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HOMELAND BIOLOGICAL WARFARE CONSEQUENCE
MANAGEMENT: CAPABILITIES AND NEEDS
ASSESSMENT

by

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Abstract

In recent years, concern over potential terrorist WMD acts in the U.S has blossomed. Since 1995, the U.S. has passed legislation and published presidential decision directives designed to address the U.S. capabilities to respond to such an incident. Additionally, millions of dollars have been spent on domestic preparedness. Yet the numerous agencies involved (FEMA, DoJ, DoD, HHS, etc.) make a comprehensive, organized solution to the problem difficult. Focusing on the consequence management functions (incident identification, unity of effort, containment, treatment, security, fatality management and social response), the capabilities and shortfalls of local, state and federal assets are examined. This paper highlights significant progress in areas including treatment supply stockpiles and surge capability by the federal government and National Guard to support local efforts. However, the analysis also identifies gaps in local planning, public health surveillance, supply and equipment distribution, and lack of general public education. Additionally, the analysis indicates that initial efforts and financial support for overarching federal programs and surge capability have come at the detriment of local and state improvements. These shortfalls if not corrected may impair our ability to respond to a biological warfare incident.

Chapter 1

Background

The acquisition, proliferation, threatened or actual use of weapons of mass destruction by a terrorist group or individuals constitutes one of the gravest threats to the United States.”

—Louis Freeh (FBI Director)

The balance of power that held many countries and terrorist organizations under control ended with the cold war. Now the U.S. has received a wake up call to the threat of terrorism in her country. The World Trade Center bombing, the Oklahoma City bombing, and the bombing of the USS Cole demonstrate the vulnerability of the U.S. to terrorist activity. The sarin gas attacks in Japan elevated awareness levels of the risk of biological and chemical warfare terrorist attacks.

The concept of biological terrorism is not new to the U.S. As early as 1972 the Order of the Rising Sun, a neo-nazi group, was caught in the U.S. with 80 pounds of typhoid-bacillus.¹ The 1982 cyanide poisoning of Tylenol was a biological attack to which the U.S. responded. What is new about biological warfare is the growing accessibility of the technology and skills to successfully execute an attack. Aum Shinrikyo, a private organization, proved capable of an attack in Tokyo that killed 12 and sent over 5000 to local hospitals.

The death toll in Tokyo was equivalent to a bombing or mass shooting, affecting 5000 directly. Indirectly their families and friends were also impacted and the medical system was

overwhelmed. The Tokyo experience demonstrates the potential of future biological and chemical warfare attacks. If inciting fear is the point of terrorism, then biological and chemical warfare agents are the perfect weapons.

The power of biological and chemical agents as a weapon is not lost on terrorist groups. In recent years there has been a sharp increase in Federal Bureau of Investigation (FBI) cases involving toxic or infectious agent threats. Before the 1990s the FBI investigated about twelve cases per year; in 1997 that grew to 74 cases; and in 1998 there were 181 cases.² Additionally, the general public and symbolic buildings or organizations have increasingly been the focus of terrorist attacks.³

It is not surprising that many intelligence experts and scientists believe the U.S. will experience a nuclear, biological, or chemical terrorist attack sometime in the next 10 years.⁴ The question is, are we prepared for it? Fearing that we are not, the U.S. recently began throwing money and legislation at the problem.

To clarify responsibilities for managing terrorist incidents, Presidential Decision Directive 39, United States Policy on Counterterrorism, issued in 1995, delineated tasks for response components. Crisis management was assigned to the FBI and consequence management to the states with the federal government providing assistance through the Federal Emergency Management Agency (FEMA) and the Federal Response Plan.⁵ Crisis Management incorporates law enforcement functions such as identifying and planning for the resources necessary to anticipate, prevent, and/or resolve a terrorist threat or incident. Consequence Management includes measures to respond to medical and health needs, to prevent the spread of contamination, to restore essential government services, and to provide emergency relief to government, businesses and individuals affected by the consequences of terrorism.⁶ Though

consequence management and crisis management are not always distinctly separate, this paper focuses on consequence management.

To enhance response capabilities, the Defense Against Weapons of Mass Destruction Act was passed in 1996. In this act the Secretary of Defense is tasked with enhancing the federal government's capability to respond to terrorist incidents and with improving capabilities of state and local response agencies. More recently, in 1998, additional Presidential Decision Directives (62 and 63) were issued. They address specific biological warfare defense requirements by calling for a national public health surveillance system, new and better medicines and vaccine development, and pharmaceuticals and supply stockpiling for contingencies.⁷

Along with the enabling and tasking legislation, money was allocated to support these programs. In fiscal year 2000, the DoD spent over \$700 million on domestic preparedness and response for terrorist incidents. The Department of Justice spent over \$400 million in support of domestic preparedness.⁸ The concern is, do money and legislation equate to capability?

Notes

¹ Mercier, Charles L., Jr, Col. "Terrorists, WMD (weapons of mass destruction), and the US Army Reserve." *Parameters* vol 27 no 3 (Autumn 1997), 102

² Tucker, Jonathan B. "Historical Trends Related to Bioterrorism: An Empirical Analysis" *Consensus Statements of the Working Group on Civilian Biodefense*, 6 Jul 99, 1

³ *Ibid.*, 4

⁴ Mercier, Charles L., Jr, Col. "Terrorists, WMD (weapons of mass destruction), and the US Army Reserve." *Parameters* vol 27 no 3 (Autumn 1997), 13

⁵ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 17-18

⁶ US Department of Defense. Improving Local and State Agency Response To Terrorist Incidents Involving Biological Weapons. Aberdeen Proving Ground, MD: Army Soldier and Biological Chemical Command, Domestic Preparedness Office, September 12, 2000, 23

⁷ *Ibid.*, 18

⁸ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, M3 & N2

Chapter 2

Introduction

The problem with a bioterrorist event or a terrorist event in general is, how do you retaliate against a limited faction of the population? Personally, my feeling is that we have to have a strategy of preparedness. Preparedness to respond will reduce the likelihood that a terrorist would select that forum to try to cause harm.

—General Donna F. Barbish

What are our biological warfare response capabilities and are they adequate to support the full range of consequence management activities associated with a biological warfare response? To provide a framework for addressing this complex question it is important to have a general knowledge of the agencies that are prepared to respond, a structure for examining the consequence management activities, and an understanding of what is needed for a biological warfare response.

During the analysis, this paper addresses two categories of response agencies: first, local and state agencies and second, national agencies. Local and state agencies are in position to initially identify a problem and respond. Local agencies include local responders, hospitals, law enforcement, fire/rescue personnel, and hazardous material (HAZMAT) teams. At the state level, poison control centers, laboratories, state public health agency, and the state department of emergency services may respond. No two states or cities are alike and their capabilities may vary drastically. However, for this study broad generalizations will be made regarding the capabilities of the local and state agencies in responding to a biological warfare incident.

Elected officials, such as mayors and governors, also play an integral role in the response efforts. Usually the state's emergency management agency communicates with federal agencies and requests federal support. This request is supported when the Governor declares a state disaster and the President follows with a declaration of a federal disaster.

Triggered by a declaration of emergency or by the state emergency management agency, national level agencies involved in consequence management include:

- The Federal Bureau of Investigation (FBI)
- The Department of Health and Human Services (DHHS)
- The Federal Emergency Management Agency (FEMA)
- The National Disaster Medical System (NDMS)
- The Department of Defense (DoD)
- The Centers for Disease Control (CDC)
- Veteran's Administration (VA)
- American Red Cross (ARC)

Appendix A provides a snapshot of some of the organizations involved in biological warfare response, their capabilities and programs.

The National Guard plays a unique emergency response role within the individual states and DoD. National Guard units take direction from the state Governor but are funded and trained by DoD. Additionally, they are primarily comprised of residents from the state who are familiar with the area and can provide quick support when directed.

Given the potential for attack, community leaders must be prepared to react with the full range of consequence management response elements. The Biological Warfare Improved Response Program template contains 13 response components.¹ The DHHS Health and Medical Services Support Plan for the Federal Response to Acts of Chemical/Biological Terrorism lists 20 critical components.² The applicable consequence management response components can be summarized into a framework of six key elements: incident identification, unity of effort, hazard containment, casualty management, and social support functions.

Biological agents are unique and the response to them differs from other WMD attacks. A biological agent is a disease-producing microorganism (pathogen) or a poison produced through the activities of living organisms (toxin).³ Major differences between a biological attack and a conventional attack include the difficulty in detection, potential for delayed detection, potential to spread, and the number of casualties that may occur.⁴

Difficulty in detection arises from the stealth of a biological attack. Unless a terrorist chooses to announce the attack, there is no explosion, smell, noticeable gas, or any indicator that a biological agent has been released. This inability to recognize that an attack is occurring delays discovery until the first people get sick and the public health system correlates the cases.

Expansion of the pathogen depends largely on the contagiousness of the agent. Generally, biological agents are classified as contagious or non-contagious. Contagious agents include influenza, plague, smallpox, hemorrhagic fevers and rhinoviruses. Non-contagious agents include Q-fever, toxins, bucellosis, anthrax and tularemia. Non-contagious diseases are much easier to control because they are self-limiting. Contagious diseases have the greatest potential for generating large numbers of casualties.

The variations and unique characteristics of biological organisms present a great challenge in our ability to respond and effectively deal with a biological warfare attack. Local, state and national agencies each bring their unique capabilities to the efforts. But the question remains, is there enough capability to fulfill all the elements of effective biological warfare consequence management? Examination of each response element to include current capabilities and shortfalls will help answer this question.

Notes

¹ US Department of Defense. Improving Local and State Agency Response To Terrorist Incidents Involving Biological Weapons. Aberdeen Proving Ground, MD: Army Soldier and Biological Chemical Command, Domestic Preparedness Office, September 12, 2000, 1.

² US Department of Health and Human Services. *Health and Medical Services Support Plan for the Federal Response to Acts of Chemical/Biological (C/B) Terrorism*. 21 June 1996, 5

³ Air Force Manual (AFM) 10-100. *Airmain's Manual*. 1 August 1999, 119

⁴ Mercier, Charles L., Jr, Col. "Terrorists, WMD (weapons of mass destruction), and the US Army Reserve." *Parameters* vol 27 no 3 (Autumn 1997): 4

Chapter 3

Incident Identification

...and he that will not apply new remedies must expect new evils; for time is the greatest innovator.

—The Essays by Sir Francis Bacon, 1601

Incident identification is the lynchpin of biological attack response efforts. Identification includes detecting an epidemic or unusual disease, identifying the source involved, and epidemiological tracking of that agent so the extent of the incident is known and an effective damage control plan can be developed.

The potential exists for biological agents to be released in either an overt or covert manner. In an overt attack, with pre-warning, there is a distinct possibility that the attack is a hoax. Panic and the resource expenditure may themselves be the ends the terrorist sought. For example, Los Angeles experienced over four dozen hoax disseminations of anthrax in the past two years. The first two responses cost over \$600K each.¹ Accurate threat analysis and detection will help minimize the terrorist value of a hoax and insure resources are available for an actual attack.

With a covert release, the biological attack is unrecognizable until enough cases are observed and reported to allow detection of an epidemic of an unusual disease. Compounding the detection problem are the facts that most exposed victims will probably not seek medical care in the same facility and many biological agents present with flu like symptoms. A strong public health surveillance system is a must for timely detection.

To improve accuracy and speed of detection, intelligence should be shared between the FBI or local law enforcement and local hospitals and the public health system. Providing threat information to the hospitals and public health system will increase vigilance by those with early victim contact. Likewise, immediately addressing potential disease/epidemic problems will allow law enforcement to provide information from their investigation that may facilitate establishing etiology and other important information.

Upon identifying a biological incident, it is essential to identify the exact nature of the problem. Identifying the agent is vital in deploying containment actions, determining precautions for emergency and hospital workers, and establishing medical needs. To identify those at risk and initiate an appropriate response it is important to identify the origin of infection. Both location and intentional versus naturally occurring dissemination are significant.

The bulk of the agent identification comes from medical laboratories. The medical providers must recognize disease signs and symptoms and request definitive diagnosis from medical labs. In turn, the labs must be prepared to perform diagnostic assays for diseases rare in the United States. Timely results must then be passed to the provider and public health system

Agent detection and origin identification are crucial in the initial response. However, the epidemiological tracking of contacts to track the spread of the agent, particularly if it is contagious, will enable effective containment and resolution. With contagious diseases, treating the initial cases will not successfully contain the spread of disease because those victims may have infected others prior to becoming symptomatic or seeking medical attention. Though labor intensive, tracing contacts and tracking the disease dispersion will allow the medical community to proactively identify and treat, isolate, for those who may have been exposed. Most importantly, the potentially escalating spiral of infections can be halted by early response to

those at risk from exposure. Accurate tracking of the pathogen is also important from a public information and panic avoidance perspective during consequence management. Without accurate tracking, response personnel can only be react to the disease and cannot prevent future cases.

State and Local Capability

States and localities have exiguous capabilities to rapidly identify unusual diseases or epidemics. Most local surveillance systems are passive and rely on reporting from providers. They are known for their poor sensitivity and lack of timeliness.² The expectation is that the health care provider will recognize the problem or disease, make the effort to fill out and file necessary paperwork, and do so in a timely fashion. When focusing on biological warfare, this seems important but in the busy working day of a doctor, it takes a low priority. These expectations of the average medical provider may be unrealistic.

Many medical personnel are unfamiliar with diseases that are likely to result from a biological warfare incident. It is common for doctors not to have seen the diseases one would expect in a biological warfare incident. For example, the last case of smallpox was in the 1970s so providers today do not anticipate seeing a case nor do they have the experience in identifying the disease. Emergindex (a commercial product) is one tool that may help. It's available in most medical facilities to provide diagnostic and treatment information based on signs and symptoms and includes those illnesses that may occur as a result of a biological warfare incident.³ However, most medical personnel have to rule out flu and other common illnesses before they turn to the index.

Most states have labs capable of basic analysis to determine many of the pathogens that may be involved in a biological warfare incident.⁴ However, these labs may be quickly overwhelmed depending on the magnitude of the incident. Just maintaining a chain of custody of specimens in

a mass casualty situation may overtax many labs. Some of the biological agents (assays for smallpox and hemorrhagic fevers) require biosafety level 4 which are not common even among research facilities.⁵ Very few states or localities have stand-alone biodetection.⁶

While most public health offices are capable of epidemiological tracking, it is unlikely that most cities and states will have resources available to support contact tracing during a biological warfare incident. In the case of a large number of victims it is unrealistic to expect state or local agencies to have the manpower to conduct the interviews necessary to trace contacts for a hundred victims. Additionally, the demand of other response activities and immediacy of victims may leave public health personnel overtaxed even before starting tracing efforts.⁷

National Capability

Considerable public health and lab capabilities exist at the national level. The CDC can provide substantial diagnostic and confirmatory capability. Additionally, the U.S. Army Medical Research Institute of Infectious Disease (USAMRIID) can provide robust capability. In case of a confirmed biological agent release, the CDC has public health officers prepared to augment local resources.

The CDC oversees the National Notifiable Disease Surveillance System, which is the primary public health surveillance system. However, this system is inadequate for biological warfare incident identification. All states participate and report approximately 50 diseases including some potential biological warfare agents (anthrax, botulism, brucellosis, plague and eastern and western equine encephalitis). Federal agencies cannot legally dictate which diseases states should report. The list of reportable diseases is compiled and revised by a collaboration of state and CDC epidemiologists and currently the list is fairly limited. Additionally, reporting relies on old-fashion paper reports and is usually not timely, consistent or accurate. The

limitations of the current system leave the CDC constrained in its ability to manage national surveillance. This will delay detection and response.

Several other surveillance systems are in development. The National Electronic Disease Surveillance System (NEDSS) is a system designed to facilitate the collection, management, transmission, analysis, accessibility and dissemination of public health surveillance primarily through the creation of standards.⁸ The CDC is also examining development of an emergency department based surveillance system called Data Elements for Emergency Department Systems (DEEDS) which is designed to standardize electronic emergency department reporting across clinical systems of care. Plans to look at electronic reporting of lab results may also help surveillance efforts.⁹ Similarly the Air Force, in conjunction with the CDC, is developing a web based surveillance system called lightweight epidemiology advanced detection and emergency response system (LEADERS). This system allows providers to input and access information from the spectrum of detection sources, medical, vets, labs, agriculture department staff, etc.. Together, if used at the local level in a timely manner, these systems may offer an improved surveillance system.

National assets can enhance local laboratory capabilities. The CDC is creating a multilevel laboratory response network for bioterrorism (LRNB). This network will link clinical labs and public health agencies in all states to state-of-the-art facilities that can analyze biological agents. Additionally, the CDC is also creating an in-house rapid-response and advanced technology (RRAT) laboratory. This laboratory will provide around-the-clock diagnostic confirmatory and reference support for terrorism response teams.¹⁰ Other capabilities include the National Guard's Weapons of Mass Destructions Civil Support Teams (WMDCST) Mobile Analytical Lab System (MALS)¹¹ and the Marines Chemical Biological Incident Response Force (CBIRF) lab.

Shortfalls

While enhanced capability is available with the national assets, the local and state levels have significant gaps. The inadequacy of timely incident identification is alarming. Several cases, such as the hantavirus outbreak in 1993¹² and an *e.coli* outbreak in Wyoming in 1998, demonstrate how slow the system is to respond and identify the source of natural outbreaks. In the Wyoming case, it took months and over a hundred cases before the source was found.¹³ Another case from Arizona illustrates how poorly and slowly information travels to the public health system. On a flight of 125, 50 passengers developed severe diarrhea. The plane landed in Arizona, offloaded the sick patients, and continued to its original destination. The Arizona county public health officer was alerted to the incident the next morning when he heard about it on National Public Radio.¹⁴ Such delays in notifications and inability to recognize or identify sources of naturally occurring incidences exemplifies how response efforts could be jeopardized by public health delays.

Surge capacity of national agencies to support public health and laboratory efforts exists, but may be inadequate. In a large biological attack incident the CDC and DoD may not be able to respond quickly or with enough assets to avert disaster. The TOPOFF biological incident exercise in Denver demonstrated the shortage of health department officials for handling the event despite pre-warning of the exercise and having 31 CDC staff members to support the response.¹⁵ While the CDC has a pool of approximately 1000 individuals who can respond they have to be pulled from other critical duties. Additionally if the event is not limited to one city or state, DoD and the CDC may be quickly spread thin with the demand for their services. The shortage of public health assets is an ominous indicator of the potential for resources to be overwhelmed in a real biological incident.

Notes

¹ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, G11-13

² Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 66

³ Ibid, 257

⁴ Ibid, 5

⁵ Ibid, 72

⁶ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, 33

⁷ Inglesby, Thomas, Rita Grossman, Tara O'Toole. "A Plague on Your City: Observations from TOPOFF" *Biodefense Quarterly*, 2, no 2 (September 2000), 11

⁸ Supporting Public Health Surveillance through the National Electronic Disease Surveillance System (NEDSS) available at :
<http://www.cdc.gov/nchs/otheract/phdsc/presenters/nedss.pdf>

⁹ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 73-74

¹⁰ "Biological and Chemical Terrorism: Strategic Plan for Preparedness and Response Recommendations of the CDC Strategic Planning Workgroup." *Morbidity and Mortality Weekly Report*, vol 49 (No.RR-4), 21 April 2000, 6

¹¹ Morales, LTC Mario, Georgia National Guard, US Army. Briefing "4th (WMD) Civil Support Team; The Point of the Military Response Spear". Center for Counterproliferation Annual Conference 2000, slides 8 &9

¹² Eppright, Charles T. "The US as a Hot Zone: The Necessity for Medical Defense" *Armed Forces and Society* vol 25 no 1, 47

¹³ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, viii

¹⁴ Willingham, Stephen "Military Role in US Response to Terrorism Remains Unclear" *National Defense* vol 84 no 559 (Jun 2000)

¹⁵ Inglesby, Thomas, Rita Grossman, Tara O'Toole. "A Plague on Your City: Observations from TOPOFF" *Biodefense Quarterly*, 2, no 2 (September 2000), 6

Chapter 4

Unity of Effort

But should a weapon of mass destruction actually be used, responders – be they local, state or federal, civilian or military – will confront unique and daunting challenges.

—Charles L. Cragin, Principal Deputy Asst Secretary of Defense

There are over a dozen local, state, federal and volunteer organizations that respond to a biological attack. To provide effective response, agency efforts must be unified. An integrated, cohesive response will enable capitalization on the strengths of each agency, while reducing the chance the organizations will work at cross-purposes to each other. Unity of effort can be achieved through unified command and control and effective communication, both of which require pre-planning as a catalyst.

Unified command and control is an important aspect of response efforts. Quick decisions are critical because confusion leads to delay. Confusion may also create duplicating efforts or incongruous actions. Unified command and control insures agencies effectively act together to resolve the situation. The sheer number of agencies that may respond to biological warfare will cause confusion if each agency's roles and responsibilities are not understood and practiced. A single incident commander must be identified and accountability assigned. Centralized authority will minimize disconnects and synchronize the activities of the numerous agencies.

Effective coordination is contingent on a communication system that effectively passes information from numerous agencies through the centralized control point. Effective communication also includes timely, two-way contact and a common language and understanding of the information. Mechanisms that enable communication must be in place and interoperable to facilitate interagency coordination. Mechanisms for communication include electronic communication devices (phones, FAX, radios...) as well as low-tech solutions, such as co-location and runners. The information being passed must be clear while using vocabulary that all parties are familiar with. Agency specific jargon and acronyms should be standardized and defined before disaster strikes. Expedient information transmission is critical to focus efforts, reduce stress, and minimize casualties.

Unity of effort is most effectively served by pre-planning. Assigning a chain of command, knowing each agency's roles and expectations, and designing an interoperable communication plan can and should be accomplished and practiced realistically and regularly before a disaster. Without proactive planning and practice, confusion will delay the response from the outset.

State and Local Capability

Most cities and states have an established system for handling disaster situations. Initially, command, control and communications for a biological warfare response should mirror local disaster response adding only the public health component. In most localities there are plans in place which are exercised annually and include a system with some sort of emergency operations center for command, control, and communication. Often the local fire chief runs the operation until the state emergency management agency arrives. If prolonged efforts are required and federal and volunteer agencies arrive, problems of command, control and communication will become significant unless they are planned and rehearsed.

National Capability

Several agencies are capable of responding to a biological warfare disaster. The Federal Emergency Management Agency's (FEMA) National Response Plan (FRP) provides a basis for national level domestic response. This plan includes terminology, lead agent responsibility for various tasks, roles, and set up of coordination centers. Additionally, most national agencies, particularly DoD assets, arrive with their own command and control components and some come with a communication infrastructure. As long as information of contact numbers and locations are distributed early on and the FRP is used by all agencies, problems should be minimal.

Shortfalls

Although state and local agencies can effectively manage local area events and the national system can effectively manage federal assets with FEMA coordinating, difficulty arises when both federal and local agencies come together to run emergency response. The more robust national agencies tend to overwhelm the local agencies although, technically, the states are responsible for consequence management with FEMA providing a coordinating role. If leaders in the states or one agency do not step forward as the command and control element, effective response could falter and fail. For example, during the TOPOFF exercise there was confusion about who owned the "lead agency" role. No one stepped forward and claimed responsibility during the incident management.¹ Such a lack of leadership could have disastrous consequences for U.S. citizens and national security.

Notes

¹ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, L3

Chapter 5

Containment and Countermeasures

Biological weapons are an even more serious problem. For example, they could be readily introduced into mass transportation systems and quickly spread to thousands of people with devastating consequences.

—National Defense Panel

Containment and countermeasures are the steps taken in consequence management to prevent problem expansion. The three components to biological warfare containment are residual hazard mitigation, quarantine/isolation of those infected or suspected to be infected, and mass prophylaxis. Containment is a two-tiered approach with the first two components working to limit or control propagation of the agent, and the third protecting the surrounding community from harmful effects.

Identifying and understanding the biological agent involved is a prerequisite for residual hazard mitigation. Most biological warfare agents present minimal residual effects risk because they are sensitive to temperature, time, and/or ultra-violet light. However, some, such as anthrax, require considerable decontamination. Determining the origin, the agent, and the manner of dispersal drives decontamination efforts. The best-case scenario may leave few requirements and free up resources for other efforts. In the worse case, decontamination of wide areas, vehicles, personnel and/or patients will be essential. Additionally, vector and animal

control must be considered with complete environmental sampling (air, water, soil, surface) to ensure the area is clear.¹

The biological agent involved will determine whether quarantine or isolation of patients may be necessary to control the outbreak. These decisions have both medical and political implications. If executed, civil authorities must consider the feasibility of closing/controlling the population, obtaining public support, and supplying food and water for the quarantined population. Other containment options include closing borders, segregating contacts, using holding tanks for the incubation period, and isolation of patients.²

Mass prophylaxis involves distributing antibiotics, vaccines or medicine to prevent disease in exposed or high-risk personnel. To apply these preventive measures, an effective system of identifying exposed or high-risk personnel is imperative. The role and veracity of self-reporting in an environment of limited resources must be considered. Emergency and critical personnel, as well as their families should be considered for prophylaxis treatment. Treating these emergency personnel and their families decreases the likelihood illness and worry will pull them away from their duties. Public appearance of the “preferential” treatment may cause political concerns and should be dealt with proactively. Establishing plans and personnel listings of those in emergency and critical positions before an incident, as well as clear communications with the public during the crisis, can reduce community outrage.

State and Local Capability

Most states and cities are ill prepared for mass decontamination efforts.³ Decontamination is primarily the duty of HAZMAT units and fire departments. Although units have significant experience with chemical decontamination, biological agents are new territory. This unfamiliarity may necessitate technical assistance from federal agencies. Furthermore,

depending on the size and scope of efforts, local and state units may be quickly inundated. Hospitals who have patient decontamination responsibilities are also often poorly prepared for these efforts.⁴

The decision for quarantines, holding areas or other containment options comes from the state and local political officials in coordination with the public health and other medical advisors. In the event of a major incident, most states have a statutory basis for quarantine. However, in many states the statutes are ambiguous which may degrade emergency actions.⁵

Most cities and states do not have a stockpile of vaccines and medications or a working strategy to adequately support a mass prophylaxis action. Most communities do not pre-identify the emergency responders and critical personnel who would receive prophylaxis. These discrepancies would force key decisions to be made during the heat of the crisis when emotions are high and community support is more difficult to gain. While appropriate medications and vaccines are on hand at local pharmacies and hospitals, these would be inadequate for mass prophylaxis. Communities will have to quickly turn to federal support.

National Capability

Residual hazard mitigation assistance is available from a variety of national sources. Technical advice is available through the 24-hour Chemical Biological (CB) Hotline, which will also trigger notification to the FBI and other DoD assets of a potential response. The National Guard Weapons of Mass Destruction Civil Support Teams, Marine Chemical Biological Incident Response Force, and the National Defense Medical System's (NDMS) Metropolitan Medical Response System have decontamination capabilities. While there is fairly robust capability among these organizations, most of the capability is biased toward chemical attack.⁶

Local authorities initiate quarantines and isolation actions, but once that decision is made, numerous federal agencies can help with implementation. The Centers for Disease Control and the CB Hotline can provide advice on best courses of action and the National Guard can assist in enforcement.

Prophylaxis supplies can be obtained through the Veterans' Administration (VA), the CDC, or Department of Defense (DoD). However, for some agents, prophylaxes are unavailable (hemorrhagic fever) or supplies are limited (smallpox) even at the national level. Research is ongoing in several organizations to fill in the gaps for many of these agents.⁷

Shortfalls

Biological warfare decontamination is a concern both in capability and preparedness at all levels of the government. There is a distinct emphasis on chemical decontamination to the detriment of biological warfare response. Research into biological warfare residual mitigation is also lacking. In reference to biological warfare decontamination, Dr Barry Schneider, Director USAF Counter Proliferation Center, said, "We need a breakthrough in techniques for solving the large area decontamination problem (such as ports/airfields). Solvents may not work unless they are so caustic that they are also harmful to health and equipment."⁸ While not totally unprepared, these deficits may hamper critical response efforts.

Quarantine requirements need to be addressed at the state level. Laws should be clarified and the processes and plans for executing them should be well thought. Mechanisms for public relations campaigns should also be planned out in advance of an incident. These state requirements must be coordinated before and incident when emotions and stress are running high.

Notes

¹ US Department of Defense. Improving Local and State Agency Response To Terrorist Incidents Involving Biological Weapons. Aberdeen Proving Ground, MD: Army Soldier and Biological Chemical Command, Domestic Preparedness Office, September 12, 2000, 23

² Inglesby, Thomas, Rita Grossman, Tara O'Toole. "A Plague on Your City: Observations from TOPOFF" *Biodefense Quarterly*, 2, no 2 (September 2000), 10-11

³ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 100

⁴ Ibid, 101

⁵ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, 34

⁶ NDMS Website available at: http://ndms.dhhs.gov/CT_program/mmrs/mmrs.htm

⁷ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 111

⁸ Dickinson, Lansing E. Lt Col, USAF "The Military Role in Countering Terrorist Use of Weapons of Mass Destruction." *Counterproliferation Papers Future Warfare Series* no. 1 (September 1999) Air University, 34

Chapter 6

Casualty Management

In a biological weapon event, we are talking numbers in the thousands to tens of thousands to hundreds of thousands of victims.

—Brigadier General Donna F. Barbisch

Casualty management is a significant part of recovery and preserving national security during any disaster. Biological warfare incidents magnify the need for quick recovery because of the potential for high numbers of casualties and chaos. There are four components to casualty management, 1) patient treatment, 2) worried well management, 3) logistics (supplies, equipment and personnel to support these efforts), and 4) fatality management. Each of these functions is vital to recovery.

In most disasters there are few casualties requiring extensive medical care. Biological warfare agents cause diseases that require just that. Unlike other disasters where casualties surge and then they taper off, unless contained early, a biological warfare incident may continue to balloon in second and third waves of patients requiring care while the first wave patients are still being treated. Pre-planning by local health care agencies on where to send patients, where to treat other illnesses and injuries, and where overflow patients should go can improve effective response to a biological warfare incident. The capacity to overwhelm medical facilities is one of the appeals of biological warfare terrorism.

A unique component to biological and chemical warfare incidents and a potential major drain on resources are the worried well. Worried well experience symptoms of exposure but are disease free. In the sarin gas release in Tokyo there were 1000 exposed casualties and 4500 worried well.¹ The ability to effectively triage masses of people, identify those at high risk, and relieve the fears of those not at high risk is required for successful response. The worried well must be planned for or they will compound the problems of an overwhelmed health care system.

To effectively treat victims, a system must support the medical caregiver with adequate supplies and equipment. Treatment regimens, prophylaxes, basic supplies (masks, gloves...), equipment (beds, respirators...) must be available in mass quantities. The workers will need food, change of clothes, showers, and beds (near or in the hospital). These items must be on hand in a timely fashion. A mechanism for identifying, obtaining, prioritizing and distributing the resources to medical facilities and the community is important.

With biological warfare agents there is a likelihood fatalities will occur and may occur in large numbers. Numerous issues surrounding fatality management must be considered in planning and responding. One critical issue is treatment of the remains, particularly if they are contaminated or contain an infectious disease. Public health's recommended disposition of the deceased may conflict with family desires or religious values. Additionally, the need for victim identification, overwhelmed morgues, proper tracking and notification of deaths must be addressed.²

State and Local Capability

Treatment protocols for the various biological warfare agents are available or easily accessible in most areas. Many of the biological warfare agents are also naturally occurring diseases and are covered in medical text. Additionally, the CDC, DoD, and NDMS all publish

specific biological warfare treatment protocols that are accessible online or through those agencies. These protocols are being expanded to include treatment of pediatric and geriatric patients, which should provide adequate guidance to medical personnel. Most areas have plans to handle an initial influx of casualties, but the biggest limiting factor is the surge capacity of staff, equipment and supplies. Communities have limited supplies of antibiotics like penicillin and streptomycin. Ciproflaxin and doxycylin may be more available but their availability may not be adequate.³ Depending on the type of infection, equipment, such as respirators and even hospital beds, may come in short supply. If arrangements for surge supplies and equipment are made, most communities do not have a prioritization and distribution plan, which significantly degrades the capability to employ additional assets. Furthermore, biological warfare has the capacity to shut down airports and other transportation centers if panic and fear infect the population.

The capacity for holding remains may vary significantly from state to state. The use of meat freezers and other locations can be used in an emergency, but butcher and grocery shops may be resistant. The tracking, handling, identification and notification of next of kin does not vary significantly from other disasters, so plans in place for these actions should be adequate.

National Capability

In recent years a number of teams geared toward WMD casualty response have flourished providing a host of organizations and agencies capable of WMD casualty management support. They include the NDMS, National Medical Response Teams (NMRTs), MMRS, WMD CSTs, and CBIRF. These teams, if they should be tasked to respond, can provide some surge capacity within 1-2 days but must be “invited” by state authorities. While these teams can each handle hundreds of casualties per day some like the CBIRF only support stabilization.

Recently, pharmaceuticals and supplies support has been enhanced. The CDC manages a National Pharmaceutical Stockpile (NPS), which upon authorization from the CDC, can arrive at any U.S. location within 12 hours. The stockpile is arranged in palletized “push packages” that can treat thousands. Fact sheets and handouts are being created for patients and medical staff to go along with the push packs. The CDC is working the follow-on pharmaceuticals via a vendor-managed inventory (VMI) program.⁴ Supplies and pharmaceuticals can also be obtained through the VA or DoD. DoD maintains a fair amount of biological and chemical warfare defense pharmaceuticals in their War Reserve Material (WRM), which can be released for domestic use in the case of an emergency.

The Red Cross can support next of kin notification needs particularly if the family is out of the area. Additionally, the NDMS system has a Disaster Portable Morgue Unit (DPMU) and Disaster Mortuary Operational Response Teams (DMORTS) to provide mortuary services.

Shortfalls

When it comes to casualty management the limiting factors are surge casualty management equipment (such as respirators) and effective supply distribution. While numerous teams support casualty management and provide significant augmentation to local resources, they may be spread thin if the biological incident is not contained to one community. During TOPOFF, a lack of adequate prioritization for supply distribution was noted. To whom or where supplies should go and the capacity to adequately deliver supplies where they were needed were specifically noted.⁵ This could significantly impact treatment capability and degrade community trust.

Notes

¹ US Department of Defense. Improving Local and State Agency Response To Terrorist Incidents Involving Biological Weapons. Aberdeen Proving Ground, MD: Army Soldier and Biological Chemical Command, Domestic Preparedness Office, September 12, 2000, 14

² Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, 18

³ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 135

⁴ CDC, National Pharmaceutical Stockpile (NPS) Program Fact Sheet, Aug 30, 2000

⁵ Inglesby, Thomas, Rita Grossman, Tara O'Toole. "A Plague on Your City: Observations from TOPOFF" *Biodefense Quarterly*, 2, no 2 (September 2000), 8&13

Chapter 7

Social Support

Remember, citizens should be given all the information they need to know in order to plan their response to disasters and to instill their confidence in the plan...don't wait until a disaster strikes before you tell the people what to do. Your motto should be the same as the scouts. You want the people to BE PREPARED!

—FEMA Introductory Management Course

Social support functions can help maintain community order, provide support and a sense of control to the general population. Components of social support include psychological services, ongoing communication, family support services and security.

The nature of a terrorist attack involving biological warfare agents lends itself to psychological impact. In fact, terrorists use WMD primarily for their behavioral and psychological effects.¹ Terrorism, like other crimes where the aggressor is unknown, deprives people of a potentially beneficial expression of anger, producing a futile sense of helplessness, depression, demoralization, and hopelessness.² Furthermore, studies show high rates of Post Traumatic Stress Disorder (PTSD) cases for survivors of terrorist attacks (30% of injured at 5+ years).³ With Japanese sarin victims even when treated for PTSD shortly after onset, 30% of the patients required ongoing therapeutic treatment.⁴

Providing psychological care is an important component of response. This care must span not only those directly affected, but also their families, emergency workers, volunteers, the

worried well, and the community as a whole. Debriefing, preventing quarantined and isolated individuals from feeling cut off, and providing simple, easily read and remembered information on the physical and psychological effects of biological warfare agent are all examples of necessary psychological care.⁵ Information overload, as well as lack of information and rumors, can be a problem in handling the psychological aspects of a biological attack.⁶

Timely, accurate information about the nature of the threat and actions being taken will go a long way in maintaining confidence in the government, minimizing panic, and maintaining control. Biological warfare is unknown to most people. Reducing that unknown, early through information, will give the population a reassuring measure of control. Specific media releases and ongoing communications, multi-lingual if needed, will reduce rumors and anxiety.

A strong, proactive, familiarization campaign aimed at the public will reap many rewards if a biological attack occurs. For most disasters, such as earthquakes, hurricanes, and tornados, the public is aware of the basic response actions and their responsibilities. Early communication saves time, alleviates fear and provides a more orderly public should a terrorist attack occur.⁷

Numerous family concerns can arise because of mass casualty situations. In the case of biological warfare, children may need care if their parents are affected or quarantined. Adult caregivers who are ill may need assistance with activities of daily living, such as shopping, bathing, cleaning, and cooking. Housing services may be necessary if access to areas is restricted. Legal services, insurance information, access to workman's compensation, access to financial assistance, victims' assistance, and other services may be needed. Strong support in these areas helps recovery and confidence building.

The potential for panic, anger, and fear in response to a biological warfare incident cannot be understated. While an orderly community is ideal, response to a biological warfare incident

must include security concerns. Potential security requirements include site management, crowd control at hospitals and distribution points, escorts for emergency personnel, protection of vital infrastructure and the potential to enforce quarantines and/or provide safe zones and routes of evacuation.⁸ Americans need to understand that civil authorities may have to encroach on personal freedom until order is restored.

State and Local Capability

Many communities have some basic psychology services and are familiar with critical incident stress debriefing, which minimize post traumatic stress. Many religious organizations and community groups can provide additional support and forums to assist people in coping.

In a biological warfare incident, communication requirements are more important for controlling the population and ensuring proper measures are being taken than in other disasters; however, existing mechanisms to communicate with the public are probably well established through disaster management plans.

Police at the local and state level generally have the capability and training to support initial operations. However, if the incident is expanded or prolonged there will be inadequate local resources to support the numerous security requirements. National Guard, mutual aid agreements, or other actions will likely be needed and should be set up in advance.

National Capability

FEMA offers a Crisis Counseling Assistance and Training Program to help relieve grief, stress, and other mental health problems caused or aggravated by a disaster. This service is primarily funded to support short-term response. The Red Cross offers disaster mental health services to those affected by disasters and those working the relief operations. They will meet

with families and provide community education services on stress and coping.⁹ Additionally, the Red Cross provides integrated services with the American Psychological Association which has a disaster response network of 1500 psychologists who volunteer to provide on-site mental health services to disaster survivors and responders.¹⁰

FEMA typically runs a disaster recovery center which is established near the community affected and is useful in supporting general assistance needs. People can go to the DRC to meet federal, state, local and volunteer agencies and obtain information, to teleregister for assistance, complete loan applications or request other information.¹¹ The Red Cross provides some sheltering, feeding and family assistance.

The National Guard is the primary source for augmenting local security forces. They have the training and capability to respond to disasters and incidents. However, military presence in a domestic role may cause consternation among the general public.

Shortfalls

The most noticeable shortfall is population pre-education. FEMA generally offers information on how to cope with emergencies but no such pamphlets, checklists or other guidance has been provided to the populace on terrorist incidents much less biological attacks or incidents.¹² The Israeli program for preparedness identifies this as a critical to ensure public cooperation and reduce panic. Their goal is a calm, alert, and cooperative public.¹³ Yet, U.S. efforts to increase awareness and understanding are virtually non-existent.

Notes

¹ Department of Psychiatry, F. Edward Herbert School of Medicine, Uniformed Services University of the Health Sciences *Psychological and Behavioral Responses to a Chemical and Biological Warfare Environment Final Recommendations*. Bethesda, Maryland, 5

Notes

² Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 165

³ Ibid., 165

⁴ Ibid., 165

⁵ Department of Psychiatry, F. Edward Herbert School of Medicine, Uniformed Services University of the Health Sciences *Psychological and Behavioral Responses to a Chemical and Biological Warfare Environment Final Recommendations*. Bethesda, Maryland, 9

⁶ Ibid., P11

⁷ Taylor, Eric R. "Are We Prepared for Terrorism Using Weapons of Mass Destruction? Government's Half Measures." *Policy Analysis* no 387 (November 27, 2000), 14

⁸ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, 14

⁹ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 166

¹⁰ Ibid., 171

¹¹ FEMA Website www.fema.gov

¹² Taylor, Eric R. "Are We Prepared for Terrorism Using Weapons of Mass Destruction? Government's Half Measures." *Policy Analysis* no 387 (November 27, 2000)

¹³ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, F8

Chapter 8

Conclusions

The terrorist is a criminal, not a soldier. He strikes indiscriminately at the target of his choosing, with any means, at any time. All targets are legitimate in his eyes. He seeks to inflict as much damage as possible to horrify and shock the local population and global audience and to embarrass the leaders of a country.

—General J.H. Binford Peay

Over the past five years significant resources have been allocated to prepare the U.S. to respond to a domestic weapons of mass destruction terrorist attack. However, shortfalls remain. Significant progress has been made but some areas still lack critical capability. Appendix B provides an illustrated capability assessment and summarizes the level of capability for each response element at the national and state and local levels.

The capabilities at the national level are fairly robust due to federal funding, pharmaceutical stockpiling, and national response team development. Limitations in prophylaxes and treatment regimens for some biological agents, bias toward responding to chemical rather than biological events, and deficits in decontamination capabilities are critical issues. Although there has been marked improvement, research on prophylaxes and treatments as well as decontamination methods continue to be priorities. The glaring national level weakness is the lack of ongoing public awareness campaigns.

Little effort and money are being spent on general public awareness. Implemented wisely, education is cost effective and benefits the populace during a crisis including mitigation of panic

and ability to cope with the incident. Israeli efforts in this area provide an excellent template for addressing this weakness. By reducing the terror factor, the appeal of such attacks also drops.

While considerable focus and funding has enhanced federal capability the local and states are far less prepared. Of the \$1.2 billion spent in fiscal year 2000, only \$100 million was spent on state and local domestic preparedness.¹ Yet due to the nature of biological warfare local agencies require tools to identify agents and provide initial response.

Efforts to enhance local capabilities in 120 cities through training programs designed to educate city officials and emergency responders and by providing seed money have been implemented.² This is a start but leaves 50 percent of U.S. population centers under trained and unprepared.³ A wise use of funds would be to train the states and allow them to train and guide their cities in a pyramid type effort rather than a federal focus on a few cities.⁴

Appendix B shows significant gaps in local and state capabilities in six areas. Some, but not all, of those are offset by national capability. Logistics and detection are two areas that state and local areas must improve. Logistics pre-planning and developing mechanisms for prioritization and distribution require significant attention. Without such improvement delivering national stockpiles to the right place at the right time will be futile.

The most disturbing deficit is the inability to detect and identify a biological incident. National assets cannot provide this critical component that triggers all other actions to combat a biological attack. Enhancing the public health disease tracking system will benefit the public health of our nation in war and peace. With the ever-increasing globalization, naturally occurring, emerging diseases as well as bioterrorism are threats. Enhancing our public health system should be a primary national security focus.

Funds to enhance the surveillance system are available. The CDC's Emerging Infections Program offers grants to state and local health departments for improving epidemiological and laboratory capability.⁵ Computerized surveillance systems are being developed within CDC and DoD. The lowest government levels, throughout the country, must procure the technology and adopt processes that enable reliable and timely population surveillance and incident identification. If they do not, the country cannot effectively combat biological attack.

The capability to support the surge of work during a biological incident is critical to the United State's response during a biological warfare incident.⁶ In most areas, such as decontamination, prophylaxis, and patient treatment, enhanced capabilities are required. Public awareness, logistical plans, and improving the public health system are three components where immediate attention will reap the greatest benefit. Without considerable efforts in this direction our ability to manage the consequences of a biological warfare incident will leave our nation vulnerable to a major catastrophe.

Notes

¹ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, N3

² Mauroni, Albert J. *America's Struggle With Chemical-Biological Warfare*. Westport, Conn: Praeger, 2000, 250 .

³ Taylor, Eric R. "Are We Prepared for Terrorism Using Weapons of Mass Destruction? Government's Half Measures." *Policy Analysis* no 387 (November 27, 2000), 1

⁴ Ibid, 13

⁵ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 7

⁶ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 184

Appendix A

National Level Agencies, Programs, and Capabilities

1. **Department of Health and Human Services (DHHS)** – “The Department of Health and Human Services is the United States government's principal agency for protecting the health of all Americans and providing essential human services, especially for those who are least able to help themselves” (<http://www.dhhs.gov/>)
 - a. **Office of Emergency Preparedness (OEP)** has the Departmental responsibility for managing and coordinating Federal health, medical, and health related social services and recovery to major emergencies and Federally declared disasters including: Natural Disasters Technological Disasters Major Transportation Accidents and Terrorism (<http://ndms.dhhs.gov/>)
 - i. **National Disaster Medical Service (NDMS)** is a cooperative asset-sharing partnership between HHS, the Department of Defense (DoD), the Department of Veterans Affairs (VA), FEMA, state and local governments, private businesses and civilian volunteers which augments local and state medical resources by providing medical care to disaster victims. NDMS hospitals make ready a total of more than 100K inpatient hospital beds, the VA provides medicines and DoD provides patient transport **1-17a** (<http://ndms.dhhs.gov/>)
 1. **Management Support Team (MST)**. “A Management Support Team (MST) provides field command and control in a disaster for deployed Federal medical assets. The MST can provide and coordinate communications, transportation, a medical cache, and other logistical support to DMATs and Specialty Teams.” (http://ndms.dhhs.gov/NDMS/About_Teams/about_teams.html)
 2. **Disaster Medical Assistance Teams (DMAT)** “A DMAT is a group of professional and paraprofessional medical personnel (supported by a cadre of logistical and administrative staff) designed to provide emergency medical care during a disaster or other event.” (http://ndms.dhhs.gov/NDMS/About_Teams/about_teams.html#dmat) The teams are sponsored, staffed and trained by a major medical facility, private organization or other agency. NDMS has 60 existing DMATs for prehospital treatment during a disaster or other event. Twenty-one are fully deployable and can be on the scene in 12-24 hours with enough food, water, shelter and medical

supplies to remain self sufficient for 72 hours and treat about 250 patients per day. 3 teams are being organized and trained specifically to respond to chemical or biological terrorism. (1-p.11&25)

- a. **National Medical Response Teams (NMRTs)** specialized DMAT team that are “equipped and trained to provide medical care for victims of weapons of mass destruction.” (http://ndms.dhhs.gov/NDMS/About_Teams/about_teams.html#dmat)
 - b. **Disaster Mortuary Operational Response Teams (DMORTs)** specialized DMAT to provide mortuary services – has available a Disaster Portable Morgue Unit (DPMU) (http://ndms.dhhs.gov/NDMS/About_Teams/about_teams.html#dmat)
 - c. **Veterinary Medical Assistant Teams (VMATs)** for emergency veterinary services.
3. **Metropolitan Medical Response System (MMRS)** (formerly Metropolitan Medical Strike Teams (MMST) – “Primarily a chemical response team, the MMST was capable of providing initial, on-site, emergency health and medical services following a terrorist incident involving a weapon of mass destruction (chemical, biological, radiological and/or nuclear). The team can provide emergency medical services, decontamination of victims, mental health services, plans for the disposition of non-survivors and plans for the forward movement of patients to regional health care facilities, as appropriate, via NDMS” Currently two teams in place but the HHS is authorized to develop 25 additional teams for selected cities. (http://ndms.dhhs.gov/CT_Program/MMRS/mmrs.html)
4. **HHS Emergency Operations Center (EOC)/NDMS Operations Support Center (OSC)** (HHS EOC/NDMSOSC) “will provide liaison between the Federal Government headquarters and appropriate regional officials in the response structure at the disaster scene for the coordination of Federal health and medical assistance to meet the requirements of the situation.” (<http://www.fema.gov/r-n-r/frp/frpesf8.htm>)
- b. **Center for Disease Control and Prevention (CDC)** “The CDC is recognized as the lead federal agency for protecting the health and safety of people at home and abroad, providing credible information to enhance health decisions, and promoting health through strong partnerships. CDC serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and education activities designed to improve the health of the people of the United States.” (<http://www.cdc.gov/aboutcdc.htm>)
 - i. **Multilevel Laboratory Response Network for Bioterrorism (LRNB).** This network will link clinical labs to public health agencies in all states,

- districts, territories, and selected cities and counties and to state-of-the-art facilities that can analyze biological agents.¹
- ii. **Rapid-Response and Advanced Technology (RRAT) laboratory.** CDC developing this in-house laboratory to provide around-the-clock diagnostic confirmatory and reference support for terrorism response teams.
 - iii. **Epidemic Intelligence Service officers (EIS):** “CDC has trained numerous EIS officer who are available to assist state and local epidemiological response.”²
 - iv. **National Notifiable Disease Surveillance System:** all states participate and report approximately 50 diseases including anthrax, botulism, brucellosis, plague and eastern and western equine encephalitis through this system.³
 - v. The **National Electronic Disease Surveillance System (NEDSS)** is a system designed to facilitate the collection, management, transmission, analysis, accessibility and dissemination of public health surveillance primarily through the creation of **standards**. “The long-term vision for NEDSS is that of complementary electronic information systems that automatically gather health data from a variety of sources on a real-time basis; facilitate the monitoring of the health of communities; assist in the ongoing analysis of trends and detection of emerging public health problems; and provide information for setting public health policy.” (<http://www.cdc.gov/nchs/otheract/phdsc/presenters/nedss.pdf> Supporting Public Health Surveillance through the National Electronic Disease Surveillance System (NEDSS))
 - vi. **Epidemic Information Exchange (EPI-X)** A secure, web-based communications network for public health officials designed to simplify and speed the exchange of routine and emergency public health info between state health departments and CDC. Will notify of events, track info, have a database for researching outbreaks, allow communication with colleagues, ...7-H-7
 - vii. **Data Elements for Emergency Department Systems (DEEDS).** Designed to standardize electronic emergency department reporting across clinical systems of care. The National Center for Injury Prevention and Control (NCIPC) is coordinating a national effort to develop uniform specifications for data entered in emergency department (ED) patient records. If the data definitions, coding conventions, and other recommended specifications are widely adopted, then incompatibilities in ED records can be substantially reduced... And can facilitate communication and integration with other automated information systems. <http://www.cdc.gov/ncipc/pub-res/deedspage.htm> DEEDS Data Elements for Emergency Department Systems
 - viii. **National Pharmaceutical Stockpile (NPS)** Is a program to ensure availability of life saving pharmaceuticals, antidotes and other medical supplies and equipment necessary to counter the effects of biological or chemical agents. These supplies are arranged in “push packages” and

ready for deployment in 8 locations. They are designed to reach any US area or territory within 12 hours of the decision to release. The CDC is in the process of preparing a treatment guide and fact sheets (for both providers and patients) to go with the push packs.
http://www.bt.cdc.gov/press/Ostroff_03082000.asp

- ix. **Vendor Managed Inventory (VMI)** Currently the CDC is finalizing contracts to provide follow-on pharmaceuticals which could arrive from vendors 24-36 hours after initiation and which will contain the same items as the push pack.

http://www.bt.cdc.gov/press/Ostroff_03082000.asp

- x. **Epidemiology and Laboratory Capacity in Infectious Diseases (ELC)** program makes funds available to “assist State and eligible local public health agencies in strengthening basic epidemiologic and laboratory capacity to address infectious disease threats with a focus on notifiable diseases, food-, water-, and vector-borne diseases, vaccine-preventable diseases, and drug-resistant infections.

<http://www.cdc.gov/od/pgo/funding/01022.htm>

- 2. **Federal Emergency Management Agency (FEMA)** “FEMA is an independent agency of the federal government, reporting to the President. Since its founding in 1979, FEMA’s mission has been clear: to reduce loss of life and property and protect our nation’s critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery” (<http://www.fema.gov/about/>)

- a. **Federal Response Plan (FRP)** “provides the mechanism for coordinating delivery of Federal assistance and resources to augment efforts of State and local governments overwhelmed by a major disaster or emergency” (<http://www.fema.gov/r-n-r/frp/frpplnc.htm>). It is signed by 27 agencies and it addresses responsibilities of various agencies and the response structure at the federal level. The FRP includes an annex on health and medical services and an annex on terrorism/WMD incidents. Teams and functions which support FRP operations once activated include

- i. **Regional Operations Center (ROC)** “The Regional Operations Center (ROC) staff coordinates Federal response efforts until an ERT is established in the field and the FCO assumes coordination responsibilities.” (<http://www.fema.gov/r-n-r/frp/frpconc.htm#ert>)
- ii. **Emergency Support Team (EST)** “An interagency EST, composed of Emergency Support Function (ESF) representatives and FEMA support staff, carries out initial activation and mission assignment operations and supports the ROC from FEMA Headquarters” (<http://www.fema.gov/r-n-r/frp/frpappd.htm>)
- iii. **Federal Coordinating Officer (FCO)** is “appointed by the FEMA Director on behalf of the President, coordinates Federal activities. The FCO works with the State Coordinating Officer to identify requirements.” (<http://www.fema.gov/r-n-r/frp/frpappd.htm>) also heads the Emergency Response Teams

- iv. **Emergency Response Team (ERT)** “The ERT is the principal interagency group that supports the FCO in coordinating the overall Federal disaster operation. Located at the DFO, the ERT ensures that Federal resources are made available to meet State requirements identified by the State Coordinating Office. The size and composition of the ERT can range from FEMA regional office staff who are primarily conducting recovery operations to an interagency team having representation from all ESF primary and support agencies undertaking full response and recovery activities.” (<http://www.fema.gov/r-n-r/frp/frpconc.htm#ert>)
 - 1. **Advance Element (ERT-A)** ERT-A assesses the impact of the event, gauges immediate State needs, and makes preliminary arrangements to set up operational field facilities
- v. **Catastrophic Disaster Response Group (CDRG)** “The CDRG, composed of representatives from FRP signatory agencies, convenes at FEMA Headquarters when needed to provide guidance and policy direction on coordination and operational issues.” (<http://www.fema.gov/r-n-r/frp/frpappd.htm>)
- vi. **A Disaster Recovery Center (DRC)** is a “facility established in, or in close proximity to, the community affected by the disaster where persons can meet face-to-face with represented Federal, State, local, and volunteer agencies to: Discuss their disaster-related needs Obtain information about disaster assistance programs, Teleregister for assistance, Update registration information, Learn about measures for rebuilding that can eliminate or reduce the risk of future loss, Learn how to complete the SBA loan application, Request the status of their Disaster Housing Application” (<http://www.fema.gov/about/drc.htm>)
 - b. **Crisis Counseling Assistance and Training Program (CCP)**. “The purpose of the crisis counseling program is to help relieve any grieving, stress or mental health problems caused or aggravated by the disaster or its aftermath. These short-term services, provided by FEMA as supplemental funds granted to State and local mental health agencies, are only available to eligible survivors of Presidentially-declared major disasters” (<http://www.fema.gov/r-n-r/counsel.htm>)
 - c. **The Rapid Response Information System (RRIS)** “can be used as a reference guide, a training aid, and an overall planning and training resource for response to a chemical, biological and/or nuclear (NBC) terrorist incident. The RRIS contains databases of characteristics and safety precautions for NBC agents and materials, a database of NBC specific Federal Response Capabilities, a list of commercially available NBC unique equipment, and detailed information on the Federal government's surplus property.” (<http://www.fema.gov/rris/>)
- 3. **Federal Senior Interagency Coordination Group (SICG)**, “The Senior Interagency Coordination Group (SICG) was established to facilitate the interagency coordination of federal policy issues and program activities in support of federal consequence management training initiatives concerning terrorist incidents involving WMD. The SICG is composed of senior members from FEMA, FBI, DOE, EPA, the Department of Health and Human Services (DHHS) and DoD.”⁴

4. Department of Defense (DoD)

- a. **Chemical/Biological Rapid Response Team (C/B-RRT)** is a deployable source of advice and expertise that can coordinate specialized assistance as necessary. C/B-RRT has bomb disposal and chem./bio detection and disposal personnel from Army and Navy.p1-.26
- b. **Chemical and Biological Defense Program (CBDP)** DoD program designed to provide a jointly coordinated and integrated program within the DoD for research, development and acquisition of capabilities to protect the joint warfighting forces.⁵
- c. **Defense Threat Reduction Agency (DTRA):** Has the purse strings and is the policy coordinator for the DoD CB defense program.
- d. **Counterterror Technical Support Program (CTTS)** and the **Interagency Technical Support Working Group (TSWG)** R&D program addressing terrorism they track technology development in DoD programs that have applicability—provide opportunities to combine efforts and avoid duplication. 8 US departments and over 50 US organizations identify, coordinate, and prioritize R&D requirements. They have an outreach program to ensure getting the word to and from state and local responders.⁶
- e. **Army** Secretary of Defense appointed the Army as Exec lead on domestic preparedness.
 - i. **U.S. Army Soldier and Biological Chemical Command (SBCCOM)** – formerly Chemical Biological Defense Command (CBDCOM) – DoD lead on domestic preparedness. Provides 24 hour access to DoD assets and telephonic advice 1-26
 1. **Program Director for Domestic Preparedness (PD DP)** responsible for mission execution. Initially responsible for developing program and training 120 cities response and executive personnel and preparedness of CB terrorism. -- By 2001 the FBI will have taken over the training program under the National Domestic Preparedness Office (NCPO) (2-p. 254)
 - a. **CB Hotline** “The hotline is for emergency use 24hr/day through the National Response Center to the FBI and CBDCOM Emergency Operations Center. This hotline is the trigger to notify the FBI and other DoD assets of a potential no-notice CB incident as well as provide immediate technical assistance to guide emergency responders prior to the arrival of federal forces.”⁷
 - b. **CB Help Line.** “The Help Line provides emergency responders and emergency planners with information to plan, mitigate and otherwise prepare for the effects of a chemical or biological terrorist incident.” (http://www.sbccom.apgea.army.mil/ops/dp/fs/dp_helpline.html)
 - c. **BW Improved Response Program (BWIRP)** “The BW IRP’s purpose is to identify, evaluate, and demonstrate the best practical approaches to improve response to terrorist

incidents involving biological weapons”⁸ .is composed of over 60 federal and state experts, local responders and technical experts

2. **Chemical-Biological Rapid Response Team:** DoD is required to maintain at least one team (not including the WMDCSTs by the Guard)
- ii. **The Director of Military Support (DOMS)** acts as the DoD member to the Federal Senior Interagency Coordination Group and is the policy lead for DoD.⁹
- iii. **Army Technical Escort Unit (TEU)** TEU provides expert advisers and assistance disarming and transporting CB devices—primarily crisis action efforts. There are Army TEUs in 3 locations.¹⁰
- iv. **U.S. Army Medical Research Institute of Infectious Disease (USAMRIID)**
 1. **Aeromedical Isolation Team (AIT):** A team of physicians, nurses and technicians from USAMRIID who specialize in the rapid transport of patients with highly contagious diseases. They also offer portable containment laboratory, and limited environmental decontamination. For transport they can handle highly contagious, lethal, or unidentified diseases but is not for mass casualty evacuation. USAMRIID maintains a small isolation ward as one destination option for transported patients.¹¹
 - v. **Specialty Response Teams (SRTs)** – Teams located at the Army’s Regional Medical Centers which “can provide advice on casualty management and coordinate more extensive support.”¹²
 - vi. **Special Medical Augmentation Response Teams (SMART)** – “Provides medical augmentation (technical advice & support) to local medical authorities in the detection, neutralization & containment of chemical, biological and associated hazardous materials in accidental or Weapons of Mass Destruction (WMD) related incidents.”¹³
 - vii. **Consequence Management Program (CoMPIO)** “The CoMPIO program responsibilities include: management of the operational training exercises for the WMD Civil Support Teams and Military Support Detachment, and existing Reserve Component domestic response, casualty decontamination, NBC reconnaissance, medical, engineering, security, information, communications, logistics, and transportation organizations support civil authorities in preparing for and responding to the consequences of terrorist attacks using weapons of mass destruction within the United States.”¹⁴
- f. **Marines**
 - i. **Chemical Biological Incident Response Force (CBIRF)** may provide assistance in evacuation, decontamination and medical stabilization of victims. This 350 person force can have an advance party airborne four hours after notifications. Provides capability of most consequence management functions under one commander.¹⁵
- g. **Air Force**

- i. **Small Portable Expeditionary Aeromedical Rapid Response (SPEARR):** Is a deployable (within 2 hrs) unit that can provide initial disaster medical assessment, primary medicine, emergency surgery and critical care transport preparation.¹⁶
 - ii. **War Reserve Material (WRM):** WRM, which contains BW/CW treatment and prophylaxis material, is available at numerous military medical facilities. The medical facility commander can release these for emergency purposes.
 - iii. **Lightweight Epidemiology Advanced Detection and Emergency Response System (LEADERS):** integrated system of bio-hazard surveillance and detection, electronic medical record, link to other DoD, State and National Centers.¹⁷
 - h. **Navy**
 - i. **U.S. Navy Medical Research Institute (NMRI):** Mission is “to conduct research, development, tests and evaluations, and disease surveillance, in order to enhance the health, safety, performance and deployment medical readiness of Navy and Marine Corps.” And competencies include: “Worldwide infectious disease surveillance, particularly on emerging or reemerging infectious diseases with military importance... Forward deployable diagnostic and consultant capabilities in Infectious Disease, Bone Marrow and Biological Defense to support Operational Commanders. Worldwide research laboratory infrastructure and support capabilities.”
(<http://www.nmri.nnmc.navy.mil/nmrcmainindex.htm>)
 - i. **Guard and Reserve**
 - i. **WMD Civil Support Teams (WMDCST) – Formerly called Rapid Assessment and Initial Detection (RAID) teams.** These teams consist of 22 full-time National Guard personnel who can respond to a WMD attack or incident in support of the state and local response forces. They can assess suspected events, advise local responders, and facilitate requests for assistance. They are establishing 32 such teams with one each from the initial 10 in each of the FEMA regions. As guard units the State governor can direct actions.¹⁸
 - 1. **Mobile Analytical Lab system (MALS).**¹⁹ A stand alone lab capability designed to support diagnostic needs of the WMDCST.
 - ii. **NBC Reconnaissance Elements:** DoD is establishing 43 elements in the Guard and Reserves.²⁰
 - iii. **Decontamination Elements:** DoD is establishing 127 elements in the Guard and Reserves.²¹
- 5. **Veterans Administration (VA):** The VA is able to mobilize health professionals who are not necessarily part of a formal “team,” depending on emergency requirements. VA can be tasked to provide engineering services, mass care and sheltering, resources support, health and medical services, and urban search and rescue assistance during disasters. (<http://www.fema.gov/r-n-r/frp/frpesf8.htm>)

- a. **Emergency Medical Strategic Healthcare Group (EMSHG):** responsible for fulfilling several mandated missions relating to VA’s response to natural and man-made disasters and to national defense contingencies.
 - b. **Emergency Medical Response Teams (EMRTs):** Emergency response teams which support the NDMS system
6. **DoJ**
- a. **Domestic Preparedness Program** responsible for developing program and training 120 cities response and executive personnel and preparedness of CB terrorism. the FBI took over the training program from the Army.²²
 - b. **Federal Bureau of Investigation (FBI):** Lead agent for the crisis management portion of a WMD incident.
 - c. **Interagency Board (IAB)** consists of “leading subject matter experts from local, state and national response organizations and is co-chaired by DoD and DoJ.” Responsibility is equipment standardization and interoperability. Developing standardized equipment lists for WMD response operations – focused on generating standards for equipment used by responders to WMD terrorist incidents.²³
7. **American Red Cross** “The Red Cross works in partnership with people affected by disasters to help them return to living independently as quickly as possible. All Red Cross assistance is given free of charge, as a gift from the American people. There are a variety of services that the Red Cross provides: Sheltering and Feeding, Individual and Family Assistance, Health and Mental Health, Contacting Family in Disaster Area” (<http://www.redcross.org/disaster/services/index.html>)
- a. **Disaster Mental Health Services** provides emergency and preventive mental health services to both people affected by the disaster and to Red Cross workers assigned to the disaster relief operation.” Includes meeting families traveling to the scene, communicating with families not at the scene, offering education about stress and coping, and providing information about local mental health resources.”²⁴
 - b. **Disaster Response Network (DRN):** The American Psychological Association (APA) has 1500 psychologists who have volunteered to provide on-site mental health services to disaster survivors and responders. Their services are integrated with the American Red Cross.²⁵
8. **World Health Organization (WHO)** Identifies, tracks, and responds to infectious disease outbreaks of international significance.(7-34) WHO acts as the directing and coordinating authority on international health work including work on the prevention and control of epidemic, endemic and other diseases.
<http://www.who.int/aboutwho/en/mission.htm>

Notes

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⁴ Department of Defense. *Chemical and Biological Defense Program Annual Report to Congress*. Washington, D.C.: Defense Technical Information Center, March 2000, 4

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⁶ Cragin, Charles L. "Defense research and development support to domestic emergency preparedness for response to threats of terrorist use of weapons of mass destruction terrorism: prepared combined statement before the House Armed Services Committee, Military Research and Development Sub committee." *Defense Viewpoint* (Mar 1999), 16

⁷ Mauroni, Albert J. *America's Struggle With Chemical-Biological Warfare*. Westport, Conn: Praeger, 2000, 251

⁸ US Department of Defense. *Improving Local and State Agency Response To Terrorist Incidents Involving Biological Weapons*. Aberdeen Proving Ground, MD: Army Soldier and Biological Chemical Command, Domestic Preparedness Office, September 12, 2000, 2

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¹¹ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 26

¹² Ibid 26

¹³ Ibid 26

¹⁴ Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, *Second Annual Report: II Toward a National Strategy for Combating Terrorism* Arlington Virginia: Rand, 2000, M-6

¹⁵ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 26

¹⁶ Schafer, Brig Gen Klaus O., Assistant Surgeon General, Readiness, Science & Technology, US Air Force. Briefing: "Medical Readiness in a WMD Storm" Center for Counterproliferation Annual Conference 2000, -slide 67

¹⁷ Ibid., Slide 29

¹⁸ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 27

¹⁹ Morales, LTC Mario, Georgia National Guard, US Army. Briefing "4th (WMD) Civil Support Team; The Point of the Military Response Spear". Center for Counterproliferation Annual Conference 2000, slides 8 & 9

²⁰ Cragin, Charles L. "Defense research and development support to domestic emergency preparedness for response to threats of terrorist use of weapons of mass destruction terrorism: prepared combined statement before the House Armed Services Committee, Military Research and Development Sub committee." *Defense Viewpoint* (Mar 1999), 5

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²⁴ Institute of Medicine National Research Council. *Chemical and Biological Terrorism Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press, 1999, 166-167

²⁵ *Ibid.*, 171

Appendix B

Capability Assessment

	<i>State/Local</i>	<i>National</i>
Identification (overall)		
Detection		
Agent Identification		
Epidemiological Tracking		
Unity of Effort		
Command and Control		
Communication		
Planning		
Hazard Containment (overall)		
Residual Hazard Mitigation		
Quarantine/Isolation		N/A
Mass Prophylaxis		
Casualty Management (overall)		
Patient Treatment		
Worried Well Management		
Logistics		
Fatality Management		
Social Support Services		
Psychological Services		
On-going Communications		
Family Support Services		
Security		

Significant concerns and shortfalls
 Some concerns and/or limitations
 Adequate capabilities



Glossary of Acronyms

BW	Biological Warfare
CBIRF	Chemical Biological Incident Response Force
CCP	Crisis Counseling Assistance and Training Program
CDC	Center for Disease Control and Prevention
CISD	Critical Incident Stress Debriefing
CW	Chemical Warfare
DEEDS	Data Elements for Emergency Department Systems
DHHS	Department of Health and Human Services
DMORTS	Disaster Mortuary Operational Response Teams
DoD	Department of Defense
DoJ	Department of Justice
DPMU	Disaster Portable Morgue Unit
DRC	Disaster Recovery Center
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FRP	Federal Response Plan
HAZMAT	Hazardous Material
MMRS	Metropolitan Medical Response System
NBC	Nuclear, Biological, or Chemical
NDMS	National Disaster Medical Service
NPS	National Pharmaceutical Stockpile
PTSD	Post Traumatic Stress Disorder
USAF	United States Air Force
USAMRIID	U.S. Army Medical Research Institute of Infectious Disease
VA	Veterans Administration
VMI	Vendor Managed Inventory
WMDCST	WMD Civil Support Teams
WMD	Weapons of Mass Destruction

Glossary of Terms

Biological Agent A disease-producing microorganism (pathogen) or a poison produced through the activities of living organisms (toxin)

Crisis management. Incorporates law enforcement functions such as identifying and planning for the resources necessary to anticipate, prevent, and/or resolve a terrorism threat or incident. Consequence Management includes measures to respond to the medical and health needs, to prevent the spread of contamination, to restore essential government services and providing emergency relief to government, businesses and individuals affected by the consequences of terrorism

Consequence Management. Includes measures to respond to the medical and health needs, to prevent the spread of contamination, to restore essential government services and providing emergency relief to government, businesses and individuals affected by the consequences of terrorism.

Epidemiology the science of incidence, distribution, and control of disease in a population

Pathogen. A disease-producing microorganism

Prophylaxis Measures designed to preserve health and prevent the spread of disease

Toxin A poison produced through the activities of living organisms.

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