Training Technology against Terror:

Using Advanced Technology to Prepare America's Emergency Medical Personnel and First Responders for a Weapon of Mass Destruction Attack

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Summary of Findings

- 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.

- A coordinated interagency plan is essential to build and operate the kinds of new training systems that have become essential. This should:
  (a) provide timely updates, quality control, and peer review of the content,
  (b) encourage uniform standards in training skills for all relevant occupations,
  (c) provide for the design, installation, and upgrade of communication and other infrastructure needed, and
  (d) plan to deliver training quickly using existing technology and to continuously upgrade capabilities to use advanced simulations and other tools as new technologies are developed.

- This plan should ensure that:
  (a) each federal agency is assigned missions consistent with its core competencies,
  (b) state and local governments are well integrated into the process, and
  (c) draws as appropriate on existing professional certification organizations, universities, and private businesses.

1) Introduction

Without an effective investment in training, the nation's investment in Weapons of Mass Destruction (WMD) response will be largely wasted. WMD training demands are dramatically larger in scope and more complex than anything the nation has faced before. A chemical, biological, nuclear, explosive, or radiological attack will require managing a large site, possibly with thousands of casualties, and organizing local, state, and federal law enforcement, fire, rescue, and medical teams with diverse backgrounds and specialties. There can be no room for delay or confusion— participants will be called upon to do extraordinary things even though most of them will have never confronted a similar situation. But the nation's emergency responders, medical personnel and law enforcement officials indicate that they are not prepared. Numerous new federal training programs are being funded or are under active consideration, but absent better coordination and approaches to the dissemination of training materials, much of the investment is likely to be wasted and decades could pass before the need is met. Poor quality control and the absence of plans for ensuring continuous improvement in the training mean that obsolete or inaccurate information could remaining in training programs for years. This document outlines a strategy for managing a coherent national approach to this urgent problem. It reviews the scope of the training challenge, and the comparative advantage new technologies offer to the different federal, state and local organizations that must work together to meet it. Skillful management of new information technology must play a prominent role in the solution. These technologies can reach large numbers of people quickly with timely information, allow for the tailoring training to unique local situations, and provide simulated experiences (including group interactions) that transfer efficiently into high levels of performance in an actual emergency.

Over 1.7 million full time and volunteer firefighters, 2.7 million nurses, over 620 thousand civilian law enforcement officials, 150 thousand emergency medical technicians, 32 thousand emergency physicians, 50 thousand Army medics, and millions of other medical personnel and local officials from different backgrounds need to be trained quickly in complex skills ranging from incident management to the detection and treatment of unusual injuries. In an emergency we will expect their instincts to be right, and that they will work as effective parts of a complex incident management team – expectations that are difficult to fulfill absent experiences that leave vivid memories.

In the near term we have no choice but to build on traditional methods of delivering WMD training, integrating that training into methods now used to provide continuing education and into the curricula that now prepare first responders and emergency room staff. But the scale of the problem is so great that traditional methods need to be augmented quickly, and with dramatically new approaches to training.

Fortunately new information tools are available that make it possible to deliver an innovative kind of training – systems that can be tailored to people from very diverse backgrounds, including people uncomfortable with traditional classroom instruction – and systems that can provide graphic simulated experiences. These experiences can include working closely with diverse teams of people who share the same "virtual world." The Department of Defense (DoD) and others have demonstrated that such training transfers to operational skills in very powerful ways. Groups training together in these environments gain confidence in each other and develop styles of communication and collaboration under stress that are invaluable in real combat situations. Military personnel trained in these systems are able to avoid the mistakes and high casualties that are typical when fresh troops are sent to combat situations for the first time. They are particularly helpful when the training can be refreshed using simulations that reproduce the actual terrain and tactical situations the trainees will face.

However, without rapid action the US investment in WMD training will not take advantage of this new approach. The groups most knowledgeable about medical treatment of WMD casualties and managing incidents are largely unfamiliar with these training methods and, absent a new federal strategy, will not use them for years.

A systematic national strategy can ensure that systems put in place today to meet immediate training needs can continuously improve over the next few years. This requires an interagency approach drawing on expertise in incident management, medical triage and treatment, as well as expertise in managing secure information networks and building innovative training technologies. This paper proposes the framework of such a program, reviewing the activities that must be undertaken and outlining a strategy for managing the process.

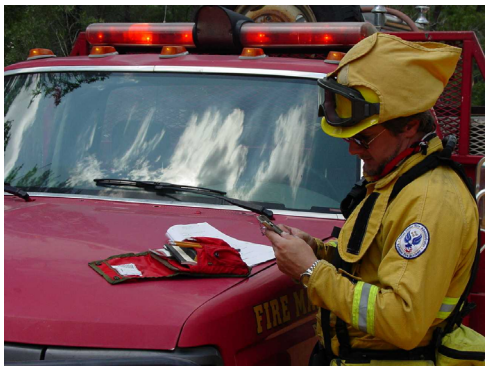
2) The Current State of WMD Training and Mechanisms for Delivering this Education

a) What Needs to be Learned

A terrorist incident could involve a bomb in a building, releasing poisonous gas into a subway system, sending infectious agents to many parts of a city or dispersing radioactive materials. Few would have predicted a coordinated attack by commercial aircraft or the mailing of anthrax. The precise nature of the next major terrorist incident in the US is likely to be something completely unexpected. The core challenge in preparing professionals for a terrorist incident, therefore, is finding a way to prepare a diverse group of people to (a) quickly recognize that a dangerous incident has occurred, (b) know how to form effective teams quickly in response, (c) mobilize and integrate the response capability, and (d) master specialized skills needed to cope with the unusual search, rescue, triage, and treatment challenges that will be presented.

These situations present enormous challenges for developing courses of study and a curriculum for WMD training. Experience and practice are critical for building expertise that can be used quickly and efficiently in the case of a real emergency. Yet direct experience is impossible to acquire since the scope of terrorist incidents covers a wide range of possibilities, and such incidents have few precedents anywhere in the world.

Consider what would need to happen in an attack scenario involving a fire crew responding to an alarm at a downtown office complex that is the center of a chemical attack. The crew must know enough to quickly determine that this is a dangerous event, know how to summon help, and take immediate action to protect themselves and the community. Early intelligence about the nature of the chemical and its likely dispersal could save many lives and prevent injuries, by providing immediate guidance to the people in the area, ensuring that the right equipment and personnel are summoned, and saving valuable time in establishing a managed response. Other crews arriving at the scene must establish a command center; set up a safety perimeter along with procedures for moving people and equipment across the perimeter; build a coordinated team of fire and police teams for search and rescue and for containing fires; and establish a complete triage, treatment, and transportation system (See Figure 1). Large numbers of emergency medical technicians and other medical professionals must be able to diagnose symptoms, perform triage, know what treatment must be provided on the scene, manage the transfer of patients across a safety perimeter, and coordinate a large transport operation to hospitals – trying not to saturate capacity at any unit. The site will also be a crime scene, so evidence must be identified and protected and custody chains



clearly recorded. Without adequate public information and incident management, panic and confusion could lead to further casualties and swamp hospitals with walk-in patients who aren't seriously injured. Moreover the work may involve coordinating many different jurisdictions on the federal, state, and local levels.

Each incident will be unique, and it is not possible to prepare for every contingency. An attack involving anthrax, for example, is likely to be detected first by staff in a hospital emergency room or a CDC analysis of reports from hospitals in a region. Responders would need to mobilize quickly to identify the sources and the regions affected to manage the large numbers of people requiring treatment and preventative interventions. A radiological attack would not result in large numbers of casualties, but emergency facilities could be swamped with walk-in cases, many of whom would have psychosomatic symptoms. The chief concern of police and other crews would be to organize an orderly and safe evacuation if necessary, and ensure that people in contact with radioactive material are decontaminated.

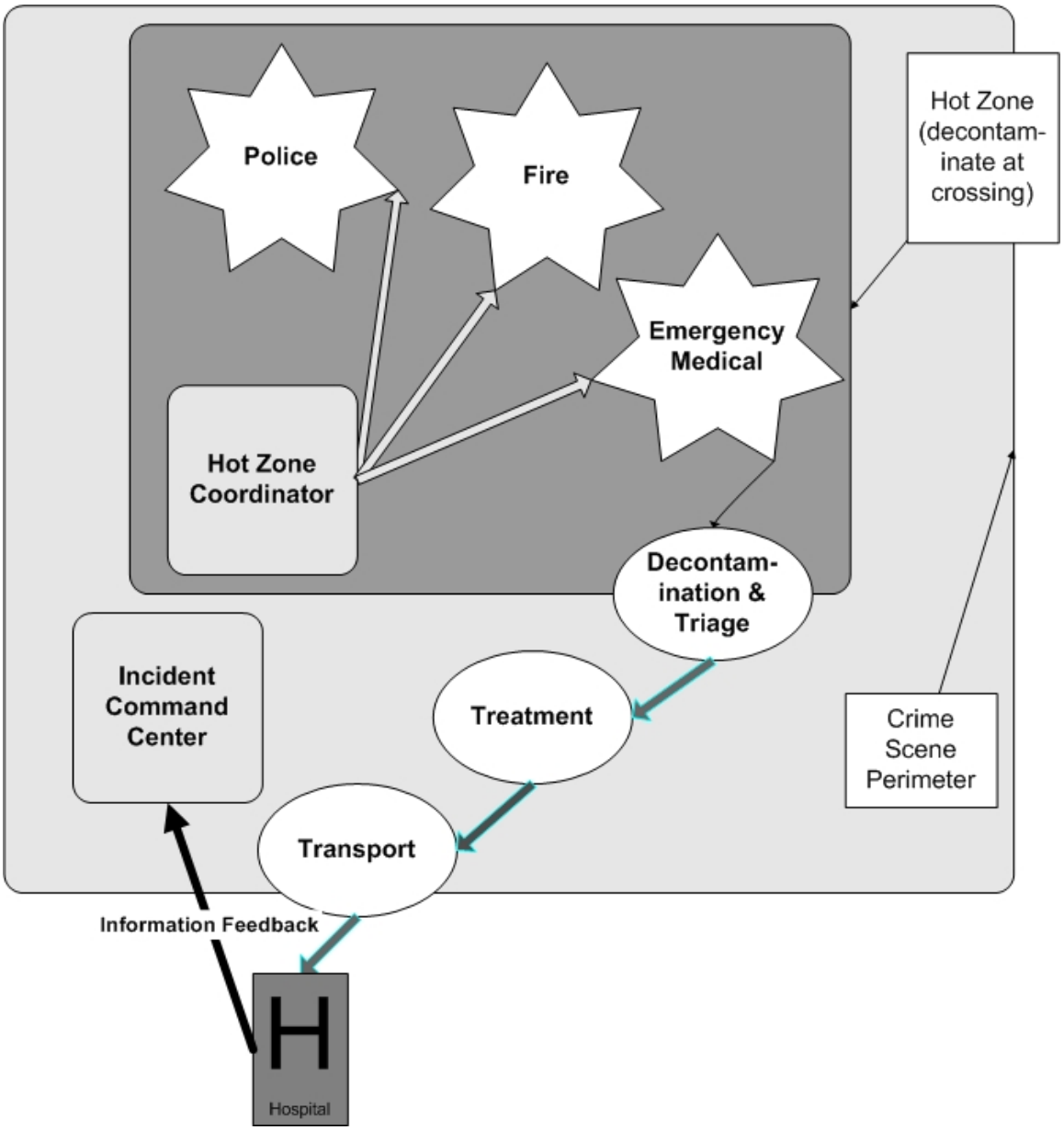


Figure 1:
Managing a Multi-Casualty Incident

Each WMD incident will be unique, and is unlikely to resemble any specific event used in an exercise. To prepare, medical personnel and first responders must be able to adapt, learn, or refresh specialized skills efficiently. The training goal must be to provide a core set of skills that should be useful to the broad set of people who may become involved in responding to a terrorist incident (see Table IA), and to provide in-depth experience to a smaller group of people who will be brought to the scene to provide specialized assistance (Table IB). In both cases it is necessary to provide experience in a large number of areas so that participants can confidently adapt their skills to whatever events they may confront.

A survey conducted as part of the *Third Annual Report to the President and the Congress of the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction* (Gilmore Report) indicates that police, fire, Emergency Medical Technicians (EMT) workers, hospitals, public health officials and others value the training they have received from federal agencies (favorable responses averaged about 3.5 on a scale of 1 to 5) but that not enough training had been provided. Most felt that they were not prepared for a WMD emergency (responses in this area averaged 2 on a scale of 1 to 5 where 5 meant that they were confident in their training).[1]

[1] Gilmore Report, December 2001, Appendix G (http://www.rand.org/nsrd/terrpanel/terror3-screen.pdf).

Developing Objectives, Content, and Competencies for the Training of Emergency Medical Technicians, Emergency Physicians, and Emergency Nurses to Care for Casualties Resulting from Nuclear, Biological, or Chemical (NBC) Incidents

Table IA: Awareness Objectives

Terrorism	· Current threat potential · Current level of preparedness
Event Types	· Threat agents (chemical, biological, radiological, explosive, incendiary) · Possible scenarios for each agent
Index of Suspicion and Event Recognition	· General indications of a terrorist attack · Comparison of biologic attack with endemic disease · Epidemiology and surveillance issues · Incident identification and reporting · Information sharing · Activation of response
Response Systems and Communica-tions	· Integration of health care professionals · Roles of federal, state, and local agencies · Integration of federal, state, and local agencies · Incident command system · Communication issues
Key Elements of a WMD Response	· Special preparedness and response needs of a WMD incident · Mass casualty care issues · Personal and scene safety issues · Contamination, containment and security issues · Decontamination indications and issues · Psychological impact of an incident · Issues and challenges of mass patient care · Issues and challenges of fatality management · Maintenance of regular health care services · Characterize principles of effective response to a biologic, chemical, or radiological incident
Personal Protection and Safety	· Personal protection issues · Secondary threats · Personal protective equipment · Personal behaviors and procedures

Table IB: Performance Objectives

Event Recognition	· Use surveillance systems · Recognize a possible terrorist attack · Report WMD-related information to the appropriate person(s)
Unified Incident Command/Management Structure	· Use a unified system of command
Response Support	· Provide the necessary logistical support for victim care, responders, and the response as a whole
Safety and Protection	· Select and work effectively in personal protective equipment · Demonstrate behaviors that help ensure personal safety.
Decontamination	· Decontaminate victims at an incident site, medical facility, or other areas as needed
Isolation and Containment	· Appropriately isolate and contain victims of each type of WMD event
Evidence Preservation	· Use appropriate techniques for preserving possible evidence at an incident site or medical facility
Psychological Effects	· Prepare for, recognize, and treat the psychological impact of a WMD event on victims and healthcare professionals
Communication and Agency Interaction	· Maintain and help facilitate effective communication during a WMD incident response · Interact effectively with appropriate agencies and organizations involved in responding to an event
Triage	· Perform effective triage of victims of specific types of WMD incidents involving a variety of agents
Treatment	· Perform effective assessment, stabilization, diagnosis, and treatment of victims of specific types of WMD incidents involving a variety of agents
Transportation	· Transport victims as required, considering potential contamination risks, resource shortages, and communication needs
Recovery Operations	· Complete recovery operations, including reports and debriefings
Fatality Management	· Appropriately handle human remains, addressing safety, psycho social, and forensic needs

Source: American College of Emergency Physicians NBC Task Force, April 23, 2001.

b) The Target Audience for WMD Training

A diverse group of people needs to be given at least some level of basic awareness training (see Table II). Taken together several million people require at least awareness training. It includes:

- Community health workers in school and office clinics, public health facilities, security guards and personnel from a variety of other sites.
- Emergency Medical Technicians, who may also be firemen, police, or members of ambulance crews, or military medics. About 80% of these individuals are unpaid volunteers. Their skill levels range from basic knowledge of emergency procedures to that of highly skilled paramedics. Many have specialties in areas like hazardous material (HAZMAT) or specialized search and rescue. There are about a million police and fire personnel in the US.
- Military medics, most of whom work for the US Army. The DoD is attempting to ensure that all medics meet basic EMT certification requirements.
- Law enforcement first responders, including crime scene investigators, explosives handling experts, search and rescue details, and other entities among local and state police forces.
- National Guard reservists, including medical personnel.
- Emergency room physicians and nurses.
- Other physicians and nurses who may be called upon to perform emergency procedures if emergency room facilities are overwhelmed.

Table II
Current Training Requirements for Emergency Personnel

Emergency Medical Technicians (EMT)

Requirement Level	Number	Training Requirements		Certification
		Primary	**Continuing**	
Basic	540,000	130 hours minimum of basic emergency care, scene size-up and strategies, infection control, shock, bleeding, trauma, automated defibrillator, airway procedures. Does not administer medication (see Appendix A, Table A-1 for more detail)	Varies by state. Nat'l Highway Traffic Safety Admin. (NREMT) requires at least 48 hours every 2 years, 24 of which have to be standard refresher, others can be video, online, conferences.	State by state National Highway Traffic Safety Administration (DoT) publishes National Standard Curricula The non-profit National Registry of Emergency Medical Technicians (NREMT) develops and administers certification exams used by 39 sites (see Table C) and recertification courses.
Intermediate	57,000	Basic plus 200-400 additional hours. More extensive pharmacological, ECG monitoring, intravenous medication, manual defibriallation. Works with paramedic. (see Appendix A, Table A-1 for more detail)	Varies by State. NREMT requires basic review plus 16 advanced cardiac life support review every two years.	

Paramedic	114,000	Basic plus 600-1000 hours. Intravenous or intramuscular injection, needle chest decompression (see Appendix A, Table A-1 for more detail)	NREMT requires 48 hours of EMT/P refresher plus an additional 24 hours of continuing education every two years.	

Hospital Emergency Staff

Position	Number	Training Requirements		Certification
		Primary	Continuing	
Nurses	90,000	Varies. May include basic life support, advanced cardiac life support, pediatric advanced life support, advanced trauma nursing, emergency pediatric.		Board of Certification for Emergency Nursing, National Council Licensure Examination (administered by each state, not all states require)
Physicians	32,000	In addition to basic medical training: 36 months of curriculum work; 5 hours/week of problem-based learning, labs, conferences		US Medical Licensing Examination, Residency training and Emergency Medicine Certification from Accreditation Council for Graduate Medical Education

Source: American College of Emergency Physicians NBC Task Force, *Developing Objectives, Content, and Competencies for the Training of Emergency Medical Technicians, Emergency Physicians, and Emergency Nurses to Care for Casualties Resulting from Nuclear, Biological, or Chemical (NBC) Incidents*, April 23, 2001.

c) Current Approaches and Tools for Education, Training, and Certification

Four kinds of training challenges present themselves:

1. Integrating WMD response training into medical schools, nursing schools and other institutions that provide initial training
2. Integrating WMD response training into existing continuing education and refresher courses
3. Providing enhanced, and in some cases new, training for specialty WMD response teams (extensions of HAZMAT)
4. Providing immediate training for all medical personnel beyond ongoing continuing education requirements.

This proves to be a difficult task given the complexity of the training systems now in place. Most certification is done by states and standards vary. There is no central clearing house for training materials. And curricula are seldom updated –a particularly serious problem for WMD training since new threats and new response procedures are constantly being identified. For example, the basic National Standard Curricula for Emergency Medical Technicians (EMT-B) maintained by DoT's National Highway Traffic Safety Administration was updated in 1994, a full decade after the last revision, but the new revision was not, however, adopted by all states until 1999.

At present the DoT's training requirements do not include WMD components, but there is increasing pressure to change this situation. The Gilmore Commission, for example, recommended that:

..the Secretary of Transportation direct the National Highway Transportation Safety Administration's – Office of Emergency Medical Service to revise the existing Emergency Medical Technician (EMT) and Paramedic National Standardized Training Curricula, and corresponding Refresher Curricula, to incorporate required educational modules to address:

1. *EMS Response to Terrorism Incidents;*
2. *EMS Response to Hazardous Materials Incidents;*
3. *EMS Operations in Hazardous Environments; and*
4. *EMS Disaster / Multiple Casualty Incident (MCI) Response and the Incident Management System for EMS.* [2]

[2] Gilmore report, December 2001.

The current system for initial training, continuing education and certification is summarized in Table II. Any new WMD training system must build on the experiences of these institutions. But given the decentralized control that now prevails in medical and EMT training, encouraging greater national coordination will not be easy. States have become increasingly reluctant to conform to national standards – particularly if they are developed by non-governmental standard-setting organizations such as the National Registry. Great political skill will need to supplement technical competence in developing and promulgating new curricula.

Military training has operated with only loose coordination with civilian standards organizations in the past. Changes in war fighting capabilities and doctrine have resulted in extended evacuation distances and the average time a medic spends with patients. Advanced skills beyond past requirements necessitated a change in training for army personnel. The 91B (medical specialist) and 91C (clinical specialist) military occupational specialties have been combined into the new 91W healthcare specialist. The 91W will operate independently with highly dispersed, highly mobile combat formations and therefore must have the skills necessary to sustain treatment for a variety of illnesses and injuries without close supervision. Now each 91W will be certified at a civilian emergency medical technician level (EMT-B) and in basic trauma life support. All active former 91Bs and 91Cs need to complete any additional training needed for 91W by 2007, and reserve medics will complete conversion by 2009. Among the skills that 91W specialist must have are the ability to treat chemical, biological and nuclear exposed casualties. Even in the military, the requirement for maintenance of practical skills in this diverse domain is not robust.

Most hospitals do routinely have disaster drills and some are beginning to incorporate WMD incidents, but there is clearly much room for improvement. First responders, such as police and fire personnel who have not attained EMT status, may at best have taken an awareness program. Some specialized police, such as SWAT teams and bomb squads, receive significant training in limited areas of HAZMAT and WMD for their own personal protection, but they are not prepared to help the general public. Most rely on the local fire department to provide the personnel in an emergency.

Currently most HAZMAT, WMD, and other specialty training is acquired by individuals on a voluntary basis. WMD subjects are not covered in any depth in courses leading to standard certifications. As a result, few emergency medical personnel or EMTs have WMD expertise or skills. The cursory treatment in courses of the rare diseases and injuries associated with WMD attacks means that the public health system is not particularly alert to warning signals, or prepared to cope with a major incident.

Experience from earlier training exercises underscored the need for additional training and led to much greater interest in training investments. In a 1995 exercise based on a simulated chemical weapons attack in Los Angles, for example, emergency room staff found to their horror that their emergency room facilities would have been highly contaminated because EMTs had brought in “chemically dirty” patients. When New York City conducted a mock test of an incident similar to the 1995 Sarin attack in Tokyo, results indicated that over 100 first responders would have been killed immediately had the incident been real. The responders set up a “frozen zone” designed for an explosion,

not a chemical release, and the entire command center could have been destroyed since it was located close to the incident.[3]

The Defense Against Weapons of Mass Destruction Act of 1996, (known as the Nunn-Lugar-Domenici Amendment to the National Defense Authorization Act for FY97) provided funding for WMD training in cities with populations over 144,000 for:

> *Training in the use, operation, and maintenance of equipment for—*
> *(A) detecting a chemical or biological agent or nuclear radiation;*
> *(B) monitoring the presence of such an agent or radiation;*
> *(C) protecting emergency personnel and the public; and*
> *(D) decontamination.*

The bill initially provided $300,000 for each of the120 qualifying cities. Control was eventually transferred to the Department of Justice.[4] Prior to transfer the DoD had completed training exercises for 68 cities.[5] Since the funding was not adequate to train large numbers of people in each city, the goal was instead to "train the trainers" who would, in turn, provide training for larger numbers of people.

Unfortunately the impact of the program has been difficult to assess since systematic information about what actually happened in each city is unavailable since each city's experience was different. Most reports suggest that the program improved steadily over the years. Some cities made major efforts while others mounted much less ambitious programs. A typical training program provided 3-5 days of training for 10-20 people in each city and included some table-top exercises. The trainees were then supplied with handbooks, CDs, and other instructional materials. Unfortunately, there has been no systematic review of the impact of the program, and it is extremely difficult to judge its effectiveness. Anecdotal evidence suggests that few of the people trained felt confident enough to actually provide training for colleagues in their home facilities.

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[3] Steve Macko, Emergency Net News Service, "Senate hearings say Local Fire and Emergency Services not Prepared". March 1996.

[4] Title XIV of the National Defense Authorization Act of 1996 (Public Law 104-201, September 23, 1996), which authorized funding for the Department of Defense (DoD) to develop a domestic preparedness training and equipment program. The law directed that the Secretary of Defense act as the interagency lead to develop this program. However, under Sec. 1412(a)(2) and 1415(d)(1) of the legislation, the President was given authority to designate the head of another agency to assume responsibility for carrying out the program on or after October 1, 1999. On April 6, 2000, the President designated the Attorney General to assume programmatic and funding responsibilities for several elements of the Nunn-Lugar-Domenici Domestic Preparedness Program as of October 1, 2000. Funding was subsequently appropriated for this purpose under the Fiscal Year 2001 Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act (Public Law 106-553). (from Fiscal Year 2001 Nunn-Lugar-Domenici Domestic Preparedness Equipment Program, US Department of Justice, Office for State and Local Domestic Preparedness Support. (www.ojp.gov/odp/docs/106120.pdf)

[5] US Department of Justice. www.ojp.gov/odp/ta/training_nld.htm .

While these exercises have been extremely useful, many gaps remain simply because of the magnitude of the task and the scope of the material that must be mastered.[6] A number of limitations are clear:[7]

- There is neither a provision that requires refresher courses, nor a provision to monitor their content.
- No provision was made to monitor what actually happened after the federal training programs were complete, i.e. whether the trainers actually went on to train other individuals, or to evaluate the quality the initial training provided.
- Rural and suburban areas received little or no training since the cities covered included only 22% of the U.S. population; 25 % of the cities were in CA and TX, and in one instance, there were four training centers within a thirty miles of each other.
- The program provided equipment for WMD response but often did not provide training on how to use it.
- There was little if any adaptation to reflect unique problems faced by individual cities (e.g. ports).
- The program did not make adequate use of existing emergency training facilities and programs and, in many cases, duplicated other efforts.

Voices from the Trenches:
Comments made by police, fire, and medical personnel from a survey conducted for the Gilmore Commission.

"There is little to no coordination at the federal level & too much duplication."

"Conferences/lectures have been very good about telling us what WMD are and that we should be prepared and coordinated. What they lack are real nuts and bolts of 'how to.'"

"The next generation of attention should include expansion and refinement of informatic networks locally, statewide and nationally. Telemedicine capabilities should be additionally included as a component of future planning."

"Hospitals have been totally forgotten and have not received any money for planning or preparedness."

Another program designed to assist cities in improving their WMD preparedness is the Metropolitan Medical Response System (MMRS) administrated by the Department of Health and Human Services (HHS). This program provides grants to cities for activities that include incident management training and the training of local medical staff to recognize disease symptoms so that they can initiate treatment.

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[6] Sandra I. Erwin, "Distance-Learning Could Help Train more First-Responders, National Defense, November 2001; and Gilmore report (December 2001), p. 8.

[7] Based in part on a series of reviews by the GAO (see especially *Combating Terrorism: Observations on the Nunn-Lugar-Domenici Domestic Preparedness Program* October 2, 1998, GAO/T-NSIAD 99-16).

In addition to the Nunn-Lugar-Domenici and the MMRS programs, training is also provided by programs supported by a large number of agencies. Many courses are available in a variety of forms (a preliminary survey of the material is displayed in Table III). Other courses have been developed and offered by a variety of public and private education and training institutions.[8]

Table III
Participation in federal WMD programs

		Have not Requested WMD preparedness assistance from Federal agency	Have not participated in any federally sponsored programs for funding equipment, training, or other WMD preparedness
City and County	Fire	72	66
	Hospital	71	73
	Law	92	84
	Offices of Emergency Management	59	57
	Public Health Department	83	65
	Emergency Medical Services	85	85
State	Emergency Medical Services	46	34
	Office of Emergency Manage-ment	3	5
	Public Health		0

Source: Gilmore Commission Appendix G

While these programs are beginning to have an impact, there is still a long way to go. A 2001 survey indicated that between 25% and 60% of local fire, law enforcement, and hospitals and 80% of state emergency medical service organizations received some kind of WMD training materials. Table III indicates that large numbers of city and county police, fire, and medical organizations have not participated in any WMD programs. Healthcare providers are particularly poorly served. If anything the table overstates the extent of training since: (a) an organization's participation does not mean that all of its employees have received training or that employees have attained the requisite level of necessary skills, and (b) the table includes organizations that have received equipment but no training. Some of the most successful programs for city and county providers include the National Fire Academy's Emergency Response to Terrorism course (21% of fire departments and 19% of offices of emergency management participated), the DoE's training for radiological emergencies (8% of offices of emergency management sent a representative to the course), and the medical management of biological casualties course

[8]An extensive list of courses on responding to biological weapons can be found at www.hrsa.gov/terrorism/bioterror.htm. Comprehensive training for medical professionals is available in a number of media from firms like Healthstream (www.healthstream.com/hcp/index.html), organizations such as Prehospital Trauma Life Support phtls.org and Advanced Medical Life Support amls.naemt.org.

(13% of public health organizations participated), and their medical management of chemical casualties course.

In addition to the issues surrounding participation, some studies have pointed to problems with knowledge retention. The few studies that have examined this in detail show a great, and not well understood, range of decay rates. A year after mastering a series of skills, assessments showed that only about 25% of the students performed to criterion on cardiopulmonary resuscitation, and only about 5% passed a "don gas mask" test satisfactorily.[9]

While there is a need to provide training for the large and diverse target population, there appears to be a considerable amount of overlap and duplication in current efforts. It is also not clear that these efforts are coordinated, or if any procedures are in place to ensure that materials are consistently updated or peer reviewed. Newly authorized programs may make matters even more confusing. The diversity of programs and formats also makes it extremely difficult to ensure that training material is kept up-to-date in a field where new information is being developed continuously.

A number of groups who have examined the situation have made urgent calls for a more coherent and sustained national approach.[10]

3) A New Approach

The challenge, therefore, is to find an efficient way to: (a) integrate WMD training into a system that is decentralized and designed to move quickly, (b) deliver complex information to a diverse, geographically dispersed audience in a short period of time when the information itself will be constantly changing, (c) provide practical, hands-on experience in situations that can not easily be practiced using real scenarios, and (d) ensure the essential skills are sustained once they are attained by an individual, team and/or organization.

Traditional books, workplace training sessions, off-site training seminars, and other traditional methods are not up to the task. Limitations inherent in traditional approaches work against the imperatives for rapid development and deployment of new training for WMD response. Because the audience is widely distributed, traditional classroom instruction will be slow to address training needs, as many instructors must first be recruited and trained, and then must travel extensively to far-flung training

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[9] Montague, William E. and F.G. Knirk, "What works in Adult Instruction: the Management, Design and Delivery of Instruction", Navy Personnel Research and Development Center, TR 93-6 (June 1993). Citing Hagman, J.D. and Rose, A.M. (1983) Retention of military skills: a Review", Human Factors, 25(2), 199-213.

[10] American College of Emergency Physicians NBC Task Force, *Developing Objectives, Content, and Competencies for the Training of Emergency Medical Technicians, Emergency Physicians, and Emergency Nurses to Care for Casualties Resulting from Nuclear, Biological, or Chemical (NBC) Incidents*, April 23, 2001; Gilmore Report, (December 2001), p. 8; Statement of Paul M. Maniscalco M.P.A.,Ph.D. Past President National Association of Emergency Medical Technicians Before the Armed Services Military Procurement Subcommittee, March 5, 2002 (http://www.house.gov/hasc/openingstatementsandpressreleases/107thcongress/02-03-05maniscalco.html).

locations (a slow and expensive process). In addition, a traditional classroom setting cannot provide the advantages and efficiencies of individualized instruction. Furthermore a significant percentage of adult learners, coming from very diverse backgrounds, would not perform well in the traditional classroom environment where conformity is emphasized and variability is minimized. In-person instruction necessarily limits the ability to widely distribute highly specialized WMD response curriculum. These are the results to be expected from employing 19th century instructional approaches to meet distinctly 21st century training needs.

Large scale training exercises are also needed and have proven increasingly successful. They must be supplemented by skillful use of new instructional technologies. In the near term, these technologies can be used as an efficient way to deliver up-to-date materials over the internet even if this only means transmitting the electronic equivalent of manuals. Such technologies can also be used to administer online tests. The Department of Justice (DoJ) programs now use a variety of approaches developed for the Nunn-Lugar-Domenici program including the internet (see Appendix B). But over the next few years a skillfully managed program can use the technology to do much more.

a) The Potential of New Learning Technology

While Internet and CD-based training materials provide an efficient way to deliver material, this is only a small fraction of the potential offered by new technologies. Training opportunities may be enriched through application of advanced instructional technologies, including simulations and intelligent tutoring systems. Advances in systems integration allow for new training opportunities to reach the training audience through two versatile approaches: embedded training and distributed training.

Decades of cognitive science research have shown that people perform better after instruction when they have learned information in the context of doing.[11] They develop a deeper, fuller understanding of the knowledge presented,[12] they retain information better, and can adapt acquired information better when it is learned through the process of solving complex problems in realistic situations.[13] Perhaps most importantly, learning by doing improves the chances that learners will actually call upon this information when they are confronted with new problems.[14] The problem is that "learning by doing" is often much too expensive, and too dangerous, to be practical for most WMD training needs.

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[11] Bransford, J.D. Brown, A.L., Cocking, R.R. (Eds). *How People Learn: Brain, Mind, Experience, and School.* Committee on Developments in the Science of Learning, National Research Council. Washington, D.C. National Academy Press (1999).

[12] Perkins, D.N. *Knowledge as Design*. Hillsdale, NJ: L. Erlbaum; Schoenfeld, A.H. (1985). *Mathematical Problem Solving*. Orlando, FL: Academic Press (1986).

[13] Bransford, J.D., J.J. Franks, N.J. Vye, and R.D. Sherwood, New approaches to instruction: Because wisdom can't be told. *In Similarity and Analogical Reasoning*, S. Vosniadou and A. Ortony, eds. Cambridge, UK: Cambridge University Press (1989).

[14] Barron, B.J., D.L. Schwartz, N.J. Vye, A. Moore, A. Petrosino, L. Zech, J.D. Bransford, and Cognition and Technology Group at Vanderbilt Doing with understanding: Lessons from research on problem and project-based learning. *Journal of Learning Sciences.* **7**, (1999), pp. 271-312.

It has also been shown that individual tutoring and apprenticeship experiences provide enormous advantages over standard classroom practices.[15] In fact a study of a wide range of instructional interventions found that tutoring was twice as effective as any other intervention.[16] This is particularly important for adults who may be entering the training system with diverse training and work experiences. A skilled tutor should be expert in the subject matter and have the ability to tailor instruction to the student's skills, mood, and level of interest. Unfortunately, this option is not affordable for large numbers of individuals – even if adequate numbers of instructors could be found.

i) Simulations and Games

Technology now entering the market, however, can make discovery or game-based learning and individual tutoring both practical and feasible. During the past few years the DoD and industrial organizations with major training requirements have found that large, distributed, multi-user simulations provide highly effective in training large groups of people to work together in performing complex tasks.[17] Recognizing that advanced training methods must supplement a revolution in defense technology, the Defense Science Board recently underscored the need to make instructional technology a major priority for DoD.[18] It should also be a national priority in preparing for WMD threats.

Simulations can supplement traditional training methods by providing challenges and experience that closely approximate an actual event in the field. The course of events in these simulations is determined by the decisions and actions of the participants as well as by chance events built into the scenario. Such simulations can place learners in complex situations where they must think in real time; they can reproduce the drama, emotion, and tension of real events leaving participants nearly as drained.[19]

Digital gaming scenarios allow users to replay and explore different scenarios and practice scenarios from multiple perspectives. In the examples outlined above, players were able to both replay the scenario for high scores, as well as to test out different theories. In real life, trying new strategies, such as immediately shutting down an airport could have serious economic or public relations consequences. In a game-based training scenario, players develop a deeper understanding of *why* a procedure works and can

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[15] G.B., Ellis, J.A., Fitch, M., and Kuti, M.B. "On the job training (OJT): Theory, Research, and Practice", in S.Tobias and J.D. Fletcher (Eds.), *Training & Retraining: A Handbook for Business, Industry, Government, and the Military*. Macmillan Reference, New York, NY (2000); Bloom, B.S. "The 2 Sigma problem: The search for methods of group instruction as effective as one-to-one tutoring", *Educational Researcher*, 13(1984), pp. 4-16.

[16] Montague, William E. and F.G. Knirk, "What works in Adult Instruction: the Management, Design and Delivery of Instruction", Navy Personnel Research and Development Center, TR 93-6 (June 1993).

[17] On the job training (OJT): Theory, Research, and Practice", in s.Tobias and J.D. Fletcher (Eds.), *Training & Retraining: A Handbook for Business, Industry, Government, and the Military*. New York, NY: Macmillan Reference; Macedonia, M. Games Soldiers Play: Computer games and virtual reality are radically altering the way the military prepares for war. *IEEE Spectrum*, 3 (2002). www.spectrum.ieee.org/WEBONLY/publicfeature/mar02/mili.html

[18] Defense Science Board, *Defense Science and Technology*, published May 2002. (http://www.acq.osd.mil/dsb/sandt.pdf)

[19] For a detailed discussion of this approach to training see: Zsambok C.E. & Klein G.(Eds) *Naturalistic Decision Making (Expertise-Research and Applications)* Lawrence Erlbaum Assoc., (1996).

practice applying it across multiple scenarios. Players can also practice taking different roles. An emergency technician may try playing as a security guard, or a security guard might role play as a fire fighter. Role playing from different perspectives allows the learner to develop a richer mental model for how emergency teams operate. Learners come to understand how each part fits together, as well as the specific needs and challenges of each role, which can lead to greatly performance for the whole organization.[20]

Prototype Urban Simulation

DoD has invested about $4 million in a "virtual emergency response training simulation" (VERTS) that provides an immersive, virtual reality training experience for use at specially equipped facilities. The system would be operated in a 1,500 to 2,000 square foot site with two large simulated training areas where trainees equipped with sensors, radios, and other equipment can work wearing protective gear. Other students can participate in the same simulated environment as avatars using standard computers connected to the shared virtual space over the internet. The simulations will include detailed models of major US cities with large crowds of simulated people reacting to emergency situations. Unfortunately numerous delays have slowed the development and implementation of a virtual system for training.

Source: Institute for Defense Analysis (virtualcities.ida.org)

Live-action game and simulation activities[21] and problem-based learning modules have proven benefits in training.[22] The problem-solving instruction methods can compress years of on-the-job experience and reduce training times by as much as 80 percent. These methods are also highly motivating since participants immediately recognize the importance of the training they are receiving.

The technologies exploited by the DoD are now affordable. Spectacular advances in computational technology – particularly the kinds of inexpensive graphics devices now

[20] Senge, P. *The Fifth Discipline: the art and practice of the learning organization.* New York: Doubleday Publishers (1990).
[21] Thiagarajan, Thiagarajan, S. The myths and realities of simulations in performance technology. *Educational Technology*, 38:5 (1998), pp. 35-41.
[22] Savery, J.R. & Duffy, T.M. Problem Based Learning: An instructional model and its constructivist framework. *Educational Technology* 35:5 (1994), pp. 31-38.

mass produced as consumer products – make it feasible to deliver high quality simulations on inexpensive devices. New communication systems can ensure efficient delivery of up-to-date information and allow the construction of systems that link large numbers of learners and instructors in the same system. The popular online computer game Everquest often has over one hundred thousand players at any given time.

ii) Simulation for Skills Training in Medicine

An important challenge is the need to train emergency medical personnel in skills necessary for treating the casualties of WMD incidents. Complex tasks in domains such as aviation and transportation have been taught for decades using computer-based simulation.[23] Computer-based simulation is now being used extensively to train and evaluate medical skills, such as placement of an intravenous line and chest tube insertion. The American College of Surgeons and other accreditation organizations are now mandating the use of virtual reality simulation trainers for assessment of technical proficiency in medicine. As simulation is used extensively to prepare the warfighter for combat, it is now also becoming the standard approach for training military medics in emergency and trauma skills.[24]

iii) The Effectiveness of Simulation-based Training

Many studies have found simulation to be an extremely effective training instrument. These include studies in which a meta-analysis of the simulation literature has been performed to provide a more sensitive measure of the benefits of this type of training, using "field effects analysis" and other statistical methods.[25]

There are several ways in which simulation-training efficacy can be measured. The measure most commonly used in aviation and the military for determination of simulation-based training efficacy is "transfer," that is, how much student performance

[23] Swezey and Andrews, 2001.
[24] Higgins and Champion, 2000; Issenberg et al, 1999.
[25] (Advisory Group, 1980; Carreta and Dunlap, 1998; Hays and Singer, 1989; Hayes et al, 1992a; Hays et al, 1992b; Jacobs et al, 1990; Knerr et al, 1986; Moroney and Moroney, 1998; Orlansky and String, 1979; Orlansky et al, (1994).

can be transferred from the simulator to actual, real world procedures. The performance of a student trained only on a simulator can be compared to a control student trained with conventional methods, by testing both students on the same criterion task. These data are evaluated using statistical tests designed specifically to compare simulation performance with actual performance in the real world. The results determine transference.

For all military simulators that have been examined for effectiveness and cost savings, training with simulators has been shown to be as effective as training on actual equipment. Many studies aimed at evaluating the effectiveness of simulation training have compared the amount of training time needed to perform a specific task in an airplane after training either only in an aircraft or following training in a simulator. This can be expressed as a quantitative value as the Transfer Effectiveness Ratio (TER). For example, Table IV shows the median of 34 TERs compiled from 22 flight simulation studies is 0.48, meaning that about one half hour is saved in the air for every prior hour spent learning the same task in a simulator. Although this can be expressed as a transfer effectiveness ratio (TER), which has been reported for a number of cases in the literature,[26] more recent studies have not involved a formal determination of TER, but rather a combination of objective and subjective measures.[27]

Table IV: Benefits Realized with Military Flight and Maintenance Simulators

Simulator	TER	Student Time Savings	Acquisition Savings	Operating Savings	Life-Cycle Cost	Amortization
Flight	0.48	50%	30-65%	10%	65%	2 years
Maintenance	0.60	20-50%	20-60%	50%	40%	4 years

(Adapted from Orlansky et al, 1994)

[26] Higgins and Champion, 2000.

[27] Carretta, T.R. and R.D. Dunlap, *Transfer of Effectiveness in Flight Simulation: 1986 to 1997*. U.S. Air Force Research Laboratory, NTIS ADA362818 (1998); Hays, R.T. and M.J. Singer, *Simulation fidelity in training system design*. New York, Springer Verlag (1989); Hays, R.T., J.W. Jacobs, C. Prince and E. Salas Flight simulator effectiveness: A meta-analysis. *Military Psychology* 4:2 (1992a), pp. 63-74; Hays, R.T., Jacobs, J.W., Prince, C. and Salas, ERequirements for Future Research in Flight Simulation Training: Guidance Based on a Meta-Analytic Review. *The International Journal of Aviation Psychology* 2:2 (1992b), pp. 143-158; Higgins, G.A. and H.R. Champion, *The Military Simulation Experience: Charting the Vision for Simulation Training in Combat Trauma*, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD. DAMD17-99-2-9028 (2000); Issenberg, S.B., W.C. McGaghie, J.W. Mayer, J.M. Felner, E.R. Petrusa, R.A. Waugh, D.D. Brown, R.R. Safford, I.H. Gessner, D.L. Gordon and G.A. Ewy, Simulation technology for health care professional skills training and assessment. *JAMA*. 282:9 (1999), pp. 861-6; Jacobs, J.W., C. Prince, R.T. Hays and E. Salas *A meta-analysis of the flight simulator training research. Human Factors Division, Naval Training Systems Center*. NAVTRASYSCEN TR-89-006 (1990); Knerr, C.M., J.E. Morrison, R.J. Mumaw, D.J. Stein, P.J. Sticha, R.G. Hoffman, D.M. Buede and D.H. *Holding Simulation-Based Research in Part-Task Training. Air Force Human Resources Laboratory*, DTIC AD-B107293 (1986); Moroney, W.F. and B.W. Moroney, Flight simulation, In: *Handbook of Aviation Human Factors*, D.J. Garland, J.A. Wise, V.D. Hopkin (Eds.). New York, Erlbaum (1998); Orlansky, J. and String, J. *Cost-Effectiveness of Computer-Based Instruction in Military Training*. Alexandria, VA: Institute for Defense Analyses, Report IDA P-1375 (1979); Orlansky, J., C.J. Dahlman, C.P. Hammon, J. Metzko, H.L. Taylor and C. Youngblut, *The Value of Simulation for Training. Institute for Defense Analysis*, Report IDA P-2982 (1994); Swezey and Andrews, *Readings in Training and Simulation: A 30-Year Perspective Contributor*. Human Factors & Ergonomics Society (2000).

iv) Tutors

There has also been significant progress in building artificial tutors that can track each individual's progress during instruction.[28] The best systems are not designed to replace human instructors, but to allow them to spend more time helping individuals. A well designed system can summon an instructor when a student appears to need special attention. Intelligent systems can also help support dialogues, encouraging students to formulate questions when they are confused and provide context-sensitive answers when appropriate.[29]

v) Embedded Training Systems

A major WMD incident may force emergency responders and hospital personnel to confront unprecedented situations and quickly learn or refresh their skills. In some cases it will be necessary to communicate new information quickly during an incident (For example, during the US Anthrax attacks last year, new information about the infectiousness of Anthrax was discovered during the emergency.)

For these reasons, it is essential that training be available to responders and hospital workers in their ordinary working environment and integrate seamlessly with the tools and systems that they routinely use to perform their jobs. Training should, for example, be available in the mobile trauma units, ambulances, and other transport used to take responders to staging areas. In large scale emergencies, emergency workers may travel significant distances to reach the scene.

Most of these advanced vehicles are equipped with sophisticated equipment, many of which are integrated with digital systems: computers, telemetry, and other communications gear. EMT personnel are routinely able to get information about an emergency during their trip to the scene; this helps them prepare for the event and allows them to consult with trauma physicians via radio and telemetry-based monitoring systems.

These same systems can also provide efficient "just in time" training to prepare for the unprecedented problems that will be confronted during a WMD incident. The training systems can be ***embedded*** in the devices already present in emergency vehicles and hospitals.

Embedded training may take on one of several distinct forms. A fully embedded training system is one in which all learning content, instructional presentation, performance assessment and training management functions are integrated with the digital platform or system. This is most often found in general purpose computers and other command and control systems where the platform incorporates all the capabilities to support required functions of the training solution. Another approach is for the training solution to be attached or appended to the target digital system. Such an "appended trainer" is often the desirable solution when the digital system is quite fixed or

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[28] Anderson, John R., *Rules of the Mind*, Hillsdale, NJ: Lawrence Erlbaum Associates, (1993); Anderson, J. R., et al., "Cognitive Tutors: Lessons Learned," *The Journal of Learning Sciences,* 4 (1995), pp. 167-207.

[29] Issues, Tasks and Program Structures to Roadmap Research in Question & Answering (Q&A) (www.nlpir.nist.gov/projects/duc/papers/Final-Vision-Paper-v1a.pdf).

constrained in function and cannot provide the means for storing the learning content or handling presentation of instruction, etc.

An increasingly common form of embedded training is found in many systems that can support a web browser capable of interactive multimedia presentations. Through connectivity with the Internet or a governmental intranet, these "loosely" embedded training solutions provide for a wide range of interactive multimedia instruction to be partially embedded in the target digital system. Access to large repositories of courseware is possible, thus the range of training options is significantly extended over the fully embedded approach.

So far, none of these loosely embedded training solutions require a high degree of interoperability between the mission system (e.g., the trauma response digital system employed by the EMT professional) and the embedded training system. Mainly these systems are very loosely integrated, where the key functional requirement is for the training system to strictly avoid having any negative functional impact on the mission system. In these configurations, the training functions are embedded in, but not highly interdependent on, the target platform or mission system.

More complete or "fully" embedded training solutions would also provide for a full range of simulation capabilities, including intelligent tutoring capability, which would be more highly interoperable with the target digital systems. In this approach, the training system components must be able to interface directly with the mission systems to be able to query the state of the target platform and to be able to manipulate its operations for training purposes. To achieve this highly interoperable system design, the mission system architecture must often become more open and provide a range of well-defined system interfaces that allow for the embedded training system to interactively monitor and control the target platform.

b) Assessment

Ensuring that a workforce has successfully completed training is a challenge, especially when the goal is to ensure that workers not only perform well on a test, but also apply their knowledge in real world situations. In traditional environments, learners are given practice problems, expected to complete them on their own, and then given feedback days or even weeks after the performance. In simulation-based exercises, individual learners can be assessed continuously. Learners will understand their own abilities and gauge their own understanding of material. If, for example, an emergency response technician playing a Biohazard simulation game kills an airport full of people, they know that they've failed and are anxious for advice and a second chance. Feedback in the form of "after action review" is supported by the ability to replay the entire simulation at whatever level of detail and from whatever point of view is desired. Follow-on, post-simulation instruction can be generated by the system or by human instructors and tailored to the needs of specific participants – again working as either groups or individuals.

The learning system can provide learners, and instructors, detailed information on an individual's level of skill and provide a clear outline of their abilities in different areas. Automated systems can also provide detailed records (a multi-dimensional transcript) that can follow the learner throughout their careers. These records can record refresher courses as well as initial instruction. Individuals might then be required to analyze their

results, explain where they failed and why, and devise remediation plans for improving their performance. If they were easily accessible in an emergency, the records could help incident commanders quickly identify individuals to serve in different capacities.

If these methods are applied in WMD training exercises, they can be made accessible to all who need them, anytime, anywhere. It should also be possible to tailor the training content quickly and easily to the needs of specific situations and training audiences. Groups can train together in the same simulated "virtual environment". The training can include colleagues in the local area as well, state and federal participants who may be geographically distant, and they can be joined online by a variety of instructors, and experts.

Moreover, it will be possible to tailor the training to each individual entering the course. This is particularly important for retraining existing EMT and hospital personnel who have varying degrees of formal training and field experience.

4) Technical Capacity

Using advanced learning technologies will require participants to have reasonable access to modern computers and communication equipment. The Defense Acquisition University (DAU) has compared its biggest challenges in e-learning (see the box below) to those of private industry and other federal agencies.[30] Survey results indicate that bandwidth constraints and poor staff/help desk support are cited as the biggest problems for federal entities. It's essential that any system for continuously upgrading the instructional systems designed to deliver WMD training to diverse audiences be coupled with investments needed to provide the communication and computer infrastructure capable of using the more sophisticated systems.

Fortunately, quite powerful instructional experiences can be provided using equipment already installed in many homes and medical facilities around the country. And these systems are likely to be upgraded for reasons unrelated to WMD training. In some cases it may be possible to provide training using secure, flexible communications being installed for emergency communications in the event of an attack. DoD has particular expertise in designing these systems.

Satellite television links are widely used to deliver continuing education courses using equipment available in many major health facilities. Even comparatively inexpensive computers can be used to provide instructional material – particularly if they are equipped with CD players. And simple dial-up Internet connections, even at quite slow speeds, can be used to deliver quite powerful interactive materials that can be continuously updated.

A survey conducted for the Gilmore Commission (see Table V) provides some indication of what is now being used. At the city and county level, nearly 60% of the hospitals and 50% of the emergency medical service organizations surveyed which had received federal training assistance made use of "individual study/videos" – a percentage much higher than public health or fire and law enforcement agencies. This suggests that

[30] *The DAU Road Map for e-Learning and Online Performance Support***,** The Defense Acquisition University Strategic Plan 2002-2009 Training Transformation (T2)

professional medical personnel will be much easier to reach quickly with new technologies.

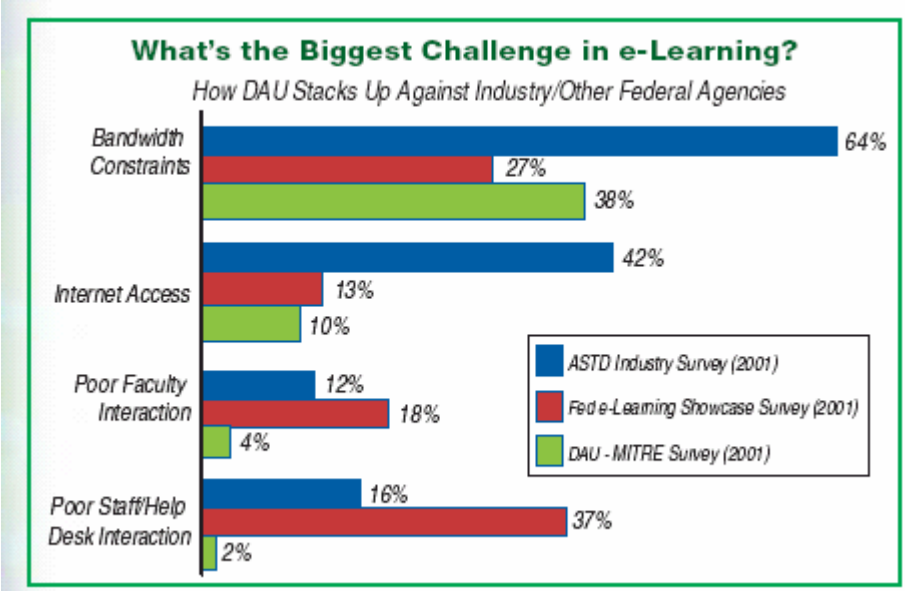

Table V Percent of Organizations Receiving Federal Support who used the funds for different training media					
		Organization-wide Training/exercises	Individual study materials/videos	Handbooks or reference materials	Support to attend or organize conferences or lectures
City and County	Fire	27	25	50	-
	Hospital	60	58	64	68
	Law Enforcement	48	32	50	-
	Office of Emergency Management	42	50	49	57
	Public Health	30	26	27	38
	Emergency Medical Services	38	50	50	-
State	Emergency medical Services	45	50	68	77
	Office of Emergency Management	60	78	8	65
	Public Health	34	46	66	85
Source: Gilmore Report, Appendix G.					

Planning for introducing new learning technologies is obviously hampered by the lack of solid information about the kinds of access police, fire, and medical personnel have to computers and communication either at work or at home and by the absence of good forecasts of future capacity. Planners even seem to have difficulty determining the practical capacity available to train personnel at military bases and hospital facilities.

5) Recommendations for a Path Forward

While the need for the productivity gains possible through use of new training technology in WMD training is clear, and the opportunity is real, progress is likely to be extremely slow without a dramatically new approach to managing training. First, there is no coherent program for managing the development, certification, and distribution of training materials in place today. Second, there is no coherent plan for ensuring continuous improvement in the technology used to provide this training. Third, there is

no concerted program supporting the development and testing of advanced instructional systems. Fourth, the economic framework for a public WMD response system has not identified with sufficient clarity to fully support a continuous requirement for adult learning and practice, especially in the face of the relative rarity of the actual event drivers. And finally, many sites needing WMD training do not have the computer and communication equipment needed to support advanced systems. It will be necessary to design systems that can be easily adaptable to operate on older systems and slow communication rates. This management problem cries out for urgent action.

Any successful system must be able to:

- serve a very diverse audience and be useful for learners entering the system with a wide variety of backgrounds, skills, experience, and languages (it must work for security guards, school nurses, EMTs, nurses, and emergency room physicians)
- provide basic awareness instruction, performance skills, and "just in time" training for people being dispatched to emergency sites – and even during the incident itself through reach-back capability to subject matter experts (SMEs),
- ensure quality control and operational integrity of the system,
- build on existing organizations with specialized expertise needed to make the overall system work,
- encourage competitive approaches and continuous innovation (a variety of university, corporate, and partnership developments should be encouraged), and
- respect the need for local control and diversity.

It's necessary to develop a coherent plan for delivering WMD training in the coming year and this need is reflected in recent legislation and legislative proposals (see Section 6 below). Technology is likely to play a significant role even in the near term. But it's essential that a system be put in place that contemplates rapid future advances and is not built on the assumption that current methods of delivering material are the final step.

With some care it should be possible to build such a system by making full use of the expertise that now exists in federal and state agencies. Table III suggests key missions that must be performed and suggests the organizations with a comparative advantage in delivering them. It's clearly essential that organizations with knowledge about the training objectives have control over the curricula. These are medical and nursing schools in the case of hospitals and the variety of university and FEMA and other organizations that provide WMD training. Existing certification organizations should remain in charge of certifying content.

In both cases, however, these organizations need to rethink their operations to reflect the need to develop and certify new instructional design systems. Teaching institutions must reconsider how to define and measure expertise given the opportunity to test skills in the near-operational environment that can be created by simulations and games. Certification organizations must be able to certify these new instructional systems as well as providing a gatekeeper's role in any changes.

Today's instructional and certification organizations, however, seldom have the expertise to design the kinds of secure, nationwide instructional system or to design and build state-of-the-art simulation based software. This specialized expertise today lies primarily in DoD, universities, and a few sophisticated private firms. These groups must

be focused skillfully on building training systems that deliver the expertise specified by the content specialists.

Figure 2 illustrates a system that could deliver needed services. Put together in the next few years, it could support near-term delivery of courses and provide the basis for a more sophisticate future system.

Table VI suggests where to find the expertise needed to make such a system work. The key issue, of course, is where to find management capacity adequate to design and build the system. In the immediate future, only the DoD appears to combine the technology and management skills needed to design and operate a sophisticated, technology-based training system. In the future, a Homeland Security Department that includes FEMA and other organizations important to WMD training may be able to acquire the needed skills and may be in a better position to manage a complex interagency operation. Given the critical nature of the training problem, it's essential that a program be built quickly and that any transition to new management be anticipated and carefully planned.

Figure 2
Basic Tasks in Development and Operation

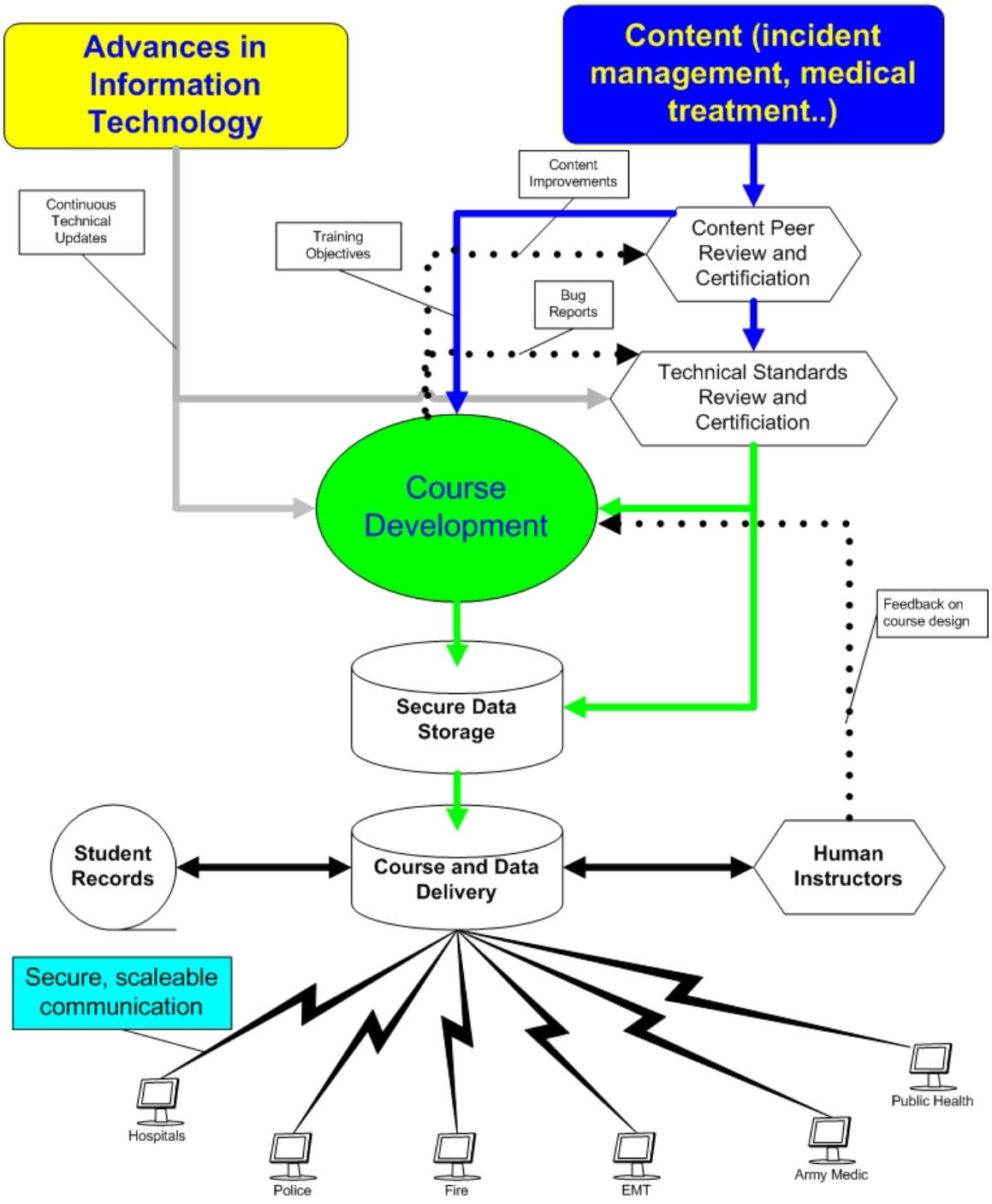

Table VI
Roles and Responsibilities

	Agency Expertise
Overall system management strategy and design • Design and implement plan for software design and system operation • Identify appropriate agencies and professional organizations for specific tasks • Develop a strategy for managing technical change allowing immediate delivery of training using existing technology and a research and development plan allowing continuous improvement	**DoD** **Homeland Security**
Content (subject matter expertise) • Prepare clear training objectives, including clear descriptions of the way learners should be evaluated. The goals should be stated in performance terms – not "has memorized the names of the fifteen parts of the gas mask" but "checked equipment at appropriate time in an incident and made appropriate adjustments when the device was damaged during the incident." • Identify background information and data useful as reference material and for providing automated answers to questions.	**Hospital:** • HHS • VA • CDC **WMD:** • FEMA • DoJ • DoD
Certification of courses, materials, and instructors • Review and approve content materials • Review and approve training objectives and assessment tools • Evaluate the system for: user satisfaction, achievement of training objectives, application to real-life needs, and contributions to national objectives for homeland security and crisis management • Recommend on a continuing basis modifications and maintenance actions needed to improve the cost-effectiveness of the system	**Hospital:** Board of Certification for Emergency Nursing, Accreditation Council for Graduate Medical Education **EMT:** States, National Highway Traffic Safety Administration
IT Systems (design and operation)	**Design:** DoD/

• Design the performance of a scaleable, secure data storage and communications network • Provide technical checks to ensure that data and software components entered into the system have been appropriately tested and reviewed • Respond to bug reports	**Operate: DoD**
Design, construction, testing, and maintenance of courses: • Design training systems for specific learner groups (e.g. emergency room nurses) around specific learning objectives (e.g. appropriate response to mass casualties from a chemical attack in a large city). • Build appropriate training systems using available, approved data and software tools • Operate training systems (identify and manage courses, records, instructors)	**Design guidance:** DoD **Construct:** Universities and contractors **Integrate/Operate:** Universities, state organizations, contractors

6) Recent Legislation and Legislative Proposals

Last year's Anthrax attacks demonstrated that the nation needed to be better prepared to respond to terrorist attacks involving biological agents. **The Public Health Security and Bioterrorism Preparedness and Response Act of 2002**, signed by President Bush on June 12, 2002, was designed to address this need. This legislation is a compromise between two somewhat different bills passed by the Senate and House last December. The original bills were sponsored by Bill Frist (R-TN), and Edward Kennedy (D-MA), in the Senate and by Bill Tauzin (R-LA), and John Dingell (D-MI), in the House.

The act includes a variety of measures aimed to better prepare the nation to prevent, identify and respond to biological attack. Included is the authorization of more than $1.6 billion for fiscal year 2003 in grants to states, local governments and other public and private health care facilities and other entities to improve planning and preparedness activities, enhance laboratory capacity, educate and train health care personnel, and to develop new drugs, therapies and vaccines. Specifically, the legislation authorizes $1.08 billion in funding for state public health emergency response plans through the Centers for Disease Control and Prevention and $520 million in funding for states to improve hospital emergency capacity through the Health Services Resources Administration (HRSA).

Regarding training the legislation states that specifically these funds can be used to:[31]

- To improve training or workforce development to enhance public health laboratories.
- To train public health and health care personnel to enhance the ability of such personnel--
    - to detect, provide accurate identification of, and recognize the symptoms and epidemiological characteristics of exposure to a biological agent that may cause a public health emergency; and
    - to provide treatment to individuals who are exposed to such an agent.

Training is also addressed in **Section 154 entitled, "Enhancement of Emergency Preparedness of Department of Veterans Affairs**," as follows:
"The Secretary (of the Department of Veterans Affairs) shall ensure that the Department medical centers, in consultation with the accredited medical school affiliates of such medical centers, develop and implement curricula to train resident physicians and health care personnel in medical matters relating to biological, chemical, or radiological attacks."

The Department of Veterans Affairs was authorized $133M in fiscal year 2002 for all of the activities outlined in Section 154 (not only training activities) and authorized "such sums as may be necessary for each of fiscal years 2003 through 2006."

[31] SEC. 319C-1., Public Health Security and Bioterrorism Preparedness and Response Act of 2002

The **Department of Veterans Affairs Emergency Preparedness Act of 2002** has passed the Senate and House. This act authorizes $20,000,000 for each of fiscal years 2003 through 2007 for the Department of Veterans Affairs (VA) to establish four centers for medical emergency preparedness within existing VA medical centers. These centers are to:

- perform research on the detection, diagnosis, prevention, and treatment of injuries, diseases, and illnesses resulting from the use of chemical, biological, radiological, or incendiary or other explosive weapons or devices.
- provide education, training, and advice on the treatment of the medical consequences of the use of such weapons or devices to VA health care professionals, and to non-VA providers at the Secretary's discretion.
- provide such laboratory, epidemiological, medical, or other assistance to Federal, State, and local health care agencies and personnel involved in or responding to a national emergency.

The education, training, and advice can be provided to health-care professionals outside the VA through the National Disaster Medical System (NDMS) or through interagency agreements entered into by the Secretary for that purpose. The NDMS is the federal government's plan to help provide services, resources and personnel to state and local governments dealing with health effects during large-scale emergencies. The system is a partnership of HHS, FEMA, VA, and the Department of Defense.

The Administration's **First Responder Initiative** calls for $3.5 billion to be spent on enhancing the terrorism response capabilities of the nation's local police, firefighters, and emergency medical professionals. The Federal Emergency Management Agency (FEMA) is to implement simple procedures designed to speed the flow of this money to the States and localities. The funds may be used for the following types of first responder activities:

Develop comprehensive plans to prepare for and respond to a terrorist attack.
Purchase equipment needed to respond effectively to a terrorist attack, including personal protective equipment, chemical and biological detection systems, and interoperable communications gear.
Train firefighters, police officers, and emergency medical technicians to respond and operate in a chemical or biological environment.
Support coordinated, regular exercise program to improve response capabilities, practice mutual aid, and assess operational improvements and deficiencies.

Senators Jim Jeffords (I-VT) and Bob Smith (R-NH) introduced legislation entitled the "**First Responder Terrorism Preparedness Act of 2002**," that authorizes $3.5 billion for the first responder initiative that would be administered by the Federal Emergency Management Agency (FEMA). Under the legislation, each state would receive a base amount of $15 million and additional amounts would be distributed according to risk factors such as population and critical infrastructure. Grants would pass through the states to the local governments with at least 75 percent of the money received by a state flowing down to local governments. The legislation also would establish a new Office of

National Preparedness at FEMA whose duties would include encouraging mutual aid agreements between states, setting guidelines and standards for first responders, and managing the first responder grant program.

Adequate resources are likely to be available to prepare responders to terrorist events involving weapons of mass destruction. A major challenge is that programs that support medical and emergency responder training are spread through the federal government. Possibly the creation of the Homeland Security Department would eliminate this redundancy. Among the ideas being considered is bringing the domestic disaster preparedness programs for firefighters, police, and emergency personnel currently managed by FEMA, the Department of Justice, and the Department of Health and Human Services under the administration of the Department of Homeland Security.

The Public Health Security and Bioterrorism Preparedness and Response Act and the First Responder Initiative both recognize that local communities are best prepared to determine how their responders should be trained. However, these communities should not be burdened with each having to develop training material, training tools, and delivery means when a great deal of effort has been made in developing content and communication infrastructure. We need to build on and not duplicate these efforts. A national database of peer-reviewed and certified training material that communities could draw upon to prepare their own emergency responder appropriately would help ensure that training resources are used effectively.

Appendix A

Table A-1
Course Requirements for Emergency Medical Technicians

Basic	Intermediate	Paramedic
Taking and recording vital signs Basic airway management Oropharyngeal airways Nasopharyngeal airways Pharyngeal suctioning Advanced Airway Management (optional)—Sellick maneuver (cricoid pressure), orotrachael intubation, endotrachael intubation Administration of oxygen Via nasal cannulas and masks Use of Bag Valve Mask, inhalers Obstructed airway management and CPR, Infant, child and adult Use of epinephrine auto-injector Use of automated external defibrillator Managing closed and open soft tissue injuries Managing major injuries, including open chest injuries, abdominal injuries, impaled object, amputation, burns Managing suspected fractures Managing shock Use of PASG Managing medical emergencies Managing environmental emergencies	Establish Intravenous Lines (peripheral in extremities) Maintain Intravenous Lines (peripheral) Discontinue Intravenous Lines (peripheral) Cardiac manual defibrillation Cardiac automated defibrillation EKG monitoring/interpretation Advanced Airway Management Endotracheal intubation Tracheal suctioning Establish/monitor peripheral IV (extremities) Establish/monitor capped IV Infuse IV fluids (all) Intraosseeous Infusion Collect blood samples Administer Medications by order or in the presence of an authorized paramedic Administer/monitor IV drip medications Monitor blood/blood by-products	Cannulation of peripheral or external jugular veins. Intraosseous needle placement and infusion. Administration of intramuscular, inhalation, subcutaneous, rectal, endotracheal and oral medication for adults, children and infants. Drawing blood from a central venous line. Decompression of thoracic injuries; need chest decompression for newborn, neonate Vascular access cannulation for newborn; peripheral intravenous catheters for infants and children. Endotracheal intubation for infants and children; management of intubation complications. Needle cricothyroidotomy in infants and children. Placement of gastric tube in infants and children. Insertion of an intraosseous line for infants and children. Management prehospital management of thermal burn, inhalation burn, chemical burn and electrical burn injuries and radiation exposure, including airway and ventilation, circulation, pharmacological, non-pharmacological. Airway and ventilation devices,

Prehospital childbirth		including CPAP/ BiPAP unit. Transcutaneous cardiac pacing, defibrillation, synchronized cardioversion; evaluation of major peripheral arterial pulses. Assisted ventilation, endotracheal intubation, including techniques for complications; meconium aspiration suctioning technique for a newborn; direct larnyngoscopy and foreign body retrieval in infants and children with a completely obstructed airway. Insertion of an orogastric tube.
Source: Colorado State Board for EMT Certification	Source: Colorado State Board for EMT Certification	Source: US DoT/NTSA. National Standard Curriculum.

Table A-2: State use of the National Registry of Emergency Medical Technicians (NREMT) for Licensing EMT (many of the largest states don't allow reciprocity)

State	EMT-Basic	EMT-Intermediate	EMT-Paramedic
Alabama	X	X	X
Alaska			X
Arizona	X	X	X
Arkansas	X	X	X
California			X
Colorado			X
Connecticut	X	X	X
Delaware			
Florida			
Georgia	X	X	X
Hawaii	X	X	X
Idaho	X	X	X
Illinois			
Indiana			X
Iowa	X	X	X
Kansas	X		X
Kentucky	X		X
Louisiana	X	X	X
Maine	X		
Maryland			X
Massachusetts			

Michigan	X	X	X
Minnesota	X	X	X
Mississippi	X	X	X
Missouri	X		X
Montana	X	X	X
Nebraska	X	X	X
Nevada			
New Hampshire	X	X	X
New Jersey	X	X	
New Mexico			X
New York			
North Carolina			
North Dakota	X	X	X
Ohio	X	X	X
Oklahoma	X	X	X
Oregon			X
Pennsylvania			X
Rhode Island	X		X
South Carolina	X	X	X
South Dakota	X	X	X
Tennessee			
Texas	X	X	X
Utah			
Vermont	X		X
Virginia			X
Washington	X		X
West Virginia	X		X
Wisconsin	X	X	X
Wyoming	X	X	X

Appendix B:
Department of Justice National Domestic Preparedness Consortium:

The Office **for Domestic Preparedness** (ODP) utilizes the capabilities of a number of specialized institutions in the design and delivery of its training programs. These include private contractors, other Federal and state agencies, the National Domestic Preparedness Consortium, the National Terrorism Preparedness Institute at St. Petersburg Junior College, the U.S. Army's Pine Bluff Arsenal, and the National Sheriff's Association.

The **National Domestic Preparedness Consortium** (NDPC) is the principal vehicle through which ODP identifies, develops, tests and delivers training to state and local emergency responders. The NDPC membership includes ODP's Center for Domestic Preparedness in Anniston, Alabama, the New Mexico Institute of Mining and Technology, Louisiana State University, Texas A&M University, and the Department of Energy's Nevada Test Site; each member brings a unique set of assets to the domestic preparedness program. The following is brief description of each member and their expertise:

Center for Domestic Preparedness (CDP): The CDP provides hands-on specialized training to state and local emergency responders in the management and remediation of WMD incidents. Located at the former home of the U.S. Army Chemical School, Fort McClellan, the CDP conducts live chemical agent training for the nation's civilian emergency response community. The training emergency responders receive at the CDP provides a valid method for ensuring high levels of confidence in equipment, procedures, and individual capabilities. The CDP offers two training courses of instruction: WMD HAZMAT Technician and WMD Incident Command. For additional information on this program contact the CDP at (256) 847-2132, or DicksonR@ojp.usdoj.gov.

New Mexico Institute of Mining and Technology (National Energetic Materials Research and Testing Center) (NMIMT): NMIMT offers live explosive training including the use of field exercises and classroom instruction. NMIMT is the lead NDPC partner for explosives and firearms, live explosives, and incendiary devices training. NMIMT offers one course of instruction, the Incident Response to Terrorist Bombing course. For additional information on NMIMT courses contact NMIMT at www.emrtc.nmt.edu.

Louisiana State University (LSU) (Academy of Counter-Terrorist Education): LSU provides training to law enforcement agencies and focuses its efforts on the delivery of the Emergency Response to Terrorism: Basic Concepts for Law Enforcement Course, and the development and delivery of the Emergency Response To Domestic Biological Incidents Course. For additional information on LSU courses contact LSU at www.ace.lsu.edu.

Texas A&M University (National Emergency Response and Rescue Training Center): Texas A&M delivers a set of courses to prepare public officials, emergency medical services, law enforcement, fire protection, and public works for the threat posed by weapons of mass destruction. Courses are developed and designed to provide each specific segment of the emergency response community with the tools needed to accomplish its role in the event of a WMD incident. Additionally, Texas A&M has developed an Interactive Internet WMD Awareness Course for emergency responders. Texas A&M also provides technical assistance to state and local jurisdictions in the development of WMD assessment plans. The Texas Engineering Extension Service (TEEX) offers the following courses of instruction: WMD Threat and Risk Assessment, WMD Incident Management/Unified Command, Emergency Response to Terrorism Basic Concepts, Emergency Medical Operations, and WMD Awareness (Internet Course). For additional information on TEEX courses contact TEEX at http://www.teex.com/campus or nerrtc@teexmail.tamu.edu.

U.S. Department of Energy's Nevada Test Site (National Exercise, Test, and Training Center) (NTS): NTS conducts large scale field exercises using a wide range of live agent stimulants as well as explosives. NTS develops and delivers a Radiological/Nuclear Agents Course. NTS, in coordination with ODP, is establishing the Center for Exercise Excellence. The Center will allow NTS to train jurisdictions in the planning and conduct of exercises, tailored to the unique threats faced by participating jurisdictions. The Center will provide a critically needed new component of the overall exercise training program, meeting those special exercise needs as the state and local jurisdictions define their exercise priorities. For additional information on NTS courses contact NTS at www.nv.doe.gov/nts/.

Source: Department of Justice, Office for Domestic Preparedness.
(www.ojp.gov/odp/ta/training.htm)