The return on investment, by leveraging those physicians already in place, is huge.

Scarce dollars must be distributed wisely by informed agencies and funding sources to educate the largest numbers of professionals in the most effective way. Hopefully this thesis and the model will guide their thinking and provide a building block for further research.

2. Transforming Organizations

Transforming reluctant organizations requires trust and strong, effective leadership.

a. Transformational Leadership

> We hope that this report marks the beginning of a truly transformational state of preparedness throughout all levels of our nation. Yet with collective determination, unity of effort and effective organizational change, the true legacy of Katrina can be that of a catalyst that triggered a real and lasting improvement to our national preparedness.[253]

The challenges posed by meeting the goals, objectives and initiatives outlined in the National Strategy for Homeland Security,[254] as well as the challenges posed in the Homeland Security Presidential Directives, require significant effort to prepare, respond and recover from attacks at the federal, state and local levels.

Medical leaders must develop new thinking about how best to handle new challenges using evidence-based outcomes. Current disaster planning and drills are based on the concept of providing the best care to one patient and replicating it for large numbers. In mass casualty scenarios, the numbers of potential victims are suddenly massive.

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[253] Office of the President of the United States, *The Federal Response to Hurricane Katrina: Lessons Learned* (Washington, DC, February 2006), Foreward, 3.

[254] Office of Homeland Security, *National Strategy for Homeland Security* (U.S. Government Printing Office, Washington, DC, July 2002), vii-x.

The success of this metamorphosis relies on transformational leadership. Important characteristics of this leadership include:

- Credibility and knowledge
- Imagination and vision
- Charisma
- Integrity
- Mentor
- Culture of creativity
- Collaboration
- Commitment to excellence
- Communication
- Sense of Time

The transactional leader will get the job done usually through a reward system or through a superior-inferior manager/employee working relationship. The transformational leader recognizes the urgency, establishes a powerful guiding coalition, creates a strategy, communicates a vision, empowers others to act on the vision, plans for and creates short term wins, consolidates improvements, produces still more change and institutionalizes new approaches. He or she will advance changes so comprehensive and pervasive that it fosters change in depth and breadth. This accelerated revolution introduces new sources of power, new structures and new cultures.[255] A key component of this transformation is trust.

b. Trust

> Executives tempted to take shortcuts should remember the dictum of Confucius that good government needs weapons, food and trust. If the ruler cannot hold onto all three, he should give up weapons first and food next. Trust should be guarded to the end because "without trust, we cannot stand.[256]

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[255] James MacGregor Burns, *Transforming Leadership* (Atlantic Monthly Press, New York, 2003), 24-25.

[256] Steven M. R. Covey, *The Speed of Trust* (Free Press, NY: NY, 2006), 272.

An important issue for Homeland Security is how to develop the commitment necessary to make a major transformational change in healthcare to address the nation's preparedness in 2009. To make medical preparedness real, trust has to be developed at many levels.

The House of Medicine must secure its credibility by demonstrating integrity, intent, capabilities and results. This social contract begins with the five waves of trust as defined by Stephen Covey.[257]

The first wave, self trust,[258] involves seeing the need for change in how healthcare providers and institutions prepare; speaking the need for change to their colleagues and their regulators; and embracing a behavioral shift to reflect the change by providing leadership and mentorship. Physicians must believe that they can improve response and that their response can improve outcomes.

The second wave of trust is the relationship trust.[259] Covey describes it as consistent behavior evidenced by talking straight, demonstrating respect, creating transparency, righting wrongs, showing loyalty, delivering results, getting better, confronting reality, clarifying expectations and practicing accountability.[260] These relationships develop around the communities of interest and respect that are developing at the ground level of healthcare with regard to preparedness. Non-traditional alliances and reporting mechanisms that perhaps threaten traditional leadership are included. Participants challenge each other with their interests and their knowledge. This ground swell of interest becomes tipping point leadership. Fundamental change occurs when beliefs and energies of a critical mass of people create a sweeping movement toward an idea. Examples include interagency collaboration such as regional preparedness committees, and non-traditional leadership such as the leadership provided from the Greater New York Hospital Association, which, in a reversal of traditional roles, guides hospitals and regulatory agencies toward preparedness. Since hospitals plan as part of

[257] Steven M. R. Covey, *The Speed of Trust* (Free Press, NY: NY, 2006), 32.

[258] Ibid., 34.

[259] Ibid.

[260] Ibid.

regional preparedness organizations, they develop more interdisciplinary and interagency collaboration, strengthen the community response, share the burden and achieve local economies of scale. It requires reaching outside the hospital to network and university affiliates and other partners to grow the community of interest. It also requires looking within the hospital to empower others to join the team.

The final three waves improve shareholder trust. In this case, the shareholders include the hospital, the practitioner and the public.

The third wave, organizational trust, is necessary to effect organizational change. According to Covey, low trust results from redundancy, bureaucracy, politics, disengagement, turnover, and fraud. High trust results in increased value, accelerated growth, enhanced innovation, improved collaboration, strong partnering, better execution and heightened loyalty.[261] Practitioners and hospitals must trust and partner with each other to create this new reality without negatively impacting current patient care, physician productivity, or revenues of either the practitioner or the institution. The relationship between physicians and other healthcare providers must become collaborative and self-advancing. Both sides face huge risk if they fail as Hurricane Katrina proves. Departments can develop more interdisciplinary collaboration, strengthening hospital response, sharing the burden and achieving economies of scale.

The fourth wave is the market trust where brand matters.[262] The healthcare industry must redirect effort to build domestic preparedness capability and resiliency and encourage their clinicians to participate. Heightened preparedness has been present for years in Israel and in the U.S. military, but U.S. hospital practices have yet to fully absorb them. However, the Department of Homeland Security and the Department of Health and Human Services, in conjunction with the American Board of Medical Specialties, should advance the overriding structure of this organizational change to ensure uniformity, accountability and critical mass participation to achieve the tipping point.

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[261] Steven M. R. Covey, *The Speed of Trust* (Free Press, NY: NY, 2006), 35.

[262] Ibid.

The fifth wave is societal trust.[263] Only when healthcare achieves this level of preparedness will the public rightfully have trust. Once appointed, a national preparedness spokesperson must be a non-political, trusted, credible and identifiable face to the public, similar to Marcus Welby. This spokesperson should be the single voice that all Americans can turn to for advice and guidance in time of a disaster. Having such a person before Hurricane Katrina to order evacuation might have saved lives. In an explosive or chemical event, it can be crucial to keeping the worried well from adding to the surge.

D. RECOMMENDATIONS FOR STRATEGY IMPLEMENTATION

1. Organizational Hurdles

Kim and Mauborgne describe tipping point leadership as an approach that manages the key organizational hurdles of change including cognitive resistance, resource limitations, motivational weakness and political barriers. Tipping point leadership ignores the conventional wisdom that change is dependent on resources and time and instead focuses on points of disproportionate influence. It focuses on areas with uncontested space rather than competing for the same limited resources and time.[264]

a. Cognitive Resistance

Preparedness still seems abstract and remote. Engaging healthcare professionals, including physicians, nursing and administrators, to understand that the current preparation is not acceptable and accept the need for change is a cognitive hurdle. Even physicians who deal with critical emergencies every day feel they are doing well and that their preparedness is sufficient, yet most have never dealt with a mass casualty event where systems become overwhelmed.

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[263] Steven M. R. Covey, *The Speed of Trust* (Free Press, NY: NY, 2006), 35.

[264] W. C. Kim, and R. Mauborgne, *Tipping Point Leadership Harvard Business Review on Leading through Change 19-44* (Harvard Business School Press, Boston, MA), 2006.

The civilian medical community is not as adequately prepared as the military medical community for disaster medical response. These CBRNE terrorism threats are new to the United States homeland. Physicians and PAs receive limited training and few have exposure to managing CBRNE agents. However, they have or have had skills and knowledge necessary to stabilize victims of these agents. In the research many voice some concerns about time and money but indicate a willingness to participate and prepare. Some clearly never thought of their ability or responsibility to respond, but when reframed into skills they have or had and could easily relearn, many indicate interest.

Even physician literature perpetuates the cognitive dissonance. The literature about response to the Tokyo Sarin release,[265] and the Oklahoma City,[266] Madrid[267] and London[268] bombings is only published in literature that surgeons or Emergency Medicine physicians read. There is some literature in military literature.[269] Other physicians would not be exposed to that literature. The American Medical Association first published a bimonthly journal called "Disaster Medicine and Public Health Preparedness" in June 2007.[270] However, the cost and the limited time availability for reading may preclude this journal and others from being widely read.

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[265] T. Okumura, and K. Suzukiet al., "The Tokyo Suand bway Sarin Attack: Disaster Management, Part 2: Hospital Response," *Academic Emergency Medicine* 5, no. 6 (June 1998): 618-624.

[266] David Hogan, Joseph F, Waeckerle, Daniel Dire, and Scott Lillibridge, "Emergncy Department Impact of the Oklahoma City Terrorist Bomb," *Annals of Emergency Medicine*, 34, no. 2 (August 1999): 1.

[267] J. P. Gutierrez de Cebellos, F. Turegano Fuentes, D. Perez, D. Diaz, M. Sanz Sanchez, C. Martin Llorente, and J. E. Guerrero Sanz, "Casualties Treated at Closest Hospital in the Madrid March 11 Terrorist Bombings," *Critical Care Medicine*, (1 Suppl) (January 31, 2005): S107-12, 107.

[268] J. Christopher Aylwin, Thomas C. Konig, Nora W. Brennan, Peter J. Shirley, Gareth Davies, S. Michael Walsh, and Karim Brahi, "Reduction in Critical Mortality in an Urban Mass Casualty Incident: Analysis of Triage, Surge and Resource Use after the London Bombing on July 7 2005," *The Lancet* 368 (2006): 2219.

[269] Joseph DeFeo, *Joint Medical Readiness*, *Are We Ready to Answer the WMD Threat*? (U.S. Army War College, Carlisle Barracks, PA), March 2006.

[270] "Disaster Medicine & Public Health Preparedness," *Lippincott Williams & Wilkins* 1, no. 1 (July 2007).

Clinicians know that to practice across professional and subspecialty lines incurs jeopardy with licensing and hospital medical boards, and jeopardizes their medical liability coverage. Most follow the rules. Concerning disaster medical capability and response, the rules need to be reassessed and rewritten. Once the clinicians are apprised of the new rules, this research indicates they will willingly participate.

Communication could be used effectively to sensitize the hospital community to the need for a different strategy. Putting key physician leaders face-to-face with operational problems during drills will enlist their support. New ways to drill these scenarios would hopefully emphasize the imperative. This change is an issue of leadership and knowledge.

b. Resource Limitations

In tipping point leadership, one reaches the goal by applying limited resources in a targeted strategy.

Hospitals operate on razor-thin margins and often have no resources or infrastructure to develop or support a preparedness program other than what they have received from HRSA. The Federal Government cannot provide resources to almost 5000 hospitals to develop and support these programs. Resiliency is not improved by granting money to facilities that may not know where best to invest the limited money or use it differently hospital to hospital. Granting money to build more DMATs and MRCs that will not always be available in time or substance does not improve it either.

This research confirms that clinicians are present within a hospital that self- assess themselves to be qualified and competent. It confirms that they are willing.

The return on investment for this strategy of leveraging physician resources at hand can be huge. Rather than each hospital striking out to determine its path at significant cost, the training and credentialing requirements are set at the DHS/DHHHS/ABMS level after analyzing and negotiating with their respective agencies. Education can be offered nationally while on site training and drill participation occurs at the local level.

To be successful, CBRNE training should begin in medical school, be emphasized throughout residency and be a required part of the Board certification and recertification curriculum for all specialties. Much of what is needed to improve healthcare preparedness already exists in terms of military curriculum and training. Simulations already exist for laparoscopic and robotic surgery. Computer games and computer or model simulations funded by the government, guided by the medical specialties and developed by public-private technology partnerships could advance these goals.

Hospitals and physicians should incur no financial burden since the commitment of time and interest will be borne by the physicians and the hospitals. State Health departments and other regulatory agencies might be encouraged to review, reduce or remove other repetitive, onerous requirements or to extend the length of the certification periods in favor of garnering time and interest in education and training to improve healthcare preparedness.

c. Motivational Weakness

New information in medicine is published every day. Physicians are challenged to stay abreast of developments in their own specialty and changes in other fields of medicine daily. The massive volume of information conflicts with available time. This discrepancy is compounded by responsibilities to teach, conduct research and manage busy practices.

Physicians are often mandated for many courses some of which are repetitive, redundant, and add little useful information. These courses compete for available time for reading. Requirements by regulatory agencies such as JCAHO, CMS or state health departments often become a disincentive.

This hurdle will challenge individual physicians and hospitals. Overcoming the motivational hurdle requires national medical leadership to successfully identify and speak to the need for change, and provide a framework for how it can be accomplished with minimal financial impact on the clinician or their practice. They must encourage the development of communities of practice across specialties and voluntary

participation. Training must be convenient, challenging, and engaging. Faculty must be competent and effective teachers. There should be an incentive system for those who do participate.

Key influencers such as the specialty college leadership can frame the challenge, provide information and build communities of practice through courses and simulations at national and regional meetings. They can establish interest sections at these colleges devoted to hospital preparedness. Hospital networks and regional preparedness councils and regional hospital associations may also promote communities of practice.

Physicians understand the "why" of this initiative—the GWOT has moved onto home soil. This research reveals an interest in learning more about the "what"—the CBRNE agents and the response. Homeland Security and medical leadership must strategize to standardize the "how." The respondents raise many valid issues to be resolved on a national level prior to finalizing and implementing a strategy.

Physicians by nature are a competitive group. Singling out the right key influencers and motivators, highlighting them in public forums such as conferences and journals, and using them to frame the response in terms of knowledge and skills that many physicians have will be most useful. If physicians think they can contribute to preparedness and realize they are being asked to prepare, many will accept the challenge. If colleagues receive a badge of qualification, other physicians will be challenged to compete. If the challenge is broken down to the least common denominator, physicians will see what they need to do and the challenge will be doable rather than all-encompassing. Once physicians exert the leadership, mid-level providers such as physician assistants, nurse practitioners, and nursing profession could follow the guidance of their physicians.

Physician investment in the strategy will partly come from altruism. But there should be a win-win opportunity for them as well. Physicians do respect their specialty board and the corresponding trade representative agency, for example the American Board of Surgery and the American College of Surgeons. Each specialty board

is a member of the American Board of Medical Specialties. In a win-win situation, a certificate or "added qualification" designation from the specialty board or the American Boards of Medical Specialties could encourage and reward successful participants. This incentive could also bridge the competition between specialties and foster cross specialty cooperation and respect.

Hospitals have incentives to engage their leadership and transform their organization to one that promotes an interdisciplinary disaster response. Hospital Medical Boards could strive to have a certain percentage of their staff certified. This certification could be one of the core measures that regulatory agencies such as JCAHO monitor. More positively, hospitals could be financially rewarded for promoting participation in preparedness efforts under the CMS Pay-for-Performance (P4P) projects.

In this study, many physicians and physician assistants express interest in training. The program can be successful if conducted on a professional basis with competent, experienced faculty; is voluntary, convenient, challenging and stimulating; and provides the participant with an incentive, whether it is personal satisfaction that they are part of the nation's response to the Global War on Terror or an "added qualification."

d. Political Hurdles

This blue ocean strategy crosses many lines of authority and traditional alliances and will result in new communities of practice and changing allegiances beyond departmental, hospital or specialty divisions. It does not wait for approval from regulatory agencies. It challenges them to build a framework that meets their requirements and concerns but, most importantly, meets the needs of the public. It will raise many concerns from powerful vested interests that will resist this new strategy. It will raise issues about time, cost, competencies, patient safety, liability, licensing concerns and sustainability.

The House of Medicine is a stove-piped profession. Intellectual arrogance and financial protectionism exist. For example, Emergency Medicine competes with Cardiology and Radiology for the reimbursement for EKG and radiological interpretation of studies done in an Emergency Department, respectively. It is usually settled by

medical board policy. Hand surgery is variously done by surgeons, hand surgeon specialists, orthopedists or plastic surgeons, depending on hospital protocol and physician availability. Departments and divisions guard their turf very determinedly. Hospital leadership will have pro and con reasons for participation. Members of the ABMS and the ACGME will also have pro and con reasons.

For financial, regulatory, professional, personal and control reasons, there will be non-participators and non-supporters of this strategy. As the strategy develops, all participants from the continuum of medical training (LCME, ACGME, ABMS, hospital associations, DHS, DHHS, major state licensing boards, the insurance industry, the major physician trade organizations, such as the AMA, and specialty colleges) must participate in developing this strategy. The focus must stay on achieving the goal by building powerful alliances of willing participants and lobbyists who understand the plotting, intrigue and politics to overcome the barriers. The more likely change becomes, the more fiercely and vocally these negative influencers—both internal and external—will fight to protect their positions. Some might support one part of the concept and reject another. My interview with the hospital association representative indicates that they would support the concept as long as no cost was involved for their hospital members. Potential supporters include professionals who recognize the challenge such as the Schools of Public Health who are involved in studying and challenging preparedness. Additional supporters include the military where cross training has been successful and medical professionals from Israel where response involves all hospital employees. Potential advisors include counterparts from Tokyo, London and Madrid since the literature published after those events does not include all that needs to be told.

There will be pushback from those organizations, agencies and individuals who seek to make a profit from medical education. There will be resistance from some physicians if the project is not clearly and completely defined and framed for them at the outset. Some of the medical trade groups have previously come out against specific education requirements since they seek to increase membership and generate revenues from those physicians who oppose mandates or feel oppressed. These organizations will have to be identified early and co-opted to be early adopters.

Discussions will be needed within the medical, hospital and legal communities and with the public about liability coverage and altered standards of care, and at what point and with whose authority does the emergency medicine community switch to this disaster mode.

E. CONCLUSIONS

The U.S. Government, especially the Department of Homeland Security and the Department of Health and Human Services, has oversight for the care and well-being of all Americans. However, all disasters are local and initially so is all response. At the local level, hospitals need to improve their preparedness and strengthen their ability to care for victims of a mass casualty event happening in their backyard, regardless of their trauma status. It is shortsighted to think that EMS can and will divert to the designated hospitals as has been the experience in Tokyo, London and other catastrophes.

The research of this thesis shows that hospitals hold physician and physician assistant resources within their institutions around the clock that have cognitive and technical skills useful in response to a disaster. They have indicated their willingness to train to participate in a response effort. They are immediately available, currently credentialed and well-experienced in the systems and operations of a particular hospital, making them immediately functional and useful.

Many opportunities exist along the career continuum of a physician or physician assistant for training and demonstration of competency to strengthen their preparedness and skills. Courses need to develop and provide a focused approach to the assessment and management of patients who are victims of several different scenarios that are possible in a terrorist or other attack. Newer technologies should be promoted.

The value proposition offered here is that each hospital will significantly improve its preparedness and be better positioned to manage the public trust of healthcare. The value is improved surge capability that is available almost immediately. By shifting the focus and redefining the problem, it simplifies the response for all U.S. hospitals around the country. It obviates the need to have metropolitan response teams ready in every

town. It shifts the focus from outside teams who would be delayed in these scenarios to a ready made, fully operational and functional in-house team. It would be most productive to work with the team one drilled with regularly.

The window of opportunity to successfully impact the outcome of victims of the explosive and chemical scenarios is different from the response time for bioterrorism or even most radiation exposure. Looking at the timeline for response mandates a new solution. While the cost of training and maintaining those skills at the local level is significant, the value at the local level is vastly improved for these two scenarios. Shifting the focus of the physician manpower to the local level, the federal government can focus on the more global issues and a longer term response. It will provide a higher level of local preparedness and give comfort to the public.

One of the six critical mission areas of The National Strategy for Homeland Security is emergency preparedness and response. One of the initiatives under this area is preparation of health care providers for catastrophic terrorism. HSPD 21 calls for an enhanced disaster medical capability. Financial resources are limited at all levels. Current response plans would not be operational in the time frame necessary to positively impact victims of an explosive or chemical event. This thesis offers a simple strategy of using physicians immediately at hand in any hospital to expand the initial response in the "Golden Hour" in a model of graduated responsibility to improve response capability. The research of this thesis supports that many physicians have or had skills that could be leveraged to provide that response. The medical community has the building blocks already available and resources yet to be leveraged to provide life-saving assistance in the first hours of need. It requires guidance, organization and direction to orient the profession into a disaster medical capability that will improve preparedness and response. This challenge is analogous to the patient who has the right medication but does not take it for various reasons. He does not get the benefit and may suffer the consequences. Healthcare has the building blocks of physician resources, but they are not being applied effectively to ensure the benefit. We should not have to experience the consequences.

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APPENDIX A. A SURVEY OF PHYSICIANS (ATTENDINGS & RESIDENTS) AND PHYSICIAN ASSISTANTS ON THEIR PREPAREDNESS & WILLINGNESS TO EVALUATE AND STABILIZE VICTIMS OF MASS CASUALTY EVENTS

National Preparedness Response requires trained, willing and available practitioners.

This survey is designed to measure clinician perception of their own preparedness and willingness to participate in response to a natural or terrorist event.

.

Demographics (Check all that apply)
Male_____ Female_____
Your specialty:
Primary: _____ Board Certified Y_____ N_____ BE_____
Secondary: _____ Board Certified Y_____ N_____ BE_____

Your status (choose all that apply**)**

Attending _____ Resident ____ PGY level **_____ Physician Assistant_____**
Paid Hospital Staff___Full time_____
Voluntary Staff ___Part time_____
Current Position: (choose one) Clinical_____ Academic_____ Administrative_____

Year of Medical School or PA Program graduation_____

Your predominant hospital:
Urban _____ Suburban _____ Rural_____
Hospital A _____ Hospital B_____

Training (Check all that apply)

	currently certified	never certified	once certified
BLS			
ACLS			
PALS			
ATLS			

Have you ever taken Chemical, Biological, Radiological, Nuclear, Explosive (CBRNE) training? (Please check those that apply)

	Medical School	Residency	Military	CME (conferences, online etc)	Grand Rounds	In-service	Other (please indicate)
Chemical							
Biological							
Radiological							
Nuclear							
Explosive							

SCENARIO I-Explosion

Your Emergency Department receives notification that there has been an explosion on a nearby train. Hundreds of victims will be distributed to nearby EDs. While your responsibilities may or may not involve the ED today, you are in the hospital when the patients begin arriving. Soon the number of patients overwhelms the ED staff resources and an urgent request for assistance is initiated. Please answer the following questions:

1. Do you think you are qualified and competent today to work alongside ED and Trauma Attendings to assess and stabilize victims with <u>unstable vital signs or an unstable airway?</u> Yes_____ No_____
    a. If yes, move to question #2
    b. If no, please answer the following questions:
        i. Do you think that with additional advance training, you could learn to perform assessment & stabilization during a catastrophic event? Yes_____ No_____
        ii. What type of training would you require?
        _____
        _____
    c. Comments_____
    _____
2. Today: Can you Yes_____ No_____
3. Manage an Airway Yes _____ No_____
    1. Intubate ___ ___
    2. Manage resuscitation fluids ___ ___
    3. Assess need for blood ___ ___
    4. Transfuse Packed RBCs ___ ___
    5. Control external hemorrhage ___ ___
4. Do you think you are qualified to work with ED and Trauma Attendings to assess and stabilize <u>urgent but stable victims</u>? Yes____ No____
   If yes, move to question #4
    a. If no, please answer the following questions
        i. Do you think that with additional advance training, you could learn to assess and treat stable patients (simple fractures, burns, simple lacerations) during a catastrophic event? Yes_____ No_____

ii. What training would you require?

_____

_____

iii. Comments_____

_____

5. Today can you Yes_____ No_____
   a. Triage? ___ ___
   b. Clean and dress a wound? ___ ___
   c. Repair simple lacerations? ___ ___
   d. Order and Interpret x rays? ___ ___
   e. Splint? ___ ___

SCENARIO II–Chemical Exposure

Your Emergency Department receives notification that an unknown liquid has been dispersed at a local high school. Hundreds of victims are complaining of difficulty breathing and some are seizing. Large numbers of patients will be distributed to nearby EDs. While your responsibilities may or may not involve the ED today, you are in the hospital. Assume that all involved have been decontaminated at the scene. Please answer the following questions:

1. Do you think you are qualified and competent today to work alongside ED and Trauma Attendings to assess and stabilize victims with <u>unstable vital signs or an unstable airway?</u> Yes_____ No_____
   a. If yes, move to question #2
   b. If no, please answer the following questions:
      i. Do you think that with additional advance training, you could learn to perform assessment & stabilization during a catastrophic event? Yes_____ No_____
      ii. What type of training would you require?

      _____

      _____

      _____
2. Today: Can you Yes_____ No_____
   a. Manage an Airway ___ ___
   b. Intubate ___ ___
   c. Manage seizures ___ ___
3. Do you think you are qualified to work with ED and Trauma Attendings to assess and stabilize <u>urgent but stable</u> victims? Yes_____ No_____
   a. If yes, move to question #4
   b. If no, please answer the following questions
      i. Do you think that with additional advance training, you could learn to assess and treat stable patients (difficulty breathing, nausea, vomiting, irritated eyes, and hysteria) during a catastrophic event? Yes_____ No_____

ii. What training would you require?

_____

_____

_____

4. Would you be willing to respond to the request for help to assess and stabilize victims with unstable vital signs or unstable airways?
   Yes_____ No_____

Please complete the following:

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Medical specialists have skills applicable to a catastrophic response team					
Medical professionals have an ethical responsibility to respond					
Medical professionals are receptive to additional training that enable them to provide additional assistance during catastrophic events					
Medical specialists are receptive to assistance from other professionals during a catastrophic event					
Training in CBRNE should be mandated for all physicians/PAs					
I have concerns about risk and malpractice					
Training costs are a concern					
Amount of training time is a concern					
The cost of my time for training is a concern					
I have concerns that I can learn these skills					
I have concern about retention of these skills					
Training in CBRNE should be mandated for all physicians/PAs					
CBRNE training should be standardized across all disciplines					
Retraining in CBRNE should occur at regular intervals					
CBRNE training should be a requirement for					
Medical Board credentialing/recredentialing					
State license					

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Board certification/recertification					
Post graduate CBRNE Response Training should be conducted by					
Hospital					
Department of Health					
Medical Society					
CDC					
Private organizations (ie.American Heart Association)					
National Specialty Society(ACP)					
U. S. Military					

What type of CBRNE training would you like or wish you had?

_____
_____
_____
_____

What ideas for successful CBRNE training can you offer?

_____
_____
_____
_____

What barriers to CBRNE training do you envision?

_____
_____
_____
_____

Other
Comments:_____
_____
_____
_____
_____

Thank you for participating in this survey. Your time is valuable. So too is your input into National Preparedness. Thanks.

Joan McInerney, MD

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APPENDIX-B. LETTER OF INTRODUCTION OF SURVEY TO PHYSICIANS/PAS AT HOSPITAL A

April 26, 2007

To all my colleagues at (Hospital A):

I am asking you to give 10 minutes of your valuable time to complete a survey titled:

A Survey of Physicians (Attendings & Residents) and Physician Assistants on Their Preparedness & Willingness to Evaluate and Stabilize Victims of Mass Casualty Events

This is a research project that has been approved by the IRB at (Hospital A). It is research for my thesis for a Master's degree program through the Center for Homeland Defense and Security of the Department of Homeland Security.

It is an opportunity for clinicians to contribute valuable input to the Department of Homeland Security on physician or PA preparedness and willingness to participate in 2 particular scenarios-one a chemical event, the other a blast event should there be a natural or terrorist event.

The survey is anonymous.

Thank you for your contribution.

Joan McInerney, MD, FACEP

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APPENDIX C. LETTER OF INTRODUCTION OF SURVEY TO PHYSICIANS/PAS AT HOSPITAL B

April 26, 2007

To all my colleagues at (Hospital B):

I am asking you to give 10 minutes of your valuable time to complete a survey titled:

A Survey of Physicians (Attendings & Residents) and Physician Assistants on Their Preparedness & Willingness to Evaluate and Stabilize Victims of Mass Casualty Events

This is a research project that has been approved by the IRB at (Hospital B). It is research for my thesis for a Master's degree program through the Center for Homeland Defense and Security of the Department of Homeland Security.

It is an opportunity for clinicians to contribute valuable input to the Department of Homeland Security on physician or PA preparedness and willingness to participate in 2 particular scenarios-one a chemical event, the other a blast event should there be a natural or terrorist event.

The survey is anonymous.

Thank you for your contribution.

Joan McInerney, MD, FACEP

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APPENDIX D. RESPONSES TO OPEN ENDED QUESTIONS

Responses to question "What type of CBRNE training would you like or wish you had?"

Training for CBRNE should be all that is available.

Do not wish any training.

I cannot tell because it's the first time I heard of CBRNE.

Emergency care and emergency preparedness training.

How to handle each event/basically everything.

All.

Any.

Biological/Chemical/Mass casualty.

Chemical/Radiological.

ACLS.

I wish I could have had it in medical school. I would definitely like to attend one if I am offered in the hospital.

ATLS.

Primary trauma care/Disaster management.

First aid, chemical & biological injuries/explosion.

Chemical exposures.

Regulation based simulated cases.

CBRNE.

Explosive, chemical.

BLS.

Biological exposure and chemical exposure.

Biological, explosive.

CBRNE.

I have had only one chemical lecture in school. I would like all the rest of it.

I would like one course that covers all topics.

I am only a first year. I need a lot of training skills.

Bio & chemical.

None.

Don’t know.

CBRNE.

Chemical/biological/radiological/nuclear/explosive.

No interest.

All.

I do not want any.

Nuclear/radiological/explosive.

None.

Army/hypotension.

Everything.

All.

More explosive training.

I’d like to learn more than explosives.

Biological, chemical.

?.

Adequate common knowledge for generally encountered.

Chemical/radiological.

ATLS/ACLS/PALS.

Chemical/Biological.

BLS/ACLS.

Explosive.

Efficient enough to be capable of contributing to a disaster.

Efficient in skills required.

Hard to define.

Chemical/Biological.

Chemical, biological.

Basic to advanced.

Chem/Bio.

Much of this is covered in ACLS/BLS. More specific training.

A basic trauma course.

Chemical.

Nuclear/chemical/biological.

I would like to have CBRNE training in how to respond to a terrorist event such as chemical or biological.

Much of this is covered in ACLS/BLS. More specific training in management of fractures/splinting, burns, controlling bleeding would be useful. ACLS which covers codes and airway management should be mandatory.

Nuclear & explosive.

Training modeled after ACLS.

All- CBRNE training is appropriate given the daily threats of terrorism and disasters. It should be mandatory training to meet disasters.

All-very interesting.

CBRNE trainings are helpful in case of emergencies-explosion, exposure to chemical or radiological.

All.

All that is available.

Use of detox equipment, intensive training in use of antidotes for specific toxins. A response team concept- a dedicated small group eg 5-6 persons who work through the training process together and become familiar with the emergency response as a "platoon" concept.

Responses to question "What ideas for successful CRNE training can you offer?"
Should be mandated.

Request retraining opportunities.

Request a residency in CBRNE.

Have it as part of standard hospital training like fire drills. Make it available at different hours of the day so that everyone can participate, not just medical staff but support staff also.

Increase awareness among people.

None.

Training videos/seminars; essential that manuals be made available for guidelines in the event of a disaster.

Exposure to basic principles early in training/career.

More time for demonstration of required skills.

To be compulsory provided by hospital.

It must be routine training or else it will not be remembered.

Make it part of orientation and should be paid for.

Regulation based simulated cases.

Practice Scenarios.

Interactive.

Conduct CBRNE at hospital/Make it easier to go to the classes etc. If people have to travel long distance in traffic, it is a deterrent.

Regular interval training available after working hours or on weekends or organized educational leave for training or some level of or complete (if possible) on-line, video or computer-based home study.

Practice Scenarios.

Chemical scenarios.

Brief, recurrent refresher course.

Don't know.

Certification test, actual simulation.

Expand emergency medicine residencies.

Training program/hospital should provide the training free of charge.

3 day course.

Clinical scenarios.

Drills with actual scenarios.

Grand Rounds.

On-line learning.

Case scenarios with practice management.

Enough common sense.

No cost for physicians/enthusiastic, interested teachers.

Good training.

I am willing to train and participate.

Willing to learn.

It should be offered but not mandated. Physicians go into specialties and that is the area in which they want to focus. So maybe according to specialty interest, it can be offered, like ID people should be offered training in biological, etc.

Clinical scenarios.

On-line or limited time frame.

Should be offered but not mandated for physicians.

Airway management workshops across the board to all physicians involved in patient care.

I hope the training course can offer some videotape/DVD to cover the topics.

Airway Management workshops across the board to all physicians involved in patient care. Basics of resuscitation (fluid management, blood transfusions, wound care).

Offer training programs/courses during Department conference/teaching hours.

Training should be conducted during departmental conference time.

More informative.

If taught to physicians, it must be taught by physicians.

Hands on chemical or blast disaster scenario.

On-line training.

Simulations/drills.

On-line/simulation/field.

Classroom conferences.

Scenarios/drills.

Simulation/classroom.

Field training.

Scenarios.

It is important to have this training in today's world because of complex scenarios and magnitude of disaster can be really high.

Field training.

Field/ simulation.

Field training.

Classroom & scenarios.

Simulations/Drills.

Conferences.

Field training.

Field simulations.

Simulations/on-line.

Conferences/Teleconference/on-line.

Drills/simulations.

Practice.

Classroom/Drills/On-line.

Simulations/drills.

Practice/Drills.

Simulations/drills.
Classroom/drills.
Classroom/simulations/drills.
Simulations/drills.
Classroom/simulations/drills.
Simulations.
Field training.
Field training/simulations/drills.
Training/drills.
Scenarios & drills.
Field training and simulations.
Training/Drills/On-line.
Training/on-line.
Field training/Simulation/drills.
Classroom/drills.
Classroom/drills.
Simulations/drills.
Classroom/drills/online/simulations.
Field training.
Field training/simulations/drills.
Classroom/drills.
Field training/simulations/drills.
Field training/ drills/simulations.
Field training.
Field training/simulations/drills.
Field training/simulations/drills.
Field training.
Simulations/drills/teleconferencing/on-line.
Field training.
Drills.
Classroom conferences and practical training.
Classroom conferences/field training and simulations/drills.

Field training/drills.

Simulations/drills.

Field training/classroom conferences/simulations/drills/teleconferencing.

Simulations/drills.

Field training/simulation/drills.

Field training/simulation/drills.

Field training.

I have had field training-most valuable.

Field training/simulations/drills.

Field training/simulation/drills/Teleconferencing.

Field training.

Field training/simulation/drills.

Field training/simulation/drills.

Field training/simulation/drills/classroom conferences.

Field training/simulation/drills.

Classroom conferences.

Field training/simulation/drills.

More video presentations.

All.

Field training/simulation/drills/classroom conferences.

Teleconferencing/on-line/drills/simulations.

Field training/simulation/drills.

Simulations/drills.

Field training/simulation/drills/Classroom conferences.

Field training/simulation/drills/classroom conferences.

Field training/simulation/drills/classroom conferences.

Field training/simulation/drills/classroom conferences.

All.

Field training/simulation/drills.

Field training/simulation/drills/on-line.

All.

Teleconferencing.

Field training/classroom conferences.

Field training/simulation/drills/classroom conferences/teleconferencing.

All.

On-line training.

Simulations/drills/on-line.

Field training.

On-line.

On-line.

Field training/simulation/drills/classroom conferences.

Field training.

Field training/simulation/drills.

Field training.

All.

Field training/simulation/drills.

Field training/simulation/drills.

Field training/simulation/drills/teleconferencing.

All.

Field training/simulation/drills.

Field training/simulation/drills.

Simulations/online.

Field training/simulation/drills.

Field training/simulation/drills/classroom conferences.

Classroom conferences.

Field training/simulation/drills/classroom conferences/teleconferencing.

Field training/classroom conferences.

Field training.

Field training/simulation/drills/classroom conferences.

Field training.

Classroom/simulations/drills.

Field training/simulation/drills/classroom conferences.

Field training/simulation/drills.

Field training.

Field training/simulation/drills.

Classroom conferences/on-line.

Classroom conferences.

It could be mandated & started in med school. There should be re-training by hospital every year. The sooner the better.

My idea is to recruit committed persons (those who want to do the job, not to get a title).

Field training.

Field training/simulation/drills.

CBRNE training should be voluntary.

Responses to question "What barriers to CBRNE training do you envision?"

Concerned about costs.

Concerned about retention.

Concerned about time requirements.

Resources.

Time and money constraints.

Getting off from residency training.

Fees/Getting paid for time.

If it is costly, afraid this institution would not pay for it.

Time concerns; peoples' acceptance.

City vs. rural scenarios; job description (ER vs FP).

Funding/Time management.

Cost of training.

It might not be as essential as ACLS training/Though might be a barrier to make it necessary before joining a health profession.

Cost.

Cost/time.

Some physicians are not comfortable in emergency situations. It is almost like a specialty.

Good training, time and cost.

Time & retention & value to daily practice.

Time/money.

Time.

Cost/time.

Time limitations and limited availability of coverage for the person training.

Cost.

Time.

I would never have the time.

Time constraints.

Time.

Finding the time.

Time.

Time.

Don't know.

Time to train.

Time available.

The farther along a specialist is in training, other areas that were not practiced become rusty.

Time/money/compensation.

Cost/interest.

Cost.

Qualified instructors.

Difficulty.

Time.

Time/time/time.

Time/money.

Time/money.

Should be guided by experts.

It is difficult for doctors not specialized in Primary Care or ER to want to train or help under catastrophic circumstances in view of possible lawsuits after crisis resolves.

Cost/time/interest.

Time constraints.

Time constraints/costs.

Lack of interest.

Retention.

Time/time/time.

Cost.

Cost and willing/qualified instructors.

Time factor.

Time factor.

Lack of interest.

I think the major barrier is time. If hospital can provide the physician some time to take the trainings, most physicians would be happy to receive the training.

Time commitment from busy practices. Cost issues for large scale training. Interest level may not be high for every physician.

Many of these skills are difficult to retain if not regularly practiced. Also, though most would want to help, people are wary of the liability issue of assisting when the type of situation is beyond their scope of expertise. Regular credentialing in ACLS & BLS should be mandatory so that practitioners can retain these skills.

Time commitment.

Time off to get certified and cost of certification.

Communication & practice.

Retention.

It will be difficult to compel practicing physicians to participate in training.

None.

Confidence that I would be able to actively participate efficiently in a real life situation.

Time & money.

Lack of time.

Time & funding.

Difficult to retain.

Time.

Cost/lack of trained staff.

Time during normal working hours. Comprehension & training. It should be practical.

Work schedule.

Not having enough time.

Time allotment for training.

Not enough time.

Scheduling to be off.

Busy schedule.

The time involved for that kind of training. The malpractice issues for specialties that don't deal with emergencies.

Time.

Time constraints.

Time for training.

No courses have been offered even though I have an interest.

Time and place of training.

No time during residency to take courses.

Knowledge.

Lack of continuity of disaster planning.

$$.

Focus training.

Time.

Not having enough time.

Time.

Cost.

Simulations/drills.

Time.

No previous experience.

Cost/manpower/resources.

Governing Body to organize training.

Time.

Waste of time.

Time.

I am not interested in the least.

Time.

Time related.

Time is very limited.

Time & money.

Time & money.

Time of programs available.

Organizational disasters/funding.

Time concerns.

Time & expense.

Fear/lack of initial interest/laziness.

Bureaucrats who like to see their resume or paycheck expand…

Availability.

Fear of another attack.

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