Meeting Proceedings: Linkages of Acute Care and EMS to State and Local Public Health Programs: The Role of Interactive Information Systems for Responding to Events Resulting in Mass Injury

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INTRODUCTION

Historically, public health agencies, emergency departments, and EMS systems have functioned independent from one another and have typically maintained informational systems that were not interactive. Given the rapid growth in information technology, exchange of information has an unprecedented potential for addressing public health emergencies in a timely and effective manner, yet this exchange of information goes largely unrealized.

Essential communication links are required within and between public safety and public service communication systems. Units from two or more different agencies must be able to interact with one another and to exchange essential information to coordinate operations in an effective manner. Exchange of information often requires communication between governmental and non-governmental public safety and public service providers. Interoperability in communications can be defined as the ability of first responders to communicate in the field across agency and jurisdictional lines. In this context we use interoperability as a very broad term incorporating all aspects of collaboration and interaction that are needed among all responders during a mass-casualty event.

The Meeting

In order to promote linkages in communication between various stakeholders involved in acute care, EMS, and public health, a two-day Meeting was convened on July 8 and 9, 2003 in Washington, DC. The purpose of this Meeting was to identify opportunities for the rapid exchange of information with the theory that interactive

information systems between EMS Physicians and Public Health Agencies would strengthen day-to-day operations and better prepare systems for catastrophic events.

The Meeting featured presentations from experts in communications, EMS, acute care, public health, and hospital care. Presenters were asked to identify problem areas and opportunities for improving linkages between EMS, acute care, and public health. These presentations were used to stimulate discussion among all attendees on each of these topics, and to develop strategies for improvement. The meeting attendees and the organizations they were sent to represent are shown in table 1.

A Writing Team was assembled prior to the conference whose charge it was to analyze the information presented at the meeting and produce this manuscript based on the proceedings. The proceedings were divided into five general areas: communications, EMS, acute care, public health, and hospital care. What follows is a summary of each of the meeting topics.

INTEROPERABILITY IN EMS COMMUNICATIONS

Communications Infrastructure

The role of public safety communicators has been the recent focus of media attention, which has had the effect of raising public awareness. However with increased awareness comes increased scrutiny. Since dispatchers are often the true first-line responder to emergencies and security crises, assessment of the nature and urgency of the problem is required so that pre-arrival activities can be coordinated before EMS response initiation. In order to effectively provide these services it is incumbent on public safety communicators to upgrade their facilities, staffs and systems. Numerous challenges confront public safety communications; increased call volume, rapid growth in information technology, and information overflow to name a few. There is a need for many enhancements in EMS communications to increase interoperability.

Implementation of a wireless enhanced 911 system will permit dispatchers to precisely locate the site of call origin for all callers. The ability to locate wireless callers has assumed paramount importance given the wide proliferation of wireless communications. Current technology of triangulation or Global Positioning Sytem (GPS) use is being explored, as the FCC has mandated that E-911 systems be in place for wireless communications by the year 2007. Even if E-911 systems are put in place, most communication agencies suffer from working with congested, overburdened radio systems.

There is a need for EMS dispatch to implement new communication tools, such as data transmission via video communication. These efforts are hampered by a lack of interoperability among agencies and between jurisdictions. The degree of existing

interoperability across agency and jurisdictional lines varies across the nation for both day-to-day operations and in response to major events. The way to achieve greater interoperability is through better planning, implementation of short-term remedies such as cross-band patches, improved equipment standards, and additional spectrum allocations for multi-agency radio systems. Such measures would also provide needed capacity to relieve congestion and provide for new communication tools.

Increasing interference from commercial carriers has hampered improvement efforts. Since popular radio and television transmissions are competing for the same frequency range, such interference has become commonplace. State and local governments obtain licenses to use specific channels from spectrum allocated by the FCC for public safety. Radio spectrum is critical to the ability of first responders to react to natural disasters, emergencies, and terrorist attacks, and is essential to police, fire and EMS ability to fulfill its public safety mission. The usable spectrum that has been allocated for public safety is insufficient, and channels designated for public safety are not in adjacent frequencies of the radio spectrum, hence are not usable. Mission critical communications require extremely high reliability, ubiquitous coverage, immediate access, and control of security.

The 1996 Public Safety Wireless Advisory Committee (PSWAC) was convened by the National Institute of Justice in order to address wireless communications and interoperability among state and local law enforcement agencies. The PSWAC identified the need for 97.5 MHz of additional radio spectrum for public safety by 2010 to address interoperability and capacity issues. In addition, the report identified that approximately 24 MHz would be needed within 5 years of the report, yet by the fall of 2001, few of

these recommendations had been implemented. The 1997 Balanced Budget Act enabled the FCC to allocate 24 MHz for Public Safety from TV Channels 60-69 (746-806 MHz). Existing TV stations are to relinquish these channels by December 31, 2006 or when 85% of households in the market have switched to DTV, whichever is later. State and local governments need a firm date for planning, funding, system design, and construction. The current 85% exception creates a loophole that may hamper implementation of the 1997 rules. The December 31, 2006date should be firm for making channels 63, 64, 68, 69 and adjacent channels 62, 65, and 67 available.

In densely populated areas, agencies must contend with congestion on their radio systems. This congestion forces geographically contiguous agencies to operate on different radio frequency bands. Public safety personnel from different agencies responding to the same emergency cannot readily communicate with each other, because they operate on incompatible, non-interoperable radio systems. The most effective resolution to this problem is to allow agencies in the same geographic area to operate on common, or at least compatible, radio frequency bands.

Cellular interference also creates problems with interoperability, and occurs when public safety portable radios operate far from the base station but very close to a low-elevation cell site transmitting in the same portion of the radio spectrum. Many cellular licensees operate throughout the 800 MHz band. This problem will continue to get worse as cell sites proliferate.

Inadequate spectrum also prevents public safety agencies from implementing new communications tools, such as wide-area mobile data systems that can provide law enforcement officers, firefighters, and EMS technicians with a wealth of critical on-scene

data. Modifying the band plan to segregate public safety from low-site cellular operations is essential to achieve long-term public safety equipment and system design improvements.

Communications Networking

It is apparent that voice communications lack interoperability, and cannot communicate securely across jurisdictional and agency lines in an emergency. Another glaring problem is the inability to share data among multiple emergency response and public health agencies. The emergency communications systems have not fully utilized modern communications or information management tools that are common in most industries. Problems with communications have been documented where emergency calls are dropped, 911 operators are overwhelmed with multiple calls, and responses delayed for lack of information. In mass emergencies, wireless and wireline communications systems become grid-locked. For example, telephone communications throughout the Northeastern United States suffered severe, lingering disruptions as a result of the terrorist attacks on the World Trade Center on September 11, 2001.

In order to increase the capacity and reliability of America's communications networks, emergency responders must have unrestricted use of the necessary bandwidth, fixed and wireless, to handle extreme communications volume in times of emergency. Emergency response agencies and their staff should have access to the best available communications equipment and information technology. There is an ongoing need to ensure that new employees and volunteers are fully prepared for the challenges that face our nation, and that new communications technologies should be used to make training more efficient. There also need to be significant efforts to protect

emergency responders and to inform the public of their responsibilities in civil preparedness and defense.

Knowing exact location is critical to any emergency response. The most effective and efficient methods of enhanced 911 deployment must be used, including wireline and wireless technology. In order to deploy modern end-to-end emergency communications systems, all emergency response and public health agencies must have access to broadband connections and basic modern information technology. The 911 systems need to be upgraded so that wireless E911 systems can integrate information from schools, hospitals, public information, hazardous materials management, and early detection of chemical and biological agents into the emergency response system.

Such high-speed networks would connect responders to a national emergency electronic directory, with data sharing systems, mapping, and other applications handling real time emergency information among multiple agencies. Communications systems should bring together all stakeholders, with sophisticated and integrated emergency and transportation communications and information systems. These new information technologies hold great promise in helping bridge the gap between urban and rural response capabilities.

Examples of how other data sources can be used during day-to-day operations include location technology (wireless E911), personal medical data services, EMS fleet location, Intelligent transportation systems (ITS), homeland security alerts (similar to Amber alerts), bio-terrorism reporting, syndromic surveillance, and data mining.

One example of how interoperability can improve day-to-day operations as well as response to mass casualty events is through the development of Automatic Crash Notification (ACN) technology. Currently, emergency personnel rely on passing motorists, highway patrols, and traffic reporters to report motor vehicle crashes. ACN systems detect a crash has occurred and automatically notify 9-1-1 dispatchers of the event and the location leading to a decreased scene response time as was shown in a field test conducted in Western New York State. However, because the ACN system measures real-time collision parameters, such as force vector, change in velocity, and vehicle dynamics it can also be used to predict the likelihood of injury in a given crash. If this technology were integrated with an organized trauma system and data were efficiently and effectively relayed to all care providers, it could not only expedite identification of vehicle crashes but also predict injuries. This system will allow for streamlined delivery of appropriate medical care including the selection of the appropriate transport mode and medical facility. (Pieske 2002)

While reducing response times (RTs) may improve survival, some argue that this opinion remains speculative and unsupported. A recent study was conducted to determine the effect of current RTs on survival in an urban EMS system. The 90% fractile RT specifications required for county compliance include 10:59 minutes for emergency life-threatening calls (priority I) and 12:59 minutes for emergency non-life-threatening calls (priority II). All emergency responses resulting in a priority I or priority II transport to a Level 1 trauma center emergency department over a six-month period were evaluated to determine the relation between specified and arbitrarily assigned RTs and survival. Five thousand, four hundred twenty-four transports were reviewed. No

significant difference in median RTs between survivors (6.4 min) and nonsurvivors (6.8 min) was noted. Further, there was no significant difference between observed and expected deaths. However, mortality risk was 1.58% for patients whose RT exceeded 5 minutes, and 0.51% for those whose RT was under 5 minutes. The mortality risk curve was generally flat over RT intervals exceeding 5 minutes. In this observational study, emergency calls where RTs were less than 5 minutes were associated with improved survival when compared with calls where RTs exceeded 5 minutes. While variables other than time may be associated with this improved survival, there is little evidence in these data to suggest that changing this system's response time specifications to times less than current, but greater than 5 minutes, would have any beneficial effect on survival. (Blackwell 2002)

An additional barrier to communications networking is that there is no comprehensive, electronic directory of all emergency response and public health agencies. No entity, government or otherwise, has the ability to send emergency warnings or data to all or some emergency responders or public information outlets in a particular area. A system must be developed so that emergency data and information can be sent to a shared map resource by emergency managers, telematics companies, wireless carriers, and others, and displayed/shared by all relevant emergency responders. These and broadband connections to a safety network create a basic platform on which a wide variety of other applications can operate.

Emergency Medical Dispatch

Over the last 15 years, the overwhelming majority of states enacted some form of EMS legislation or rules/standards regulating EMT and paramedic training and practice.

Prior to 1979, the EMS dispatcher typically had not a single hour of medical training. Since that time, the concept of medical priority dispatch training has spread throughout North America, with an estimated 400 municipalities using some form of medical priority dispatching. The emergency medical dispatcher (EMD) is the principle link between the public caller requesting emergency medical assistance and the emergency medical service (EMS) resource delivery system. Traditional medical dispatch systems used to dispatch EMS to medical emergencies includes the following: (a) systemized caller interrogation questions, (b) systemized pre-arrival instructions and (c) protocols matching the dispatcher's evaluation of injury or illness severity with vehicle response mode and configuration. As such, the EMD plays a fundamental role in the ability of the EMS system to respond to a perceived medical emergency.

The emergency medical dispatcher should be a specially trained telecommunicator with specific emergency medical knowledge. However, the training and practice through the use of a written or automated medical dispatch protocol is not sufficient in itself to ensure continued medically correct functioning of the EMD. Dispatch-specific medical training and the focal role in EMS require ongoing quality assurance/quality improvement (QA/QI) activities. These activities should cover initial hiring, orientation, training and certification, continuing dispatch education, recertification, and performance evaluation be given appropriate managerial attention to help ensure the ongoing safety in their performance of the EMD.

Dispatch lives in a world of protocol and interrogation techniques. For the EMD everything is protocol, policy, and procedure-based Emergency Dispatch. A critical component of early detection and warning resides with the dispatcher. Early warning

biosurveillance system uses real-time information pulled from 9-1-1 and other public safety calls to recognize aberrant patterns in call density or frequency. Such a system analyzes calls as they are coded by a dispatch center, compares them to historical and regional data, and automatically alerts specified personnel and leadership of any suspicious activity based on pre-set triggers. Such systems allow pre-setting of call clustering triggers to alert 911 of out-of-the-ordinary data observations based on standard dispatch interrogation and clinical coding system input.

Modern emergency medical dispatch provides appropriate resource responses with the use of a systematic protocol for all aspects of the dispatch process, including interrogating the caller, matching responses with severity, and providing pre-arrival care. A study by Clawson, et. al. tested the hypothesis that appropriate performance feedback would increase dispatcher compliance with the protocol. The authors examined how emergency medical dispatchers complied with the protocols contained in a dispatch system. Six key areas and overall compliance were studied. Dispatchers performed for 2 months without feedback and for a further 2 months with performance feedback. The mean overall compliance score improved from 76.4%+/-10.2% (mean+/-SD) in the absence of performance feedback to 96.2%+/-4.0% (n=217; P <.001) when performance feedback was provided. Five of 6 key areas showed similar improvements. The authors concluded that providing emergency medical dispatchers with regular and objective feedback regarding their performance dramatically improves how rigorously they follow a systematized dispatch protocol. (Clawson 1998)

Dispatch will likely be the first point of contact in any incident. How dispatchers react depends on the balance between the need for information collection versus time

constraints imposed by needing to act quickly and decisively. It is imperative that dispatchers relay information regarding the event and how to deal with it to responders and leaders. Information management must guard against the “garbage in…garbage out” problem. Data acquisition and analysis must be standardized and reproducible, so that data between centers must be compared and preset threshold can be used to screen for situations requiring more detailed analysis.

Bailey et al. conducted a study to determine whether implementation of an emergency medical dispatch (EMD) system would reduce the rate of inappropriate advanced life support (ALS) utilization, and enable more accurate identification of those patients requiring ALS care. The study compared the prospective identification of patients as ALS or BLS using EMD with that using chief complaint-based dispatch criteria. Each patient served as his or her own control. The ALS or BLS priority was assigned using both chief complaint and EMD criteria. Chief complaint-based dispatching meant that all patients with pre-established chief complaints received ALS without further triage questions, while EMD allowed the dispatchers to question callers using a scripted set of questions. The outcome measures included the number of calls categorized as ALS or BLS, the number of calls cancelled by BLS, and the number of ALS calls released to BLS care. There were 11,174 patients enrolled. The use of EMD was associated with a significant decrease in the proportion of calls designated as ALS (44.7% vs 55.8%), as well as a significant decrease in the number of ALS responses cancelled by BLS (9.2% vs 23.8%) and patients released to BLS by medical control (4.7% vs 7.3%). The authors concluded that implementation of an EMD system

significantly decreased inappropriate ALS dispatching, as defined by decreased rate of ALS cancellations and BLS releases. (Bailey 2000)

With bioterrorism a mounting threat, early detection of a possible "stealth" attack from agents such as smallpox or anthrax has become a national priority. Data provided from hospitals, labs, drug stores, schools and the workplace must be integrated to facilitate detection of abnormal patterns. Home-land Security and public health officials have been seeking ways to more quickly detect trends representing possible outbreaks. However, current U.S. epidemiological systems designed to identify public health trend changes cannot react as quickly as would be needed to preempt widespread inoculation. Using data from 9-1-1 calls may be attractive to public health officials because it comes from a centralized, standardized database, using standard data pathways.

Data pathways need to be established to permit identification of processes for coalescing dispatch data and coordinating the response among appropriate agencies. Plans need to be in place to permit sharing of information at the local, regional, national, and even international levels. Information sharing must be balanced by confidentiality issues such as HIPAA and other privacy issues, knowing when and what to tell responders, the need to protect responders using standardization of protective gear, and knowing when to restrict access to scenes that are likely to pose a threat to rescuers must all be balanced. A unified system is needed for data identification at dispatch that is generated through a scientific process within a central group and routinely distributed to everyone with potential involvement in rescue and recovery operations.

Most emergency planning today is taking place under the auspices of Homeland Security initiatives. Because of this urgent need, assembling the necessary communications technologies and systems is essential for different public safety agencies to communicate seamlessly and reliably with each other. However, modern emergency communications must have sufficient dedicated radio spectrum for unfettered and high-quality reliable communications in emergency situations. Developing the ongoing dialogues with other agencies to allow for joint planning and coordination is essential for a coordinated response to an all hazards emergency.

Survivability during crisis requires that system redundancy be in place and that planners are given ready access to resources to build public safety communications systems that can withstand a terrorist attack or other significant manmade and natural threats. Security is essential to implement processes and procedures to assure that public safety communications systems, centers and staff are protected with substantially increased security to thwart attempts by enemies of the United States to disrupt and destroy our emergency communication capability.

Personnel must be trained to enable them to plan for any type of terrorist event, to utilize new technology, to be aware of new security systems and procedures, and to deal with the stresses associated with working in an environment characterized by perpetual anticipation.

INTEROPERABILITY IN EMS FIELD CARE

Extent of Disaster Response Resources Available To EMS Systems

Significant variation and disparity exists in both the resources available to EMS and in the magnitude of the threats to which EMS systems and individuals may be exposed. Although it may not be possible to accurately predict the optimum level of protection needed within individual systems, it is essential to match resources to the level of threat most likely to occur.

There are several types of structural command systems designed to direct resources in emergency situations. Integrated incident command provides one example of a shared resource available to EMS. However, the structure of incident command can vary considerably by location. For example, the following command structures will likely become active during a mass event: the medical metropolitan response systems, local emergency planning committees, as well as federal and state initiatives.

Based on the new threats of terrorism, it appears that some of these initiatives work for specific situations, and that some do not. On a day-to-day basis, they all work to initiate dialog. Terrorism early warning groups that call together individuals within a community to discuss the threat matrix within that community are also effective structural systems. These groups should include business leaders from within the community in addition to the usual emergency response groups.

Communication Of threat and vulnerability to local agencies

Assessment of vulnerability and threat must be understood at the local level. Input from the federal level regarding the degree of threat that exists for that area is essential to ensure appropriate prioritization of that threat and to hasten the allocation of

resources within individual catchment areas. Presently individuals at the local level are often the last to receive this type of information. A system for communicating regional/local threat levels to first responders would assist local efforts for preparedness.

The threat of communicable disease certainly has an effect on resource utilization. When a situation such as SARS or even an anthrax threat is imminent, it is essential to have a plan for how to operate when resources are taken out of play. In the case of ambulance service resources in the face of a highly communicable disease, more than 30% of the resources may be taken out of the system initially as first responders are exposed to the threat. Plans for how to alter operations in the face of this type of challenge need to be in place.

Funding of resources requires prioritization

Because resource management must be built from the bottom up; from the local level to the regional, to the state and national levels, local and regional resources must match the local and regional needs. Federal input about how to prioritize the issues and needs at a local level is essential. An integrated plan for the development and maintenance of resources that can respond to changes in the threat matrix is needed.

In the past, an all hazards approach and vertical systems of response strategies have worked to manage resources in many areas. However, in the last 5 years, planning has moved away from using the all hazards manner and become more driven by single event issues. With this event-driven style in place, the all hazards approach is lost. Local agencies are no longer clear about the priorities and feel the need for guidance.

State, regional and local offices of preparedness are being created, which in many cases parallel and duplicate existing agencies. The major question of who is providing the leadership required for appropriate prioritization of these needs often remains to be answered.

It is important to remember that more than half of all EMS providers are volunteers, and as such, are often the last individuals to be trained. Information flow, training and equipment are less available as one moves away from metropolitan areas. Funding is essential to extend communication flow to these individuals. It is also important to note that not all EMS services are governmental. While municipal fire services do provide some emergency medical response they do not cover the entire country. Therefore, funding initiatives must account for the various types of EMS services that exist throughout the country.

How Can EMS Agencies Protect Responders From Hazards?

Training

There is an obvious need for more and better education and training to protect first responders from hazards. Internet access to training and certification could be used to move some of these agendas along. To organize responses in a disaster requires immediate action, which often includes self-dispatch. This issue needs to be dealt with, as does the issue of secondary triage and transport decisions.

Integrated training exercises can offer a structure that allows several agencies to work together in a process that will lessen the hazards to all during an actual disaster requiring multi agency response. Although disaster drills can be expensive, participation at all levels is vital, and realistic training with actual equipment should be employed.

Hazmat provides a good model on which preparedness planning and multi level training situations can be based. Additionally, the core curriculum for emergency medical technicians should contain some material regarding preparedness and interoperability issues.

Standardized planning

Consensus is necessary regarding when standardized planning or planning based on local variation is used. National guidelines need to remain “guidelines” and should be afforded the flexibility on the local level that is necessary due to the unequal allocation of resources among services. General guidance is needed for the development of standards for response and recommendations for what equipment should be available. These guidelines must be tied to funding and implemented throughout the system to the level of regional and local agencies.

Standardization in equipment

The lack of standardization in equipment is a huge problem. Much of the important equipment (e.g., SCBA tank fittings) is not standardized and therefore, agencies are not able to share these often vital resources. It is of note however, that recreational SCUBA equipment is in fact standardized and interchangeable among recreational divers in the event of a crisis. The first priority for interoperability of equipment is to establish and enforce standardization for equipment necessary for all operations and to ensure that vendors provide only the standardized equipment from this point forward.

Responders deserve to know the risks from which they are vulnerable

Emergency actions are always driven by the nature of the threat. Interpretation of the situation has to involve flexibility and fluidity on behalf of the decision maker. Disaster response should be protocol driven. First responders should be able to make the first moves; and everyone in the community should know the first three things to do. The skills and education of first responders should be raised to a level where they are able to provide an initial disaster response.

Other safety issues include the ability to communicate the risk/benefit ratio of the situation to the emergency responder. A method for assessing the risk/benefit ratio and for communicating this information to the provider is not currently available and must be developed. Access to information is essential, and the method for providing information in real time must be established. Standards and perhaps combined access to equipment, such as: personal protective equipment; antidotes and decontamination supplies are essential.

How Can EMS Assist With Surveillance, Disease Reporting?

In order to assist in the surveillance process, EMS has the ability to provide data to surveillance systems in an effortlessly manner through the use of data that is already collected from individual run reports. These data should be collected and analyzed in real time, and their use should conform to clear and unencumbered reporting policies that will continue to facilitate the surveillance and reporting processes. The sharing of information among agencies has become mired in misunderstanding with the recent institution of HIPAA regulations. This is a barrier that needs to be overcome.

Additionally the use of a comprehensive reporting system involving Computer Assisted Dispatch as a means for reporting to state and local authorities will be valuable. Surveillance systems need to include a two way communication process. Ideally surveillance systems should have the added capability to notify first responders of safety issues and help them to expand practice standards and disaster response strategies. Community groups should be involved in providing data to the system and members should include local law enforcement, school officials, local business persons, and lay representatives.

At the local or community level, a focal point should be established through emergency management and a hierarchy built to facilitate the movement of information from the state to either CDC or to the Office of Homeland Security. Regarding syndromic detection, local public health officials should be involved in making decisions about whether or not it is safe to respond when a threat exists. Local public health officials, emergency dispatch or emergency service providers need to make decisions either together or individually about whether to attend a threat, depending on the situation. Some type of qualified immunity needs to be available for individuals who make these difficult decisions based on the best information available at the moment. Depending on the magnitude of the event, the correct resources need to be activated at the appropriate level, local, state or federal.

How Can National Organizations Work Together to Facilitate Interoperability at the Local Level?

National organizations have begun to work together toward the adoption of interoperability protocols. Recently several organizations have agreed to recognize

common disaster training courses. Additionally, meetings like the one described here, offer another method of ensuring that representatives of national organizations talk to one another about how interoperability can be facilitated.

However, there does appear to be some cooperation between agencies. A lack of standards is not the problem; the problem is that there are too many standards currently in play. One set of standards should be adopted universally. As an example, Hazmat has certification for special operations across disciplines. This seems to work, as there have not been any legal problems inherent in creating these specialized teams.

At the local level, there is a problem acquiring funding for equipment and training. State agencies and national organizations may be able to help with this problem. For example, it is being highly suggested that all states go to a three tiered system of EMS (Basic, Intermediate, Paramedic); however, this has caused concern at the rural level where there is no incentive for volunteers to obtain certification to this standard.

Three major areas have been identified in which there is the opportunity to enhance interoperability in EMS field care. Training and educating first responders in combined exercises is essential for interoperability. The use of surveillance systems with two-way communication ability should be put into place to communicate threats in real time and for use in protecting vulnerable first responders. Interdisciplinary consortiums should be developed to represent the needs of all agencies in funding issues, governing issues and to prevent barriers to information gathering.

Interoperability in EMS field care is the ability to manage relationships in the field and to have trust in those managing the incident. To build this type of trust will require meeting at the local level with all those who have a stake in the safety of the community.

The development of relationships among these individuals will be essential to making interoperability successful.

INTEROPERABILITY IN ACUTE CARE

Introduction

Acute care is the phase of emergency response involving the treatment and care of individuals harmed from a mass casualty incident. Acute care is traditionally perceived as involving only the prehospital and in-hospital arenas. However, in this section we discuss how acute care must encompass the full range of public health and public safety responses to individual, multiple, and mass casualty incidents, including the interface with and partnership between community, government, military and other agencies.

How Can Healthcare Systems Increase Community Capacity To Deal With Disasters?

One of the most important factors in responding to a mass casualty situation is the ability of the entire community to accommodate the surge in need for medical services. While individual healthcare systems (i.e. hospitals) might be prepared to respond to events of a limited size, larger-scaled incidents may require drawing upon outside resources. Certain events may present operational challenges that individual healthcare systems are not prepared to handle. Therefore, the preparation of the entire community to provide acute care in a large-scale incident requires the involvement and active participation of multiple community partners.

The first step in increasing community capacity is to perform a detailed inventory of existing facilities and services in the community. This inventory must account for:

- Specialized response capacity – Does the facility have specialized resources such as decontamination facilities, isolation rooms, etc.?

- Surge capacity – Does the facility have physical room to accommodate excess surge and overflow from traditional care centers?
- Medical equipment and resources – Does the facility possess or have ready access to medical equipment and resources needed for handling an event?
- Personnel resources – Does the facility have existing personnel (or access to personnel) to operate the facility in the event of a disaster?
- Support services – Does the facility have adequate support services (food, clothing, shelter) to enable personnel to perform their duties during a disaster?
- Special populations – Does the facility have the ability to care for patient populations with special healthcare needs, such as children, elders, the chronically ill, and the permanently disabled?

Large-scale events may quickly overwhelm the capacity of traditional healthcare facilities such as hospitals. Therefore, in identifying community partners that may participate in a disaster response, it is important to consider the involvement of non-traditional, non-medical facilities. For example: convention centers, hotels, schools, gymnasiums, community centers, or sports complexes. These facilities are accustomed to handling large numbers of people and often have large areas that can be used for treating or staging large numbers of victims. Alternatively, these sites may be used for staging personnel and equipment. Conversion of a non-medical facility into an acute care service requires considerable preparation. Therefore, it is imperative that potential community partners be identified and integrated early in the community-wide pre-planning process.

The inventory of community resources must also account for personnel resources. Acute care naturally involves prehospital and in-hospital personnel. While the community inventory must plan for the numbers of individuals needed to respond to an event, it is also imperative to consider other important factors such as the seasonal or daily fluctuation of personnel and the existing workload potentially present at the time of an event. There may also be instances where medical personnel are harmed and cannot provide care or where equipment is damaged and cannot be accessed for use. Volume fluctuations involve not only personnel but also equipment and availability of ancillary services. Response plans must consider that in addition to meeting emergency needs, the baseline needs of the communities must continue to be met during an event. This is particularly true when medical, surgical, or pediatric subspecialty care is required, as the numbers of skilled subspecialty providers available to any community is apt to be limited.

As alluded to previously, non-medical personnel should also be considered important ancillary resources for providing acute care. While some of these volunteers might be able to provide basic minimum medical care, others will be able to play important logistical/support roles. Many of these personnel may have pre-existing official community volunteer roles (Freedom Corps, Red Cross), but many will not. Community planning must account for the use of these non-medical personnel and must include strategies for quickly training and preparing these individuals to provide needed services. The advantage of using existing community groups is that these teams are already assembled; they can be prepared, trained, dispatched and utilized as a single

unit. Many of these agencies are already accustomed to providing vital non-medical support (food, shelter, etc.) that may be needed for a sustained response.

How Can Healthcare Systems Take Steps To Improve Community-Based Planning?

Community pre-planning is paramount for effective emergency response. Community preparedness planning for a mass casualty incident involves multiple components and processes. While many algorithms have been described and advocated, one important first step is to identify and assemble a working group of interested stakeholders. Such a process brings leaders and decision-makers to the table to understand, discuss, and evaluate the current infrastructure, vulnerabilities, and areas for improvement. Depending on the local political atmosphere, there may also be the need to consider a non-partisan group facilitator so that issues may be entertained in a fair and concise manner. All emergency response agencies should be represented, including:

- Law Enforcement
- Fire
- EMS
- Local, regional, and State Emergency Management Agencies
- Federal and State Agencies
- Local office of the Federal Bureau of Investigation (because of their role as the lead agency for crisis management).
- State bureau of investigation or state highway patrol office.

- Hospitals, nursing homes, and urgent care faciliites (both local and regional)
- Local medical professional societies (general and subspecialty)
- Public Health Department
- Medical Examiners Office
- Infectious Disease Specialists
- Mental Health and Social Work Practitioners
- Environmental and Agricultural Specialists
- Local or regional political representation.
- Military Agencies
- Representatives from private industry that may be involved in logistical support or supply lines

Once all agencies are assembled, it is important to establish an integrated plan based on a common response philosophy with the clear definition of the roles and responsibilities for each participating agency. It is imperative that all agencies participate and cooperate with the systems concept, design, and planning. The representation of each response and healthcare agency ensure interface with and dissemination of information to the community.

The community partners pulled together for an emergency response may not be accustomed to working with each other. Therefore, the pre-definition of a chain-of-command is important to facilitate efficient communication and execution of interventions in the event of a mass casualty incident. A back-up contingency command must also be established because there may be instances where key individuals are not present or available or have been harmed by the event itself. It should be noted that

while there are many existing models for incident command structure, there are few (if any) models of command structure for community-wide response.

Hospitals and healthcare systems must update their existing disaster and response plans to account for newer threats. It is understood that such occurrences are rare; however, when they occur, there are now public expectations that such systems are prepared. The availability of surge capacity is a newly recognized requirement in disaster response, and existing plans must be updated to address this requirement.

While each response agency or healthcare systems may have their own response plan, it is important to evaluate how these plans interrelate between the agencies. All prehospital field plans must be compatible (and integrated) with receiving healthcare facility plans. Likewise, healthcare system plans must be augmented to support unique mass causality's needs such as decontamination. Each agency must understand the resources available at any point in time and be aware of the functionality of other agencies and facilities. (For example, it may be necessary for a hospital to perform decontamination of patients that inadvertently bypass field decontamination.) There may also be situations where a community's specialized team or resource is most useful or vitally needed in another community. Along these lines, active or passive surveillance systems used in selected communities for detecting events must be integrated with the existing system response plans so that there is a coordinated response to an identified community threat.

Likewise, hospital plans for managing excess patient surges must be integrated between different healthcare facilities. Not only should hospitals develop plans with response agencies, but should also develop patient allocation plans between facilities

depending on their individual capabilities and experiences. Hospital staff must become familiar with current or revised plans, and understand how these plans may change in the event of certain mass casualty events. Prospective planning should identify those facilities capable of providing specialized care such as pediatric, obstetrical or trauma care. Similarly, individual physician practice groups may be assigned to respond as a team to designated facilities depending upon the needs of the situation. Allocation decisions at the time of an incident must consider current emergency department, critical care, or overall hospital census.

While EMS and hospitals must be integrated into the emergency response planning processes and plans must be developed to maximize response and resources, hospitals must be incorporated into the local incident command system to ensure that system components are fully integrated. For example, many hospitals in North Carolina have adopted and integrated the Hospital Emergency Incident Command System (HEICS) into their response plans. The HEICS incorporates multiple vital departments of a hospital support system, organizes these areas based on functionality, and provides for a well-coordinated infrastructure that is able to address patient care needs and resources as issues or problems arise. Integration of hospitals into chain-of-command will serve to ensure consistency and competency in communications, notification procedures, acute care capabilities, capacity, and bed availability. This integration would also facilitate communication between hospitals and field providers regarding patient triage and allocation. This is important to ensure that patients are proportionally and appropriately distributed to receiving hospitals. Integration of command can also facilitate dispatch of specialized rescuers or resources where

needed; for example, mobilizing a surgical team to a local hospital without trauma care capabilities.

Collegial relationships with community partners must be fostered early in the process to ensure success. Problems with agency interrelationships can interfere with effective emergency response or planning. Therefore, organization efforts must be supported by strong leadership or facilitators to ensure that all parties are not only "at the table" but able to communicate and cooperate.

Community-Based Planning, Best Practices – The North Carolina Experience

North Carolina has implemented various response initiatives at the local and State level. There are three Metropolitan Medical Response Systems in the State:

- The Advanced Local Emergency Response Team (ALERT) is the original emergency response program and was formed in Charlotte. This is a multiagency team of law enforcement (local, State, Federal), fire, and emergency medical personnel. The Team may be called to respond to any natural or man-made disaster involving mass casualties, including weapons of mass destruction.
- The Mecklenburg Operational Surveillance Team (MOST) is an active public health surveillance program that has a system in place for receiving secure electronic data regarding absenteeism from the public schools or daycare centers, adult and pediatric clinic activity, daily emergency department census, retail pharmacy information, veterinarian clinic activity, and EMS call volume. Information is downloaded daily to capture the previous 24-hours of activity. The average state of health for the county can be measured such that any significant

deviations from the normal would be recognized and epidemiological processes for cause may be implemented.

- The North Carolina Office of EMS has developed the State Medical Assistance Team (SMAT) I, II, III initiative which is designed to support local hospitals (SMAT I and II) and EMS (SMAT III). Each SMAT incorporates a medical equipment, personal protection, and pharmaceutical cache that may be quickly mobilized to an incident site to assist in mitigation.
- Further, the Regional Advisory Councils (RACs) for Trauma have been developed in seven regions across the State. Based in the trauma center, the purpose of each RAC is to bring prehospital and hospital representatives together into a forum that facilitates open dialogue between organizations as it relates to trauma care and transportation. Each RAC is responsible for establishing a Disaster and Preparedness Subcommittee that allows for regional planning initiatives.
- In addition, the North Carolina Public Health Department has developed seven Public Health Regional Surveillance Teams designed to provide oversight and bioterrorism preparedness coordination activities to all local health departments.
- Finally, the North Carolina Office of Emergency Management has identified, outfitted and funded a group of Regional Hazardous Materials Response Teams and limited Urban Search and Rescue Teams to assist any jurisdiction with those particular resources.

How Can National Organizations Be Brought Together To Outline Steps For Interoperability At The Local Level?

As discussed previously, an effective acute care response plan must involve the identification and integration of multiple community and governmental agencies, and these bodies must be brought together to the same table for active discussion and pre-planning. Additional input from local representatives of national organizations may also be imperative in the planning process. The impetus and leadership for this planning process should come from the federal or State level to ensure that a conceptual “master plan” is in place prior to development of detailed local or regional plans.

Federal involvement in community planning for emergency response is mandatory because many issues extend beyond the delivery of healthcare. For example, in a more catastrophic event, rebuilding of community physical infrastructure may play a high priority. Where damage is extensive enough to impact government operations, redevelopment of a government infrastructure may be necessary. Since many catastrophic emergency events may result from overt acts of war, federal involvement may be mandatory to maintain security and safety. Therefore, partners from the federal government, including the Department of Homeland Security and Department of Defense, must be involved early in the community pre-planning process.

Since emergency events may quickly escalate to involve multiple systems or communities, it is important that agencies pursue a unified approach to emergency response. A National Model for Interoperability and Emergency Response should be created to provide a standard template for response. While the plan might be customized for individual communities, the presence of common plan elements would ensure a uniform approach to emergency response by all communities and facilitate communication and operations across communities during an event. A uniform plan

would also establish a uniform language for defining and carrying-out emergency response. The development of a model national response plan might be the task for a "National Institute for Best Practices," which might be charged with overseeing national emergency response.

Emergency response plans, including communications, operations and command structure, must be integrated with daily operations. Regular use of emergency response plans on a small scale will ensure that these strategies are familiar to all parties involved when a large-scale incident is encountered. Pre-planning between communities ultimately must also be tested in action. Therefore, training in emergency response must be carried-out in a multi-community fashion. The effectiveness of a mobilized team or resource can only be evaluated if it is actually tested in a foreign environment outside of its home community.

Community-Based Planning, Best Practices – The Morris County, New Jersey Experience

Begun about 1998, the Morris County, New Jersey Bioterrorism Taskforce was developed as a broad community based group to address emergency preparedness from all angles. The "all-hazards approach" was immediately embraced, and the phases of preparedness and surveillance, response and recovery were incorporated early in the planning of the group. Critical to the Taskforce's success were the initiating efforts of a non-partisan champion, the City Health Officer of Morristown, the County seat, to bring diverse representation to the group, to maintain communication with and between all groups, and to get them to interact in a routine fashion that created "habitual

relationships." Community, government (local, State and federal), healthcare, law enforcement, business and education entities are all represented in the Taskforce. Because the participation is so large and diverse, communication is maintained between taskforce members and more by NJ Lincs, an information pass-through from State level or above. There are numerous benefits to such a large and diverse group. Drawbacks are minimized by good communication, a common good and organized leadership. Critical to the success of such a group is the integration of the available services, avoiding unnecessary parallel service development and subsequent confusion during an event. Among the projects that have come out of the taskforce are the following:

- Picatinny Arsenal, a military research center, in conjunction with the NJ Institute of Technology is working to modify SERIS, a military software that tracks emergency personnel and vehicles. This software even has the capability to track individual victims and victim contacts during a biologic event.
- A mechanism and agreement is in place for corporations with large numbers of personnel to report absenteeisms of more than 15% (when not a holiday). This broad sweep may help to identify and track epidemic occurrences.
- Grant disbursement that is consistent with need and standardized for interoperability across all agencies in the county. One example here is the geographic location of decontamination units, the direction of monies for that purpose and the purchase of identical units for fire, OEM, public health and the trauma center.

- A focus on functional/geographic boundaries to disaster preparedness and management that will ignore political boundaries.

Finally, a better understanding of the roles and capabilities is had by all that participate in this group. From this comes the acknowledgement that the general public needs the same, and a true "trickle down" effect at schools, industry, etc., is set in motion.

Future Needs For Acute Care

Funding Emergency Response

None of these efforts can be effective without government budgetary support at the local, regional, state, and federal levels. Emergency planning in itself is an expensive process, and many communities do not have the financial resources to carry out proper planning. Yet, post-disaster debriefing exercises have repeatedly shown that, along with failure of communication systems and incident command, lack of regional disaster planning and coordination are the most common causes of sub-optimal responses to mass casualty incidents. While government often provides seed money for response organization efforts, follow-up funding to sustain those efforts is often not available. Furthermore, there is little incentive for private industry to become involved with emergency response. As alluded to previously, a "National Institute for Best Practices" might be charged with overseeing funding for emergency response preparation.

Unifying the Language of Hospital Capacity/Diversion

Hospital/emergency department diversion is not only an ongoing national crisis but also a concept that is an integral concern in emergency response. During a mass casualty incident it will be vital to accurately describe and communicate hospital activity and capacity in order to facility appropriate transport and flow of patients. A fundamental prerequisite is to develop a common unifying language for describing hospital diversion status. If all systems are using the same system nationally, this will facilitate communication in the event an incident involves several different communities. Since many victims of a mass casualty event will require only minor medical care, a standard diversion status system would also facilitate communication with the public, helping "walking-wounded" to easily determine where to go to seek medical care.

Educating the Public Regarding Emergency Response – Improving Public Communication

It is important to educate the public regarding emergency response. The use of national standard terms for describing emergency response would help to streamline public notification and instruction. An important adjunct to this goal is to improve existing national public alerting systems. While the Emergency Broadcast System presently exists to communicate emergency information to the public, this system needs to be updated to incorporate standard terminology and up-to-date emergency response instructions. Since they currently play such a large role in providing information to the general public, communication with news media should be integrated into a public communication plan.

Communications Between Agencies and Facilities

Communication is one of the most important elements of any emergency event. Communication must be improved to facilitate coordination across multiple agencies. Not only are new technology and technical standards warranted, but these systems must be expanded to encompass hospitals and healthcare facilities; these services cannot be integrated into the emergency response plan unless the same communication system is in use. An “Emergency Broadcast System” strictly for medical facilities would help to facilitate immediate important communication to these facilities. Continued technological innovation will undoubtedly facilitate improvement in this area. These developments must also consider loss of communication infrastructure due to an incident.

There must exist a hierarchy and chain-of-command for communication and dispatch. For example, in the event of a disaster, although a medical facility may have available a full complement of staff, it may only be necessary to dispatch a subset of those professionals. Surplus staff may be kept in reserve to relieve rescuers during a sustained disaster response. Therefore, while communication between agencies and facilities is important, it must be supported by pre-determined protocols.

Improve Tracking of Multiple Victims

Mass casualty events involve multiple victims and multiple hospital facilities. Improved methods for tracking victims and patients must be developed for emergency response. Conceptually, this might involve the use of a new triage tagging or barcode system, and would unify field triage information with prehospital and in-hospital care. Linkage with destination facilities is vital in order to identify where specific patients have

been transported. The prompt availability of patient location information can conceivably reduce the information burden upon each hospital as friends and family members strive to locate the destination hospitals of individual patients.

Efficient Transfer of Information

The efficient and effective transfer of medical information is crucial in a mass casualty event. Medical record information may be useful or even life-saving in selected instances. Effort must be applied towards breaking down the technological barriers preventing efficient exchange of hospital and pre-hospital medical data. Uniform medical data transfer and technology standards should be developed and adopted. New versatile technology should be developed that is operable outside of the hospital environment. Likewise, governmental regulatory barriers to the exchange of information must be addressed; for example, the current HIPAA rules.

Other Acute Care Issues

Rescuer Credentialing

Emergency response may require mobilizing healthcare professionals from across jurisdictional borders. It may also be necessary to consider emergency credentialing for professionals that appear at an incident but are separated from their home institution. Mechanisms must be established for providing emergency credentialing to these individuals so that they can practice their full duties at the location of the disaster. This type of an effort requires coordination with licensing boards at the local, regional, and state levels. Current national practitioner data banks may

conceptually provide a readily available source of information on individual healthcare providers. Parallel to this issue is the provision of liability insurance or immunity to rescuers mobilized to a disaster to provide care.

Volunteer Responders

Mass casualty events typically receive unsolicited responses from volunteer medical personnel or agencies. Emergency response plans must contain a component addressing how volunteer responders will be used at an emergency. These plans must include procedures for authenticating individuals or teams. The response plan must address how volunteer rescuers will be integrated into the response effort and how their actions will be supported, guided or supervised. A volunteer unit will not be useful in an emergency response if it cannot perform basic functions within the community; for example, navigating to designated hospitals.

INTEROPERABILITY IN PUBLIC HEALTH

Definition of Public Health and the Public Health System

A widely quoted definition of public health is the following: “Public Health is what we, do collectively to assure the conditions in which people can be healthy.” (From, *The Future of Public Health”,* 1988: Washington, DC, Institute of Medicine). That same publication defined the core functions of public health as assessment, policy development, and assurance.

Public health services are largely delivered through organized systems built around a base of governmental services administered by health departments at the national, state, and local levels. However, other public and private sector organizations are involved in the development, delivery, and evaluation of public health services, and the role of these organizations is increasing in scope over time. This is particularly evident in the development of effective public health responses to emergency situations.

Role of the Public Health System in the Identification of Outbreaks of Communicable Diseases and Other Emergency Situations

The role of the public health system in response to emergency situations can be described as occurring under three different “states” namely, baseline operations, peak busy periods, and disaster/emergency situations.

Baseline Operations involves the routine operations of the disease surveillance system, which collects data on the incidence of communicable diseases from the reports of healthcare providers and laboratories, and responds in an appropriate fashion to these reports. These efforts are ongoing along with the routine work of the practicing

medical community; the spectrum of activities encompassed under pre-hospital care including the EMS functions; and activities in the hospital including triage, acute care and urgent care. In the state of Baseline Operations, the clinicians in the community would likely be the first to identify an outbreak of a communicable disease.

In the **Peak /Busy Periods State**, as for example during an outbreak of the flu or of a "cold", identification and control of the disease outbreak involves the collaborative efforts of community clinics, the pre-hospital care system, hospitals, and the public health system. The collaboration of these groups is often informal at first, with more structured interactions developed depending upon the severity of the outbreak.

In the **Disaster/Emergency State**, the identification of the involved communicable disease agent would largely be the responsibility of the public health system. However, the response to a disaster/emergency situation would require the closely coordinated efforts of the pre-hospital care system, hospitals (i.e., particularly their emergency departments), and the public health system. This collaboration is essential in the effort to accurately identify and treat the victims of the disaster/emergency, and to help assure that the involved agent is contained.

The Public Health System's Response to the Challenges of the 21st Century

In contrast to the more routine responses of the public health system to fairly predictable or easily contained situations, the challenges of the modern world, including the actions of terrorists, require a series of new approaches to disasters. First, a reliable capacity for preventing emergencies/disasters must be developed throughout the Country. This includes a system for educating the community about the threats of future

disasters and indicating the types of responses that must be made if they occur. This system must assure that the information provided to the community is accurate and is continually updated in a timely fashion.

Second, the medical community must be oriented to their role in an emergency/disaster, and should be strongly encouraged to report all cases of communicable diseases to the public health system as soon as possible. This is in contrast to the present situation, when only 50% of diseases on the mandatory reporting list are actually reported.

Third, in order to help prevent emergencies/disasters and to control them when they have occurred, it is absolutely essential that all members of the response teams, including both healthcare providers and front line responders, be connected by a highly efficient communication system that operates in real time.

Fourth, new technologies in data collection and management, disease reporting, communications, and other areas must be developed and implemented if the preventive/restorative efforts are to be successful. In addition, investment in human capitol to operate these technologies is absolutely necessary if they are to be used properly.

Development and Implementation of an Improved Disaster Surveillance System

Another major area of need in the development of an effective disaster/emergency capability is that of designing and implementing an improved disaster surveillance system. For this to occur vigorous efforts must be made to recruit the most highly trained and dedicated people that can be found to manage and operate the system. These individuals should be provided with the best working conditions

possible, and their level of expertise should be enhanced by regular continuing education.

In order for the staff members to succeed in their work they should be provided with the most effective technology, and this technology should be upgraded whenever indicated by future research. The technology adopted should be redundant so that an unexpected failure of one part of the system will not significantly interrupt the effective functioning of the whole system. It should also be recognized that in the rush to embrace “high tech” systems, many very effective “low tech” solutions may be overlooked.

If the surveillance system is to accomplish its intended mission, early detection of the release of a biological or chemical agent is absolutely essential. For this to occur, the routine reporting of disease by healthcare providers must be strongly encouraged, and the surveillance system must be highly sensitive to clues from small numbers of cases or clusters of symptoms.

The continuing failure of healthcare providers to consistently and promptly report cases of communicable diseases is a particularly serious issue in the setting of potential terrorist attacks. The current rates of reporting of diseases that are mandated by state and federal authorities are no better than 50% with regard to sexually-transmitted diseases, and may not be much better for the other categories of communicable diseases. In order to help correct this deficiency, it is necessary that the reporting system be strengthened to indicate very precisely what information is to be reported and the urgency of timeliness and assurance that there be will be relevant feedback to those

who report. In addition, the use of paperless online reporting systems should be adopted wherever possible.

In the effort to build an effective electronic surveillance system, care must be taken to avoid overburdening the system with excess data, and to refrain from building excess complexity into the system. In so far as possible, the system should be built in an evolving stepwise fashion so that it can take advantage of the most current technological innovations. On the other hand, efforts should be made to avoid the excessive use of unique technologies so as to ease the process of repair when problems arise and to expedite the development of linkages with other relevant sources of information.

Wherever possible, the system designers should utilize the experience of others who have constructed electronic surveillance systems so as to avoid the errors that they may have made and the difficulties they encountered in their efforts.

The Public Health Information Network

The federal government is in the process of developing its Public Health Information Network (PHIN), which is intended to be a nation-wide interoperable network of health information systems. When completed, the PHIN is expected to effectively connect in real time all levels of the public health system in the United States.

Several of the components of the PHIN were developed as a series of separate, and independent reporting systems. However, in 2002, the CDC decided to standardize all of its information technology systems and to integrate the separate systems into one nationwide network based on the Internet.

The current components of the PHIN are as follows:

- Surveillance Systems including the National Electronic Telecommunications System for Surveillance (NETSS); the National Electronic Disease Surveillance System (NEDSS), the National Healthcare Safety Network (NHSN), and the Environmental Public Health Tracking Network.
- Communications and Learning Management Systems including the Epidemic Information Exchange (Epi-X), Health Alert Network, Laboratory Information Management System, and the Public Health Training Network.

The ultimate goal of the PHIN System is to be live and real time, secure, interoperable, able to manage multiple data sources, capable of monitoring the public's health, and useful for routine, urgent, and emergent situations.

In the practice setting, the PHIN will be expected to detect health problems (preferably at an early stage), analyze the data accessed, alert the appropriate bodies that must be involved in the response phase, help manage the response, and assist with the education of the public with regard to the resolution of the health problem that was detected. A more detailed description of the PHIN is given in Appendix A.

Telemedicine in Public Health

The PHIN System can be conceived of as an example of public health connectivity through telemedicine. "Telemedicine" here is defined as the use of electronic information and communication technologies to provide and support public health and emergency medical care when distance separates the participants. Its components include: high sped interactive voice, data, and video networks; wireless,

remote systems (e.g., PDA, computers); Internet and e-mail, fax, telephone (i.e., land/cellular) and pagers with text capability, as well as computerized data and disease surveillance systems. The use of these several systems in the work of a health officer who is faced with an outbreak of anthrax is presented in Appendix B.

This scenario presented in Appendix B, with its happy outcome, depends critically upon the prompt and accurate transmission of information among the individuals and organizations involved in the response efforts. Unfortunately not all health departments are currently equipped with the communications systems that are included in the scenario. Specifically, the following types of interactive systems are only available to a limited extent in most health departments: a health department online disease surveillance system, a state-wide integrated electronic surveillance system, a state-wide interactive video system, a wireless communication system, interactive video conferencing, telemedicine linkages with laboratories, blast fax and e-mail, interactive high speed fiber optic video networks, and video conferencing systems. Although much can be done to contain a communicable disease outbreak without all of these devices, truly effective responses to future outbreaks will be less successful than was depicted in the scenario without them.

Another point to be noted from this scenario is that it dealt with a non-communicable agent, the Anthrax bacillus. When the agent is communicable, such as the SARS virus, then additional resources would be needed to control an outbreak. For example, with SARS as compared to anthrax, there is the need for isolation of infected individuals, use of medical nonhospital facilities, use of nonmedical facilities,

interhospital transport, prehospital diversion, and hospital closure due to an outbreak among its staff of the disease.

A caveat that should be observed is that data that is gathered about a disaster situation should wherever possible go to the local and state health departments and related organizations first before being forwarded to the federal level. If all of this data goes to federal level directly before analysis and refinement at the lower levels it will create noise in many instances rather than being helpful.

Syndromic Surveillance

One cutting edge issue that is currently much discussed is that of syndromic surveillance. This approach to surveillance is controversial in that it is unclear when to turn the system either on or off; the difficulty of distinguishing background noise from critical data; and the understanding of the point at which the data gathered by the system is worthy of being used as definitive information. Syndromic surveillance appears to have some definite promise but it should not be widely used until the controversies about it have been satisfactorily resolved.

Issues Relating to the Response of Local Health Departments to Emergency/Disaster Situations

Local health departments are highly variable in their capacity to respond to public health disasters. Furthermore, each state has a different set of structures around which it has organized its state and local health departments. This lack of uniformity in organization and capacity is further compounded by the vast and pervasive under

funding of public health activities throughout the United States. In addition, those funds that are available for public health are often very rigidly and specifically circumscribed with regard to their use.

One of the major consequences of limited funding for public health is that information systems in most local health departments are not designed for high levels of connectivity to other data-collecting systems. Even beyond this deficiency is the fact that many information systems utilized by local health departments simply do not work as intended.

Maricopa County in Arizona, as a case in point, has only a small number of staff to maintain its information systems, and their compensation is not competitive with the private sector. In addition, hospitals in Arizona historically have not seen the need to share information with local health departments, and state and local public health departments have unresolved jurisdictional issues that complicate emergency preparedness planning.

These organizational, technical, and resource issues aside, the system of routine, required reporting of communicable diseases at the local level does not work. It depends upon human motivation and compliance and is very labor intensive for the individuals doing the reporting. As a result, the reporting of communicable diseases by healthcare providers is limited.

In looking at approaches to the sharing of public health information among the various collaborating agencies and through the several levels of governmental public health, it is essential that the current separate systems be integrated into a single effective entity. Laboratory data must be included in this integrated system, and there

are several models for this such as those being currently utilized by the states of Nebraska and New York.

If disaster response systems are to become fully effective, they should be built on strong relationships between the various groups that must collaborate in operating the system. One of the most critical of these relationships for local public health is that with the emergency medical system. A basis for improving this particular set the public health community wrestles with this problem, it should seek to convince the political decision-makers that we need a holistic system to cover all aspects of public health, and not one that is skewed towards defense.

Additional Issues Raised About Public Health Response to Disaster/Emergency Situations

Biomonitoring Systems–It appears that the available systems have a low level of sensitivity and specificity. They must be further tested to establish their usefulness. Furthermore, it may be necessary it actually culture suspicious organisms identified by these systems before taking action on a "positive" response.

Quarantine—Public health has had a long experience with quarantine, but only with small numbers of individuals at one time. These experiences may not apply when large numbers of people are involved. The CSIS *Playbook on Quarantine* will be released this fall, which will provide additional perspectives on this issue.

Emergency Medical Systems—EMS is often low on the organizational hierarchy, and as a result, it does not have involvement in the decision-making process at the

state level. Since each state is permitted to develop its own disaster response plans in order to qualify for federal funding, the role of EMS in these plans is highly variable.

All-Hazards Approach—It is essential that public health systems develop an all-hazards approach to planning for responses to disaster situations. This would mean that these plans cannot only be limited to control of communicable diseases but must also deal with explosives, radiation, toxins, and chemicals as the basis of a disaster situation.

INTEROPERABILITY IN HOSPITALS

Introduction

Since the human component of most disasters is eventually moved to the hospital setting, hospitals can and should play a vital role in emergency preparedness planning. While the term "hospital" is somewhat nebulous, the intent of testimony for this section was to provide commentary primarily from the vantage of hospital administrators. The Health Research and Educational Trust of the American Hospital Association, American Medical Association, and American College of Physicians were invited to address specific questions from the perspective of those they represent regarding the role of hospitals in emergency preparedness planning. Various themes emerged from their testimony including communication/information technology, surge capacity, and regionalism.

Communication/Information Technology

The role of hospitals (as well as all other involved agencies) in disaster mitigation depends heavily on reliable and timely information. The lack of community-wide information and communication systems is a hindrance during daily operations. The physical remoteness of hospitals from a disaster site amplifies this information gap. While hospital staff may be aware of the occurrence of an incident, details such as number injured, types of injuries, presence of contamination are often not known until patient arrival.

Challenges illustrated by patient destination selection and tracking is a good example of the void that currently exists in many parts of the nation. Participation in transport decisions by field providers, incident commanders, and in-hospital providers hinges on technological solutions capable of tracking patient movement to any potential receiving facility, real-time monitoring of the capacity and diversion status of each of these facilities, as well as facilitation of field to hospital, hospital to hospital, field to emergency operations center, and emergency operations center to hospital communications. What is clear is that there is a need for some type of central data clearinghouse that can receive the status of field providers and hospitals and generate reports to both on capacity and need.

Communication is the Achilles Heel for multiple-casualty disaster response. While maintaining patient confidentiality and limiting access to sensitive information is paramount, many individuals and agencies need to be “in the loop.” Traditionally, low-technology solutions such as telephones and radios have been utilized to address these matters. However, advanced technological solutions such as web-based data

management systems could enhance flow of information to all interested parties and enhance security.

Another emerging area of technology that could enhance day-to-day operations as well as have significant impact during disasters is an all-inclusive electronic medical record system. These systems would allow information to be transferred seamlessly and quickly throughout the institution in addition to those with a need to know outside the institution. However as with many other aspects of interagency operations, standardization of these systems is vital. As such, standard platforms, data dictionaries, and the like must originate at the federal level and be promoted through funding requirements, mandates, etc.

Surge Capacity

Absent disasters, hospital surge capacity has been identified as a national crisis in hospital operations. This issue will only intensify during mass casualty events. In an age when patients are treated in halls and are held in emergency departments for hours and even days until an in-patient bed is available, the simultaneous presentation of multiple patients from a disaster could stress the system to the point of collapse. While most hospitals deal with this issue daily, regional collaboration is needed to create a plan for the community.

Real-time community-wide hospital census and capacity data are largely unavailable. Data that might exist is typically based on single daily census counts and may only include the emergency department. However, this static information does not reflect ongoing fluctuations in patient census and capacity that occur throughout the

day. Further, during real events hospitals may be required to go beyond their normal maximum capacity (i.e., surge); which is dependent upon the availability of space, staff, and equipment and supplies. This baseline information is essential for regional disaster planning.

While the number of licensed beds available at each hospital is widely known, each hospital's true surge capacity is generally unknown. However, it is important to note that a community's total surge capacity is greater than the sum of each hospitals surge capacity since patient care can be conducted outside hospital walls.

Disaster officials may seek additional treatment space within the community. Public buildings (e.g., hotels, arenas, schools, long-term care facilities) can be converted into patient care areas. However, legal, financial, political, and logistical issues should be addressed prior to an event.

Confinement of patients to their homes may be another alternative especially with infectious agents that result in mild illness. This unconventional approach became reality during the recent outbreak of SARS in Toronto, Canada where health officials isolated minimally ill individuals with SARS in their homes. This may have helped reduce the spread of disease within hospitals, and minimize the impact on hospital routine operation. However, it also created a host of other challenges such as labor intensive patient monitoring, insurance of basic human needs (e.g., delivery of food), and the need to enforce confinement for a few unwilling individuals. Interestingly, this approach shifted much of the burden of care from hospitals to public health. This raises the question about who becomes responsible for care in non-traditional settings.

The ability of a hospital to surge is highly dependent upon its staff. Hospital administrators must consider training and protection of staff, as well as recruitment and credentialing of additional staff during an event.

For various reasons, personal protection of hospital staff is arguably less than optimal under normal conditions. However, the need for such becomes critically important during some biological, chemical, or radiation events to ensure the safety of themselves, their families, and other patients. Further, hospital administrators need to be mindful of the likely reluctance of workers to leave family members during disasters that threaten those in their own neighborhood. Convincing staff that their family, property, and pets will be safe might be difficult. Other “peace of mind” assurances such as guaranteed workers compensation coverage, reimbursement for medical care, and death benefits is also important to minimize absenteeism.

As hospitals and communities collectively plan for an event, they must consider the likelihood that staff and anticipated volunteers will be available. Various agencies may rely on the same pool of individuals. For example, hospital staff may have overriding military obligations or have more allegiance to their local volunteer fire department.

Space and staff are not the only concerns; hospitals will likely need additional equipment (e.g., decontamination facilities) and supplies (e.g., antidotes) depending on the specifics of the event. While the Strategic National Stockpile and Vendor Mediated Inventory can be accessed, hospital administrators must bear in mind that these resources may not be immediately available. Solutions might include local stockpiles maintained by the hospital or other entity, borrowing from other facilities, purchase from

local retailers, or rapid replenishment of supplies by hospital vendors. As with hospital staff, administrators must be mindful that competition may exist for these additional equipment and supplies. Further, simply identifying a source for needed equipment and supplies may not be enough; transport and distribution within the facility should be considered.

Lastly, hospitals must consider how far they are willing to bend day-to-day operating procedures in the event of a mass-casualty incident. While patient safety and quality of care must be maintained, there might be a need to reengineer operating procedures and accept slight increases in risk to meet additional demands. These decisions may need to be made by hospital administers in consultation with clinicians "on the fly." For example, a decision to use expired drugs or assignment of extra responsibilities to minimally trained staff might need to be considered. Many of these important decisions will need to take into account various legal considerations such as EMTALA, HIPAA, EPA regulations, legal liabilities, insurance coverage, and OSHA guidelines.

Given the complexity of these issues, hospital administrators clearly need to sponsor disaster rehearsals. Many have concluded that today's issue of ED overcrowding is simply a symptom and the actual bottleneck may be deeper within the facility. Therefore, these exercises need to go beyond the traditional focus on patient arrival in the emergency department in order to test the entire hospital network.

Regionalism

During large scale multiple patient events, area hospitals should respond in concert. However, operational decisions regarding the coordination of hospital activity ideally need to be made during the planning process. Stimulation and success of this process may prove to be challenging given the often competitive nature between hospital systems, and may necessitate governmental oversight.

Perhaps the most graphic example of this challenge stems from planning for hospitalization of highly contagious patients. At the beginning of an outbreak patients with an infectious disease will present to the hospital of their choice. As the disease spreads, individual hospitals will not have the capacity to care for large numbers of infected patients without compromising the safety of their facility. Therefore, as the outbreak develops and the disease spreads it may make sense to treat patients using a ward style approach. In fact, developing infectious disease centers, similar to trauma centers, that receive all of the infected patients may be the most practical approach.

However, if one hospital is designated to receive only patients infected with the disease, while other area hospitals treat those with other illnesses or injuries, it is unclear whether the hospital dedicated to the infectious disease would remain viable at the conclusion of the event. Financial incentives for adherence to a plan such as this will need to be considered and a government official may need to decide whether and which hospital to designate as the receiving facility. Given the financial burden such a decision might create, a federal facility might be the most appropriate choice since it will not have the same potential for revenue loss post-event.

There also needs to be some coordination of the messages sent to the public by all agencies involved in a disaster event. People tasked with public relations should be cautious not to create a climate of mistrust or panic. Hospitals must work with the media to get the appropriate messages across, telling potential patients where they should go and informing family members of how to find their loved ones.

Lastly, regional hospital disaster plans should include the local Poison Control Center since they may be a valuable resource and they may be a place where the public turns for information. For example, during the anthrax outbreak in Florida many citizens called the Poison Control Center for information.

Hospitals play a crucial role in disaster response and must be included in disaster planning. Particular concerns from the hospital prospective for disaster planning include communication and information technology, surge capacity, and regionalism. Agencies at all levels must work together and they must prepare for an event before it occurs through both planning and practice.

Ideally hospitals should be represented in planning activities that address day-to-day patient transportation via ambulance and helicopter, patient care at a hospital, transfer of some patients to specialty care, and medical oversight by physicians. Arguably, this involvement becomes even more crucial for these same activities during disasters.

Summary Recommendations:

1. Increase the available radio spectrum for emergency communications

2. Create secure, redundant communication systems that allow for two-way cross agency communication
3. Properly train staff to use new systems and technology and for current working conditions which may be more stressful and demanding given the increased threat of a terrorist attack.
4. Create a regional-based “threat forecast” which would be updated as needed and reviewed annually by regional first responder organizations. Funding and training levels could be guided by the threat forecast so that high probability and high impact threats are addressed.
5. Multi-agency training opportunities should be mandated. Training should focus on establishing and maintaining critical linkages between law enforcement, EMS, medical, public health and emergency management.
6. Threat-warning systems should be developed for first responders to enable them to utilize protective equipment at the earliest possible moment.
7. Obtain HIPPA exclusion for national security related health issues and cover reporters under “Good Samaritan” statutes.
8. Emergency Medical Technician curriculum should be redesigned to reflect current issues.
9. A consortium of first responder agencies should be assembled. Their tasks should include review of and suggestions for revisions of federal legislation as well as ensuring that future programs be designed to ensure seamless response and maximum efficiency.

10. Acute care/emergency response must involve partnerships with the community, the government, and the military.
11. Develop a national model for emergency response to help standardize response on a national scale.
12. Establish and mandate the use of standard language/terms among emergency responders
13. Create national standards for training and equipment performance and interoperability.
14. Develop reliable real-time two-way communication systems between hospitals, field providers, and public health for use during day-to-day operations, as well as, during a disaster response.
15. Communities should determine hospital surge capacity as well as community-wide surge capacity. These plans should address each of the types of resources necessary for different types of disasters. Specifically, the types and amounts of equipment, supplies, beds and personnel necessary to care for patients with trauma, burns, infectious diseases, chemical contamination, inhalational injuries, etc. should be considered.
16. Develop plans for how the system will “degrade gracefully” in times of disaster. That is which rules must be followed and which can be bent, including federal regulations.
17. Develop regional plans as well as those plans that are already in place for individual hospitals or agencies. Create a “big picture” plan that includes the entire region.

OVERALL CONCLUSIONS

Several general themes seemed to emerge during the meeting. First there needs to be a standard national architecture. However, the challenge is getting so many independent agencies from so many backgrounds to standardize. A possible solution may be to create a National Agenda for the Future on mass-casualty preparedness to guide agencies. This may also include a disaster template for how to develop a community's capacity to respond to a disaster. Along with plan standardization there also needs to be some consideration for equipment standardization so that equipment can be used across agencies as patients are transported to receiving facilities or equipment is brought in from outside agencies.

Second good communication and strong relationships are key to a successful disaster response. It is essential that agencies work together and know each other before a disaster occurs. These relationships can be built during disaster planning or practice drills. However, maintaining communication during day-to-day operations not just in the event of a disaster can also enhance inter-agency relationships. Along with building relationships, jurisdiction issues need to be resolved and mutual aid infrastructure developed. For this to be accomplished a clear leadership chain will need to be developed.

Refinement and enhancement of communication must include systems for communicating with the general public. Disaster planners must consider how they will work with the media to get important messages to the public as they decide how to deal with a disaster.

The third general concept is that communities need to make decisions about how they will request, credential, and train additional personnel in the event of a disaster. If there are multiple casualties there will definitely be a need for more manpower at all levels (in the field, at hospitals, in public health offices). Planners must consider where this manpower will be acquired from and to ensure that various agencies are not relying on the same pool of individuals (e.g., EMS volunteers, who work as emergency department nurses, and are members of the national guard).

The fourth concept is the need for Funding. All of the needs and recommendations contained in this document cannot be meet without funding. The federal government has put several billions of dollars toward disaster preparedness since 9/11. However, money still needs to reach the people in the trenches to provide the needed infrastructure for an appropriate disaster respond in all locales.

In closing, to ensure that interoperability moves forward it will be essential to develop strategies for effective integration and strengthening of support between EMS, acute care providers, hospital administrators, and public health officials. A good strategy to begin the planning for future needs would include the use of the recommendations from the EMS Agenda for the Future (1) and to convene a national consensus panel for the purpose of establishing standards. There is a need for a national template that could be used by communities to achieve a fully interoperable response system. These strategies and the evaluation of best practices should be used to determine how funding dollars would be spent. Communities and national associations should be provided with a mechanism to allow feedback to policy makers at the federal level. Lastly, it is important to note that many of these changes could have a positive effect not only on a

community's response to a mass-casualty incident but also on their day-to-day operations.

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APPENDIX A: The Public Health Information Network (PHIN)

Overview of the PIHN

This is a brief summary of the components of the PHIN, which is under active development by the Centers for Disease Control and Prevention along with a large number of stakeholders in the public and private sectors. The PHIN is currently a work in progress, whose development will continue for the immediate future. A more detailed summary of the PHIN may be obtained from the Association of State and Territorial Health Officials through the organization's web site, www.ASTHO.org.

The PHIN is an electronic system that can assist in the monitoring of the public's health. It can detect health problems, analyze accumulated data, create useful information, communicate alerts as needed, and transmit appropriate responses. The overall vision for the PHIN is to be the information network that integrates public health partners across the nation, both for routine public health activities and during

The PHIN will be a live, secure, Internet-based network for exchanging comparable critical information between all levels of public health (i.e., local, state, and federal) and other critical information systems. A key PHIN building block is the adoption of IT standards and specifications so that public health and its partners can be readily shared and analyzed.

The PHIN will provide other significant services to public health. One of its most outstanding features is its ability to support the analysis of multiple data sets that can be turned into meaningful information. In addition, it can facilitate communication between public health and both the healthcare workforce and the general public.

PHIN Building Blocks

1) Surveillance Monitoring and Tracking Systems

- National Electronic Telecommunication System for Surveillance (NETSS)-This system permits the reporting of surveillance data from the states to CDC.
- National Electronic Disease Surveillance System (NEDSS)-This system is a step in the effort to develop efficient, integrated, and interoperable surveillance systems at local, state, and federal levels.
- National Healthcare Safety Network (NHSN)-This system accumulates, exchanges, and integrates relevant information on infectious and noninfectious adverse events associated with healthcare delivery.
- Environmental Public Health Tracking Network-The goal in developing this system is to have a source that integrates data about environmental hazards and exposures with data about diseases that are possibly linked to the environment.

2) Communications and Learning Management

- Epidemic Information Exchange (Epi-X)-This is an up-to-the-minute source of health information that is both protected and available to public health professionals nationwide.
- Health Alert Network (HAN)-This is an initiative to strengthen the capacity of health departments to serve as an early warning and response system for the nation. It will provide health departments with rapid and timely access to emerging information.

- Laboratory Information Management System-This system will link information on all specimens and samples received and processed by public health laboratories and will exchange this data with other information systems.

The Benefits of the PHIN

- Supporting disease and threat surveillance
- Analyzing real-time data
- Transmitting emergency alerts
- Providing reference information, distance learning, and decision support
- Hosting professional discussions and collaborative activities

APPENDIX B: A Day in the Life of a Public Health Officer

This is a fictitious scenario that is based upon the "typical" experiences of state and local health officers. The added feature to this otherwise recounting of a typical day is an encounter with a bioterrorist weapon. Unfortunately, several health departments have encountered and dealt with just such a weapon in the recent past.

At the start of the health officer's day, (i.e., 8:30 a.m.) he has received a report from an emergency department physician who informed him that during the previous evening three unrelated patients were admitted with fever, muscle aches, and chest pain. All three patients had attended the same conference over the weekend with 300 other people.

By 8:45 a.m. the health officer had checked his health department's online disease surveillance system for the latest information on communicable diseases in his community of jurisdiction. By 8:50 a.m., he had discovered that there were a high number of ambulance runs noted over the previous 24 hours; and that a larger state-wide outbreak of disease has occurred causing the same symptoms as in his community. By calling up the State's Integrated Electronic Surveillance System, he was able to see a detailed mapping of cases of this disease by county and zip code.

At 9:00 a.m., the health officer alerts state health officials by e-mail about a possible statewide outbreak. The state health officer, in turn, alerts the heads of the medical, educational, epidemiology, EMSD, and public relations teams, and schedules a meeting using his PDA. The meeting will be run through the use of the state's interactive video system. In preparation for the meeting, the state health officer reviews

information on infectious agents through components of the PHIN System and concludes that a bioterrorist act might be the basis for the outbreak.

The scheduled meeting takes place at 9:45 a.m. At that point it is clear that the outbreak is continuing to spread and that it has crossed state lines (i.e., identified by GIS mapping). By 10:30 a.m., neighboring health agencies and EMS directors have been contacted in the three states in which the outbreak is occurring. These leaders agree on a regional strategy using interactive video conferencing.

By 12:05 p.m., epidemiologists in the three jurisdictions have had an audio conference on the outbreak, and the three state health officers have had a videoconference with an expert on anthrax. Shortly thereafter, the labs report that the victims' blood smears are positive for anthrax. This conclusion is reported to CDC via the Laboratory Response Network. A telemedicine linkage with the laboratory permits everyone to view the actual results of the lab tests.

At 1:10 p.m., the state health officials have alerted the CDC, the medical community, and law enforcement about the anthrax outbreak through the Health Alert Network. Following that, screening and treatment protocols are sent out, and the 1-800 "Hot Line" that informs the community about public health emergencies has been updated with the most current information.

By 1:25 p.m., the state health department's public information staff has issued a press release to alert the media and the public regarding the outbreak and the steps that are being taken to control it. This information is being released by blast fax and e-mail.

At 2:20 p.m., the state and local health department staffs begin holding teleconferences with community physicians, EMS supervisors, and other healthcare workers to provide new information on diagnosis and therapy, via an interactive high-speed fiber optic video network. At the same time, local health departments begins the process of providing prophylaxis against anthrax to the potentially affected population.

Throughout the day, the managers of components of the emergency response system use secure videoconferencing to coordinate additional regional disaster response approaches.

The end result of this entire process is realized by 4:00 p.m. that day. By that time, the regional response has been coordinated, the outbreak has been identified, prophylaxis has been provided, and the effort to contain the outbreak is well underway. Due to the timely and coordinated action on the part of the state and local health departments and their partners at all levels, the outbreak has been contained and many lives have been saved.

Appendix C
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