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Bioterrorisrn Preparedness of Rural Hospitals Compared to Urban Hospitals in Minnesota

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CERTIFICATE OF APPROVAL

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Abstract

Bioterrorism has been a threat to many cultures around the world for centuries. The first record of their use dates back to 184 B.C. in a battle between Hannibal and King Eumenes of Peranum. Within the past five years, the concern over biological weapons and bioterrorism has greatly increased in the United States because of worldwide political dynamics. Is the United States prepared for a bioterrorism attack? Is Minnesota prepared for an attack? These are important questions, and many experts have not agreed upon the answers. Currently there is no industry standard for hospitals in regards to bioterrorism preparedness. Utilizing data from a survey of Minnesota hospitals conducted by the Minnesota Department of Health in 2002, this study compared rural and urban hospitals in Minnesota and their level of bioterrorism preparedness. From the data, no overall statistical difference was found between rural and urban hospitals. It became clear, however, that there existed a need for improved preparedness in all Minnesota hospitals. Additionally, there was a need for an industry standard for minimal preparedness and the resources to help hospitals attain and maintain that level of preparedness.

Table of Contents

Chapter One: Introduction

There are different views regarding the need for our country, specifically our health care system, to prepare for biological weapon attacks. How prepared we should be is an important question that should not be ignored. The reality of the world confronts us everyday; terrorist attacks abroad and now at home affect the way we live our lives. What are the best uses of our nation's limited resources, especially in the health care industry? Should we put money into fighting terrorism directly or should we to try to prevent terrorism at its roots? Should we build our defenses at home? In preparing ourselves, do we decrease our risk of attack? Is it right to put money into defenses for an attack that may never occur? How likely is it that an attack will occur? These questions involve both personal beliefs and political views. There is no way to be certain of the right course to follow because we cannot predict the future.

Some experts feel that preparedness is a waste of limited resources. Cohen, Sidel and Gould (2001) believe that the need for preparedness is not a given. In an era of tight budgets, preparedness for an attack that may not occur is a "dangerous diversion of resources" (p.1423). They describe the call for preparedness as an unnecessary return to an era of fear that accompanied the cold war. They believe preparedness programs could do more harm than good by taking away from programs that deal with the health care problems the country is facing right now. They claim that the money would be better spent on preventing terrorism rather than on the worst possible outcome. However, many believe otherwise, thinking that all of our hospitals, rural as well as urban, need some level of preparedness for bioterrorist attacks. Margaret Hamburg (2002), vice president for Biological Programs at the Nuclear Threat Initiative, argues that to effectively

respond to a bioterrorist attack will require quick recognition and subsequent action at the local, state and federal levels. Dr. Ken Alibek (1999), former deputy chief of the Russian bioweapons facility Biopreparat, claims that a rapid response is pivotal in decreasing the number of casualties from a bioterrorist attack. He believes health care providers may have as little as one hour to detect and contain a deadly agent before the situation becomes uncontrollable.

The risk of an attack is unknown, and likely relatively low for any specific area. However, the risk exists, and the potential consequences from not preparing are catastrophic. This is demonstrated in an estimate from the United States Congressional Office of Technology Assessment, stating that from a single release of 100 kg of anthrax, between 130,000 and 3 million deaths could occur in a given area (Inglesby et al., 2002).

The threats to the United States (U.S.) from around the world and at home are real. Most Americans know this painfully from the September 11, 2001 attacks on the World Trade Center and Pentagon and the anthrax letters in the following months. Jones, Terndrup, Franz and Eitzen (2002) call these acts, *asymmetric* attacks. This type of attack is performed by a nation or non-state actor using biological weapons or other atypical weapons because they cannot fight equally with larger nations such as the U. S. Asymmetric attacks are popular with terrorist groups because they level the playing field and virtually anyone can produce the weapons needed.

Jessica Stern (1999), author of *The Ultimate Terrorist*, writing for *Emerging Infectious Diseases*, stated that there are currently three trends fostering bioterrorism. First, more terrorist groups are willing to take the political risk related to massively destructive events. Second, the availability of biological agents has increased. Finally,

the nature of the groups allows them to remain in secrecy. Simon (1997, p.428) summarizes the risk, "The first step is to accept the reality that we will not be able to prevent every act of BW [biological weapons] terrorism." Michael Osterholm (Osterholm & Schwartz, 2000, p. 188), former Minnesota State Epidemiologist, in his book *Living Terrors*, states, "Whatever we do, America will remain a uniquely compelling target for terrorists. But our lack of preparedness doubtless heightens our vulnerability to bioterror attack." These threats apply to everyone. Even Minnesotans are not immune from the possibility of attack. In 1995, two members of a Minnesota militia group tried to use a homemade biological toxin, ricin, to retaliate against local government officials (Danzig & Berkowsky, 1997). According to the U.S. Office of Technological Assessment, in 1995 there were at least 17 countries believed to have biological weapons. The countries included: Iraq, Iran, Syria, Libya, China, North Korea, South Korea, Egypt, Vietnam, Laos, Cuba, Bulgaria, India, South Africa, Russia, Israel, and Taiwan (Alibek, 1999). The political nature of many of these countries such as Iraq and North Korea makes the fact that they may have biological weapons more significant.

What would a bioterrorism attack look like? Would it be obvious to those being attacked? D. A. Henderson (1999), professor at Johns Hopkins University and former director of the World Health Organization's (WHO) program to end smallpox, described a potential biological attack, "The release could be silent and would almost certainly be undetected. The cloud would be invisible, odorless and tasteless" (p.1279). The agent could spread through an area without detection for days. It would likely not be discovered until patients became ill and visited their local health care provider or Emergency Department (ED) with an illness that few people are trained to recognize.

What needs to be done to become prepared is debatable, but many experts agree on the basic principles of preparedness. Schultz, Mothershead and Field (2002) described the fundamental aspects of bioterrorism preparedness as including a well-rehearsed plan, training and education, expansion plans for a surge of patients, knowing when and how to activate the plan and the use of an incident command system. The Centers for Disease Control and Prevention (CDC) emphasized areas of preparedness through program funding between 1999 and 2001. These areas included planning, surveillance, improved laboratory capacity, and training (Meyer & Morse, 2002).

In the small amount of work that has been performed on bioterrorism (BT) preparedness, results show a lack of preparedness. Wetter, Daniell and Treser (2001, p.710) found in their study of hospitals that they "are not prepared in an organized fashion to treat victims of chemical or biological terrorism." In a survey mailed to 61 different Emergency Departments in the Philadelphia area in June and July of 2000, Greenburg, Jurgens and Gracely (2002) found "the overall level of preparedness for hospital EDs responding to this survey was low…"(p. 273). Within Minnesota, there is less information regarding the level of preparedness. Currently, there are no published articles regarding the current ability of hospitals statewide to handle BT events.

How prepared is Minnesota? How prepared are it's communities for a BT attack? Society is very mobile today, with people driving farther to work each day. There are numerous commuters traveling from rural to urban areas everyday. The mobility that many enjoy puts the entire state at risk for bioterrorism, not just urban areas. Are the resources going towards preparedness in just the urban areas because more people live

there? The key question of this study is: how prepared are rural hospitals compared to urban hospitals in Minnesota for bioterrorist attacks?

Background to study

The use of biological agents as weapons dates back to 184 B.C. Preparing for a naval battle with King Eumenes of Peranum, Hannibal ordered his troops to fill clay pots with snakes and serpents. During the battle, Hannibal's soldiers threw the pots onto King Eumenes' ships, causing the enemy to deal with an additional threat, and subsequently leading to their defeat (Noah, Huebner, Darling & Waeckerle, 2002). During the Middle Ages, the Tartars surrounded the city of Kaffa. At the time of the attack, Tartar soldiers were being affected by the plague. In an attempt to turn this to their favor, soldiers were ordered to catapult cadavers into the city of Kaffa (Christopher, Cieslak, Pavlin & Eitzen, 1997).

Smallpox has been used many times historically as a biological weapon. During the French and Indian Wars of 1754-1767, Sir Jeffery Amherst gave blankets contaminated with smallpox to native Indians loyal to France. The result was the fall of Fort Carillon into English hands (Christopher et al., 1997). Smallpox was also used against Native Americans in the Ohio Region. In 1763, Captain Ecuyer of Fort Pitt gave smallpox contaminated gifts of blankets and a handkerchief to unknowing Indians, fearing their potential attack (Noah et al., 2002).

During the 1970's, covert assassinations were carried out using a powerful toxin called ricin, which is made from caster beans. The toxin was put into 1.7 mm metal pellets with a hole drilled through them. The pellet was covered with a wax that would melt at body temperature. These pellets were "shot" from spring-loaded umbrellas and

were successfully used in the assassination of Georgi Markov, a Bulgarian defector, and were tried again in an attempt on Vladamir Kostov, another defector (Christopher et al., 1997).

In the fall of 1984, in a small community in Oregon called The Dalles, 751 people were intentionally infected with Salmonella. On two separate occasions, followers of an Indian guru named Bhagwan Shree Rajneesh intentionally infected the salad bars at local restaurants with *Salmonella typhimurium*. Patrons of 10 different restaurants contracted the gastroenteritis-causing bacteria and became ill. During the criminal investigation, it was discovered that members of the religious commune had infected the patrons in an apparent attempt to affect local elections (Torok et al., 1997).

A well-publicized attack was carried out in March of 1995 by the religious cult Aum Shinrikyo. Members of the cult intentionally released sarin, a powerful nerve gas, into the Tokyo subway system. This attack resulted in 5500 visits to health care facilities, with over 1000 of the victims requiring hospitalization and 12 fatalities (Noah et al., 2002). The attack was carried out using umbrellas to punch holes into plastic jugs filled with sarin gas. In the following investigation it was revealed that the cult was also trying to create biological weapons from *Clostridium botulinum*, *Bacillus anthracis* and the Ebola virus. At the time of the attack, the cult had approximately 50,000 members worldwide with assets of $1.4 billion (Osterholm & Schwartz, 2000).

In 1996 at a Texas medical center, doughnuts and muffins intentionally laced with *Shigella dysenteriae* were anonymously left in a break room. Twelve staff members became ill with severe diarrhea. It was believed the bacteria likely came from the hospital's stock cultures (Kolavic et al., 1997).

Question to be answered

What is the level of preparedness for bioterrorist attacks in Minnesota hospitals in counties with populations under 50,000 people compared to counties with populations over 50,000?

Purpose of the study

No formal studies surveying Minnesota hospital preparedness for BT have been published to date. Because of the risks related to and the nature of bioterrorism, it is important for all hospitals in Minnesota to have some level of preparedness. An attack is possible anywhere in the U. S. As Osterholm & Schwartz (2000) point out, certain areas are at more risk than others, such as airports or large malls. Because of their design, they allow easy access to thousands of people who could spread an agent throughout the country. We live in a mobile society where an individual can be in the Chicago airport in the morning and home in a rural Minnesota farming community that evening. If this person is contaminated with a BT agent, they could possibly spread the infection to everyone he or she encounters, including their family and coworkers. The disease could spread until the problem was large enough to move into a "prepared" area and be correctly diagnosed and treated. It does not work to protect certain areas when all areas are so easily connected. It is important to understand the current level of preparedness for bioterrorism in Minnesota hospitals because critical improvements are likely needed. This information may help hospitals and policy makers to understand what the local and regional issues are for preparedness.

Definition of terms

Biological Terrorism (BT): a terrorist act that uses a biological weapon to cause mass physical harm or death.

Bioweapons / Bio-Weapons (BW): any weapon that incorporates a biological agent or disease (such as anthrax or botulism toxin) as an integral part of its destructive capability.

Chemical Weapon: any weapon that incorporates a chemical agent (such as sarin gas) as an integral part of its destructive capability.

HAZMAT: hazardous material

Rural: a population in a defined area (e.g. a county) under 50,000 people.

Terrorism: the FBI has defined terrorism as "… the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." (Osterholm & Schwartz, 2000, p. 31)

Urban: a population in a defined area (e.g. a county) that is over 50,000 people.

Weapons of Mass Destruction (WMD): any weapon such as a biological weapon, chemical weapon or nuclear device that is intended to cause massive mortality and morbidity.

Communication: communication capabilities and protocols for information exchange with the public and local, state and federal authorities.

Facility Drills: participation in bioterrorism drills and exercises.

Patient Isolation: the use of hospital space to adequately isolate patients with a communicable illness.

Personnel Management: plans for augmentation of personnel, including credentialing and supervision of non-facility healthcare providers.

Planning: the presence of plans and protocols for dealing with a bioterrorism scenario.

Protective Measures: the availability of vaccines, pharmaceuticals and personal protection equipment for patients and healthcare workers.

Staff Training: current level of training and access to training for healthcare workers.

Assumptions and limitations

Preparedness for chemical attacks was not addressed in this study because such attacks create a scenario that would not put the hospital as the likely first responder to the attack. As Khan, Levitt and Sage (2000) discuss, chemical attacks are more likely to be overt because the effects of chemical agents are known immediately. In a chemical attack scenario, a scene response team, such as Metropolitan Medical Response Teams (MMRT), with on-site decontamination capabilities, would be more appropriate than delayed decontamination and treatment at a hospital. Many of the present laws such as the Nunn-Luger-Domencini Amendment in 1997, have created rapid response teams such as the MMRT and others to deal with these attacks (Henderson, 1999). In addition, many hospitals already have hazardous material or chemical protocols in place in response to private and industrial use of chemicals. In short, hospital preparedness for chemical agents is an area that has some level of preparedness currently in place. Also, inclusion

of chemical weapons preparedness would have created a study too broad to focus on adequately.

The original survey inquired about the hospital's capability to respond to a bioterrorist attack. It is assumed that the person/persons who completed the original survey had adequate knowledge of the facility and were able to accurately describe the facilities capabilities and limitations. In addition, it was assumed that the original surveys were filled out truthfully, reflecting the facilities current level of preparedness and not it's projected level. Reporting bias of respondents may have caused a higher level of preparedness to be reported than what was actually in place.

This study was limited to the number of facilities that returned the requested information. It is not a true population study because all hospitals in Minnesota were not asked to participate. The study was also limited by the questions and categories covered in the original survey, the *Hospital Assessment Survey for Biological Emergencies*. The original survey may not have adequately covered all areas of preparedness, nor allowed accurate response options to reflect current preparedness levels.

The following chapters will review the history of BT from its origins to current threats. The methods used in gathering the data from the *Hospital Assessment Survey for Biological Emergencies* will be explained along with the results of that data. Biological terrorism is a complicated subject matter that has been in existence for hundreds of years. In today's complicated political climate, BT has become a dangerous threat that should be addressed in one way or another. To face this threat we need to understand what the threat is as well as our current capability to face that threat to know if and where improvements need to be made. There currently is insufficient published data regarding

the ability of Minnesota hospitals to face the threat of BT. This study looks to add information to the field of BT preparedness and aid in the understanding of what needs to be accomplished in Minnesota hospitals for them to become as prepared for BT as possible.

Chapter Two: Review of Literature

Introduction

After review of various databases, including PubMed, WebMD and MedlinePlus, information related to bioterrorism preparedness in hospitals is summarized below. Keywords searched were: bioterrorism, bioterrorism and preparedness, bioterrorism preparedness, biological terrorism, weapons of mass destruction, hospital preparedness, hospital preparedness for bioterrorism, local preparedness for bioterrorism.

The following are major contributors to the field of bioterrorism preparedness:

D. A. Henderson is a professor at Johns Hopkins University. He directed the World Health Organization's (WHO) global eradication of smallpox form 1966–1977, helped initiate the WHO's global immunization program in 1974, and was deputy assistant secretary and senior science advisor in the Department of Health and Human Services. He has been active in educating the world about the threat of bioterrorism through numerous articles.

Dr. Ken Alibek, formerly Kanatjan Alibekov, was born in Kazakhstan in 1950 and trained to become a physician in the Russian army. He eventually gained PhDs in microbiology and biotechnology. He was deputy chief of the Russian bioweapons facility Biopreparat from 1988–1992. In 1992 he defected to the U. S. and has shed light on the extent of the Russian bioweapons program, testifying before Congress numerous times.

Michael Osterholm, former Minnesota State Epidemiologist, is a recognized leader around the world in the field of infectious diseases. He was the personal advisor to

the late King Hussein of Jordan and is now the director of the Center for Infectious Disease Research and Policy at the University of Minnesota.

Agents

Biological attacks may be noticed in one of two ways. Recognition of the symptoms related to a potential biological weapon is the basis for *syndrome-based criteria.* Waiting for laboratory confirmation in certain instances, such as a smallpox attack, may not be practical in the isolation and treatment of some bioweapon diseases. The second way an attack may come to light is through *epidemiologic features.* Certain epidemiologic presentations may indicate a covert BT attack, such as a rapid increase in patients with fever, respiratory or gastrointestinal problems (English et al., 2002).

The CDC has categorized potential biological weapons agents into three categories (A, B and C) based on ease of transmission or dispersal and the threat to public health. Category A agents are the top priority and are considered a threat to national security. These agents are: anthrax (*Bacillus anthracis*), botulism (*Clostridium botulinum* toxin), plague (*Yersinia pestis*), smallpox (*Variola major*), tularemia (*Francisella tularensis*) and viral hemorrhagic fevers (English, et al., 2002). Of these agents, Henderson (1999) states that anthrax and smallpox currently pose the greatest and most likely threat. In 1994, Anatoliy Vorobyov, a Russian bioweapons scientist, informed the National Academy of Sciences that Russian scientists felt smallpox was the most likely agent for BT attacks, followed by anthrax and plague (Henderson, 1998).

The history and threats associated with anthrax and smallpox are more widely documented than the other four Category A agents on the CDC's list. This is likely due to the fact that they are thought to be the most likely agents used and potentially the most

dangerous. This fact alone could make the other agents such as botulism and plague more attractive to terrorist groups because of their designation as unexpected agents. However, with the ease of transmission, ease of attainment and high fatality rates associated with anthrax and smallpox, they still remain the most feared and most likely agents used by terrorist groups. A review specific to these two diseases follows.

Smallpox. Between the years 1901 and 2001, nearly 500 million people have died from smallpox. This is more than from all war-related deaths, the Spanish Flu of 1918 and all AIDS related deaths combined in the same time period (Osterholm & Schwartz, 2000). Smallpox is so contagious that in the past, separate hospitals have been used for isolation of smallpox patients due to its communicable nature (Henderson, Inglesby, et al., 1999).

In aerosolized form, smallpox can survive for 24 hours and is highly infectious in small quantities. There are an estimated 10 secondary cases for each index case of smallpox (Henderson, 1999). In modeling a smallpox attack with 100 initial victims, Meltzer, Damon, LeDuc and Miller (2001) showed that it would take up to one full year for a combination of vaccination and quarantine to end the outbreak. Additionally, from the initial 100, approximately 4200 cases of smallpox would result if all measures to contain the outbreak were taken immediately. From the 4200 subsequent cases, at least 1260 people, or 30%, would have a fatal outcome (Henderson et al., 1999).

The capacity of smallpox to spread has been shown in two specific outbreaks. In Germany in 1970, an electrician became ill shortly after traveling to Pakistan. He was soon diagnosed with smallpox, hospitalized and isolated in a special hospital designed to house patients with communicable diseases. From his infection, 19 cases of smallpox

occurred, within a population of well-vaccinated citizens (Wehrle, Posch, Richter & Henderson, 1970). In Yugoslavia in 1972, from one index case, 11 friends and family members became ill. Their physicians did not diagnose the initial illnesses as smallpox until four weeks after the first person became ill. At that point, 150 people were infected with the virus. The country launched a control campaign resulting in the vaccination of twenty million people. In addition, 10,000 people were isolated and held under military guard for two weeks. In the end, 175 cases were confirmed with 35 fatalities (Henderson, 1998).

The U. S. stopped vaccinating people against smallpox in 1972. According to the *U.S. Census Bureau* (n.d., *Age: 2000.* Retrieved November 3, 2002), approximately 42% or 118 million of the U. S. population is under the age of 30 and have not been vaccinated for smallpox. O'Toole, Mair, & Inglesby (2002, p. 4) described the level of immunity that carries through to today by stating, "an estimated 228 million U.S. citizens would be expected to be highly susceptible to smallpox infection." Henderson (1999) estimated that 20% or less of the population is protected against smallpox. With the advent of a vaccine, historically, an average of 2155 vaccines were given for each case of smallpox. This would indicate that a supply of 40 million doses would be needed to cover one outbreak of smallpox (Meltzer, Damon, LeDuc & Miller, 2001). The U. S. currently holds 15.4 million doses of smallpox vaccine through the CDC (O'Toole et al.).

Smallpox has an insidious onset. After 12–14 days of incubation the victim will initially develop symptoms such as high fever and malaise. The prodrome is followed by a rash, which becomes vesicular, then pustular. It is at this stage that patients transmit the virus to those around them. These patients will need isolation suites with negative

airflow or need to be isolated in separate facilities. Mortality, often due to toxemia from circulating immune/antigen complexes, is approximately 30% and usually occurs two weeks after the onset of illness. At this time, there are no effective treatments other than supportive therapy along with antibiotics as needed for secondary infections (Henderson et al., 1999).

Currently there are two repositories for the smallpox virus that are sanctioned by the World Health Organization. One of them is in Koltsovo, Novosibirsk at the Russian State Research Center of Virology and Biotechnology. The other is in the U. S., at the Centers for Disease Control and Prevention in Atlanta, GA (Henderson, 1999). These are the only facilities that are legally allowed to contain and perform research on the smallpox virus.

Anthrax. Anthrax is a disease caused by *B. anthracis,* a naturally occurring bacteria that typically affects herbivores. Humans may become infected with anthrax in three different ways, via cutaneous, gastrointestinal or inhalational routes. The usual route for human infection is through cutaneous contact with an infected animal or animal product that is contaminated with the bacteria. Cutaneous contact usually manifests as a black skin lesion. With antibiotic treatment, mortality is rare. Gastrointestinal anthrax is relatively rare, with few reported cases to draw information from. It comes from the ingestion of under-cooked meat infected with the bacteria. Mortality is estimated to be similar to that of inhalational anthrax. Inhalational anthrax is the most serious of the three, with a mortality rate of almost 90%. Between the years 1900 and 1976, there were only 18 cases of inhalational anthrax reported in the U. S. The illness has two stages. The first, lasting hours to days, presents with vague symptoms such as fever, cough,

headache, vomiting and chest pain. The second stage comes with the sudden onset of fever, sweating, difficulty breathing and shock. Almost one half of patients affected will develop hemorrhagic meningitis with eventual delirium and obtundation (Inglesby et al., 2002).

Anthrax is relatively easy to produce and is very stable in its desiccated form. The danger of inhalational anthrax came to light in an incident at a Russian bioweapons factory in Sverdlovsk in 1979. From an accidental release of anthrax spores, 77 people contracted the illness and 66 of them died (Noah et al. 2002). It was estimated that the release of an amount as small as a few milligrams of aerosolized anthrax could have caused the illnesses at the factory (Meselson et al., 1994). A release of anthrax spores, such as an attack or the factory incident, would be invisible, odorless and able to travel several kilometers before it would no longer be a threat (Inglesby et al., 2002).

In the fall of 2001, on the east coast of the U.S., an unknown party mailed letters containing *B. anthracis* to various locations. This attack resulted in 22 cases of anthrax, of which 11 were cutaneous cases and 11 were inhalation cases. Of the 11-inhalation patients, five died. The Aum Shinrikyo cult, the group responsible for the 1994 Tokyo subway sarin attacks, reportedly tried to disperse anthrax and botulism at least eight different times in Tokyo (Inglesby et al., 2002).

The average time between onset of symptoms and death is three days. With this rate of infection, early administration of antibiotics is pivotal. Currently the only medications approved by the FDA for inhalation anthrax are penicillin, doxycycline and ciprofloxacin (Inglesby et al., 2002). The fatality rate of inhalational anthrax is over 80% (Henderson, 1999) and cases have been reported to occur between two and 43 days after

exposure to *B. anthracis* spores. Optimal protection against the disease for exposed individuals is thought to be vaccination with the anthrax vaccine and co-administration of antibiotics for 60 days. Prophylactic vaccination has been used by the armed forces. The anthrax vaccine has questionable safety, however, and current stocks in the U.S. are too limited to be used widely. Therefore, currently the best treatment for exposure is the administration of antibiotics (Inglesby et al.).

Threats

Noah et al. (2002) describe that the viability of a threat stems from a combination of the ability of a country or terrorist to produce an effective weapon, the mindset or intent to use that weapon and the target's vulnerability to that weapon. According to Michael Osterholm (2000), a successful biological weapons laboratory could be set up in anyone's basement using equipment from a high school or college lab and supplies that are available through catalogs. This is in agreement with Danzig and Berkowsky's (1997) claim that an inexpensive, effective weapon could be created by virtually anyone with a background in biology. They stated that there are even plans and recipes for biological weapons on the Internet. Osterholm & Schwartz (2000) discussed the variety of current threats, stating that they may come from countries such as Iraq, terrorist groups such as Al Qaeda or *lone wolf* or *cowboy terrorists* such as Timothy McVeigh or Ted Kaczynski. In 1997, the FBI filed 27 bioterrorist threats; in 1999, the number had increased to 187 (Noah et al., 2002).

It takes more than a deadly organism to create a biological weapon. Zilinskas (1997) described a biological weapon as four parts that need to work smoothly together—the payload (the organism or agent), the container that houses and protects the

organism (munitions), the method of delivery (rocket, airplane, etc.) and the mechanism to spread the payload (sprayer, an explosion, etc.). Simon (1997) stated that the most likely method of a biological attack would be through aerosolization of an agent, such as anthrax or botulism spores. A deadly but stable cloud of microscopic particles would be created. This could be accomplished using crop dusters, trucks with spray tanks, or small canisters, which could be placed anywhere and are timed to release the agents. Using an explosive device to deliver the spores would destroy much of the payload, making such a weapon less effective. In 1993, the Office of Technological Assessment released a report stating that a small airplane spreading 100 kg of anthrax would be more deadly than a missile carrying a hydrogen bomb (Office of Technology Assessment, 1993). The anthrax could potentially kill one to three million people in a 300 square mile area around Washington D.C. (Osterholm & Schwartz, 2000).

After the fall of Russia, many truths came to light in regard to their bioweapons programs. The largest facility, called Vector, was located in Koltsovo, Novsibirsk. It encompassed 30 buildings and employed up to 4000 people. The facility worked with smallpox, Marburg, Ebola and other hemorrhagic viruses trying to turn them into weapons (Henderson, 1999). At one point in 1990, the facility was capable of creating nearly one hundred tons of smallpox per year (Alibek, 1999). With the breakdown of the Russian system, there has been a migration of scientific knowledge regarding biological weapons. Dr. Alibek (1999) claims in his book *Biohazard* that he has personally heard of five former Russian bioweapons scientists now working in Iran, a country feared to have an active biological warfare program (Noah et al., 2002). Henderson et al. (1999) stated that there were rising concerns about the spread of materials and knowledge from

Russian facilities into foreign hands due to massive cutbacks in funding for Russian laboratories. Currently in Russia, biological weapons are available for sale to anyone wanting to buy them. A company in Moscow called Bioeffekt Ltd. offers three different strains of tularemia for sale (Alibek, 1999). This is an agent the CDC defines as a category A agent, one that could threaten national security. In 1998, there were roughly 450 repositories of various biological agents worldwide, of which over 50 sold anthrax, 34 sold botulism producing bacteria and 18 sold plague bacteria (Osterholm & Schwartz, 2000).

Dr. Osterholm shared his view regarding the anthrax letters sent in October 2001 in an open forum discussion at the University of Minnesota (Osterholm & Miller, 2002). He said the frightening aspect of the anthrax letters was the fact that the perpetrator(s) have not been caught. It is not known if it was someone within the U.S. or a foreign actor who had carried out these attacks. To make the situation worse, in all likelihood the attackers have more anthrax remaining. He stated, "A person does not make just one cookie, they make a whole batch." In an article from the Washington Post (Gugliotta and Matsumoto, 2002, p. A6), experts voiced their belief that it would require the resources of a country and not a lone attacker to carry out the anthrax letter attacks of the fall of 2001.

With the resolution of the Gulf War, members of the Iraqi military admitted to creating a bioweapons program. They acknowledged producing *Bacillus anthracis,* aflatoxin and the botulinum toxin, all to be used in bioweapons. Eight thousand liters of anthrax were produced, of which 6000 liters were used to fill weapons. Twenty thousand liters of botulism toxin were produced, 12,000 liters of which were used in weapons and weapons testing. The Iraqi military deployed an arsenal including 25 SCUD missiles and

200 bombs, all containing either botulinum toxin, anthrax or aflatoxin. In addition, they outfitted a MIG-21 fighter jet, piloted by remote control, with a 2200 L storage tank and spray mechanism (Zilinskas, 1997). At the same open forum discussion with Dr. Michael Osterholm, Judith Miller, a Pulitzer Prize winning columnist for the New York Times and author of the bestselling book *Germs*, stated in regard to the Iraqi leader Saddam Hussein, "He does have biological and chemical agents… There is a large chance that he would use these weapons" (Osterholm & Miller, 2002).

History of Preparedness

Global. The first attempt at diplomatically controlling biological weapons came in 1925. It was through the 1925 Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare. The protocol did allow for research and production of biological weapons, but did not allow their use during war. It was not until 1975 that the U.S. finally ratified the Geneva Protocol. The protocol did little to curb the propagation of biological weapons, however. This was shown with Japanese biological weapons research between 1932 and 1945. This research caused the death of 10,000 prisoners as they studied anthrax, the plague, meningitis and other agents (Christopher et al., 1997).

In 1972, over 140 nations came together again to halt the proliferation of biological weapons. This was part of the Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological and Toxin Weapons and their Destruction, also called the 1972 Biological Weapons Convention. The agreement was ratified by at least 140 of the participating countries. In 1975, the agreement went into effect, however, it soon became clear that there were problems with the treaty.

Monitoring and enforcement became problematic. Soon after ratification, Russia knowingly began violating the agreement via their civilian biological warfare organization called "Biopreparat." Many other countries were suspected of doing the same (Noah et al., 2002).

National. The initiation of an offensive bioweapons program in the U.S. came in 1942 at Camp Detrick, Maryland, with additional testing facilities in Mississippi and Utah. At Camp Detrick, tests were conducted on Bacillus anthracis and Brucella suis. Eventually 5000 bombs were filled with B. anthracis at Camp Detrick. In 1969, President Nixon changed U.S. policy on biological weapons by terminating the programs. In addition, he initiated a defensive program that ultimately became the U.S. Army Medical Research Institute of Infectious Diseases or USAMRIID (Noah et al., 2002).

In 1995, Presidential Decision Directive 39 (PDD-39) was issued in response to terrorist actions. The full document is classified, but reports say it addresses ways to stop terrorist acts proactively and methods of responding to terrorist attacks. Critics, however, describe the directive as unclear and not helpful in dealing with an actual crisis (Osterholm & Schwartz, 2000). In 1996, the U.S. government passed a law that required companies selling biological agents to check the identity of potential buyers to ensure that the use was for research (Alibek, 1999). The FBI is in charge of crisis management and investigation in relation to BT attacks within the U.S. As part of the Nunn-Luger-Domencini Amendment in 1997, the Office of Emergency Preparedness has trained Metropolitan Medical Response Teams (MMRT) in 120 cities. These are teams of first responders that can rapidly respond to a biological attack. Also, the National Guard is

training 10 Rapid Assessment and Initial Detection Teams with 22 full-time members that are able to mobilize quickly to an affected area (Henderson, 1999).

In 2000, the U.S. government spent $8.4 billion on counter-terrorism programs, of this, $315 million was spent in the U.S. for BT preparedness training. Of the $315 million, 6% or $18.9 million went to the public health systems across the country (Miller, Engelberg & Broad, 2002). In 2002, the CDC made available $918 million as part of its Public Health Preparedness and Response for Bioterrorism program. This money went toward local, regional and interstate preparedness for bioterrorism (Centers for Disease Control and Prevention, 2002).

The CDC has also created a National Pharmaceutical Stockpile (NPS) Program. This program would supply vaccines, antibiotics and other medical supplies to any region within the U.S. in case of an attack. These supplies are placed into *12-hour Push Packages* that could arrive anywhere in the U.S. within 12 hours of notification. In addition, a group of technical advisors called a Technical Advisory Response Unit will accompany the first shipment. This program is in place and was activated with the attacks on September 11, 2001 (Centers for Disease Control and Prevention, n.d.).

There are currently 15.4 million doses of smallpox vaccine available in the U. S. One hundred and fifty-five million new vaccine doses have been ordered by the government and were to be delivered in the fall of 2002 (Jones et al., 2002).

The CDC is creating a national Laboratory Response Network (LRN) that will allow for rapid referral and training. Hospital laboratories can become part of the LRN. There are four levels of capabilities, A through D. Level A laboratories would have general rule-out capabilities for most biological agents and are located in many hospitals.

Laboratory capabilities increase as the level increases. Currently there are two laboratories, level D, which are capable of Biosafety Level 4, with the highest level of safety and detection. One is located at USAMRIID and the other is at the CDC's National Center for Infectious Disease in Georgia (Jones et al., 2002). Regional involvement in this network would be a key feature in a region's preparedness.

Region. A series of community meetings addressing preparedness needs for terrorism involving the Minnesota Hospital and Healthcare Partnership, Minnesota Department of Health, Minnesota State Emergency Medical Services Regulatory Board and Minnesota Local Public Health Association were conducted between December 2001 and January 2002. In these meetings, a number of areas for improvement were cited, including training, communication systems, planning, command control, drills and pharmaceutical supplies (Minnesota Department of Health, 2002).

In 2002, the Minnesota Department of Health received $16 million from the CDC for the preparedness needs of local and state public health agencies. These funds will be used for preparedness assessment, surveillance capacity, laboratory capacity, public information, training, communications and the Health Alert Network (HAN). Over $5 million will be distributed to health departments at the local level (Minnesota Department of Health Fact Sheet, 2002a). Also in 2002, The Health Resources and Services Administration (HRSA) gave the Minnesota Department of Health $2,155,835 for its Hospital Bioterrorism Preparedness Program. This program divided the state into eight regions. In each region, a plan must be developed to support a surge of 500 patients from a BT attack (Minnesota Department of Health Fact Sheet, 2002b).

Why hospitals are on the front lines

Previous approaches to preparedness for terrorist attacks assumed that there would be a "scene" to respond to and therefore a need for a response team. This was the thinking behind much of the funding thus far for BT. The Nunn-Luger-Domencini Amendment supplied $50 million for training of on-scene first responder teams. However, this type of funding may not help with response to a bioterrorist attack. Alibek (1999, p. 283) describes one of the problems, "...it assumes an identifiable scene of attack; biological weapons will most likely be deployed in secret and leave no trace." Miller et al. (2002, p. 232) point out that this type of first responder training is "...worthless against anthrax or smallpox. In a germ assault, there would be no 'scene' at which experts could converge."

The rate of onset of illness is a major factor dictating whether hospitals will be the first to receive victims of a BT attack. For a person exposed to a biological agent the onset of illness is delayed, ranging from days to weeks. Depending on the agent used, the distribution is potentially very wide with BT. Agents such as smallpox can be transmitted person to person outside of the initial attack zone. The people who respond first to a biological attack will be health-care workers in hospitals and emergency departments (EDs). Victims will develop a severe illness and present to their local ED or primary provider days to weeks after they were exposed to a biological agent (Osterholm & Schwartz, 2000).

Logistical factors also play a role in why hospitals should be relied on to be the front line. Vaccines and antibiotics will be needed in mass quantities because of the potential for 10 secondary cases of illness for each primary victim (Henderson, 1999). In

addition, patient isolation may play an enormous role in mortality and morbidity for biological weapons that are communicable, such as smallpox and plague. Smallpox is so communicable that patients need isolation rooms with special airflow to limit the risk of exposing more people (Henderson et al., 1999).

In many of the articles published to date, there is agreement that hospitals will likely be the first place victims of BT will be seen. According to Schultz et al. (2002) and Henderson (1998), the ED and the emergency physician are key players in recognition and management of victims in a bioterrorist event. They claimed that how well a facility responds to an event such as BT depends on the level of preparedness of the hospital and the staff. Treat et al., (2001) and Miller et al. (2002) discussed similar beliefs, claiming hospital physicians and nurses will likely be the first to encounter victims of BT attacks due to the nature of biological agents. Finally, the CDC Strategic Planning Workgroup discussed that primary health providers will be the initial people to see the effects of a BT attack and therefore should be prepared (Khan et al., 2000).

Opposition

There are some who disagree with the philosophy of expending resources to prepare for possible BT attacks. Sidel, Cohen and Gould (2001) discussed the possibility that preparedness and research into preparedness could trigger another arms race, this time in biological weapons. They say people are being misled by preparedness policies. The risks right now are only hypothetical with no explicit data to support them. Sidel et al. (2001, p. 716) state, "Preparedness does not make sense without an estimate of risk." They claim that other authors are over estimating the current level of risk of BT. In an

article for the *American Journal of Public Health*, Cohen, Gould and Sidel (1999) estimated the risk of a catastrophic BT attack at next to zero.

Geiger (2001) addresses current real costs in the U.S. as opposed to hypothetical numbers concerning the possibility of BT. Currently, diseases stemming from food-borne illnesses have 76 million victims and 5000 deaths per year. Chemical releases such as spills or explosions result in 60,000 victims and cause over 300 deaths each year. These are real problems that affect our nation now. He states, "With limited resources, the public health community needs to set its priorities with care" (p. 709).

Henderson (1998) poses four common points policy makers and citizens have used to not move forward with preparedness. First, biological weapons have rarely been used in the past, and it is likely that they will continue to not be used. Secondly, they are such an abhorrent weapon that no one would actually use them. Third, the technology to produce a working weapon is out of reach of most laboratories. Finally, they are so dangerous and deadly that no one could rightly use them. He continues in his article to discuss how all of these beliefs are false.

Need for preparedness

Is there a need for preparedness? Are hospitals currently able to manage a BT attack? What could happen if hospitals were not prepared? The Minnesota Department of Health described bioterrorism as "low probability, high consequence" and "consequences of such an attack could be devastating, and thus, there is a need for preparedness." (Minnesota Department of Health, 2001, para. 2). They go on to state that the best protection from BT is to have "a strong and prepared public health system..."(para. 8).

In 1997, the economic impact of an attack against a city of 100,000 (assuming 50,000 exposures and 32,875 deaths) was estimated to be $26.2 billion for anthrax (Kaufmann, Meltzer & Schmid, 1997). The authors concluded that preparedness would reduce the probability of an attack. Jones, Terndrup, Franz and Eitzen (2002) also discussed that the ability to detect rapidly and respond adequately to a bioagent could help deter a terrorist attack.

Henderson (1998, para. 25) expressed his view on the level of preparedness, "We are ill-prepared to deal with a terrorist attack that employs biological weapons." He discussed the need for a standard approach among hospitals in treating victims of BT. He states that hospital personnel dealing with these patients on the front lines, such as ED physicians and nurses, need to be familiar with potential agents and their subsequent isolation and infection control needs. Lack of knowledge can lead to increased mortality rates, as shown in a 1972 outbreak in Yugoslavia. There, from one index case of smallpox, 175 cases of smallpox and 35 deaths occurred because the diagnosis of smallpox was missed initially (Henderson, 1998). In a later article, Henderson (1999) addressed BT preparedness, claiming there are needs for: training of primary care and ED physicians in early detection of BT agents, training of laboratory personnel for identification of BT agents and improved vaccines in higher quantities.

Personnel are not consistently trained in how to respond to victims of BT attacks. Between 1998 and 1999, almost 6000 people in the United States were victims of anthrax hoaxes. The responses to these threats varied greatly. In some cases, patients were not treated and were told to go home by scene personnel. In other incidents, people were made to disrobe and bathe with a bleach solution in portable hazardous materials

showers. In one case, the level of care varied numerous times; patients went through two pre-hospital decontaminations, and a third decontamination at the hospital. At the hospital, the same patients were sent home without chemo-prophylactic therapy (Keim & Kaufmann, 1999).

Khan et al. (2000) discuss the need for response time to be brief, especially with smallpox. This is due to the small window of time between initial victims and subsequent secondary victims from contact with those infected. Early identification of an attack and what agent was used could mitigate the spread of the disease through prophylaxis treatments and vaccination. If this does not occur, there could be multiple waves of infections that could quickly spread worldwide (O'Toole et al., 2002). Lack of preparation would lead to the health-care system becoming quickly overwhelmed (Khan et al., 2000) and virtually ineffective.

In 2000, a large exercise called TOPOFF was conducted, testing governmental response to a simulated bioterrorism attack on the U.S. The results showed that community hospitals would be unable to respond adequately to such an attack. In the simulation, hospitals were theoretically understaffed, ran out of supplies and medicine and were overwhelmed by patient numbers (Inglesby, Grossman & O'Toole, 2000).

In the summer of 2001, a senior level exercise was held to simulate a covert smallpox attack on the U.S. It was called "Dark Winter" and was put together by the Johns Hopkins Center for Civilian Biodefense Strategies along with the Center of Strategic and International Studies, the Analytical Services Institute for Homeland Security and the Oklahoma National Memorial Institute for the Prevention of Terrorism. It examined senior level policy makers when confronted with a bioweapons attack. The

exercise showed that policy makers were unfamiliar with the seriousness and possible consequences of a bio-terrorist attack; that insufficient drug and vaccine supplies (at the current level) greatly hindered an adequate response; health-care systems were unprepared to deal with the potential level of casualties; and there were conflicts between state and federal priorities (O'Toole et al., 2002).

What has been studied

What is the current level of preparedness of hospitals? In Minnesota there have been no published reports on hospital preparedness. Nationally, however, some studies have been conducted. Wetter et al. (2001) studied preparedness in hospitals (N=186) in four northwestern states. They showed less than 20% of responding hospitals had plans in place to deal with victims of biological or chemical attacks. Overall, they found levels of preparedness low in the areas examined—planning, awareness of staff, training, supplies and physical resources. Rural hospitals were shown to be less prepared than urban hospitals in certain survey questions. Urban hospitals were three times more likely to have BT response plans in place than rural hospitals. Urban hospitals were also more likely to have decontamination units, appropriate protective equipment, and drugs to treat chemical attacks. Overall, the study showed rural hospitals were less prepared than already inadequately prepared urban hospitals. They concluded that reduction in the loss of life due to biological terrorism would come from preparedness at the local level. This is the largest, most complete study published to date regarding the level of preparedness of hospitals. It gives valuable information on the current state of preparedness of rural and urban hospitals. This study is the most often cited in discussions about BT preparedness.

Case, West and McHugh (2001) surveyed 10 hospitals in central New Jersey. They showed that 50% of laboratories were able to identify smallpox and 70% could identify anthrax. Ninety percent of respondents stated that one fifth or 20% of their ED staff had training related to casualties of biological terrorism. All hospitals had negative airflow rooms with special ventilation systems. Sixty-seven percent had protocols to deal with biological and chemical terrorism and 80% had conducted at least one drill related to a bio-weapons attack. Finally, 60% of hospitals had chemical protective suits for ED staff. The study also showed, based on the 10 responses, no statistical differences in response between rural and urban facilities. Overall they found that hospitals "would be able to deliver only the basic services to a limited number of victims" (p. 31). The design of this study mirrored the Wetter et al. study of 2001 with some modifications. Because of the small size of this study it is difficult to draw solid conclusions from its results. However, the findings are interesting in that they differ from most studies of preparedness, finding a majority of hospitals having some level of preparedness.

Treat et al. (2001) surveyed 30 (22 rural and 8 urban) hospitals in Federal Emergency Management Agency (FEMA) Region III on the east coast of the U.S. The study was based on a convenience sample of 40 hospitals with interviews of ED staff investigating their perceived levels of their hospital's preparedness. It showed overall that hospitals were not prepared to handle events caused by weapons of mass destruction (WMD). In dealing with large influxes of patients and levels of staff training, hospitals were found to be inadequate. Overall, only 27% had incorporated WMD planning into their hospital disaster plan. Of the 22 rural hospitals, all responded that they had no overall level of preparedness for biological terrorism. This study shed some light on the

problem, but did not represent directly the level of preparedness due its methodology. It was a convenience study asking for the staff's perception of preparedness. This perception may be positively or negatively affected by many factors such as current job satisfaction or interest in accurately completing the survey. However, it directly surveyed the people who would most likely respond to a BT attack, and they were the people who needed to be prepared.

Greenburg, Jurgens, and Gracely (2002) studied 62 Philadelphia hospitals. Almost 67% of the responding EDs had written protocols in place for evaluating and treating victims of bioweapons. Of those surveyed, 29.6% had not conducted drills specific to biological and chemical threats and 9.3% did not know if they had. Just over 61% did not have protocols for contacting proper authorities in case of a suspected attack and 61.1% did not have protocols for post-exposure prophylaxis treatment for staff members exposed to agents. This is a strong study with thorough methodology. The study surveyed aspects of preparedness that many authors agree are pertinent.

Chen, Hicker, Fink, Galliher and Burstin (2002) surveyed 976 family physicians and their perceptions about BT preparedness. Approximately 63% of the physicians responded to the survey. Of the respondents, 95% felt that BT within the U.S. was a genuine threat. Less than 17% felt that their local health care system could adequately respond to a BT attack. Eighteen percent had training in BT preparedness and 26% felt they knew what to do in case of an attack. The authors concluded that more training was needed for physicians in regard to BT preparedness. This study provided good insight into the reality of what is believed could be realistically done to respond to a BT attack in the U.S.

These studies illustrated that across the U.S., hospitals generally were not prepared for bioterrorist attacks. Wetter et al. (2001) is the most often cited study among articles regarding BT preparedness. It is often regarded as an accurate portrayal of the current level of preparedness. Of the studies, only three offer any data regarding preparedness of rural hospitals. These studies, Wetter et al. (2001), Treat et al. (2001), and Case et al. (2001), all agreed that hospitals, both urban and rural, need to be better prepared for BT attacks. Case et al., however, in their study of 10 hospitals, found no statistical difference between urban and rural New Jersey hospitals in their levels of preparedness. There may be many reasons for this discrepancy such as higher regional awareness of BT risks. Conversely, Wetter et al. and Treat et al. both show significantly lower levels of preparedness of rural hospitals compared to urban.

In all, this review of the current studies illustrates the need for further studies. There are currently few studies on hospital BT preparedness and fewer that look at differences between rural and urban hospitals. The lack of information is more evident in Minnesota because there are no published studies on this issue.

How prepared should we be?

Currently there is no consensus on what preparedness should include or what a minimal level of preparedness for healthcare facilities entails. Wetter et al. (2001) define minimum preparedness as follows:

> 1) A hazardous materials or chemical weapons plan; 2) either (a) an ED indoor area with isolated ventilation and a shower with water containment or (b) an outdoor portable decontamination unit; 3) at

> least 1 self-contained breathing apparatus or supplied air-line respirator; and 4) at least 1 chemical-protective garment. (p. 2)

Greenburg et al. (2002) developed a minimum level of preparedness for biological and chemical weapons, because no specific criteria had been published at the time. These criteria included: 1) one or more trained physicians on staff trained in management of victims of bioweapons, 2) decontamination capabilities 3) written protocols for evaluation and treatment of casualties 4) written agreements with other agencies for cooperation 5) participation in drills related to bioweapons attacks 6) appropriate levels of supplies.

In the Case et al. (2001) study of preparedness in New Jersey hospitals, they stated that planning should include: training, proper equipment for personnel, care plans for victims, medication and supply stockpiles, and protocols for agent identification. As part of Michael Osterholm's broader plan for preparedness, he included: creating a usable stockpile of vaccines and pharmaceuticals, increasing hospitals surge capacity, strengthening the public health system, clearly defining federal, state and local roles, and performing real life drills (Osterholm & Schwartz, 2000). Schultz et al. (2002) chose nine basic components for an adequate response plan to bioterrorism. They are: "Activation and notification; Facility protection; Decontamination; Expansion of services and alternative care sites; Supplies and logistics; Staff education and training; Command and control; Coordination and communication; Recovery issues" (p. 442). Jones et al. (2002, p. 515) state, "...aspects of preparedness include logistic concerns such as infrastructure, including hospital beds, quarantine facilities, and stockpiling of pharmaceuticals and supplies."

The American Hospital Association (AHA) recently made recommendations for bioterrorism preparedness. A key aspect of this was the issue of staffing. The group suggested: the identification of *reserve staff*, people who are trained but no longer working in healthcare; advanced jurisdiction agreements for physicians and nurses letting them practice in other areas during emergencies; and plans to support the families of staff members needed during emergencies (Bentley, 2001).

Local, state and regional resources should be included in the planning process for each hospital (APIC, 2002). Greenburg et al. (2002, p. 277) stated that written policies for evaluation and treatment are essential for "functional preparedness plans." If there is a large-scale exposure, hospitals should have advanced planning on how they will triage and deliver care. This should include: good communication networks, established hierarchy of authority, cancellation of non-emergent care, sources for additional supplies, methods to efficiently evaluate and discharge patients, and discharge instructions for non-contagious patients (English et al., 2002).

On a national level for preparedness, the CDC has created five areas of focus for assistance in dealing with biological weapons: "Preparedness and prevention; detection and surveillance; diagnosis and characterization of biological and chemical agents; response; and communication." Each area should incorporate training and research. In addition, the CDC will support local and state health agencies by providing "...guidelines, support and technical assistance..." to help create preparedness plans (Khan et al., 2000, p. 4).

Areas to study

All hospitals, including rural hospitals, need to have some ability to recognize and manage a number of BT victims. Wetter et al. (2001), Case et al. (2001) and Treat et al. (2001) all looked at the ability to handle a surge of 50 patients. This is an appropriate number to use as a benchmark for minimum preparedness for rural and urban hospitals for two reasons. First, if an attack does occur in a rural area, the number of casualties would potentially be so large as to overwhelm any single hospital in that area. It is not financially realistic for all hospitals to be fully prepared for hundreds of victims. In that scenario, local, regional and state facilities will have to be utilized. However, if an attack occurs in a metropolitan area such as Minneapolis, victims will likely spread out into rural areas. It is realistic that a few individuals in any major city live in a rural area and will return to that area whether they know they are sick or not. Taking into account an average of 10 secondary victims for each index case for smallpox, the capacity for 50 initial patients may be temporarily adequate until further state and federal help is available.

In reviewing the literature on BT, 10 subdivisions of preparedness stand out as areas that should be addressed by hospitals. These areas include: patient isolation, protective measures (which includes pharmaceutical stockpiles, vaccines and personal protective equipment), training, drills, communication, planning, personnel, command, surveillance and laboratory readiness. The Hospital Assessment Survey for Biological Emergencies, which was used in this study to gather data, did not include questions that cover the areas of command, surveillance and laboratory readiness, and therefore, were not addressed in this project.

The need for decontamination as part of the response to a chemical or biological attack has been debated. Some authors of preparedness studies have included decontamination capabilities in survey questions. Many authors, however, believe decontamination is not an important area of preparedness. Decontamination in regard to covert bioweapons is not an issue due to the incubation period of the agents likely to be used (Osterholm & Schwartz, 2000). The patient may not present to the ED until days after the attack, at which point decontamination would not help. In a chemical weapons attack, immediate decontamination would be a key factor because immediate removal of the agent may reduce morbidity and mortality. Biological agents that present inhalation risks have low associated risk from skin or surface contamination, therefore topical decontamination is of little use. In addition, there is low associated risk with secondary aerosolization due to removal of contaminated clothing (Keim & Kaufmann, 1999). In guidelines for health care facilities put forth by The Association for Professionals in Infection Control Bioterrorism Working Group, along with the CDC, decontamination for people exposed to inhaled agents "in most cases will not be necessary" (English et al., 2002, p. 6). This is in agreement with Henderson, regarding BT agents, "Decontamination of patients and environment: Not necessary in most cases" (1999, p. 1280). Jones et al. also agreed, "Decontamination is unlikely to be of any significant value with any of the probable bioterrorist agents" (2002, p. 511). Except for the potential large volume of patients, the exposure may be dealt with under already existing hospital disaster protocols (Schultz et al., 2002). Because the need for biological decontamination capabilities is doubted, it was not included in this study as an area of preparedness.

Biological agents have been used as weapons for hundreds of years, however, it is only recently that BT has become an issue that the U.S. is being forced to deal with. There is no agreement on the best way to prepare for the threat of BT, but many experts agree that the U.S. and it's health care system should be as prepared as possible. Much of the research that has been conducted on BT preparedness shows that the health care system in the U.S. is not adequately prepared. These studies suggest areas of improvement such as training and adequate pharmaceutical supplies. Currently there is limited information and little agreement on the best way to confront the issue of BT preparedness, but it is clear that more research and information are needed to help deal with this issue.

Chapter Three: Methodology

This study compared the current levels of preparedness for biological terrorism in rural hospitals versus urban hospitals in Minnesota. Rural hospitals are described as being within counties that have a population less than 50,000 and urban hospitals are within counties that have populations over 50,000.

Description of methodology used

The goal of this study was to discover if rural hospitals and urban hospitals were equally prepared for a bioterrorist attack. This was done through a quantitative descriptive approach that utilized a yes/no/partial survey to gather data. The responses to the survey used described the current level of preparedness in a cross-sectional manner. During 2002, the Minnesota Department of Health commissioned a survey of all hospitals in Minnesota regarding their current level of preparedness for bioterrorist attacks. The survey was titled: *Hospital Assessment Survey for Biological Emergencies* (Appendix A). The responses to this survey were used because there have been no other regional studies published regarding Minnesota preparedness and there is no consensus on an accurate tool for preparedness assessment. A new survey was not be conducted by this author, per the request of the Minnesota Department of Health. Responses to the *Hospital Assessment Survey for Biological Emergencies* by rural hospitals in counties with a population under 50,000 were compared to the responses of urban hospitals in counties with populations over 50,000. This study was submitted to the Augsburg College Institutional Review Board and was approved (Appendix B). The following seven specific areas were studied: isolation, protective measures (includes: pharmaceuticals, vaccines and personal protective equipment), staff training, facility drills, communication, personnel management and

planning. Each area of preparedness listed above was addressed through a number of questions within the survey.

Design of the study

A request was mailed to the administrators of pre-selected hospitals, asking for a copy of their responses to the *Hospital Assessment Survey for Biological Emergencies.* This survey was generated by the Minnesota Hospital and Healthcare Partnership for the Minnesota Department of Health (MDH) and was administered between May and August of 2002. The survey included 46 yes/no questions and two open ended questions that allowed for written qualitative responses. These questions covered topics that could be put into the seven categories previously listed. In addition, the survey included questions that addressed the needs of special populations, essential goods and services, crisis counseling and emergency transport. These areas were also compared for rural versus urban hospitals looking for differences, but were not focused on in this study because they were not deemed vital in the review of literature.

The names and addresses of hospital administrators were public information and were available through the MDH web page at: www.health.state.mn.us/divs/fpc/directory/showprovideroutput.cfm. Requests for survey responses (Appendix C) were mailed to hospital administrators at their listed address. With each request, a self-addressed stamped envelope was enclosed for the return of each survey response. If there was no response from a hospital within two weeks, a second request was sent to the hospital administrator. If hospitals did not respond within two weeks of the second request, they were considered a non-participating hospital and were removed from the study. Return envelopes from participating hospitals were coded to track hospitals that had responded. Each survey response received was separated from its coded envelope and filed anonymously with all survey responses received. Rural and urban facilities

were kept separate using the envelope codes. After the allotted time for responses to be received had expired, results from the received surveys were entered into the Statistical Package for the Social Sciences (SPSS) program and analyzed.

Sample and Population

The population studied included all 142 hospitals in Minnesota. This population can further be broken down into sub-populations of 88 rural hospitals and 54 urban hospitals. The names and location of each hospital were available at the MDH website at: www.health.state.mn.us/oep/docs/hospitals.pdf. The sample populations surveyed were from four different regions in Minnesota. The Minnesota Department of Health defined these regions for their Hospital Bioterrorism Preparedness Program (HBPP). In the HBPP program, the state is divided into eight regions with an average of 17 hospitals per region. The Central region and the Northeast region were chosen because they both have approximately 50% rural and 50% urban hospitals. In addition, the Metro region, which has all urban hospitals, and the Southwest region, which has all rural hospitals were also chosen. Data was gathered for this project by requesting survey responses from all hospitals in the above listed four regions: 21 in the Central, 17 in the Northeast, 28 in the Metro and 24 in the Southwest (sample size = 90). Rural counties were defined as those with fewer than 50,000 people and urban counties as those with more than 50,000 people. This number is based in part on the U.S. Census definition of a rural area (U.S. Census Bureau, (n.d.), *Definitions and Glossary*, retrieved 3/23/2003). Counties were chosen to define an area because they have pre-existing borders and many rural counties have only one hospital in each county.

Instrumentation

The *Hospital Assessment Survey for Biological Emergencies* (Appendix A) was used to gather data from each hospital. This survey was commissioned by the Minnesota Department of Health in 2002 and was conducted from May through August of 2002 (Minnesota Department of Health, 2002). The *Hospital Assessment Survey for Biological Emergencies* was already conducted, therefore it was not sent to hospitals again. For the present study, hospitals were asked to send a copy of their responses to the survey, therefore the data gathered was secondary data. The Minnesota Department of Health had instructed this author in writing to gather data in this manner.

Data collection and analysis

Survey responses were mailed to this author by each hospital. Survey responses that were received were collected and the data was entered into the Statistical Package for the Social Sciences (SPSS). Using SPSS, descriptive statistics were utilized to analyze the data, looking for frequencies and percentages to the questions asked in each category. For statistical analysis, seven separate subscales were created, one for each general area of preparedness (isolation, protective measures, staff training, facility drills, communication, personnel management and planning). These subscales provided a natural comparison of rural versus urban hospitals in regards to these specific areas. Each of the subscales was based on the responses to the survey for questions pertaining to that area of preparedness. The number of affirmative responses in each of the seven preparedness areas, as well as the total of the responses were compared for rural and urban hospitals, looking for differences between them. The possible responses were no, partial or yes for each question, and they were given weighted values for One-Way ANOVA analysis (no = 0, partial = 1, and yes = 2). A "yes" response to a question was considered a

positive indicator of preparedness and a "no" response was considered a negative indicator. ANOVA analysis was conducted to measure if there was a statistical difference between rural and urban facilities in each of the seven areas of preparedness as well as a total, with all seven areas combined. The level of statistical significance of 0.05 was utilized in this study to remain consistent with past studies such as Wetter et al. (2001). The weight of the analysis varied between the seven groups because each of the seven groups had a different number of questions that were asked in regards to that area of preparedness. Isolation had two questions, protective measures had four questions, training had two questions, drills had one question, communication had 3 questions, personnel management had 5 questions and planning had 11 questions, with a total of 28 questions being analyzed. This analysis assumed that the importance of each question in regards to preparedness was equal. The goal of this study was to describe the differences between rural and urban hospitals in their level of preparedness for BT. The present study did not assess whether Minnesota hospitals were or were not prepared for BT.

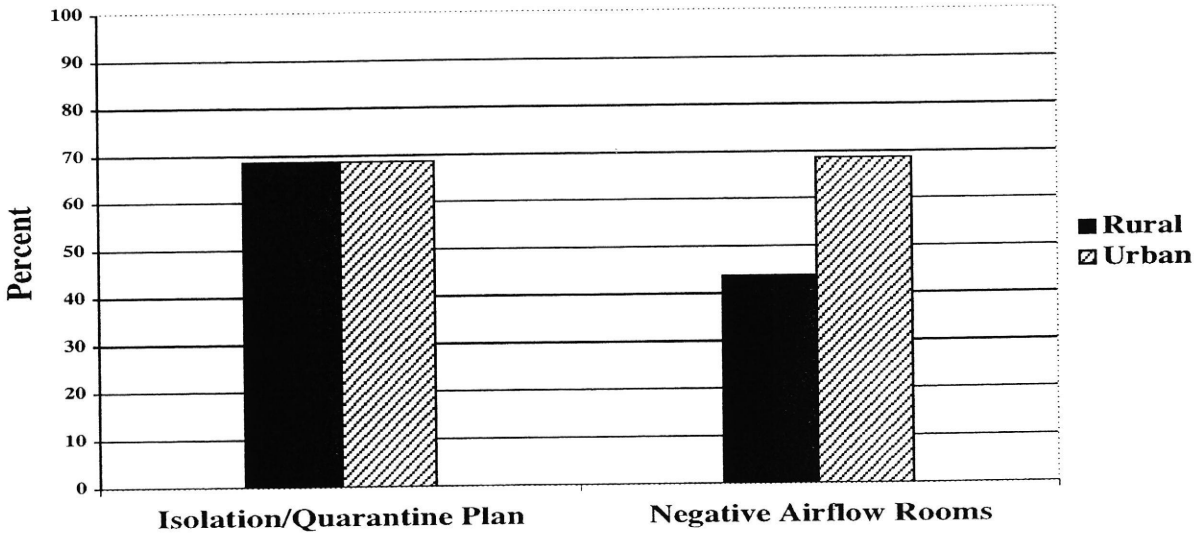
Chapter Four: Results

This study examined the differences in the level of preparedness for biological terrorism in rural versus urban hospitals in Minnesota. Hospital responses to the *Hospital Assessment Survey for Biological Emergencies,* conducted by the Minnesota Department of Health in 2002, were analyzed.

Ninety Minnesota hospitals were asked to send their results to the above-mentioned survey to this author. From this population, 32 hospitals participated in this study by submitting their survey responses (response rate = 35.6%). Within this responding subpopulation, 16 were urban hospitals and 16 were rural hospitals. Seven areas of preparedness were the focus for the present study. These areas included isolation, protective measures (pharmaceuticals, vaccines and personal protective equipment), staff training, facility drills, communication, personnel management and planning.

Isolation questions involved a facility's plan to isolate and quarantine patients with communicable diseases, and their ability to place patients in negative airflow rooms for isolation.

Figure 1: Hospitals Responding Yes/Partial to Questions Regarding Isolation



In rural facilities, 68.8% responded that their plan called for the isolation and quarantine of patients, and 43.8% had negative airflow rooms. In metropolitan facilities, 68.8% were able to isolate and quarantine patients according to their plan and 68.8% had negative airflow rooms. See figure 1.

Hospitals were asked if their facility's pharmaceutical needs had been identified, and whether pharmaceuticals for biological emergencies had been obtained or were planned to be obtained. Eighty one point three percent of rural and 68.8% of urban hospitals stated that they had identified their pharmaceutical needs. Regarding the pharmaceuticals had been obtained or planned to be, 56.3% of rural hospitals said yes and 62.5% of urban hospitals said yes.

The availability of vaccines, prophylactic treatment and personal protective equipment in regards to personal protection of staff was asked. For responding rural facilities, 37.6% stated they were prepared to give prophylaxis or vaccinations if there were a bioterrorist attack. In urban facilities, 50% had this capability. Personal protective equipment such as personal respirators was available to clinicians in 75.1% of rural hospitals and 68.8% of urban hospitals. See figure 2.

Hospitals were asked about the training of their staff. In rural hospitals, 62.5% stated that they had trained their staff in the recognition and reporting of possible bioterrorism agents, and 81.2% of urban hospitals stated they had trained their staff in this manner. Diagnostic and treatment protocols were available to staff in 93.7% of rural hospitals and 93.7% of urban hospitals.

Drills and exercises related to bioterrorism where part of facilities bioterrorism plan in 56.2% of rural facilities and 81.2% of urban hospitals. See figure 3.

Figure 2: Hospitals Responding Yes/Partial to Questions Regarding Pharmaceutical Needs

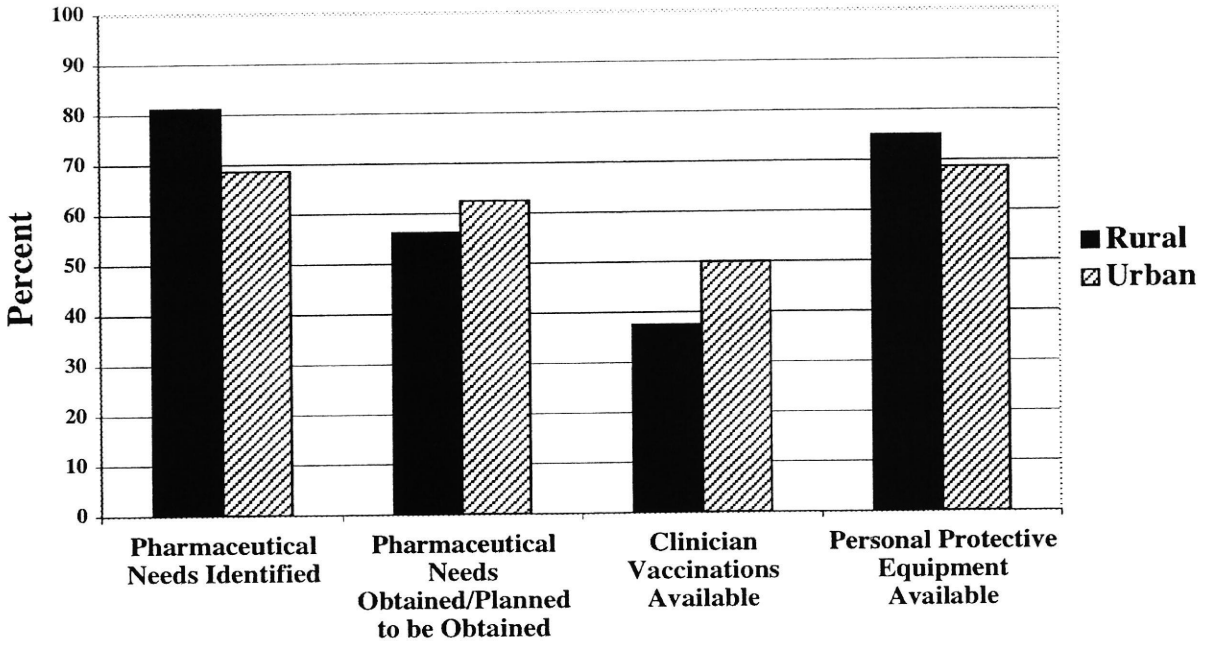
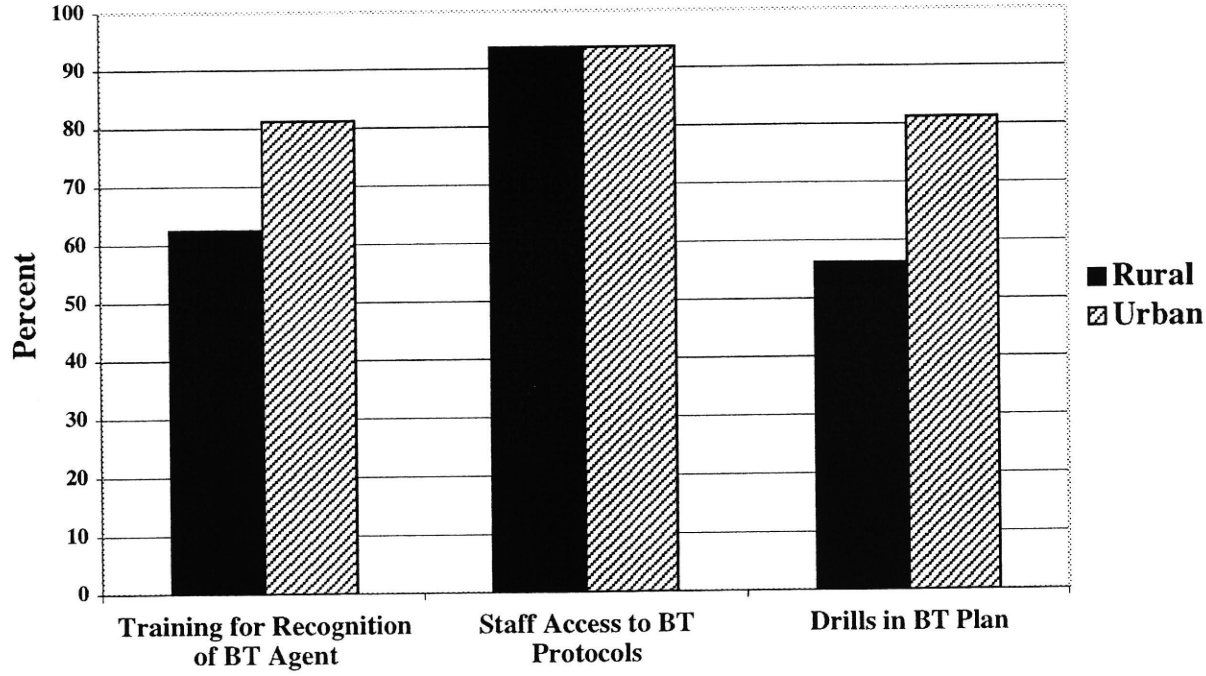
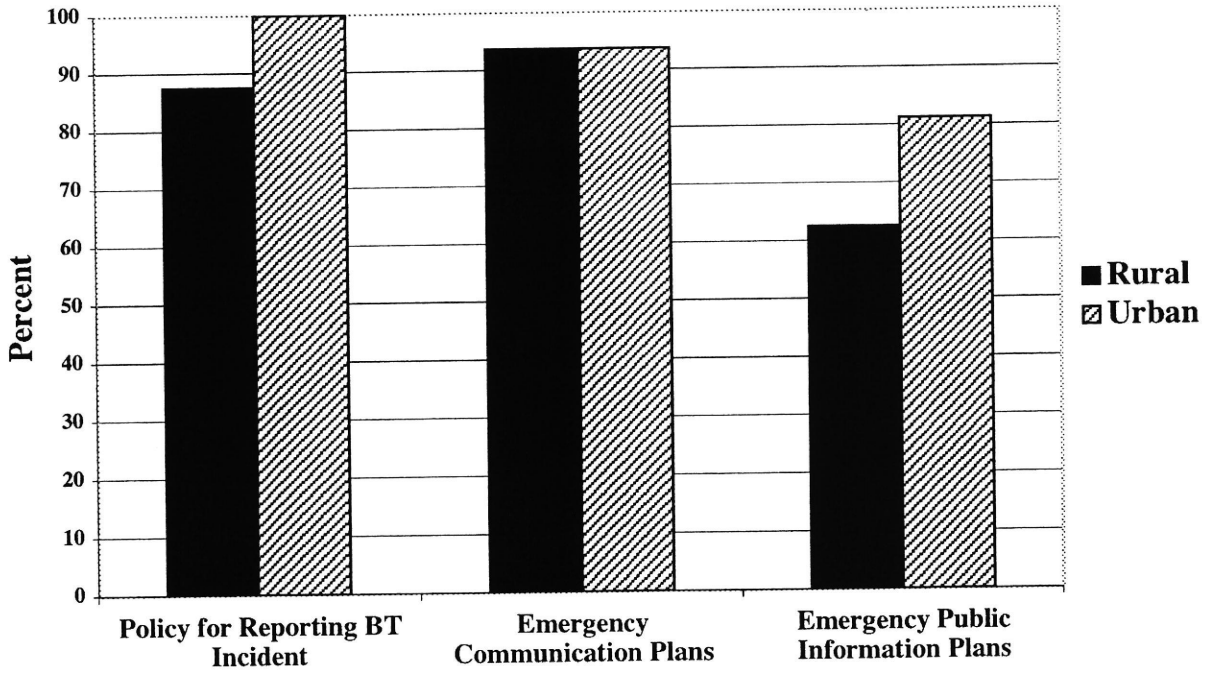


Figure 3: Hospitals Responding Yes/Partial to Questions Regarding Drills and Exercises



Hospitals were asked about their communication policies and procedures. When asked if there were procedures in place for reporting information to local, state and federal authorities; 87.5% of rural facilities responded yes; 100% of urban facilities responded yes. Ninety three point seven % of rural hospitals stated that they had emergency and back-up emergency communication plans in place, and 93.7% of urban facilities stated they had these plans in place. In regards to public information procedures, 62.5% of rural stated that they had addressed this issue, and 81.2% of urban hospitals had addressed this issue. See figure 4.

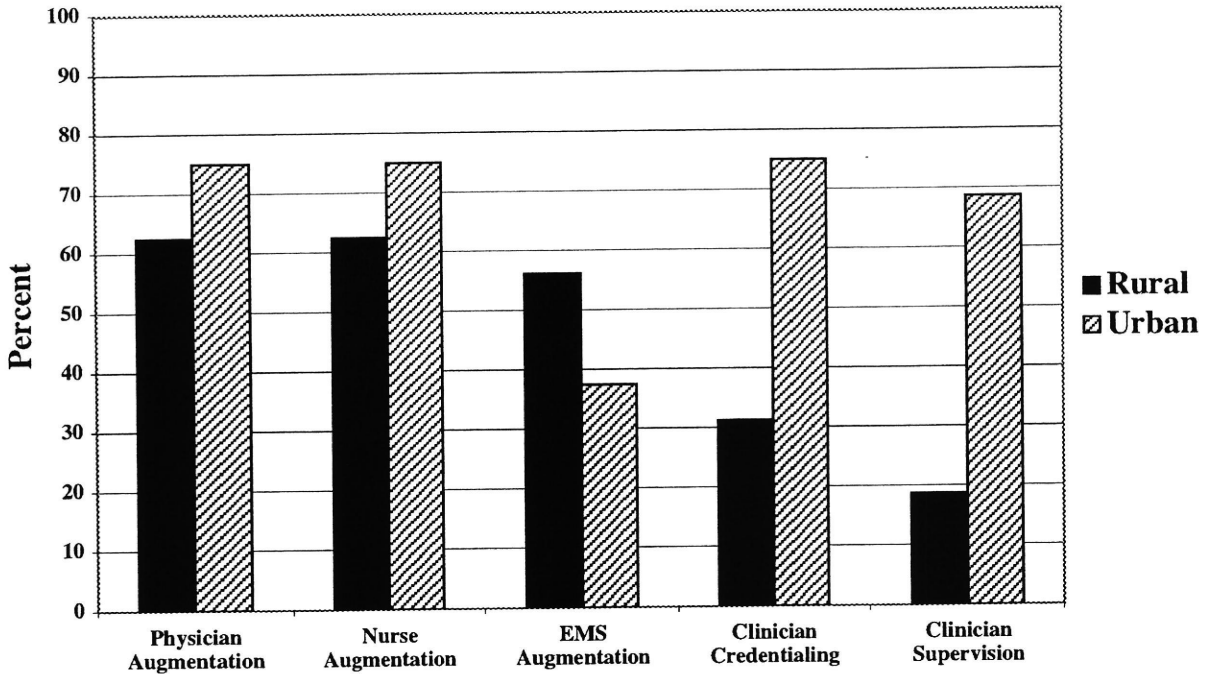
Figure 4: Hospitals Responding Yes/Partial to Questions Regarding Communication Plans



Hospitals were asked if they had made plans to address personnel needs during a biological incident. In rural facilities: 62.5% had plans for extra physicians; 62.5% had plans for additional nurses; 50% had plans for more EMS personnel. In urban facilities: 75% had plans for extra physicians; 75% had plans for additional nurses; 37.5% had plans for more EMS

personnel. When asked whether hospitals have made plans for credentialing additional clinicians that do not work at they facility, 31.2% of rural hospitals replied yes; 75% of urban hospitals replied yes. Regarding the supervision of clinicians that do not normally work at their facility; 18.7% of rural facilities stated that they had plans that accounted for this; 68.7% of urban facilities had plans in place. See figure 5.

Figure 5: Hospitals Responding Yes/Partial to Questions Regarding Presonnel Needs



The most detailed questioning in the survey, involved hospital planning for bioterrorism. Of rural hospitals, 68.7% had a bioterrorism plan, where 87.5% of urban hospitals had a bioterrorism plan. When asked whether facilities were prepared to perform initial assessment and treatment of BT victims, 81.2% of rural hospitals said yes and 81.2% of urban hospitals said yes. Did the hospital's plan allow for the hospitalization of victims of a biological attack; 56.3% of rural hospitals said yes and 81.3% of urban hospitals said yes. Did the facility's planning call

for the reconfiguration of hospital space to treat large numbers of casualties; 68.7% of rural hospitals said yes; 37.5% of urban hospitals said yes. See figure 6. When asked if facilities were involved in community health planning for bioterrorism vaccination and prophylaxis; 56.2% of rural hospitals said yes; 87.5% of urban hospitals said yes. Were facilities prepared to provide essential goods and services like food and water; 87.5% of rural hospitals said yes; 100% of urban hospitals said yes. Hospitals were asked if there were plans for the use of non-hospital facilities for shelter and treatment of mass casualties if facilities are overwhelmed; 56.2% of rural hospitals said yes; 81.2% of urban hospitals said yes. Did facilities have plans for the storage/transfer of bodies during a BT event; 43.7% of rural hospitals said yes; 25% of urban hospitals said yes. When asked if plans were prepared for facility security and crowd control; 68.7% of rural hospitals said yes; 93.7% of urban hospitals said yes. Were plans developed for patient evacuation and housing in case of a BT event; 62.5% of rural hospitals said yes; 87.5% of urban hospitals said yes. Were there plans for overcrowding and hospital diversion; 56.2% of rural hospitals said yes; 81.2% of urban hospitals said yes. See figure 7.

Figure 6: Hospitals Responding Yes/Partial to Questions Regarding Planning

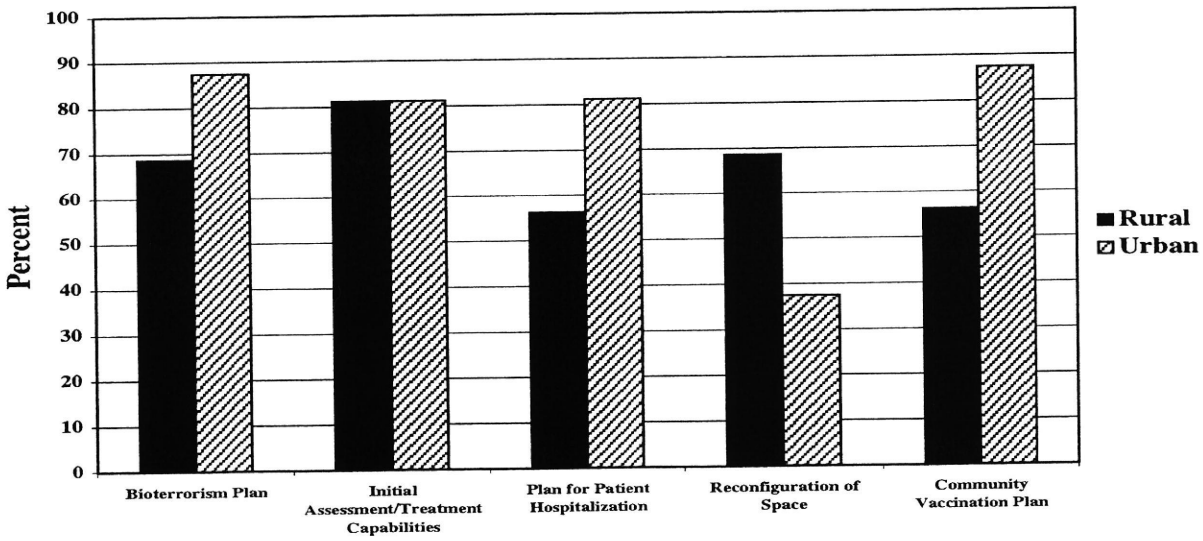
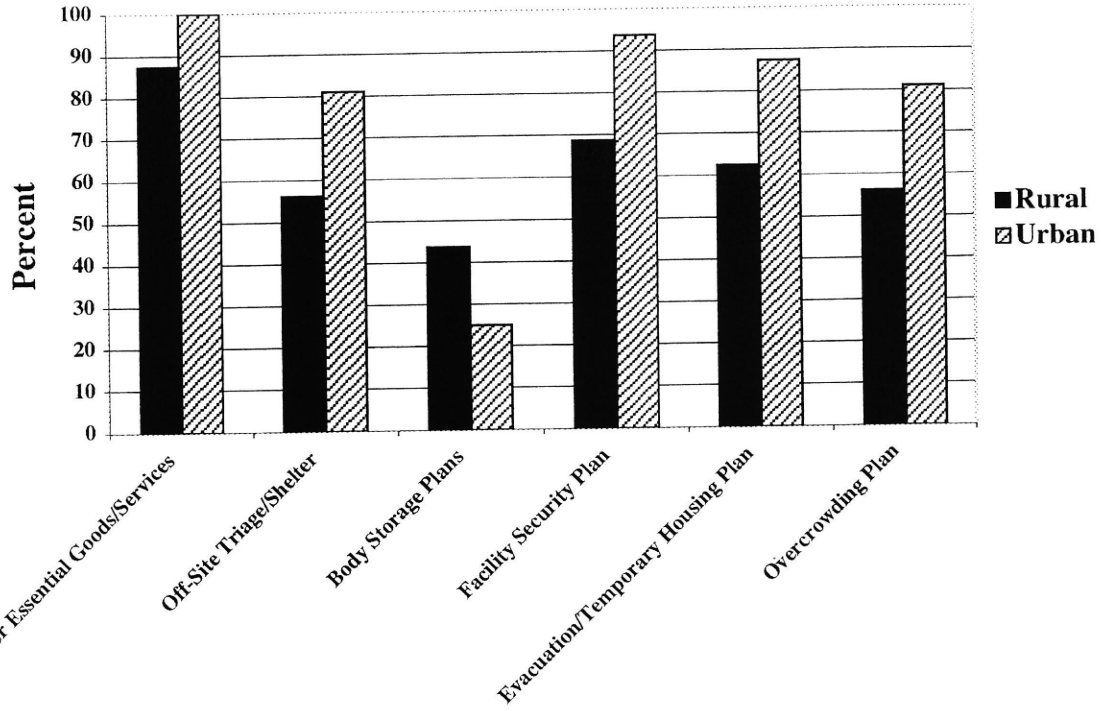


Figure 7: Hospitals Responding Yes/Partial to Questions Regarding Planning



The results of the One-way ANOVA analysis are presented in Table 1. As shown in the table, the only area of preparedness that demonstrated a statistical difference between rural and urban facilities was the area of facility drills, where rural hospitals showed a lower level of preparedness than urban hospitals ($F(1,30) = 5.581$, $p = 0.025$). In all other areas, including isolation, protective measures, staff training, communication, personnel management, and planning, there was no statistical difference between rural and urban hospitals. In addition, when totaled and all areas of preparedness were considered, there was no statistical difference between rural and urban hospitals ($F(1,30) = 1.215$, $p = 0.279$).

Table 1.

Subscales	df	F	P-value
Isolation	(1,30)	1.497	0.231
Protective Measures	(1,30)	0.004	0.951
Staff Training	(1,30)	0.118	0.733
Facility Drills	(1,30)	5.581	0.025
Communication	(1,30)	0.848	0.364
Personnel Management	(1,30)	1.556	0.222
Planning	(1,30)	1.000	0.325
Total	(1,30)	1.215	0.297

Chapter Five: Discussion

Implications

Within this study, the level of preparedness for bioterrorism within rural and urban Minnesota hospitals was examined. Currently there is limited research studying the level of preparedness of hospitals nationally and regionally. Of the major published reports, only three examined to some degree, differences between rural and urban hospitals and their level of preparedness. The most often cited report is Wetter et al. (2001), which showed that in general, rural hospitals were less prepared than urban hospitals (N=186). Treat et al. (2001) mirrored these findings in their study of east coast hospitals (N=30), showing that urban hospitals were more prepared for a BT attack when compared to rural hospitals. In a limited study of New Jersey hospitals (N=10), Case et al. (2001) differed, finding no difference between rural and urban hospitals. The results from Minnesota hospitals within the present study are in accordance with Case et al., showing no statistical difference overall in the level of preparedness of rural and urban hospitals in Minnesota. When the seven areas of preparedness were examined separately, only the area of *facility drills* showed a statistically significant difference between rural and urban hospitals. All other areas, including isolation, protective measures, staff training, communication, personnel management and planning, there was no significant difference found.

There could be many reasons for this particular disparity between rural and urban hospitals. All hospitals are required to conduct regular drills, but not specifically for a BT attack. Rural hospitals may not consider a BT attack an imminent threat in their region, therefore other types of drills may take precedence. In general, there may be less concern in a rural setting about BT, therefore it is a lower priority to focus already limited resources on. The opposite may be true in the urban setting. Urban hospitals may feel they must focus more on BT preparation.

Conducting full-scale drills may also show a more advanced over-all level of preparedness. In order to conduct an effective drill, much of the planning and preparation for a BT attack must already be in place. It is one thing to have plans on paper, but another to have procedures fully in place and supplies on hand. Drills are a final step in preparation and the inability to conduct drills may indicate a lower over-all level of preparedness in rural hospitals. It is difficult to fully understand this however, because there is currently no bench-mark to decide whether a hospital is or is not truly prepared for a BT attack. This study did not look at whether or not hospitals in Minnesota were considered prepared because of the lack of an effective standard. With the information available within this study, it can only be speculated as to how prepared hospitals are and why there are differences in drills and how significant these differences truly are. Looking at the data, however, illustrates the need for greater preparedness in both rural and urban hospitals. Both settings demonstrate many basic areas where improvement is needed, such as obtaining pharmaceutical stockpiles and vaccines, personnel augmentation, and overall planning.

Limitations

This study was limited to the number of facilities that returned the requested information. It is not a true population study because all hospitals in Minnesota were not asked to participate. The study is also limited by the questions and categories covered in the original survey, the *Hospital Assessment Survey for Biological Emergencies.* The original survey may not have adequately covered all areas of preparedness, nor allowed accurate response options to reflect current preparedness levels. In addition, this study assumed that the person/persons who completed the original survey had adequate knowledge of the facility and were able to accurately describe the facilities capabilities and limitations. It also assumed that the original surveys were filled out truthfully, reflecting the facilities current level of preparedness and not it's projected

level. Reporting bias of respondents may have caused a higher or lower level of preparedness to be reported than what was actually in place.

Within the statistical analysis, it was necessary to assume that all of the individual questions analyzed had equal weight in regard to level of preparedness. This may not be the case in reality. For example, it was assumed that whether or not a hospital had a BT plan was equally weighted as whether a hospital had adequate facilities for body storage. This was done out of statistical necessity and the limitations present in the design of the survey questions. The final analysis was limited by the response options in the original survey of *no, yes* and *partial*. A response of *partial* is undefined, and it is unclear what level of preparedness this correlates to. For statistical analysis, the responses of *no, yes* and *partial* were weighted as described in *Data collection and analysis* on page 41. The undefined level of *partial* creates some ambiguity in the statistical analysis, which was unavoidable based on the original survey.

Discussion

The present study showed no statistical difference between rural and urban hospitals for a BT event. This does not imply that they are adequately prepared. There has been a great deal of work done by all of the hospitals within Minnesota to meet the current needs for BT preparedness. There are limited resources available and many hospitals are doing everything that is possible to become adequately prepared. It is encouraging to see that rural facilities are not lagging behind urban hospitals, even though there may be a higher perceived need in urban hospitals. Even though it was not the focus of this study, it is evident that there is still a great need to increase the overall level of preparedness in all Minnesota hospitals. There are varying opinions on this subject and currently no consensus on the "right" way to do things. However, it

is clear that the problems cannot be ignored and some level of preparedness needs to be maintained in all hospitals.

Recommendations

In reviewing literature for this study, it became evident that an important initial step is to create an agreed upon bench-mark or set of standards that describes a minimal level of preparedness. Currently there is no such bench-mark. This has left the topic open for controversy and criticism from many different parties. An independent commission of bioterrorism preparedness experts should be instituted to create an initial minimum level of preparedness that could and should be further refined in the future as needed. There has to be a starting point, and currently there is not one. Once a minimum set of requirements is agreed upon, there should be a single commissioning body either on the federal level or at least on the state level that has oversight of this issue along with a well-defined set of standards. Feedback mechanisms from hospitals also need to be incorporated. Hospitals need to be involved from the ground level on decisions that they will be mandated to abide by.

It also became clear that there needs to be further research into this subject on both a national and a regional level. Research into the responses of hospitals that have already experienced some type of BT attack should be conducted. An understanding of how they responded, which procedures worked and which ones did not, would be beneficial to this field. Additionally, further research into better methods for hospitals to respond to attacks is needed. Are the present protocols and procedures the best and most efficient methods to respond to a BT attack? Further study into these areas as well as a thorough understanding of the current level of preparedness would be a valuable next step. The application and further refinement of these regulations, procedures and protocols will also be needed in the future. The new regulations and

oversight could be included into already existing governing bodies such as the Minnesota Department of Health and the Office of Homeland Security. In addition, although difficult in the current financial state, there must be adequate funding for these new requirements. Hospitals are already often running in a deficit mode, and do not have additional resources to cover mandated reforms. Financial assistance from local, state and federal governments are needed to make any changes a reality.

If this study were conducted again, only *yes/no* questions would be asked, leaving out *partial* as a response option. This would help clarify the statistical importance of the findings. Additionally, questions regarding only the seven basic areas of minimal preparedness (isolation, protective measures, staff training, facility drills, communication, personnel management and planning) would be asked. This could aid in the interpretation of the study and ways to utilize the information. Finally, a full population study of all Minnesota hospitals would be conducted.

Conclusions

For hundreds of years, biological agents have been used to fight wars and to terrorize people. In the U.S., the concern over the use of these agents has greatly increased in the past decade. It is an issue that no one wants to face, but we currently are being forced to face it. There are different views on the best way to deal with this threat, but many agree that hospitals should be as prepared as possible. Much of the research that has been conducted on BT preparedness shows that the health care system in the U.S. is not adequately prepared. The results of the present study show that there is no disparity between rural and urban hospitals. In one view, this is encouraging. However, these findings do not answer the more important question of whether the current level is adequate. Even though the focus of this study was not to describe the level of preparedness, it became clear that more work and increased resources are

greatly needed for hospitals to be even minimally prepared. With the current overall lack of information available and the new and pressing nature of this topic, it is difficult to dictate exactly what should be done and how it should be done. There is limited information and little agreement on the best way to confront the issue of BT preparedness, but it is clear that more research and information are needed to help deal with this issue. There needs to be an agreed upon standard of minimal preparedness for hospitals to work towards and the resources for them to do it. To start to solve the issue of bioterrorism and hospital preparedness, there will need to be an increased level of involvement, funding and collaboration at local, state and federal levels.

References

Alibek, K. (1999). *Biohazard.* New York: Dell Publishing.

Bentley, J. D. (2001). Hospital preparedness for bioterrorism. *Public Health Reports*, 116 (Suppl. 2), 36-39.

Case, G. G., West, B. M., & McHugh, C. J. (2001). Hospital preparedness for biological and chemical terrorism in central New Jersey. *New Jersey Medicine*, 98(11), 23-33.

Centers for Disease Control and Prevention. (n.d.). *NPS Synopsis*. Retrieved October 10, 2002, from http://www.cdc.gov/nceh/nps/synopsis.htm

Centers for Disease Control and Prevention. (2002, February 15). *Guidance for fiscal year 2002 supplemental funds for public health preparedness and response for bioterrorism.* Retrieved November 10, 2002, from http://www.bt.cdc.gov/planning/coopagreementaward/CDC2BTEmergencySupplemental_2_19_2002_Master-4-00.asp

Chen, F. M., Hickner, J., Fink, K. S., Galliher, J. M., & Burstin, H. (2002). On the front lines: Family physicians' preparedness for bioterrorism. *Journal of Family Practice*, 51, 745-750.

Christopher, G. W., Cieslak, T. J., Pavlin, J. A., & Eitzen, E. M. (1997). Biological warfare: A historical perspective. *JAMA*, 278, 412-417.

Cohen, H. W., Gould, R. M., & Sidel, V. W. (1999). Bioterrorism initiatives: Public health in reverse? *American Journal of Public Health*, 89, 1629-1631.

Cohen, H. W., Sidel, V. W., & Gould, R. M. (2001). Preparedness for bioterrorism? [Letters to the editor]. *New England Journal of Medicine*, 345, 1423.

Danzig, R., & Berkowsky, P. B. (1997). Why should we be concerned about biological warfare[Commentaries]? *JAMA*, 278, 431-432.

English, J., Carrico, R., Clements, B., Cundiff, M., Difato, T., Franck, J. et al. (2002). *Interim Bioterrorism Readiness Plan Suggestions*. Retrieved September 10, 2002, from http://www.apic.org/bioterror/readinessSupp.doc

Geiger, H. J. (2001). Terrorism, biological weapons, and bonanzas: Assessing the real threat to public health. *American Journal of Public Health*, 91, 708-709.

Greenberg, M. I., Jurgens, S. M., & Gracely, E. J. (2002). Emergency department preparedness for the evaluation and treatment of victims of biological or chemical terrorist attack. *The Journal of Emergency Medicine*, 22, 273-278.

Gugliotta, G., & Matsumoto, G. (2002, October 28). Experts raising doubts that anthrax attacker did it all alone. *Star Tribune*, p. A6.

Hamburg, M. A. (2002, February 22). Public health preparedness [Editorial]. Science, 295, 1425.

Henderson, D. A. (1998). Bioterrorism as a public health threat. *Emerging Infectious Diseases*, 4, 488-492.

Henderson, D. A. (1999, February 26). The looming threat of bioterrorism. *Science*, 283, 1279-1282.

Henderson, D. A., Inglesby, T. V., Bartlett, J. G., Ascher, M. S., Eitzen, E., Jahrling P. B. et al. (1999). Smallpox as a biological weapon: Medical and public health management [Electronic version]. *JAMA*, 281, 2127-2137.

Inglesby, T., Grossman, R., & O'Toole, T. (2000). A plague on your city: Observations from TOPOFF. *Biodefense Quarterly*, 2(2), 1-17.

Inglesby, T. V., O'Toole, T., Henderson, D. A., Bartlett, J. G., Ascher, M. S., Eitzen, E. et al. (2002). Anthrax as a biological weapon, 2002: Updated recommendations for management. *JAMA*, 287, 2236-2252.

Jones, J., Terndrup, T. E., Franz, D. R., & Eitzen, E.M. (2002). Future challenges in preparing for and responding to bioterrorism events. *Emergency Medicine Clinics of North America*, 20, 501-524.

Kaufmann, A. F., Meltzer, M. I., & Schmid, G. P. (1997). The economic impact of a bioterrorist attack: Are prevention and post attack intervention programs justifiable? Emerging Infectious Diseases, 3, 83-94.

Keim, M. & Kaufmann, A. F. (1999). Principles for emergency response to bioterrorism. *Annals of Emergency Medicine*, 34, 177-182.

Khan, A. S., Levitt, A. M., & Sage, M. J. (2000). Biological and chemical terrorism: Strategic plan for preparedness and response [Electronic version]. *MMWR Morbidity and Mortality Weekly Report*, 49(RR-4), 1-14.

Kolavic, S. A., Kimura, A., Simons, S. L., Slutsker, L., Barth, S., & Haley, C. E. (1997). An outbreak of *Shigella dysenteriae* Type 2 among laboratory workers due to intentional food contamination. *JAMA*, 278, 396-398.

Meltzer, M. I., Damon, I., LeDuc, J. W. & Millar, J. D. (2001). Modeling potential responses to smallpox as a bioterrorist weapon. *Emerging Infectious Diseases*, 7, 959-969.

Meselson, M., Guillemin, V., Hugh-Jones, M., Langmuir, A., Popova, I., Shelokov, A., et al. (1994, November 18). The Sverdlovsk anthrax outbreak of 1979. *Science*, 266, 1202-1208.

Meyer, R. F., & Morse, S. A. (2002). Bioterrorism preparedness for the public health and medical communities. *Mayo Clinical Proceedings*, 77, 619-621.

Miller, J., Engelberg, S., & Broad, W. (2002). *Germs*. New York: Touchstone.

Minnesota Department of Health. (2001). *Bioterrorism: Questions and answers.* Retrieved November 3, 2002, from http://www.health.state.mn.us/divs/dpc/han/bioterqa.pdf

Minnesota Department of Health Fact Sheet. (2002a, August 12). *Hospital bioterrorism preparedness program.* Retrieved November 3, 2002, from http://www.health.state.mn.us/oep/docs/facthrsa081202.pdf

Minnesota Department of Health Fact Sheet. (2002b, August 20). *CDC funding for public health preparedness for bioterrorism, infectious diseases, and other threats to public health.* Retrieved November 3, 2002, from http://www.health.state.mn.us/oep/docs/factcdc.pdf

Minnesota Department of Health. (2002). *Request for non-competing funding for bioterrorism hospital preparedness program: Phase 2 implementation plan.* Retrieved October 15, 2002, from http://www.health.state.mn.us/oep/funding/hospitalgrant.htm#btt

Noah, D. L., Huebner, K. D., Darling, R. G., & Waeckerle, J. F. (2002). The history and threat of biological warfare and terrorism. *Emergency Medicine Clinics of North America*, 20, 255-271.

O'Toole, T, Mair, M, & Inglesby, T. (2002). Shining Light on "Dark Winter" [Electronic version]. *Clinical Infectious Disease*, 34, 972-983.

Office of Technology Assessment, US Congress. (1993). *Proliferation of Weapons of Mass Destruction.* (Publication OTA-ISC-559). Washington, DC: US Government Printing Office.

Osterholm, M. T., & Miller, J. (2002, September). Great Conversations: The war with germs. Symposium conducted at the Ted Mann Concert Hall, University of Minnesota, Minneapolis, MN.

Osterholm, M. T., & Schwartz, J. (2000). *Living Terrors.* New York: Dell Publishing.

Schultz, C. H., Mothershead, J. L., & Field, M. (2002). Bioterrorism preparedness I: The emergency department and hospital. *Emergency Medicine Clinics of North America*, 20, 437-455.

Sidel, V. W., Cohen, H. W., & Gould, R. M. (2001). Good intentions and the road to bioterrorism preparedness. *American Journal of Public Health*, 91, 716-718.

Stern, J. (1999). The Prospect of Domestic Bioterrorism. *Emerging Infectious Diseases*, 5, 517-522.

Simon, J. D. (1997). Biological Terrorism: Preparing to Meet the Threat. *JAMA*, 278, 428-430.

Török, T. J., Tauxe, R. V., Wise, R. P., Livengood, J. R., Sokolow, R., Mauvais, S. et al. (1997). A large community outbreak of Salmonellosis caused by intentional contamination of restaurant salad bars. *JAMA*, 278, 389-395.

Treat, K.N., Williams, J.M., Furbee, P.M., Manley, W.G., Russell, F.K., & Stamper, C.D. Jr. (2001). Hospital preparedness for weapons of mass destruction incidents: an initial assessment. *Annals of Emergency Medicine*, 38, 562-565.

U.S. Census Bureau. (n.d.) *Age: 2000*. Retrieved November 3, 2002, from http://www.census.gov/prod/2001pubs/c2kbr01-12.pdf

U.S. Census Bureau. (n.d.) *Definitions and Glossary*. Retrieved March 23, 2003, from http://www.census.gov/geo/www/glossary.html#ruralandurban

Wehrle, P. F., Posch, J., Richter, K. H., & Henderson, D. A. (1970). An airborne outbreak of smallpox in a German hospital and its significance with respect to other recent outbreaks in Europe. *Bulletin of the World Health Organization*, 4, 669-679.

Wetter, D. C., Daniell, W. E., & Treser, C. D. (2001). Hospital preparedness for victims of chemical or biological terrorism. *American Journal of Public Health*, 91, 710-716.

Zilinskas, R. A. (1997). Iraq's biological weapons: The past as future? *JAMA*, 278, 418-424.

Appendix A

The following is the survey used to assess Minnesota hospital preparedness for a biological incident. It will be updated to indicate improvements in hospitals their emergency plans and the increased availability of medications, vaccines, equipment and supplies. The current needs assessment is a baseline identifying the level of preparedness for Minnesota hospitals. Program development will be proceeding from this baseline into the various avenues of emergency preparedness as outlined in the needs assessment and grant objectives.

HOSPITAL ASSESSMENT SURVEY FOR BIOLOGICAL EMERGENCIES

Responses to the following questionnaire will be used to evaluate and assess the current preparedness for bioterrorism and other biological emergencies at the state and local level in Minnesota. Participation in this survey is prerequisite to receiving emergency preparedness grant funds. Your responses should be based on what your organization has in place now that would be adequate to meet the following considerations during a biological incident involving bioterrorism, biological attack, or accident. We are attempting to elucidate the current preparedness for such incidents, and then to determine what needs to be done to improve the system over time.

Check "YES" if you have completed the item in question. Check "PARTIAL" if substantial progress has been made, but it is not fully completed. Check "NO" if substantial progress has not been made regarding the item.

1 BIOLOGICAL EMERGENCY PLANNING

1.1 Does your organization have a bioterrorism plan?
1.2 Are your hospital emergency department and local outpatient centers prepared to do initial assessment and treatment of bioterrorism victims?
1.3 Does your plan address decontamination activities for a biological incident?
1.4 Does your plan provide for the hospitalization of infected patients from a biological incident?
1.5 Does your plan take into account local treatment and regional referral of multiple casualties from a bioterrorism incident?

2 RECONFIGURATION OF HOSPITAL SPACE

2.1 Does your plan provide for the reconfiguration of hospital space for the treatment of large numbers of casualties?
2.2 Does your plan provide for the reconfiguration of hospital space for the isolation and quarantine of communicable diseases?
2.3 Does your facility have negative airflow, isolation rooms?
2.4 Does your plan describe how patients could be triaged to make additional hospital bed space available during a terrorism event?

3 PERSONNEL AUGMENTATION

Does your plan provide for the need for personnel augmentation during a large-scale biological incident:

3.1 Physicians?
3.2 Nurses?
3.3 Pharmacists?
3.4 Mental Health Professionals?
3.5 EMS?
3.6 List any other personnel your plan provides for:

4 CREDENTIALING AND SUPERVISION

4.1 Does your plan provide for the credentialing of clinicians (not normally working in your facility) treating victims of a biological incident at your facility?
4.2 Does your plan provide for the supervision of clinicians (not normally working in your facility) treating victims of a biological incident at your facility?

5 VOLUNTEER CLINICAL HELP AND DONATED ITEMS

5.1 Does your plan provide for the management of volunteer clinical help?
5.2 Does your plan describe how items donated to your facility during a bioterrorism incident will be managed?

6 PROTECTION OF CLINICIANS

6.1 Have preparations been made to provide prophylaxis or vaccination for clinicians in the event of biological emergency?
6.2 Is personal protective equipment such as N 95 masks available for your clinicians in an emergency?
6.3 Have applicable clinicians been educated concerning infection control measures for a biological incident?

7 TRAINING

7.1 Have the laboratory and clinical personnel been trained in the recognition and reporting of rare diseases with bioterrorism potential?
7.2 Do staff have access to diagnostic and treatment protocols addressing bioterrorism diseases and concerns?
7.3 Have mechanisms been developed to bring clinicians up to speed on these protocols before and during an event?

8 PHARMACEUTICALS AND VACCINES

8.1 Have the needs for pharmaceuticals for patients or exposed individuals during a biological emergency been identified?
8.2 Have pharmaceuticals needed for a biological emergency been obtained or otherwise planned to be obtained in an emergency?
8.3 Is the facility part of the community health planning for vaccination/prophylaxis in a bioterrorism event?

9 SPECIAL NEEDS

9.1 Have the special needs of children, pregnant women, the elderly, non-English speaking people, and those with disabilities been considered in emergency planning?

10 COMMUNICATION AND COLLABORATION

10.1 Have hospitals and EMS collaborated to develop diversion and referral policies during an emergency situation?
10.2 Have processes and procedures for reporting unusual cases or other relevant information to local, state and/or federal authorities?
10.3 Have emergency communication plans including back-up emergency communications been prepared?
10.4 Have emergency public information plans and procedures been addressed?

11 REFERRAL CENTERS

11.1 Have the sources of expert consultation and referral centers capable of addressing biological exposures been identified?
11.2 Have staff members been identified who will consult and refer?

12 ESSENTIAL GOODS AND SERVICES

12.1 Does your hospital and patient care facilities have a plan to provide essential goods and services such as food, water, and electricity?
12.2 Have provisions been made for the safe disposal of linens and biological wastes during an emergency?
12.3 Have plans been prepared for using non-hospital facilities to shelter and treat mass casualties or epidemic victims if your facilities are overwhelmed?

13 SECURITY

13.1 Have plans to provide facility security, security force augmentation, and crowd control been prepared?
13.2 Do you have plans to rapidly control all entry and egress points early on in an emergency?

14 DRILLS AND EXERCISES

14.1 Does your plan incorporate bioterrorism drills and exercises?
14.2 Does your hospital participate in community drills and exercises?

15 CRISIS COUNSELING

15.1 Are plans in place to address emotional and mental health impacts of a biological emergency on staff, patients, and family members?

16 EMERGENCY TRANSPORT

16.1 Do plans exist regarding patient transport and destinations?
16.2 Have plans been developed on the evacuation of facilities and the temporary housing of patients in the event of bioterrorism?
16.3 Have plans for overcrowding and hospital diversion in a biological emergency been prepared?

17 PROGRAM SHORTFALLS

17.1 Do you need technical assistance in biological incident preparedness? If yes, please specify:
17.2 Please list any other gaps or shortfalls in bioterrorism preparedness that you have identified?

Thank you for participating in the Biological Emergency Hospital Assessment Survey. Please give us contact information for the person who completed the survey:

Name:
Title:
Phone:
Fax:
Email:

Appendix B

Institutional Research Board
Augsburg College
Box 107

May 16, 2003

To: Les Schotzko

From: Norma C. Noonan, Chair

I am pleased to inform you that the IRB has approved your application for the project: **A Comparison of Bioterrorism Preparedness of Rural and Urban Hospitals in Minnesota**

_X_ _ as submitted

___ _ as revised with the additional form(s)/changes

__ with the following conditions:

Your IRB approval number which should be noted in your written project and in any major documents alluding to the research project is as follows:

2003-31-3

I wish you success with your project. If you have any questions, you may contact me: 612-330-1198 or noonan@augsburg.edu.

c. Dr. Terry Lewis

Appendix C

Feb 12, 2003

Hospital Name
Address
Address
Attn: Mr/Mrs/Ms/Miss Administrator

Dear hospital administrator,

My name is Lee Schotzko. I am a student in the Augsburg College Physician Assistant Program in Minneapolis, MN, and am currently working on my master's thesis. My thesis topic is a comparison of the level of preparedness for bioterrorism of rural versus urban hospitals in Minnesota. This past summer, the Minnesota Health and Hospital Partnership (MHHP) surveyed Minnesota hospitals for the Minnesota Department of Health (MDH) in regards to bioterrorism preparedness. As of yet, it is unclear how the MDH will analyze this data. I am interested in analyzing a subsection of this data to discover if there are differences in preparedness issues between rural and urban hospitals in Minnesota. I have discussed my thesis with the Office of Emergency Preparedness at the MDH. They have stated that I could use their survey if I obtain the results directly from each hospital. I am interested in obtaining the responses to the Hospital Assessment Survey for Biological Emergencies that your health organization sent to MHHP/MDH this year. The survey was a web-based questionnaire. I have enclosed a stamped envelope and would appreciate a copy of your responses. The envelope will be coded to track which hospitals have responded. Upon receipt of the survey responses, I will separate the survey from the coded envelope and file the information anonymously with all other received survey responses. The records of this study will be kept anonymous and private. In any type of report that I may publish, I will not include any information that will make it possible to identify your institution.

All surveys will be kept in a locked file; only my thesis advisor, Terry Lewis, and I will have access to the records. All survey responses and raw data will be destroyed upon completion of my thesis on or before July 31, 2004. Upon completion of my thesis, I would be happy to share my results with your institution if you would like. The return of survey responses will be considered your consent to participate in this study. If you have any questions, please contact myself at the address below or my advisor Terry Lewis at Augsburg College, (612)-330-1284 or email Mr. Lewis at: lewist@augsburg.edu. I appreciate your time and attention to this matter and look forward to hearing from you.

Sincerely,

Lee G. Schotzko, Physician Assistant S2
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