Every day in the United States, emergency responders answer calls for help and take on jobs that place them in harm’s way. Firefighters, law enforcement officers, emergency medical technicians, and paramedics play a critical role in protecting the American public and property in the event of fires, natural disasters, medical emergencies, or actions by terrorists or other criminals. Emergency responders’ responsibilities extend from dealing with small-scale, “everyday” emergencies that may affect only a single individual, family, or business, to responding to large-scale disasters such as earthquakes, hurricanes, or terrorist attacks. Accordingly, it is in the nation’s interest to aid in the protection of these workers both for their own sake and to sustain their ability to protect the country.

STUDY TASK AND PURPOSE

In an effort to understand the range of hazards to which emergency responders are exposed and to identify critical protective technology needs, RAND conducted a series of structured, in-depth discussions with a wide range of representatives from the emergency response community. The study was requested by the National Personal Protective Technology Laboratory (NPPTL) within the National Institute for Occupational Safety and Health (NIOSH) to help guide development of a research agenda. NPPTL was created in 2001 with the mission of “providing world, national and [NIOSH] leadership for the prevention and reduction of occupational disease, injury, and death for workers who rely on personal protective technologies—through partnership, research, service, and communication.” An important objective of NPPTL is to ensure that the development of personal protective technology (PPT) keeps pace with employer and worker needs as work settings and worker populations change and as new technologies emerge. NPPTL’s initial area of emphasis is to respond to the critical need for effective personal protective technologies for the nation’s emergency responders.
Among NPPTL’s strategic goals are understanding the hazards for which personal protective technologies are used, the use and limitations of personal protective technologies and the programs guiding their use, the barriers to effective use of protective technologies, and personal protective technology failures. Accordingly, the objective of RAND’s discussions with representatives from the nation’s emergency responder community was to elicit the community’s views on the following questions:

- What are the principal tasks that emergency responders undertake and how might those tasks change in the future?
- What are the occupational risks and hazards that are of greatest concern to emergency responders, and which are the highest-priority for improving protection?
- What are the current and emerging technologies critical to protecting emergency responders’ health and safety and enhancing their capabilities?
- What are the drivers of, impediments to, and gaps (i.e., shortfalls in equipment availability, price, utilization, performance, or management) in technology development that limit progress in reducing injuries to and improving the capabilities of the emergency response workforce?

While a substantial amount of data is collected about emergency response activities and responder injuries and deaths, first-hand views from the emergency responder community about the hazards they face and their protection needs provide insights about those needs that cannot be derived from injury and fatality statistics. One significant problem with the data is that they provide no insight into the details on why different personal protection options do or do not work well. In addition, these data provide little information to link specific types of activities to specific types of injuries. The community views can reveal many important gaps in personal protective needs that are not apparent through analysis of available occupational health and safety surveillance data.

HOW THE STUDY WAS CONDUCTED

RAND researchers led structured discussions with 190 representatives from 83 organizations across a broad spectrum of the emergency responder community nationwide. The findings presented in this report are drawn largely from input provided by representatives from 61 local (i.e., front-line) emergency responder organizations. These organizations include 33 fire departments (28 city and county agencies, 4 private industrial and municipal services firms, and 1 volunteer department); 22 law enforcement agencies (19 city police departments, 1 state police department, 1 county sheriff’s department, and 1 tribal police de-
partment); 3 independent (third-service) emergency medical service (EMS) organizations; and 3 local emergency management offices.

These local agencies typically have responsibility for responding to structural fires, medical emergencies, transportation accidents, crimes, public disturbances, natural disasters, and terrorist acts within their jurisdictions. In arranging the discussions with representatives of the responder community, participants with special expertise in emergency medical services, hazardous material (hazmat), and special law enforcement operations response were specifically invited and participated in most discussions with departments that provided such special services. Hazmat response is also handled primarily by fire departments, with 25 of the 33 participating fire departments providing hazmat response.

The rank of participants was mostly at the assistant, deputy, or battalion chief level, though several department chiefs as well as lower ranks were represented. Most participants had expertise in either special operations or protective equipment acquisition and maintenance. In some cases, safety officers, training officers, and occupational health experts participated in the discussions.

Participating organizations were selected according to several criteria. The goal was to sample a range in department size and type, socioeconomic composition of the community served, and geographic location. Departments were also included based on their reputation within the profession and on recommendations from other discussion participants. Finally, some departments were selected based on logistical considerations as well (i.e., how easily they could be accessed). In the end, the RAND sample was biased toward larger departments relative to the national average. This bias was intentional and was prompted by the understanding that larger departments generally have greater resources and capabilities for analyzing risks and assessing personal protective technology needs.

To supplement the information gathered from local agency representatives, the RAND team also met with representatives from 22 business, government, non-governmental, and academic organizations, including 9 technology and services suppliers and 13 agencies and organizations engaged in PPT research, policymaking, and program development. These community representatives,

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1 Service from a third party, after fire and police departments.

2 Although only three independent EMS providers were included in the RAND roster, nearly all of the fire departments that were contacted are the primary EMS providers for their jurisdictions, and representatives specializing in EMS participated in most discussions. However, the EMS input in this study is biased toward the fire service and does not reflect the diversity of EMS delivery models that are in use.

3 Due to logistical constraints, a few participants were contacted by telephone.
typically operating at the national level or focusing on a specific topic, provided the RAND team with important background information on technical issues related to personal protection and emergency response, research agendas, and programs and policies. Many representatives also assisted us by identifying local agencies for inclusion in the RAND discussions.

All of the discussions were conducted between March and July 2002. They typically were conducted on the participants’ premises and lasted from 90 minutes to two hours; all discussions were held on a not-for-attribution basis.

Figure 1.1 shows the geographical distribution and type of organizations that participated in the study. Many organizations elected to delegate more than one representative to this research effort, bringing the total number of individuals who participated in the RAND study to 190. A list of discussion participants and their affiliations is provided in Appendix A. In almost every instance, we found the participants to be highly engaged, thoughtful, and willing to address even sensitive issues.
To maintain consistency, discussions were guided by a 20-question protocol developed by RAND in conjunction with NPPTL. The protocol is reproduced in Appendix B. The protocol was designed to encourage participants to think broadly and creatively and pursue issues of special interest related to their particular localities or individual experiences, yet at the same time keep the discussion focused on the questions listed earlier in this chapter.

Most discussions were conducted by one or two members of a five-member RAND team. To further minimize inconsistency among discussions and to facilitate consistent interpretation of responses, 65 of the 83 discussions (78 percent) were conducted by one or both of two team members, with both of those members present during 11 discussions (13 percent). All discussion notes were shared among team members, and team meetings were regularly held so that team members could share the input they received.

LIMITATIONS OF THE STUDY APPROACH

Our approach, which utilizes structured discussions to elicit the views and priorities of the emergency responder community, offers unique insights that are relevant to the questions surrounding the hazards and protection needs that emergency responders face. However, such an approach has significant limitations, particularly within the context of using the views of the community to inform the higher-level objective of defining research and development (R&D) priorities for personal protective technologies. While we have taken steps to mitigate these limitations, they nonetheless must be kept in mind when interpreting our findings.

One limitation is the qualitative nature of the input. Because of the broad scope of the discussion protocol, the wide range of types of agencies and organizations included in the study, and the individual nature of the discussions, the information collected from the discussions covered a vast range of topics and typically could not be quantitatively classified in certain ways, such as according to the exact number of participants or departments expressing a particular view. In addition, discussion participants were asked to express their personal views and did so with varying degrees of clarity and emphasis, which leaves open the possibility of inconsistency in interpreting responses.

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4 The protocol was tailored primarily for discussions with the 61 emergency responder departments. Discussions with the 22 business, government, nongovernmental, and academic organizations loosely followed the protocol, but tended to focus more narrowly on the organization’s specific area of expertise.

5 Of the 70 discussions with emergency responder departments and manufacturers and service providers, 62 of the discussions (89 percent) were conducted by one or both of two team members.
Another related limitation is the degree of reproducibility of the findings. Despite our use of a discussion protocol and our efforts to maximize consistency among RAND discussion leaders, each discussion was unique and depended on the roles and experience of the individual participants. We attempted to mitigate this effect by sampling a large number and wide range of organizations. This approach generally was successful in that clear themes emerged, and there were clear distinctions among issues with low, moderate, or high degrees of consensus. However, it is possible that a different sample or discussion approach would have yielded somewhat different findings.

A final limitation is the inherent incompleteness of and bias in the information that can be obtained solely from the viewpoint of the emergency responder community. Emergency responder organizations in the United States are very decentralized, and many agencies, particularly the smaller ones, may not be aware of certain initiatives or resources that are available to address various problems. As municipal agencies, emergency responder departments’ budgets are often tight, and in many cases, the primary concern of emergency responders is not the availability of technologies but the availability of funds to acquire those technologies. In addition, as end-users, many emergency responders are primarily interested in and knowledgeable of fully developed, tested, and accepted technologies. As a result, they may pay little attention to, or may even actively dismiss, some emerging technologies that are not fully developed or widely diffused. In so doing, they may misconstrue some of the community’s needs. We attempted to balance this potential shortcoming by including in this report discussions of emergency responder injury and fatality data as well as descriptions of existing technologies, standards, and programs whenever they were relevant to concerns raised by participants.

DEFINITIONS

In this study, we adopted a broad definition of technology—namely, the application of knowledge toward practical ends. Accordingly, personal protective technologies include not only conventional protective equipment, such as clothing, gloves, respirators, and helmets, but also other physical hardware (e.g., detectors and communications systems) in addition to operational procedures, organizational structures, and management practices. The inclusive nature of this definition is important: According to the community members with whom we spoke, some of the most effective means for protecting emergency responders entail organizational policies and management practices.

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6While procurement of PPT is one of the issues addressed in this study, the emphasis of this study is on obtaining the information needed to select the appropriate PPT rather than on funding problems or opportunities.
We use the term community to refer to the professional emergency responder community as defined by the types of organizations included in the discussions. The term emergency responders refers to those personnel within this community that deploy to emergency incidents. The term first responders was often used by participants in the RAND discussions; we use this term wherever it is valuable for highlighting issues that are salient to individuals who are the first to arrive at an incident scene.

SCOPE OF STUDY

Emergency responder organizations and specialties represented in this study include firefighting, law enforcement, emergency medical services, hazardous materials response, urban search and rescue (USAR), anti-terrorism, special weapons and tactics (SWAT), bomb squads, and emergency management. Note that this study did not include several actors that often serve in an emergency response capacity during particularly large events or when specialized expertise is required. Those actors may include municipal agencies and private organizations responsible for transportation, communications, medical services, public health, disaster assistance, public works and engineering, construction, and wildlands firefighting, as well as military elements such as the National Guard and the Army Corps of Engineers. As illustrated most recently by the September 11, 2001, attacks, the roles of such responders can be central in some cases (Jackson et al., 2002). However, because of the particular challenges involved in defining the roles and needs of workers who do not normally engage in emergency response, and because of the challenges presented by the diversity of practices, capabilities, and missions among these groups, evaluating the hazards and protection needs faced by “contingency” emergency responders requires a separate, dedicated research effort.

This study focused on obtaining input from responders and organizations at the local (city and county) level, given our interest in obtaining community views “from the field.” Federal emergency response organizations were contacted to help provide background information on personal protection policy and technology research and development.\(^7\)

In recent years, and especially after September 11, 2001, a number of efforts have examined emergency responder needs in a weapons of mass destruction (WMD) scenario (see, e.g., Dower et al., 2000; InterAgency Board for Equipment Standardization and InterOperability, 2001). This study endeavored to cover the

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\(^7\)Federal (i.e., Federal Emergency Management Agency) and state urban search-and-rescue task forces, who are major users of PPT, were not contacted as a group. However, because these forces are staffed largely by local firefighters and other specialists, the views of several USAR task force members regarding their USAR activities were noted during the discussions.
entire spectrum of operations undertaken and environments encountered—both usual and unusual—by local emergency responder organizations. In light of the September 11 terrorist attacks and the ensuing heightened attention to homeland security during the period when the discussions were conducted, the subject of terrorism preparedness and response was a prominent theme in many of those discussions. Nevertheless, participants' emphasized that needs for ongoing "conventional" operations must be considered along with needs emerging from unconventional operations such as for weapons of mass destruction scenarios.

ABOUT THIS REPORT

This report presents the results of RAND's discussions with 190 members of the emergency responder community concerning the risks they face in the line of duty and recommendations they made for enhancing their personal protection capabilities. The report conveys the views, experiences, and recommendations of the discussion participants. The emergency responder community is very diverse, and the discussions reflected that diversity. Accordingly, we have attempted to identify areas of consensus and disagreement and bring to light the implications of these perspectives for policymaking. We also highlight technology standards and initiatives from government and professional organizations that are germane to the issues and concerns raised in the discussions.

Before presenting the results of the community discussions, in Chapter Two we provide a brief overview of the emergency response community. This overview summarizes emergency responder organizational structures, emergency response activities, and injury and fatality data. The injury and fatality data complement the community views because the data can provide insights into the hazards that lead to injuries and deaths, while community views can help to identify those hazards for which the concerns are greatest within the emergency responder community. The hazards that emerge from the two sources are not always consistent. Protection from terrorism and protection from pathogens are two examples of concerns that are unimportant according to injury and fatality statistics but are nonetheless high priorities within the community.

Chapters Three through Six present the community views by major service lines:

- Firefighting (Chapter Three)
- Emergency medical response (Chapter Four)
- Law enforcement (Chapter Five)
- Hazardous materials and terrorism response (Chapter Six).
Within each of these chapters, we highlight the major risks, and the major health and safety and personal protection technology needs at the individual-responder level voiced by community members.

We encourage readers to review the findings in all of these chapters, not just those for their particular field of interest. While the conventional divisions among fire, EMS, and police are useful in terms of distinguishing professional career paths and primary job functions, there is considerable overlap among the services in the activities they perform, the hazards they encounter, and the education and training they need. Many personal protection issues—such as respiratory protection, personnel accountability, ballistic protection, and reducing the risk of exposure to pathogens, which were once relevant primarily to a single service—are becoming germane to all responders.

Expanding upon this point, many issues were raised in the discussions that do not fit neatly into conventional functional or service frameworks. These crosscutting issues are presented in Chapters Seven and Eight.

Chapter Seven addresses systems-level protection issues such as communications systems and hazard information, identification, and assessment. Community members also illustrated how personal discretion and decision-making can be critical determinants of PPT effectiveness. To this point, the chapter addresses safety practices and enforcement, knowledge management (i.e., effectively utilizing available information), and the influence of service traditions and organizational culture.

Another crosscutting theme that emerged in the community discussions concerned the organization and management of personal protection: how PPT is selected, purchased, maintained, deployed, and retired. The findings in Chapter Eight highlight the centrality of PPT procurement and logistics in improving the personal protection of emergency responders when they are in the line of duty.

Finally, Chapter Nine extends the views and recommendations made in the discussions and presents several broad themes that may inform a personal protection agenda for the future for the entire emergency response community. The diverse and often complex issues raised by the community reveal a number of challenges for improving the personal protection of America’s emergency responders, not just in the area of personal protection equipment, but also in the areas of risk assessment, education and training, information management and communications, and organizational development. Some issues can be addressed immediately through policy and program improvements, while others will first require analysis, research, and development.

Many of the points raised by emergency responders mirror issues raised at a NIOSH/RAND workshop that brought together personnel involved in the re-
sponses to the terrorist attacks of September 11, 2001, the anthrax attacks later that year, and the attack on the Murrah Federal Building in Oklahoma City six years earlier (Jackson et al., 2002). The information in this report and in Jackson et al., in addition to information on occupational injuries and deaths, will be used to develop a research and development road map for NPPTL. Further, given the wide range of organizations with a stake in improving emergency responder safety and health, we expect that a variety of other agencies and organizations will benefit from the findings of this study and act upon the ideas and challenges presented in this report, thereby better serving and supporting America’s emergency responder community.