Merging Interactive Multimedia Technology with Counter-Bioterrorism Training

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Abstract

America is not as prepared as it could be to respond to incidents of bioterrorism. First responders, public health officials, and coordinators of emergency response need more frequent access to higher quality training materials. A recent survey illustrates that an overwhelming majority of hospitals do not have annual staff training for biological agents or basic orientation for new employees. At the same time, staff training for emergency procedures was rated as the number one priority for action.

Technology can help to bridge the gap between the current state of bioterrorism preparedness and where the nation needs to be. The complex and dynamic nature of a biological outbreak makes detection and response difficult. There are unique aspects of multimedia and computer-based simulations that can remove some of these obstacles to response and training. Few high-quality software titles are available for training purposes. This paper explores game-based training simulations such as Biohazard, a cutting-edge program under development that simulates a release of a toxic agent in a shopping mall. A separate commercially available software package is *Bioterrorism Simulator 2002*, a low-end simulator program with only very limited functionality. A synthetic interview is another example of how multimedia software can help prepare for incidents of bioterrorism, by allowing hundreds of users to ask questions of virtual experts and get prerecorded responses. Synthetic interviews can both educate the public during a crisis and teach public health officials skills before an event occurs.

In conclusion, technology can and should be integrated into existing training and preparedness activities to prepare public health workers and other professionals for incidents of bioterrorism. Multimedia and simulations are under-utilized in the bioterrorism training arena today. Carefully designed training programs conforming to general design practices can supplement existing training material and can result in a better educated and prepared population.

Bioterrorism – the use, or threatened use, of a micro-organism or the product of a micro-organism in order to generate fear, morbidity, or mortality in a population (Center).

A Brief History of Bioterrorism

Before the tragic events of September 11, 2001, only a small proportion of the general public was concerned with the possibility of terrorist attacks on the United States. After all, the last major attack on mainland United States occurred when the British burned much of Washington, DC during the War of 1812. Even fewer people concerned themselves with the possibility of bioterrorism; that is until the anthrax attacks of October 2001. Many people are surprised when they learn that there had already been an orchestrated biological attack in the United States, an event that was initially downplayed by the United States government. This act was carried out in 1984 by a religious cult called the Rajneeshees.

Rajaneeshees Biological Attack of 1984

The Rajaneeshees, a group originally from India, constructed a 64,000 acre "Buddhafield" in Wasco County Oklahoma in 1981 to celebrate their credo of beauty, love, and guiltless sex (Miller, p 17). The sect took charge of the neighboring municipality of seventy-five residents after winning a majority of the electoral seats and renamed the town to Rajneesh, angering many residents. They proceeded to build a 160-room hotel, shopping mall, and an airstrip on the land that was originally zoned for agricultural purposes (Miller, p 17). The commune's zest for control did not stop there.

They devised a plan to transport 3,000 homeless people from New York to the commune in an attempt to win electoral control of the entire county (17). Suddenly in September 1984, dozens of individuals around the county began to get sick. By the time the crisis was over, 751 people who ate at ten different local restaurants tested positive positive for salmonella, a condition that is relatively rare under natural circumstances (Miller, p 19).

This biological outbreak occurred before the age of computers and automated record-keeping, and it was days before authorities contacted the Epidemic Intelligence Service at the U.S. Centers for Disease Control. This illustrates why high-tech monitoring is needed to analyze hospital records and identify outbreaks of biological agents. In the case of the Rajanshees, it was more than a year before the authorities realized that the event was a deliberate attack (Miller, p 23). The group had intended to sicken county residents so that the 4,000 commune members could defeat the 20,000 Wasco county residents in the election (Miller, p 28). This case study illustrates the ease with which an individual or group could conduct a biological attack (this group merely spread the toxin over publicly-available salad bars). It also stresses the need for tools to both detect biological outbreaks and prepare public officials and first responders to respond to incidents of bioterrorism.

Biological agents have been used as weapons for centuries. In ancient times, armies would catapult dead animals over walls to enemy territory, knowing that germs associated with dead carcasses would bring disease to the adversary. Smallpox was used in the French and Indian War when infected blankets were given to Native American tribes, causing smallpox to spread among the tribes (Lawrence, p 9). Knowledge about biological agents has grown rapidly in recent years, increasing the risk of a biological attack. Public health workers must be trained to detect and respond to this emerging threat.

Biological Terrorism Agents

The Rajaneeshees used an unconventional weapon in the form of salmonella, and they were quite effective in its use. It was fairly easy to easily sicken over 700 residents and to conceal the source of the epidemic – and this was only a test run! The biological (or “germ”) agents that are most frequently associated with bioterrorism agents are potentially much more dangerous than salmonella. The Centers for Disease Control and Prevention (CDC) is at the forefront of the bioterrorism preparedness arena (and has many good materials at their website: http://www.cdc.gov). The CDC has identified six biological agents as Category A agents, or the ones with the highest priority and most likely to be used in a terrorist attack. They are: anthrax, smallpox, the plague, tularemia, botulism, and viral hemorrhagic fever. These agents have a high mortality rate and, like the salmonella incident, are relatively easy to disperse. The threat of these agents is very real, emphasizing the need for quality prevention, detection, and education of personnel to respond to these agents.

Production of many Category A toxins is fairly widespread, due to biological warfare programs that exist in many countries, and the seemingly innocuous research conducted in scientific laboratories. The production of many germ agents has already been accomplished; the question of using them in a bioterror attack comes down to acquiring the agent and dispersing it to affect a large number of individuals. It is expected that an aerosol release would be used in a large-scale bioterrorism attack, because it is the most likely to kill large numbers of people (Lawrence, p 1).

Even before the anthrax attacks that shocked the nation in October 2001, the United States was aware of the magnitude of the threat and the amount of anthrax potentially in existence. In 1995, American officials caught a firsthand glimpse of the production capabilities of the Cold War-era Soviet Union when they were shown a facility in Sepnogorsk, Kazakhstan (Miller, p 165). Known as the Scientific Experimental and Production Base, the super secret facility contained ten 20-ton fermentation vats, capable of producing *three hundred tons* of anthrax spores in a production cycle of 220 days (Miller, p 166). With proper distribution, only one hundred grams of dried anthrax is enough to annihilate a small city (166). In its peak in the late 1980's, the Soviet biological weapon program employed sixty thousand people, with an annual budget of close to $1 billion (167). Much of the anthrax, plague, smallpox, scientists, and technical know-how from the Soviet Cold War-era program remain unaccounted for today.

Inhalational anthrax is the type of anthrax that is most likely to be encountered during a biological attack, and it is also the most deadly out of the three forms of anthrax. Human mortality rates are difficult to estimate due to the limited number of documented cases, but they range from 45% in the 2001 attacks (five deaths out of eleven inhalational anthrax cases) to 89% for documented cases throughout the 1900's (Lawrence, p 2). Cutaneous anthrax, the most common form of naturally-occurring anthrax, and gastrointestinal anthrax (quite rare) have lower mortality rates (Lawrence, p 3). Difficulty in anthrax detection can contribute to its high mortality rate. Anthrax has an incubation period in which there are no apparent symptoms for 2 to 43 days, although it generally lasts between 4 to 7 days after exposure (Lawrence, p 4). Symptoms consist of nonspecific flu-like symptoms, including fever, nausea, chest discomfort, and nonproductive cough (Lawrence, p 4). Even worse, there are no specific laboratory tests to suggest anthrax (Lawrence, p 4). Because testing for anthrax requires a high level of suspicion and proper treatment is essential, it is critical that health care workers are trained to detect and respond to incidents of bioterrorism.

Smallpox is a disease that is especially harmful due to its highly contagious nature. More than one out of four people who contract smallpox die from the disease. For every index case of smallpox, three to four additional people will be infected, mostly through close face-to-face contact (Lawrence, p 9). Like anthrax, smallpox also has a period in which no symptoms are present – usually twelve to fourteen days (Lawrence, p 9), before the characteristic rash appears. After symptoms appear, there are no antiviral treatments available for the victim, and vaccination is not effective (Lawrence, p 10). During the Cold War, the Soviet Union stockpiled twenty tons of smallpox virus – enough to attack 4,000 square miles of enemy territory (Tucker, p 147). Because smallpox is highly contagious and difficult to control once it has been released, smallpox is a grave concern of many health care professionals. Like some other Category A agents, symptoms can resemble the flu during the early stages of the infection. Because detection and treatment are key to controlling an outbreak and reducing casualties, our nation's hospitals are the first defense against biological agents once they have been released.

Pennsylvania Hospital Preparedness

Much has been done in terms of bioterrorism preparedness in Pennsylvania and the nation in general, but major deficiencies continue to exist in training and communication systems. In August 2002, The Pennsylvania Department of Health distributed extensive surveys to assess the preparedness level of 208 hospitals, and 100% of the hospitals contacted returned them for the Department of Health to analyze (HRSA, p 3). The striking results of the survey: the majority of hospitals do not have annual staff safety training for biological agents, and most do not have a general orientation for new employees. See Figure 1 for a graph of the percentage of hospitals that have annual safety training programs and orientation related to bioterrorism. Only 39% of hospitals reported an annual training program, and even fewer (24%) had basic orientation for new employees (HRSA, p 16). This critical shortage in staff training leaves our health care providers inadequately equipped to respond to incidents of bioterrorism. An increased emphasis on training and better tools and forms of training can help bridge this gap and provide a safer workforce and general population.

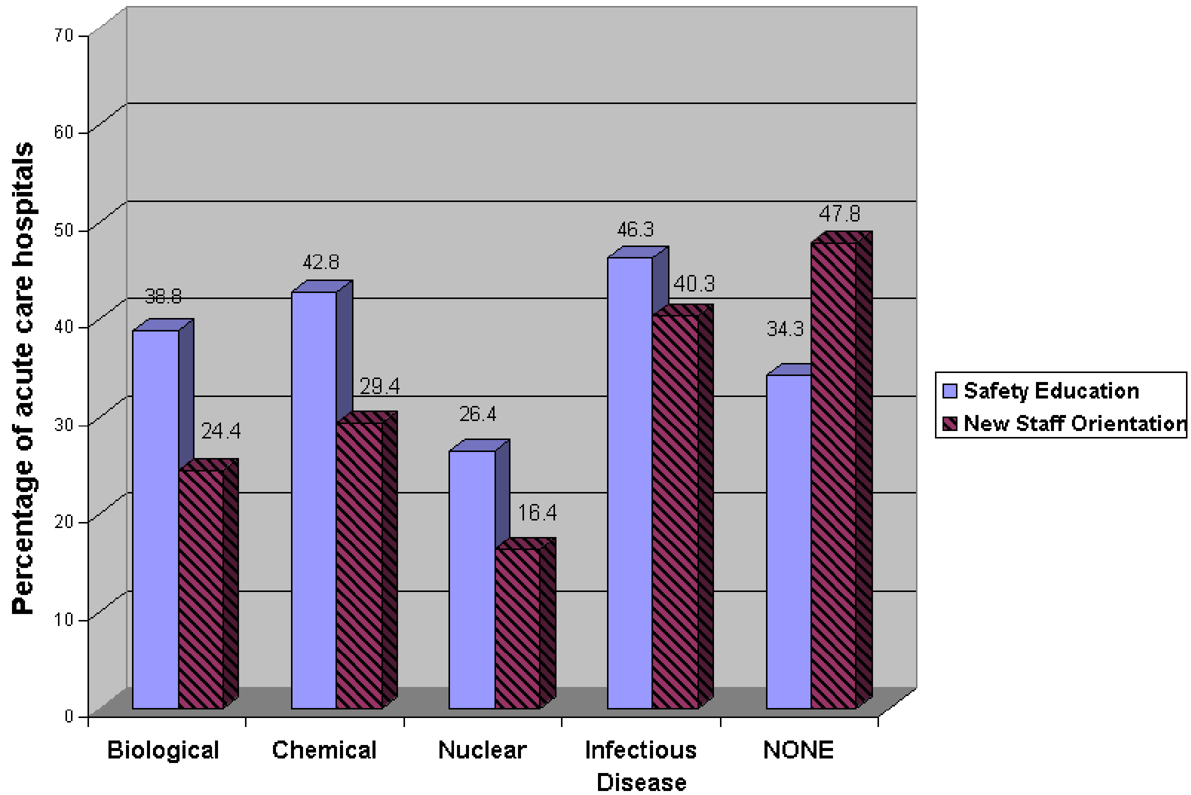

Figure 1. PA Hospital Staff Training Preparedness

Despite the limited hospital preparedness with respect to bioterrorism training, hospitals *are* aware of this vulnerability. Hospitals were asked to rate twenty-six preparedness items in terms of priority need. The *number one* priority of hospitals was staff training for emergency procedures (HRSA, p 33). Advances in training ability and technology would be welcomed with open arms by hospitals and workforce training organizations, given the severe need for training.

Impacts of Multimedia on Learning

Multimedia software is a type of tool that can be used to fight the war on bioterrorism. Computer simulations for bioterrorism training offer unique benefits that traditional methods of instruction and training cannot. What are some of the key characteristics that make an interactive bioterrorism simulation unique? First, the medium of a computer is unique in that it requires inputs and active engagement from the user (Chabay, p 152). It is impossible for the learner to be completely passive in this environment, as the multimedia sequence often will not continue without user intervention. (Chabay, p 154). In addition to this, there are many reasons why multimedia environments are well suited to the learning process. Unlike a training manual or static textbook, a multimedia environment allows an individual dealing with an outbreak of bioterrorism to change a variable in a simulated situation and immediately witness an outcome. This is especially important given the interaction that biological agents can have with population density, wind speed, and other factors. Unlike a lectured training environment, electronic materials are self-paced, repeatable, and allow the ability for review, additional explanation, or experimentation at will. Also, illustrations can be dynamic and more detailed than on a blackboard or similar device. Well-designed multimedia applications can measure learner comprehension via input and offer individualized instruction based on his or her needs (Chabay, p 153). For these reasons, a computer-mediated environment can improve the bioterrorism training experience in ways that other mediums cannot.

The majority of bioterrorism simulations are paper-based (Boak) and little formal research has been conducted on software specifically related to bioterrorism. Thus, a case study outlining the educational benefits of a simulated environment will be presented on an unrelated subject matter. One of the most comprehensive studies of the effect of multimedia on learning was conducted over a course of three years with students enrolled in a Carnegie Mellon University philosophy course. The philosophical case study concerned a 25 year old car accident and burn victim named Dax Cowart who wished to die (Right). Although on the surface this case seems to be unrelated to the training of officials to deal with a bioterror outbreak, there are some similarities. Like an incident of bioterrorism, the Dax Cowart case required the assimilation and integration of many different variables before recommending a specific course of action. Additionally, concerns of individuals with varying viewpoints must be considered in a complex environment before making a decision.

The Dax Cowart Case

Some specifics on the Dax Cowart case: Dax Cowart's injuries required an *extremely* painful and lengthy treatment, followed by an unknown quality of life after treatment. Dax wished to stop treatment, which would certainly result in the end of his life, but caregivers and health professionals refused (Right). Three consecutive experiments were conducted around this case, ending in 1999, exploring the effectiveness of the multimedia environment on student learning. In the experiments, students from a large philosophy course were randomly assigned to one of three groups to learn the material (Cavalier, p 10) during a 90 minute period of time. The first group read textual materials, the second group watched a film, and the third group used an interactive CD.

Sixty-eight students participated in the third experiment, and exams were scored by independent graders (Cavalier, p 21). Students in the interactive CD group (mean score of 17.7) had a significantly higher mean score than the film group (mean of 12.2) or the text group (mean of 14.6) (Cavalier, p 21). Results of the study showed that students who used the interactive CD-ROM for study outperformed students using traditional methods of study.

The Dax Cowart CD-ROM was designed in a way that promoted the usage of critical reasoning by a technique called *reflective engagement* (Cavalier, p 24-25). The CD-ROM is designed so that students must synthesize, analyze, and reflect about the content of the case at certain intervals throughout the case study. Multimedia allows the student to receive ‘rich data’ consisting of personal narratives and videos of individuals involved in realistic settings (Cavalier, p 4). This is information that one cannot glean from text and images alone, and the reflective engagement and intermediate questions cannot be expressed in film. The CD-ROM also contained a ‘guided inquiry’ tour of the case with video clips of key players. Since the three student groups were equal in terms of assignment, content, and student background (Cavalier, p 25) the multimedia nature of the CD-ROM seemed to be the cause of improved exam scores in the CD-ROM student group. Improvements were seen in student *understanding* of positions of key players and the ability to *analyze* details about the case (Cavalier, p 24). Software having these qualities can be created to better train public health officials and elected officials to respond to biological attacks.

Synthetic Interviews

Limitations of current training methods and advances in technology have made apparent the need to merge technology with bioterrorism training. A problem of communication and bioterrorism training arises when a large number of people need to get information from a small group of experts. When dealing with an incident of bioterrorism, there are two categories of individuals who will attempt to get information from a small number of sources. The first is the public. During a crisis, the thirst for knowledge among members of the public is insatiable. For example, during a biological outbreak in a major city, thousands of people will immediately want answers to similar questions about the nature of the germ agent and the appropriate course of action. The second category of people wanting bioterrorism-related information is professionals who train others and individuals who will be the first responders to an outbreak. These individuals also want information when there is not a breaking biological incident, for training purposes. The question becomes, how do we prevent a small number of experts from being overwhelmed with questions from the public and professionals wanting information? One solution to this problem is an emerging technology called a *synthetic interview*.

Simply stated, a *synthetic interview* is a computer-mediated communication tool that allows individuals to ask questions of an expert or other person and get an appropriate answer from a set of pre-recorded responses. One individual at the forefront of synthetic interview technologies is Dr. Scott Stevens, a senior systems scientist and adjunct professor at Carnegie Mellon University. Some of the information for this section came from an interview with Dr. Stevens, and a full transcript of this interview appears in Appendix A. Synthetic interviews are appropriate for bioterrorism response and training because many people will be asking the same types of questions. If anthrax were detected in downtown Pittsburgh or other major city, for example, the set of questions that an inquiring person would reasonably ask on this topic is finite. Hundreds of people will be asking "How can I protect myself? What do the authorities recommend? Should I create a 'safe room' in my house with plastic sheeting?" Even many questions that are related to anthrax are unlikely to be asked, for example, "What is the name of the scientist who first discovered anthrax?" This is an ideal situation for a synthetic interview. Nearly all of the reasonable questions that members of the public would ask in such a situation could be answered by using a databank of a few hundred pre-recorded questions and answers.

The Internet has become a useful tool used to empower one-to-many communication. The characteristics of the text-only medium, however, limit forms of communication (Riva, p 281). In fact, due to the lack of important characteristics such as voice inflection and facial expression, computer-mediated communication is often described as an "efficient form of ***mis***communication" (Riva, p 583). A synthetic interview has the advantage of a calming voice or an empathetic face, unlike cold text on a computer screen. Another advantage of a synthetic interview is that it can convey a sense of authority and competence that text alone cannot. One form of miscommunication in computer-mediated communication is that of false identities (Riva, p 584) and other deceptions. It is relatively easy for an amateur to pose as an expert and give inaccurate advice on the Internet. Skeptical members of the public may be wary about taking advice from text from a website when the author is not known. Video of a professional in an established setting can lend some credibility to the advice. A well-crafted synthetic interview can circumvent some of these problems.

Figure 2 shows an example of an existing synthetic interview that conveys a sense of authority and reputability. (Currently available from: http://websi-01.ci.cs.cmu.edu/wntemp/WebSI.asp?char=westnile .) This is a panel of experts that answers questions regarding the West Nile virus via a synthetic interview. Users can ask questions by typing them in a text box, and the system will recall the appropriate video clip to answer the question. The panel includes the Pennsylvania State Veterinarian, the Pennsylvania State Physician General, and an expert from the Pennsylvania Environmental Protection Agency (Medical). The interview system is designed so that the appropriate person answers to questions pertaining to his area of expertise. For example, the State Physician General will respond if the question is about human symptoms, but the State Veterinarian will answer if the question concerns a pet contracting a disease. This is an example of a synthetic interview implemented using a web-based interface and streaming video.

Figure 2. Synthetic interview example

The Department of Health website was a demonstration project that was never fully implemented due to changes in organizational structure and politics. With a change in personnel, the champion for the project and the motivation for it disappeared. Synthetic interviews are not just theory, however; there have been successful interviews developed for practical use. One example is a system that Dr. Stevens created for Bell Atlantic to service DSL customers. Much like the public during a terrorist attack, these customers often asked the same questions. A web-based synthetic interview was developed that guided customers through answers to common questions. The system resulted in a reduced number of calls to human operators, allowing the company to focus their resources in other areas. Customers were increasingly satisfied because the "expert" was available twenty-four hours a day, and the interaction was more personable. A similar system could be created to provide information and assuage public fears during a biological outbreak.

A synthetic interview was successfully integrated with the existing information and organizational structure of a corporation providing high speed Internet service, but would such a system work in the domain of health care and bioterrorism planning? Statistics indicate that such a system could blend well with existing hospital emergency planning. Eighty-seven percent of Pennsylvania hospitals surveyed address the use of spokespeople in their emergency plans (HRSA, p 8). Ninety-five percent of hospitals cite a specific news conference location (8). The systems for identifying spokespeople in times of crises are already identified; these people could be selected in advance to conduct a synthetic interview. In the case of synthetic interviews, a web address would be communicated in addition to the news conference location that is already in the plan. Due to the existing structure and content of hospital emergency plans, synthetic interviews could integrate nicely into the existing preparedness schema.

As speech recognition systems increase in versatility and accuracy over the next few years, a telephone-based system of synthetic interviews will become a reality. This will increase accessibility of synthetic interview technology to individuals who do not have access to a high-speed Internet connection or who are intimidated by the web-based interface, and to areas in situations in which a telephone conversation is more convenient. This technique could increase the amount of reliable information being provided to individuals in a crisis or ambiguous situation, while freeing essential personnel to complete other necessary tasks.

There is a strong need for telephone-based information for members of the public, and synthetic interviews can fill this need. Individuals already heavily use telephone call-in centers to ask for information. For example, during the peak of the West Nile virus scare of 2002 and anthrax scare of October 2001, the Allegheny County Health Department received between 75 and 100 calls per day with residents concerned about the West Nile virus, according to a health department official. At the peak of an outbreak, a health department employee must spend three to four hours per day fielding calls from the public, many of which are repetitive in nature. For example, during the West Nile scare, most people wanted to know the warning signs of West Nile, how they should avoid it, and the likelihood that they had contracted the disease. The level of inquiries during a major bioterrorism attack could be much higher than seen in prior events.

When implemented successfully, synthetic interviews could fill an existing gap in communication systems. Less than one in three Pennsylvania hospitals has an established telephone hotline that can be used for public information during an emergency (HRSA, p 33). Funding is available; however, if a health agency such a hospital was interested in creating a sophisticated synthetic interview system. For acute care hospitals in Pennsylvania, upgraded communication systems account for the largest planned spending increase for the 2002-2003 year, outpacing all other emergency preparedness activity funding increases. In 2001-2002, 42% of hospitals spent money to upgrade communication systems (HRSA, p 37). This figure jumps to a predicted 71% in 2002-2003. A synthetic interview session planned in advance could answer many of the most common frequently asked questions raised by the public and could assist in training health workers to prepare for an incident of bioterrorism. A simulation of a biological attack is another way that training could be enhanced.

Game-based Simulations

Simulation – the imitative representation of the functioning of one system or process by means of the functioning of another <a computer *simulation* of an industrial process>. Examination of a problem often not subject to direct experimentation by means of a simulating device (Merriam-Webster).

An interactive gaming environment is a training concept that can be used to train individuals to respond to an incident of bioterrorism. A gaming environment can be thought of as a simulation that monitors and records a user's progress toward a goal in terms of a score. One domain for which gaming is particularly useful is simulating a release of a biological or chemical agent, Gaming is also useful for any crisis situation such as a natural disaster or other weapon of mass destruction. In the current training paradigm, real life *exercises* are conducted in which a group of experts come together and respond to a simulated event. Many times, these exercises are conducted so that they are as realistic as possible, at significant expense.

One example of a realistic live exercise was Mall Strike 2001, conducted at the Greengate Mall in Greensburg, Pennsylvania. In this elaborate exercise, a terrorist attack using gas and a radiological agent was simulated in a shopping mall. The exercise was complete with volunteers pretending to be sick victims, ambulances, fire departments, and smoke-releasing devices. Firefighters and first responders in full gear rushed into the mall and rescued victims. Some responders were tapped on the shoulder to indicate they were considered dead or injured because they had not followed proper procedures or were otherwise exposed to the chemical agent. Once the victims got out of the mall, they were physically transported to local hospitals, where nurses on duty decontaminated and evaluated the victims. Some victims acted aggressively or irrationally, mimicking a real-life crisis situation. All told, this exercise required the participation of hundreds of officials and volunteers, including 600 emergency first responders and emergency managers (Pavetti, p 12). The event consumed $32,000 of federal dollars (Meeting), which does not include the time and lost wages of the people involved. This was only one of the many exercises that take place across the United States in a given year.

There are benefits and drawbacks to the existing method of conducting real-life simulations. There is value in having first responders and all actors in the flesh and simultaneously working to respond to a crisis. Logistics such as transportation, crowd control, communication networks that are unique to a specific geographical area are best represented by using actual equipment in a real environment. An exercise provides a level of realism that is unmatched by computer simulations and participants arguably get more practical know-how and practice from a live exercise. There are definite benefits to conducting a live exercise, and such exercises should remain a part of training for biological attacks.

On the other hand, costs are high for an event that occurs only one time. A well-designed software package can simulate many of the variables and characteristics present in a live exercise, with very low marginal costs. Another constraint of a live exercise is that only a limited number of individuals can benefit from it. A few hundred professionals in a specific geographic area learn from a live exercise. Conversely, a software package can be easily distributed far and wide, and literally thousands of individuals could benefit from it. Finally, options for integrating live exercises into existing training methods are limited. The model of preparing for the exercise, conducting the exercise, and then debriefing and identifying deficiencies and strategies for improvement is a quite good one. This may not be an adequate model for some situations, however; such as a classroom environment or a session for a small group of individuals. A multimedia simulation can be integrated with traditional forms of learning in various manners. For example, the simulation can be run, the results can be discussed in the classroom, and additional academic research and training can be conducted. The simulation can then be run again to demonstrate and assess the learned skills in an iterative fashion. Small groups can use the simulation, and then they can discuss the best method to respond to the situation. For all of these reasons, there is a place for simulations and gaming environments in bioterrorism-related training.

Biohazard Training Module

A simulated gaming environment under the name of Biohazard is being developed as a joint project between the Carnegie Mellon Entertainment Technology Center and the Massachusetts Institute of Technology. Much like the Mall Strike 2001 exercise, this software package simulates a chemical release in a shopping mall. For in-depth information about this project, read the transcript of an

Figure 3. Biohazard end of level screenshot [1]

[1] Screenshots are compliments of the Biohazard project team.
Website at http://www.etc.cmu.edu/projects/biohazard/spring03.

interview with the Biohazard producer in Appendix B. Biohazard is a game in which the player acts as a firefighter rescuing victims in a shopping mall by through the mall and stores and

performing crowd control. See Figure 3 for a screenshot of the virtual environment. Keyboard and mouse commands allow the user to navigate through the environment. Civilian shoppers have some autonomy in the simulation and randomly wander in and out of the hotzone. Navigating the virtual mall with other firefighters and rescuing civilians forms the basis for this game.

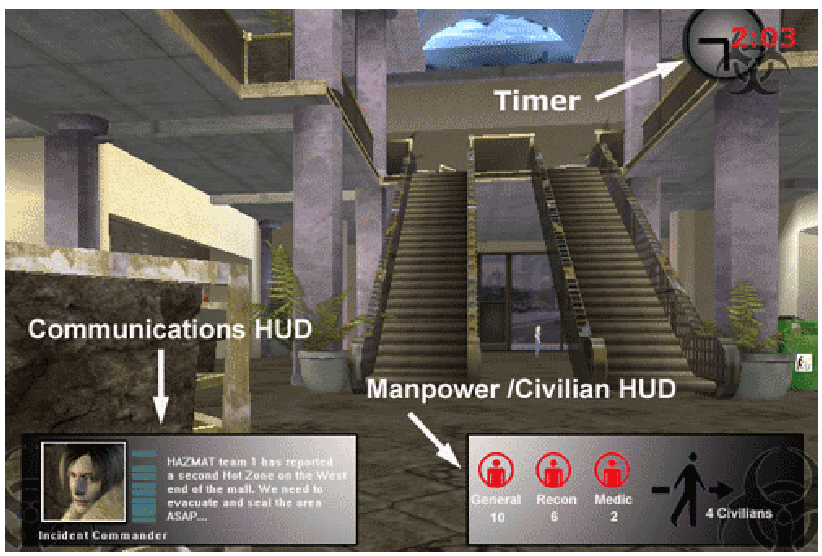

Figure 4. Biohazard status indicator screenshot

While using the terrorist incident simulation software, the user receives information about the progress of the rescue effort in several ways. Contact with a civilian shopper in the mall increases the "rescued civilian" score by one. The software records the number of civilian deaths and the remaining time in the current round on screen. Although the simulation could be used individually, the game is designed for use in a team environment with a coach. The coach is generally not a participant in the game, and is often the person who would command the firefighters during an actual incident. The coach can provide feedback and suggestions to firefighters in real time. This interaction can augment the training of incident first responders in a safe and repeatable environment.

A caveat to using Biohazard to prepare for the release of biological agents: biological agents often are released unnoticed. Biological agents are often colorless and odorless, and victims often do not show signs of infection for days after the release. For this reason, Biohazard was designed to simulate a chemical release, not a biological one. Although the Biohazard simulation is not a polished product that is ready for primetime, it serves as a prototype of what training tools are possible.

Commercially Available Software

Anesoft Bioterrorism Simulator 2002

One example of a complex-dynamic simulation is the Bioterrorism Simulator 2002 by Anesoft Corporation (see also related information in Appendix C.) Anesoft Corporation is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians. Physicians can earn continuing education credits by completing the simulation and mailing a form that indicates the number of hours that the student used the simulation. This software provides an interactive simulation with twenty-four potential victims of biological and chemical terrorist attacks. The victims suffer from biological agents likely to be used in an attack, including anthrax, smallpox, plague, botulism, and viral fevers such as Ebola. First responders and health care workers responding to terrorist attacks are potential audiences for this software. See Figure 5 for a screenshot of the software.

After reading a brief description of the particular case, the software user can examine the patient by performing an electrocardiogram and checking blood pressure and oxygen levels. The user can then control the airway and ventilation and start IV fluids. The user can order labs or other studies, decontaminate the patient, and administer any combination of the many drugs available in the program. The case simulation is considered complete when the learning objectives have been met and when the heart icon appears on the screen. After the simulation, the user can read a debriefing section for comments on what could have been improved in the user's actions, and a learning objectives section to read reference information about the case. The software maintains a detailed record of the user's actions which can be saved or printed for reference. See Appendix D for additional information and a full review of the software.

Figure 5. Partial screenshot of Bioterrorism Simulator software.

The Ideal
Bioterrorism Training Environment

The ideal training environment for bioterrorism preparedness would include instructional material in many different forms: traditional lecture, reading, multimedia productions, and interactive evaluative software. A student learns the most when the same information is presented in slightly different ways in various forms of media. Each of these instructional techniques should not exist in a vacuum, however; they should be part of a comprehensive curriculum. Technology-based learning tools should not be considered stand-alone instruments – instead, they should supplement and complement material already taught in a traditional environment. The technology-based tools should follow general design properties that maximize learning potential, as outlined below. Existing multimedia and educational materials for bioterrorism training are somewhat lacking. The ideal bioterrorism training software would engage and captivate the learner and provide a scaffolding approach to teach new skills and knowledge. Designing good software eliminates barriers to learning by allowing the student to focus on the material at hand rather than the logistics of operating the software itself. For example, consider a virtual reality environment in which a first responder must move about a neighborhood to identify and isolate biological agent dispersion devices. If the user is preoccupied with understanding the navigation and agent controls, very little knowledge would be generated throughout the exercise. To promote quality software applications, there are guidelines that should be followed when building the software.

Complex-Dynamic Simulations

A multimedia simulation is one of the best tools that can be used to train for the complex and very dynamic situation that a bioterrorism attack would cause. *Complex-dynamic simulations* are simulations that require users to use their existing knowledge to generate solutions to problems (Tennyson, p 651). After basic training on how to respond to bioterrorism (either part of the multimedia suite or by more traditional methods), the simulation could then be used. The model of interactive cognitive learning that would be used in the simulation involves several facets of human mind and behavior: *sensory receptors* (in this case, sensory memory), *executive control, knowledge base*, *affects*, and *cognitive strategies* (Tennyson, p 653). Modern multimedia allows each of these components to be realized. Rich content such as sound, animation, and three-dimensional visualizations of situations surrounding a biological attack can create information for *sensory memory*. Interactivity and consideration of user input in multimedia environment promotes *executive control* and the encoding, storage, and retrieval of information. The Chinese philosopher Confucius stated, “I hear and I forget, I see and I remember, I do and I understand" (Adams). Multimedia simulation environments are optimal for this type of learning by doing. Details embedded in a well-designed virtual environment provide declarative, procedural, and contextual *knowledge* needed to navigate and understand the environment (Tennyson, p 653). The multimedia experience as a whole, utilizing the qualities of agency, immersion, and transformation, provides a framework for *affects*, such as attitudes, emotions, and anxiety. Finally, the development and synthesis of *cognitive strategies* are reinforced by interacting with a dynamic-complex simulation that requires user involvement (Tennyson, p 653).

One of the purposes of using a multimedia simulation is to teach a complete task or process from beginning to end, rather in successive parts (Tennyson, p 661). A holistic approach such as this is required for high-level incident response. Such task-oriented simulations are ideal at improving cognitive performance in complex situations using problem solving (Tennyson, p 661). The Minnesota Adaptive Instructional System (or MAIS) is a computer-based research tool that has embraced a complex-dynamic simulation technique as part of the curriculum. The MAIS consists of two components; one of which is centered on the curriculum. This component maintains a student model (the cognitive and memory states of each student) and a curriculum knowledge base. An expert tutor system in the software selects the appropriate information to be learned based on the current student’s mental model (Tennyson, p 662). The second MAIS component is an instructional component that “adapts instructional strategies according to moment-to-moment learning progress and need” (Tennyson, p 662). This is how a simulation of a biological attack could provide a personalized learning environment for each student.

One of the unique advantages of an interactive multimedia environment over traditional mediums is that the system can respond to the user's needs and provide an optimal, personalized learning environment.

A complex-dynamic simulation should be designed so that it develops the three aspects of cognitive strategies. The simulation should promote *construction* (the development of new knowledge and strategies) *differentiation* (selection of pertinent knowledge) and *integration* (the restructuring and elaboration of existing knowledge) (Tennyson, p 652). A well-designed simulation could promote **construction** of strategies by illustrating the warning signs of a potential biological disbursement device, and then requiring the user to locate a device in the virtual environment. **Differentiation** strategies could be achieved by designing software that first teaches techniques of interpersonal communication, and then displays videos of hysterical individuals who are potential victims of a germ agent. The simulation could use a technique of reflective engagement to ask, "Which information did the victim provide that should be disregarded? …that should be considered?" The **integration** of strategies could be promoted by having a public health coordinator or incident commander allocate resources to respond to a large-scale biological attack in a SimCity macro-level style of simulation. The same simulation could stress the importance of risk communications by having members of the media and public request information about what was occurring. A simulation could stimulate cognitive strategies by including additional characteristics as outlined by Tennyson (p 662):

- Complex situations to challenge the differentiation process of selecting relevant knowledge

- Situations that expose users to alternative solutions to improve the integration process
- Situations that allow for predicting value of future states and similar problems.
- Situations that use reflective evaluation rather than simple right or wrong answers.

There are several requirements of a successful multimedia simulation. Before beginning the simulation, the user must have necessary knowledge about the domain, so that he or she can improve upon existing knowledge (Tennyson, p 663). In the domain of bioterrorism training, this means that an individual should have a basic understanding of managing biological outbreaks before using a simulation. There are two facets to the construction of a simulation: the problem situation and the computer management system. The problem situation is what the multimedia developer must build into the system; all of the information necessary for the user to understand and navigate the system. The simulation should allow for increasing difficulty of the situation, and addition and reduction of select environmental variables. The computer-based management sections should provide initial conditions, assess the user's solution, and establish the next portion of the simulation in response to the user's decisions and inputs (Tennyson, p 633). The problem situation and the computer management system are two required facets of simulations that are needed to create interactive multimedia simulations for counter-bioterrorism training.

Complex-dynamic simulations have been developed and implemented for various situations, and they result in significant improvement in higher-order cognitive strategies (Tennyson, p 665). One application currently in use is a simulation of a county flood control system within a county that is operated by an "executive" (or in this case, the simulation user). In another simulation, the user controls fuel and energy consumption to meet modern-day needs. The domains of possible multimedia simulations are virtually endless, and the Minnesota Adaptive Instructional System as outlined by Tennyson is one that could be modeled to create bioterrorism response training content. The rich data and interactivity of technologically-advanced multimedia is what makes this possible.

Multimedia Application Requirements

Two distinguishing characteristics of multimedia applications are that they are information intensive and they have a complex design space for information presentation (Sutcliffe, p 109). Because of this, the interface design must allow for intuitive navigation that allows the user to focus on the main goal of the application, rather than requiring the user to devote cognitive resources to manipulating and navigating the design space. If a student using a simulation is attempting to administer medication to a victim while monitoring vital signs and rapidly changing conditions in the external environment, the student should not be struggling to retrieve drugs or monitor sensors due to poor interface design.

There are five viewpoints used to evaluate quality and effectiveness of multisensory user interfaces (Sutcliffe, p 2):

1. *Operational usability* – How easy is the product to evaluate?
2. *Information delivery* – How well does the software deliver the message and informational content to the user?
3. *Learning* – How well does someone learn the content delivered by the product?
4. *Utility* – What is the value of software as perceived by the user?
5. *Aesthetic appeal* – How appealing is the software to the user?

Usability of current multimedia and virtual reality products is quite poor, because most products are created without thorough testing (Sutcliffe, p 3). Three different approaches can be used to improve the usability. First, psychological models of the user can be used so that designers can better understand how people perceive and comprehend complex media (Sutcliffe, p 3). Second, design methods and guidelines built upon basic psychology principles can provide targeted design advice (Sutcliffe, p 3). Requirement-gathering and task analysis are integral (3). The third approach is to use design advisor tools during development; although comprehensive design advisor tools have not yet been developed for virtual reality and multimedia (Sutcliffe, p 3).

Simulations and Virtual Reality Requirements

Any interactive simulation, such as ones used in the bioterrorism training arena, should follow some Generalized Design Properties (GDP's). Too often designers do not consider the needs of the end user when building software, leading to an inefficient product that frustrates the user, rather than maximizing the learning experience. The *task-action cycle* is driven by the goals of the person using a simulation or other software package. It provides a framework for discussing the GDP's at each stage in the user's process of interaction with the software. Figure 6 lists the GDP's that should be followed during each stage of the task-action cycle. An example of a GDP implementation in each stage for a bioterrorism training module is provided. This table has been adapted from *GDP's and User Resources Associated with Task-Action Cycle Stages for Novice User(s)* (Sutcliffe, p 96). An interactive simulation for bioterrorism training purposes should conform to the following generalized design properties.

The Task Action Cycle:

Retrieve procedure → form intention → locate control → specify action → perform preparatory actions → execute action → recognize feedback → interpret feedback → evaluate change → decide if finished.

Task-Action Stage	Generalized Design Properties	Bioterrorism Simulation Example
Retrieve procedure	Task map, list of search facilities : appropriate tools to support user's task	User can adjust levels of vaccine to administer to biological agent victim.
Form intention	Necessary information and status indicator : reinforces current task or goal	A city map indicating areas of critical biological agent infection.
Locate control	Clear structure and consistent layout. Layout matches user's model.	In an interactive medical environment, drugs are located in close proximity to syringes and IV's.
Specify action	Clear affordances; power tools and controls. Indication of active objects, clear operational metaphors.	When performing crowd control, usable objects in the environment are highlighted; background is dimmed.
Perform preparatory actions	Accessible controls.	Open, uncluttered space surrounds navigational controls in a VR environment.
Execute action	Visible, consistent controls. Precise effects corresponding with user action. Indicate proximity to objects. Object selection by snap-to effects.	The 'L' key *always* 'looks' at an object in more detail, whether in different buildings, different rooms, or outdoors.
Recognize feedback	Locatable, perceivable feedback. Active notification of invisible objects. Discriminable detail.	Selecting an object is indicated by a temporary color change.
Interpret feedback	Meaningful messages. Observable state change.	Placing an EKG on a patient initiates an on-screen heart rate monitor.
Evaluate change	Explanation of change.	User sees change in

	Comparison of before/after states.	breathing rate after administering O_2.
Decide if finished	Task completion indicator.	An informational screen appears indicating that time has elapsed and a particular number of victims have been rescued.

Figure 6. Generalized Design Properties in task-action cycle

Following generalized design properties minimizes errors when designing multimedia simulations. There is no such thing as a perfect application, however; errors will still occur. Even when software is designed well, users will make mistakes and get confused. Figure 7 is a flowchart that offers an explanation to user confusion. The *motivation/training problem* is what we want to minimize with a successful application. When developing a bioterrorism training module as an interactive simulation, this process may help to identify the cause of the error.

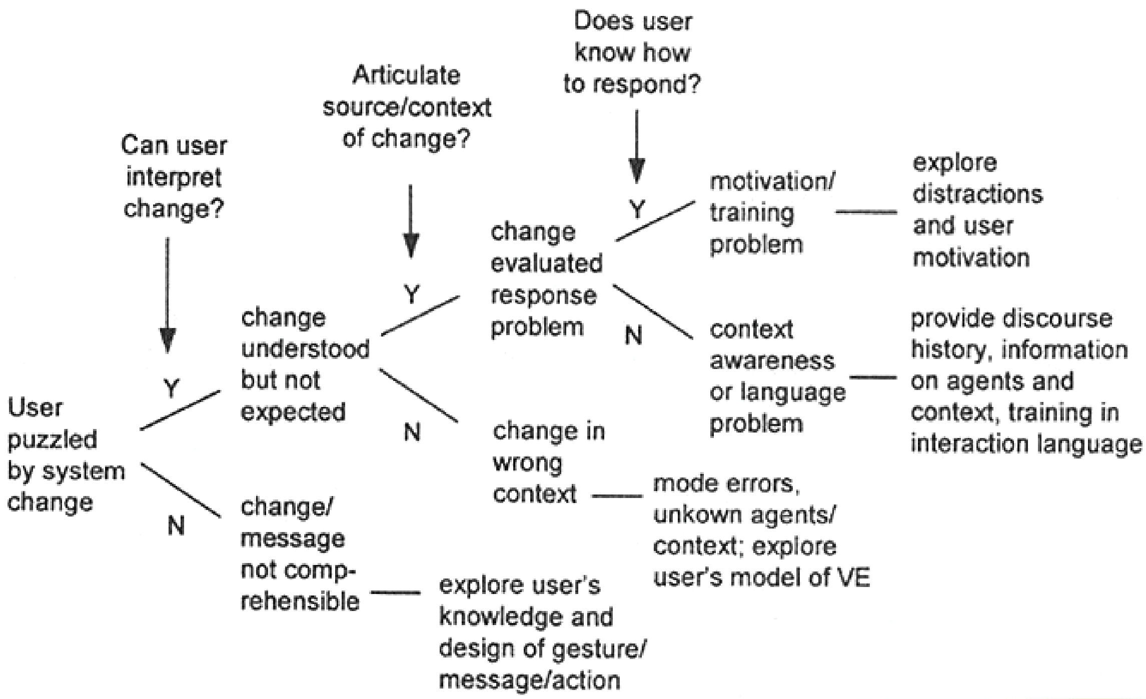

Figure 7. User processes during a simulation (Sutcliffe)

Who needs training and why?

A diverse group of public health and other professionals need to be trained to respond to incidents of bioterrorism. It is particularly important to train public health workers who diagnose and treat potential victims of biological agents because it is often difficult to distinguish an incident of bioterrorism from that of a naturally occurring disease. In fact, it is sometimes not discovered that a biological attack has occurred until months after the event (as in the Rajanshee salmonella case and others). A high level of suspicion is required to consider a malicious biological agent as a potential candidate for diagnosis, because the likely agents are rare or non-existent as naturally occurring diseases (Lawrence, p 1). Particular characteristics in the environment should serve as red flags to a possible biological agent. Such circumstances include an unusual clustering of cases in a geographical area, otherwise healthy people exhibiting signs of disease, and a sudden increase in sick or dead animals (Lawrence, p 2). A naïve or novice health care worker without training may not instinctively look for such signs. This is one of the reasons why it is critical that public health workers receive sophisticated training that is frequent and comprehensive.

Kristine Gebbie from the Columbia University School of Nursing has synthesized two years of research to create a report entitled *Bioterrorism and Emergency Readiness: Competencies for all Public Health Workers* (Columbia). This is a 24-page document that lists the skills (or "competencies") of various public health workers, if mastered, assure that the worker will be able to perform adequately in the event of a biological attack (Bioterrorism). There are many diverse types of public health workers that need to be trained, including top public health leaders, health professionals that treat victims, laboratory staff that works to identify biological agents, and much more. Figure 8 contains staff categories from the report, with competencies that would be particularly useful to train using a multimedia simulation. For example, communicable disease staff that investigates sources of disease and develops strategies to prevent further damage needs to develop criteria (algorithms) that dictate when additional investigation should be conducted (Bioterrorism). In a simulation, a student could set a threshold so that if a certain number or percentage of population is exhibiting symptoms indicative of a biological agent, laboratory tests are automatically run on emergency room patients. Clinical staff and first responders need to perform triage of victims. An interactive multimedia simulation could present video of victims and information on vital signs, and the student would have to correctly perform a triage to assess the criticality of a patient. Figure 8 lists competencies for various staff categories, and could be used as a starting point for concept design during multimedia simulation development.

Staff Category	Bioterrorism Readiness Competencies
Public health leaders *(e.g. directors)*	▪ Communicate with emergency response partners ▪ Coordinate resources for enhanced surveillance ▪ Active infection control measures specific to the biological agent
Communicable disease staff *(e.g. epidemiologists)*	▪ Apply algorithms that trigger further investigation ▪ Identify probable victims of a biological agent ▪ Demonstrate proper personal protection equipment and procedures
Clinical Staff *(e.g. nurses)*	▪ Identify signs and symptoms of a biological agent ▪ Perform assessment, stabilization, and treatment of victims ▪ Establish and perform triage of victims
Environmental health staff *(e.g. air pollution specialist)*	▪ Develop and connect event-specific risk communication to the public and public health workforce ▪ Apply public health measures to ensure protection of population
Laboratory staff	▪ Identify (and rule out) samples of biological agents
Medical examiner/coroner	▪ Identify nuclear, biological, or chemical agents from autopsy and other evidence ▪ Handle human remains appropriately
Public health information staff *(e.g. spokespersons)*	▪ Serve as a spokesperson to the media ▪ Coordinate communication between the public, media, health care providers, and responders

Figure 8. Bioterrorism Competencies for Public Health Workers

Note that the previous table lists only *public health* workers. Many other responders could also benefit from interactive multimedia simulations. The Biohazard simulation trains firefighters to perform crowd control. Another simulation could train law enforcement officers to secure an area, quarantine individuals, or safely apprehend perpetrators of a bioterrorism incident. The possibilities for multimedia applications to train for incidents of bioterrorism are nearly endless.

Conclusion

The Federation of American Scientists (FAS) recently published a 44-page report entitled "Training Technology against Terror: Using Advanced Technology to Prepare America's Emergency Medical Personnel and First Responders for a Weapon of Mass Destruction Attack." This report emphasizes the critical need for technology and multimedia-based applications to train professionals to respond to and prepare for biological attacks, among other incidents. Figure 9 is a summary of FAS findings, adapted from the report (Federation, p 3). The ideal training environment would use technology to enable professionals to quickly teach skills and review information needed during a crisis situation.

- Millions of civilian and military medical personnel need to be trained quickly to respond to events involving WMD and have continuous access to refresher courses, including "just in time" training during an emergency.
- Physicians, nurses, emergency medical workers, police and fire officials feel unprepared for a WMD emergency – particularly at the level of cities and counties.
- Even with adequate funding, current programs to provide this training are not adequate to the task.
- New information and training technologies can build a training system that will reach this audience quickly with timely information, allow tailoring training to unique local situations, and provide simulated experiences that transfer efficiently into high levels of performance in an actual emergency.
- To build new training technologies, a coordinated interagency plan should exist and draw on appropriate resources from existing professional certification organizations, universities, and private businesses.

Figure 9. Summary of FAS findings

The lack of funding, dedication to training, and innovative training tools is leaving first responders and public health workers less than prepared to respond to incidents of bioterrorism. The American Hospital Association estimates that $11 billion dollars are needed to improve the nation's 4,900 hospitals to respond to a biological attack (Bioterror). This is twice as much than the federal government is allocating for this task (Bioterror), which would leave America's health workforce ill-prepared for a biological attack without additional forms of training. There is not a well-publicized and comprehensive multimedia simulation available for training purposes that covers all major facets of a biological outbreak. The Department of Defense has spent approximately four million dollars in an attempt to create a "virtual emergency response training simulation" (or VERTS) that would create a real-life simulation in an area the size of a city block, and an Internet-based simulation featuring models of U.S. cities and large crowds of virtual people reacting to emergency situations (Federation, p 24). Numerous delays have slowed the development and implementation of this system, however (Federation, p 24), and the system would not focus on the idiosyncrasies of a *biological* attack. The Bioterrorism Simulator 2002 is a low-budget application that serves only very specialized medical personnel. Computer-based simulation of biological outbreaks is an area that represents a deficiency in available training materials – and quite possibly a market opportunity for software developers.

Computer-based multimedia forms of training are needed to train for bioterror incidents due to their unique complex-dynamic nature. Elaborate real-life simulations and exercises have merit, but they are costly, available to a relatively small number of participants, and are not repeatable. Multimedia simulations are unique as a type of training device in that they allow individuals to assume various roles throughout a simulation; for example, a student could become an incident commander, firefighter, or a medic at different times during the simulation. Software packages often have the ability to provide an individualized training environment by using intelligent tutor systems, artificial intelligence, or simply providing the option to repeat and review information at the learner's choosing. Studies have shown that individual tutoring experiences improve the learning process when compared to standard classroom packages (Tobias). The marginal cost of reproducing software is extremely low, eliminating the cost of training experts and paying for their travel to train a relatively small number of individuals. For all of these reasons, technology, multimedia, and simulations can and should be developed and used to train officials to respond to incidents of bioterrorism, which will lead to a safer world.

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Appendix A: Scott Stevens Interview Transcript: ”Synthetic Interviews”

Personal Interview: Scott Stevens, PhD
by Eric Barker
Wednesday February 12, 2003; 11:30am
Newell Simon Hall 3529, Carnegie Mellon University

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1. Dr Stevens – could you please tell me a little bit about yourself, your current work projects, and your background?
2. What exactly is a synthetic interview?
3. Are there synthetic interviews in use today in a practical environment, or are they at the research stage?
4. Why do you feel that synthetic interviews are particularly useful in the area of bioterrorism?
5. So one of the benefits of text is that you get a calming effect?
6. Has anyone expressed interest in developing a system for bioterrorism training or public information?
7. Can you describe for me a couple scenarios in which synthetic interviews could be used to respond to incidents of bioterrorism?
8. In general, what are that you get with a synthetic interview that you don’t get with just plain text?

Eric This is Eric Barker, senior Information Systems major, doing this interview as part as my honors thesis. I’m here interviewing Dr. Scott Stevens today, being February 12, 2003.

[Question #1] Dr Stevens – if you could, could you please tell me a little bit about yourself, your current work projects, and your background?

Scott Sure. I’ve been developing interactive video projects since the mid-70’s – I was involved with an experimental system to deliver compressed video in the home. Since ’76, I was working on that. After that, I worked on interactive video disc design. Here at CMU, I developed the first video CD-ROM when I was at the Software Engineering Institute. Since the mid-90’s I’ve been working principally on digital video libraries, using computing technology to automatically understand what’s in a video and applying vision technologies, speech recognition, and natural language understanding so you can put video into a black box at one end and at the other end be able to query and get the appropriate video back.

Eric *[#2]* So one of your projects is synthetic interview. What exactly is a synthetic interview?

Scott Well, it's a attempt to capture, in a very easy way, expertise much like you have an expert system hooked up, all of the rules that you have, and much like a regular interview might be like this is, but with a lot more utility. It really came out of a couple different projects. One, the Informedia project. We had a project called Advanced Learning Technologies project where we created synthetic characters for training... It was simulated for humans with digital video. In the early 90's, I was with DARPA – the Defense Advanced Research Projects Agency – and every year they have a couple week session in the summer where they host a particular topic of interest to them and I was one of the scientists that was there, and I remember hearing someone from Stanford saying the Internet was going to democratize education because any student anywhere, whether living in a city or affluent suburbs can get access to any of the great scientists in the world, which is a stupid idea, because –

Eric Right. I was just reading about whenever television first came out, they thought that television was going to end global conflict and put everyone on the same level, and a few years ago they were saying the same thing about the Internet.

Scott ***[time: 5:45]*** Well, the problem is, people don't scale up. So if a few hundred, much less a few tens of thousands students decide to ask somebody a question, for example, a Nobel Laureate of Physics, he's just not going to have time to do it. I have colleagues who have unfortunately had to just have automatic responses to email, because they will get students who, for whatever reason, their teacher will say "okay, today, try and track down somebody and ask them a question" and they will get inundated with questions and they just have to say, "I don't really have time."

At the same time, Internet chat – in particular, celebrity chats – were really taking off. I remember there were two: one with Pamela Anderson Lee that literally brought down Prodigy – literally took the network down, so many questions were asked. Another one with Paul McCartney; in a space of an hour, there were over four million questions were asked. It was clear that these weren't formulated unique questions. There might have been a hundred unique questions, or a thousand unique questions – but whatever number it was, it was manageable. People are only going to ask so many kinds of questions. The idea came to me that we could capitalize on that.

Eric *[#3]* Are there synthetic interviews in use today in a practical environment, or are they at the research stage?

Scott We have had some that were in a practical environment. One was does for Bell Atlantic as a customer service agent. One was a guide for lasvegas.com, which was used by thousands of people…

Eric So the system for Bell Atlantic – is that one that you worked on?

Scott Yes.

Eric And was it a telephone-based thing where people could call in with questions?

Scott No. It was designed for their DSL customers. It was essentially a help agent; we wanted to highlight the broadband types of events, with video.

Eric So people could ask technical questions and that person responded?

Scott Yes.

Eric So how were the results of that? Were they pleased?

Scott They were very pleased. What happened was with Bell Atlantic, when Verizon took over, that piece just went by the wayside, so they don't really use it anymore.

Eric What were the benefits that Bell Atlantic saw with that kind of system?

Scott Well, reduced number of questions to human operators, increased customer satisfaction because they had someone that was available twenty-four hours a day, and customers liked that better than text – frequently asked questions – because it seemed more personable.

Eric *[#4]* Why do you feel that synthetic interviews are particularly useful in the area of bioterrorism?

Scott ***[12:18]*** I think there are probably two areas where they're useful. One is training, where you may want to train first providers with … It's probably more useful as an information source for the general population. For example, "should I get plastic in case there's a chemical attack?" Just having somebody available all the time that you could go to and ask questions. It would beneficial as a source of information, but it could also be a calming device. It's someone you could "talk" to.

Eric *[#5]* So that's one of benefits of video over text, right, that you get that calming effect?

Scott Not only that – people enjoy it. There have been studies that given instructions given in text and video that people retain video information better than just reading the text.

Eric *[#6]* So has anyone expressed interest in you developing a system for bioterrorism – either for training, or for the public?

Scott There's a project that we may focus on: there's someone focusing on putting together a bioterrorism training program right now; Jesse Schell. There's not a synthetic interview in it now, but there definitely could be. There has been some talk about developing a system as a public information source… We did do one for the Pennsylvania Department of Health that was for the West Nile virus; panelists answered questions about the virus; a very similar concept to what you would have if someone was calling about anthrax.

Eric *[#7]* Can you describe for me a couple scenarios in which synthetic interviews could be used to respond to incidents of bioterrorism?

Scott ***[16:10]*** Sure. Again, you have the experts there that are there for people to ask questions. If there was an anthrax letter in downtown Pittsburgh, everybody in the surrounding areas will wonder if they should go to a doctor to get antibiotics. What's the antibiotic they should ask for? What has happened, there are *huge* spikes of people calling their doctor and asking for prescriptions when there is no reason to do it. Not only is there no reason to do it, we know that overmedicating is a bad thing; plus making more drug-resistant bacteria.

So having a [synthetic interview] available for people to know – so you could consistently ask them questions that would lead the system in the synthetic interview to have an understanding whether or not this person was at-risk: "Were you in that building in that part of Pittsburgh?" If so, and there is any chance that you're at risk, if it's not zero and you're experiencing symptoms, *then* you should call your doctor. Just that alone could unburden primary care physicians, emergency rooms, etc.

Eric *[#8]* In general, what are that you get with a synthetic interview that you don't get with just plain text?

Scott ***[19:10]*** Again, it allows your experts to scale and expand time if you will. You're capturing, in essence a normal conversation…

Appendix B: Ira Fay Interview Transcript : "Biohazard Project"

Personal Interview: Ira Fay, Carnegie Mellon Graduate Student
by Eric Barker
Tuesday, March 18, 2003; 3:30pm
Carnegie Mellon Entertainment Technology Center, Doherty Hall 4301

1. Could you please describe what the Biohazard project is?
2. Currently without the game, what are the current ways in which the training is done?
3. Are there other game-based training modules for biological or chemical attacks already in use?
4. And who did you use as subject matter experts for background information when building the software?
5. Did you speak with anyone in terms of software design?
6. Did you find that any advice you were given was contradictory or conflicting?
7. What are the separate training areas that this piece of software addresses?
8. What qualities of this software will be beneficial when training first responders to deal with biological and chemical incidents?
9. What are the different roles of the Carnegie Mellon and MIT team in this project?
10. How many person hours does it take to do this project, and how do envision the costs of developing future training simulations?
11. How does the cost for software development for training compare with costs for the existing method of real-life simulations?
12. What do you see as the major drawbacks or limitations to the practical use of this software?
13. In an ideal environment, how would this particular software package be used and how would it be integrated into existing training methods?
14. What's next? What are your plans for the future of this software?

Eric This is Eric Barker; I'm a senior Information Systems undergraduate at Carnegie Mellon interviewing Ira Fay, who is a Carnegie Mellon graduate student working on the "Biohazard" project at the Entertainment Technology Center.

[Question #1] Could you please describe what the Biohazard project is?

Ira Sure. We're working on a training simulation game designed to teach firefighters how to respond to a chemical attack in a mall, and it's using Unreal Tournament 2003 as the game engine, and the setup will be four or five firefighters in the same room at the same time with the instructor in the same room with them but not necessarily playing – simply observing and giving suggestions as they go along. The game itself allows them to interact with the simulation and the [virtual] world without any of the risks of doing that in real life.

Eric *[#2]* Currently without the game, what are the current ways in which the training is done?

Ira Currently, the training is done with readings, they're given specific literature to read – they're also given lectures – where some experienced firefighters will teach a class. Finally, there are a lot of role-playing real-life simulations where they get hundreds of volunteers to portray sick civilians or whatever the situation is and allow the firefighters to go in and rescue those civilians in real life. But that's a very expensive method – not only in time, but also in money and organization to get one together. It's also not very repeatable; you can't do that every day. You can only do that once, and it requires a lot of organization.

Eric *[#3]* Right. Are there other game-based training modules for biological or chemical attacks already in use?

Ira I'm not sure. From my search, I did not find anything relating specifically to biological or chemical. I know games exist that train firefighting skills and responding to emergency situations in general, but I don't know of any biological or chemical attack simulations designed to train firefighters. I do know there are simulations designed to train incident commanders – the people involved in making the decisions at the event – but I don't know of anything that's designed to train the first responder or firefighter who actually goes into the mall or goes to wherever the hotzone [area affected by biological agent] to deal with the problem.

Eric *[#4]* And who did you use as subject matter experts for background information when building the software?

Ira Obviously there is a lot to learn in order to build a convincing and realistic simulation, so you talk to a lot of different people, including:

Al Wickline who is a knowledgeable about hazardous materials and also is the chief instructor at the Allegheny Fire Training Center, as well as several other hazmat people who I can't even name all the people we talked to – also we spoke with Region 13 Weapons of Mass Destruction Task Force – specifically, Chief Full and also Dennis Narey – who are over at Region 13 – and also we spoke to Knox Walk, who is the EMS coordinator for the Allegheny County Area.

So basically we spoke with firefighters, hazardous materials responders, weapons of mass destruction experts, and medical experts.

So basically we spoke with firefighters, hazardous material responders, weapons of mass destruction experts, and medical experts.

Eric *[#5]* Did you speak with anyone in terms of software design or things along that nature?

Ira Software design is one of our skills. We are graduate students and our expertise on the team is art, animation, and programming.

Eric *[#6]* Did you find that any advice you were given was contradictory or conflicting?

Ira Certainly. There's not one right way of going about it, and there's not one answer. We're not sure exactly what the approach is, and neither were the experts. They were very knowledgeable in their field, but in terms of going about creating this training simulation, we can't entirely simulate the real world. We have to make choices about what to include and what not to include, and deciding which to include was really where we got the conflicting advice.

When we spoke to the EMS coordinator, he said, "Let's make it about hospitals, and events that occur near a hospital." The hazardous materials people said, "Well, we already know a lot about these sorts of issues. You should make it a much more challenging situation and give us very difficult problems to deal with." The firefighting people said, "This is about the right level of difficulty, and there are some very basic things that you could include that would be useful to train.

Eric *[#7]* What are the separate training areas that this piece of software addresses?

Ira So responding to a chemical attack in a mall is a very large problem. We're specifically training on the evacuation piece of it. How does the firefighter go into a mall and evacuate any remaining civilians that are in that mall and get them out to safety? That's the area we're focusing on, as well as teamwork among the firefighters as they go in and as they explore.

Eric *[#8]* What qualities of this software will be beneficial when training first responders to deal with biological and chemical incidents?

Ira Hopefully they learn the two things that we're trying to teach them. The first is how to go about evacuating civilians in a chemical attack situation, and also in general how to work better with their team and their commander. One of the things that the software will allow you to do is either separate entirely and spread out in the mall – which would allow you to cover more distance – or stick together in groups of two or four or however many. So what we'd like the firefighters to try is go out in the mall individually, and go out in the mall in a group – and see which is better. In real life, it's much better to stay in groups of two because if something happens to an individual fireman when they're inside, they need their buddy to get them out.

Eric *[#9]* What are the different roles of the Carnegie Mellon and MIT team in this project?

Ira So this project is a joint project between Carnegie Mellon and MIT, and Carnegie Mellon is primarily responsible for the design and implementation of the game, and MIT's primary responsibility will be [evaluating] whether or not the game actually taught the firefighters anything. We have already done basic play tests to find out, "is it a reasonable game?" but to really get significant statistics, we're going to leave that piece of it to MIT.

Eric *[#10]* How many person hours does it take to do this project, and how do envision the costs of developing future training simulations?

Ira It takes a lot of time. I don't know how to calculate it, but if we said something like, "There are five students and one advisor working on the Carnegie Mellon side of this project, and we're working for a semester – which is approximately fourteen weeks – and we work approximately five hours a day – that would be a lot of time.

[*ed. note*: 6 people working 14 weeks, 5 days a week, and 5 hours per day would yield 2,100 person-hours. There are approximately 2,000 hours in a typical work-year (40 hours/week for 50 work-weeks).]

In terms of the future training simulations, I think that it would be many orders of magnitudes larger than that, because the scope that this could encompass is very large. You could eventually simulate a 100- or 500-person training event and have it all captured within a computer game. I think that's eventually where this might go.

Eric *[#11]* When you're using the software for training, how would you compare the cost of training multiple individuals with what happens now where you have it at a real mall, or a "real simulation" (an oxymoron there!) how would that compare?

Ira The numbers that I was given for a real-life simulation was $25,000. To create a multi-player large simulation would probably be more than $25,000 – but if you consider that after the game is developed it can be played by anyone, will last for many years, and provide large amounts of information over time, I don't know how to compare those costs.

Eric *[#12]* What do you see as the major drawbacks or limitations to the practical use of this software?

Ira Well, we have to develop it and also get in the hands of people that need it. Firefighters primarily are volunteers – and thus they have a very low budget, especially to spend on computers and games. I think one of the biggest practical limitations is actually distributing it to the people who could benefit from it. I think that would cost money, and who's going to come up with that money I don't know – hopefully the government.

Eric *[#13]* In an ideal environment, how would this particular software package be used and how would it be integrated into existing training methods?

Ira Our specific project is fairly narrowly focused, and in an ideal world we'd have a lot of money and a lot of people working on the project, and it would be a very vast project – but for our specific project, it would be great if we could get it in the hands of firefighters in the Pittsburgh area and around the world and have them use it. It could only add to what already exists. I don't think it would *replace* the lectures or replace the readings, but it would add to it.

Eric *[#14]* What's next? What are your plans for the future of this software?

Ira I think that our project will serve as a prototype and as an example of what could be accomplished with training simulation games, and I think the future of our particular project – if the specific thing that we create gets completely thrown away and replaced by something new and better, we wouldn't mind at all. The goal is to prove to the world that training simulation games are a useful approach to this complex and difficult problem.

I think that our software *will* get used and the game will get played and I think over time we will continue to develop it to become a better and better simulation encompassing more and more of what a chemical attack in a mall would involve. And perhaps not just a chemical attack; perhaps a biological attack, a radiological attack. Perhaps not just a mall, maybe different environments; so I think there are a lot of different ways we could take this project, and the key is to start small.

Eric Is there anything that you would like to add that I didn't ask about or anything you'd like to say about the project?

Ira I feel like we covered it very well.

Appendix C: Pittsburgh area Bioterrorism Resource Individuals

There are many individuals in the Allegheny County, Pennsylvania region working on various aspects of the response to bioterrorism. This is a partial listing of such individuals, many from Carnegie Mellon University and the University of Pittsburgh.

To contact an individual whose contact information does not appear, contact the affiliated institution.

http://www.pa-region13.org/

Note: *"Region 13" herein refers to the PA Region 13 Weapons of Mass Destruction Working Group.*

Michael Allswede

Originally from the University of Pittsburgh Department of Emergency Medicine; now an established national expert on bioterrorism and biological expert. He is a licensed emergency room doctor and also works with the FBI. His emphasis is on training.

Eric Barker

Author of this report; "Merging Interactive Multimedia Technology with Counter-Bioterrorism Training"

ebarker@alumni.cmu.edu
http://www.yourinter.net/barkers
77 North Lincoln Street / Homer City, PA 15748

Carnegie Mellon University
College of Humanities & Social Sciences
Information Systems Class of 2003.

Marshall Boak

Student, University of Pittsburgh Graduate School of Public Health. Marshall is developing a library of materials for emergency management/preparedness curriculum development for the Center for Emergency Preparedness, and contributed to this report.

mbb4@pitt.edu, mbboak@attbi.com

Kathleen Carley

Developed *Biowar* software to detect Bioterrorism outbreaks.
Professor and researcher, Carnegie Mellon University

Baruch Fischoff

Expert at Risk Communications, the strategies used to communicate risks to the public during a crisis environment.

He is with the Carnegie Mellon Social & Decision Sciences and Engineering & Public Policy departments.

Elizabeth (Betsy) Gettig, MS, CGC

The Genetic Counseling Program addresses preparedness for natural disasters and other crisis, with a strong emphasis on bioterrorism.

Assistant Professor of Human Genetics
Director, Genetic Counseling Program
University of Pittsburgh

Address: Dept. of Human Genetics,
A-300 Crabtree, 130 DeSoto St.,
Pittsburgh, PA 15261
betsy.gettig@mail.hgen.pitt.edu

Robert Full, Chief

Region 13 Weapons of Mass Destruction Taskforce
C/O Allegheny County Emergency Services
400 North Lexington Street
Pittsburgh, Pa 15208
412-473-2550 (Office) 412-473-3004 (Fax)
RFull@county.allegheny.pa.us
http://www.pa-region13.org/

Anne Humphreys, (SEI)

Anne Humphreys gets contracts to create bioterrorism training modules.

department: Carnegie Mellon Learning Systems Architecture Lab
e-mail: ah34@andrew.cmu.edu

Andrew Moore, CS

Associate professor of Robotics and Computer Science at the School of Computer Science. Director, Biomedical Security Institute (BMSI).
Andrew works on electronic detection system to detect biological outbreaks.

Carnegie Mellon University
http://www.cs.cmu.edu/~awm

J. David Piposzar, M.P.H.

David Piposzar also contributed to the development to this report.

David Piposzar is the former Region 13
J. David Piposzar, M.P.H.
Executive Director, Center for Public Health Preparedness
University of Pittsburgh-Graduate School of Public Health
Forbes-Allies Center : 3109 Forbes Avenue, Suite 210
Pittsburgh, PA 15260
Phone: 412-383-2232
Region 13 MMRS Chair

Amy Sain

A University of Pittsburgh graduate student collecting information on bioterrorism workforce development. Among other things, she is collecting a large amount of resources for the University of Pittsburgh Library system.
amy.sain@mail.hgen.pitt.edu

Scott Stevens

Expert on synthetic interviews.
Human Computer Interaction Institute
e-mail: ss8s@andrew.cmu.edu [forwarded to: Scott.Stevens@cs.cmu.edu]

Jesse Schell –

Co-director, Carnegie Mellon Entertainment Technology Center.
Supervisor of the Biohazard project.
jschell@andrew.cmu.edu

Victor Weedn, MD, JD

Dr. Weedn is very resourceful and contributed to this report.
He is the Carnegie Mellon Director of Biotechnology and Health Initiatives
412-268-6250
weedn@cmu.edu

Randy Weinberg

Dr. Weinberg has taught terrorism-related classes and works occasionally works with students on projects blending technology with terrorism preparedness. He was the direct advisor to this report.

Director, Carnegie Mellon Information Systems program, H&SS
e-mail: randy2@andrew.cmu.edu

Appendix D: Multimedia Bioterrorism Training Resources

Multimedia presentations and resources serve as an excellent form for counter-bioterrorism due to their dynamic interactive nature. Computer simulations allow individuals to participate in real-life situations and make decisions that affect the condition of the situation. Multimedia also offers a unique medium to provide information in a unique and readily accessible manner. This is just a few of the available resources in this area.

The Centers for Disease Control and Prevention is one of the best repositories for high-quality and easily accessible training material.

Center for Disease Control and Prevention
Public Health Emergency Preparedness and Response
Free Resources: PowerPoint Slides, Streaming Videos, Online Training:

→ **http://www.bt.cdc.gov/training/index.asp**

Video: Bioterror: Anthrax, Smallpox, Ebola and More: The Frightening Past and Lethal Future of Biological Warfare.

Description: This video reviews some of the major agents used in bioterrorism, and discusses why it is such a serious problem. It also discusses the United States' involvement in the development of biological weapons, and discusses popular methods of distribution (i.e. onboard motors on boats traveling up the coastline, etc.) Running time is approximately 60 minutes.

Intended Audience: General public, students of an introductory bioterrorism class.

Prerequisite Knowledge: None.

Outcome: Viewers appreciate the magnitude and seriousness of the issue of bioterrorism.

Editorial Comments: This is a high-quality Nova video that gives a high-level overview of bioterrorism. This video should not be used as a source for in-depth information, but instead a springboard for discussion or an introduction to the topic. A suggestion for use would be a week one assigned viewing for an introductory class.

Intended Audience: Members of the public; individuals with a limited knowledge of bioterrorism.

To Acquire: Call 1-800-949-8670.

Cost: $20.

CD-ROM Multimedia Presentation: *Bioterrorism: A Clinical Review for Physicians*.

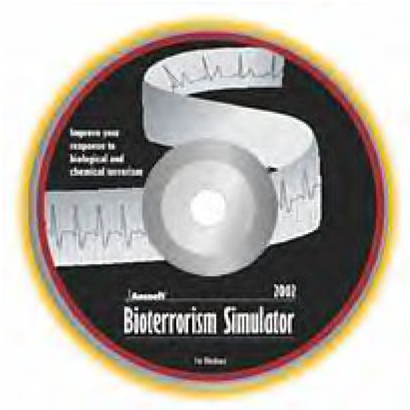
Description: This multimedia presentation contains a thorough overview of biological agents that have been identified as the most likely agents to be used in an incident of bioterrorism. It contains:

The *Course Presentation* is a multimedia slideshow presentation (created with Macromedia Shockwave) with a narrator speaking, showing video of the speaker, a PowerPoint-style slideshow presentation, and relevant images, such as skin lesions on smallpox victims (*note*: may be inappropriate for some viewers). The presentation gives historical and practical on biological agents, with a medical emphasis. The presentation contains the sections: Introduction to bioterrorism, anthrax, smallpox, plague, tularemia, botulism, and viral hemorrhagic fever. The presentation covers the history of the agent, relevant statistics and facts, detailed information about the agent's effect on the human body, and how to treat a victim (e.g. specific drugs). The CD also includes:

Training Tools 2 – a downloadable and editable PowerPoint presentation containing the slides in the Course Presentation. This includes speaker notes with each slide.
Transcript of Presentation – a PDF file with the full text of the narration that is played during the slideshow.
Bibliography – A 61-page PDF document containing a bibliography for the sources cited in the Course Presentation slideshow, with articles from the Journal of the American Medical Association (JAMA), explaining each biological agent in detail.

To Acquire: Contact the Saint Louis University of Public Health. 3545 Layfayette St., St. Louis, Missouri, 63104. 314-977-8257. Download an order form from http://www.bioterrorism.slu.edu under "Products."

Bioterrorism Simulator 2002



"The Bioterrorism Simulator helps physicians, nurses and other first responders review the latest recommendations for management of biological and chemical agent exposure. Using this interactive graphical simulator you will learn to recognize the signs and symptoms of each illness, and order appropriate isolation, decontamination, diagnostic tests and treatment in 24 different clinical scenarios."

Additional information about the Bioterrorism Simulator 2002 appears in the body of this thesis. On request, this software was graciously reviewed by Betsy Gettig, the Director, Genetic Counseling Program at the University of Pittsburgh. Her contact information appears in Appendix C and her complete review follows.

Bioterrorism Simulator 2002

Format: CD-Rom – Interactive teaching approach. CD operates on any Windows system with Java and JavaScript enabled browser, requires Internet Explorer 4.01 or higher or Netscape 4.x

Contents: CD comprised of modules simulating bioterrorist and chemical agent exposure in patients. Online Demo: http://www.anesoft.com/Products/bio.asp (Contributors: Howard A. Schwid, MD, Jeff Duchin, MD,MPH, Jennifer K. Brennan, MD, MPH, Kenichiro Taneda, MD, Ben H. Boedeker, DVM, MD, PhD, Amitai Ziv, MD)

Structure: The CD has 6 interactive modules, with four cases within each module. This provides the user with 24 different clinical situations. Users are presented with a patient. Users can review medical history, check and monitor vital signs, administer medications, and proceed with any necessary interventions for the patients.

Audience: Emergency room physicians, nurses, EMT's, and other first responders. Program offers 12 CME and CNE credits from the University of Washington.

Production Date & Product Support: Copyrighted 2002. Expires in August 2005. Produced by Anesoft Corporation.

Cost: v2002 Single License $89
v2002 Single Upgrade* $69
v2002 Network License $449
v2002 Network Upgrade** $249
v2002 Network Conversion* $359

* You must own a **previous (Single License)** version of Bioterrorism Simulator to qualify for upgrade or conversion pricing.

** You must own a **previous (Network or Departmental License)** version of Bioterrorism Simulator to qualify for upgrade pricing.

SUMMARY

This CD is an excellent training module for emergency room staff and other first responders. The CD helps physicians, nurses, and other first responders review the latest guidelines for management of biological and chemical agent exposures. Users will learn to recognize the signs and symptoms of each illness, and order appropriate isolation, decontamination, diagnostic tests, and treatment in 24 different clinical scenarios. The agents presented in this CD are: anthrax, botulism, Ebola, plague, smallpox, tularemia, nerve agents, toxic gases, and vesicants. The 24 different scenarios expose the user to a wide variety of emergency room situations. The user must care for the patient and gains exposure to possible terrorist agents in a practice setting. Each module has specific learning objectives.

Each of the 24 different clinical scenarios presents the user with several options by which to treat the patient. A patient history is available to review the history of the present illness, the patient's past medical history, medications and allergies, and a brief review of symptoms. An exam on the patient can be done on general signs, vital signs, pulse, breath sounds, heart sounds, abdomen, skin, pupils, and a neurological exam. Several lab tests and studies can be preformed on the patient including a CBC, ABG, electrolytes, glucose, BUN, CT, liver function test, microbiology, chest X-ray, chest CT scan, head CT scan, and an electromyogram. Under the monitor option, the user can place an ECG on the patient, change the ECG lead, place a BP cuff, change the NIBP, place a pulse oximeter, place a capnogram, train of four, and respiratory. The airway option allows the user to suction, place/remove nasal oxygen, place/remove face mask, place/remove anesthetic mask, intubate, tube position, and removing the intubation tube.

The ventilation option can be selected to be spontaneous or controlled. Drugs/IV can be administered by selecting from the provided list of medications and the selected list of drips. When selecting a medication or IV drip, the amount and rate of administration must be provided. Under the decontamination/isolation/public health, the user can remove clothes, shower the patient, bleach wash, universal precautions, droplet precautions, aerosol precautions, and notify public health officials. The rate of the simulation can be controlled using the simulation option. The help option may be of use to the user as it provides information about the learning options, information about the agent used, drugs used, and instructions for using the CD. The help option will lead users to information regarding the biological or chemical agent. Information such as the clinical presentation, treatment, transmissibility, complications, and differential diagnosis are discussed.

The first module is on anthrax. The learning objectives for the four clinical situations in this module are to: describe the infectious agent in anthrax, to describe the clinical presentations of anthrax, describe the difference in presentation between influenza and inhalational anthrax, describe prophylaxis for anthrax exposure for adults, describe utility of the nasal swab test for inhalational and cutaneous anthrax, describe the cutaneous presentation of anthrax, describe the transmissibility of cutaneous anthrax, describe the treatment for cutaneous anthrax for adults, pregnant women and children, describe the use of anthrax vaccination for cutaneous anthrax, describe the difference in presentation between the flu and inhalational anthrax, describe appropriate diagnostic tests for anthrax, describe circumstances under which anthrax vaccination might be recommended, describe the potential radiographic and CT findings in a patient with inhalational anthrax, describe laboratory confirmation of anthrax, and to list complications associated with anthrax and their treatment.

The four clinical situations within the anthrax module are: a 52-year old male with flu-like symptoms, a 16-year old male with possible cutaneous anthrax, a 4-year old with a credible threat of anthrax exposure, and a 29-year old female with respiratory distress. The main learning objectives are to differentiate between the influenza-like illness and early inhalational anthrax, to manage a case of cutaneous anthrax, to manage a patient with possible exposure to aerosolized anthrax, and to manage late inhalational anthrax and its complications, respectively.

Module two presents four clinical situations involving smallpox. The four clinical situations are a 64-year old female with fever and flu-like symptoms, a 6-year old male with possible smallpox exposure, 7-year-old girl with fever and rash, and a 12-year old female with a severe case of smallpox. The main learning objectives for each case are to differentiate the prodromal symptoms of smallpox from other illnesses in order to isolate patients before they become contagious, to understand the transmissibility of smallpox and the recommendations for isolation and post-exposure vaccination, to distinguish smallpox from other febrile rash illness, and to learn to manage a case of severe smallpox infection.

Other learning objectives for the smallpox section include: to describe the infectious agent in smallpox, to describe the clinical presentation of smallpox, to describe the transmissibility of smallpox, to describe the difference in presentation between the flu and smallpox prodrome, to describe the management for smallpox exposure, and to describe the recommendations for smallpox vaccine, to describe the clinical presentation of smallpox and how to differentiate it from chickenpox, and to describe the treatment for hemorrhagic smallpox.

The third module focuses on botulism. The four clinical cases presented are: a 72-year old male with new onset of weakness, a 20-year old male college student with double vision, a 68-year old female with diplopia, dysarthria, and dysphagia, and a 5-year old female with respiratory distress. The main learning objectives for the four cases are to learn to distinguish botulism from other causes of muscle weakness, to distinguish features of the case history or outbreak that might suggest a deliberate source of infection, to discuss desensitization schedule for botulinum antitoxin and treatment of anaphylaxis, and to manage a case of respiratory distress from deliberate aerosolized release of botulinum toxin, respectively.

Other learning objectives for botulism include: to describe the infectious agent in botulism, describe the types of botulism and clinical presentations, describe the differential diagnosis for sudden onset of weakness, to describe the diagnostic testing for botulism, to describe the differential diagnosis for acute onset of cranial nerve abnormalities with weakness, describe treatment for food-borne botulism, describe feature of the case history or outbreak that might suggest a deliberate source of infection, describe the test for hypersensitivity to botulinum antitoxin, describe the desensitization schedule for botulinum antitoxin, list the signs and symptoms of an anaphylactic reaction, and to lest botulinum toxin antibody types present in the current botulinum antitoxin licensed in the US.

Module 4 presents cases of other infectious agents. The four cases presented are: a 6-year old male with swollen arm and painful axilla, a 44-year old male with dyspnea and hemoptysis, a 62-year old female with severe cough, 28-year old female with high fever and petechiae. The four cases present scenarios of bubonic plague, inhalational plague, tularemia, and hemorrhagic fever virus. For all four agents, the user should be able to describe the clinical presentation, the transmissibility, diagnostic criteria, treatment, and post-exposure prophylaxis.

Module 5 presents cases of nerve agents. The four cases presented are a 16-year old male with eye pain plus nausea and vomiting, a 6-year old male with nausea, vomiting and mild dyspnea, a 48-year old male with respiratory distress, and a 71-year old female with respiratory failure and seizures. The four nerve agents presented are VX, Sarin, Tabun, and Soman. The main learning objectives for the four cases are to learn to manage a mild nerve agent exposure and decontamination and triage of a mass casualty situation, to learn to manage a moderate nerve agent exposure progressing to dyspnea, to manage respiratory distress caused by nerve agent, and to manage respiratory failure and seizures caused by a nerve agent.

Other learning objectives include: to describe how to prioritize your efforts when the emergency room has 200 patients, describe the clinical presentations of nerve agent exposure, describe the aging of the enzyme-agent complex, describe the unique clinical aspects of each agent, describe the decontamination process, describe how medical personnel should be protected, and to describe the recommended treatment for nerve agent exposure.

The last module presents cases involving other inhalational agents. The four agents used are mustard gas or nitrogen mustard, Lewisite, hydrogen cyanide, and benzilate. The four cases are an 11-year old female with conjunctivitis and cough, a 4-year old female with multiple painful blisters, a 6-year old male with cyanosis and stupor, and a 30-year old female with confusion and hallucinations. Other learning objectives for this module are to describe the clinical presentation of each agent, to describe the decontamination process, describe how medical personnel should be protected, and to describe treatment.

In comparing this CD to the CDC core competencies:
All Public Health Workers: 6, 7, 8, 9
Public Health Leaders/Administrators: 2,
Public Health Professionals: 3
Public Health Technical and Support Staff: none