

## Worker Training for New Threats: A Proposed Framework

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**Background** *In an effort to identify health and safety training needs for various groups of workers related to weapons of mass destruction, including chemical, biological, radiological, and nuclear weapons and high yield explosives (CBRNE), a conference, “Worker Training in a New Era: Responding to New Threats,” was held at the Johns Hopkins Bloomberg School of Public Health in October 2002.*

**Methods** *Two questions were addressed: Which general skills and knowledge are common to all workers who might be exposed to terrorist threats from CBRNE weapons? What are the particular skills and knowledge relevant to these threats that are specific to workers in different sectors?*

**Results** *Thirteen core components for pre- and post-event training were identified. Pre-event training applies to all workers. Post-event training applies to selected personnel including first responders, skilled support personnel, and other workers involved in these operations. Recommendations to improve worker safety training related to preparedness include: identify specific competencies for worker pre- and post-event training; coordinate Federal policy on worker training for CBRNE hazards; adopt federal guidelines or standards on worker training for new CBRNE threats, based on the competencies and coordinated Federal policy; conduct an inventory of training programs and other resources that could be used or adapted for use for new threats; and develop new training content and methods for pre- and post-event training to address specific competencies.*

**Conclusions** *Given the possibility for the introduction of CBRNE threats into the workplace, all workers need some training in the potential hazards involved: the individual worker’s specific role in an emergency; incident command; activation of the emergency notification system; use of personal protective equipment (PPE); and safe evacuation of the workplace. While some occupational sectors have developed effective training related to these new threats, there is a need to develop, implement, and evaluate training programs across many different sectors of the workforce.* Am. J. Ind. Med. 46:423–431, 2004.

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## INTRODUCTION

Most of the “new threats” associated with weapons of mass destruction are “new” primarily in the sense that they have not been deliberately introduced into the workplace or the general population with the intention of causing harm, although the hazards themselves are not necessarily new in American workplaces. Workers in many industries are potentially exposed to chemical, biological, radiological, nuclear, and high yield explosive hazards on a regular basis. Highly toxic and reactive chemicals are manufactured, transported, stored, and used every day in large quantities. Biological organisms and their toxic products are commonly found in research facilities, medical institutions, and a variety of industries. Radiological agents are used widely in industrial non-destructive testing, medicine, research, and in other industries. Nuclear materials are used in the nuclear energy industry, as well as in the defense industry. Many industries use agents capable of causing fire and explosions. These hazards are already part of the landscape of the American workplace.

Most of the activity and research around worker training for preparedness and new chemical, biological, radiological, nuclear, and explosive (CBRNE) weapons has focused on a only few occupational groups: emergency responders, health care workers, and law enforcement personnel [Anonymous, 2001; NIEHS, 2002]. Relatively little information has been published regarding training of other work groups, even though there is reason to be concerned about their potential exposure to CBRNE weapons. Of particular importance is a need to define the general skills and knowledge required for all workers, and specific skills and knowledge required for particular categories of workers in the pre-event, event, and post-event phases of an event involving CBRNE weapons.

These topics were the subject of a conference held in October 2002 at the Johns Hopkins Bloomberg School of Public Health, “Worker Training in a New Era: Responding to New Threats.” Based in part on that conference, we discuss worker training needs related to new CBRNE weapons from the perspective of lessons learned about training from the events of September 11, 2001 and the anthrax attacks in the mail, and current training efforts within private and public sector organizations related to new CBRNE threats. We propose a framework for teaching workers the knowledge and skills needed to respond to potential CBRNE threats in the workplace.

## Lessons Learned From Recent Events

Following the attacks on the World Trade Center and Pentagon on September 11, 2001 and the subsequent use

of anthrax in the mail as a weapon, renewed attention has focused on bolstering the security and preparedness of various public and private systems in the United States. This includes the public infrastructure, such as the public health system and public safety sectors, and many private sector enterprises, such as the postal and transportation industries. Many of these organizations had already engaged in considerable activity prior to the terrorist attacks on New York and Washington DC, but these events spurred even greater efforts.

One critical aspect of preparedness is worker training. Because of the hazardous nature of certain types of work, worker training is an essential aspect of occupational safety and health programs. Many OSHA standards include a component of worker training. One example of a training requirement already in place that applies to potential terrorism incidents is the hazardous waste operations and emergency response (HAZWOPER) standard, 29 CFR 1910.120 and 1926.65, and 40 CFR 311 [U.S. Department of Labor, 1994]. The HAZWOPER standard describes requirements for employers and workers engaged in five different types of activities: cleanup operations at uncontrolled hazardous waste sites; cleanup operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA); voluntary cleanup operations at uncontrolled hazardous waste sites; operations involving hazardous wastes at treatment, storage, or disposal facilities covered by RCRA; and emergency response operations involving the release or potential release of hazardous substances, which includes chemical, biological, and nuclear agents. It also makes provisions for both emergency response operations (§1910.120(q)) and for post-emergency response operations, such as cleanup or decontamination (§1910.120(e)). Other Federal agencies with worker safety and health standards also require training specifically for emergency conditions or operations.

The importance of worker training was apparent in both the successes and shortcomings of the response to the attacks at the World Trade Center and Pentagon on September 11, 2001 and the subsequent introduction of anthrax into the U.S. postal system. Previous reports have examined the role worker training played in the context of these events [Jackson et al., 2002; NIEHS, 2002]. Some of the critical issues identified by these reports include: the need for cross-functional training (e.g., training emergency responders about the role of skilled support personnel and vice versa, so that they can function more effectively in a large recovery effort); the need for training that addresses the transition from the rescue phase to the cleanup and remediation phase; the need for incident command system (ICS) training among worker

populations other than fire and police; and the need to improve coordination among the various agencies responsible for worker safety training.

Workers served multiple functions during the post-event effort. First responders traditionally have been thought of as fire personnel, hazardous materials (HAZMAT) teams, police, and emergency medical service (EMS) personnel. In the case of the World Trade Center and Pentagon emergencies, many skilled support personnel such as heavy equipment operators functioned in part as first responders. Law enforcement personnel, too, had “dual functions” in performing legal/investigatory and first responder roles.

Another challenge is the transition from emergency response to the post-emergency response cleanup operations (decontamination and remediation). The OSHA HAZWOPER standard distinguishes between operations during and immediately after the emergency, and post-emergency response operations that take place some time after the initial response. In particular, there are detailed training requirements for emergency responders and for workers involved in post-emergency response cleanup operations, but the requirements for training of skilled support personnel during emergency response are far less stringent. Under HAZWOPER (29 CFR 1910.120(q)(4)), skilled support personnel are required to have only an “initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment (PPE), what chemical hazards are involved, and what duties are to be performed.” Because the transition to post-emergency response was not clearly delineated during the events of September 11, 2001, training requirements for skilled support personnel under HAZWOPER were not as clearly defined as they might have been.

A recent RAND report [Jackson et al., 2002] on protecting emergency responders noted the factors that had hindered emergency response at the WTC: a loss of command staff; inadequate resources; logistical difficulties; jurisdictional and political issues; the treatment of the sites as crime scenes; and the need to deal with citizens at the site. There were other challenges confronting the WTC and Pentagon responders that differed from other disasters: the nature of the hazards; a major loss of emergency response personnel; the duration of the response; the fact that job requirements and equipment requirements were atypical; and the presence of many skilled support personnel onsite.

Other issues that have been identified as challenges for preparedness training in the future include: the role of critical incident stress debriefing; protection of workers against the possibility of secondary threats (including intentional secondary threats); and collection and use of injury and illness data during and after the emergency response, both for first responders and for workers involved in cleanup and remediation. It should be noted that some training curricula,

particularly those developed for construction safety, may have an appropriate role within the context of an emergency response operation, in contrast to longer, more detailed courses. It should also be noted that training curricula should focus on hazards beyond normal responder training, such as chemical, biological, and radiological hazards, the risks associated with demolition, and the use of air purifying respirators (APRs).

## **NEW DEVELOPMENTS IN WORKER SAFETY TRAINING IN SELECTED OCCUPATIONAL SECTORS**

There are significant differences in the degree to which different occupational sectors have integrated training on CBRNE threats into general worker training. While some sectors, such as public safety, have made significant strides in developing effective worker training, other sectors have made less progress. In this section, we review the progress in worker safety training related to new threats that has occurred in five selected industrial sectors: general manufacturing; transportation; health care; emergency response; and skilled support.

### **General Manufacturing**

Many manufacturing companies are now looking at new threats and their potential risk. Some industries (such as the chemical industry) have been involved in these efforts for years and have developed relatively comprehensive plans, while other industries are just beginning to address the problem. A recent report by the General Accounting office notes that even for chemical industries, considered some of the most significant potential targets amongst manufacturing facilities, there are no specific laws or regulations requiring vulnerability assessment or security precautions. However, a number of laws and regulations including the Clean Air Act, the OSHA Act, and the Emergency Planning and Community Right-to-Know Act impose requirements on chemical facilities that could include vulnerability assessment and mitigation measures. The extent to which worker safety training is a part of this was not specifically addressed in the report [U.S. General Accounting Office, 2003]. Other existing standards that influence planning and training in this area include HAZWOPER and the OSHA Egress and Evacuation standard (29 CFR 1910 Subpart E). The OSHA Process Safety Management standard, which requires employers to analyze their manufacturing processes to minimize the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals, is also an important component of these regulations [U.S. Department of Labor, 1992, 2002]. OSHA has some existing training requirements for emergency response planning, including 29 CFR 1910.38

((employee emergency plans), 29 CFR 1910.120(q) (emergency response to hazardous substance releases), 29 CFR 1910.1200 (the hazard communication standard), and 29 CFR 1910.1450 (occupational exposure to hazardous chemicals in laboratories). Although not reviewed here, a number of government, professional, and trade organizations have also published guidelines and recommendations on preparedness. Most, however, do not address worker training in detail.

## Transportation

The transportation industry is highly integrated and highly interdependent. The system incorporates a wide variety of jobs, and transports a large quantity of hazardous materials on a constant basis. While much attention has been focused on the vulnerability of the transportation infrastructure, vehicles, and cargo, less attention has been focused on the specific training requirements of vehicle operators or other transportation workers relative to CBRNE threats. DOT's general training requirements for transportation workers, include: the ability to recognize and identify hazardous materials; specific functions to be performed by the employee; emergency response information; self protection safety measures, and accident prevention methods and procedures [U.S. Department of Transportation, 1992]. DOT has developed training resources, but there are industry-specific obstacles to effective training, including the geographic dispersion of the workforce and industry and the volume and diversity of potentially hazardous materials that are transported. Other challenges to worker training are presented by the existence of many small and independent operators in some transportation modes and the fact that there are multiple Federal agencies in addition to DOT that regulate and influence the industry.

## Health Care

There is more published literature on the training of health care workers than most sectors other than emergency responders [Greenberg and Hendrickson, 2003; Shadel et al., 2003; Sigler and Diedrich, 2003]. In part, this is because health care workers play a central role in the response to bioterrorism. Training the health care workforce is complicated because it is a diverse workforce that includes physicians, nurses, dentists, pharmacists, public health workers, veterinarians, and a large number of other professional groups. Research at Columbia University's Mailman School of Public Health Center for Public Health Preparedness has focused on training needs for health care workers. Pilot studies suggest that training is effective, but that the availability of health care workers in an emergency may be influenced by many factors—including the availability of childcare and/or eldercare, personal health problems, or

concerns about compensation (Robyn Gershon, Mailman School of Public Health, unpublished data).

The diversity of the health care system is such that there are both core and specific training competencies for health care workers, according to their roles and functions. Public health agencies, for example, must continue to deliver essential services even while responding to an emergency. Gebbie [2001] has described the training needs of the public health workforce. These include: communication systems; emergency management or command systems; specific technical knowledge; and mental health skills. Core competencies for emergency preparedness for public health workers have been promulgated by the Centers for Disease Control and Prevention (Table I). Newer competencies, based largely on the core competencies, are being developed for specific types of emergencies (e.g., bioterrorism events) and specific types of workers (e.g., administrators, clinicians, laboratory workers, public information officers, technical and support staff, etc.) across all phases of an event [Gebbie and Qureshi, 2002]. Competencies in additional areas, such as informatics and legal issues, are also needed and are in development [Lichtveld et al., 2002].

Thorne et al. [2003] have also examined training needs for non-clinical health care workers. The authors found that non-clinical workers in the health care setting also express a desire for role-specific information on CBRNE threats, with a desire for frequent hands-on drills.

## Emergency Response

First responders include fire fighters, emergency medical technicians (EMTs) and paramedics, and police. First responders are at risk in any future events involving CBRNE threats. This has led to some changes in risk perception, as well as a recognized need for more and improved equipment and training for hazard detection, health surveillance, communications, personnel tracking, and PPE [Waeckerle et al., 2001]. For example, conference attendees noted that having

**TABLE I.** CDC Core Competencies for Public Health Workers

**Every public health worker should be able to**

- 
- Identify and locate the emergency plan
  - Describe the role of public health
  - Describe the chain of command
  - Describe and *demonstrate* functional role
  - Recognize deviations from the norm
  - Identify limits to own authority
  - Describe communication roles
  - Demonstrate use of communication equipment
  - Apply creative problem solving skills
- 

Source, Gebbie [2001].

reference materials available electronically for immediate access in the field will improve hazard recognition and threat management. There is a need to augment basic skills training, particularly with respect to hazardous materials and CBRNE weapons, personal scene safety, risk management, and to cross-train with federal responders and skilled support personnel. All new recruits who may be first responders should be trained to the operations level, and training should integrate the new increased focus on detection, protection, and decontamination.

Members of the first responder community have long been aware that in any event involving CBRNE weapons, they will, by definition, be the first on scene and among those with the greatest potential exposures. Challenges at the state and local level for emergency responders include potential exposures not previously encountered, increased requirements for planning and meeting, as well as expansion of the core mission of the fire service and first responders. Responder health and safety remains the priority, and thus the training for new threats must be coordinated with the need for basic emergency response training. The hazardous materials-level training that should be provided to every first responder includes: use and limitations of PPE (especially respiratory protection); vaccination against blood borne pathogens; communications; command structure; and basic operations. Partnerships such as those between fire fighters, Federal agencies, and other trades (e.g., skilled support personnel) are key in developing effective training, especially given the magnitude of the need and limited resources.

### **Skilled Support Personnel**

Skilled support personnel are those workers temporarily on a site for specific purposes, as defined in the HAZWOPER standard. 29 CFR 1910.120(q)(4) defines skilled support personnel as: “personnel, not necessarily an employer’s own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer’s own employees, and who will be or may be exposed to the hazards at an emergency response scene.” In reality, although these are thought of as temporary workers, such workers were on site at the World Trade Center and Pentagon for many months, so the definition of skilled support personnel, and the estimates of exposure potential, need to be considered carefully.

Training for skilled support personnel has been recognized as a critical issue in the wake of the events of September 11, 2001. Among the issues that affected training for skilled support were: construction procedures are defined by contracts, and in these events there were no established contracts and no planning for the project; the strict structure

governing contractors, supervisors, and workers was absent, compared with normal construction operations; and there was both formal and informal training, with less formal training at the outset, followed by more formal training after several months. Based on these observations, important considerations for the training of skilled support personnel include: an ability to identify hazards and the population at risk; basic safety principles; and specific training related to their job description. Supervisors need to know the capabilities of their workers, and do advanced training as much as possible. Issues such as confined space training, fall protection, night operations, HAZWOPER, and respirator training need to be incorporated in the basic training plans of the contractors, employers, and unions. Pre- and post-incident training should also be considered. A recent report by the National Clearinghouse for Worker Safety and Health Training highlights the importance of supplementing HAZWOPER training for skilled support workers, with more specific training that depends on whether the training is pre- or post-incident [Lippy and Murray, 2002]. Hick et al. [2003] have discussed the training of workers who could be involved in the decontamination of health care facilities receiving contaminated patients. Their training recommendations are based on 29 CFR 1910.120, and they utilize an ICS model.

## **RECOMMENDATIONS FOR A NEW TRAINING AGENDA**

### **General Recommendations: Knowledge and Skill Recommendations for All Workers**

Based on the discussion above, the following questions are suggested: What are the common knowledge and skills workers in different workforce sectors need in order to safely respond to an event involving CBRNE hazards? What specific knowledge and skills do workers in different workforce sectors need in order to safely respond to an event involving CBRNE hazards?

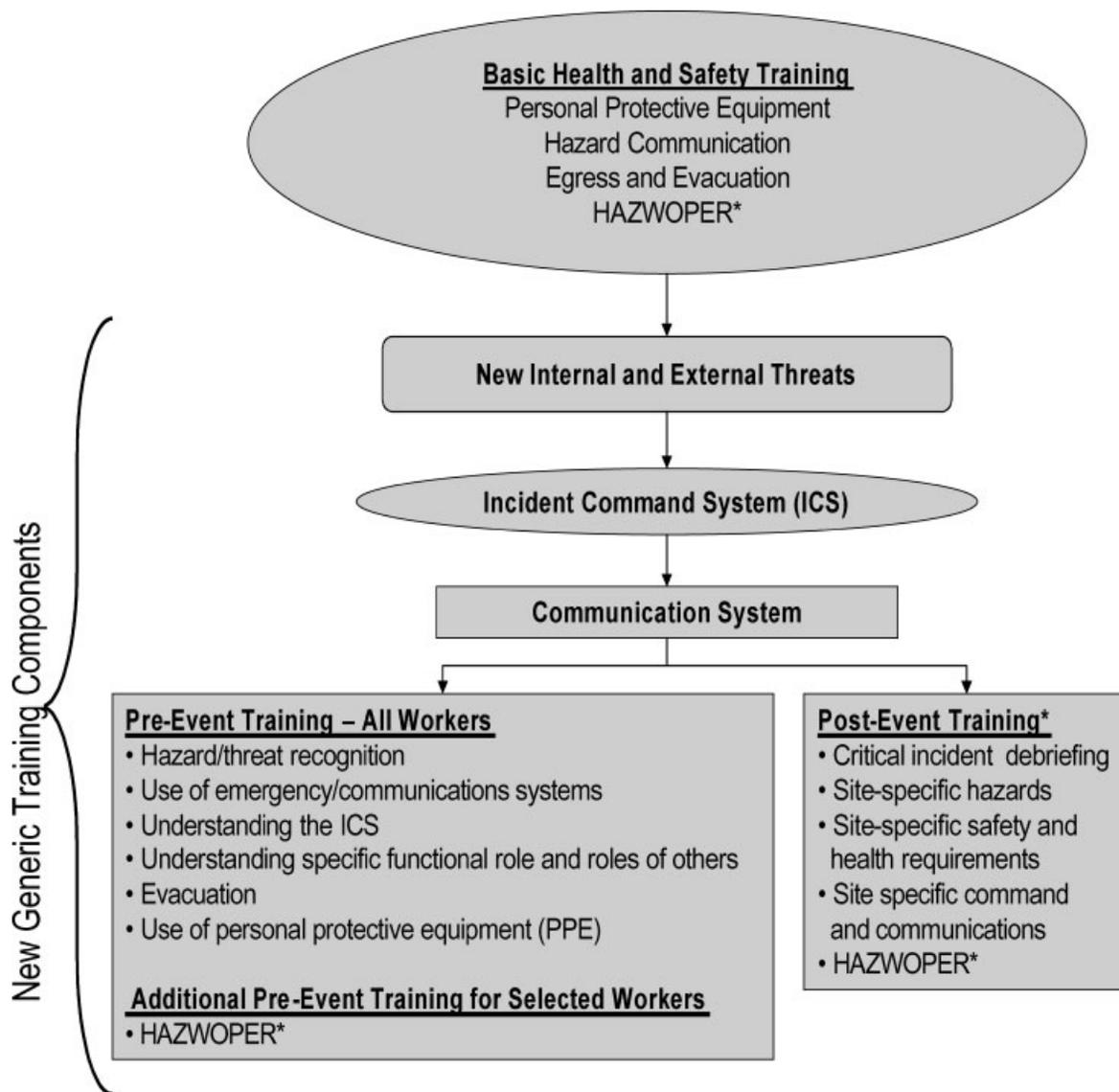
The following generic training components are proposed as knowledge and skills that all workers should have in order to be prepared for potential CBRNE threats in the workplace, regardless of the workforce sector involved: a basic understanding of the hazards involved, including concepts of contamination and decontamination; an understanding of each employee’s specific role in an emergency, the roles of other potential participants and responders, and the limitations of individual roles; an understanding of the ICS and the role it plays; and knowledge of how communications systems work in the response to an emergency. In addition, we believe that all workers, in addition to their own occupational skills, should receive training in and possess the following skills:

- the ability to recognize a threat or abnormal condition,
- the ability to access the emergency notification system,
- the ability to use PPE safely and appropriately,
- the ability to use specific information resources and tools, and
- the ability to evacuate the workplace safely.

A model of these generic training recommendations, and the workers to whom they apply, is shown in Figure 1. These new recommendations are contrasted with current worker training requirements in Table II. Recommended training for all workers includes threat recognition, activa-

tion of the emergency notification system, and the ICS (including a description of the functional roles of each potential responder).

It should be stressed that the skills component of these suggested requirements (activation of the emergency notification system, use of PPE, and evacuation) must be practiced in “real-world” simulations. It should also be stressed that all workers should receive training, not just those who are deemed likely to be “at risk.” For example, workers involved in communications (dispatchers) are an especially important group to train because of their central role in recognizing and responding appropriately to an emergency situation.



**FIGURE 1.** Recommended generic training elements for all workers related to new chemical, nuclear, biological, radiological, and high yield explosive (CBRNE) threats. Asterisk (\*) indicates training that applies to specific workers, such as first responders, skilled support personnel, and others involved in emergency response and post-emergency response operations. All workers would receive pre-event training. This framework does not include trade-specific knowledge and skills.

**TABLE II.** Generic Training Recommendations for All Workers Related to Chemical, Biological, Nuclear, and Radiological Threats and Other Weapons of Mass Destruction

Current worker training requirements under the OSHA HAZWOPER standard (29 CFR 1910.120)	Proposed new generic training requirements for all workers potentially exposed to chemical, biological, nuclear, radiological, and other weapons of mass destruction	
	Pre-event training for all workers	Post-event training <sup>a</sup>
<ul style="list-style-type: none"> <li>Names of personnel and alternates responsible for site safety and health</li> <li>Safety, health, and other hazards present on the site</li> <li>Use of personal protective equipment (PPE)</li> <li>Work practices by which the employee can minimize risks from hazards</li> <li>Safe use of engineering controls and equipment on the site</li> <li>Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards</li> <li>Specific contents of the site safety and health plan                             <ul style="list-style-type: none"> <li>Decontamination procedures</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Basic health and safety training (legal, regulatory, hazard communication)</li> <li>Basic knowledge and recognition of industry-specific potential hazards and threats</li> <li>Ability to access emergency notification system and notify appropriate parties</li> <li>Knowledge of incident command system (ICS)</li> <li>Knowledge of the worker's specific functional role in an emergency, the limitations of that role, and the roles of others</li> <li>Emergency evacuation and egress</li> <li>Ability to use PPE</li> </ul>	<ul style="list-style-type: none"> <li>Site-specific or event-specific hazards and threats</li> <li>Site-specific or event-specific safety and health plan requirements</li> <li>Ability to use PPE</li> <li>Site-specific command and communications</li> <li>HAZWOPER requirements</li> <li>Critical incident stress debriefing</li> </ul>
	<b>Pre-event training for selected workers<sup>a</sup></b>	
<ul style="list-style-type: none"> <li>The emergency response plan, including necessary PPE and other equipment</li> <li>Confined space entry procedures</li> <li>Spill containment program</li> </ul>	<ul style="list-style-type: none"> <li>HAZWOPER</li> </ul>	

<sup>a</sup>Training requirements for first responders, skilled support personnel, and other workers involved in post-emergency response operations.

It is assumed that these generic training requirements will be supplemented by trade-specific knowledge and skills recommendations. In some cases, such as emergency responders and health care workers, these competencies have been defined in some detail. In other cases (e.g., for transportation workers) there have been some efforts to define specific skills and knowledge requirements, while in other cases a great deal of development still needs to be done in order to define the correct knowledge and skill sets. Second, and importantly, the pool of workers eligible for pre-event HAZWOPER training, because they are likely to be involved in any emergency response or post-emergency response cleanup operations, may well be larger than it is currently conceived today.

## CONCLUSION

Worker training for CBRNE threats is an important aspect of overall worker safety and health training. Based on the findings of the Baltimore conference, several suggestions are offered as to how to implement the training within the context of existing health and safety training.

- Training plans should recognize the significant differences among different workforce sectors in the degree to which they are prepared to respond to the threat of CBRNE attacks. Some workers, particularly emergency responders, receive considerable training, while many others receive little or no applicable training. Generally, workers who, in their daily work activities, are further removed from emergency response activities (manufacturing workers, food and agricultural workers and service sector employees not involved in emergency response) receive little or no applicable training.
- Training for new CBRNE threats should be integrated into basic safety and health training, in a unified training plan that builds on and supplements other current training requirements. Training for different types of hazards should be based on a single emergency response plan. Such an approach simplifies training and increases the likelihood of successful implementation. Additionally, it allows the training plan to address responses that are not necessarily dependent on the nature of the threat. Thus workers should be prepared to deal with single or multiple threats, known or unidentified.

- The many Federal agencies involved in regulating or guiding activities of certain industries must coordinate their guidance and regulations regarding worker training. Because there are many agencies involved in the regulation of different occupational sectors, there are a number of different and often-conflicting regulations that need to be reconciled regarding different aspects of worker training. For example, chemical manufacture and transportation involves OSHA, EPA, and DOT, to name just three. Creating uniform requirements will facilitate the development and adoption of training programs.
- At a minimum, the Federal government should issue recommendations on worker safety training for new threats, including chemical, biological, radiological, and nuclear weapons. Conference participants were divided on whether there should be only guidelines as opposed to standards for training, but there was agreement that guidance on training from the Federal government is needed. Many participants felt that some workers do not receive even basic safety and health training now, so to expect any increase in training in the absence of a strong Federal initiative or requirement was unreasonable.
- At all levels of response, training should reflect a high degree of coordination between the emergency response and public health communities. The key to effective emergency response is coordination between the emergency response community, public health agencies, and the employer and employees. Communication between the public health and emergency response organizations is especially critical. In some cases, these links are well developed and smooth. However, many public health organizations are not accustomed to the top-down incident command structure widely used by emergency responders. The greater the coordination between these entities in the pre-event phase, the better the response will be in the event of an actual attack.
- Whatever the training plan, an essential element must be frequent and regular “real-life” rehearsals. This requires a commitment of resources on the part of employers, employees, and the government, but that it is essential if training is to accomplish its goal of preparing workers to respond effectively in any future events.

There are additional opportunities for research and development in this area. They include development and validation of specific competencies for worker training among different workers, with input from a broad cross-section of stakeholders involved in worker training and preparedness; and development and/or inventory of worker training modules across a broad array of industries. Finally, there are significant questions related to the role the Federal government should play in encouraging worker training requirements related to new CBRNE threats. While there was no consensus among conference participants about guide-

lines versus standards, many attendees felt that it was important for the Federal government to offer some guidance relative to training for CBRNE threats. Many also expressed a desire for improved coordination of federal policy and requirements on worker training, involving the many agencies that govern worker health and safety—OSHA, CDC/NIOSH, NIEHS, FEMA, DOT, EPA, the Justice Department, the new Department of Homeland Security, and other state and local agencies. Given the complexity of this area, such coordination seems essential.

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