Nationwide Response Issues After an Improvised Nuclear Device Attack: Medical and Public Health Considerations for Neighboring Jurisdictions: Workshop Summary

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Nationwide Response Issues After an Improvised Nuclear Device Attack

Medical and Public Health Considerations for Neighboring Jurisdictions

Workshop Summary

Forum on Medical and Public Health Preparedness for Catastrophic Events

Board on Health Sciences Policy

Miriam Davis, Megan Reeve, and Bruce M. Altevogt, *Rapporteurs*

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"Knowing is not enough; we must apply.
Willing is not enough; we must do."
—Goethe

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Reviewers

This workshop summary has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published workshop summary as sound as possible and to ensure that the workshop summary meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process. We wish to thank the following individuals for their review of this workshop summary:

Timothy Cooper, Delaware Division of Public Health
Steven Englender, City of Cincinnati Department of Health
Onora Lien, Northwest Healthcare Response Network
Ruth McBurney, Conference of Radiation Control Program Directors
Monica Schoch-Spana, UPMC Center for Health Security
Tammy Taylor, Los Alamos National Laboratories

Although the reviewers listed above have provided many constructive comments and suggestions, they did not see the final draft of the workshop summary before its release. The review of this workshop summary was overseen by **Hellen Gelband,** Center for Disease Dynamics, Economics and Policy. Appointed by the Institute of Medicine, she was responsible for making certain that an independent examination of this workshop summary was carried out in accordance with institutional procedures and that all review comments were carefully considered. Re-

sponsibility for the final content of this workshop summary rests entirely with the rapporteurs and the institution.

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APPENDIXES

1

Introduction[1]

Our nation faces the distinct possibility of a catastrophic terrorist attack using an improvised nuclear device (IND), according to international and U.S. intelligence (Jenkins, 2008). Detonation of an IND in a major U.S. city would result in tens of thousands to hundreds of thousands of victims and would overwhelm public health, emergency response, and health care systems, not to mention creating unprecedented social and economic challenges. Although preparing for an IND may seem futile at first glance, thousands of lives can be saved by informed planning and decision making prior to and following an attack.

BACKGROUND

In 2009 the Institute of Medicine published the proceedings of a workshop assessing the public health and medical preparedness for responding to an IND detonation (IOM, 2009). Since that time, multiple federal and other publications have added layers of detail to this conceptual framework, resulting in a significant body of literature and guidance. Many of these materials can be found in the resource list located in Appendix E. However, there has been only a limited planning effort at the local level, as much of the federal guidance has not been translated into action for states, cities, and counties. According to an informal survey of

[1]This report has been prepared by the workshop rapporteurs as a factual summary of what occurred at the workshop. The planning committee's role was limited to planning and convening the workshop. The views contained in the report are those of individual workshop participants and do not necessarily represent the views of all workshop participants, the planning committee, or the Institute of Medicine.

community preparedness by the National Association of City and County Health Officials (NACCHO), planning for a radiation incident ranked lowest in priority among other hazards by 2,800 local health departments.

Meeting Objectives and Statement of Task

In partnership with NACCHO, this workshop, held on January 23–24, 2013, focused on key response requirements faced by public health and health care systems in response to an IND detonation (see Box 1-1). Especially included were the planning needs of state and local jurisdictions outlying the detonation site. The specific meeting objectives were as follows:

- Understand the differences between types of radiation incidents and implications of an IND attack on outlying communities.
- Highlight current planning efforts at the federal, state, and local level as well as challenges to the implementation of operational plans.
- Examine gaps in planning efforts and possible challenges and solutions.
- Identify considerations for public health reception centers:
  - How will public health and health care interface with functions and staffing?
  - How will radiological assessments and triage be handled?
- Discuss the possibilities and benefits of integration of disaster transport systems.
- Explore roles of regional health care coalitions in coordination of health care response.

OVERVIEW OF KEY MESSAGES

Although facing and planning for an improvised nuclear device attack continues to be a daunting task, many participants and speakers highlighted the amount of work and progress that has already been made across the country through dedicated "all-hazards preparedness" planning at the federal, state, and local level and by interagency workgroups.

BOX 1-1
Medical and Public Health Preparedness for an Improvised Nuclear Device Incident: A Workshop

Statement of Work

An ad hoc committee will organize a public workshop that will examine public health and medical preparedness to respond to an improvised nuclear device (IND) incident. The committee will develop the workshop agenda, select and invite speakers and discussants, and moderate the discussions. Specifically, the topics to be addressed at the workshop will include the following:

- How state and local health department planning is informed through threat intelligence and risk assessments.
- How an "informed" evacuation would be coordinated after a period of sheltering in place.
  - How to effectively communicate to the public the importance of sheltering in place immediately following a no-notice detonation (including coping with societal elements such as family member separation).
- Strategies to assess radiation exposure and triage patients.
- Opportunities to integrate the Radiation Injury Treatment Network with the National Disaster Medical System and the national health care "system" so as to be able to provide care to tens or hundreds of thousands.
- Discuss re-entry and recovery considerations related to potential contamination concerns, including the necessary public health monitoring, that will inform what medical and public health assets and critical infrastructure will be available.

An individually authored workshop summary will be prepared based on the information gathered and the discussions held during the workshop.

Irwin Redlener of the National Center for Disaster Preparedness at the Mailman School of Public Health at Columbia University, stated that, if such an attack occurs, it will be nothing like any disaster or emergency the United States has experienced before, but many individual lessons learned from natural disasters the country has experienced can help to inform planning for an incident of this magnitude. Carrying those lessons forward, in addition to the ever-increasing amount of federal guidance available, and making important connections between systems and organizations could lead to a much more successful response to an IND detonation than if no planning were done at all. The following themes

were identified by various participants throughout the workshop as areas that, given more attention, could positively influence state and local planning progress:

- High-level political support and direction to supplement available guidance
- Translation of federal guidance into actionable local tools
- "Socializing" preparedness—getting the public to take personal responsibility for being prepared—to increase resiliency and decrease public dependency on already taxed services
- Need for education of first responders, local leadership, and health care providers on types of radiation attacks and different vulnerabilities
- Coordinating transport systems: Radiation Injury Treatment Network, National Disaster Medical System, Civil Reserve Air Fleet, and regional/local transports
- Robust risk communication, including pre-event messaging if possible
- Expanding health care coalitions to include a wider, more diverse range of partners
- Integration of public health and medical services into command and control infrastructure, emergency operations centers, and unified command
- Core capabilities that receiving communities should focus on related to an IND—and corresponding commonalities with the Public Health Emergency Preparedness/Hospital Preparedness Program agreements

An IND detonation would be a terribly traumatic event, but positive messages were heard during the workshop, and steps in the right direction have already been taken. The health and medical system is moving forward toward a coalition model of cooperation during responses, which will be critical. Shelter-in-place and other initial-action educational messages for the public have been developed; now, authorities need to dedicate plans to ensure that the messages are heard and understood. Many tools and strategies already tested in jurisdictions (reception centers, vaccination sites, and alternate care sites) are the same ones that will allow communities to successfully support victims of an IND event. However, specific guidance and the education of key personnel are critical to assure that responders are able to provide assessments and care required by

victims of radiation. Much work has already been done, but many speakers and discussants voiced concern that it is time to build on the existing "all-hazards capabilities" that communities have built during the past decade and make them as robust and scalable as possible to respond to a radiological emergency such as an IND attack.

Themes and Opportunities

Although it is generally accepted that larger U.S. cities likely represent the highest-risk targets for an IND terrorist attack, the ripples from an IND detonation would overwhelm the surrounding communities and spread nationwide. Thus, this workshop set out to bring under examination, as part of the focus of planning, the effects of an IND attack on outlying communities. This encompasses neighboring jurisdictions as well as regional and national receiving sites. Having these communities be prepared for the influx of evacuees demanding medical care and services might greatly alleviate the overall severity of the disaster. Because there has not yet been an IND incident in the United States, the closest approximation to the widespread displacement that might be seen after an IND attack, however understated, comes from the migration patterns following Hurricane Katrina in 2005. Less than 1 month after the hurricane, the Federal Emergency Management Agency had received 1.36 million individual assistance applications from Katrina victims in all 50 states. Forty-six percent of applications were received from within 100 miles of New Orleans, while 53 percent were from 100 to 3,000 miles away from New Orleans (*New York Times,* 2005).

Being unaffected physically, outlying communities are likely to be in the best position to save lives following an IND attack. However, these communities will experience an unparalleled number of evacuees who will need emergency medical care for blast, burn, and radiation injuries; screening for contamination and acute radiation syndrome; and provision of radiation countermeasures, shelter resources, and mental health and material support. Yet, most outlying communities have not considered the potential burden they may experience and so have not undertaken planning for an IND detonation in a nearby city, making them drastically underprepared. The influx of tens of thousands of displaced victims will require dedicated command, control, and resource capabilities from across the region and nation to ensure a successful response.

Outlying communities face numerous barriers in planning for an IND attack, as Jack Herrmann of NACCHO noted in his introductory remarks. He also went on to highlight three main issues that should be considered, that various speakers and participants also emphasized throughout the 2-day workshop:

- At a basic level, there is an issue of translation, in that much of the federal guidance has not been easily implemented at the local level.
- The amount of resources that communities would need to bring to bear in such an event is extremely large. No community has modeled the resources required to screen and administer countermeasures and health care to a large displaced population.
- An ever-present issue, time, remains a factor because most public health officials are struggling to meet their current public health responsibilities and therefore are unable to prioritize the complex and multidisciplinary planning required to respond to an IND detonation when they may not even be the direct target.

ORGANIZATION OF THE REPORT

The report that follows summarizes the presentations by expert panelists and open discussions that took place during the workshop. The three papers that were commissioned for this workshop can be found in the appendixes, along with a resource list of available federal and collaborative tools and websites to assist state and local planners. The beginning of each chapter features highlighted key points from individual speakers and can serve as a collection of recurring messages expressed during discussions throughout the workshop.

Chapter 2 provides background and distinguishes IND incident from other radiological emergencies as well as expected public health issues. Chapter 3 presents existing perspectives and programs from federal agencies that play a role and describes their capabilities. The roles of regional planning, whether through municipalities or health care coalitions, and the work that advanced cities have already done, are examined in Chapters 4 and 9. Chapter 5 considers the important challenges to command and control as well as the infrastructure and agreements that can assist in alleviating problems. Chapter 6 focuses on important risk communication and the education of the public and first responders. Monitor-

ing and health care services that would be provided in outlying communities, including community reception centers, triaging, and addressing the mental and physical health of responders and volunteers, are discussed in Chapters 7 and 8.

2

Public Health and Logistical Considerations

Key Points Made by Individual Speakers

- For those who survive an improvised nuclear device (IND) blast, the most immediate danger is from radioactive fallout, which emits radiation of sufficient energy to penetrate into cars, certain types of shelter, and skin. The danger from fallout is greatest during the first 24 hours post-detonation.
- Sheltering in place during the first 24 hours is the policy promulgated by Federal Emergency Management Agency. No evacuations are swift and accurate enough to surpass the widening path of radioactive fallout, which drifts outward according to wind direction and speed, and other environmental conditions. Sheltering in place saves lives.
- Public health officials use a zoned approach to emergency response. This approach precludes entering the most heavily damaged areas, where survival is highly unlikely, and instead concentrates the response to a moderate damage zone, which has the highest number of victims who can survive.
- Outlying communities are in the best position to save lives and reduce morbidity. Pre-planning is necessary to ensure an adequate supply of medical countermeasures and health services. Outlying communities will have to shelter and feed evacuees and maintain public safety and order, particularly in hospitals and shelters.
- No current national system is capable of handling and tracking down displaced persons and reuniting families across states and regions.
- Political support is needed to initiate and sustain planning for an IND attack, taking into account planners' competing priorities, the magnitude of the task, the diversity of agencies providing services, the extreme resource needs, and the uncharted terrain.

To set the stage for this workshop and continue to build on the work and summary previously published by the Institute of Medicine (IOM, 2009), the session began with introductory and distinguishing characteristics of an improvised nuclear device (IND) attack. Because many attendees and other relevant planners often work with radiological dispersal devices and nuclear power plant leaks, it was important to clearly separate the important fundamental differences in impact that an IND attack would have on response and operations. In addition, the first white paper of the workshop (see Appendix G) was presented to paint a vivid picture of an affected community and the corresponding public health needs and issues that would arise 30 days after an incident.

DIFFERENCES IN NUCLEAR EVENTS

An IND is a nuclear weapon bought illicitly, stolen from a nuclear state, or fabricated by a terrorist group from illegally obtained nuclear weapons material (e.g., plutonium or highly enriched uranium) (OSTP, 2010). An IND explosion on the ground yields the same physical and health effects as detonating a nuclear weapon in the air, similar to the hydrogen bombs dropped during World War II. An initial conventional explosion produces an imploding shock wave that drives plutonium pieces inward into a central sphere housing a pellet of beryllium/polonium, creating a "critical mass"—that is, enough fissile material to sustain a nuclear chain reaction—which leads to a nuclear chain reaction that releases several million times more energy than could be produced by a chemical reaction proceeding in the same mass of material.

An IND is not to be confused with a radiological dispersal device (RDD), informally known as a "dirty bomb." According to speaker Brooke Buddemeier of the Lawrence Livermore National Laboratory, an RDD is a weapon that combines explosives with radioactive material. The explosion vaporizes or aerosolizes radioactive material, propelling it into the air, but the explosion does not trigger a fission reaction that releases the mammoth amounts of energy or fission products that are associated with a nuclear detonation. The effects of an RDD extend over an area the size of multiple city blocks, whereas the consequences of an IND detonation extend for miles. Buddemeier explained that most of the nuclear hazard of an RDD attack is due to people breathing radioactive dust in the immediate area of the explosion (although there is some external radiation), whereas with an IND attack, most of the nuclear hazard

is from fallout, which emits radiation of sufficient strength to burn or penetrate the skin and travel into the body cavity to trigger acute radiation syndrome. Fallout particles, though, are too large to become a breathing hazard.

Fallout is generated, Buddemeier explained, by thousands of tons of debris—from collapsed buildings and other structures destroyed by the blast—combined with radioactive fission products and catapulted upward by the extreme heat of detonation. The radioactive debris-filled cloud rapidly ascends through the atmosphere up to 5 miles high for a 10-kiloton (kt) device. Highly radioactive particles coalesce and drop back down to earth as they cool to form fallout. Within 10 to 25 miles of the detonation, fallout particles are the size of table salt or sand as they fall back to earth, contaminating all surfaces, including clothing, skin, and hair. The particles give off penetrating radiation—primarily gamma and beta radiation—that can injure people inside cars or in inadequate shelters (NCRP, 2010). The path of fallout depends on wind direction and speed and other environmental conditions (e.g., terrain and weather). Fallout's radioactivity decreases with distance and decays rapidly with time, with the greatest danger occurring within the first few hours after the detonation (NCRP, 2010). A ground-level detonation produces more fallout than one exploded above ground, as was the case for the atom bombs dropped on Hiroshima and Nagasaki. Fallout is the primary source of radiation exposure in outlying communities. Buddemeier assured attendees that the best method of reducing radiation exposure from fallout is to remove outer clothing and remove particles from hair when entering a safe shelter.

> "The real hazard from fallout is the direct shine of radiation. It's not breathing in the particles, they're too large."
>
> –Brooke Buddemeier

Acute Radiation Syndrome

Acute radiation syndrome (ARS) is the most immediate health effect of radiation exposure. It appears after whole-body or significant partial-body irradiation of more than 1 Gray (Gy) delivered at a relatively high dose rate (Waselenko et al., 2004). Depending on the dose to which one is exposed, symptoms may manifest within hours or days or, in cases of

low doses, weeks or even months. There are three main clusters of symptoms: gastrointestinal (nausea, vomiting, lack of appetite), hematopoietic (drop in the number of blood cells), and neurovascular (dizziness, headache, decreased levels of consciousness). There is also a cutaneous syndrome that is caused by thermal or radiation burns. The extent, severity, and time course of the symptoms are strictly determined by radiation dose. The greater the dose, the shorter the delay in symptom onset.

There are four stages of ARS: (1) a prodromal phase with gastrointestinal symptoms that lasts minutes to several days; (2) a latent stage in which the patient is asymptomatic for a few hours to a few weeks[1]; (3) a manifest illness stage (with different clinical presentations, depending on the symptom cluster, but almost always marked by intense immunosuppression) lasting several weeks; and (4) either recovery or death (CDC, 2013; Waselenko et al., 2004). The early course of ARS can be monitored with repeated complete blood counts and absolute lymphocyte counts, from which the dose can be inferred. ARS is treated with antibiotics, fluids, blood products, and, with higher doses, cytokines and stem cell transplants (Waselenko et al., 2004). According to co-chair John Hick, Hennepin County Medical Center, one of the problems with existing medical guidance is its focus on external contamination from dirty bombs and nuclear reactor releases. In contrast, the focus after an IND attack should be on screening in order to classify a large number of salvageable victims who are in the latent phase of ARS. If those victims receive cytokines in a timely manner, ideally within 24 hours after an otherwise lethal exposure, evidence from animal studies indicates that their lives can be saved (Farese et al., 2001, 2013). However, there is no current guidance on how medical responders should assess and initiate countermeasures, much less how they should conduct blood tests to monitor the course of ARS, Hick said.

RESPONSE PROTOCOLS

In the event of a nuclear detonation, the Federal Emergency Management Agency (FEMA) advises all people within a 50-mile radius to take shelter in the nearest and most protective building or structure and to listen for instructions from authorities (FEMA, 2008). This so-called shelter-in-place recommendation is for the most dangerous period of

[1]For doses of 200–500 rad (2–5 Gy), the latency period is typically 3 to 4 weeks (OSTP, 2010).

exposure—up to 24 hours post-detonation—and for exposures beginning at 1 roentgen equivalent man (rem). Sheltering in place is the most rational approach because no evacuations are swift enough to stay in front of the widening path of fallout. Shelter-in-place is not the appropriate strategy for dealing with nuclear reactor accidents, in which the radiation exposure comes not from an immediate release but from release over time in "puffs" from the smoke stack. This type of release gives sufficient time for evacuation and so has different implications for recommended action from FEMA. However, it is important that these differences be made clear to the public ahead of time, as many people will still evacuate even when given shelter advisories, causing more panic and infrastructure overload.

Zoned Approach to Emergency Response

A relatively new approach to responding to an IND—the "zoned approach"—was formulated in a recent federal government report (OSTP, 2010). The goal of creating a zoned approach is to save lives while minimizing the risks to emergency response workers. The zoned approach, Buddemeier explained, establishes four areas surrounding the site of detonation: the severe damage zone (SDZ), moderate damage zone (MDZ), light damage zone (LDZ), and dangerous fallout zone (DFZ). In the SDZ, which extends out to 0.5 miles for a 10-kt ground detonation, collapsed buildings and major structural damage are ubiquitous (see Figure 2-1). The SDZ is so hazardous that first responders are

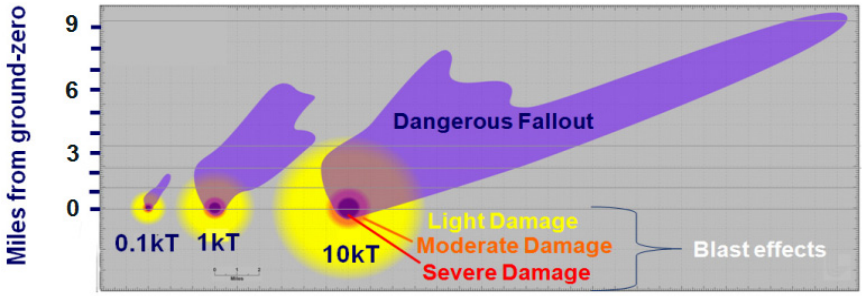

FIGURE 2-1 Zones surrounding nuclear detonation.
SOURCE: http://www.remm.nlm.gov/PlanningGuidanceNuclearDetonation.pdf (accessed June 2, 2013).

cautioned not to enter until radiation dosages drop with the continued decay of radioactive particles. Most victims in the SDZ cannot survive, whether because of radiation exposure, major trauma from collapsed buildings, or thermal radiation from the extreme heat and light of the expanding fireball (IOM, 2009). In the MDZ, which covers the area 0.5 to 1 mile from a 10-kt ground detonation, he explained, there is significant damage from collapsing buildings, downed power lines, and overturned automobiles, but there is not the extent of wholesale devastation that is found in the SDZ. The MDZ has the highest concentration of survivable victims for emergency responders. A survivable victim is generally defined as someone who can survive only with a successful rescue and treatment. First responders face formidable obstacles in the MDZ, including unstable buildings, downed power lines, ruptured gas lines, and hazardous chemicals (OSTP, 2010).

In the LDZ, which lies 1 to 3 miles from the detonation, virtually all windows are broken, making glass injuries likely. The structural damage is highly variable and depends upon shock waves from the blast rebounding multiple times off of buildings, the terrain, and even the atmosphere. Emergency personnel will encounter victims with mostly superficial wounds and occasional flash burns. Injuries are more serious if the LDZ overlaps with the path of the DFZ, i.e., the plume of fallout, extending up to 25 miles downwind, which has the highest concentration of radiation, corresponding to exposures of more than 10 roentgens/hour. In this zone, fallout can deliver fatal doses of radiation. The location and extent of radiation in the DFZ are affected by wind direction and speed and other environmental conditions. After the contours of the DFZ have been mapped, the following responder activities can be initiated outside its perimeter: establishment of community reception centers and triage sites, extraction of and care for the injured, and fighting fires and controlling hazards. The DFZ is too hazardous for responders unless they have a critical mission and the ability to monitor their exposure, Buddemeier said.

In the case of a 10-kt detonation in Washington, DC, Buddemeier said, it is likely that 45,000 people would perish immediately and 100,000 would be at risk of death. An additional 320,000 people would be likely to be seriously injured, and another 175,000 would likely have minor injuries. After the DFZ is mapped and when the first 24 hours have passed, emergency responders can enter the area to triage survivors and evacuate them to outlying communities. Buddemeier concluded his presentation by pointing out that the zoned approach has improved the

outlook for overall increased survival following the detonation of an IND. Critical lifesaving actions have been identified and incorporated into planning guidance, which emphasizes early sheltering in place followed by delayed deliberate evacuation.

PUBLIC HEALTH IMPACT ON OUTLYING COMMUNITIES

The likely impact of an IND attack on outlying communities was described in a presentation by Irwin Redlener of the National Center for Disaster Preparedness, who also wrote a companion white paper on the topic (see Appendix G). Redlener emphasized that the scenario being depicted is not a scientifically based prediction, and he asserted that the consequences of an IND attack would be so dire that none of the nation's previous disasters can accurately inform planning.

The scenario Redlener envisions is set in a fictitious community identified as Roberts County. A 10-kt IND has been detonated in a nearby major city in the middle of the workday. Roberts County, in this hypothetical scenario, has 350,000 residents spread across two smaller cities and numerous smaller towns. It has 5 acute-care hospitals with 1,200 total beds and 1 psychiatric hospital. Its emergency medical services are composed primarily of volunteers. Its workforce of public health and public safety employees has been depleted over the years because of extensive budget cuts.

In the first days after detonation, a massive number of people will try to flee the city in their cars in spite of exhortations to shelter in place. This mass exodus may hamper or paralyze rescue and response efforts. The emergency response also may be hampered by workers unwilling to show up for duty because of fear for personal safety or the imperative to find and save family members (Barnett et al., 2012; Tippett et al., 2010). Roberts County hospitals will be overwhelmed with people whose radiation status is not known. Furthermore, many people will seek care even though they are unaffected except for extreme anxiety. Fights may break out in hospitals as people compete for care.

By day 30, according to this scenario, Roberts County is in dire straits. It has experienced a 50 percent population increase in each of its two cities, based on estimates by a new model predicting population surge after an IND attack (Meit et al., 2011). Two-thirds of 100,000 evacuees are in motels, makeshift temporary shelters, or cars. Five thou-

sand evacuees no longer have jobs and do not know the status of their health insurance. Local authorities are still in crisis mode, with only sporadic help from local, state, and federal governments. The authorities find themselves in competition with other nearby counties for scarce federal and state resources. There has been little planning for the sort of coordination between levels of government that is necessary to equitably distribute resources to communities that need them.

Roberts County has experienced 500 deaths since the arrival of the evacuees. The deaths have been caused not only by radiation exposure but also by heart attacks and other conditions for which medications are in short supply. Besides health issues, the economic issues are enormous. Evacuees do not have the funds to pay for food, shelter, or transportation. Theft and other crimes are rampant. Schools are saddled with an additional 25,000 child evacuees. The overcrowding in the schools is exacerbated by many teachers' having left the area. The evacuated children are stigmatized and ostracized. Mental health problems, in both children and adults, are pervasive in terms of the incidence of acute stress disorder, sleeping disorders, depression, paralyzing grief, and suicide.

One of the greatest hurdles facing Roberts County is family reunification. It is exceedingly difficult to determine if a missing family member has perished or has been transported to a different area. At least 500 children are separated from parents. Even though the National Commission on Children and Disasters recommended in 2010 that the Department of Homeland Security lead the development of a nationwide information technology capability to collect, share, and search data from any patient and evacuee tracking or family reunification system (National Commission on Children and Disasters, 2010) and other efforts in the private sector are ongoing, no current national system is capable of handling and tracking down displaced persons and reuniting families.

Planning Priorities

In Redlener's view, outlying communities need to conduct pre–IND attack planning relating to the following areas of concern:

- Competition for federal, state, and local resources for all types of public services. Resources are expected to be scarce.

- Ensuring adequate supply of medical countermeasures, health care and health services, and deferral of elective and non-urgent procedures.
- Sheltering and feeding evacuees, volunteers, and relief workers.
- Sustaining public safety and order, particularly at hospitals and shelters.
- Ensuring disposal of excess hazardous waste and human waste, especially from makeshift evacuee encampments.
- Ensuring safety of the food supply, especially agricultural products that may be contaminated by radiation.
- Delivery of mental health and crisis services, especially to children and other vulnerable populations.
- Suspension and curtailment of routine state and local government public health and safety functions.

While admitting that the list of planning activities may be overwhelming, Redlener encouraged communities to engage in discussions. Such discussions should include not only public health but also health care, emergency management, hazmat, sanitation, transportation, and other community-based services. Several participants in the discussion session following his presentation stressed the importance of developing high-level political support for detailed planning activities. Considering planners' competing priorities, the magnitude of the task, the diversity of players providing services, the extreme resource needs, and the uncharted terrain, Redlener said, in addition to simply providing guidance, high-level political support is needed to put IND attack planning on the radar of outlying communities throughout the country. One of the discussants suggested that, after the detonation of an IND, the outlying communities will not be facing a temporary problem, as they would if they had experienced a hurricane, earthquake, or other natural disaster, after which cities are rebuilt. Instead, the discussant said, population displacement may be permanent because "the city is gone, nobody is coming back. There's no way to fix the problems that make it worth staying."

SUMMARY

An IND is a nuclear weapon bought illicitly or stolen from a nuclear state or fabricated by a terrorist group from illegally obtained nuclear weapons material (e.g., plutonium or highly enriched uranium). Through

a fission reaction, the IND releases a massive amount of energy greater than any chemical reaction. By contrast, an RDD, or dirty bomb, combines explosives with radioactive material, but it is not sophisticated enough in design to undergo a fission reaction. The explosion from a dirty bomb does not release the mammoth energy or fission products of a nuclear detonation. An IND is far more likely than an RDD to cause acute radiation syndrome, a dose-related illness defined by three main symptom clusters—gastrointestinal, hematopoietic, and neurovascular. After an IND detonation, federal policy recommends sheltering in place. Federal policy also recommends a zoned approach to the emergency response: It calls for attending to casualties in the MDZ over the SDZ because most people in the SDZ cannot survive even with treatment and resources, and the resources should be spent where they will have the most impact.

Public health activities and responsibilities in outlying communities will also be highly impacted during this time. Thousands of evacuees will be fleeing through surrounding areas, potentially needing medical attention, housing, and schooling and straining the area infrastructure. Although answers may not be immediately available, Redlener stressed, it is important to begin having these conversations now and call attention to planning priorities.

3

Federal Programs and Perspectives

Key Points Made by Individual Speakers

- The Office of the Assistant Secretary for Preparedness and Response (ASPR) is the lead U.S. Department of Health and Human Services agency responding to any public health or medical disaster, including an improvised nuclear device (IND) detonation. ASPR's mission is to plan for all health hazards, to augment state and local capabilities when requested, and to coordinate all civilian and federal medical and public health responders.
- The Centers for Disease Control and Prevention helps state and local governments to develop formal plans for preparedness to an IND attack, including developing radiological toolkits for local public health departments and clinicians, building radiation volunteer corps, and including acute radiation syndrome–specific countermeasures in the Strategic National Stockpile.
- In preparing for an IND attack, the Federal Emergency Management Agency can also assist communities in conducting a threat and hazard identification and risk assessment as well as help to coordinate urban search and rescue and plume modeling after an attack.
- More than 18,000 military responders could be summoned to the site of an IND attack. The forces would come from several existing commands overseen by governors (through their state National Guard) or by the U.S. Northern Command.

One of the objectives of this workshop was to spend time understanding why the gaps in state and local planning efforts for an improvised nuclear device (IND) have remained, even though a wealth of federal guidance exists. To assist with this charge, four federal agencies that have done a significant amount of work in the area of IND attack planning gave attendees a synopsis of their efforts and the resources they

would be able to provide after an incident occurred. The agencies included the Office of the Assistant Secretary for Preparedness and Response (ASPR), the Centers for Disease Control and Prevention (CDC), the Federal Emergency Management Agency (FEMA), and the Department of Defense (DOD) via the U.S. Northern Command (USNORTHCOM).

OFFICE OF THE ASSISTANT SECRETARY FOR PREPAREDNESS AND RESPONSE

George Korch of ASPR described his office as being strategically situated within the U.S. Department of Health and Human Services (HHS) to respond to an IND attack or any other public health emergency. Its mission is to plan for all health hazards, to augment state and local capabilities when requested, and to coordinate all civilian and federal medical and public health responders.

The federal assets that ASPR delivers include self-sustaining medical teams for triage, transportation, decontamination, mental health care, medical care, and mortuary duty. Other assets include medical countermeasures available through the CDC, such as hematopoietic, gastrointestinal, decorporation,[1] and thermal burns therapies; biodosimetry and diagnostics; therapeutics; and supportive therapies. ASPR can help to prepare disaster waivers to suspend nonessential tasks, and it can help facilitate sign-off by the Secretary of HHS for the declaration of a public health emergency.

ASPR oversees the National Disaster Medical System (NDMS) whose three-part mission is to (1) provide medical response to a disaster area in the form of personnel, teams and individuals, supplies, and equipment; (2) assist in patient movement from a disaster site to unaffected areas of the nation; and (3) provide definitive medical care at participating hospitals in unaffected areas. NDMS includes approximately 8,000 medical professionals who can be summoned for rapid response and who are organized into units referred to as disaster medical assistance teams (DMATs). DMATs include not only medical professionals but also logistical and administrative staff. Another source of medical professionals is the Public Health Service's Commissioned Corps, with at least 4,200 deployable personnel.

[1]Removal of radioactive isotopes from the body.

Countermeasures and Biodosimetry

Another key function of ASPR is to assist in the efforts of the CDC to procure medical countermeasures for the Strategic National Stockpile (SNS), a cache of medications and medical countermeasures that can be delivered to the site of the disaster or stored nearby. If a medical countermeasure or device does not yet exist, ASPR funds research and development through its Office of Biomedical Advanced Research and Development Authority (BARDA). It already has under development, in partnership with pharmaceutical companies, several hematopoietic and gastrointestinal countermeasures, lung and skin countermeasures, and decorporation agents.

One of the most pressing needs after an IND attack will be to determine which patients are most heavily exposed and thus need immediate care. That is the goal of biodosimetry, which includes any technique used to determine radiation dose using the assessment of an individual's biological data (NCRP, 2010). According to speaker Rodney Wallace of BARDA, two of the existing biodosimetry methods are too time-consuming or too complex to be effective for dealing with mass casualties in the field.

Wallace reported that the biodosimetry program is in the process of developing two generic types of devices for assessing radiation exposure: point-of-care devices and high-throughput devices. The point-of-care devices are designed for ease of use and rapid sampling (less than 30 minutes) in the field and should have the capacity for processing 1 million samples in 6 days. These point-of-care devices are designed to distinguish between heavily exposed and moderately exposed patients, using 2 Gray (Gy) as the line of demarcation: Doses higher than 2 Gy need immediate treatment, whereas lower dose exposures need not be treated for several weeks. High-throughput devices are highly sensitive, high-volume devices being designed to be used in hospitals and other fixed facilities and to provide a rapid turnaround time of no more than 24 hours per sample. They will be able to measure exposures of from 0.5 to 10 Gy, and they are expected to process 400,000 samples over several weeks. The operators of high-throughput devices will need training. Wallace noted that 11 dosimetry projects have been funded, but none are near completion and it will be a few more years before the products are operational.

CENTERS FOR DISEASE CONTROL AND PREVENTION

The CDC's radiation expertise is housed in the Radiation Studies Branch of its National Center for Environmental Health. The branch, as described by Robert Whitcomb, lead physical scientist, strives to leverage national, state, and local resources for the purpose of planning for a radiological event. Realizing that radiation control programs are often separate from public health programs at the local level, several years ago the branch facilitated the creation of the National Alliance for Radiation Readiness (NARR). NARR is a forum for sharing and evaluating practices, resources, and tools related to radiological readiness. The CDC and NARR are helping state and local governments develop formal plans for emergency preparedness for an IND attack, as most existing plans deal with nuclear reactor releases or a radiological dispersion device (RDD) attack.

The CDC's Radiation Studies Branch conducts several other activities concerning radiological events. It has developed toolkits for use by local public health departments and clinicians. One toolkit is for "just-in-time training" for hospital clinicians, and another is for population monitoring guidelines. The latter was first published in 2007 and is currently being revised. It covers community reception centers, virtual reception centers, decontamination, and essential medical care. The Radiation Studies Branch is also working on the creation of a volunteer program for radiological incidents that is similar to the Medical Reserve Corps, a nationwide list of professionals to summon in the event of any type of health emergency.

The CDC's Radiation Studies Branch also provides expertise to other CDC programs, most notably the program that manages the SNS of medical countermeasures to distribute in times of health emergencies. Whitcomb described one of the agents in the SNS as the cytokine Neupogen, a drug used to treat neutropenia, which is one of the manifestations of acute radiation syndrome. Neupogen is an analogue of granulocyte colony–stimulating factor that induces proliferation and differentiation of neutrophils, the most abundant type of white blood cell. The Radiation Studies Branch is expecting to help state and local governments develop plans for Neupogen's use in radiation incidents.

Finally, the Radiation Studies Branch plans to help communities conduct a threat risk assessment with regard to IND events. The focus will be not only on cities, but also on outlying communities that would

be coping with large numbers of displaced persons who need decontamination, medical countermeasures, and long-term follow-up.

FEDERAL EMERGENCY MANAGEMENT AGENCY

Robert Farmer, director of the operations division of FEMA, gave a broad overview of FEMA's role in an IND attack or any other disaster. Since 2008 FEMA's role has been spelled out in the Department of Homeland Security's (DHS's) National Response Framework (NRF) (DHS, 2008). The purpose of the NRF is to lay out guiding principles for all response partners to use in preparing for—and providing a unified response to—national disasters and emergencies.

The NRF is a generic framework for any type of emergency or disaster. If a state or local agency is expressly concerned about an IND incident, then FEMA, under a new policy, would encourage and assist the agency to prepare a threat and hazard identification and risk assessment (THIRA). The preparation of a THIRA is a five-step process: (1) assess threats and hazards; (2) assess the vulnerability of the community to those threats and hazards; (3) estimate the consequences of the direct hazard; (4) establish capability targets; and (5) set an informed foundation for prevention, protection, mitigation, response, and recovery.

According to Farmer, other resources that FEMA or its interagency partners can bring to bear in the event of an IND detonation include

- **Urban search and rescue:** It can operate in the moderate damage zone to rescue people from collapsed buildings. DOD has special teams capable of working in a heavily contaminated environment.
- **Plume modeling:** DHS has an Interagency Modeling Atmospheric Assessment Center that maps out the geographic area affected by the release of radiation, among other hazards.

U.S. NORTHERN COMMAND AND OTHER MILITARY FORCES

USNORTHCOM is the operational command of the U.S. military responsible for homeland defense and providing defense support of civilian authorities (DSCA), said Jody Wireman, Force Health Protection Direc-

tor at USNORTHCOM. Wireman reported that more than 18,000 military responders could initially be summoned and time-phased to the site of an IND attack, with additional forces available to be requested, if needed. These initial response forces would come from several existing units overseen by governors (through their state National Guard) and active duty and reserve forces via USNORTHCOM. The troops have a variety of capabilities, from detection and analysis of the radiological threats and exposures to emergency medical care, command and control, decontamination, engineering, rescue operations, and medical transport and evacuation.

More specifically, National Guard forces attending to a national disaster site can be drawn from three distinct types of units: civil support teams (CSTs; approximately one per state or territory); chemical, biological, radiological, and nuclear (CBRN) enhanced response force packages (CERFPs; 17 units across the United States); and homeland response forces (HRFs; one per FEMA region). The system is tiered, with CSTs able to respond to a scene within a few hours to assist, and the CERFPs and HRFs needing a few more hours to respond but bringing with them a wider medical skillset and more capabilities. Within a few days, USNORTHCOM forces will respond to the event with a still larger array of capabilities. There are two USNORTHCOM response units that will integrate with the above National Guard forces and support DSCA mission assignments: the Defense CBRN Response Force (DCRF; approximately 5,000 personnel) and two Command and Control CBRN Response Elements (C2CRE; approximately 3,000 personnel). The C2CRE(s) could be utilized for command and control or augmented to form additional DCRFs for an event.

This new 18,000-member response force concept integrates National Guard and USNORTHCOM forces into plans and exercises. It improves on previous concepts for DOD DSCA responses that were not integrated and slower to respond. In addition, future plans and concepts aim to capture active duty, National Guard, and Reserve forces that may be available, but are not part of the above-identified 18,000-member forces, thereby integrating all available DOD forces into the planning process.

Wireman explained that the determination of where military forces would be sent to support medical and public health requirements is expected to be done through coordination with the HHS Assistant Secretary for Preparedness and Response and other federal leads for medical and public/worker health requirements. The development and refinement of region-specific IND plans is the approach that can best identify where

response assets (to include DOD forces) should be sent and best assist the DOD in determining whether the current force structure would be efficient and effective for an IND response. These regional FEMA plans are developed through local, state, and federal participants. He said it is important that both response areas and outlying communities be involved in the regional planning to ensure the determination of requirements, to evaluate asset availability, and to identify whether gaps in resources need to be addressed.

SUMMARY

Before, during, and after an IND attack, numerous federal agencies will play active roles. ASPR has wide-ranging roles, from oversight of NDMS to directing hospital preparedness and research on new methods to assess a person's radiation dose. The CDC and NARR are helping state and local agencies develop plans for emergency preparedness for an IND attack. The CDC is also helping cities and outlying communities conduct a formal threat risk assessment regarding an IND. FEMA marshals resources and provides a unified response to all hazards, including a potential IND incident. USNORTHCOM is the DOD agency responsible for providing civilian authorities with homeland defense and civil support, and it estimates that more than 18,000 military responders could be sent to an IND site to carry out roles that vary from detection and analysis of the radiological threat to command and control, decontamination, and medical evacuation.

4

Local, State, and Regional Perspectives and Programs

Key Points Made by Individual Speakers

- There are important differences between improvised nuclear devices (INDs) and disasters of other types, but experience with other disasters has helped to build capabilities that will be executed, regardless of incident type.
- In case of the detonation of an IND, planners envision widespread destruction of infrastructure, including loss of power, communications, fuel, water, and sewer systems.
- Fire departments will require special training for an IND incident in order to counter the impulse to rush to the zone of destruction.
- State and local officials have a need for the federal government to provide useful tools for outlying communities, including a detailed list of response decisions that need to be made and a prioritized list of assets likely to be needed. In addition, high-level political support would help those at the local level tremendously.
- A top priority after an IND attack will be to establish effective communication with the public, build their trust, and convey real-time information and guidance.
- While there may be a lot of potential resources available, there is no history of events of this type to help guide accurate planning.

Few state and local health departments have begun to develop concrete plans for an improvised nuclear device (IND) attack, despite considerable guidance from the federal government. Speaker Mitch Stripling, director of emergency planning for the New York City Department of Health and Mental Hygiene, described this problem as one of *translation*, i.e., turning federal guidance into concrete state and local policies. He offered three strategies to facilitate translation:

1. Focus on developing criteria for which communities are held accountable, rather than focusing on a specific set of capabilities that they do or do not possess.
2. Demystify the science and develop specific tools for cities and outlying communities so that they can assess their risk and initiate planning.
3. Build political support for IND attack planning at local and state levels.

PLANNING FOR AN IND ATTACK: A CASE STUDY

Federal Emergency Management Agency (FEMA) Region 5, in the Midwest of the United States, was one of the first regions to initiate planning for an IND attack. The planning is being conducted through a series of summits, working groups, and workshops. More than 300 local, state, federal, and private-sector partners have participated during the past 2.5 years, including elected officials and governors. The goal of the exercise is to develop a formal plan for the region that also can serve as a template for other FEMA regions throughout the nation, said Andrew Velasquez, regional administrator for FEMA Region V.

The planning is focused on the first 72 to 96 hours after a 10-kiloton (kt) IND detonation in the middle of a working day in the heart of a large metropolitan area's business district. Based on modeling by the Department of Energy's national laboratories, Velasquez said, the blast would be expected to incapacitate large segments of federal, state, and local government. The modeling postulates are described in Box 4-1.

Velasquez continued to describe the postulated scenario, saying that secondary casualties would be expected from the brilliant flash of light associated with detonation. The flash can cause temporary blindness lasting seconds to minutes for anyone who is outdoors within 5 miles of the blast. Although the effect is only temporary, the abrupt loss of vision to drivers and pilots could cause roadway and airline crashes and, as a result, might make roads impassable. The staggering extent of casualties would be expected to overwhelm the affected city's hospitals, where occupancy rates are already likely to be high, as they are generally high across the nation. The planners estimate that only 15,000 free beds would be available for handling hundreds of thousands of casualties. Planners also predict that pharmaceuticals and supporting medical equipment

BOX 4-1
Modeling Postulates from Department of Energy National Laboratories

- 400,000 fatalities
- 110,000 urgent care injuries
- 300,000 non–urgent care injuries
- 300,000 "worried well" requesting radiation screening
- 16,400 exposed or contaminated

would be in short supply. These shortfalls would likely reverberate through regional hospitals in outlying communities.

Infrastructure and Personnel Vulnerabilities

Planners are also considering the effects of an IND attack on key infrastructure, namely, electrical, communications, water, sewer, and fuel systems. According to Velasquez, they expect that a failure of one system might lead to failure in another. Damage to the electrical grid from the electromagnetic pulse that may occur after an IND detonation is likely to disrupt communications and medical equipment (Vandre et al., 1993). Planners also expect the city's water intake and distribution system to be disrupted, with millions of people expected to lose their water supply. Without water, hospitals are unable to operate and firefighters are unable to the control ubiquitous fires set off by the IND's thermal effects. Planners also anticipate a reduction in fuel because of the failure of the electrical system. Fuel disruption not only affects residents, but also hampers movement of emergency vehicles. The broad damage to infrastructure presents momentous challenges, Velasquez observed.

The planners conclude that first responders must be self-sustaining for a significant period of time because of the damage to the fuel, water, and electrical systems. Based on modeling and the data collected through planning workshops, planners are able to estimate the amount of fuel, water, and power needed to support the response effort through the first 96 hours of operation.

In the next stage of planning, Velasquez expects to develop detailed and concrete plans to focus on core capabilities, including operational communications, public information and warning, mass care services,

critical transportation, public and private services, operational coordination, command and control, and situational assessment. The planning thus far focuses on building strong interagency relationships and an understanding of the resources and assets that exist within the region that can be utilized in an event of this magnitude.

EFFORTS IN A LARGE METROPOLITAN REGION

Alonzo Plough, the director of emergency preparedness and response in Los Angeles County, spoke about the planning activities for that county, which serves a population of 11 million across 88 cities, multiple school districts, and several fire departments. Los Angeles County, he said, is more like a region than a county in terms of its size and complexity.

Los Angeles County has conducted some planning for an IND or radiation incident and has 25 staff dedicated to a radiation unit. It held a training activity based on modeling by Brooke Buddemeier of Lawrence Livermore National Laboratory. Following this, the county worked for almost a year in collaboration with FEMA and other federal, state, and local agencies on the response during the first 12 to 48 hours after an incident—the time they will have to wait until the arrival of massive federal assistance. Through this effort, Los Angeles County completed a multiple-agency radiation response plan (Kaufman, 2011), which specifies roles and responsibilities of a variety of Los Angeles County agencies in the event of an IND or other radiation event. The plan was completed with support of the Centers for Disease Control and Prevention (CDC), and Los Angeles County is one of few jurisdictions with a plan in place for the early phases of a radiological emergency.

Lessons Learned

Plough spotlighted several lessons learned from the planning experience. The first is that communication with the public is a key factor in effective planning. His experience has been that the success of post-event communication depends on strong pre-event communication and the establishment of trust in health officials among the public. Strong communication is essential to ensuring that the population stays in shelter for the first 12 to 24 hours. Los Angeles County has taken the initiative to de-

velop public communication and warning activities. It has created a joint information center focusing on radiation incidents and has also developed an information card advising each county agency on the steps to take in the first 30 minutes after an incident.

A second lesson Plough highlighted is that fire departments will require special training for an IND detonation. The main reason is that firefighters are drilled in the importance of scrambling to the site of the emergency and thus will find it counterintuitive to refrain from entering the severe damage zone. Another lesson is that the roads are likely to be impassable, given the county's experience with frequent and massive gridlock. The upside of gridlock is that it may help persuade residents to shelter in place, Plough noted.

His department has not only made plans with the school system for dealing with mass casualties, but has also made similar plans with hospitals. Although the hospital-based exercises are designed to practice response to an earthquake, Plough said, the experience will also be valuable for planning a response to an IND attack. In his view, an IND can be seen as part of a continuum for catastrophe planning. There are important differences between IND attacks and disasters of other types, but experience with other disasters has helped to build capabilities that can be exploited, regardless of catastrophe type.

EFFORTS IN AN OUTLYING COMMUNITY

Ventura County, California, is one of the few outlying communities to have developed a full-fledged disaster plan for responding to an IND detonation in a nearby city, which in this case would be Los Angeles. Ventura County has infrastructure that supports 832,000 residents. According to Robert Levin, the medical director for Ventura County Public Health, the Ventura County Nuclear Explosion Response Plan expects that within a day or two of such a detonation, an additional 2 million people would arrive in the county. These people would need to eat, drink, use toilets, and be able to park at least 1 million additional cars. Many vehicles and gas stations would be out of gas, and vehicles would be littering highways and surface streets. The hospitals would likely be overstretched, Levin said, as there are only 1,500 hospital beds in the county. The county's plan includes working with law enforcement and hazmat groups as well as with a plume trackers group.

Pre-Event Risk Communication

Through the planning process, Levin and colleagues realized that a top priority was to inform citizenry as to what steps they could take to protect themselves and loved ones and to urge citizens to welcome into their homes friends from Los Angeles. In July 2010, JAMS, a public relations firm in Los Angeles, began working with the public health department in Ventura County to develop a strategy to educate the public on how best to respond to a nearby IND detonation. The plan is based on a series of town hall meetings. With a subsequent CDC grant, the county developed an educational video and a more detailed plan for a public information campaign. The video features Levin, the chief county health official, spreading the shelter-in-place message "to get inside, stay inside, and stay tuned." The language was coordinated with other nuclear preparedness planners nationwide. The information campaign will be launched through a number of town meetings, and it will be bolstered by an informational website, thanks to an additional grant from FEMA.

> "It's time to stop guidance and start working on tools."
> –Mitch Stripling

Levin realized that children and their parents constitute a critical audience that warrants separate messaging, because parents are unlikely to heed the shelter-in-place recommendation if it means they are separated from their school-age children at the time of the event. In 2012 the county began to meet with superintendents of its 23 school districts. In subsequent months, the county produced reports addressing a nuclear explosion classroom disaster plan, a curriculum for teachers, frequently asked questions, and talking points for parent-teacher association leadership.

NEW YORK CITY EMERGENCY MEDICAL SERVICES

The New York City region, the nation's largest metropolitan area, has 67 emergency medical services (EMS) agencies with more than 1,300 ambulances. The New York City Fire Department runs the EMS system and its communication centers, which are shared with the police department, explained Mordechai Goldfeder, a senior health and medical planner at New York City's Office of Emergency Management. There are actually two command centers, one of which is far removed from the other, in the event that one of them is compromised by an IND attack or other cata-

strophic event. Through participation in local and regional catastrophic planning groups, New York City has standing memoranda of understanding with nearby counties and the State of New Jersey to bring in extra ambulances and other assets if needed. If the region as a whole does not have the resources needed, which would likely occur in the event of an IND incident, New York City has the option of drawing on the National Ambulance Contract, which was used for Hurricane Sandy. The National Ambulance Contract, which can provide 300 ambulances, 25 air ambulances, and paratransit for 3,500 people to support mass evacuations, has been activated several times since its inception in 2007, supplementing emergency medical transport resources during hurricanes Dean, Gustav, Ike, and Irene and the presidential inauguration in 2009 (AMR, 2011). However, it is important to note that its resources are limited.

As was pointed out in the discussion session by Irwin Redlener of Columbia University, despite available EMS assets, studies suggest that emergency workers may sometimes be unwilling to respond, particularly in pandemic flu and radiological incidents (Barnett et al., 2012; Garrett et al., 2009). Discussants thought that lack of training and education in this area also contributed to the unwillingness and atypical fear of responders to get involved. Redlener also pointed out that the number of ambulances available to New York City—even with surge capability from local, state, regional, and national sources—will be insufficient to deal with mass casualties in the range of tens to hundreds of thousands, as would be predicted for a 10-kt IND detonation in a major city. "The scale is so disconnected to reality," he said.

In summing up the presentations, John Hick, Hennepin County Medical Center, observed that there were two somewhat opposing themes: One, that there is a great deal of potential resources available, but, two, there is no level of preparedness that will be clearly sufficient for an IND attack because there is no history of events of this type to help guide planning.

SUMMARY

Few U.S. regions, cities, or outlying communities have plans—whether under way or completed—to respond to an IND detonation. FEMA Region V, with state, local, and federal partners, has been working for almost 3 years to develop a region-wide plan. Once the plan is

completed, FEMA hopes that it will serve as a model for other regions. The plan focuses on the first 72 to 96 hours post-detonation and envisions widespread destruction of infrastructure, including loss of power, communication, fuel, water, and sewer systems. Knowing that the National Ambulance Contract is available to cities in need of augmented emergency transport is encouraging, but with the effects of an IND attack rippling beyond one or two communities, it is important for localities to plan together as regions and to understand the limitations of federal resources.

Los Angeles County, after learning specific lessons concerning the importance of strong public communications, the need for specialized firefighter training, and the value of school and hospital partnerships, realized that IND attack planning can be applied to any "all-hazards" planning and that it falls into the continuum of overall preparedness for any incident. The county, after studying which agencies can respond the fastest and with the right capabilities, has completed an integrated multiagency radiation response plan, using 13 playbooks, which clarifies the roles and responsibilities of different county departments. Nearby Ventura County has also developed a formal plan for responding to a detonation in the city of Los Angeles, understanding that it will receive thousands of evacuees, perhaps as many as a million, which would stress the county's infrastructure and resources. A key feature of the county's plan is to establish effective risk communication through a robust information campaign. The intent is to ensure that the public has a better understanding of IND risks and vulnerabilities, so that members of the public may better adhere to shelter-in-place recommendations made by authorities. These case studies of different cities tackling nuclear response planning at the local and regional level are examples of beginning steps in the translation of federal guidance into actionable implementation.

5

Challenges to Command and Control

Key Points Made by Individual Speakers

- The command and control framework using the Incident Command System and the National Incident Management System is sufficiently flexible to apply to the enormous challenges of an improvised nuclear device (IND) attack.
- If the target area's command and control infrastructure is rendered unusable, an incident command post from a neighboring jurisdiction needs to assume control. To facilitate the transfer, memoranda of understanding and delegation of authority to an alternate jurisdiction should be in place prior to an IND attack.
- The integration of command and control systems among local, state, and federal agencies will be one of the foremost challenges in the event of an IND attack.
- The factors crucial to the successful implementation of command and control are feasibility and flexibility, reliance on evidence-based practices, reliance on multiple-use technologies, and possessing a range of capabilities, including behavioral health, communication, and laboratory surge.
- The establishment of command and control starts with developing specific plans and policies ahead of time, ensuring clarity in roles and responsibilities, and planning for complex commands throughout the affected region.
- Command and control systems are uniquely compromised in IND incidents relative to other disasters because of the massive disruption of communications, transportation, and financial systems, the scarcity of resources, the inability to deploy first responders into the severe damage zone, and ethical dilemmas for triaging patients.

Another important issue identified by the ad hoc committee during the workshop planning process is the challenge of reconstituting command and control after an improvised nuclear device (IND) incident. To help address this, the Institute of Medicine commissioned a team at National Security Technologies, a contractor to the Department of Energy, to write a paper describing the needs and planning recommendations for jurisdictions to avoid a lack of infrastructure if the existing command and control system sustains damage. Following the presentation of the white paper, other command and control experts offered their challenges and solutions to reconstituting functional operations.

ESTABLISHING FUNCTIONS AFTER AN IND ATTACK

David Pasquale[1] and Richard Hansen[2] organized their presentation and their companion white paper (see Appendix H) around a series of questions regarding the complex problem of establishing effective command and control functions after an IND attack. This establishment starts with developing specific plans and policies ahead of time, ensuring clarity in roles and responsibilities, and planning for multiple levels of command throughout the affected region. The framework that ensues should be regarded as a collaborative effort among federal, state, and local jurisdictions. That collaborative effort entails sharing of plans before the incident and the sharing of situational awareness during the incident. Without rapid situational awareness, the effort cannot succeed, Pasquale said.

Changing Basic Framework

The first question the two speakers addressed was, *Would the current command and control framework change in the face of an IND incident?* They said that the command and control framework using the Incident

[1]Former fire department chief officer, Raton, New Mexico, and president of the New Mexico Fire Chiefs Association.

[2]Resident scientist for Counter-Terrorism Operations Support (CTOS) Research, Analysis, and Development Department and team leader for the development of Department of Homeland Security (DHS)/Federal Emergency Management Agency (FEMA) training program.

Command System (ICS) and the National Incident Management System (NIMS) should not change. The framework of ICS and NIMS has been developed over decades, starting with a system for fighting fires, and it was embraced in 2004 by the Department of Homeland Security for responding to hazards of all types (FEMA, 2013a). The framework is known nationwide and has been adopted by responders at all different levels and by communities of different sizes. Importantly, Pasquale said, the framework has proved itself to be sufficiently flexible, scalable, and adaptable to be applicable to an IND attack.

Management of Operations

Their second question was, *What would the management of operations look like as the event unfolded?* Each jurisdiction needs to set up an incident command post (ICP) that has the legal authority to manage the incident, and an emergency operations center (EOC), which is a hub of communication and coordination serving the ICP. As quickly as possible, one or more ICPs should transition to an area-wide command, the purpose of which is to manage an integrated response by multiple ICPs. The area command should include representatives from all affected agencies, such as law enforcement, public health, fire, emergency medical services, public works, and mass transit and transportation. As the response grows and becomes more complex, one of the area commands should evolve into a unified command. A unified command helps to determine each jurisdiction's complex needs, including the need for health care, mass evacuation, and medical equipment. Pasquale noted that one major purpose of a unified command is to manage each jurisdiction's competition for resources, which in the event of an IND detonation are likely to be scarce. Because an IND attack affects a broad geographic area, there may be a need for more than one unified command. To better coordinate a unified command with several jurisdictions, many state and local authorities often utilize Web-accessible resources to assist in the setup and operation of an ICP or EOC during a response. These could also prove very useful in an IND attack response.

Jurisdictional Coordination with the State

The third question was, *How do neighboring and affected jurisdictions coordinate with the state?* The state needs to set up a state EOC, the purpose of which is to coordinate the activities of local EOCs and area commands (see Figure 5-1). Because an IND detonation will quickly become a regional, state, and national incident, the state EOC will be crucial in drawing resources from other states and from the federal government.

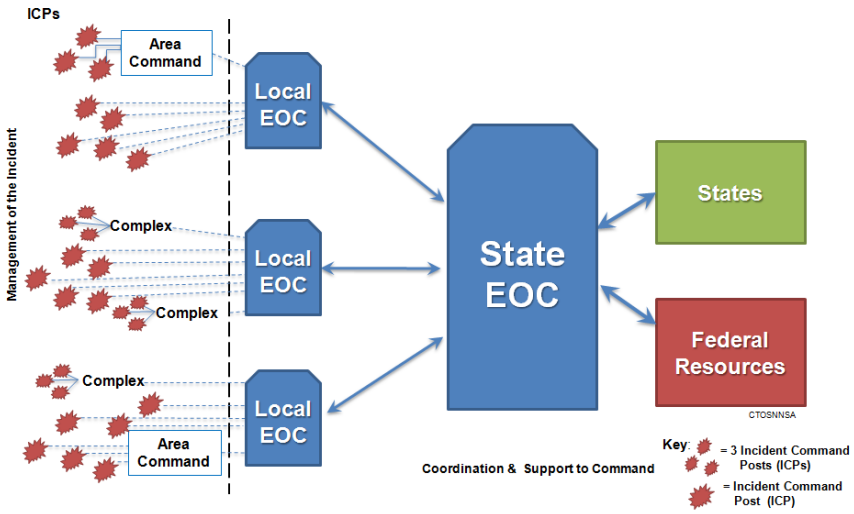

FIGURE 5-1 Organizational diagram for ICPs and EOCs at the local and state levels.
NOTE: EOC = emergency operations center; ICP = incident command post.
SOURCE: Pasquale, D. A., and R. G. Hansen. Implications of an Improvised Nuclear Device Explosion on Command and Control for Surrounding Regions at the Local, State, and Federal Levels (see Appendix H).

Assisting Disabled Infrastructure

The fourth question Pasquale and Hansen addressed was, *If the target area's command and control infrastructure is destroyed or disabled, how can neighboring jurisdictions assist with command and control of the targeted jurisdiction?* An ICP/EOC from a neighboring jurisdiction will need to take over command and control functions in the event that a local ICP/EOC is unable to perform its duties. To facilitate the transfer of operations, preplanning must be undertaken to ensure that memoranda of understanding, joint power agreements, and delegation of authority documents are already in place prior to an IND attack. Without preexisting agreements, a neighboring jurisdiction cannot readily and efficiently assume command and control functions. A preexisting agreement can also cover an IND incident in which the city being targeted happens to be a state capital, such as Boston, Massachusetts.

Public Health and Medical Services

The fifth question is, *How would public health and medical services fit into the command and control structure?* No single public health agency will be able to manage mass casualties. Not even multiple public health agencies can handle the response, which will include medical care, population monitoring, triage, stabilization, transport, and decontamination. There will be a need to exploit surge health care capacity from nongovernmental organizations, disaster medical assistance teams, the military, and volunteers. Senior public health professionals should participate in the unified incident command structure and EOC. A new algorithm for uniform patient triage should be considered, justified by specific circumstances to focus more intently on the needs of the entire community as opposed to individual patient care (IOM, 2012). This algorithm includes the assessment of traumatic injuries, radiation dose, and availability and time to access definitive care (Casagrande et al., 2011; Coleman et al., 2011).

One of the most daunting tasks for command and control is the coordination of patient transfer and transport. No matter how many ambulances there are, there will probably not be enough. Even if there are enough ambulances, they will not have easy access to highways and transportation corridors because of the traffic congestion from people evacuating the area. Air transport, which must be included and coordi-

nated, will be covered in more depth in Chapter 7. The participation of public health in the command and control structure is needed throughout the incident.

Influence of Preplanning on Response

The final question is, *How can preplanning and common policies improve coordination and response effectiveness?* Preplanning and preparation with partners throughout the region is critical to success, Pasquale said. Some of the thorniest regulatory discrepancies across different jurisdictions relate to personal protective equipment requirements and contamination levels for first responders. Consensus is needed in advance, Hansen said, to adopt a pragmatic policy of "clean enough for now." Such a policy could maintain the flow of patients, commerce, and response. The magnitude of an IND attack will make it impossible to have the time and resources to clean everything down after each use. Without uniform standards for contamination, the whole response effort may falter. Currently, there is a group working on addressing uniform standards for contamination action levels sponsored by the Chemical, Biological, Radiological, Nuclear, and Explosives Branch at the Federal Emergency Management Agency (FEMA) and the Office of Infrastructure and Protection at the Department of Homeland Security. If the IND attack occurs before a variety of other regulatory discrepancies are remedied, help will be available through a federal advisory team dealing with the environment, food, and health. The advisory team can be contacted through a local or state EOC.

FEMA PERSPECTIVE

Robert Farmer, again speaking for FEMA as the director of the operations division, opened his presentation by saying that after an IND attack or similarly catastrophic event, FEMA will immediately start sending resources to the affected area without waiting for a formal declaration of a state of emergency under the Stafford Act, the federal law designed to marshal an orderly flow of federal disaster assistance to state and local governments. A proactive stance by FEMA can save lives, he said. In terms of command and control functions, FEMA's successful response to Hurricane Sandy in 2012 showed that it can manage a com-

plex disaster across multiple states, which in that case included Connecticut, Massachusetts, New Jersey, and New York. The command and control function remained intact throughout all phases of the response.

Command and control is predicated on a communications infrastructure. In the event that communications are destroyed by an IND attack, FEMA, the military, and the private sector have vehicles specially equipped to set up cell towers for emergency communications. Farmer also suggested that the Federal Bureau of Investigation (FBI) will play a leading role after an IND attack because the site of the attack is also a crime scene. The FBI will be investigating who is responsible for the attack and how to respond appropriately.

STATE INVOLVEMENT

Jonathan Monken presented his perspective as the Illinois state director of emergency management on the IND exercise he participated in, sponsored through FEMA. Through the experience he ascertained that command and control was the foremost function to protect after an IND attack. One of the greatest challenges for command and control, he said, was to coordinate the local, state, and federal assets flowing into the affected area. In the IND scenario, the city's main government buildings were destroyed, with significant loss of local leadership, and the state of Illinois immediately moved to assume command and control functions over the city and region. One significant downside of locating command and control so far from the site was the loss of situational awareness. Because of this, the State of Illinois and FEMA developed a plan to preposition five potential sites for command and control closer to the site of detonation. The choice of alternative sites was based on their proximity to the city and airports but also on having sufficient distance from the site to avoid fallout and loss of communications, water, electricity, and road access.

Monken said that his experience with the recent North Atlantic Treaty Organization summit held in Chicago was also instructive in anticipating the consequences of an IND attack. The summit was an international, multijurisdictional coordinated event with significant security presence. Twenty-six emergency operations centers were set up in and around Chicago, which led to a duplication of effort that Monken and colleagues realized should be avoided in future planning. Still, he said, the experi-

ence was instructive in demonstrating that civilian and military resources could be successfully co-located and combined.

Monken affirmed the importance of having plans in place in the event of an IND attack. He said that preplanning gave him a good idea of what resources exist through the mutual aid system both within and outside of his state. The state of Illinois, for example, has 1,150 fire departments and 1,100 police agencies. If more assistance is needed, Illinois has plans in place to draw from nearby states and the federal government. One specific plan covers the loss of command and control by his state agency. Through the planning process Monken also discovered that the Department of Defense (DOD) has plans in place for deploying to Illinois a homeland response force from nearby Ohio. One problem with the DOD plan is that it situates its forces in the same facility that the state plans to reserve for the Illinois National Guard. This is one reason why a major challenge of command and control among local, state, and federal agencies is integration. Monken also would like to see command and control plans integrated with the business community in his state. He learned that a business emergency operations center exists at both the city and state level in Illinois. He would like all private and public agencies to have access to the same information in order to make more efficient use of resources and to ensure the protection of command and control systems.

PERSPECTIVE FROM THE OFFICE OF THE ASSISTANT SECRETARY FOR PREPAREDNESS AND RESPONSE

Dr. John Koerner of the Office of the Assistant Secretary for Preparedness and Response (ASPR) began his presentation by emphasizing that command and control systems are uniquely compromised in IND incidents relative to other disasters. What makes them uniquely compromised is the massive disruption of communications, transportation, and financial systems; the scarcity of resources; the inability to deploy first responders into the severe damage zone; and ethical dilemmas for triaging patients. Conversely, he emphasized that the factors leading to the successful implementation of command and control include feasibility and flexibility, reliance on evidence-based practices, reliance on multiple-use technologies, and possessing a range of capabilities that include behavioral health, communication, and laboratory surge.

ASPR has developed numerous so-called playbooks to help implement the role of the Department of Health and Human Services (HHS) as the lead agency for public health and medical services under FEMA's 2008 National Response Framework (Murrain-Hill et al., 2011). The purpose of the playbooks is to provide strategic guidance for command and control and other types of decision making under a distinct set of disaster scenarios. The playbooks highlight key decision points, actions, capabilities, and assets that may be needed to respond to a disaster. The playbooks contain a concept of operations that delineates the phases of the response and identifies specific action steps for each phase. ASPR has developed playbooks supporting several scenarios, including attacks with a radiological dispersal device as well as an IND, all available on its website (ASPR, 2012).

ASPR's emergency management group (EMG) is the command and control hub for HHS, with direct communications to the White House's Disaster Resiliency Group. The EMG is a high-level decision-making body that deals with situational awareness and responds to requests emanating from EOCs at the state and local level. The EMG makes decisions about the range of resources that HHS can deploy, including disaster medical assistance teams and the U.S. Public Health Service's Commissioned Corps. The EMG interfaces with HHS's regional emergency coordinators through an entity known as the incident response coordination team, which controls activity on the ground. To ensure continuity of operations in the event that HHS itself is among the sites of an IND attack, command and control activities devolve to the Centers for Disease Control and Prevention or to an undisclosed location.

Situational awareness on the ground is indispensable for command and control functions, Koerner emphasized. MedMap is currently one of the foremost tools for gaining real-time situational awareness. It is an interactive geographic information system (GIS)-based electronic mapping application that relies on data from numerous sources during a public health emergency. It combines data from multiple agencies at the federal (e.g., modeling of the zones by Department of Energy's national laboratories), state, and local levels into a single visual environment. MedMap is designed to display the three damage-level zones, the dangerous fallout zone, medical care sites, assembly centers, evacuation routes and evacuation centers, and other important information. Figure 5-2 displays a hypothetical MedMap that overlays the sites used for the RTR (Radiation-specific TRiage, TReatment, and TRansport) system (Hrdina et al., 2009). MedMap was first used after the earthquake in Hai-

ti, Koerner said. Once satellite photos were updated, responders on the ground had a better sense of which structures had collapsed and which were still standing. Analysts marked the location of health care facilities that were known to be there before the earthquake and then tried to reconcile that knowledge with observations on the ground.

Finally, command and control surrounding the movement of patients to care is one of the critical functions that HHS coordinates with FEMA and DOD. Koerner explained that strategic command and control decisions are jointly made as to who gets moved, how they are moved (e.g., ground transportation via ambulance, air evacuation), and to which location in the network of 17,000 National Disaster Medical System receiving facilities.

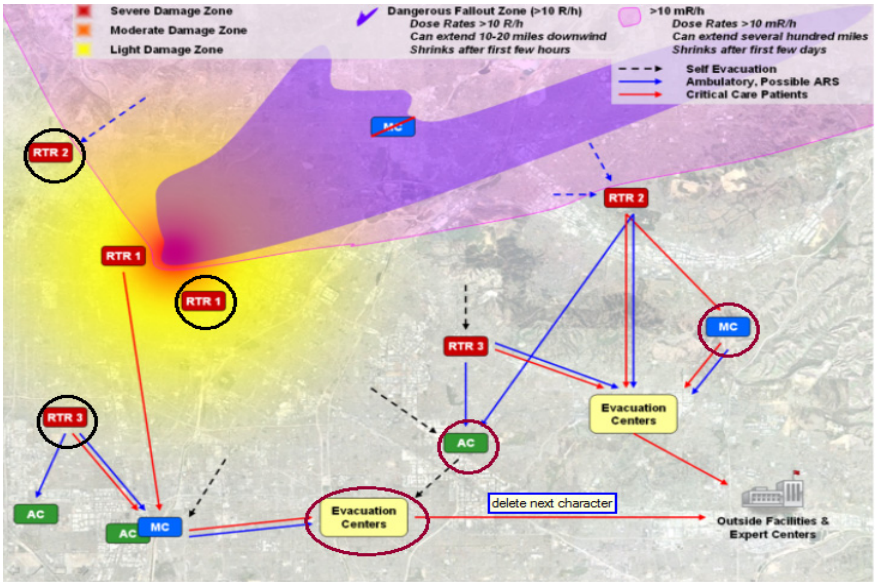

FIGURE 5-2 Example of a MedMap.
NOTE: AC, assembly center; EC, evacuation center; MC, medical care; RTR, Radiation Triage, Treatment, and Transport system.
SOURCE: http://www.remm.nlm.gov/RTR.htm (accessed June 10, 2013).

SUMMARY

Command and control systems are uniquely compromised in IND incidents relative to other disasters because of the massive disruption of communications, transportation, and financial systems; the scarcity of resources; the inability to deploy first responders into the severe damage zone; and ethical dilemmas for triaging patients. Still, speakers noted the command and control framework using ICS and NIMS should be retained. It affords sufficient flexibility and adaptability to be used. The establishment of command and control starts with developing specific plans and policies ahead of time, ensuring clarity in roles and responsibilities, and planning for complex commands throughout the affected region. To facilitate the transfer of command and control from the target city to an outlying community, documents should be in place in advance of an IND attack. During or following an attack, each jurisdiction needs to set up an ICP, which has the legal authority to manage the incident, and an EOC (a hub of communication and coordination serving the ICP). As more and more jurisdictions become involved, a uniform command, with participation by public health, transportation, law enforcement, and other agencies, should assume control and should interact with state and federal authorities. It is also important to remember that the FBI will be playing a leading role in command and control, as they will be trying to ascertain the source and intelligence behind the incident. Command and control must possess situational awareness, which can be provided in part by MedMap. MedMap is a GIS-based electronic mapping application that displays key features such as location of area commands, emergency operations centers, damage zones, and sites for triage and evacuation.

6

Risk Communication and Education

Key Points Made by Individual Speakers

- Effective risk communication after an improvised nuclear device (IND) attack can save lives, reduce social and economic impact, and foster resilience and recovery.
- Effective risk communication staves off panic and mental distress. Mental disorders such as depression and posttraumatic stress disorder have been the most common health outcomes after nuclear accidents.
- To avoid problems such as social stigma, effective risk communication will also be crucial in areas that receive evacuees after an IND incident.
- Messages to the public should be brief, clear, and free of inconsistencies and scientific terminology. They must sound serious and urgent, yet instill hope. They also must provide concrete steps that members of the public can take to reduce risk to themselves, their families, and their homes.
- First responders and medical professionals must be trained to reduce their own misplaced fears about low levels of radiation and to avoid unnecessarily stigmatizing patients and evacuees.
- Addressing the information needs and concerns of first responders and other medical professionals during a radiation emergency is essential for an effective response.
- Public health and safety officials in outlying communities need training in risk communication around radiation hazards.

Because many people are unaware of the extreme implications of an improvised nuclear device (IND) attack, its differences from other nuclear emergencies, the public health consequences from such an attack, and the most effective life-saving responses, risk communication, and disaster education are extremely important. Providing more education—to

both the public and first responders—before, during, and after an incident can result in many more lives saved and a quicker, more efficient response overall. This chapter highlights important lessons that have been garnered from focus group research and real-life radiation emergencies to guide cities and states in their communication planning.

LEARNING FROM FOCUS GROUPS

Charles Miller, chief of the Radiation Studies Branch of the Centers for Disease Control and Prevention (CDC), opened his presentation with the observation that effective communication with the public during an IND attack will save lives. Given the importance of risk communication, the CDC sponsored a study that used focus groups to test dozens of messages about an unfolding IND attack (CDC, 2012). The messages being tested had been developed in 2009–2010 by the Radiation Communications Working Group, a federal interagency group of communication and radiation experts who issued an interim document, *Nuclear Detonation Preparedness: Communicating in the Immediate Aftermath* (Nuclear Detonation Response Communications Working Group, 2010). The idea behind developing messages in advance is for officials to have at their immediate disposal the capacity to communicate effectively with the public in the aftermath of an IND detonation. Focus groups were held in Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York City, Seattle, and Washington, DC.

The focus group study found that the radiation field does not speak clearly to the general public. The public is confused by radiation and is unaware that people are already being exposed to background radiation from natural sources. Further confusion is added by the message to seek shelter in the center of multistory buildings; people who neither work nor live in multistory buildings were confused about where they should go. Miller and his group also found that the distinctions between high and low levels of radiation and corresponding health consequences are not well understood. In addition, terms such as *sheltering*, *responders*, *dose*, *contaminant*, *contamination*, *radioactive material*, and *radiation protection standard* add uncertainty to an already anxiety-inducing message. Analysis of the study's findings led the authors to make these main recommendations:

- Be brief and clear, and address public concerns.

- Tailor messages to different phases of the attack and to different zones.
- Avoid scientific terminology, like the use of radiation exposure levels in rems or Sieverts.
- Keep the tone of the messages urgent and serious, but impart a sense of hope.
- Do not issue contradictory messages.
- Ensure that messages contain simple action items people can undertake to protect themselves, their families, and their homes.

The person delivering the message also matters, Miller said. The public wants to hear messages from subject matter experts. Having medical directors of public health agencies deliver messages is a good idea because they are seen by the public as trustworthy and credible. A television meteorologist is also considered to be credible. Also, the public wants to hear a live voice rather than a voice recording. A live voice sends a message of reassurance that there are other people out there who have survived.

> "When the fear often associated with radiation combines with inadequate or ambiguous communications, the impacts of an event can be greatly exacerbated."
> –Steven M. Becker

Reliance on radios to transmit messages is problematic because the study found that less than half of the focus group members owned a radio other than the ones in their cars. Most people are reachable through cellular phones, Facebook, and Twitter, but these methods of communication might be disrupted by the IND attack. Another finding was that a community's frame of reference should be taken into account. This was most applicable to New York City. On September 11, 2001, after the terrorist attack on the World Trade Center, people in the twin towers were told to remain in the building, a message that led to more deaths as the towers unexpectedly collapsed. Consequently, New Yorkers are likely to be wary of messages to stay inside their buildings. In other jurisdictions, Miller advised getting out IND-related messages by "piggybacking" them onto existing disaster planning, such as for earthquakes and hurricanes. Finally, Miller said, the CDC's next step is to translate messages into Spanish and test them with Spanish speakers.

LESSONS FROM NUCLEAR REACTOR ACCIDENTS

Steven M. Becker, professor of community and environmental health at Old Dominion University College of Health Sciences, said that effective risk communication is one of the most important factors affecting the outcome of an IND attack: It can reduce fatalities, illness, and injuries; it can reduce the social, psychological, and economic impacts; and it can foster resilience and facilitate recovery in affected communities. Although streamlined and accurate risk communication is vitally important, it is very difficult for reasons including the suddenness of the attack (which gives little time to formulate effective messages), the huge numbers of deaths, graphic images of burns and disfigurement, and the expectation of additional attacks to follow.

Decades of research, as well as real-world experience, show that people perceive radiation as one of the most fearful of all hazards (Becker, 2007; Slovic, 2001). The combination of fear and inadequate communication exacerbates the adverse effects of a radiation episode. For example, after the nuclear accident at Three Mile Island, officials delivered conflicting statements about risk. Mixed messages, as well as inadequate messages, were partly responsible for leading an unnecessarily high number of people—an estimated 150,000—to evacuate the area despite radiation doses being below background levels (Talbott et al., 2003). Almost 45 people evacuated for each single person who was actually advised to evacuate. Inadequate information led to increased distress. Similarly, after the reactor accident at Chernobyl, disclosure to the public was minimal, and the most common health consequence was mental disorders—anxiety, depression, and posttraumatic stress disorder (Bromet, 2012).

Although past radiation events have not been the same as an IND attack, Becker said that much can be gained by looking at the lessons learned. The most recent nuclear reactor disaster occurred in 2011 at the Fukushima Dai-ichi nuclear generating station in Japan following an earthquake and a tsunami which killed more than 15,000 people. About 150,000 people were evacuated from a 20-km "no go" zone established by the authorities around the crippled reactors where no one was allowed to enter. Becker was part of a three-member team of experts invited to Japan for a radiological assistance mission shortly after the accident (Becker, 2011). The team spent time in the 20-30 km emergency evacuation preparation zone and outlying communities, meeting with disaster

response officials, politicians, medical personnel, and members of the public.

Maintaining Public Trust

The first lesson the expert team learned is that in the midst of a nuclear crisis it is easy to lose sight of the importance of risk communication. Public announcements after the Fukushima Dai-ichi accident were delayed, press releases were held back, and explanations were intentionally ambiguous in an effort to avoid panic. The failure of risk communication had the opposite effect, however: It heightened fear, and it generated a profound lack of trust and confidence in authorities.

The second lesson Becker imparted was that risk communicators need to find a way for the public to determine whether text messages, e-mail, and other communications are genuine. During the Fukushima Dai-ichi event there were many hoaxes, including fake e-mails purporting to show dead bodies and e-mails advising what medications could substitute for potassium iodide, which protects the thyroid gland from exposure to radioactive iodine. The substitutes mentioned were actually unhealthy. In the discussion period, Jack Herrmann of the National Association for County and City Health Officials pointed out that rumor control is exceedingly challenging. When the Red Cross sought to keep track of rumors during Hurricane Sandy, he said, it found the task to be incredibly difficult. There were hundreds of thousands of tweets, Facebook posts, and other social messaging. For every erroneous tweet, it took multiple tweets to correct it. Herrmann said that public health agencies will need to identify credible sources for where the public can turn.

Furthermore, Becker explained, government agencies should anticipate and be prepared to meet widespread demand for potassium iodide. The demand for potassium iodide skyrocketed immediately after the accident began. When people could not obtain it, they sought any iodine containing products, regardless of the life-saving potential, such as disinfectants, iodine gargles, foodstuffs, and topical medications. Some of the products, including an herbal supplement, were actually dangerous, Becker said.

Another lesson learned that Becker shared is that to combat misjudgment and haphazard evacuations, authorities should disclose the path of the radioactive plume to the public as soon as it is known. Japanese officials failed to disclose this information to local governments and the

public. One unfortunate consequence from this was that in a number of outlying communities people evacuated from a safe area to an area directly under the path of the plume. This lack of disclosure left a legacy of fear, distress, and bitterness toward government officials.

Finally, in receiving areas public agencies should be ready to respond effectively to questions about radiation and fallout in order to prevent the stigmatizing of evacuees. In an outlying community unaffected by radiation, hotels refused to accept evacuees, and children were bullied at school. Even medical professionals held stigmatizing views; many of them left the area. In a survey by the Hospital Association of Japan, responding hospitals reported that 534 physicians and nurses moved away. This figure is an underestimate because more than half of the area's 127 hospitals failed to respond to the survey, and a shortage of health professionals still persists. Becker concluded that there needs to be a strategy for addressing this stigma in outlying communities.

Becker concluded his presentation by emphasizing that risk communication is crucial to the response after an IND event. There are major communication, information, and messaging needs in both the target city and outlying communities.

BOX 6-1
Lessons from Fukushima Dai-ichi, 2011 (Steven M. Becker)

- In the midst of a nuclear crisis, it is easy to lose sight of the importance of effective risk communication. Do not wait for better information to issue messages.
- Include a way for the public to recognize whether a text message, e-mail, or other communication is genuine.
- In all areas, including neighboring jurisdictions, agencies should anticipate and be prepared to meet a rapid, widespread, and immense demand for information about and access to potassium iodide.
- It is vital for authorities to be able to rapidly issue easy-to-read plume maps to the public.
- In receiving areas, agencies should anticipate having to answer many questions about evacuees and radiation and fallout. Effectively meeting these information needs is an important part of efforts to prevent the problem of stigma.
- As part of a risk communication strategy for neighboring jurisdictions, it will be crucial to be able to address the concerns and information needs of health care, hospital, and public health staff.

RISK COMMUNICATION EFFORTS AT FEMA

The Federal Emergency Management Agency (FEMA) has spearheaded two major activities supporting risk communication through its interagency Radiation Communications Working Group, according to Bruce Foreman, the working group's co-chair and an analyst in the Chemical, Biological, Radiological, Nuclear, and Explosives Branch of FEMA's Response Directorate. The first activity is the development of 96 messages for the public in the immediate aftermath of an IND attack. This was the set of messages, published as an interim document in 2010 that the CDC tested in its focus group study. A final version of the document, which has been revised from the interim version to incorporate comments from focus groups, has recently been given approval by the National Security Council and the White House Office of Communications and was publicly released in June 2013 (FEMA, 2013b). FEMA is developing a roll-out strategy to accompany the document as well. The roll-out will likely include a separate document containing messages about responding to a nuclear power accident. With the release of these documents, the theme of translation continues, and state and local authorities will have another set of tools that can be readily used in the event of a radiological incident.

Translating Information to the Local Level

The Radiation Communications Working Group has also produced a video that explains to the lay public the shelter-in-place recommendation. The video, similar to the one developed by Ventura County (described in Chapter 4), carries the pre-incident message "Get inside. Stay inside. Stay tuned." FEMA is working with other federal agencies as well as with state and local authorities on a roll-out strategy for the video to ensure that its impact is maximized.

With the help of the U.S. Defense Threat Reduction Agency, the working group is developing a tool for states and localities to map the plume of fallout and advise people where to go to avoid it. A final activity under development is a risk communication tool for state and local authorities to better handle the "worried well," i.e., people with minimal radiation exposure whose health is not threatened but who are concerned about their health. Because of the need to optimize resources in this type of event, it is critical for the worried well to be deterred from seeking

care at hospitals because hospitals will already be overwhelmed with people harboring more serious threats to health.

THE ROLE OF PUBLIC INFORMATION OFFICERS

Public information officers are the "boots on the ground" after an IND incident, said Edward McDonough, a public information officer for the Maryland Emergency Management Agency. Citing the complexity of the task facing public information officers, McDonough called for training of public information officers in radiation risk communication, whether in person or by webinar or conference call. He concurred with the CDC's focus group finding that, in the aftermath of an IND attack, members of the public need to know what protective actions they can take in order to give them a sense of empowerment. The public needs hope about survivability. McDonough also concurred with the point that risk messages should eschew scientific jargon. For example, instead of describing exposure in rems for a message to the public, the radiation dose from an IND could be compared with the dose one gets from flying from Washington, DC, to Denver, using relevant terms the public would understand. He also advised that risk communicators should take into account how people actually behave in disasters. He pointed to the example of the accident at Three Mile Island and the public's overreaction, which led to unnecessary evacuation. After an IND attack, it will be difficult to ensure that people shelter in place without a strong pre- and post-event messaging strategy.

McDonough made the case that even in the face of scant information, risk communicators should err on the side of giving more information rather than less. He also raised the point that public officials in a crisis should avoid making promises that cannot be kept. Doing so will undermine confidence and trust in authorities. Finally, risk communicators need to be aware that, although a trusted public health official should play a leading role in risk communication, the press will reach out to fire, law enforcement, and emergency management. Representatives from these agencies also need training in risk communication.

SUMMARY

Effective risk communication during and after an IND attack can reduce fatalities, illness, and injuries; it can reduce the social, psychologi-

cal, and economic impact; and it can foster resilience and facilitate recovery in affected communities. Although risk communication is vitally important, it is very difficult. Several years ago, FEMA's Radiation Communications Working Group developed 96 messages for the public in the aftermath of an IND attack. The CDC tested the messages on focus groups, only to discover that the messages were generally confusing and ineffective. The authors of the focus group study interpreted their findings to mean that messages must be brief and clear and address public concerns; they should be urgent and serious in tone but impart a sense of hope; and they should include actions that the public can take to protect themselves, their families, and their communities. As a result of the focus group study, FEMA is revising its messages. Further, FEMA has created a video carrying the shelter-in-place message "Get inside. Stay inside. Stay tuned," which will reach the public sometime soon to help improve current awareness of the IND threat.

Risk communicators can take advantage of important lessons learned from the Fukushima Dai-ichi nuclear accident in 2011. Some of the lessons include the need for rapidly disclosing the path of the radioactive plume and the importance of using credible and trustworthy communicators who must swiftly respond to counteract hoaxes and fake information promulgated through social media and other technology.

7

Monitoring and Mass Care in Outlying Communities

Key Points Made by Individual Speakers

- Population monitoring and screening for radioactive contamination after an improvised nuclear device (IND) attack are highly labor-intensive. The functions can be carried out by volunteer radiation professionals who are trained and registered. Thousands of radiation professionals are found in each state, and hundreds have already been trained.
- No coordinated, national systems are in place to track movement of evacuees, unify families, account for patients, and report the missing and the dead. An IND incident would result in nationwide displacement of patients and families.
- Surge capacity, beyond what is available at hospitals, could be supplied by alternate care facilities for patients whose injuries are not serious enough to warrant hospitalization.
- It is vital to improve personal and family preparedness, which is currently extremely low. Socializing preparedness decreases dependency on resource-strapped public services and improves chances of survival.

Communities both close to and far from the detonation will see a large influx of evacuees who may or may not have been exposed to dangerous radiation. By setting up reception centers with screening and monitoring activities, communities can better triage incoming patients and victims to the appropriate care and more quickly integrate needy patients into national transport systems or the Radiation Injury Treatment Network (RITN) for specialized treatment. Reception centers are scalable and modular, said Armin Ansari of the Centers for Disease Control and Prevention (CDC). Communities can build flexibly on the core center functions—monitoring, screening, and decontamination—by adding

such services as behavioral health care and advanced biodosimetry, depending on resources available. The speakers following Ansari gave other examples of planning approaches and resources that could be used to build up a community's capacity to respond to this type of event.

THE NEED FOR RECEPTION CENTERS AND POPULATION MONITORING

The goals of population monitoring, according to Ansari, are to build on the existing capabilities of mass care and public sheltering to assess evacuees' medical needs related to a radiological emergency. Components might include delivering first aid, determining radiation exposure, screening for radioactive contamination, performing decontamination, and establishing an exposure registry. These reception centers will have similar components whether just outside of the disaster or hundreds of miles away. Daniel Weisdorf, executive committee member of RITN, described in greater detail the specific medical needs of victims that might present at a reception center. In contrast to the therapeutic radiation used in medicine, radiation from an improvised nuclear device (IND), radiological dispersal device, or nuclear plant incident may have these differentiating features: high dose rate, mixed isotope exposure, accompanying trauma or burns, and variable partial body shielding. With partial body shielding, the patient may not require treatment because the preserved marrow will repopulate, enabling blood counts to recover. After radiation exposure significant enough to produce acute radiation syndrome, the hematopoietic system, as assessed by lymphocyte depletion kinetics, is one of the first systems to be affected, and the need for ongoing screening and monitoring of victims is warranted.

As previously discussed, patients with injury to the hematopoietic system will need cytokine treatment, which will not be readily available in large amounts at typical community hospitals. Weisdorf explained that a smaller percentage of patients will warrant bone marrow transplants, depending upon the dose of radiation, the rate of lymphocyte depletion, the volume of body exposed, other injuries, and the number of other casualties competing for bone marrow (which is a scarce resource). These patients will need to be transported to more specialized medical centers that are capable of providing this treatment. Community Reception Centers with population screening and monitoring functions can triage incoming victims to see what types of treatment are needed and determine

priority. Generally speaking, patients exposed to less than 3 Gray (Gy) will recover with medical support; if exposure is 4–10 Gy, more medical care is warranted, and if exposures exceed 10 Gy, the patient is unlikely to recover.

How Many Patients Are Expected?

Based on modeling by the U.S. Defense Threat Reduction Agency, estimates indicate that a 10-kiloton (kt) IND detonated in a city of 2 million would produce more than13,000 immediate fatalities, 300,000 people who need medical care, and another 600,000 who need ambulatory or epidemiologic monitoring (see Table 7-1). The dose an individual was exposed to can be estimated from the individual's location with respect to ground zero or the dangerous fallout kone along with time to vomiting. Although these indicators are imprecise, a failure to display gastrointestinal symptoms implies that the radiation dose was low. For those patients not displaying gastrointestinal or other severe symptoms, monitoring would continue over a period of days or weeks to make sure conditions do not deteriorate. This level of care could take place at a community hospital or alternate care sites and would likely not warrant transport to specialized hospitals or cytokine treatment. It is important to take into account the many victims who would need psychological monitoring after the incident, even if they were not exposed to any radiation. This care could also occur at a reception center or community hospitals and will be covered in more detail in Chapter 8.

TABLE 7-1 Estimated Number of Irradiation Casualties

		Patients, *n*	
Patient Category	**Radiation Dose, *Gy***	**1-kiloton Detonation**	**10-kiloton Detonation**
Combined injuries (minimal to intensive care)	All doses	1,000–3,000	15,000–24,000
Immediate fatalities	All doses	>7,000	>13,000

Patient Category	Radiation Dose, *Gy*	Patients, *n*	
		1-kiloton Detonation	10-kiloton Detonation
Radiation fallout			
Expectant care	>10	18,000	45,000
Intensive care	5–10	19,500	79,400
Critical care	3–5	33,000	108,900
Normal care	1–3	66,000	70,000
Ambulatory monitoring	0.5–1	82,500	139,000
Epidemiologic monitoring	0.25–0.5	106,000	147,000
Monitoring for psychosocial well-being without other injury	<0.25	>150,000	>270,000

NOTE: The table depicts projected casualty estimates based on a 1- or 10-kt detonation. Assumptions include a city with a population of 2 million people and casualties estimated on the basis of the Hazard Prediction Assessment Capability Program, version 3.21 (Defense Threat Reduction Agency, Fort Belvoir, Virginia). Combined injuries consist of radiation injuries in addition to burns or blunt trauma.
SOURCE: Waselenko et al., 2004.

BUILDING CAPACITY FOR COMMUNITY RECEPTION CENTERS

Ansari described one tool recently developed by the CDC to guide local public health planners, a virtual community reception center (CRC).[1] It is a CD-ROM that graphically illustrates population monitoring through a simulated three-dimensional environment and can give planners in cities and towns an idea of how to model existing shelter plans to adapt to the need for a CRC following an IND attack. After

[1]See http://www.bt.cdc.gov/radiation/crc/vcrc.asp (accessed July 11, 2013).

many years of developing shelter plans for natural disasters, community planners nationwide are familiar with the core functions of staffing and running an emergency shelter. Because many features of a community reception center will be similar to those of a shelter, various participants recommended starting with plans already in place. Building on this existing "all-hazards" capacity and adding functions specific to a radiologic emergency can give local and state authorities confidence and progress in IND attack planning without the frustrations of starting from the beginning.

Population Monitoring: Resources and Personnel

To conduct population monitoring at a CRC requires a large cadre of trained staff. John Williamson of the Florida Department of Health estimated, using CDC simulation software, that 200 to 300 trained staff would be needed to screen 1,000 people per hour. To meet the demand, during the past 3 years his department has recruited and trained 640 volunteers. The volunteers are from his state's Medical Reserve Corps, and they participated in a course on radiation and emergency medicine—training that was paid for with CDC grant funds. An underlying goal of the training was to demystify the science and to help professionals overcome misplaced fears about radiation exposure. An additional 342 Medical Reserve Corps members participated in a 1.5-day course developed by the Oak Ridge Institute of Science and Education and held at various sites across Florida. An additional 50 Medical Reserve Corps volunteers were sent to Oak Ridge, Tennessee, to attend a full-scale radiation emergency course.

Seeking additional personnel, Williamson's department turned to its own ranks of environmental health strike teams. These multidisciplinary teams, with a total of 150 members, are distributed across the state of Florida and are trained to respond to hurricanes and other types of emergencies. His department added a radiation training course so that the teams could also be equipped to respond to a radiation emergency.

Establishing a CRC requires not only trained staff, but also radiation detection equipment. With funding from the Department of Homeland Security (DHS), the Florida Department of Health purchased 200 instrument kits (portable dosimeters of several types), 40 digital ratemeters, 22 walk-through portal monitors, and 20 beta air particulate monitors. These instruments, plus 500 other sensors, are being used at numerous sites throughout the state. In the event of a radiation emergency, the instru-

ments could be deployed at CRCs, public shelters, and hospitals to ensure that the facilities are not being contaminated. The instruments require calibration and repair, which is handled by Florida's Bureau of Radiation Control. The funding for that in-house calibration unit comes in part from fees collected from Florida's three major nuclear power stations and radioactive materials licensees.

Promoting the Use of Volunteers for Population Monitoring

The recruitment and training of volunteer radiation professionals to conduct population monitoring in the event of an IND or other radiological emergency is the focus of a cooperative agreement between the CDC and the Conference of Radiation Control Program Directors (CRCPD), according to Ruth McBurney, the group's executive director. CRCPD is a national organization of program directors, mostly from state and local agencies, who regulate the use of radioactive material, X-ray machines, and nuclear medicine and who oversee emergency planning for radiological events. The agreement with the CDC began as a pilot program in five states (including Florida) and one city[2] to incorporate radiation professionals into the Medical Reserve Corps (McBurney, 2012). There is a large pool of radiation professionals from which to draw volunteers. For example, in one state alone, Florida, there are 25,000 radiation professionals. Radiation professionals include medical physicists, health physicists, nuclear medicine technologists, X-ray technologists, radiation therapy technologists, and radiation professionals who work at nuclear power plants. Each of the pilot program's states entered into a contract with CRCPD to recruit, manage, and train the volunteers through the vehicle of the Medical Reserve Corps. Each state developed a publishable plan for effective deployment and utilization of the volunteers and developed an action plan for continued and expanded use of the program. Altogether, 275 to 300 volunteers were recruited and trained during the first year of the program.

Several lessons emerged from the pilot project. One was the need for improved communications between CRCPD and the Medical Reserve Corps. Consequently, CRCPD's working group overseeing the program brought in a liaison officer from the Medical Reserve Corps. Another

[2]Florida, Kansas, New York City, North Carolina, Ohio, and Oregon.

lesson was the need for long-term funding mechanisms to ensure continued training and drills to keep the volunteers engaged. Finally, a need was shown for specific instructions for dealing with internal contamination, which occurs after inhalation, ingestion, or transdermal absorption of radioactive materials. With support from the CDC, the CRCPD program was expanded to an additional 10 states and localities in 2012, and further expansion is expected in 2013.

Practicing Community Reception Center Operations

Thomas Langer of the Kansas Department of Health and Environment described an exercise held in his state to simulate the detonation of two dirty bombs. The foremost goal of the exercise was to establish a community reception center for population monitoring, decontamination, and registration of citizens. The exercise, called Amber Waves, was jointly sponsored by his department and Wyandotte County, Kansas. In the scenario the bombs were simultaneously detonated in front of the local fire department at the time of a shift transfer. The hypothetical blasts succeeded in knocking out two shifts of first responders as well as their equipment. Langer said that the focus of the exercise was especially on the first 48 hours—a crucial time before the expected arrival of substantial state and federal resources.

> "It's important for us, and we realize that as well. It's not about just what happens in my community; it's what happens in yours. It's going to be a national response."
>
> –Thomas Langer

The exercise proved highly successful for one specific goal: to demonstrate that the newly formed Kansas Radiation Response Volunteer Corps could effectively handle population monitoring. This volunteer group, drawn from the ranks of Kansas's radiation health care workers, was set up with the backing of the CDC and CRCPD. The exercise also successfully tested the integration of the Kansas State Animal Response Team, a new group that screens and decontaminates pets, into the CRC. That group was set up because of experiences from Hurricane Katrina, which revealed that people would not leave their homes if they could not take their pets.

Although the CRC was set up in an armory, a future goal is to set up the CRC next to a hospital. There, the CRC staff would be in a better position to conduct triage and deter the "worried well" from entering the

hospital. To counter low levels of preparedness in the population, Langer proposed holding a Radiation Preparedness Day, which would be a statewide drill similar to that held by Kansas for tornado preparedness and would make radiation a more familiar hazard for people.

FAMILY ASSISTANCE IN OUTLYING COMMUNITIES

Families will be devastated after an IND attack, according to Onora Lien of the Northwest Healthcare Response Network. For incidents of this magnitude, she said, there are no coordinated national systems in place to track movement of evacuees, unify families, account for patients, and report the missing and the dead. There is also nothing in place to systematically deal with the psychological burden of survivors. Family assistance centers (FACs) could carry out many of these functions, she said. The concept of using an FAC after mass casualties traces back to the 1990s, when the military and the National Transportation Safety Board established FACs as a focal point for information and services geared for families of crash victims. Some of the functions of an FAC after an IND attack could be Web-based, Lien said, while others could be carried out in dedicated physical space.

FACs can also be organized to deliver social and psychological services to those dealing with highly traumatic events and traumatic grief, to provide appropriate triage and referral to services, and to carry out case management. FACs also could deliver assistance to crime victims (funds for victims distributed by the Department of Justice). Lien suggested that FACs should try to integrate with already operational CRCs wherever possible, but some situations may call for a separate location depending on what services are offered and the population. She urged the creation of a model FAC that applies not only to IND attacks, but also to all hazards.

Lien posed a number of questions that could be used when establishing the protocols that will be used by FACs, and she emphasized the need for political support and direction to sustain this planning. Her questions related to three different issues:

- **Missing persons:** What systems need to be established to centralize information? Who will be responsible? How will local law enforcement coordinate with any efforts? How will the Red Cross's Safe and Well program interface with any efforts? (Safe

and Well is a Red Cross–run website for displaced persons to self-identify and to search for family members.) Who will be responsible for unaccompanied minors?

- **Antemortem data collection:** What is required for scientific identification? Where should antemortem data be collected, such as through a centralized victim identification center and call center? What are the best ways to coordinate with local law enforcement or medical examiners? What about fatalities not occurring at the incident site?
- **Patient tracking:** Can a system be centralized? How would such a system interface with the Joint Patient Assessment and Tracking System, which is a patient tracking system expressly for the subgroup of patients being treated by the National Disaster Medical System? Who is responsible for communicating with families about patients' status and whereabouts? What is the role for Department of Health and Human Services (HHS) service access teams[3] and the Red Cross?

One of the workshop participants said that centralized tracking of patients could be done using barcodes and smartphone technologies, referencing a system used in a radiological dispersal device drill performed in Israel. The technology would allow the medical record to accompany the patient, but this has yet to be implemented and tested here.

NATIONAL NETWORKS TO ASSIST IN VICTIM TRANSPORT AND CARE

As mentioned previously, this type of incident would overwhelm local and even regional health care systems and would also demand very specialized treatment. To enhance a response with needs going beyond local health care, national transport systems and health networks could be used, decreasing the burden on systems in close proximity to the detonation site and giving victims more access to needed beds and treatment. Daniel Weisdorf of the Radiation Injury Treatment Network (RITN) explained that RITN's purpose is to provide surge capacity and management guidance for radiation casualties with bone marrow suppression. RITN's nationwide network consists of 51 academic medical

[3]See http://ccrf.hhs.gov/ccrf/FactSheets/SAT_Fact_Sheet_FINAL.pdf (accessed December 11, 2013).

centers, 6 blood donor centers, and 7 umbilical cord blood blanks. It receives funding from the U.S. Office of Naval Research and coordinates with the Office of the Assistant Secretary for Preparedness and Response (ASPR). In the event of an IND attack, the network would take casualties with bone marrow suppression after they were triaged near the site of detonation. Patients would need to be accompanied by their earliest blood count results before being transported to a receiving hospital within RITN.

Once patients are admitted, RITN has established guidelines for how they should be treated for acute radiation syndrome (RITN, 2010). Depending upon their level of exposure, patients can be given blood transfusions, antibiotics, intravenous fluids, cytokines, and marrow transplantation. RITN has the capacity to conduct human leukocyte antigen (HLA) typing for 6,000 to 10,000 people per week, making it much more capable of handling large numbers of this type of patient than any typical community hospital. HLA typing is essential for matching patients to donor bone marrow for the purpose of transplantation. According to RITN's annual tabletop exercise, its centers can handle up to 30,000 irradiated casualties (or approximately 550 patients for each of the 51 treatment centers), Weisdorf said. RITN has an established plan for the stockpiling of medications and constantly rotates products from stockpiles into clinical pharmacies in order to avoid expiration. The system is designed for managing medications in a cost-effective manner and for having them strategically located for immediate need, making RITN perfectly poised as an able partner in the specialized response that would follow an IND incident.

National Disaster Medical System

Andrew Garrett of ASPR gave an overview of the National Disaster Medical System (NDMS), which is an ASPR-led collaborative partnership among HHS, the Department of Veterans Affairs (VA), the Department of Defense (DOD), and DHS. Its threefold mission is medical response, patient evacuation, and definitive care, i.e., care in a hospital or clinic after someone has been evacuated. NDMS supplements state and local resources and assists with surges of military casualties. For example, it recently served in the wake of Hurricane Sandy, in which 1,800 of its personnel logged 9,000 patient encounters. This system can significantly augment the health care resources at a disaster site, in part by team

members working side by side with local clinical staff at any of 1,500 hospitals nationwide that have memoranda of understanding with NDMS.

One of the greatest challenges after an IND attack will be the coordination of medical and nonmedical information regarding all phases of care. Scant compatibility currently exists, as there is no unified data system. ASPR does have patient tracking ability through the Joint Patient Assessment and Tracking System (JPATS), but gaps in local system integration and system complications keep JPATS from being an easy solution. However, work is continuing in this area and standards for an easily integrated and operated national system are envisioned.

Another challenge Garrett described is the wide range of acuity—or the level of severity of injuries—after an IND incident. Furthermore, the acuity will evolve over time depending upon the amount of exposure to radiation. It may be difficult to predict future acuity and the need for transport based on initial presentation. Ongoing assessments and care requirements may change over the days to weeks after an IND attack. Complicating this issue is the fact that the type of care that is needed may not be feasible at the hospitals under agreement with NDMS. Currently, NDMS and RITN are not coordinated, so NDMS is considering some kind of formal relationship with RITN that would increase NDMS's capacity for handling specialty irradiated patients. All of these challenges could also represent opportunities for innovative solutions. Patients may be moved by air, ambulance, trains, buses, or specially configured semitrailers, both via official transit and unofficial ad hoc methods.

Yet another barrier stems from the fact that an IND incident does not respect geographic boundaries and jurisdictions. Even if there is a regional system of care, its capabilities will be overwhelmed by an IND attack. One regional care system will have to be coordinated with other regional care systems, and sharing laboratory results and other types of medical information among these systems will be very difficult, as will coordinating transport between systems. Garrett concluded his presentation by observing that an IND attack imposes such a staggering threat that it is likely to overwhelm the community approach envisioned by the DHS's National Response Framework. The circumstances may call for the federal government to lead the response, and NDMS could be another asset called in to assist.

During the discussion, Garrett emphasized prioritizing short-term needs, because of the known scarcity of resources that government and responders will have at their disposal to respond to an incident of this

magnitude. Improving the level of personal and family preparedness is becoming more and more necessary because current levels have been stagnant and federal funds for these activities are continuing to decline. In response to Hurricane Sandy, the shelves of stores were quickly emptied. People should have items stored away for a disaster instead of panicking at the last minute. Garrett explained that preparedness needs to become a social norm to adequately prepare communities. "Socializing" the concept of preparedness so that it permeates many parts of people's lives can dramatically decrease dependency on public services after an incident that are guaranteed to be in short supply and can improve individual chances of survival in any disaster.

Shortfalls in Military Patient Transport

Donald Donahue of the American Board of Disaster Medicine focused his presentation on the shortfalls in staging, transport, and receiving of patients that is done through the DOD's role within NDMS. Staging refers to movement of patients to the site of evacuation. The United States has a total of 55 disaster medical assistance teams, which working together could handle only about 5,000 patients per day. Military assets are not positioned for a timely response. An IND detonation in a major city would produce tens of thousands to hundreds of thousands of casualties who would need to be staged and transported, and Donahue highlighted some of the areas needing improvement. Clearly, the demand would outstrip supply.

In terms of transport, there are limitations in personnel and equipment. The trained aeromedical personnel that would be needed to transport patients are limited in number. Most military aeromedical personnel (65 percent) are in the Air Force Reserve. It will take time to mobilize them in a time of crisis. For critical care patients not only is there a limited number of highly trained personnel, but each three-member critical care air transport team can accommodate only three ventilator patients or six non-ventilator critical care patients per flight. Furthermore, the aircraft that would be used for transporting the patients are in short supply. There are only 1,000 cargo planes in the U.S. Air Force, Air Force Reserve, and Air National Guard that could be reconfigured for medical transportation. The U.S. Transportation Command has been complaining about a shortage of airlift capability since 2001, Donohue said. In addition to cargo planes there are 1,400 airframes, including 45

Boeing 767s, identified for potential use in aeromedical evacuation that could be configured for a response. They are available to the federal government on short notice from the Civil Reserve Air Fleet (CRAF), a program developed decades ago to offer surge capacity for the military in a national emergency. But CRAF is not as capable of a rapid response as IND event consequences would demand. The rate-limiting factor is that it takes 60 hours to reconfigure each plane, and there is only one contractor that can perform the reconfigurations.

Challenges in Medical Surge Nationally

Shortfalls will abound at receiving hospitals as well, Donahue said. In the decade since the September 11, 2011, terrorist attacks, about 12 percent of hospital beds have been eliminated. From 1995 to 2001, 20 percent of intensive care unit capacity was eliminated. And between 1990 and 2009 the number of emergency rooms in non-rural hospitals declined by 27 percent. The lack of surge capacity and hospital beds means that local hospitals and health care centers will be unable to handle an influx of 100 patients needing advanced medical care. No city in America and no geographic region could handle 1,000 patients suddenly needing advanced medical care, according to a Senate report (U.S. Senate Committee on Government Affairs, 2001). Currently, most hospitals are on the razor's edge of staffing to the extent that, even if beds were available, there might not be sufficient clinical staff. Another problem Donahue highlighted is coordination among networks, saying that a survey by the VA found that one-quarter of its hospitals did not even know that they were part of the NDMS.

Donohue concluded his presentation by observing that there are serious deficiencies in patient movement planning and a corresponding shortfall in receiving hospital capacity. He advised thinking outside the box for better coordination and planning. In the ensuing discussion, Donahue and Lien expressed skepticism about the estimated number of hospital beds that could be used for surge capacity. They both said they believe that hospitals may be overstating their surge capacity. Lien said that additional surge capacity could be available at long-term and other alternate-care facilities and that this should be pursued as an opportunity for increasing capacity. NDMS could partner with long-term care facilities, behavioral health centers, and other types of health care centers to accept patients whose health care needs do not fully justify hospitaliza-

tion but who need more advanced care than shelters and community reception centers can provide (see Chapter 9).

SUMMARY

After an IND blast, outlying communities will be reeling from the number of evacuees. With a 10-kt device detonated in a city of 2 million, 300,000 will need medical care, and 600,000 will need to be monitored. The goals of population monitoring are to assess evacuees' medical needs, deliver first aid, determine radiation exposure, screen for radioactive contamination, perform decontamination, and establish an exposure registry. These functions, which are to be carried out at community reception centers, are labor-intensive. One solution to this problem of resources is to recruit volunteers from the ranks of radiation professionals and train and register them. This is the intent of a recently developed program by the Conference of Radiation Control Program Directors with support from the CDC. The program has already trained hundreds of volunteers and continues to expand.

To meet the high demand for formal medical treatment, outlying communities can draw on RITN, which can provide care to some 30,000 radiation casualties with bone marrow suppression, who will generally require a very specialized treatment. Another source of medical surge resources is NDMS, which has around 8,000 volunteers, 5,000 of whom are credentialed clinicians. NDMS can deliver care in a field clinic or hospital, provide evacuation and track patient movement, and deliver definitive care through a network of 1,500 hospitals. However, obtaining patient transportation to sites of medical care is likely to be a problem. There are currently serious deficiencies in patient movement planning, particularly with aeromedical evacuation. The military transports are neither properly equipped nor positioned for a timely response, but with better coordination and interagency communication, this situation could be greatly improved.

8

Reorienting and Augmenting Professional Approaches

Key Points Made by Individual Speakers

- Under conditions of heavy patient load, triaging moderately injured patients first saves three times more victims than saving severely injured patients first.
- MedMap is an important tool for obtaining situational awareness. It posts the path of the plume, transport sites, and the locations of local hospitals and assembly centers through an interactive geographical information system-based electronic mapping.
- Instead of focusing on the diagnosis and treatment of mental disorders, mental health professionals should deliver psychological first aid post-incident. Behavioral health providers should be integrated with traditional response provider teams.
- First responders and health care workers need education and training in radiation safety to improve their perception of risks, to ensure they protect themselves and families to reduce health risks, and to improve their performance and decision making during an event.
- If the incident commander decides that high radiation doses to emergency workers are justified, the workers must be made aware of the doses and the adverse health consequences in order to give informed consent before proceeding with the rescue mission.

Throughout the workshop it was evident that many federal resources are available to assist communities, including recently developed systems and technology to give local jurisdictions and responders on the ground a better common operating picture and improved situational awareness. Traditional response protocols may not be enough to address all of the issues caused by an improvised nuclear device (IND) detonation. Additionally, local planners and authorities need to be prepared to

reorient typical approaches to their field after an event with such a magnitude as an IND detonation. Triage approaches may be altered, the mental health manifestations of evacuees and first responders may be different, and additional education in this type of workplace safety and health standards could help responders perform their job duties better.

ADDING SYSTEMS TO PLANNING

Norman Coleman, senior medical advisor and chief of the chemical, biological, radiological, and nuclear team within the Office of the Assistant Secretary for Preparedness and Response (ASPR), spoke to the importance of a systems-based approach to an IND detonation. When so many different agencies and levels of responders will be involved, having a framework to turn to would help alleviate some of the chaos. As mentioned in Chapter 5, he and colleagues devised the RTR system for responding to mass casualties, with the name an abbreviation for Radiation-specific TRiage, TReatment, and TRransport sites; the purpose of the RTR system is to characterize, organize, and efficiently deploy resources and personnel in appropriate categories (Hrdina et al., 2009). RTR-1 sites are those in which patients have both radiation and physical damage, RTR-2 sites lie in the path of the radioactive plume but do not have physical damage, and RTR-3 sites are spontaneous collection points with neither radiation nor structural damage. The RTR sites are designated by the incident commander in real time with feedback from emergency responders on the ground. At each RTR site, the following functions are performed:

- Identification
- Triage
- Medical stabilization (or provision of palliative care)
- Decontamination
- Transport of victims, many of whom are candidates for the Radiation Injury Treatment Network's (RITN's) specialty care

As another system to assist state and local entities in response, Coleman and colleagues also developed a tool called MedMap, also mentioned in Chapter 5, which is used for obtaining situational awareness for responding authorities at the site as well as at the federal level in order to coordinate resources. MedMap posts the location of each RTR

site, the path of the plume, and the locations of local hospitals and assembly centers through an interactive geographical information system–based electronic mapping. Its purpose is to create a seamless common operating picture, both within federal Emergency Support Function (ESF)-8 partners and among their local counterparts, in order to produce a more effective response. Locals can also use the tool to map critical infrastructure and to better coordinate deployments. Coleman also noted that other features can be loaded into MedMap, including hospital occupancy rates, RITN hospitals, nursing homes, schools, Veterans Administration hospitals, weather, and the locations of sites stocked with medical countermeasures.

As John Hick of Hennepin County Medical Center mentioned in Chapter 2, patients with acute radiation syndrome (ARS) resulting from an IND attack will need cytokine treatment within 24 hours. While the federally controlled Strategic National Stockpile (SNS) is designed to warehouse and distribute medical countermeasures in the event of a medical emergency, supplies will not be available to local health care facilities until 1 to 3 days after being requested, which emphasizes the importance of having the resources necessary for an adequate response available at the local level. To make cytokines more readily available and to reduce the cost of replenishing stockpiles, in 2012 Coleman and colleagues proposed the establishment of locally or regionally controlled user-managed inventories (UMIs). Serving as a supplement to SNS, UMIs would stock medical countermeasures that have dual uses (e.g., the same cytokines used for ARS can also be used after routine bone marrow transplants). Those medical countermeasures would be cycled through a local or regional pharmacy so that they would be used during non-emergencies before their expiration date. This would be a cost-effective approach because it would avoid the costs of disposal and repurchase of unused (expired) supplies.

Triaging in an Austere Environment

The magnitude of an IND attack may also dictate that first responders alter their typical triage approach in order to try to save more lives with scarce resources. Coleman described the findings from a triage model he and colleagues developed called the model of resource- and time-based triage (MORTT). This model was developed because conventional triage algorithms make the assumption of unlimited medical re-

sources being available. This alternative was designed as a flexible framework for testing various decisions related to allocating limited resources; however, it should be used to explore prioritizations in advance of an event, not after. When responding to an IND event, scarce resources will be the norm. According to MORTT, triaging moderately injured victims first, then the severely injured victims, followed by the mildly injured (Mod-Sev-Mild) saves 10 percent more lives than conventional triaging systems. The case for treating moderately injured patients first is bolstered by the additional finding that as victim loading increases in relation to resources available (at 10x on the x-axis), the Mod-Sev-Mild triaging system saves three times more victims than does Sev-Mod-Mild (Casagrande et al., 2011). When age and gender are entered into the model, the outcome is unaffected. Although first responders are expected to have a difficult transition in reorienting their approach to triaging away from severely injured first to moderately injured first, they are likely to feel more comfortable knowing that subsequent re-triaging should occur as more medical resources (e.g., hospital beds) become available. Coleman emphasized that continuing re-triaging is necessary, taking into account the ongoing fluctuating amounts of resources and personnel that could become available.

An important refinement to triaging patients in crisis conditions is to deal not only with the patient's needs, but also with the effectiveness of the intervention (Caro et al., 2011a,b). Coleman asserted that, in a crisis, priority should be given to patients with the highest need and for whom interventions are expected to be most effective. If the available resources are not going to be effective, then it is unfair to others to expend the resources on a high-need patient. Also, depending on the situation and resources at hand, it may be more effective to switch from individual patient-focused outcomes to population-focused outcomes. The goal in this type of rare response, when resource scarcity dictates interventions, should be saving the largest number of lives. As evidenced in the MORTT model, the priority shifts to victims for whom the intervention would be most effective as opposed to those with the most severe injuries (IOM, 2012). The utilitarian goal of providing "the greatest good for the greatest number" (i.e., saving the most lives) should be moderated and balanced by the principle of ethics and fairness in making decisions about lifesaving interventions. It is also important that the standards of care that emerge are standardized across regions; otherwise, hospitals operating next to one another with different parameters become even more chaotic.

Coleman concluded his presentation by noting that while general models such as MORTT are useful, preparation and response are specific to a given city or region. It is important to become familiar with the various tools and systems in advance through education, training, and updates. Deciding on the triage approach for scarce resources requires a difficult conversation and needs community agreement and attention before an incident through preplanning and interactive public discussions.

MENTAL HEALTH IMPLICATIONS OF AN IND

Ann Norwood, a senior associate at the UPMC Center for Health Security, addressed the role of mental health providers in an outlying community approximately 2 weeks post-detonation. She stressed that mental health professionals, like emergency responders, need to reorient their professional approach in the face of an IND attack. Mental health professionals must shift from their standard orientation—diagnosis and treatment of mental disorders—to realizing the near-universal set of psychological responses to an IND attack: fear, shock, horror, and anxiety; a strong urge to be with loved ones; an intense hunger for information, especially about loved ones; a diminished ability to retain and process information (i.e., cognitive narrowing); and uncertainty. As an example, research has shown that 61 percent of people living in outlying communities less than 100 miles from Ground Zero reported substantial stress within days of the September 11, 2001, terrorist attacks (Schuster et al., 2001).

Norwood emphasized that mental health providers nationwide should turn to delivery of psychological first aid, the purpose of which is to reduce the distress caused by traumatic events and to build short- and long-term adaptive functioning (National Center for PTSD, 2006). Psychological first aid is useful not only for victims, but also for health care workers and first responders. Psychological first aid can be delivered wherever these groups are situated, whether in shelters, field hospitals and medical triage areas, acute care facilities (for example, emergency departments), staging areas, respite centers for first responders and relief workers, emergency operations centers, or crisis hotlines. Norwood recommended that behavioral health providers should be integrated with teams of traditional response providers. They should tap into the natural resilience of survivors and should watch for people who are not resilient

because they will be vulnerable to developing posttraumatic stress disorder and other longer-term mental disorders.

Norwood cautioned against providing mental health consultations to one group of victims: people with stress-related physical symptoms, such as nausea, dizziness, chest pain, and other symptoms of acute anxiety. If such people seek medical help, the first responder or clinician should avoid referring them to a mental health provider. Making a psychiatric referral signifies to these patients that their symptoms are being discounted and they are "all in their head."

From a mental health perspective, an IND attack is more difficult to respond to than other disasters for several reasons: Radiation is highly feared; it is undetectable to the senses (leaving people ignorant about where they can retreat to for safety); it is poorly understood; it is linked to cancer; it is associated with genetic damage; and it engenders scientific disagreement over what levels are safe. Given the intensity of fear and uncertainty that radiation evokes, hospitals are expected to become magnets for concerned people after an IND blast. People will likely flock to hospitals to be evaluated for radiation exposure, to have medications replaced, to search for a safe haven, and to search for relatives from whom they have been separated. It will be important to deter healthy people from seeking hospital care and refer them either to family support centers for tracking down loved ones or to community reception centers for assessing their radiation exposure.

Further emphasizing Garrett's earlier point about "socialized preparedness," Norwood also noted that we need to foster greater levels of personal and family preparedness. In circumstances where it is hard to get people engaged, she suggested reaching out to people who are highly prepared and using them to model preparedness and educate their peers. Research reveals that directly reaching out to people whose preparedness is low is likely to be unsuccessful.

HEALTH AND SAFETY OF EMERGENCY RESPONDERS

Capt. James Spahr, the associate director of emergency preparedness and response of the National Institute Occupational Safety and Health (NIOSH), began his presentation by describing his agency's role in certifying personal protective equipment geared for chemical, biological, radiological, and nuclear incidents. NIOSH has approved more than 130 different types of makes and models of respirators calibrated against ra-

diation agents. The remainder of Spahr's presentation concerned challenges to responders and guidance regarding radiation exposures in emergency situations.

Emergency responders summoned to an IND detonation include the obvious—firefighters, police, emergency medical services—plus the not so obvious, i.e., urban search and rescue, utility workers, truck drivers, equipment operators, and debris contractors, among others (OSTP, 2010). One of the greatest challenges is to train the full range of responders in radiation safety in order to make a nuclear event "less scary," to minimize the responders' health risks and improve their performance and decision making. Most responders lack training in radiation safety, which likely contributes to the research finding that responders are often reluctant to respond to an event involving significant radiation hazards. Another challenge is to train responders to understand that the severe damage zone has not only radiological hazards, but also numerous physical and chemical hazards, including collapsed structures, heat and fire, broken glass and sharp objects, and downed power lines and ruptured gas lines. Monitoring responders' radiation doses is challenging. It is accomplished by a combination of area monitors and personal dosimeters. The results then need to be passed up through the chain of command because it will ultimately fall to the incident commander to determine whether radiation levels are safe enough to allow responders to remain in the area.

Another significant challenge for responders during an emergency is to shift away from compliance with radiation limits set forth by the Occupational Safety Health Administration and focus instead on emergency occupational standards and guidelines, which give more discretion when dealing with lifesaving missions. In 1992 the Environmental Protection Agency (EPA) issued radiation guidelines for emergency procedures, which established doses of 25 rem (roentgen equivalent man) as an upper limit for large life-saving operations (EPA, 1992). Because EPA's guidelines were geared for a nuclear plant accident and not nuclear terrorism, the Department of Homeland Security (DHS) modified the policy in 2008. The new policy avoided setting a dose limit for large-scale lifesaving operations after nuclear terrorism (FEMA, 2008). Instead, DHS and the National Council on Radiation Protection (NCRP) based the policy on recommendations from NCRP Commentary No. 19, using a "decision dose" not to exceed 50 rad (0.5 Gy) whole-body dose over a short period of time (NCRP, 2005). A "decision dose" refers to the absorbed radiation dose that triggers a decision by the incident commander about whether to withdraw emergency responders from within or near the inner

perimeter during the early phase of the response. The NCRP calls for establishing an inner perimeter at an emission rate of 10,000 mR/hr[1] and for other perimeters to be set at progressively lower emission rates (see Figure 8-1) (NCRP, 2005). If the incident commander decides that doses above 50 rads to emergency workers are justified, the workers must be made aware of the doses and the adverse health consequences in order to make informed decisions about proceeding with the rescue mission (NCRP, 2010; OSTP, 2010). In other words, worker participation under conditions of high radiation exposure (>50 rads cumulative absorbed dose) during lifesaving missions is voluntary and rests on informed consent. NCRP advises that informed consent documents should be filled out in advance of, rather than during, an emergency. A new guidance document is being developed by DHS to deal specifically with worker safety and health following a nuclear detonation, with expected release in 2013.

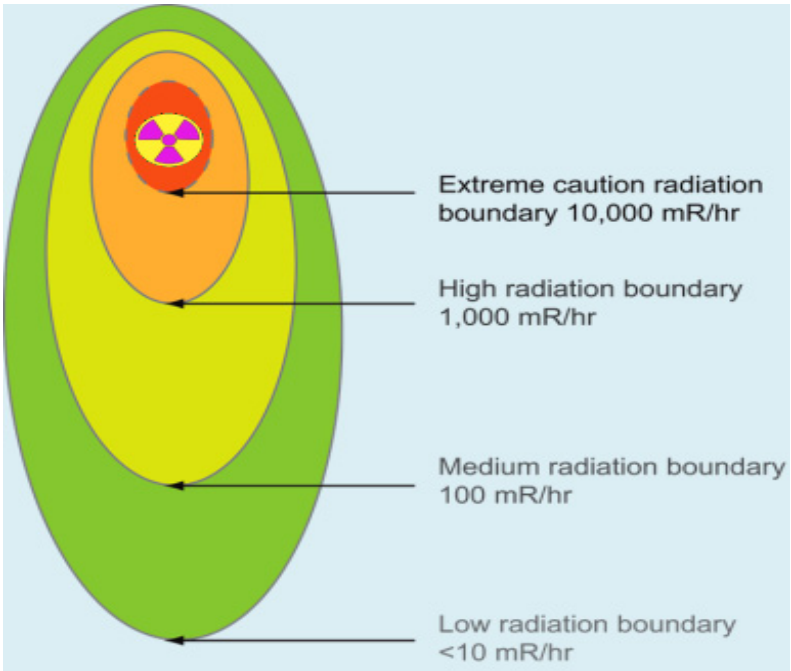

FIGURE 8-1 Decision doses.
SOURCE: Presentation by Capt. James Spahr, based on NCRP, 2005.

[1] mR = milliroentgen measurement of energy produced (different from rem, which measures the biological effect of a radiation dose).

Spahr then sought to spotlight NIOSH's new approach to worker safety and health in public health emergencies. The new approach was motivated by deficiencies in protecting workers at the World Trade Center after the September 11, 2001, terrorist attacks. Seeking to foster a culture of safety in disaster response, NIOSH and other federal agencies have created the Emergency Responder Health Monitoring and Surveillance System.[2] The system is divided into three phases: (1) predeployment (rostering and credentialing workers to ensure that only properly equipped personnel will be selected); (2) deployment (ensuring that all workers receive sufficient onsite training, monitoring, and risk assessment); and (3) post-deployment (conducting exit interviews, health tracking, and writing after-action reports). The intent of the system is to identify formerly unrecognized health hazards, to prevent or mitigate them during the incident, and to track down workers who already were exposed. This new system was successfully field-tested at the Deep Water Horizon emergency operation in the Gulf of Mexico in 2010, during which 55,000 emergency responders across four states were tracked.

Norwood also brought up that health care workers are as deeply unsettled by radiation events as is the greater public. While first responders are typically heroic in crisis situations, survey research has shown that they have a significantly lower degree of willingness to deal with radiation events (Dodgen et al., 2011). Health care workers in hospitals are also hesitant about caring for victims. To support these groups of workers, Norwood recommends educating them about radiation, providing a clear path of action, developing a plan that addresses health care workers' concerns about the well-being of their loved ones, monitoring the workplace to measure exposure levels, and briefing at the beginning of a rotation.

SUMMARY

When responding to an IND event, it will often happen that resources are scarce. Triaging moderately injured victims first saves 10 percent more lives than triaging severely injured first when resources are limited. Attending to the mental health needs of injured and healthy alike is critical to preventing distress and the development of mental disorders like posttraumatic stress disorder and depression, which are highly preva-

[2]See http://nrt.sraprod.com/erhms (accessed May 12, 2013).

lent after disasters or emergencies. Mental health professionals should focus on delivering psychological first aid to victims and the "worried well" alike. The mental and physical health of emergency workers is also highly important. In the past, EPA set an upper limit on the dose of radiation allowed for an emergency worker. Because the limit was designed for nuclear accidents, DHS modified the policy to also deal with nuclear terrorism. The new policy does not set an upper limit on dose, but rather sets a dose of 50 rads as a "decision dose" requiring incident managers to make a decision about whether to evacuate responders from the area. If the manager believes that doses above 50 rads are justified for life-saving missions, emergency workers must be notified, and they must give informed consent to proceed with the life-saving mission.

9

Roles of Regional Health Care Coalitions in Planning and Response

Key Points Made by Individual Speakers

- Among other joint functions, health care coalitions pool and share resources in order to receive and care for mass casualties, establish redundant communications, share situational awareness and scarce resources, and provide palliative care for victims not expected to survive.
- Regional health care coalitions could extend beyond the traditional partners to include long-term care facilities, community health centers, behavioral health care, and many others. This would considerably enhance surge capacity as long as health care staff is properly trained.
- Nascent health care coalitions now exist throughout the United States, but work needs to be done to help them mature and to interconnect them, especially across state lines. Regional coalitions should form a web of interconnected coalitions to further augment their capabilities and network.
- The Radiation Injury Treatment Network (RITN) has the capacity to accept and care for 30,000 radiation-injured patients; however, it is not yet integrated with existing health care coalitions. RITN is eager to become more involved with health care coalitions, whether through local public health, hospitals, or nontraditional care settings.

The utter reality of an improvised nuclear device (IND) event, in any city, is that all hospital and health care offices in close proximity will be overwhelmed. However, through collaborations of hospitals, long-term care facilities, community health centers, and other alternatives, multiple jurisdictions and regions can alleviate the burden of patient load from close-proximity hospitals and redirect patients, resources, and staff to other locations and institutions that are more capable or less stressed.

This can dramatically increase the surge capacity of a region if done correctly, but the collaboration cannot be formed overnight. Many health care coalitions have existed and evolved for years, but they still have room for important growth and adaptation that could assist affected communities and entire regions after an IND attack.

IMPROVING HOSPITAL PREPAREDNESS

With casualties running into the tens of thousands or hundreds of thousands, responding to an IND attack would be a monumental task that could not be effectively handled by any single hospital or health care organization working in isolation. David Marcozzi of the Office of the Assistant Secretary for Preparedness and Response spoke of the office's desire to develop a comprehensive national preparedness and response health care system that is coordinated to meet local, state, and national needs during public health emergencies. The system he envisions has dual uses, is financially sustainable, and is undergirded by a population-based health care delivery model. However, he admits that his goal cannot be achieved at a time when all trends point to hospitals contracting and striving to eliminate surge capacity. His goal also cannot be achieved through his agency's hospital preparedness program budget, which dispenses only $347 million in grants and cooperative agreements to a health care system that is much larger—roughly $2.5 trillion in annual health expenditures. But Marcozzi said that his goal of hospital preparedness is achievable through building regional health care coalitions composed of traditional and nontraditional care providers that combine their surge capacity. More surge capacity can also be gained by reducing hospitals' current patient load through re-triaging or normal attrition.

Health care coalitions are formal collaborations—among hospitals, public health departments, emergency management agencies, and many other health care entities in a given region—that are organized to respond to mass casualty and catastrophic health events. The coalitions extend beyond the traditional partners to include long-term care facilities, community health centers, and many others (see Box 9-1). By fostering the creation of multifaceted health care coalitions, Marcozzi's hospital preparedness program strives to better align health care and public health.

BOX 9-1
Potential Partners in Health Care Coalitions
from David Marcozzi's Presentation

- Hospitals
- Long-term care facilities
- Urgent care facilities
- Alternative care sites
- Behavioral health care
- Community-based organizations
- Community health centers
- Dialysis facilities
- Emergency medical services
- Emergency management
- National Disaster Medical System
- Primary care providers
- Public health
- Private insurance
- Home health agencies
- State medical societies
- Volunteers

Immediate Bed Availability

One way to obtain more surge capacity is for hospitals to re-triage (i.e., reverse triage) their existing patients by safely discharging them to coalition partners or home. Evidence shows that this is achievable. In an influential study, Kelen and collaborators (2006) developed a disposition classification system that categorized inpatients according to their suitability for immediate discharge. Through a tabletop exercise, the system succeeded at increasing hospital capacity while minimizing the risk of adverse effects. Furthermore, reverse triage succeeded during a real-life public health emergency in Sydney, Australia, in 2012 (Satterthwaite and Atkinson, 2012). Another way to increase surge capacity is by normal attrition. Because the average length of stay in hospitals is 5 days, according to the Centers for Disease Control and Prevention, hospitals are every day discharging approximately 20 percent of their bed volume, Marcozzi said.

Marcozzi's goal is for 20 percent of hospital bed capacity to be available for a health emergency within 4 hours. If there were 100 coalitions across the nation, each with 1,000 beds, creating a 20 percent surge capacity would provide 200 beds per coalition, for a total of 20,000 beds

becoming available. Altogether the experience shows that medical surge, whether through re-triaging or attrition, is evidence-based, operationally tenable, and ethical. It is also economically sustainable because the systems being put in place increase the efficiency of overall operations and increase referrals from coalition partners, thereby increasing hospital revenues, regardless of whether there is a true public health emergency.

NATIONAL CAPITAL REGION HEALTH CARE COALITIONS

Dan Hanfling of Inova Health System in Virginia spoke about his white paper (see Appendix I) on the functions of the National Capital Region (NCR), a regional health care coalition forged from three previously separate coalitions serving the Washington, DC, metropolitan area. The coalition partners are

- Northern Virginia Hospital Alliance, consisting of 14 hospitals and 6 freestanding emergency departments;
- D.C. Emergency Healthcare Coalition, consisting of 7 acute-care hospitals and 40 skilled nursing facilities and community health centers; and
- Maryland Institute for Emergency Medical Services System Region V, consisting of 13 hospitals and 1 freestanding emergency department.

The NCR coalition was activated for the presidential inauguration of 2013, during which coalition partners worked together to plan for and coordinate emergency response as well as developing incident action plans and other documents. Following an IND attack, the NCR coalition expects to perform numerous functions: receive mass casualties through medical surge capacity; establish communications resistant to the accompanying electromagnetic pulse; stockpile resources needed for an emergency (e.g., radiation detection equipment, respirators, and decontamination supplies); share situational awareness; contribute various areas of expertise (e.g., burn care and pediatric care); provide palliative care for victims not expected to survive; share scarce resources; and manage mass fatalities in the first few days before additional help arrives from DMORT (the Disaster Mortuary Operational Response Team, organized by ASPR).

The partners in the coalition are to be notified under the following criteria: judgment by health care leadership that notification of the other NCR partners is warranted; a single mass casualty event that involves 40 or more patients who require transportation to specialty hospitals (pediatrics, trauma) throughout the NCR; a single hazardous materials event involving 30 or more patients that may require decontamination; or an event involving a suspected or confirmed biological agent. Notification would also be required when a fire or emergency medical services agency has activated a mass casualty unit, task force, or the equivalent, or an agency or health care facility has accessed or requested a CHEMPACK (containing antidotes to toxic nerve agents)[1] or MMRS (Metropolitan Medical Response System)[2] pharmaceutical cache.

Just as the NCR was forged among three formerly separate coalitions, the NCR itself needs to evolve and become part of other regional coalitions. This kind of flexibility would make the NCR health care coalition "network centric." A network-centric community is continuously evolving and interconnected by communications, which improves mission effectiveness and optimizes resource management (see Appendix I). Being network centric is essential for an IND scenario in which one partner, such as the District of Columbia, is destroyed by the blast and the fallout patterns heavily disrupt another coalition partner. The remaining partner will need to become part of another regional coalition to handle the resulting mass casualties.

ROLES FOR OUTLYING COMMUNITIES

Eric Toner of the UPMC Center for Health Security painted a stark picture of the post–IND attack mayhem that would ensue in outlying hospitals in the absence of a health care coalition. Staff would be in short supply and unprepared to deal with radiation-related injuries, supplies would run short, surge capacity would be exhausted, and hospital functioning would near gridlock. Alternative care sites would be ill-equipped to receive patients or to receive volunteer medical staff because of the lack of credentialing.

[1]See http://www.chemm.nlm.nih.gov/chempack.htm (accessed May 1, 2013).

[2]See http://www.bt.cdc.gov/planning/CoopAgreementAward/presentations/mmrs-oep10minbriefing-jim11.pdf (accessed April 5, 2013).

Toner then outlined the essential features of a health care coalition:

- Includes most acute-care hospitals in the region
- Includes or is connected to public health and emergency medical services
- Has a formal structure and meets regularly
- Collaborates around planning, exercises, purchasing, and response
- Distributes patient load
- Shares staff, equipment, and supplies
- Coordinates the use of volunteers and other health care facilities
- Shares clinical expertise, such as trauma care, burn care, or radiation

Toner and colleagues conducted a survey of almost 5,000 hospitals nationwide, asking them about their participation in health care coalitions (Rambhia et al., 2012). Although only 10 percent of hospitals responded, they constituted a random sample. The authors found that the 477 respondents were members of 314 unique coalitions. Ninety-five percent of the responding hospitals participated in a coalition. Equal numbers of the coalitions were headed by public health agencies and by individual hospitals. Most of the coalitions were in a nascent stage. The participants in coalitions were, as expected, from public health, emergency management, emergency medical services, and hospital associations. Relatively few coalitions included primary care doctors, home health agencies, physicians' practices, state medical societies, and health care clinics, which could indicate an opportunity for growth and inclusion for those coalitions missing these areas. Almost all coalitions reported joint planning, joint training and drills, regular meetings, formal links, joint purchasing, and joint response to mass casualty events. Somewhat fewer reported sharing bed availability and surge capacity, participating in a local emergency operations center, coordinating alternative care facilities, and coordinating use of volunteers. Fewer than 25 percent reported contributing money or in-kind resources.

In the event of an IND detonation in a major city, Toner said there will be a need not only for one health care coalition, but also for interconnected networks of health care coalitions, making them network centric. Toner envisions a cascade of patient movement as each member hospital or facility within a coalition becomes full. The spillover from the first hospital is sent to a second hospital or health facility in the coalition, which, in turn, fills up and sends away or discharges patients to a third site, which is in another coalition, and so on. Coalitions are central to

federal health care preparedness policy. Nascent coalitions now exist in most U.S. locations, but in Toner's opinion work needs to be done to help them mature and become interconnected, especially across state lines.

Integration of the Radiation Injury Treatment Network (RITN) into Local, Regional, and National Response

As previously discussed in Chapter 7, RITN is a network of 51 academic medical centers, 6 blood donor centers, and 7 umbilical cord blood banks. It has published treatment guidelines for acute radiation syndrome as well as guidelines for determining eligibility for and conducting a stem cell transplant, according to speaker and RITN medical advisor David Weinstock of the Dana-Farber Cancer Institute. As part of its pre-event planning and training, RITN has developed standard operating procedures at each of its centers, site readiness assessments, annual tabletop exercises, and an annual training and educational requirement, under which more than 5,000 of its affiliated staff have received basic to intensive radiation training.

RITN has the capacity to accept and care for 30,000 patients; however, it is not yet integrated with existing health care coalitions at a local and regional level to ensure that these organizations can tap more readily into RITN's network, Weinstock said. RITN is eager to become more involved with health care coalitions, whether through local public health agencies, hospitals, or nontraditional care settings. Besides accepting patients after an IND attack, RITN physicians could consult through telemedicine or other vehicles to provide just-in-time training to treatment providers close to the site of detonation. RITN is also interested in sharing supplies, staff, and space. It is building up its stock of granulocyte colony stimulating factor (GCSF), a cytokine, through a user-managed inventory, which is like a stockpile but avoids the problem of replacing unused but expired medications (see Chapter 8). RITN's goal is to have ready access to 20,000 doses of GCSF. Weinstock noted that his organization hopes to partner with academic medical centers that are not currently participating in RITN.

EXERCISING AN IND INCIDENT AS A REGIONAL COALITION

Jenny Atas, the medical director of Region 2 South Healthcare Coalition, described her experience with the coalition's first-ever full-scale IND exercise. Her state of Michigan is already divided into eight emergency management regions, each of which functions essentially as a health care coalition and has an active advisory board. Atas said that her coalition decided to conduct the IND exercise because none of the coalitions in the state had a coordinated regional plan for responding to an IND. Much of the civil defense planning is based on the Cold War strategic thermonuclear detonation scenarios that are no longer applicable. For example, the concept of a fallout shelter worked well with the advanced warning of incoming missiles, but its applicability is less clear for an attack that occurs without any notice, which is far more likely in current times.

Atas described the planning of Operation Shared Burden, which had two phases, with Phase 1 devoted to a tabletop exercise preceded by an education seminar. The education seminar was conducted by a subject area expert from the U.S. Department of Energy Center for Radiological/Nuclear Training. The seminar also featured the state's Burn Surge Plan, operated by the University of Michigan, which had taken 5 years to develop, as well as distribution of a library of IND reference materials. The tabletop exercise used the same scenario as the full-scale exercise. Its purpose was to identify the level of preparedness and planning needed for a real IND detonation. Participants during the exercise discussed their organizations' roles and responsibilities, policies, plans, and procedures.
The second phase, which was scheduled several months after phase 1, was the full-scale exercise, held on October 4, 2012. The scenario was for a ground burst of a 10-kiloton IND detonated at 1:00 p.m. on a workday in the center of Detroit. The scenario assumed 14,000 fatalities, 30,000 seriously injured victims in the severe damage zone and moderate damage zone, and 10,000 minor injuries. It also assumed a loss of electrical equipment from the electromagnetic pulse (EMP), three EMP- and blast-related airline crashes, the impassability of roads and expressways, the loss of utilities, the closing of the Canadian border, and severe damage to rail lines. While it assumed the preservation of cellular telephone service, a severe overloading of circuits was assumed. Thirty-seven hospitals participated, as did 12,000 participants, who included 10,700 personnel (including federal, state, regional, county, and city employees),

BOX 9-2
Objectives of the Full-Scale Exercise–Michigan Region 2 South

Regionwide Objectives

- Test and evaluate primary and secondary communication tools
- Test and evaluate regional casualty transport system
- Test and evaluate patient tracking system
- Test and evaluate decontamination capabilities

Objectives for Individual Hospitals

- Test and evaluate hospital external disaster plans
- Test and evaluate hospital evacuation/shelter-in-place plans
- Test and evaluate hospital emergency operations centers
- Test and evaluate decontamination capability
- Test and evaluate primary and secondary communication systems

1,100 actors playing patients, 134 evaluators, and 58 controllers. The objectives of exercise are listed in Box 9-2.

Lessons Identified

According to the after-action report (Operation Shared Burden, 2012), the participants were highly positive about the experience. The report found good participation and problem solving, good learning experience, strong teamwork, and effective working relationships within and between organizations and facilities. The report noted that organizations showed great adaptability and flexibility under the difficult conditions created by the scenario, good internal and external communications using all systems, strong supplementary help through RACES[3] operators, proactive public information, good patient tracking through the EMTRAC system,[4] and well-prepared participants who were knowledgeable about their roles and responsibilities.

[3]RACES is the Radio Amateur Civil Emergency Service manned by volunteer operators who are licensed and certified by Federal Emergency Management Agency and the Federal Communications Commission. The purpose of RACES is to ensure communication during drills, exercises, and emergencies.

[4]See http://www.emtracsystems.com (accessed July 1, 2013).

The areas for improvement and follow-up activities included the following:

- Identify communication systems and pathways
- Assign priority of message flow because participants noted that they received multiple copies of the same message
- Establish plans and procedures for a virtual joint information center because it can be quickly activated
- Review state burn surge plans, procedures, supplies, and training because many participants were unfamiliar with them and supplies were insufficient
- Develop staffing patterns for extended operations for the regional medical coordination center (RMCC) to ensure that multiple shifts are staffed round the clock
- Review plans to coordinate RMCC with city and county emergency operations centers

SUMMARY

Responding to an IND attack is such an enormous task that it could not be effectively handled by any single hospital or health care organization working in isolation. Many speakers have supported the concept that true regional planning would be necessary to adequately and effectively respond to such a large incident. Health care coalitions have the potential to serve as convening bodies for much of this regional planning to take place. Newly developing health care coalitions have more opportunity to respond to an IND because they can pool and share their resources more easily up front. Robust health care coalitions, if sufficiently large, have the capacity to receive mass casualties; establish communications resistant to the EMP; share situational awareness and scarce resources; provide palliative care for victims not expected to survive; and manage mass fatalities, among other joint functions. Even more surge capacity can come with the inclusion of coalition partners outside of the traditional medical setting, such as long-term care centers, nursing homes, and others, making it important to have a strong convening body for collaboration. By failing to consider nontraditional partners, many coalitions have limited their scope and missed an excellent opportunity for increasing resources and surge capacity by broadening the coalition body.

Reverse triaging hospital patients can also increase surge capacity, by effectively discharging healthier patients who do not need acute care to make way for IND casualties. One large health care coalition example is RITN, which focuses on the special needs of irradiated patients and consists of more than 50 medical centers nationwide. If needed, these centers could accept approximately 30,000 patients around the country after a disaster. RITN is eager to partner with regional and local health care coalitions to augment the national response capability in an IND event.

A

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B

Abbreviations and Acronyms

ARS	acute radiation syndrome
ASPR	U.S. Assistant Secretary for Preparedness and Response
BARDA	Biomedical Advanced Research & Development Authority (located within ASPR)
CBRN	chemical, biological, radiological, and nuclear
CDC	U.S. Centers for Disease Control and Prevention
CRAF	Civil Reserve Air Fleet
CRC	community reception center
CRCPD	Conference of Radiation Control Program Directors
CTOS	Counter Terrorism Operations Support
DFZ	dangerous fallout zone
DHS	U.S. Department of Homeland Security
DMAT	Disaster Medical Assistance Team
DMORT	Disaster Mortuary Operational Response Team
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DSCA	Defense Support of Civilian Authorities
EMP	electromagnetic pulse
EOC	emergency operations center
EPA	U.S. Environmental Protection Agency
ESF-8	Emergency Support Function-Public Health and Medical Services

FAC	family assistance center
FEMA	Federal Emergency Management Agency
GCSF	granulocyte colony stimulating factor (a cytokine)
Gy	Gray
HHS	U.S. Department of Health and Human Services
ICP	incident command post
ICS	Incident Command System
IND	improvised nuclear device
JPAT	Joint Patient Assessment & Tracking System
LDZ	light damage zone
MDZ	moderate damage zone
MORTT	model of resource- and time-based triage
NACCHO	National Association of County and City Health Officials
NARR	National Alliance for Radiation Readiness
NCR	National Capital Region
NCRP	National Council on Radiation Protection
NDMS	National Disaster Medical System
NIMS	National Incident Management System
NIOSH	National Institute for Occupational Safety and Health
NRF	National Response Framework
OSHA	Occupational Safety Health Administration
PPE	personal protective equipment
RACES	Radio Amateur Civil Emergency Service
RDD	radiological dispersal device
REM	roentgen equivalent man
RITN	Radiation Injury Treatment Network
RTR	radiation triage, treatment, and transport system

SDZ	severe damage zone
SNS	Strategic National Stockpile
THIRA	threat and hazard identification and risk assessment
UMI	user-managed inventory
USNORTHCOM	U.S. Northern Command

C

Workshop Agenda

Day 1
January 23, 2013
Omni Shoreham Hotel
2500 Calvert Street, NW
Washington, DC 20008
The Blue Room

8:00 a.m. Welcome and Introductions

JACK HERRMANN, *Workshop Co-Chair*
Senior Advisor and Chief, Public Health Preparedness
National Association of County and City Health Officials (NACCHO)
Washington, DC

JOHN L. HICK, *Workshop Co-Chair*
Associate Medical Director for Emergency Medical Services
Medical Director of Emergency Preparedness
Hennepin County Medical Center
Minneapolis, MN

SESSION I:
INTRODUCTION OF PUBLIC HEALTH AND LOGISTICAL CONSIDERATIONS AFTER AN IND INCIDENT

Session Objective:

- Understand the differences between types of nuclear incidents and implications of an improvised nuclear device (IND) attack on comprehensive planning and public health morbidity and mortality for neighboring jurisdictions.

8:10 a.m. Planning and Response Considerations to Optimize Survivability in Neighboring Jurisdictions and Important Response Priority Differences

BROOKE BUDDEMEIER
Health Physicist
Lawrence Livermore National Laboratory
Key Response Planning Factors for the Aftermath of Nuclear Terrorism

8:45 a.m. White Paper Presentation: The Impact of Mass Evacuations on Host Communities Following Nuclear Terrorism

IRWIN REDLENER
Director
National Center for Public Health Preparedness

9:15 a.m. Discussion with Attendees

9:30 a.m. BREAK

SESSION II:
FEDERAL PERSPECTIVE AND EXISTING PLANNING EFFORTS FOR PREPARING NEIGHBORING JURISDICTIONS

Session Objectives:

- Discuss what resources and tools already exist at federal level.
- Examine differences and issues for requesting federal assets for neighboring communities.
- Understand barriers to interactions and exchanging of information.
- Discuss what fundamental regional planning has been done at the federal level, and what methods of inclusion were used for communities outside of detonation site.

9:45 a.m. Panel Discussion: Existing Federal Guidance on INDs and Challenges to Operations in Communities Outside Detonation Site

GEORGE KORCH
Deputy Assistant Secretary
Office of the Assistant Secretary for Preparedness and Response
Department of Health and Human Services

ROBERT C. WHITCOMB
Lead Physical Scientist
Radiation Studies Branch
Centers for Disease Control and Prevention

ROBERT FARMER
Director, Operations Division
Response Directorate
Federal Emergency Management Agency

JODY WIREMAN, *Forum Member*
Director
Force Health Protection Division
U.S. Northern Command

10:45 a.m. Discussion with Attendees

11:05 a.m. Panel Discussion: Planning for an IND Detonation: Local, State, and Regional Perspectives

Moderator:
MITCH STRIPLING
Director of Emergency Planning
New York City Department of Health and Mental Hygiene

Panelists:
ANDREW VELASQUEZ III
Regional Administrator, Region V
Federal Emergency Management Agency

ALONZO PLOUGH
Director of Emergency Preparedness and Response
Los Angeles County Department of Public Health

ROBERT LEVIN
Medical Director and Health Officer
Ventura County Public Health, California

MORDECHAI GOLDFEDER
Senior Health and Medical Planner
New York City Office of Emergency Management

12:15 p.m. Discussion with Attendees

12:30 p.m. LUNCH

SESSION III: RESPONSE CHALLENGES FOR NEIGHBORING COMMUNITIES AFTER AN IND DETONATION

Session Objectives:

- Consider responsibilities of agencies and frameworks for command, control, and communications.
- Emphasize continuity of operations planning with spillover to adjacent jurisdictions or states and other actions or supports.

- Explore opportunities to increase collaboration and cooperation between and within states and regions to support affected areas.
- Consider mechanisms of coordinating concise, coherent, and consistent messaging across agencies for the public to follow.

1:30 p.m. White Paper Presentation: Implications of an Improvised Nuclear Device Detonation on Command and Control for Surrounding Regions at the Local, State, and Federal Levels

DAVE PASQUALE
Senior Operations Specialist

RICK HANSEN
Senior Scientist

Counter Terrorism Operations Support
Center for Radiological/Nuclear Training at the Nevada National Security Site
National Security Technologies, LLC

2:00 p.m. Discussion with Attendees

2:20 p.m. Panel Discussion: Maintaining Command and Control After an IND Detonation

ROBERT FARMER
Director, Operations Division
Response Directorate
Federal Emergency Management Agency

JONATHON MONKEN
Director
Illinois Emergency Management Agency

JOHN F. KOERNER
Chief, Chemical, Biological, Radiological, Nuclear, or High-Yield Explosives (CBRNE) Branch
Office of Preparedness and Emergency Operations
Deputy Assistant Secretary for Preparedness and Response

3:00 p.m. Discussion with Attendees

3:20 p.m. BREAK

3:35 p.m. Panel Discussion: Risk Communication Strategies in the Aftermath of a Nuclear Terrorist Attack; Getting the Public's Attention

CHARLES MILLER
Chief, Radiation Studies Branch
Division of Environmental Hazards and Health Effects
Centers for Disease Control and Prevention

STEVEN M. BECKER
Professor of Community and Environmental Health
College of Health Sciences
Old Dominion University

BRUCE FOREMAN
Radiation Communication Specialist
CBRNE Branch
Federal Emergency Management Agency

ED MCDONOUGH
Public Information Officer
Maryland Emergency Management Agency

4:35 p.m. Discussion with Attendees

5:00 p.m. ADJOURN

Day 2
January 24, 2013
Omni Shoreham Hotel
2500 Calvert Street, NW
Washington, DC 20008
The Blue Room

8:00 a.m. Welcome and Introduction

JACK HERRMANN, *Workshop Co-Chair*
Senior Advisor and Chief, Public Health Preparedness
NACCHO, Washington, DC

JOHN L. HICK, *Workshop Co-Chair*
Associate Medical Director for Emergency Medical Services
Medical Director of Emergency Preparedness
Hennepin County Medical Center, Minneapolis, MN

SESSION IV: CONSIDERATIONS FOR THE PUBLIC HEALTH SHELTERING AND MASS MANAGEMENT ROLE

Session Objectives:

- Discuss added challenges of sheltering evacuees related to an IND attack compared to routine emergency sheltering.
- Examine roles of Community Reception Centers and Family Assistance Centers in neighboring areas.
- Examine radiological assessment tools being researched and developed for future use.
- Consider the integration and operation of the Radiation Injury Treatment Network, National Disaster Medical System, and emergency medical services into the health care system after an incident.

8:10 a.m. Session Introduction and Objectives

ARMIN ANSARI
Radiation Studies Branch, National Center for Environmental Health
Centers for Disease Control and Prevention

8:20 a.m. Panel Discussion: Operationalizing Community Reception Centers for Evacuees After a Nuclear Incident at Various Distances from Detonation Site

JOHN WILLIAMSON
Administrator, Environmental Radiation Programs
Bureau of Radiation Control
Florida Department of Health

RUTH MCBURNEY
Executive Director
Conference of Radiation Control Program Directors

ONORA LIEN
Health System Planning Manager
Northwest Healthcare Response Network
Public Health–Seattle & King County

RODNEY WALLACE
Chief, Division of Chemical, Biological, Radiological and Nuclear (CBRN) Medical Countermeasures Diagnostics
Division of CBRN Countermeasures
Biomedical Advanced Research and Development Authority
Office of the Assistant Secretary for Preparedness and Response
U.S. Department of Health and Human Services

9:20 a.m. Discussion with Attendees

9:45 a.m. BREAK

10:00 a.m. Panel Discussion: Opportunities for Integration Between Disaster Transport Systems

Moderator:
GAMUNU WIJETUNGE, *Forum Member*
Office of Emergency Medical Services
National Highway Traffic Safety Administration

Panel:
DAN WEISDORF
Executive Committee
Radiation Injury Treatment Network

ANDY GARRETT
National Disaster Medical System and Joint Patient Assessment & Tracking System
Office of the Assistant Secretary for Preparedness and Response
Department of Health and Human Services

DONALD DONAHUE
Member, American Board of Disaster Medicine
Managing Partner, Diogenec Group, LLP

11:00 a.m. Discussion with Attendees

11:30 a.m. LUNCH

SESSION V:
CONSIDERATIONS FOR HEALTH CARE SYSTEMS IN NEIGHBORING AREAS TO THE INCIDENT

Session Objectives:

- Examine systems available for guidance of reception centers and involvement with the larger radiation injury health care network.
- Discuss immediate needs of patients and victims, including mental health and ongoing patient tracking.
- Discuss best practices for adapting guidance to the public health field and managing mass medical centers and incidents.

- Explore issues of health care workforce protection after an IND incident.

12:30 p.m. Panel Discussion: Challenges and Guidance Associated with Hospitals/Mass Medical Care Sites in Neighboring Jurisdictions

NORM COLEMAN
Senior Medical Advisor and Chief, CBRN Team
Office of Assistant Secretary for Preparedness and Response

ANN NORWOOD
Senior Associate
UPMC Center for Health Security

THOMAS LANGER
Director, Bureau of Environmental Health
Kansas Department of Health and Environment

CAPT. JIM SPAHR
Associate Director
National Institute for Occupational Safety and Health
Office for Emergency Preparedness and Response
Centers for Disease Control and Prevention

1:30 p.m. Discussion with Attendees

SESSION VI: NEXT STEPS—THE ROLE OF REGIONAL HEALTH CARE COALITIONS IN RESPONSE

Session Objectives:

- Discuss benefits of regional health care coalitions and their potential to coordinate clinical care guidance and triage decisions.
- Understand the special needs of exposed or irradiated patients presenting at hospitals.

2:00 p.m. Session Introduction

DAVID MARCOZZI, *Forum Member*
Director, National Healthcare Preparedness Programs
Assistant Secretary of Preparedness and Response
Department of Health and Human Services

2:10 p.m. White Paper Presentation: Role of Regional Healthcare Coalitions in Managing and Coordinating Disaster Response

DAN HANFLING, *Forum Member*
Special Advisor
Emergency Preparedness and Response
Inova Health Systems

2:40 p.m. Discussion with Attendees

3:00 p.m. BREAK

3:15 p.m. Panel Presentation: Roles and Potential for Health Care Coalitions

ERIC TONER, *Forum Member*
Senior Associate
UPMC Center for Health Security

DAVID WEINSTOCK
Medical Advisor
Radiation Injury Treatment Network

JENNY ATAS
Medical Director
Region 2 South Healthcare Coalition, Michigan

4:00 p.m. Discussion with Attendees

4:20 p.m. Next Steps: Report from Session Chairs on Key Takeaway Messages

- What issues have not been addressed?
- How can people engage their communities to pass on lessons learned?

4:45 p.m. ADJOURN

D

Biographical Sketches of Speakers and Panelists

Armin Ansari, Ph.D., C.H.P., is a health physicist at the Centers for Disease Control and Prevention (CDC), serving as subject matter expert in CDC's radiation emergency preparedness and response activities. He has worked with local and state agencies on matters related to nuclear and radiological emergency preparedness, conducts training workshops, and lectures extensively on this topic to technical and nontechnical audiences throughout the country. Dr. Ansari is the lead author of the CDC guide for state and local public health planners on population monitoring and is now leading an interagency working group to develop guidance for operation of public shelters after a large-scale radiation emergency. He previously served on a Homeland Security Council interagency committee for preparedness and response to radiological and nuclear threats and was a contributing author to the federal planning guidance for response to a nuclear detonation. He is also an adjunct associate professor of nuclear and radiological engineering at Georgia Institute of Technology and author of the textbook *Radiation Threats and Your Safety: A Guide to Preparation and Response for Professionals and Community*. Dr. Ansari earned his B.S. and Ph.D. degrees in radiation biophysics from the University of Kansas, starting his career as a radiation biologist, and completed his postdoctoral research on molecular mechanisms of radiation-induced mutagenesis at Oak Ridge and Los Alamos National Laboratories. He is certified in comprehensive practice by the American Board of Health Physics and is a diplomate of the American Academy of Health Physics. Dr. Ansari previously served as a director and now serves as president of the Health Physics Society.

Jenny G. Atas, M.D., F.A.C.E.P., is associate professor of emergency medicine at Wayne State University and the disaster coordinator for the Detroit Medical Center. Dr. Atas also serves as the medical director for the Detroit East Medical Control Authority and is the medical director of Detroit Emergency Medical Services. In addition, he serves as the medical director of Region 2 South Healthcare Coalition (R2S), which consists of the southeast counties of Wayne, Washtenaw, and Monroe—the area of largest population density in Michigan. R2S is composed of four public health departments and 37 hospitals and health systems in addition to 267 agencies, including the American Red Cross, 85 emergency medical service (EMS) organizations, fire departments, police departments, institutes of higher learning, state and local governments, nonprofit organizations, and businesses. In addition, R2S has formed strategic partnerships with hospitals, EMS agencies, and government officials in Canada and Ohio. R2S is funded by the U.S. Department of Health and Human Services Office of the Assistant Secretary for Preparedness and Response Cooperative Agreement, Hospital Preparedness Program. In 2012, the coalition conducted a 2-phase disaster exercise to prepare 37 coalition hospitals to collaboratively manage a National Planning Scenario #1 terrorist incident—a ground-burst detonation of a 10-kiloton improvised nuclear device (IND). The exercise was named Operation Shared Burden 2012. Phase 1, a combined educational seminar/table-top exercise, was conducted on June 7. Phase 2, a full-scale exercise, was conducted on October 4. A primary purpose of the exercise was to increase understanding of the threat (i.e., an IND detonation is not a full-scale nuclear war) and appropriate protective actions (e.g., early, adequate sheltering in place followed by informed, delayed evacuation) to reduce potential hospital casualties. Federal, state, and local government agencies joined with the coalition in designing, planning, conducting, and evaluating the exercise. Thirty-seven (37) hospitals, 4 medical control authorities, 13 government agencies, and more than 12,000 individuals participated in the exercise. The exercise met all the requirements of the Homeland Security Exercise and Evaluation Program. The coalition and its planning partners are now working on the preparedness, response, and recovery issues that require further development or improvement as specified by the exercise evaluation team. Dr. Atas has received numerous honors and awards, the most recent of which are the City of Detroit Testimonial Resolution, American Heart Association Heart Saver Award, and the 2007 Home-

town Healthcare Hero from Michigan's Department of Community Health.

Steven M. Becker, Ph.D., is professor of community and environmental health in the College of Health Sciences at Old Dominion University in Norfolk, Virginia. He is a leading international expert on community responses to unconventional disasters, public health preparedness, and response, risk communication, and emergency messaging for chemical, biological, radiological, and nuclear issues. Dr. Becker served as a principal investigator in the Centers for Disease Control and Prevention–Association of Schools of Public Health Pre-Event Message Development Project, one of the most extensive peer-reviewed studies ever conducted of people's concerns and communication needs in situations involving unconventional health threats. More recently, he has served as principal investigator for a multiyear Department of Homeland Security study of the communication and information challenges posed by radiological threats and incidents. In addition to his scholarly research, Dr. Becker has extensive field experience at the sites of major incidents around the world. This includes cases such as a major drinking water contamination incident in Great Britain, the 1999 nuclear criticality accident in Tokaimura, Japan, and the 2001 foot-and-mouth disease outbreak in the United Kingdom. He has also done follow-up work in Ukraine and Belarus on the community impacts of the Chernobyl disaster. In 2011, Dr. Becker was a member of a three-person radiological emergency assistance team invited to Japan in response to the earthquake/tsunami disaster and the accident at Fukushima Dai-ichi nuclear plant. While on the ground, the team carried out a rapid site assessment in affected areas, exchanged information with Japanese disaster response organizations, and provided training to more than 1,100 Japanese physicians, nurses, and other health care providers and emergency responders. In 2005, Dr. Becker was elected by his scientific peers to serve on the National Council on Radiation Protection and Measurements, and his work on emergency management and risk communication has been recognized by scientific organizations such as the Health Physics Society and Oak Ridge Associated Universities. He has also been a visiting fellow at the Japan Emergency Medicine Foundation and the National Hospital Tokyo Disaster Medical Center. For more than a decade, Dr. Becker has been an invited faculty member for Harvard School of Public Health's course on radiological emergency planning. Early in 2012, he was named to the Thought Leader Advisory

Council of the National Public Health Information Coalition. In September 2012, Dr. Becker was appointed by President Barack Obama to the U.S. Nuclear Waste Technical Review Board.

Brooke Buddemeier, M.S., is a certified health physicist (radiation safety specialist) in the global security directorate of Lawrence Livermore National Laboratory (LLNL). He supports the Risk and Consequence Management Division in its efforts to evaluate the potential risks and consequences of radiological and nuclear terrorism. LLNL does this by providing expert technical information in nuclear threat assessment, nuclear incident response, and forensics and attribution. Mr. Buddemeier is a council member of the National Council on Radiation Protection and Measurements (NCRP) and serves on the scientific committees that developed Commentary No. 19—*Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism* (2005) and NCRP Report #165—*Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers* (2010). Mr. Buddemeier is an active member of the Health Physics Society (HPS) and a member of the HPS Homeland Security Committee. From 2003 through 2007, Mr. Buddemeier was on assignment with the Department of Homeland Security (DHS) as the program manager for the weapons of mass destruction emergency response and consequence management program under Science and Technology Directorate's emergency preparedness and response portfolio. He supported the Federal Emergency Management Agency and the Homeland Security Operations Center as a radiological emergency response subject matter expert. He also facilitated the department's research, development, test, and evaluation process to improve emergency response through better capabilities, protocols, and standards. Before moving to DHS, he was part of LLNL's Nuclear Counterterrorism Program and coordinated LLNL's involvement in the National Nuclear Security Administration's Radiological Assistance Program (RAP) for California, Hawaii, and Nevada. RAP is a national emergency response resource to assist federal, state, and local authorities in the event of a radiological incident. As part of RAP's outreach efforts, Mr. Buddemeier has provided radiological responder training and instrumentation workshops to police, firefighters, and members of other agencies throughout the nation. He has also trained radiological emergency responders on the use of specialized radiological response equipment throughout the United States and in Kazakhstan. Mr. Buddemeier has also provided operational health physics support for

various radio-chemistry, plutonium handling, accelerator, and dosimetry operations at LLNL for more than 15 years and has been working on emergency response issues for more than 10 years. He has participated in radiological emergency responses and exercises throughout the world.

Norm Coleman, M.D., received his B.A. in mathematics, summa cum laude, from the University of Vermont in 1966 and his M.D. from Yale University in 1970. He is board-certified in three specialties—internal medicine from the University of California, San Francisco, medical oncology from the National Cancer Institute (NCI) and radiation oncology from Stanford University. He served in the U.S. Public Health Service at the National Institutes of Health. He was an assistant and tenured associate professor of radiation and medical oncology at Stanford and from 1985 to 1999 was professor and chairman of the Harvard Medical School Joint Center for Radiation Therapy. Since 1999, he has been associate director, Radiation Research Program, and senior investigator with a molecular radiation therapeutics laboratory in the Radiation Oncology Branch of NCI. Since 2004, he has also been a senior medical advisor in the Office of the Assistant Secretary for Preparedness and Response in the Department of Health and Human Services. His focus is on radiological and nuclear preparedness and planning, but the programs apply to all hazards. This includes the Scarce Resources for a Nuclear Detonation project and participation at the U.S. Embassy in Tokyo during the Japanese disaster in March 2011. Among Dr. Coleman's honors are the gold medal from the American Society for Radiation Oncology and the 2011 Samuel J. Heyman Service to America Homeland Security Medal.

Donald A. Donahue, D.H.Ed., M.B.A., F.A.C.H.E., is president and CEO of Diogenec Group, a Washington, DC, health care professional services firm. He previously served as the director of health policy and preparedness programs at the Potomac Institute for Policy Studies, vice president with Jefferson Consulting Group, senior marketing manager for Merit Behavioral Care, emergency department administrator and consultant for New York City Health and Hospitals Corporation, and deputy surgeon for plans and fiscal administration for the Army Reserve. Dr. Donahue is a fellow of the American College of Healthcare Executives and the University of Pittsburgh Center for National Preparedness. An adjunct assistant professor with University of Maryland, University College, and the University of Maryland, Baltimore County, he holds a B.S. in

sociology and political science and an M.B.A. and doctorate in health education. His other activities include board membership in the American Academy of Disaster Medicine/American Board of Disaster medicine, work as a peer reviewer for the Health Resources and Services Administration, medical response director for Firestorm Solutions, and Chairman of the Board of Directors for Melwood, an AbilityOne services agency.

Robert A. Farmer, M.S., was appointed as director, operations division, in the Federal Emergency Management Agency's (FEMA's) Response Directorate in December 2011. A career member of the Senior Executive Service, Mr. Farmer is responsible for providing the management and coordination of the core federal disaster response teams, resources, and programs needed to support FEMA's regions; interagency partners; state, local, territorial, and tribal governments; voluntary agencies; and disaster survivors. Mr. Farmer joined FEMA in April 2007 in the program analysis and evaluation division. He was selected as a career member of the Senior Executive Service and appointed as the director of the program analysis and evaluation division for FEMA in August 2008. He served as the acting deputy chief financial officer for FEMA from June 2008 through November 2008 and as acting director of the Office of Policy and Program Analysis (OPPA) from March 2009 through August 2009. He was the deputy director for OPPA from July 2009 to December 2011. Prior to joining FEMA, Mr. Farmer served for 26 years as an officer in the U.S. Coast Guard, where he gained extensive incident management and emergency response experience. His operational tours included serving as an operations officer, executive officer, and commanding officer of Coast Guard vessels. His shore assignments included serving as commanding officer of Coast Guard Headquarters Support Command and assignments within the Coast Guard's strategic planning, financial management, strategic analysis, and planning and performance offices. Mr. Farmer earned a B.S. in physical science from the U.S. Coast Guard Academy, holds an M.S. in operations research from the Naval Postgraduate School, and graduated from the National War College with an M.S. in national security strategy. Mr. Farmer received the Administrator's Outstanding Individual Award, and his military awards include two Legion of Merit awards, the Defense Meritorious Service Medal, three Meritorious Service medals, the Coast Guard Commendation Medal, and four Coast Guard Achievement medals.

Bruce Foreman, M.S., is currently the radiation communications specialist within the Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) branch of the Response Directorate, Federal Emergency Management Agency (FEMA). Prior to joining FEMA in March 2012, Bruce served for 27 years in the U.S. Army as Chemical Biological, Radiological and Nuclear (CBRN) officer. Mr. Foreman has served in multiple tactical, operational, and strategic positions within the Department of Defense's CBRN Enterprise, including as Chief of Protection, Multi-National Corps Iraq, and First Corps Chemical Officer (2007–2011).

Andrew Garrett, M.D., M.P.H., is the director of the National Disaster Medical System (NDMS) at the Department of Health and Human Services (HHS). NDMS is located in the Office of the Assistant Secretary for Preparedness and Response (ASPR) and serves as a federally coordinated system that augments the civilian emergency medical response capabilities of the United States. NDMS consists of more than 8,000 intermittent federal employees organized into response teams such as Disaster Medical Assistance Teams, Disaster Mortuary Response Teams, and the National Veterinary Response Team. Prior to this position, Dr. Garrett was the deputy chief medical officer for NDMS for more than 2 years, and he recently served in the role of interim director for the Emergency Care Coordination Center, a division of ASPR that was established to explore and address some of the critical gaps in the U.S. emergency care system. Dr. Garrett is board-certified in pediatrics and has broad experience as a medical director for fire, emergency medical services (EMS), and law enforcement agencies. He completed a 2-year medical fellowship in EMS and disaster medicine and received an M.P.H. degree from the University of Massachusetts in 2006. He has an adjunct appointment at the Uniformed Services University of Health Sciences as an assistant professor of preventive medicine and biometrics. Prior to starting at HHS, Dr. Garrett was in a senior leadership position at Columbia University's Mailman School of Public Health, National Center for Disaster Preparedness. He maintains his role as an advisor on pediatrics, disaster medicine, and EMS for HHS. His past clinical experience includes serving as an attending physician in pediatric emergency medicine in Worcester, Massachusetts, and 3 years as a pediatric transport medicine attending physician in Los Angeles. His disaster fieldwork includes deployment to the 2010 Haiti earthquake as the chief medical officer to the HHS Incident Response Coordination

Team, the Joplin Tornado in 2011, the Deepwater Horizon environmental disaster in 2010, Hurricane Katrina, the 2006 Nias Island earthquake in Indonesia, and several others. His publications include *Children and Megadisasters: Lessons Learned in the New Millennium*, *Public Health Disaster Research: Surveying the Field, Defining Its Future*, and *Mitigating Absenteeism in Hospital Workers During a Pandemic.*

Mordechai "Mordy" Goldfeder, **M.P.A.,** is the senior health and medical Planner at the New York City (NYC) Office of Emergency Management (OEM), responsible for the ongoing development of the health and medical components to citywide response plans. During Hurricane Irene, he established and directed the operations at the Healthcare Evacuation Center (HEC), which coordinated the movement of more than 9,000 vulnerable people from hospitals, nursing homes, and adult care facilities pre-storm. During Hurricane Sandy, he opened and directed the HEC to coordinate the post-storm evacuation of more than 6,000 vulnerable people from hospitals, nursing homes, and adult care facilities heavily damaged by the storm. Before joining NYC OEM, Mr. Goldfeder worked for the NYC Fire Department. During his 19-year tenure, he worked in many different capacities, starting as paramedic, becoming an instructor in the EMS academy, and later becoming a lieutenant, in which role he led the response to many incidents, including a 2006 steam pipe explosion and a 2008 crane collapse. In addition, he was assigned to the New York City Fire Department's (FDNY's) communications center, where he was certified as a communications specialist. Prior to his work in the FDNY, he was a volunteer for the American Red Cross, where he taught CPR and first aid and was a disaster relief worker recognized by then-Mayor David Dinkins for his efforts in running a shelter for displaced families during the floods of the 1993 Nor'Easter. In addition, he is an active first-response paramedic for a volunteer ambulance service on Long Island. Mr. Goldfeder holds a B.A. in fire and emergency management as well as an M.P.A. in investigation and operational inspection from John Jay College of Criminal Justice. He is a frequent guest speaker at his alma mater and has been part of several nationally recognized conferences relating to emergency management specific to health care issues.

Dan Hanfling, M.D., is special advisor to the Inova Health System in Falls Church, Virginia, on matters related to emergency preparedness and disaster response. He is a board-certified emergency physician

practicing at Inova Fairfax Hospital, Northern Virginia's Level I trauma center. He serves as an operational medical director for air medical services and has responsibilities as a medical team manager for Virginia Task Force One, a Federal Emergency Management Agency– and United States Agency for International Development–sanctioned international urban search-and-rescue team. Dr. Hanfling was involved in the response to the Izmit, Turkey, earthquake in 1999, the Pentagon attack in September 2001, and Hurricanes Rita and Katrina in 2005 and Gustav and Ike in 2008. Most recently, he participated in the response to the devastating earthquake affecting Port au Prince, Haiti. He was integrally involved in the management of the response to the anthrax bioterrorism mailings in fall 2001, when two cases of inhalational anthrax were successfully diagnosed and managed at Inova Fairfax Hospital. Dr. Hanfling is a founding member of the Northern Virginia Hospital Alliance. He has testified before Congress on the issues of disaster preparedness and lectures nationally and internationally on prehospital-, hospital-, and disaster-related subjects. He currently serves as the vice chair of the Institute of Medicine Committee on Establishing Standards of Care in Disaster Events. Dr. Hanfling received an A.B. in political science from Duke University and was awarded his medical degree from Brown University. He completed an internship in internal medicine at the Miriam Hospital in Providence, Rhode Island and an emergency medicine residency at George Washington/Georgetown University Hospitals. He is clinical professor of emergency medicine at George Washington University, a contributing scholar at the University of Pittsburgh Medical Center Center for BioSecurity, and an adjunct distinguished senior fellow at the George Mason University School of Public Policy.

Richard Hansen, B.S., is a resident scientist for the CTOS/Center for Rad/Nuc Training Research, Analysis, and Development Department and team leader for the development of the Department of Homeland Security (DHS)/Federal Emergency Management Agency (FEMA) training program *Key Leader Training: Incident Commander Response to an IND*. Prior to this position, he was the technical subject matter expert, course director, lead course developer, and lead instructor for DHS/FEMA courses for civilian emergency responders and National Guard Civil Support Teams courses for prevention and response to radiological/nuclear weapons of mass destruction incidents. Mr. Hansen is also a former team member of U.S. Department of Energy radiological/ nuclear emergency response team and previously developed detection

instruments, isotope identification instruments, analysis software, operational procedures, and training courses for this team.

Jack Herrmann, M.S.Ed., N.C.C., L.M.H.C., is the senior advisor for Public Health Preparedness at the National Association of County and City Health Officials (NACCHO), an association that represents approximately 3,000 local public health departments across the country. In this role, he oversees the organization's preparedness portfolio, which consists of five federally funded programs aimed at enhancing and strengthening the preparedness and response capacity of local health departments. He is responsible for establishing priorities for public health preparedness within the organization and also serves as the organization's liaison to local, state, and federal partner agencies. Prior to joining NACCHO, Mr. Herrmann was an assistant professor of psychiatry and director of the Program in Disaster Mental Health at the University of Rochester Medical Center. As the former founder and director of Strong EAP, he specialized in developing critical response teams for local police, fire, and health care organizations. Mr. Herrmann has also been a long-time volunteer with the American Red Cross. Since 1993, he has responded to numerous disasters, including the New York City attacks of September 11, 2001; Hurricanes Katrina and Rita in Louisiana; the Northridge California earthquake; the explosion of TWA Flight 800; and the crash of Comair Flight 5191 in Lexington, Kentucky. Prior to relocating to Washington, DC, he was the American Red Cross disaster mental health consultant for the northeastern region of the United States (including Puerto Rico and the Virgin Islands) and a member of the Red Cross National Critical Response Team. He co-authored the training curricula *Foundations of Disaster Mental Health and Psychological First Aid*, the nationally recognized and required training for all Red Cross disaster mental health volunteers. In 2006, he adapted *Psychological First Aid: A Field Guide*, developed by the National Center for PTSD and the National Child Traumatic Stress Network, for the National Medical Reserve Corps. Mr. Herrmann earned a master's degree in education from the University of Rochester, is certified by the National Board of Certified Counselors, and is a licensed mental health counselor in the state of New York.

John Hick, M.D., is a faculty emergency physician at Hennepin County Medical Center (HCMC) and an associate professor of emergency medicine at the University of Minnesota. He serves as the associate med-

ical director for Hennepin County emergency medical services and medical director for emergency preparedness at HCMC. He is medical advisor to the Minneapolis/St. Paul Metropolitan Medical Response System. He also serves the Minnesota Department of Health as the medical director for the Office of Emergency Preparedness and medical director for Hospital Bioterrorism Preparedness. He is the founder and past chair of the Minneapolis/St. Paul Metropolitan Hospital Compact, a 29-hospital mutual aid and planning group active since 2002. He is involved at many levels of planning for surge capacity and adjusted standards of care and traveled to Greece to assist in health care system preparations for the 2004 Summer Olympics as part of a 15-member team from the Centers for Disease Control and Prevention and the Department of Health and Human Services. He is a national speaker on hospital preparedness issues and has published numerous papers dealing with hospital preparedness for contaminated casualties, personal protective equipment, and surge capacity.

John F. Koerner, M.P.H., C.I.H., is the Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) branch chief in the Office of Preparedness and Emergency Operations for the Assistant Secretary for Preparedness and Response at the Department of Health and Human Services. The work of the CBRNE branch is to provide CBRNE subject matter expertise and lead the development of innovative, evidence-based interventions to support the nation's medical and public health response to catastrophic disasters and terrorist incidents. Mr. Koerner also serves as senior public health advisor and triage chief for a charitable organization that conducts primary care clinics in remote Caribbean locales. Mr. Koerner worked previously at the U.S. Department of Labor headquarters, where he was twice awarded the Secretary's Exceptional Achievement Award for his work developing protective guidance for anthrax and pandemic influenza. Prior to that Mr. Koerner was principal of a consulting firm specializing in health care, environmental microbiology, biodefense, and emergency response. Mr. Koerner served in the U.S. Army Reserve as a Medical Service Corps officer assigned to a civil affairs battalion (airborne) and deployed to Afghanistan, where he served as public health officer and medical section chief.

George Korch, Ph.D., is the senior science advisor to the Assistant Secretary for Preparedness and Response, Department of Health and

Human Services, and is a visiting professor in the department of molecular microbiology and immunology, Johns Hopkins Bloomberg School of Public Health. Dr. Korch retired from the U.S. Army Medical Department in 2008, where he had served in a number of leadership roles, including as commander of the U.S. Army Medical Research Institute of Infectious Diseases and director of the Department of Defense Medical Chemical and Biological Defense Research Program. He also served as one of the first directors of the National Biodefense Analysis and Countermeasure Center, Department of Homeland Security. His area of expertise is in viral and rickettsial zoonotic diseases and in medical countermeasure development (vaccines, therapies, and diagnostics) for biodefense needs. He serves or has served on committees such as the Institute of Medicine's Forum on Microbial Threats, the state of Maryland's Life Sciences Advisory Board, and the Standards Development Committee for the American Type Cell Culture.

Thomas Langer, M.P.A., is director of the Bureau of Environmental Health for the Kansas Department of Health and Environment. Mr. Langer is the Emergency Support Function-10 radiation response lead for the Kansas emergency response team and served as the state policy spokesman during the 2012 Amber Waves radiological incident response activities, during which Kansas successfully demonstrated response capacities that included mass population reception, monitoring, decontamination, and dose assessment. The Kansas response also included reception and decontamination of service animals and pets. Mr. Langer is a member of the National Alliance for Radiation Readiness (NARR) board representing the Association of State and Territorial Health Officials (ASTHO) and serves on the NARR website development committee. Mr. Langer also serves on the ASTHO Environmental Health Policy Committee and contributed to the 2011 Fukushima accident after-action report. He holds an M.P.A. from the University of Kansas as well as a B.A. in social sciences from Washburn University of Topeka. He is a member of the Environmental Health Association and past president of the Kansas Chapter, American Society of Public Administration. He is a graduate of the Kansas Public Health Leadership Institute Program and is a certified adult educator.

Robert Levin, M.D., is the health officer/medical director for Ventura County, Califronia, Department of Public Health. He has served in that capacity for the past 14 years. Most recently, Dr. Levin has worked on

nuclear preparedness, including a written nuclear plan that delineates Ventura County's response to a nuclear explosion. He is currently preparing to launch a public information campaign to educate his county on nuclear explosion preparedness. Dr. Levin received his medical degree from the University of Missouri in Columbia. He completed his pediatric residency at San Francisco General Hospital and the University of California, San Francisco. He is board-certified in pediatrics and pediatric infectious diseases. He served as chairman of pediatrics at Natividad Medical Center in Salinas, California. In 1987 he moved his family to Chicago, Illinois, to become program director for the pediatric residency training program at Christ Hospital in Oak Lawn, Illinois, and then became chairman of the department of pediatrics at Mount Sinai Hospital, Chicago. He moved to Ventura County in 1998 to assume his current position as Ventura County's public health officer. As health officer, Dr. Levin has been the chief medical officer overseeing all Ventura County terrorism-related activities and threats. In October 2007, on behalf of Ventura County, he published the "Ventura County Nuclear Explosion Response Plan," which was was revised and updated in 2011. In February 2010, he spoke on the topic of nuclear detonation response at the National Association of County and City Health Officials conference in Atlanta and at the National Center for Disaster Preparedness, Columbia University.

Onora Lien, M.A., is planning manager with the Northwest Healthcare Response Network (formerly King County Healthcare Coalition) at Public Health–Seattle & King County. In this capacity, she leads regional health care planning related to health, medical, and mortuary response capabilities in coordination with health care organizations, local health departments, and other emergency response and community partners across two counties in the greater Seattle metropolitan area. Examples of Ms. Lien's current project areas include hospital and nursing home evacuation, patient movement, patient tracking, medical surge and crisis standards of care, health care situational awareness and information sharing, disaster behavioral health, and fatality management. Since 2008, Ms. Lien has been a lead project planner with the Puget Sound Regional Catastrophic Preparedness Grant Program, including projects related to Family Assistance Center operations and family reunification during large-scale mass fatality incidents and, most recently, forward movement of patients and evacuation in catastrophic events. Ms. Lien has worked for more than 11 years on issues related to emergency preparedness and

response. Prior to joining the Northwest Healthcare Response Network and Public Health–Seattle & King County in 2006, Ms. Lien worked as a research and policy analyst in the metropolitan Washington, DC, region, on issues related to public health preparedness and homeland security with the Johns Hopkins Center for Civilian Biodefense Strategies and the University of Pittsburgh Center for Biosecurity. She completed her master's in sociology at Johns Hopkins University, where her work focused on the social and behavioral aspects of public health emergencies and disaster response.

David "Marco" Marcozzi, M.D., M.H.S.-C.L., serves as the director of the newly-established Emergency Care Coordination Center (ECCC) within the Office of the Assistant Secretary of Preparedness and Response (ASPR) at the Department of Health and Human Services. ECCC's function is to coordinate and address issues that involve the delivery of the nation's daily emergency care—from emergency medical services (EMS) dispatch to disposition from the emergency department. Examining and focusing on operational, research, and policy issues, the ECCC will address concerns such as ambulance diversion, regionalization, and emergency department overcrowding. In 2006, Dr. Marcozzi completed a congressional fellowship during which he worked with the Subcommittee on Bioterrorism and Public Health Preparedness in the Senate. While there, he assisted with drafting the Pandemic and All-Hazards Preparedness Act. This statute codified the roles and responsibilities of ASPR, which included an important role in promoting EMS. Until recently, Dr. Marcozzi held the position of assistant professor of emergency medicine and director of disaster preparedness at Duke University Medical Center. He is now a faculty member at Georgetown University, continuing to practice emergency medicine at Washington Hospital Center in Washington, DC. Previously a North Carolina volunteer firefighter and member of the National Disaster Medical System, in which capacity he responded to New York City on 9/11, Dr. Marcozzi currently serves as a major in the U.S. Army Reserves. He has been mobilized twice since 2001, once as part of Operation Iraqi Freedom and again during Hurricane Katrina. He is the recipient of military and civilian awards including the Military Outstanding Volunteer Service Medal, the Army Commendation Medal, the Duke University Health System Strength, Hope and Caring Award, and the Duke Emergency Medicine Distinguished Faculty Award. A graduate of Boston College and St. George's University School of Medicine, Dr.

Marcozzi completed his emergency medicine residency at Brown University. Recently, he also completed a master's degree in health sciences in clinical leadership from Duke University School of Medicine.

Ruth McBurney, M.S., C.H.P., is the executive director of the Conference of Radiation Control Program Directors. In that position, she manages and directs the administrative office for the organization. Prior to taking that position in January 2007, she was the manager of the Radiation Safety Licensing Branch at the Texas Department of State Health Services, culminating 25 years of service in the Texas Radiation Control Program, most of which involved licensing and standards development. Ms. McBurney has served on the Nuclear Regulatory Commission's Advisory Committee on the Medical Use of Isotopes and the U.S. Food and Drug Administration's National Mammography Quality Assurance Advisory Committee and is currently serving on the National Council on Radiation Protection and Measurements. She served as a consultant to the International Atomic Energy Agency in the categorization of radiation sources and recently served on a committee of the National Academy of Sciences regarding replacement technologies for high-risk radiation sources. She is a former president of the Health Physics Society and has been a U.S. delegate to the International Radiation Protection Association's 10th, 11th, and 12th Congresses. Ms. McBurney holds a B.S. in biology from Henderson State University in Arkansas and an M.S. in radiation sciences from the University of Arkansas for Medical Sciences. She is also certified in comprehensive health physics by the American Board of Health Physics.

Edward J. McDonough became public information officer for the Maryland Emergency Management Agency (MEMA) in Reisterstown, Maryland, in 2003. He had served as public information officer for the Maryland Department of Housing and Community Development in Crownsville from 1998 through 2003. Prior to state service, Mr. McDonough spent 15 years as a journalist at a variety of newspapers and newsletters, including the *Baltimore Sun* and the *Carroll County Times* in Westminster. Mr. McDonough is a 1980 graduate of Northeastern University in Boston, where he received a B.S. in arts and sciences (journalism). As the lead state public information officer for the Chemical Stockpile Emergency Preparedness Program at MEMA, he served on three integrated process teams—the Aberdeen community, national public affairs, and national closeout—before the stockpile at

Aberdeen was fully neutralized in March 2005. He has completed the Public Affairs and Information Technology course at the Oak Ridge (Tennessee) Institute for Science and Education, the Advanced Public Information Officer course taught by the Federal Emergency Management Agency's (FEMA's) Emergency Management Institute (EMI) in Emmitsburg, Maryland, and a variety of National Incident Management System courses taught by EMI. Mr. McDonough is an instructor for FEMA's Basic Public Information and Introduction to Joint Information System/Joint Information Center courses. He also was on a team that helped develop the Master-Level Public Information Officer Course and curriculum for various training classes for FEMA External Affairs staff (full-time and reserve) at EMI. He is a member of the senior policy group for the National Capital Region Emergency Support Function-15 group, is active with the National Emergency Management Association's Public Information Subcommittee, and regularly attends and presents at meetings hosted by the Maryland Public Information Network, Public Information Leaders of Tomorrow (Southern Maryland), and the Baltimore Public Relations Council. He has given numerous presentations on operating a Joint Information Center and using social media in emergencies. He lives with his family in Taneytown, Maryland.

Charles Miller, Ph.D., is currently chief of the Radiation Studies Branch, Division of Environmental Hazards and Health Effects, National Center for Environmental Health. In this position, he provides leadership for the agency's radiological emergency response and consequence management efforts. Dr. Miller joined the Centers for Disease Control and Prevention in January 1992. Previously, he worked with the Illinois Department of Nuclear Safety, Oak Ridge National Laboratory, and Anderson (Indiana) University. His primary area of expertise is the transport and dose assessment of radionuclides released to the atmosphere and other facets of environmental radiological dose assessment. He has authored or co-authored more than 100 journal articles, laboratory reports, and meeting papers. Dr. Miller is a member of the National Council on Radiation Protection and Measurements and a fellow of the Health Physics Society. Dr. Miller holds a B.S. in physics/mathematics from Ball State University, an M.S. in meteorology from the University of Michigan, and a Ph.D. in bionucleonics (Health Physics) from Purdue University.

Jonathon Monken, M.B.A., was appointed by Governor Pat Quinn as Director of the Illinois Emergency Management Agency (IEMA) in 2011. As director, Mr. Monken oversees Illinois's disaster preparedness and response, nuclear safety, and homeland security programs, as well as more than 245 employees and a budget of more than $618 million. In this capacity, he also serves as the Illinois homeland security advisor to the governor. At IEMA, Mr. Monken has directed the response and recovery effort to 91 Illinois counties declared state disaster areas, which included the statewide response to the 2011 blizzard, the record Midwest 2011 floods that impacted multiple regions in the state, and the devastating tornado that struck Harrisburg and Ridgeway in southern Illinois. Mr. Monken is chairman of the Central United States Earthquake Consortium, a partnership of the eight states affected by the New Madrid Seismic Zone. He was most recently appointed the vice-chair of the National Emergency Management Association (NEMA) Homeland Security Committee and elected the NEMA vice-president to FEMA Region V. Mr. Monken is also a member of the Governor's Homeland Security Advisors Council. Prior to becoming IEMA director, Monken served for 2 years as acting director of the Illinois State Police, an agency with a staff of 3,400 sworn and civilian personnel and an annual budget of approximately $428 million. Mr. Monkem also possesses a distinguished military career, having served one tour of duty in Kosovo and two combat tours in Iraq between January 2003 and December 2006. While serving with the U.S. Army, Mr. Monken was awarded the Bronze Star Medal and the Army Commendation Medal with the "V" device for valor in combat. Mr. Monken graduated from the U.S. Military Academy at West Point, where his military class rank placed him in the top 1 percent of his class. He also holds an M.B.A. from Northwestern University's Kellogg School of Management. Mr. Monken enjoys being active in his community and is a proud member of American Legion Post #1922 and Springfield Mid-Town Club of Rotary International. He lives in Springfield with his wife, Jennifer, and their two sons, Jack and Luke.

Ann Norwood, M.D., a retired Army colonel, obtained her medical degree from the Uniformed Services University of the Health Sciences, where she later served as a billeted faculty member for 15 years, ultimately serving as associate chair of psychiatry. She joined the Office of Public Health Emergency Preparedness (now the Office of the Assistant Secretary for Preparedness and Response) at the Department of Health and Human Services (HHS) as senior advisor for public health

risk communication in April 2003. In 2007, Dr. Norwood left HHS and joined the Center for Biosecurity of the University of Pittsburgh Medical Center as a senior associate. Dr. Norwood has written and spoken extensively on the psychological, behavioral, and social effects of trauma and violence (with a special focus on chemical, biological, radiological, and nuclear areas), communication, and military issues. She has co-edited two volumes for Cambridge University Press and one for the American Psychiatric Association on psychological trauma and disasters. She served as chair of the American Psychiatric Association's disaster committee during 2001 and helped shape its response to the terrorist attacks.

David Pasquale has 38 years of fire service experience in New Mexico and New York. Twenty-six of those years were spent as a chief officer involved in all aspects of emergency response, including deployments to many large-scale incidents such as the Cerro Grande Fire, the 2007 California fires, and numerous other type 1 and type 2, hazmat, and natural disasters and homeland security operations. As chief in Raton, New Mexico, he managed all functions of the department as well as the emergency medical services and the Office of Emergency Management. Chief Pasquale commanded an National Incident Management System Type 1 Hazmat/Chemical, Biological, Radiological, Nuclear, and Explosives team that provided regional response for the state of New Mexico to an area of more than 16,000 square miles. In 2005, he was asked by the state to serve as a member of the Department of Homeland Security Domestic Nuclear Detection Office, Stakeholders Committee. Working with the New Mexico Department of Homeland Security, Mr. Pasquale organized the first Type 1 Preventative Radiation and Nuclear Detection (PRND) team, which serves as New Mexico's only PRND team providing mission support throughout the state. As chief, he also organized New Mexico's first regional PRND effort, which included law enforcement agencies from Colorado and New Mexico. Mr. Pasquale has served as an adjunct instructor for the New Mexico Fire Academy and the New Mexico Law Enforcement Academy, providing classes in command, hazmat, rescue, and fire operations, to law enforcement, fire, emergency medical services, and military personnel. He was appointed to the New Mexico State Emergency Response Commission by Governor Richardson. He holds numerous certifications in fire/arson investigation and hazardous materials, and is an all-hazard incident commander, operations section chief, and safety officer. He served four

terms as the president of the New Mexico Fire Chiefs Association, and as an executive board member of the New Mexico PRND Committee, the New Mexico Fire Academy Advisory Committee, the New Mexico Municipal Leagues Board of Directors, and the Domestic Nuclear Detection Office Interior Focus Group and Training Advisory Committee. Mr. Pasquale currently works with National Security Technologies, LLC, CTOS-Center for Radiological/Nuclear Training at the Nevada National Security Site, where he serves as a subject matter expert providing guidance on emergency response, the National Incident Management System, operations management, and response to weapons of mass destruction.

Alonzo Plough, Ph.D., M.P.H., joined the Los Angeles County Department of Public Health in January 2009. As director of emergency preparedness and response, he is responsible for the leadership and management of the public health preparedness activities to protect the 11 million residents of Los Angeles County from natural disasters and threats related to emerging infections and bioterrorist events. Dr. Plough coordinates activities in emergency operations, infectious disease control, risk communication, planning, and community engagement. Prior to this appointment, Dr. Plough served as vice president of strategy, planning, and evaluation for The California Endowment (TCE), 2005–2009. In this position, he was responsible for the leadership, management, and overall direction of TCE's strategic planning and development, evaluation, research, and organizational learning. Dr. Plough served 10 years as director and health officer for the Seattle and King County Department of Public Health. He continues his appointment as professor of health services at the University of Washington School of Public Health in Seattle. Prior to that, Plough served for 8 years as director of public health for the Boston Department of Health and Hospitals. During his many years in Boston, he held academic appointments at the Harvard University School of Public Health, Tufts University Department of Community Medicine, and Boston University School of Management. Plough's career includes many awards recognizing exemplary public service and leadership, service on numerous boards of directors of nonprofit organizations, an extensive body of scholarly articles and book chapters.

Irwin Redlener, M.D., is president and co-founder, along with singer-songwriter Paul Simon, of the Children's Health Fund (CHF), a

philanthropic initiative created to develop health care programs in some of the nation's most medically underserved communities. CHF programs are now active in 25 urban and rural disadvantaged communities around the United States providing high-quality comprehensive medical care to more than 75,000 children each year. In his role as pediatrician–child advocate, Dr. Redlener has published, spoken, and testified extensively on the subjects of health care for homeless and indigent children and national health policy. Dr. Redlener is also the director of the National Center for Disaster Preparedness at the Columbia University Mailman School of Public Health, which works to understand and improve the nation's capacity to prepare for, respond to, and recover from disasters. He is a nationally recognized expert on disaster preparedness policies, pandemic influenza, the threat of terrorism in the United States, the impact and consequences of major natural disasters, and related issues. Dr. Redlener has worked extensively in the Gulf region following Hurricane Katrina, where he helped establish ongoing medical and public health programs. He also organized medical response teams in the immediate aftermath of the World Trade Center attacks on 9/11 and has disaster management leadership experience internationally and nationally. He is the author of *Americans at Risk: Why We Are Not Prepared for Megadisasters and What We Can Do Now*, published in August 2006 by Alfred A. Knopf. In his various professional capacities, Dr. Redlener has assisted relief efforts in Honduras, Guatemala, Ethiopia, and numerous parts of the United States. From 1971 to 1973 he directed a rural, VISTA-run health center in East Arkansas. Dr. Redlener has also served as director of grants and medical director of USA for Africa and Hands Across America. The nationally acclaimed New York Children's Health Project, one of the country's largest health care programs for homeless children and their families, was developed in 1987 by Dr. Redlener. In 1993, Dr. Redlener served as a member of the White House Task Force on Health Reform under President Clinton. From 1997 through 2003, Dr. Redlener also had a lead role in the development of the Children's Hospital at Montefiore, where he served as president and chief spokesperson. This hospital remains one of the most advanced and innovative facilities of its kind in the world. From 2008 to 2010, Dr Redlener served as 1 of 10 members on the congressionally established National Commission on Children and Disasters. In 2012, he was appointed to the U.S. National Commission for the United Nations Educational, Scientific, and Cultural Organization. Dr. Redlener received his M.D. from the University of Miami

School of Medicine and his pediatric training at Babies Hospital of the Columbia-Presbyterian Medical Center in New York City, the University of Colorado Medical Center, and the University of Miami-Jackson Memorial Hospital in Miami. He holds an honorary doctor of science degree from Hunter College of the City University of New York and an honorary doctor of humane letters degree from Hofstra University, among numerous other awards and honors.

Capt. James S. Spahr, M.P.H., R.S., D.A.A.S., is a commissioned officer in the U.S. Public Health Service (USPHS), serving as a safety and occupational health specialist at the National Institute for Occupational Safety and Health (NIOSH), in Atlanta, Georgia. Capt. Spahr is the associate director of NIOSH's Office for Emergency Preparedness and Response, where he coordinates the institute's response to emergency events and preparedness policy. Capt. Spahr will complete 30 years of service as a commissioned officer in the USPHS this fall. Prior to his current position, he was in the division of safety research, where he conducted research related to human factors and occupational safety and health. Capt. Spahr has also served as an institutional environmental health specialist for the Health Resources and Services Administration's Hansen's Disease Center, Carville, Louisiana, and for the Indian Health Service in Alaska, Arizona, and New Mexico. Prior to his federal career, Capt. Spahr worked for the Ohio Department of Health, Project HOPE in St. Lucia, West Indies, and as a Peace Corps volunteer in Micronesia.

Mitch Stripling, M.P.A., is director of emergency planning for the New York City Department of Health and Mental Hygiene. In this capacity, he oversees the department's emergency planning efforts, including (for example) the plans for pandemic flu and biological incidents and the development of the agency's Incident Command System. He coordinated citywide planning for the 2009 H1N1 Pandemic and is currently part of the Coordinating Group for Citywide Healthcare Facility Evacuation that developed after Hurricane Irene. His unit has developed nationally-recognized Threat Response Guides for 21 of the highest-risk scenarios that could impact New York City, a data-/consensus-driven risk assessment methodology, a principal scientific advisor model for public health Incident Command System, and a strategic planning directive model for civilian use. Prior to working in New York City, Mr. Stripling worked for the Florida Department of Health. There, he helped plan and

implement the responses to six federally declared disasters, including the 2004 record-breaking hurricane season and Florida's response in southern Mississippi after Hurricane Katrina. During that time, he developed, rostered, and trained environmental health and other public health strike teams, built national training standards in collaboration with the Centers for Disease Control and Prevention, and focused on making communities more resilient in the face of environmental threats. Before working in public health, he spent several years providing strategic consulting for Fortune 500 companies and government agencies. He began his career working at the United Nations Global Teaching and Learning Project on human rights issues. Mr. Stripling holds an M.PA. from Florida State University in emergency management and received his B.A. from Williams College in Massachusetts.

Eric S. Toner, M.D., M.P.H., is a senior associate with the Center for Biosecurity of the University of Pittsburgh Medical Center. He is an internist and emergency physician. His primary areas of interest are health care preparedness for catastrophic events, pandemic influenza response, and medical response to bioterrorism. He is a managing editor of the *Clinicians' Biosecurity News*, which provides clinical biosecurity reports to thousands of clinicians across the country and around the world. He is an associate editor of the journal *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, the leading peer-reviewed journal in this field. Dr. Toner has authored numerous scholarly papers, commentaries, and editorials on hospital and pandemic preparedness, and he has organized several meetings of national leaders on the topics of hospital preparedness, pandemic influenza, mass casualty disasters, biosecurity, biosurveillance, and nuclear preparedness. He has spoken at numerous national and international conferences on a range of biosecurity topics and appeared on a number of high-profile national television and news features on pandemic flu and bioterrorism preparedness. He was the principal investigator of a multiyear project to evaluate the achievements of the Department of Health and Human Services (HHS) Hospital Preparedness Program and to propose a vision and strategy for health care preparedness for the future. He also led a project for HHS to improve health care situational awareness. Dr. Toner is a member of the Institute of Medicine's Forum on Medical and Public Health Preparedness for Catastrophic Events. Dr. Toner has been involved in hospital disaster planning since the mid-1980s. Prior to joining the center, Dr. Toner was the medical director of disaster

preparedness at St. Joseph Medical Center in Towson, Maryland, where he practiced emergency medicine for 23 years. During this time, he also headed a large emergency medicine group practice, founded and directed one of the first chest-pain centers in Maryland, and cofounded and managed a large primary care group practice and an independent urgent care center. In 2003, he spearheaded the creation of a coalition of disaster preparedness personnel from the five Baltimore County hospitals, the health department, and the Office of Emergency Management. Dr. Toner received his B.A. and M.D. degrees from the University of Virginia. He trained in internal medicine at the Medical College of Virginia.

Andrew Velasquez III, M.S., M.B.A., is administrator for Federal Emergency Management Agency (FEMA) Region V. He coordinates preparedness, response, recovery, and mitigation activities for the states of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Appointed by President Obama in 2010, Mr. Velasquez brings to FEMA extensive experience in emergency management and homeland security at both the state and local levels. In addition to directing the delivery of federal disaster assistance for numerous presidentially declared disasters and emergencies, Mr. Velasquez has implemented a number of key initiatives. These initiatives have focused on enhancing the region's readiness posture with an emphasis on leveraging technology to improve response and recovery operations, individual and community preparedness, and planning for all types of threats and hazards. Recognizing the importance of planning for catastrophic incidents, Mr. Velasquez initiated and exercised leadership over the development of a comprehensive operational plan to address the effects of an improvised nuclear device detonation in a large metropolitan area. This integrated planning effort includes FEMA Region V, the states of Illinois, Indiana, and Wisconsin, the City of Chicago and surrounding counties, and various private-sector entities. Before his appointment as FEMA regional administrator, Mr. Velasquez served as a member of the governor's cabinet, both as director of the Illinois Emergency Management Agency (IEMA) and homeland security advisor. In these positions, Mr. Velasquez oversaw Illinois's disaster preparedness, response, nuclear safety, and homeland security programs. As the IEMA director, he directed the response and recovery efforts for numerous large-scale disasters and served as the state coordinating officer and governor's authorized representative for nine presidentially declared disasters. Prior to serving as IEMA director, Mr. Velasquez was executive director of

Chicago's Office of Emergency Management and Communications (OEMC). As a member of the mayor's cabinet, he directed the city's homeland security, emergency management, 9-1-1 police and fire emergency dispatch operations, and traffic management services. Before his appointment as OEMC executive director, Mr. Velasquez served the Chicago Police Department in various capacities for more than 10 years, most recently as the director of the criminal Identification and Records Services Division, overseeing the criminal identification of arrested persons, latent fingerprint processing, criminal warrants, offender extradition, and subpoena processing. Mr. Velasquez has also served as an adjunct faculty member at the University of Chicago, teaching in the university's graduate program in threat and response management. He continues to serve the university as a guest lecturer on a variety of emergency management and homeland security subjects, including the integration of technology to support homeland security and emergency management operations. A native of Chicago, Mr. Velasquez was a member of the U.S. Army Reserve for 6 years. He holds a B.A. and an M.S. in criminal justice from Illinois State University and received an M.B.A. in management from Saint Xavier University. He also completed the Executive Leadership Program at the Naval Post Graduate School's Center for Homeland Defense and Security.

Rodney Wallace, B.S., holds the position of branch chief, Chemical, Biological, Radiological, and Nuclear (CBRN) Diagnostics, within the CBRN Division of the Biomedical Advanced Research and Development Authority (BARDA). BARDA is part of the office of the Assistant Secretary for Preparedness and Response in the Department of Health and Human Services. Mr. Wallace joined BARDA in 2009 as part of the forming diagnostics function within the CBRN division. The CBRN Diagnostics Branch funds development of diagnostics for radiation/ nuclear threats, biological agent threats, and chemical agent threats. Prior to joining BARDA, Mr. Wallace held executive positions with medical and biotech diagnostics companies, which include Digene (Qiagen) and NimbleGen Systems (Roche). His other diagnostics industry experience includes approximately 10 years with the diagnostics division of Abbott Laboratories. In addition, Mr. Wallace has experience developing electro-optical equipment for industrial, aviation, and military applications.

David Weinstock, M.D., is assistant professor at the Dana-Farber Cancer Institute and Harvard Medical School. He serves as the medical

advisor for the Radiation Injury Treatment Network, a voluntary consortium of academic medical centers, blood donor centers, and umbilical cord blood banks across the United States that is organized to provide guidance and surge capacity after a radiologic event. He received his medical degree from George Washington University School of Medicine. He completed medical training at New York Hospital/Cornell and fellowship training in Medical Oncology and Infectious Diseases at Memorial Sloan-Kettering Cancer Center.

Dan Weisdorf, M.D., is professor of medicine and director of the University of Minnesota Blood and Marrow Transplant Program and associate chair for clinical research in the department of medicine. He previously served as president of the American Society for Blood and Marrow Transplantation and scientific director of the National Marrow Donor Program and is currently senior research advisor for the Center for International Bone Marrow Transplant Research and scientific director for its Acute Leukemia Committee. He is the university principal investigator on the National Institutes of Health–sponsored Blood and Marrow Transplantation Clinical Trial's Network and past chair of the Network Steering Committee. His clinical and research interests are in application of blood and marrow transplant therapies for hematologic malignancies as well as extensive study of the clinical complications of transplantation, including opportunistic infections and graft versus host disease.

Robert C. Whitcomb, Ph.D., is a lead physical scientist with the National Center for Environmental Health at the Centers for Disease Control and Prevention (CDC). He serves as a radiation subject matter expert and CDC spokesperson for technical and public health issues related to environmental radiation and nuclear/radiological emergency response. He has more than 25 years of health physics experience in emergency response/planning, environmental monitoring, and environmental dose reconstruction in collaboration with international, federal, state, and local partners. Dr. Whitcomb has an M.A. and a Ph.D. in health physics from the University of Florida and a B.S. in biology from Florida Southern College. He is certified with the American Board of Health Physicists (Certified Health Physicist 1994–2014), served on the board of directors of the Health Physics Society (2004–2007), and is a member of the National Council on Radiation Protection and Measurements. He has published multiple articles in peer-reviewed publications

and has lectured nationally and internationally about the public health response in nuclear/radiological emergencies.

Gamunu Wijetunge, M.P.M., N.R.E.M.T.-P., currently serves as the lead staff member for preparedness and workforce issues in the National Highway Traffic Safety Administration's (NHTSA's) Office of Emergency Medical Services. Mr. Wijetunge came to NHTSA in November 2001 after working as a paramedic in Bethesda, Maryland. Mr. Wijetunge's responsibilities at NHTSA involve a broad range of preparedness issues, including pandemic influenza and integration of preparedness into the day-to-day emergency medical services (EMS) system. His work involves close coordination with a number of federal agency partners through the Federal Interagency Committee on EMS. Mr. Wijetunge holds a master's degree in public management from the University of Maryland's School of Public Policy and is a member of the public administration academic honor society Pi Alpha Alpha. He also holds a B.S. in emergency health services from the University of Maryland, Baltimore County. He has volunteered with the Wheaton Volunteer Rescue Squad since 1995, where he holds the rank of lieutenant and practices as a paramedic/firefighter.

John Williamson, M.S., is currently administrator of the Florida Bureau of Radiation Control Environmental Radiation Programs, including emergency response and training. He is a member of the Conference of Radiation Control Program Directors, serving on the Homeland Security Emerging Issues Committee, the Nuclear Sector Coordinating Council, and the Homeland Security Emergency Response Committee, and he is the co-chair of Florida's Preventative Radiological/Nuclear Detection Committee. He has worked closely with the Centers for Disease Control and Prevention in developing the Florida Radiation Response Volunteer Corps to assist with manning Community Reception Centers to provide monitoring of the public following a radiological or nuclear event. Mr. Williamson holds an M.S. in chemistry from the University of South Carolina.

Jody R. Wireman, Ph.D., M.S.P.H., M.P.A., C.I.H., is the director, Force Health Protection (FHP) Division, at the North American Aerospace Defense Command and U.S. Northern Command (NORTHCOM) at the Department of Defense. In this position, Dr. Wireman provides leadership, management, and expertise in occupational, environmental,

and chemical, biological, radiological, and nuclear force health protection for homeland defense and civil support missions. He directly supports development of deliberate and crisis action plans for NORTHCOM Area of Responsibility, including determining resource requirements and developing viable solutions to meet those requirements. Prior to this position, Dr. Wireman was the deputy division chief of the FHP division at NORTHCOM. He received his Ph.D. in environmental toxicology from Texas Tech University, his M.P.A. from the Harvard University Kennedy School of Government, and his M.S.P.H. from the University of Alabama at Birmingham.

E

Resource List

INTRODUCTION

Assessing Medical Preparedness to Response to a Terrorist Nuclear Event: Workshop Summary. IOM (Institute of Medicine): http://www.nap.edu/catalog.php?record_id=12578.

The Bridge, Linking Engineering and Society: Summer 2010, Nuclear Dangers. Volume 40, Number 2. A publication of the National Academy of Engineering, this issue contains a collection of articles on some of the major aspects of current nuclear threats and current research and guidance. Can be downloaded at http://www.nae.edu/TheBridge.

For public health information, an entire edition of the journal for **Disaster Medicine and Public Health Preparedness** was dedicated to the public health issues associated with the aftermath of nuclear terrorism. All of the articles are available for free download from http://www.dmphp.org/content/vol5/Supplement_1/index.dtl.

SESSION 1

Key Response Planning Factors for the Aftermath of Nuclear Terrorism was developed by Lawrence Livermore National Laboratory (LLNL) in support of the Department of Homeland Security Office of Health Affairs. It was released in August 2009 and identified key response issues. https://narac.llnl.gov/uploads/IND_ResponsePlanning_LLNL-TR-410067web.pdf.

National Council on Radiation Protection and Measurement (NCRP) Report No. 165—Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers was released in February 2011 and is a National Standard that supplies the science and builds on many of the concepts of the Planning Guidance. (This document must be purchased.) http://www.ncrppublications.org/Reports/165.

Public Health and Medical Implications Faced by Neighboring Communities After an IND Detonation. White paper commissioned for the improvised nuclear device (IND) workshop, authored by Irwin Redlener, available for download from the attachments menu on the right side of the meeting webpage at http://www.iom.edu/Activities/PublicHealth/MedPrep/2013-JAN-23.aspx.

SESSION 2

Planning Guidance for Response to a Nuclear Detonation was developed by the Homeland Security Council (2nd ed., June 2010). This interagency consensus document provides excellent background information on the effects of a nuclear detonation and key response recommendations. Its definition of zones (damage and fallout) is becoming the standard for response planning and should be integrated in the planning process. https://responder.llnl.gov/data/assets/docs/publications/Planning_Guidance_for_Response_to_a_Nuclear_Detonation-2nd_Edition_FINAL.pdf.

SESSION 3

Implications of an Improvised Nuclear Device on Command and Control for Surrounding Regions at the Local, State and Federal Levels: White paper commissioned for the IND workshop, authored by Rick Hansen and Dave Pasquale, of National Security Technologies, LLC. Can be downloaded from the attachments menu on the right side of the meeting webpage at http://www.iom.edu/Activities/PublicHealth/MedPrep/2013-JAN-23.aspx.

Health Effects Message Testing: Detonation of Improvised Nuclear Device, National Center for Environmental Health, Radiation Studies Branch, U.S. Centers for Disease Control and Prevention. January 2012.

http://emergency.cdc.gov/radiation/pdf/Health%20Message%20Testing-Detonation%20of%20an%20Improvised%20Nuclear%20Device.pdf.
CDC Radiation Emergencies. Information for Media and Communication Professionals. http://emergency.cdc.gov/radiation/media.asp.

SESSION 4

A Plan for Incorporating Local Volunteer Radiation Professionals into Existing Health Volunteer Programs to Assist in Population Monitoring, March 2011. Gives background and summary for five state initiatives, and lessons learned. Prepared for the CDC by the Conference of Radiation Control Program Directors (CRCPD): http://www.crcpd.org/Homeland_Security/RRVC_FinalReport.pdf.

Radiation Injury Treatment Network (RITN) Center Locations Map: http://ritn.org/WorkArea/DownloadAsset.aspx?id=2147483953.

SESSION 5

Radiation Emergency Medical Management (REMM) Website: Guidance on Diagnosis and Treatment for Healthcare Providers: New features as of 12/2012 include creation of multimedia library, YouTube channel, updates to key pages, and a mobile version of the site: http://www.remm.nlm.gov/nuclearexplosion.htm.

Materials from **Amber Waves 2012:** a series of workshops, training events, and tabletop exercises addressing the response of multiple federal, state, and local agencies to a radiological terrorism event across two states. For more information, contact Thomas Langer (speaker), Tlanger@kdheks.gov, or Kim Steves, Ksteves@kdheks.gov.

National Alliance for Radiation Readiness (NARR): A coalition of public health, health care, and emergency management organizations. These organizations represent practitioners in the field of radiation readiness, including state and local public health practitioners; elected officials at the state and local level; and first responder and first receiver groups. Reps of federal agencies participate as liaison members. http://www.radiationready.org.

National Council on Radiation Protection and Measurement (NCRP) Report No. 138—Management of Terrorist Events Involving Radioactive Material, was released in 2001 with recommendations on training guidelines, critical resources, and guidelines for internal and external exposure, as well as decontamination and cleanup. (This document must be purchased.) http://www.ncrppublications.org/Reports/138.

Emergency Responder Health Monitoring and Surveillance: NRT Technical Assistance Document and **A Guide for Key Decision Makers** were created in response to the continuing need for health monitoring and surveillance for emergency response workers by a consortium of federal agencies, state health departments, and volunteer responder groups that was convened by the National Institute for Occupational Safety and Health (NIOSH). Both documents can be downloaded at http://nrt.sraprod.com/erhms.

SESSION 6

Role of Regional Healthcare Coalitions in Managing and Coordinating Disaster Response: White paper commissioned for IND workshop, authored by Dan Hanfling, M.D., Special Advisor to Inova Health Systems for Emergency Preparedness and Response. Can be downloaded from the attachments menu on the right side of the meeting webpage at http://www.iom.edu/Activities/PublicHealth/MedPrep/2013-JAN-23.aspx.

Rad Resilient City: A Preparedness Checklist to Save Lives After a Nuclear Detonation, published by the UPMC Center for Health Security, provides cities and their neighbors with a checklist of preparedness actions that could save tens of thousands of lives or more following a nuclear terrorist attack. The workbook includes a wealth of background information, a phased implementation plan, guidance for using buildings as shelters, a community preparedness education plan, and guidelines for developing and samples of post-event messages to guide and save lives. http://www.radresilientcity.org/pdf/2011-09-27-RRC.html.

After Action Report and Improvement Plan from Region 2 South (Michigan) Bio-Defense Network Full-Scale Exercise for Operation Shared Burden, developed to assess abilities for current response capabilities

for a terrorist incident involving the detonation of an improvised nuclear device within the Detroit Metropolitan Area. Hard copy can be found by contacting Jenny Atas (speaker), Jatas@dmc.org, or Mark Sparks, Msparks@2south.org.

F

List of Speakers and Registered Attendees

Kay Aaby
Montgomery County Department of Health and Human Services

David Adams
Office of Health Affairs/Department of Homeland Security

Erik Adams
Office of the Secretary of Defense

Steve Adams
Office of Public Health Preparedness and Response/Centers for Disease Control and Prevention

Aysha Akhtar
Office of Counterterrorism and Emerging Threats/Food and Drug Administration

John Alden
Yuma County Public Health Services District

Mohammed Aliyu
Amadu Bello University Zaria

Roy Alson
Department of Emergency Medicine/Wake Forest University School of Medicine

Brian Altman
National Center for Disaster Medicine and Public Health

Armin Ansari
Radiation Studies Branch/Centers for Disease Control and Prevention

Stephen Antopol
Waterbury Hospital

Mircea (Mike) Ardelean
Walter Reed National Military Medical Center

Stacey Arnesen
National Library of Medicine/National Institutes of Health

Mario Arredondo
Columbia University, Mailman School of Public Health

Patrick Ashley
Prince William Health District

Jennifer Atas
Michigan Region 2 South Healthcare Coalition

Pam Barnard
Office of Health Affairs/Department of Homeland Security

Karen Becker
Office of Health Affairs/Department of Homeland Security

Steven Becker
College of Health Sciences, Old Dominion University

Dean BeLer
Virginia Department of Health

Annette Bertelson
Trauma Center Association of America

Amarjeet Bhullar
Food and Drug Administration

Jeffrey Blizzard
Federal Emergency Management Agency

James Blumenstock
Association of State and Territorial Health Officials

David Bowman
Department of Energy

Deborah Boyle
Office of Health Affairs/Department of Homeland Security

Shayne Brannman
Office of the Assistant Secretary for Public Health Emergency Preparedness/Department of Health and Human Services

Charlie Brannon
Walter Reed National Military Medical Center

Kathryn Brinsfield
National Security Staff

Jason Brookbank
Center for Devices and Radiological Health/Food and Drug Administration

Brenda Brooks
Food and Drug Administration

Heather Brown
Office of Health Affairs/Department of Homeland Security

Yandace Brown
Office of Health Affairs/Department of Homeland Security

Brooke Buddemeier
Lawrence Livermore National Laboratory

Melinda Byrns
Inova Fairfax Hospital Health Sciences Library

Duane Caneva
Office of Health Affairs/Department of Homeland Security

Jim Cassata
National Council on Radiation Protection and Measurements

Karen Cieslewicz
American Military University

Gordon Cleveland
National Center for Animal Health Emergency Management/Department of Agriculture

C. Norman Coleman
Office of the Assistant Secretary for Preparedness and Response/National Institutes of Health

Timothy Cooper
Delaware Division of Public Health

Gil Cosnett
Tetra-Tech

Brooke Courtney
Office of Counterterrorism and Emerging Threats/Food and Drug Administration

Adam Cox
Science and Technology Directorate/Department of Homeland Security

John Cuellar
Office of Health Affairs/Department of Homeland Security

Derrin Culp
National Center for Disaster Preparedness/Columbia University

Timothy Davis
Office of the Assistant Secretary for Preparedness and Response/Department of Health and Human Services

John Degnan
Eastern Highlands Health District

Scott Deitchman
National Center for Environmental Health/Agency for Toxic Substance and Disease Registry, Centers for Disease Control and Prevention

Jennifer Dickey
Center for Devices and Radiological Health/Food and Drug Administration

Alisa Diggs
Maricopa County Department of Public Health

Laura Dresen
Indiana Department of Homeland Security

Andrew Eggins
National Association of County and City Health Officials

Steven Englender
Cincinnati Health Department

Robert Farmer
Federal Emergency Management Agency

Sam Finklea
South Carolina Department of Health and Environmental Control

Shira Flax
Department of Homeland Security

Bruce Foreman
Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives Branch/Federal Emergency Management Agency

Betsy Forinash
Radiation Protection Division/Environmental Protection Agency

Crystal Franco
Department of Homeland Security Integrated Terrorism Risk Assessment Program

James Franks
Naval Dosimetry Center

Carl French
Berkeley County Health Department

Andy Garrett
Office of the Assistant Secretary for Preparedness and Response/Department of Health and Human Services

Daniel Gerrig
Office of the Secretary of Defense

Doug Gieryn
Winnebago County Health Department

Richard Goddard
Prince George's County Health Department

Mordy Goldfeder
Office of Emergency Management, NYC

Chad Gorman
Response Directorate/Federal Emergency Management Agency

Robert Gougelet
Geisel School of Medicine

Ken Groves
National Council on Radiation Protection and Measurements

Elin Gursky
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Day 30: The Impact of Mass Evacuations on Host Communities Following Nuclear Terrorism

A white paper prepared for the January 23–24, 2013, workshop on Nationwide Response to an Improvised Nuclear Device Attack, hosted by the Institute of Medicine's Forum on Medical and Public Health Preparedness for Catastrophic Events together with the National Association of County and City Health Officials. The author is responsible for the content of this article, which does not necessarily represent the views of the Institute of Medicine.

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INTRODUCTION

Since the Institute of Medicine (IOM) conducted its 2008 Workshop on Assessing Medical Preparedness for a Nuclear Event, scientists, policy makers, and public health and emergency management professionals have dramatically increased their focus on preparedness issues related to a terrorist attack with an improvised nuclear device (IND).[1] In a relatively

[1]Benjamin, George, McGeary, Michael, McCutchen, Susan R., ed. 2009. *Assessing Medical Preparedness to Respond to a Terrorist Nuclear Event: Workshop Report*: Institute of Medicine of the National Academies. http://www.nap.edu/catalog.php/record_id=12578.

short time, awareness and understanding of the risks associated with infrastructure damage, radiation, medical countermeasures, sheltering vs. evacuation strategies, inadequate medical and public health surge capacity, mass fatality management, and a host of other issues have expanded significantly. This includes an appreciation of the tremendous gaps that remain in every American city's ability to respond to such an event if it were the target, even with the full resources of state and federal government brought to bear. It also has been widely noted, that depending upon the scale of an evacuation that might follow an IND detonation, communities and local governments at the destination end could be overwhelmed, as well.[2]

This paper sets the stage for a thorough and systematic discussion of an issue that has been widely recognized, but that so far has received little attention: Upon an act of nuclear terrorism in a major city, what would be the mid- to long-term public health and related implications for communities that abruptly and involuntarily become host to large numbers of evacuees? In effect, how would a host community accommodate enormous and sudden population expansion under such circumstances?

To the extent that researchers and policy analysts have addressed the implications of an IND detonation for destination communities, they generally have focused on the immediate consequences and aftermath of an evacuation. Recent studies have established that few if any metropolitan regions in the United States have adequate medical, hospital, public health, triage, decontamination, emergency medical services (EMS), first responder, mass fatality management, pharmaceutical, or other critical surge capacity to deal (in the short term) with large numbers of displaced people with severe injuries, significant radiation exposure and contami-

[2]See Redlener, I., Garret, Andrew, Levin, Karen, Mener, Andrew. 2010. Regional Health and Public Health Preparedness for Nuclear Terrorism: Optimizing Survival in a Low Probability/High Consequence Disaster. New York City: National Center for Disaster Preparedness; National Center for Disaster Preparedness. *Day Three: Regional Resilience and Health Challenges in the Aftermath of Nuclear Terrorism* 2010. Available from http://www.ncdp.mailman.columbia.edu/daythree/executive_summary.pdf; National Security Staff, *Planning Guidance for Response to a Nuclear Detonation* (Second) 2010. Available from http://www.epa.gov/rpdweb00/docs/er/planning-guidance-for-response-to-nuclear-detonation-2-edition-final.pdf; Buddemeier, B.R., J.E. Valentine, K.K. Millage, and L.D. Brandt. 2011. National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. https://responder.llnl.gov/?q=home; and Lessons Learned Information Sharing. 2011. Mass Evacuation Reception Planning: Overview of Planning Issues After a Nuclear Incident. Washington, DC: FEMA.

nation, high level anxiety, and a wide range of acute, stress-related mental health conditions and overwhelming psychological trauma.[3]

Analysts correctly focus on these gaps in capacity and recommend long-term regional and inter-governmental planning processes and collaborations (for example, the Regional Catastrophic Preparedness Grant Program) to fill those gaps.[4] However, given the nearly 45 percent reduction in federal funding for homeland security grant programs since 2010, the elimination of Regional Catastrophic Preparedness Grant Program awards after 2011, and uncertainties with respect to the consequences of consolidating 16 state and local homeland security grant programs (including Regional Catastrophic Preparedness Grant Program [RCPGP]) into the recently announced National Preparedness Grant Program, it is extremely unclear whether existing collaborative efforts will endure.[5] At the same time, the fiscal year 2013 budget reflects a full one-third reduction in the Hospital Preparedness Program in the office of the Assistant Secretary for Preparedness and Response (and a further—albeit modest—reduction for the Public Health Emergency Preparedness cooperative agreement).[6] Therefore, even if efforts to prepare for an IND detonation continue at some scaled-back level within individual hospitals, local health departments, and collaborative venues, it may take years to bridge the identified gaps in IND response preparedness, if it can be done at all.

Rather than simply recap prior recommendations concerning regional planning and collaborations, this paper approaches nuclear terrorism as if

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[3]These are summarized in Redlener, I., Garret, Andrew, Levin, Karen, Mener, Andrew. 2010. Regional Health and Public Health Preparedness for Nuclear Terrorism: Optimizing Survival in a Low Probability/High Consequence Disaster. New York City: National Center for Disaster Preparedness.

[4]FEMA's regional offices also have collaborated with local agencies in formulating early-stage IND response plans. See FEMA Region V Newsletter 2012: Vol. 3, http://www.iesma.org/docs/FEMA%20Region%20V%20Newsletter%20%20Volume%203_2012.pdf, and comments from Tom Wolfe of the Arizona Division of Emergency Management, at http://www.emforum.org/vforum/111130.htm.

[5]In FY2010, the total budgeted for the 16 grant programs that are being replaced by the National Preparedness Grant Program was $2.75 billion. The FY2013 executive budget request for the National Preparedness Grant Program is $1.54 billion. See Office of Management and Budget. *Budget of the U.S. Government FY2013: Cuts, Consolidations and Savings*. Executive Office of the President 2012, p. 138, Available from http://www.whitehouse.gov/sites/default/files/omb/budget/fy2013/assets/ccs.pdf.

[6]See Department of Health and Human Services. 2012. Public Health and Social Services Emergency Fund, FY 2013 Justification of Estimates for Appropriations Committees. http://www.hhs.gov/budget/safety-emergency-budget-justification-fy2013.pdf, p. 8.

we do not have the luxury of years to plan, collaborate, and assemble a robust and fully coordinated regional response. It instead focuses on the kinds of regional public health emergency issues that leaders would have to be prepared to address as best they can if an IND detonation, followed by a massive spontaneous evacuation, occurred *tomorrow*.

Therefore, the central focus of this paper is a scenario describing the medical and public health situation in a hypothetical county located 55 miles from ground zero, 30 days after a 10-kiloton IND has detonated and millions in the metropolitan area have evacuated the central city and immediately surrounding areas. A number of authors already have described graphically and in significant detail the potentially chaotic and deadly nature of a mass evacuation as it is unfolding, and the challenges of that initial period for local, state, and federal responders.[7] The purposes of presenting this "Day 30" scenario are to focus on a time frame that has not yet been considered, to create a vivid image and visceral appreciation of how substantial and intractable the crisis is still likely to be a month after the incident, and to suggest the nature of the extraordinary challenges to be faced going forward. The scenario is based on a series of assumptions and it is recognized that changes in the underlying premises could alter the resulting Day 30 conditions in the hypothetical county.

The second section reexamines some of the conventional assumptions about how large an evacuation would be following an IND detonation. It also considers what relevant lessons we can learn from the 2005 evacuation of New Orleans after Hurricane Katrina and the 2011 evacuation of the Tohoku region of Japan. The conclusion discusses some positive actions state and local leaders can take to further prepare.

SCENARIO

Disclaimer

This scenario is not a prediction. It is neither a best case nor a worst case. Rather it is a plausible sense of conditions on the ground. As such, we present it as a tool for stimulating discussion about an event that

[7]Levin, Robert M., and Steve Johnston, 2011, Ventura County Nuclear Explosion Response Plan. Ventura, CA: Ventura County Department of Public Health, pp. 7–13, and *Day Three: Regional Resilience and Health Challenges in the Aftermath of Nuclear Terrorism,* 2010. Available from http://www.ncdp.mailman.columbia.edu/daythree/executive_summary.pdf.

would prove to be extremely complex and in many ways, unpredictable—a vehicle for presenting and thinking about the generic issues listed in Box G-1. Nonetheless, to draw a scenario one is forced to make certain assumptions. Our most critical assumptions are that the detonation has occurred in the central city of one of America's more populous metropolitan areas *and* that the detonation has prompted a spontaneous and/or managed evacuation that involved several million people.

Although those assumptions are consistent with previous writings on this subject (see the section "Questions of Scale"), we acknowledge that those sources are not the final word. Different assumptions, involving fewer people and/or greater geographic dispersion by Day 30 of those who did evacuate, could produce very different outcomes. And given *any* set of assumptions, myriad unpredictable events and complications could change the Day 30 situation for the worse *or* for the better.

Our focus on a county that is only an hour's drive from the detonation site under normal conditions is, admittedly, arbitrary; it is meant to make the scope of this paper manageable rather than to suggest that destination communities closer in and further out won't also have severe problems. There may be some unique differences in the kinds of issues that will confront smaller and more distant destination communities compared to closer and larger ones, but we believe that in most cases, the stresses will be a function of how much health care infrastructure and general response capacity the destination had to begin with, in addition to how big an increase in population it sustains due to the evacuation.

Roberts County

It is October 1, 30 days after a 10-kiloton improvised nuclear device exploded in midtown Major City on a weekday. Roberts County, located in the same state as Major City, is approximately 55 miles from ground zero. The area is experiencing seasonable daytime temperatures of 55 to 65 degrees and generally dry weather. With a pre-detonation population of 350,000, it now also is home to 100,000 evacuees from the Major City metropolitan area, including 25,000 children. Two-thirds of the evacuees still lack adequate temporary housing. Media images of certain areas within the county evoke an enormous refugee camp, with local resources stretched well beyond anything imaginable prior to the attack on Major City. County and local governments are operating in sustained crisis mode, with virtually all routine governmental and public and private

health care services remaining suspended or radically curtailed. To a greater or lesser extent, similar conditions are unfolding in cities and towns up to 100 miles from ground zero, located in the four states where fleeing citizens from the Major City metropolitan area ended up. Mired in their own overwhelming challenges, none of these destination communities is in a position to offer mutual aid to any of the others.

For the past 10 days or so, local newspapers and citizens have been referring, disparagingly, to the displaced individuals as "evacs." Immediately after the catastrophe, local residents were relatively welcoming, although concerned about radiation contamination of evacuees. Now, as it is sinking in that life in Roberts County may not return to normal for months or years (if ever), the initial compassion and caring is giving way to growing anger and resentment toward the uninvited "guests."

Health authorities have not closely monitored the radiation exposure status of the evacuees. Some 500 deaths among displaced individuals have been recorded since their arrival. Many of these fatalities were due to injuries and radiation exposure from the IND. Other individuals who were unable to get needed medications or timely medical care died from heart attacks, stroke, complications of diabetes or acute asthma. Staff of local child protective service agencies are unaware that due to the chaotic nature of the evacuation, which caused members of many families to become separated, approximately 500 of the 25,000 children that arrived in Roberts County were traveling with someone other than their parent or legal guardian.

Local conditions are conducive to the degradation of water supplies, with E. coli *and salmonella outbreaks out of control. The local school system, whose ranks were depleted by the exodus of 300 teachers and administrators, has been unable to accommodate the influx of evacuee children, most of whom have been out of school since June. Crime rates are extremely high and steadily rising. Financial assistance is limited for the "evacs" and part-time or temporary employment opportunities are nonexistent. Food stamps, school lunch and breakfast programs, and virtually all other public assistance programs have reached their limits in terms of resources and administrative capacity. Legislation to provide additional resources to these programs is bogged down in partisan congressional bickering over the extent and distribution of supplemental support for these safety net programs.*

Because of the direct consequences of the IND event in Major City, the entire region, including Roberts County, is experiencing widespread disruptions of telecommunications, transportation, and health and social

services. Workforce absenteeism from deaths, injuries, and overwhelming anxiety among government personnel, responders and service providers has been partly compensated for by an influx of deployed personnel from other regions and volunteers from across the nation—in addition to assistance deployments from many countries. The county's local chapters of national emergency assistance organizations also are struggling to assist the evacuees however they can, but their resources are no match for the scale of this crisis. Many of the volunteers are already exhausted from the workload, traumatized with the conditions they encounter, frustrated with lack of comfortable living arrangements, and increasingly anxious to return home to families and familiar environments.

In addition, due to the destruction or radiation contamination of governmental offices caused by the detonation, and widespread confusion at all levels of government about how the various applicable annexes of the National Response Framework (NRF) interact with each other and with Homeland Security Presidential Directive-5 in this instance, the Unified Command envisioned in the NRF has been fully functional for only the last 10 days.[8]

[8]This is a critical assumption of the scenario that may evoke substantive objections. However, the notion that it could take three weeks to fully establish the Unified Command is reasonable in light of both recent experiences with the Deepwater Horizon oil spill and the complexity of the nominal federal response structure to an IND. Various post mortems on the federal response to the 2010 Gulf oil spill (see notes 23 and 24) identified ambiguity in (or absence of) response doctrine, absence of operational plans, confusion about officials' roles, and other deficiencies in preparedness and execution as causes for a slow and inefficient mobilization of the federal response to the oil spill. According to the Coast Guard's formal internal assessment (the Incident Specific Preparedness Review), the National Incident Commander (NIC) organization was not established until 12 days after the well blowout, in a situation where no federal, state, or local government personnel lost their lives, no government facilities were destroyed or compromised, and no transportation or telecommunications were disrupted. The functions of the National Response Team (NRT) were not fully in place for another week to ten days, and only after the NIC appointed his own Interagency Support Group to compensate for the difficulties in getting the NRT operational. Looking to the National Response Framework, in addition to the standard Emergency Support Function annexes, an IND detonation would invoke the Terrorism Incident Law Enforcement and Investigation Annex, the Catastrophic Incident Annex, the Catastrophic Incident Supplement, the Nuclear/Radiological Incident Annex, and the Mass Evacuation Incident Annex. HSPD-5 also appoints the Secretary of the Department of Homeland Security as the "Principal Federal Official" for any major national incident. Hopefully the many experiences the federal government has had and the lessons it has learned from mobilizing responses to major natural disasters—both domestic and international—would serve it well in responding to an IND detonation. But like the 2010 gulf oil spill—which was the largest of its kind and

The federal/state Joint Field Office for the incident is based 150 miles from Major City. Senior federal emergency response officials who have deployed to the Major City area from around the United States in order to step into the shoes of the deceased and injured government officials are being introduced for the first time to their federal, state, and local counterparts—people with whom they've never planned or exercised, and with whom (in most cases) they haven't had any opportunity to develop bonds of cooperation or trust. The National Disaster Medical System (NDMS) has activated 90 percent of its DMAT, IMSURT, DMORT, and NVRT resources (consisting of approximately 4,500 personnel in aggregate) and deployed them to the periphery of the moderate damage zone surrounding the detonation site, where life-saving opportunities are considered to be the greatest and there are numerous injuries and fatalities. The Department of Defense has activated and deployed to the Major City airport and other close-in staging most of the 9,200 federal military personnel in the national "CBRN (Chemical, Biological, Radiological, and Nuclear) Response Enterprise." These are soldiers with expertise in search and rescue, decontamination, emergency medicine, logistics, evacuation, and mortuary operations.

The governor of the state in which Major City is located has deployed the equivalent CBRN specialist National Guard units under her command, accounting for about 800 soldiers, and in an incredible show of unity, the governors of other states have deployed a large percentage of the other 9,000 National Guard CBRN specialists to the Major City area. However, numerous command, control and coordination issues have arisen, as there never has been a military and/or National Guard exercise that tested capacity and effectiveness of such a large joint operation. All of these responders—NDMS, the U.S. armed services, and the National Guard—have faced severe logistical and operational challenges that have hindered their ability to operate at full efficiency.

Immediately after the detonation, the governor also invoked her disaster emergency powers under the state constitution and laws and activated every available member of the state's National Guard to be deployed among dozens of areas that, like Roberts County, are demanding supplemental assets to assist with newly displaced high-need evacs. After consulting with the Roberts County Commissioner (elected chief executive) and his counterparts in other destination counties, the governor issued unprecedented and expansive executive orders. Those orders

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the first spill of national significance—an IND detonation has never happened, there is no incident specific experience base, and there would be a huge learning curve.

temporarily suspended many county and local (as well as state) laws and regulations under the relevant public health, environmental, corrections, criminal justice, public safety, insurance, civil service, finance and taxation, and social services codes, and effectively commandeered some local government assets and some private property. Members of the governor's staff, supported by National Guard officers, are the de facto administrators of the county, dispensing and enforcing orders to implement the governor's emergency edicts. The 7 PM curfew imposed on the county 2 weeks ago and enforced by the National Guard, will change to 6 PM next week, consistent with shorter days and the anticipation of increasing crime rates.

Various parties in Roberts and other affected counties are challenging the appropriateness and legality of the governor's orders in the media and state courts. However, political leaders of the state's legislature have not objected to the governor's sweeping assumption of emergency powers other than to state that they expect the governor to rescind those orders once the situation is stabilized. The state courts have not yet responded to advocacy groups' petitions to review the governor's actions.

Contours of the Evacuation

The 100,000 evacuees still in Roberts County represent just one fourth of the total that passed through during the prior month. Those who kept going consumed large amounts of available gasoline, food, water, and over-the-counter medications along their way, creating temporary shortages for county residents. During the same period, 60,000 county residents (about 17 percent of the population) fled their homes, worried about fallout and safety if throngs of Major City evacuees arrived.[9] *Among the 10,000 Roberts County residents who have not yet come home are 300 county employees (including staff of the health, public works, EMS, and police departments) and at least 200 private doctors, nurses and other healthcare professionals.*

Roughly 15,000 of the evacuees have settled in each of the county's two primary cities, which normally have limited commuter bus service to Major City. Each city had approximately 30,000 residents and now has 45,000. The other 70,000 evacuees have clustered in a section of the county with about 200,000 residents, bounded by interstate highways

[9]This is a much smaller percentage than was assumed in National Level Exercise 2010, when 50 percent of the residents of three counties outside of Indianapolis—all roughly 50 miles away but in the path of the fallout plume—attempted to evacuate.

offering access to several other mid-size cities and the innermost suburbs of Major City.

Of the 75,000 adult evacuees, at least 45,000 no longer have a job or health insurance, as their former places of employment were destroyed or put indefinitely out of commission. Another 20,000 are in limbo, unable to get clear information about what happened to their employers or their employers' health plans. This is not an issue for the evacuees only. Of the 30,000 Roberts County residents who commute to Major City daily, approximately 3,000 died or were critically injured or permanently disabled from the results of the detonation. Most of the remaining commuters cannot get to work because of continuing travel restrictions into and around Major City, or because their workplaces were destroyed or utterly reliant upon other businesses that did not survive. Many cannot get clear answers from anybody about whether or not their health coverage is still in effect. All existing Roberts County health care providers and facilities are facing extraordinary financial challenges in the absence of clear understandings of how and when reimbursement for services will be provided.

Radiation Issues[10]

About 5,000 of the evacuees underwent decontamination at official mass decontamination facilities, usually several days after their exposure to fallout. Another 75,000 self-decontaminated and disposed of their evacuation clothing in the regular garbage, potentially creating unrecognized cross-contamination issues. The decontamination status of the remaining 20,000 evacuees is completely unknown.

Few of the evacuees were screened for cumulative radiation dose in any way. However, it is estimated that at least 20,000 of the evacuees sustained cumulative doses of ionizing radiation of at least 2 Gy (200 rad). It also is unrecognized that 30 percent of the evacuees are suffering from varying degrees of immunosuppression and that wherever evacuees

[10]This section is informed by DiCarlo, Andrea, Carmen Maher, and John L. Hick. 2011. Radiation Injury After a Nuclear Detonation: Medical Consequences and the Need for Scarce Resources Allocation. *Disaster Management and Public Health Preparedness* 5(Suppl. 1):S32–S44; by Garty, Guy, Andrew Karam, and David J. Brenner. 2011. Infrastructure to support ultra-high throughput biodosimetry screening after a radiological event. *International Journal of Radiation Biology* 87(8):754–765; and by Anderson, Victor E. 2010. Public Health Effects of an Improvised Nuclear Device Attack, California Department of Public Health Radiologic Health Branch.

are located, there are atypically high levels of colds and infections. Few of the evacuees have yet received a flu shot for the upcoming winter.

Roberts County has six geographically dispersed hospitals, including a 250-bed state psychiatric facility and five acute care hospitals with 1,200 beds in aggregate. Since evacuees first arrived in the county, all six of these facilities have been overwhelmed by the appearance of distraught, disoriented, exhausted, sometimes angry evacuees (adults and children), many with severe injuries, symptoms consistent with acute radiation syndrome (ARS), and/or in urgent need of medications or medical devices to address chronic health issues. Many have presented without visible injuries, without knowledge of whether or not they have received high doses of radiation, and without personal medical records. Simultaneously, the hospitals have received substantial demands for services by residents and evacuees alike who can no longer demonstrate that they have valid health insurance. Since the detonation, the State's health department, which regulates hospitals in the state, has insisted that the Roberts County institutions accept 250 severely injured patients who have been evacuated by air from Major City.

Over the past month, thousands of evacuees have gone to county emergency rooms presenting with severe GI distress or high fevers, but have been offered little more than OTC symptomatic relief, usually without seeing a nurse or M.D. In the last week, 500 evacuees were admitted with symptoms of hematologic ARS. None of the hospitals has sufficient staff, blood, fluids, or pain medication to adequately provide supportive care for these patients and many will not survive.

The hospitals long since have discharged everybody whom they safely could release and postponed indefinitely all elective treatments. Even so, between the evacuees and the transferred patients from Major City, hospitals are all running far in excess of their approved capacity, and have implemented triage protocols and altered standards of care more radical than anything they considered or exercised in connection with planning for pandemic flu. The hospital staffs are now physically and emotionally spent. There have been 50 documented instances of evacuees threatening or actually assaulting medical staff who lacked the resources to treat them. As a result, the hospitals have state police posted continuously—both inside and outside—to manage patient access to the buildings, protect the hospital staff, and prevent severely contaminated people from entering at will. All hospitals have established "priority and

triage committees" (PTCs) to monitor acquisition, dispersal, and accountability for all consumable supplies, medications, and medical equipment. The PTC decisions are final—and without appeal.

Current Conditions for the Evacuees

After the detonation, the county's rental vacancy rate dropped abruptly from nearly 15 percent to zero, as evacuee households snapped up anything minimally habitable and bid the median monthly rent up from $1,100 to $1,700. Five hundred good Samaritans opened their homes to evacuee families, as did most of the county's 80 houses of worship. An estimated 35,000 evacuees have found housing through these channels. The other 65,000 evacuees—including as many as 17,000 children—currently are in whatever hotels or motels they could find, or still living in their cars, in tents, in makeshift shelters, or in the open. They occupy county parks, shopping center parking lots, school athletic fields, conservation and watershed lands, public golf courses, and any other place from which the municipal police and county sheriff officers have not forcibly ejected them. Many have changed location night after night.

Within 3 weeks of the detonation, FEMA committed to make an extraordinary 200,000 temporary housing units—50 percent more than for the whole Gulf Coast following Katrina—available in the Major City metropolitan area by January 1 (still 3 months away). The governor has promised the Roberts County Executive 10,000 of those units, enough for about one-third of the evacuees who have not obtained adequate temporary housing or lodging.

In the two primary cities, the 50 percent increase in population has been accompanied by a palpable increase of congestion, noise, and unsanitary conditions. Many evacs ignore parking restriction, thereby impeding access for garbage trucks, not to mention emergency vehicles and police. There are not enough tow trucks and impound lots in the county to physically remove all the illegally parked vehicles. It is far beyond the planning and resources of either city—even with help from the county and state—to provide sufficient temporary toilets, showers, refuse collection, food, and water for that many additional people in just 1 month. Conditions in the makeshift settlements can only be described as primitive, grossly unsanitary, and highly conducive to continuing infectious disease outbreaks.

A week earlier, with cooler fall weather approaching, various county and municipal public works departments, along with the state govern-

ment, national disaster relief organizations, volunteers, and humanitarian assistance agencies, began a strictly local effort to construct barebones temporary shelters that will provide minimally adequate protecttion from the elements, safety, and sanitation for up to another 10,000 families. The governor has redirected virtually all municipal and county employees with relevant skills from their regular tasks and ordered them to help meet this challenge. She has put on hold all government-funded construction, repair, and maintenance projects that can be deferred without imminent risk to public safety, regardless of the financial consequences and contractual implications of those delays.

The typical issues that accompany a mass influx of spontaneous volunteers—coordinating their efforts, credentialing them, and ensuring that they do not inadvertently interfere with the formal incident response process—are further complicated by absence of suitable temporary housing for them. Whereas in many prior domestic disasters, houses of worship, private homes, and school facilities have opened their doors to volunteers, in Roberts County and the other destination communities, evacuees already have occupied those spaces. As a result, a substantial number of volunteers are compounding the health and safety issues associated with the temporary encampments.

Prices have shot up dramatically at most local merchants, and people wait in line for hours, rain or shine, for tractor trailers to arrive—now with National Guard escorts—to replenish local inventories. Yet many food items, OTC medications, diapers, bottled water, soap, and hand sanitizer sell out immediately and are chronically out of stock. Hoarding is widespread.

Mental Health Issues

Local authorities have been reporting extraordinary needs for mental health support for displaced people. Acute stress disorder, withdrawal, sleeping disorders, and depression symptoms all have been observed among both the evacuee population and the permanent residents.[11] *In*

[11]Although we have neither identified nor performed a comprehensive review or meta-analysis specifically of the literature concerning the association between evacuation and mental health, there are numerous articles addressing that issue in connection with evacuations following natural or technological disasters. See, for example, Bonanno, G. A.; Brewin, C. R.; Kaniasty, K.; La Greca, A. M. 2010. Weighing the Costs of Disaster: Consequences, Risks, and Resilience in Individuals, Families, and Communities. *Psychological Science in the Public Interest* 11(1):1–49; Mortensen, Karoline, Rick K. Wilson, and Vivian Ho. 2009. Physical and Mental Health Status of Hurricane Katrina Evacuees in

addition, many individuals with preexisting mental health and behavioral challenges are experiencing severe exacerbations. Yet the resources available simply to monitor such behavioral trends, much less to intervene, are grossly inadequate. Although NDMS teams have been deploying to the Major City area as quickly as possible, federal officials so far have elected to position the great majority of the Disaster Medical Assistance Team (DMAT) resources as close as they can to the detonation zone, where there is the highest absolute number of survivors needing treatment. And the DMAT teams include few mental health specialists.

Because several days following the detonation, the NDMS, working with the Department of Defense, has been transporting the most seriously injured patients out of the areas closest to ground zero. These patients have been distributed among hundreds of the hospitals that belong to the NDMS national network of more than 1,600 facilities. Overall, the system has had mixed results. Loss of medical records, refusal of many "participating" hospitals to actually accept patients, widespread problems with children being separated from parents, loss of identification

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Houston in 2005 and 2006. *Journal of Health Care for the Poor and Underserved* 20 (2):524–538; Carr, V. J., T. J. Lewin, R. A. Webster, and J. A. Kenardy. 1997. A synthesis of the findings from the Quake Impact Study: a two-year investigation of the psychosocial sequelae of the 1989 Newcastle earthquake. *Social Psychiatry and Psychiatric Epidemiology* 32(3):123–136; Jenkins, J. Lee M. D. MSc, Edbert B. Hsu M. D., M. P. H, Lauren Sauer M. B. A., Yu-Hsiang Hsieh PhD, and Thomas Kirsch D. M. D., M. P. H.. 2009. Prevalence of Unmet Health Care Needs and Description of Health Care-seeking Behavior Among Displaced People After the 2007 California Wildfires. *Disaster Medicine & Public Health Preparedness Developing the Science of Health Care Emergency and Response* 3(2):S24–S28; Ruggiero, Kenneth J., PhD, Kirstin Gros, PhD, Jenna L. McCauley, PhD, Heidi S. Resnick, PhD, Mark Morgan, Dean G. Kilpatrick, PhD, Wendy M. A. Muzzy, and Ron Acierno, PhD. 2012. Mental Health Outcomes Among Adults in Galveston and Chambers Counties After Hurricane Ike. *Disaster Medicine & Public Health Preparedness* 6(1):26–32; Ohta, Yasuyuki, Kenichi Araki, Naomi Kawasaki, Yoshibumi Nakane, Sumihisa Honda, and Mariko Mine. 2003. Psychological distress among evacuees of a volcanic eruption in Japan: A follow-up study. *Psychiatry and Clinical Neurosciences* 57(1):105–111; Kato, H., N. Asukai, Y. Miyaki, K. Minakawa, and A. Nishiyama. 1996. Post-traumatic symptoms among younger and elderly evacuees in the early stages following the 1995 Hanshin-Awaji earthquake in Japan. *ACTA Psychiatri Scan* 93:477–481; Weems, Carl F., Sarah E. Watts, Monica A. Marsee, Leslie K. Taylor, Natalie M. Costa, Melinda F. Cannon, Victor G. Carrion, and Armando A. Pina. 2007. The psychosocial impact of Hurricane Katrina: Contextual differences in psychological symptoms, social support, and discrimination. *Behaviour Research and Therapy* 45(10):2295–2306; and Tally, Steven, Ashley Levack, Andrew J Sarkin, Todd Gilmer, and Erik J Groessl. 2012. The Impact of the San Diego Wildfires on a General Mental Health Population Residing in Evacuation Areas. *Administration and Policy in Mental Health and Mental Health Services Research* 1–7.

for a number of infants, and other logistical problems have been major concerns that have slowed down this process.

Due to the delays in establishing the Unified Command and the Joint Field Office, a Substance Abuse and Mental Health Services Administration (SAMHSA)-funded psychological first aid program executed by community-based mental health workers has been visible in the cities and towns of Roberts County for only 1 week. The governor's executive orders temporarily waived many of the credentialing requirements for out-of-state mental health workers, but even so, the few volunteer mental health professionals now in the county cannot possibly meet the need.

Many permanent residents shun the evacuees out of fear of radiation exposure. Some blame them for a perceived increase in crime and the retrenchment at the hospitals and local doctors' offices, as well as for the 50 percent increase in rents, for gridlock on local streets, and even for the sudden crowding on the commuter buses. Of the 5,000 displaced children whose parents were able to enroll them in Roberts County schools, many are ostracized and taunted by local resident children, placing additional burdens on highly stressed school officials. Serious concerns are being expressed regarding physical confrontations between resident and evacuee adolescents.

The Role of the Public Health and Safety Agencies

The county's health department, which had cut back its professional staff by 20 percent and closed three community clinics over the last 5 years, is down to a core of 130, including its mental health case workers, social workers, and clinical staff (in addition to clerical and administrative). Since the detonation, it has deployed in accordance with its public health emergency plans, suspending its women-infants-children and early intervention programs and all educational services other than risk communications via TV, radio, cell phones, and social media. It has scaled back nurse visits, home health care, and clinical services (including mental health) to those which are for immediate lifesaving purposes.

The nursing staff is administering 20 times the normal level of tetanus and DPT shots. The supervising engineers and technicians have deployed with their staffs on repeated missions to check that the improvised settlements of evacuees in parks, golf courses, and watershed lands are not compromising ground or surface water quality. The sanitarians have devoted large portions of their time to inspecting temporary shelters and settlements, as well as the opportunistic and unlicensed food and water

vendors that have materialized to serve (and, in many cases, take advantage of) the evacuees. The frequency and thoroughness of inspections of existing restaurants, school and nursing home food service operations, markets, and other food distributors has suffered as a result.

The department also has suspended periodic inspections of the county's 60 mobile home parks, residential lead assessments and child lead testing, enforcement of state and county indoor nonsmoking ordinances, prenatal care services, substance abuse prevention programs, youth bureau services, air quality monitoring, and evaluation of new subdivisions for compliance with water supply and wastewater disposal rules (this effectively has halted new residential development in the county). The lone county epidemiologist is stretched to the breaking point, even with assistance from a state health department and a Centers for Disease Control and Prevention (CDC) epidemiologist who also are helping out in three other host counties, and from a nurse with an M.P.H. and some basic epidemiological training, commandeered from a city health agency.

Although 50 percent of the county's water supply comes from local surface sources and 20 percent of its fresh food historically has been produced locally, the health department also is constrained in its ability to provide reassuring messages about food and water safety. The regional shortage of trained technicians and lab facilities to perform the necessary agricultural and water radioactivity monitoring has compounded the public's concern.

Other public agencies that support public health and safety also are still in emergency mode. County and municipal public safety officials have diverted firefighting and hazmat resources to conducting impromptu and ad hoc inspections of risks in the temporary settlements. Sanitation agencies have abandoned their regularly scheduled trash collection schedules; at most homes and businesses, garbage has been picked up only twice in the more than 4 weeks since the detonation. Garbage is piling up everywhere.

The 125-officer county police force and the small municipal police departments are totally overwhelmed, managing a huge increase in traffic on local streets and county roads and responding to an unprecedented number of 911 calls. These calls have arisen from long-time residents' fear of unfamiliar cars and people in their neighborhoods, from residents' inability to get in and out of their neighborhoods due to street obstruction, from evacuees in physical, mental, or emotional distress, and from violent confrontations among residents and evacs who are now in

competition for limited local food, water, and health care. The state troopers routinely assigned to Roberts County have been diverted from most of their normal operations in order to support municipal and county law enforcement and protect the hospitals. Consequently, they devote little time to highway safety enforcement. The result is a substantial increase in highway accidents involving death or life-threatening injuries, and also of illegal roadside dumping of trash, human wastes, and hazardous materials.

Not everyone in Roberts County is cooperating fully with the overall effort to accommodate the evacuees. One-quarter of the overwhelmingly volunteer EMS ambulance crews have refused to respond to dispatches to shelters or encampments housing evacs for fear of radiation contamination or for safety concerns. Twenty health department nurses, technicians, and sanitarians (about 15 percent of the professional staff) simply have refused to engage in activities that involve contact with evacuees or potentially contaminated materials. Some of the private garbage haulers who provide routine pickups under county or municipal contract have refused to service areas with a high concentration of evacuees due to fear of radiation. Three of 10 private funeral homes in the county already have declined to work with families of deceased evacuees.

Summary

Box G-1 summarizes the key issues raised in the scenario. A month after a detonation, federal, state, and local authorities that would still be severely handicapped by the difficulty of accessing the detonation site should at least have acquired a consistent and fairly clear situational awareness and established all the essential elements of the response command structure required by the National Response Framework. They also should have begun to understand the scale of the disruption and destruction at ground zero and the magnitude of population movement in reaction to the incident.

However, the situation in destination localities is likely to still be extraordinarily dire and, because of wide and dynamic population dispersion, difficult to assess.

An additional concern, for an unpredictable period of time following the IND detonation, will remain with respect to the possibility of a secondary follow-up incident in another target zone. At the federal level, it is conceivable that some response assets will be reserved for such a sce-

nario until it can be determined that another IND detonation or other major terrorism event is not likely. In any case, uncertainty and caution resulting in asset and resource readiness may put a finite limit, even if temporarily, on deployment for the original event.

BOX G-1
Key Issues 1 Month After Detonation

Competition for federal and regional response resources: Even with deployment of unprecedented high levels of outside personnel and resources, communities hosting evacuees may have to compete for attention with the detonation city; potential for delayed federal response overall.

Loss of jobs, income, schools, health care, and other basics of daily life: An issue primarily among evacuees, but destination residents will not be exempt. Beyond basic shelter, households that have lost everything will need food, water, transportation, schools, and myriad other services to get back on their feet.

Mental health: Unprecedented incidence of acute stress disorder, withdrawal, sleeping disorders, and depression symptoms without resources to service those needs; preexisting mental health and behavioral challenges severely exacerbated; limited mental health resources of National Disaster Medical System and delayed deployment of community-based psychological first aid program.

Overwhelmed local medical and public health systems: Deferral of elective and non-urgent procedures; diminution of response capacity due to evacuation from destination county and unwillingness to report to work; physical security requirements for hospitals and health professionals; limited potential for mutual aid assistance; loss of health insurance by evacuees and residences/loss of payment for health services provided; overworked and demoralized personnel; severe triage and altered standards of care in effect.

Public safety: Evacuee cars obstruct Emergency Management Services (EMS), police and fire service; state police neglect routine highway safety patrols; local law enforcement diverted from public safety responding to evacuee-related 911 calls.

Radiation: Inadequate knowledge of evacuees' radiation status (both decontamination and total radiation dose sustained); latent acute radiation syndrome coupled with lack of resources to provide supportive care; high rate of immunosuppression and infections among evacuees; lack of information about fallout contamination of water supplies and local agricultural products; cross-contamination due to discarded clothing.

Sanitation: Uncollected garbage in built-up areas; insufficient sanitary facilities in makeshift, spontaneous evacuee encampments; roadside dumping of hazard-

ous materials and human wastes; deferred inspection of restaurants, food markets, institutional food services; appearance of unlicensed and unsupervised opportunistic food and water vendors; insufficient mass fatality management to arrange proper temporary interment.

Shelter: Potential for high incidence of heat exhaustion, hypothermia, and other exposure-related morbidity and mortality; rapid absorption of temporary housing opportunities; abrupt rental housing inflation; competition for housing among evacuees, volunteers, and relief workers.

Social problems: Discrimination against/antagonism toward evacuees; some local service providers "redline" evacuees; evacuees blamed for increased crime rates, higher prices and shortages, "ruining" the community; competition among evacuees and permanent residents for goods and services; taunting, shunning, stigmatizing, and avoidance of evacuees; violence between evacuees and permanent residents.

Vulnerable populations: Children separated from their families/guardians during the evacuation, children with special health care needs, adults with disabilities or chronic medical and mental health conditions, frail elderly, and other identifiable segments of the evacuee population in need of additional attention and resources.

Water safety: Evacuee encampments in watershed lands; possible contamination of public water supplies with infectious agents due to inadequate sanitation; possible radiation contamination from fallout.

Suspension and curtailment of routine state and local government public health and safety functions.

UNCERTAINTIES RELATED TO AN IND-PROMPTED EVACUATION

Questions of Scale

Many believe that following an IND detonation, there likely would be a large and spontaneous self-evacuation from both the targeted city and its suburbs. For example, in the National Level Exercise 2010 Operations Based Exercise, built around the hypothetical detonation of a 10-kiloton nuclear device in downtown Indianapolis, the scenario included 270,000 people evacuating the city (about 30 percent of the total population), 200,000 of their own volition. The scenario also reflected the self-evacuation of nearly 50 percent of the residents of three counties located

40–60 miles northeast of the city, which were sitting in the path of the approaching fallout plume.

Generally speaking, the driving factors behind such an evacuation would include the public's feelings of insecurity that the United States had been attacked again, worry that a second or third detonation could occur, fear of radiation, lack of awareness of the relative risks of moving vs. staying put, loss of workplace and income, short-term failures of electronic communications media, poorly conceived risk communication strategies and messages, and—for at least some portion of the population—lack of confidence in government to give trustworthy information and advice about the safest options.

The scale of such an evacuation could be huge. An expert who participated in the earlier Institute of Medicine (IOM) workshop estimated that "more than a million would be displaced by lingering radiation."[12] The Department of Homeland Security's March 2010 "Strategy for Improving the National Response and Recovery from an IND Attack" says that the number of evacuees potentially could be in the millions.[13] Ventura County's *Nuclear Explosion Response Plan* rests upon a working assumption that at least 2 million residents of Los Angeles County (about 20 percent of the total population) would evacuate to the north following a detonation in downtown Los Angeles.[14] Based upon their review of the literature concerning the evacuation from the Three Mile Island nuclear power accident and from major U.S. hurricanes, researchers at the University of Chicago's National Opinion Research Center argued that following an IND detonation in Manhattan, more than 7 million people might flee in all directions and at least half of those evacuees would settle in communities more than 150 miles away from ground zero.[15]

These are highly informed and well-educated guesses; however, there is no accepted methodology for estimating either the magnitude or directionality of a mass evacuation following an IND detonation. Therefore, it

[12]Benjamin, 2009. *Assessing Medical Preparedness*, p. 73. quotes James Blumenstock of the Association of State and Territorial Health Officials.

[13]DHS Strategy for Improving the National Response and Recovery from an IND Attack. 2010. Washington, DC: Department of Homeland Security, p. A-11.

[14]Ventura County Department of Public Health. 9. FEMA features this plan prominently in Lessons Learned Information Sharing. 2011, pp. 12–14.

[15]Meit, Michael, Redlener, Irwin, Briggs, Thomas W., Kwanisai, Mike, Culp, Derrin, Abramson, David. 2011. Rural and Suburban Population Surge Following Detonation of an Improvised Nuclear Device: A New Model to Estimate Impact. *Disaster Medicine & Public Health Preparedness* 5:S146.

is worth reexamining some of the basic assumptions that lead many to conclude that any evacuation necessarily would involve millions.

Leaders' Ability to Manage Scale and Direction

Many challenges would emerge regarding effective and informed leadership needed to oversee the state and local response to an unprecedented catastrophe. For example, would mayors or governors have access in real time to both high-quality modeling and analysis of a fallout plume, and expert scientific advice to help them interpret these data? Would these officials have immediate access to all the necessary subject-matter experts, and would they have enough history with them to be confident in relying upon their judgment? Such analysis and advice should, ideally, play a critical role in any governor's decisions to pursue an evacuation, sheltering-in-place, or hybrid response strategy. Would the telecommunications infrastructure, upon which a governor or mayor would rely to receive and disseminate information and instructions to the public, survive the blast, fires, and electromagnetic pulse created by the detonation? Would there be critical delays in pushing out time-sensitive messages? Would officials receive accurate information as to which messages had been pushed out and which had not?

Another question, barely recognized in discussions of a potential evacuation, is whether governors have emergency powers and law enforcement resources sufficient to suppress a mass evacuation or at least manage it if they believe that would be in the public interest. The governor of New York State, for example, has broad emergency powers that enable the governor, with minimal constraints, to "temporarily suspend specific provisions of any statute, local law, ordinance, or orders, rules or regulations, or parts thereof, of any agency during a state disaster emergency, if compliance with such provisions would prevent, hinder, or delay action necessary to cope with the disaster."[16] The governor may also "alter or modify" the requirements of any provision of law suspended. Would this authority enable the governor to prevent a mass exodus from New York City by closing down the bridges connecting four of the city's five boroughs—home to 85 percent of the city's entire population—to the mainland? While the governor clearly could employ National Guard

[16]N.Y. EXC. LAW § 29-a: NY Code - Section 29-A: Suspension of other laws.

troops for that purpose, would this broad authority allow her or him to commandeer county or local police officers and vehicles if necessary?

Do the governors of California, Illinois, Texas, and other states containing major cities that are potential targets of nuclear terrorism have equivalent broad powers that would enable them to intervene at transportation choke points and to muster law enforcement above and beyond their state national guard? There is not a readily available national inventory of governors' emergency powers and their legal ability to manage an evacuation. The National Governors Association (NGA) publication entitled "A Governor's Guide to Homeland Security" indicates that in some states, gubernatorial emergency powers include "suspending state regulations and statutes; commandeering the use of private property; rationing food, water and fuel; and authorizing emergency funds without prior legislative consent." The NGA, however, has not codified these.[17]

The mere existence of legal authority to manage an evacuation begs the critical political question: Even in an unprecedented crisis such as an IND detonation, would any governor be willing to assume such extraordinary powers and to make decisions of this magnitude, potentially influencing the long-term health and possibly even the survival, of hundreds of thousands? Or would governors be unwilling to impinge on personal liberty in such a consequential way?

Regardless of whether gubernatorial discretion would ever function to constrain the scale of an evacuation, sympathetic evacuations could arise in other major cities among citizens fearing a second or third terrorist detonation. It is not likely that a sympathetic evacuation would head in the direction of the first detonation, but it could interfere with the transportation of relief workers, temporary hospitals and mortuaries, critical medical stockpiles, and other resources needed in the vicinity of the first detonation. It also could compound economic and social disruption in ways that would have unpredictable cascading effects and implications for the destination communities surrounding the original detonation.

Finally, the role of the Federal Bureau of Investigation (FBI) in evacuation-related decisions is not discussed in any publicly available Department of Homeland Security (DHS) or Federal Emergency Management Agency (FEMA) documents. An IND detonation would be treated as a terrorist event. Therefore, under the National Response Framework, the FBI would have a prominent—maybe even a controlling—role in the

[17]National Governors Association. 2007. A Governor's Guide to Homeland Security. http://www.emd.wa.gov/grants/documents/03-15-07-govs-guide.pdf, pp. 14–15, and Author email exchange with Thomas Maclellan, National Governors Association.

short-term response related to its criminal investigation.[18] We have not found anything in the public domain that illuminates how the FBI's control of a post-detonation criminal investigation might impinge on a governor's or the Department of Homeland Security's ability to support and manage a controlled evacuation.

Nature of Complex Public Health Emergencies: Are There Lessons from Evacuations Following Katrina and the Great East Japan Earthquake?

Even if we accept the consensus view than an IND-prompted evacuation would be immense in scale, recent mass evacuations offer few insights as to the public health implications of an IND-spurred mass evacuation for destination communities. Estimates of number of people who evacuated the Tohoku region of Japan in response to the March 2011 tsunami and nuclear power plant accident vary considerably, with the highest official estimate to date being approximately 350,000.[19] Although even the high-end estimate appears quite small compared to what one might expect following an urban IND detonation in the United States, it still represents a massive movement of people that potentially could overwhelm destination communities. Although U.S. media and Japanese newspapers with English editions have reported extensively on the travails of the evacuees and the indignities they have faced, journalists have barely documented the evacuees' ultimate destinations within Japan, or how their arrival impacted the host cities.[20]

One also must be cautious in making inferences from the well-documented 2005 resettlement of Hurricane Katrina evacuees in Houston/Harris County and in Baton Rouge, the two cities that hosted the greatest number of people. The evidence from the Katrina evacuation is not a strong model for how suburban and exurban cities and counties outside a major U.S. city might respond to a 30 to 50 percent population

[18]The FBI's role derives from Homeland Security Presidential Directive-5 and is defined in the National Response Framework's "Terrorism Incident Law Enforcement and Investigation Annex."

[19]Government of Japan. 2012. *Road to Recovery*. Tokyo, Japan: Reconstruction Agency, p. 3, http://www.kantei.go.jp/foreign/policy/documents/2012/__icsFiles/afieldfile/2012/03/07/road_to_recovery.pdf.

[20]See, for example, *Voices of Fukushima's Evacuees*. Available from http://www.nytimes.com/interactive/2011/12/06/world/asia/Voices-of-Fukushima-Evacuees.html?_r=0.

increase such as postulated in the scenario of fictional Roberts County and its two primary cities.

The evacuation of New Orleans abruptly added as many as 250,000 people to Houston/Harris County (with a 2005 population of roughly 2.0/3.9 million) and as many as 235,000 people to Baton Rouge (2005 population of about 415,000).[21] Between one-half and two-thirds of the evacuees left those host cities within about a year. In neither city was there evidence of what one might describe as a public health emergency or a massive retrenchment of basic public health services, in spite of such large and abrupt increases in population. Certainly, there is no evidence that major disease outbreaks occurred in either metropolitan area after the arrival of the Katrina evacuees. The Houston/Harris County metropolitan area was able to absorb 150,000 to 250,000 people without having to house tens of thousands of them in sprawling tent cities or communities of FEMA-provided temporary units, whereas much smaller Baton Rouge had a much harder time integrating the evacuees into the private housing market.

Some residents of the host cities blamed and resented the evacuees for increasing crime, creating illegal overcrowding of apartments, competing for already scarce public services, bidding up rents, and increasing traffic congestion. Local and state officials lamented the fiscal burden of being good Samaritans and what they perceived as a never-ending struggle to receive reimbursement from the U.S. government. However, the only health issue that persistently appears in discussions of the Katrina evacuees in Houston and Baton Rouge is the particularly intense burden on the local mental health and substance abuse prevention and treatment systems, perceived as overtaxed long before Katrina sent a flood of new clients into those two cities.[22]

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[21]For various estimates of the number of Katrina evacuees who arrived and remained in these two cities after one year, see Dyer, Scott. 2006. Overflow City. *Planning* 72(4):28–31; Chamlee-Wright, Emily, and Daniel M. Rothschild. 2008. Hosting a Disaster: Tips for Host Cities. *Mercatus on Policy* 23, p. 1; Axtman, Kris. 2006. With bulk of Katrina evacuees, Texans begin to feel burden. *The Christian Science Monitor*, August 22; Sallee, Rad. 2007. County to get $20 million for Aiding Evacuees. *The Houston Chronicle*, November 7.

[22]Excellent sources of these perspectives include the testimony of nine witnesses at U.S. Senate 2007. Committee on Homeland Security and Governmental Affairs. *Host Communities: Analyzing the Role and Needs of Communities that Take in Disaster Evacuees in the Wake of Major Disasters and Catastrophes*. December 3; Perry, Rick, and Michael Williams. 2006. Texas Rebounds: Helping our Communities and Neighbors Recover from Hurricanes Rita and Katrina. http://www.governor.state.tx.us/files/press-office/Texas-Rebounds.pdf; http://www.hsgac.senate.gov/hearings/host-communities-

The evidence from Houston and Baton Rouge is more relevant to thinking about a mass migration to a largely independent and unaffected metropolitan area (for example, several hundred thousand IND evacuees from New York settling in Philadelphia or in Boston) than to speculating about the potential impacts in the suburban or exurban portions of an extended metropolitan area where the entire physical, economic, social, and psychological equilibrium has been totally upended by a nuclear explosion.

Furthermore, within most major metropolitan areas, the central city is home to a disproportionate population of people who are socially marginalized, undocumented, uninsured, medically vulnerable, disabled or impaired, addicted, or homeless, who often exhibit complex arrays of these attributes, and who require a high level of support services. Typically, the primary city also provides a significantly greater support system for these populations than exists in the suburbs or exurbs. This urban "safety net" consists of well-established networks of governmental and nonprofit service providers, affinity groups, and advocates. If an IND incident destroyed or disrupted this safety net and displaced this population to the suburbs and exurbs, their issues and needs would place exceptional burdens on local public health systems and private medical and social service providers that might lack the required expertise and be unaccustomed to dealing with these problems in such volume.

CONCLUSION

Public Health Priorities

In the scenario presented in this paper, a month after an IND detonation in an American city, the social and functional fabric of society—at least in the region where the detonation occurred—would still be stretched to limits never tested before. The response would challenge the resourcefulness, the creativity, the heroism, the compassion, and the en-

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analyzing-the-role-and-needs-of-communities-that-take-in-disaster-evacuees-in-the-wake-of-major-disasters-a disasters-and-catastrophes; Feldman, Claudia. 2006. Overburdened Long Before Katrina, the Public Mental Health Network Here Is Finding It Impossible to Meet Need. *Houston Chronicle*, August 20; Markley, Melanie. 2007. Making Therapy Free for Those in Need; Pro bono Push Began as Katrina Evacuees Arrived. *The Houston Chronicle*, February 4; Nichols, Bruce. 2006. Houston Wearying of Katrina Evacuees: Survey Shows Stresses from Absorbing 150,000 from Storm. *The Dallas Morning News*, April 15.

durance of all levels of government and all sectors of society in ways no previous disaster had. Leaders would need to take a long view and think about how society ultimately could stabilize and regain a sense of security and normalcy.

In the near term, however, leaders—particularly those responsible for public health—would need to focus on preventing the detonation from having massive morbidity and mortality ripple effects throughout the region. Amidst dozens, maybe hundreds of worthy possible objectives, their highest near-term priorities would be to shelter evacuees from the elements; establish the most basic sanitation and hygiene so as to minimize the chances of infectious disease outbreaks; protect the safety of food and water; provide psychological first aid and some level of clinical mental health services to a disoriented and traumatized population of evacuees; and establish emergency protocols (in terms of triage and altered standards of care) for the allocation of scarce health care and medical resources.

What If It Happened Tomorrow?

If the "unthinkable" were to occur tomorrow, leaders from all sectors would have no choice but to leap into the breach, notwithstanding the absence of comprehensive, collaboratively developed multisector plans and response mechanisms. What advice can we offer about such an eventuality?

First, several postmortems on the governmental responses to the 2010 Gulf Coast oil spill indicate that upon the occurrence of a major disaster, the public rapidly will demand a clear response leader, someone to whom they can look for information and reassurance, and someone whom they can hold accountable.[23] Those studies also concluded that governors will establish themselves as a leading public face and voice of the response, even to the extent of taking significant actions outside the

[23]U.S. Coast Guard. 2011. BP Deepwater Horizon Oil Spill: Incident Specific Preparedness Review. http://www.uscg.mil/foia/docs/dwh/bpdwh.pdf, p. 60; and Allen, Thad W. 2010. National Incident Commander's Report: MC252 Deepwater Horizon. http://www.nrt.org/production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/SA-1065NIC Report/$File/Binder1.pdf, p. 12.

formal joint response command structure or selectively opposing or complicating decisions of the formal command structure.[24]

These findings, coupled with the fact that some governors have substantially greater emergency powers than any has yet exercised, strongly suggest that future efforts to prepare for nuclear terrorism should include another element besides traditional planning and regional collaborations. Such efforts also should prepare governors to be ready to take extraordinary, unprecedented action if their state constitutions and statutes allow. Governors should understand as fully as possible the potential applications of their emergency powers in response to an IND detonation, even if political considerations ultimately might constrain how governors used those powers.

Second, the Coast Guard's internal evaluation of the federal response to the oil spill noted that "superb crisis leadership is essential for effective response to a major national domestic incident" and that "the characteristics necessary for crisis leadership are well documented and identifiable."[25] Consequently, the report recommended significant additional investment in how the Coast Guard identifies, trains, and cultivates officers to be future crisis managers.

That report also noted that "many federal, state, and local officials and industry executives do not have crisis leadership experience and training or are not temperamentally suited to the role of crisis manager."[26] Governors and other elected officials who are *ex officio* crisis managers may or may not have "the right stuff" for that role. The same may be true with respect to members of a governor's cabinet, even if they are superb administrators and have outstanding political skills. Given the critical role these officials would have to play in responding to an IND detonation and the sheer unpredictability of how such an incident would unfold, they should have real-time access to highly trained and certified crisis managers to advise them—tested individuals who meet the highest crisis leadership standards of U.S. military or federal civilian agencies.

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[24]National Commission on the BP Deepwater Horizon Oil Spill. *Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling. Report to the President,* 2011, http://www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_Report tothePresident_FINAL.pdf, pp. 138-139, 265; Coast Guard 2011, Incident Specific Preparedness Review, pp. 75-79, and Allen 2010, National Incident Commander's Report, p. 17.

[25]Coast Guard 2011, Incident Specific Preparedness Review, p. 60.

[26]Ibid.

Where to Begin?

Even though a low-yield IND detonation is 1 of the 15 national disaster planning scenarios developed by the federal government, planning for such an event may be one of the most difficult and complex challenges any leader could ever undertake. Understandably, many emergency response professionals and public officials hesitate to contemplate, much less confront, the challenges of an event as improbable and horrific as nuclear terrorism. The scale and scope of the effort and resources required to respond to an IND detonation remain largely beyond the capacity that exists in any local jurisdiction or region.

However, serious discussion and planning on a local and regional level is critically important. That is why programs such as the Regional Catastrophic Preparedness Grant Program were necessary—and why discontinuation of those initiatives is troubling. Even though the likelihood of nuclear terrorism is believed to be small, the probability is not zero—and the consequences would be extremely high. Moreover, we must recall that the ferocity and complexity of the attacks of 9/11 seemed unimaginable at the time; similar perceptions of improbability must not paralyze planning and preparation to react to a nuclear event. As long as we think it possible that an IND detonation and related evacuation could occur at any time—that we may not have the luxury of years and years to devise optimal plans—dialogue must continue and focus on straightforward consensus and best practices. This is especially true as recent studies have clearly shown that proper information and planning could make a substantial difference in lives saved.

So, where to begin?

Elected officials with responsibility for public safety could initiate high-level discussions of post-IND scenarios (such as the one presented in this paper) with leaders in health, public health, housing, law enforcement, sanitation, and so on. Participants would be encouraged to think creatively and broadly—well outside their own areas of expertise and their professional silos—about the issues raised. New ideas or elaboration of cascading consequences would likely emerge from such discussions.

Important questions might include

- What would actually happen in *our* county or state?
- What are our critical resources and unique risks?
- What assets must be protected and deployed?

- How would we stay in touch with officials from outside the jurisdiction?
- How would we handle hostilities that might arise between local citizens and evacuees?

Such discussions would be held intermittently, over time, giving participants the opportunity to really think about what might happen, what would be needed, and what they could do, individually and collectively. From the outset, many functional ideas and different, useful perspectives would emerge. For example, perhaps someone will think that guidelines for interacting with displaced persons would be helpful. Or that psychological first aid training should be provided for responders, local leaders, clergy, and interested citizens.

On their own, such discussions will not ensure sufficient supplies, hospital beds, or classroom space for evacuees. Guided by thoughtful leadership, however, a level of serious forethought will help create an environment in which citizens are mentally prepared and have far better capacity to respond to and recover from the unprecedented conditions that would inevitably unfold after a detonation of an IND.

H

Implications of an Improvised Nuclear Device Detonation on Command and Control for Surrounding Regions at the Local, State, and Federal Levels

A white paper prepared for the January 23–24, 2013, workshop on Nationwide Response to an Improvised Nuclear Device Attack, hosted by the Institute of Medicine's Forum on Medical and Public Health Preparedness for Catastrophic Events together with the National Association of County and City Health Officials. The author is responsible for the content of this article, which does not necessarily represent the views of the Institute of Medicine.

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ABSTRACT

This paper discusses command and control issues relating to the operation of incident command posts (ICPs) and emergency operations centers (EOCs) in the surrounding area jurisdictions following the detonation of an improvised nuclear device (IND). Although many aspects of command and control will be similar to what is considered to be normal operations using the incident command system (ICS) and the National Incident Management System (NIMS), the IND response will require many new procedures and associations in order to design and

implement a successful response. The scope of this white paper is to address the following questions:

- Would the current command and control framework change in the face of an IND incident?
- What would the management of operations look like as the event unfolded?
- How do neighboring and/or affected jurisdictions coordinate with the state?
- If the target area's command and control infrastructure is destroyed or disabled, how could neighboring jurisdictions assist with command and control of the targeted jurisdiction?
- How would public health and medical services fit into the command and control structure?
- How can preplanning and common policies improve coordination and response effectiveness?
- Where can public health officials get federal guidance on radiation, contamination and other health and safety issues for IND response planning and operations?

INTRODUCTION

The U.S. Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) tasked counterterrorism operations support (CTOS)–Center for Radiological/Nuclear Training at the Nevada National Security Site to develop multi-course training programs on IND response for the state and local emergency response community. The programs under development include a program for operations-level first responders and another program for incident commanders (ICs) and the Command and General Staff of the major cities and surrounding areas. Future programs are planned for the leaders in public health and emergency management. The CTOS job task analysis effort and two workshops on Incident Commander IND Response involving local, state, and federal representatives from Fire Service, Law Enforcement, Emergency Medical Services, Emergency Management, Public Health/State Radiation Protection Offices, National Laboratories, and federal agencies identified a number of command and control challenges and potential solutions (NSTec/CTOS, 2013a,b,c). Some of these challenges and potential solutions for surrounding regions in the initial days of the re-

sponse to an IND detonation are presented here. There is no single solution for each of these challenges that is appropriate for all jurisdictions and plans, nor are the potential solutions presented here intended to be taken as federal guidance.

Would the Current Command and Control Framework Change in the Face of an IND Incident?

The basic framework of command and control using the ICS and the NIMS would not change; however, specific plans and policies addressing an IND detonation will be required to enhance the ability to provide a rapid and coordinated response.

The consequences of an IND detonation in a major city will have major implications on command and control systems in the directly impacted city as well as neighboring jurisdictions. The enormity of the incident will require the rapid establishment, in jurisdictions throughout the region, of ICPs with incident management teams expanded to handle the complexity of this catastrophic incident. Unlike many other complex incidents, time will not allow for the organization of the incident command system to evolve in the normal manner or pace (NSTec/CTOS, 2013b). In addition to dealing with the fallout that could soon be arriving in a significant portion of the jurisdictions surrounding the targeted city, the neighboring jurisdictions will need to handle massive numbers of evacuees and injured victims leaving impacted areas, along with large numbers of response resources moving into the impacted areas.

The command staffs in the neighboring jurisdictions will face many obstacles when establishing command and control. Availability of staff will be a significant issue (NSTec/CTOS, 2013b).

Until situational awareness is established to determine what areas are in, or are likely to be in, the dangerous fallout zone (DFZ) and hot zone, the current guidance (Buddemeier, 2011) is, for all jurisdictions within a 50-mile radius from the detonation site, to shelter in place. This action is taken to avoid exceeding the DHS Protection Action Guide (PAG) 5-rem projected dose for sheltering-in-place or evacuation of the public in an IND incident (FEMA, 2008). While this shelter order is in effect, only limited travel outside of shelter may be authorized, limiting ability of personnel to report to the ICPs and EOCs.

Accessibility in regard to transportation infrastructure will also play a key role in the ability to assemble a command team. Fallout may im-

pact primary transportation corridors and critical infrastructure. Even in the neighboring jurisdictions, some of the general population may try to self-evacuate the area, resulting in gridlock situations. Damage in the targeted area may cause power failures and temporary outages in telephone and Internet services. Expect that the landline telephone, cell phone, and Internet services that are still operational could be soon overloaded. Power failures shutting down mass transit could all have negative implications for accessibility.

Other staffing issues that may impact the development of command could be the willingness of personnel to leave their families during a crisis, concerns for personal safety when dealing with a radiological response, and a lack of confidence in planning and capabilities.

Some possible solutions to increase jurisdictions' abilities to rapidly establish functional ICPs and EOCs under these conditions include

- Providing multiple levels of redundancy which will expand the continuity of operations plan (COOP)
- Making use of uniformed and non-uniformed staff within public safety agencies to temporarily fill staff positions at the ICP and EOC until more senior staff is available
- Addressing the need to rapidly establish command in the least effected and most operational district/area (NSTec/CTOS, 2013b)

What Would the Management of Operations Look Like as the Event Unfolded?

Initially, each of the neighboring jurisdictions would establish an ICP and EOC, with the ICPs transitioning to Unified Commands as soon as possible. As the incident evolves, the use of a "Complex" or Area Command could be established to maximize the use of available resources. As staffing becomes available from multiple response disciplines, Area Commands could transition into Unified Area Commands.

Unified Command

The Unified Command structure required for effective command and control of an IND response must reflect the needs of the jurisdiction and be based on operational requirements. Representation from all partners with jurisdictional or operational authority will be required. The Unified Command team could include local, state, or federal representation from the following:

- law enforcement
- fire service
- emergency medical services
- emergency management
- public health
- community-based health care
- public works
- mass transit/transportation
- nongovernmental organizations (NGOs), private- and public-sector partners

Area Command

Area Command is used when there are a number of incidents, generally in the same area and often of the same kind (USFA, 2006). As the IND response expands and Unified Command evolves, the coordination of multiple ICPs and EOCs with various levels of need, all competing for resources, should be clearly defined and managed. The IC having authority to manage the incident and the EOC providing operational coordination and support to command play an important role in the success or failure of the incident. At the local and county level, Area Command might prove beneficial. Area Command may be established to oversee the management of several Incident Commands and may be expanded to a Unified Area Command. If the Incident Command crosses jurisdictional boundaries, the Area Command must receive authority through a written "delegation of authority" document (USFA, 2006).

Complex

Multiple incidents managed by a single incident command, a single Unified Command, or a single incident management team (IMT) are referred to as a "Complex" (NWCG, 2004).

Overarching Approach to Planning and Response Partners

Due to the immense scope and magnitude of an IND incident, no one jurisdiction or agency possesses the resources or capabilities required to mount an effective response. Jurisdictions that attempt to manage an IND incident using existing, nonspecific plans and procedures will face the potential of significant delays related to initiating response actions and receiving aid from around the region. The incident will rapidly expand and impact multiple jurisdictions, counties, or even states. Implementing detailed regional plans, prepared before the incident, will enable jurisdictions to maximize the use of atypical, nongovernment resources, and typical local, state, and federal resources. This pre-incident regional planning should take an overarching approach by expanding current norms. The scope of partners that could be involved in both the preplanning process and the response, include

- Federal, state, and local agencies, such as public safety (law enforcement, fire department, and emergency medical services), emergency management, public health, community-based health care, and environmental agencies
- Local emergency management agencies should engage and identify all assets such as private-sector businesses, supplies, food, shipping, warehousing, and medical
- NGOs, faith-based organizations, and volunteer organizations should prepare for spontaneous volunteers

Incident Action Plan (IAP)

As the command and control team is assembled and situational awareness is being communicated, mission planning will become the next priority. Strategies, tactics, and decisions made during the first hours of the incident will potentially have the greatest impact, positive or

negative, on the population. Commanders will be tasked with analyzing available incident information and developing initial incident action plans based upon the needs of their population and available resources.

For surrounding jurisdictions not directly impacted by the fallout, careful consideration must be given to providing the best care to the greatest number of victims while maintaining the ability to protect their own jurisdiction. A commander's first instinct might be to send as many assets as possible toward the targeted city. However, if the commander has the ability to coordinate efforts with other jurisdictions, the best course of action may be to keep resources in place and prepare to receive thousands of evacuees and medical patients from the affected city, or establish and manage staging areas.

As incident commanders and planning chiefs begin to evaluate their potential actions, it will become necessary to have a primary point of contact, such as an operational EOC, to coordinate resources from the surrounding communities.

Determining the best course of action will prove challenging for many command staff personnel and planners. Crucial areas that command and control from surrounding jurisdictions must consider include

- Needs of your primary response district vs. aid for the impacted jurisdiction
  - Risk vs. benefit for your responders
    - Decision matrix for departing shelter to begin operations
  - Direct vs. indirect assistance to the impacted jurisdiction
  - Balancing needs of your citizens vs. needs of the region
- Ability to assist and control influx of evacuees, both injured and non-injured (Meit, 2011) as well as consideration of employing scaled procedures based on resource capabilities for surge, Crisis Standards of Care (CSC) (Coleman et al., 2011)
  - Ability to assess radiation exposure
  - Victim/Patient triage for IND
  - Radiation monitoring
  - Contamination surveys (individual vs. group and traditional vs. nontraditional)
  - Decontamination (traditional or nontraditional)
    - Question: Is there a common operating procedure/ standard for contamination levels that has been accepted and adopted by all regional partners, public safety,

transport providers, health care, Red Cross, shelters, etc.?
        - What level of contamination will be accepted by receiving facilities and those providing transport services around the nation?
    - Shelter operations
    - State Health support agency with Strategic National Stockpile (SNS) distribution
- Ability to assist with staging areas and resource management
    - Ground and air operations
    - Communication and Global Positioning System (GPS) resources for mutual aid units
    - Equipment caches and tailgate training for newly issued equipment
- Addressing issues of water, food, and utilities
- Public messaging for follow-up treatment, self-decontamination at home, etc.
- Potential of assuming command and control operations, ICP, EOC, or parts thereof, for impacted jurisdiction (NSTec/CTOS, 2012, 2013b)

Situational Awareness

During the initial development of command and control, post-detonation communications, or the lack thereof, will be a determining factor in the effectiveness of the command organization. It is essential that information flow from all levels of command to operations, and through all disciplines. Damage to communication systems has the potential to affect the ability of responders, ICPs, and EOCs to share information, plans, and situational awareness. Damage to infrastructure could reduce or eliminate the capability for public messaging. Pre-incident planning and the IAP must include alternative methods of communication as well as policies and protocols for personnel and commands.

Before incident objectives can be established, command and control personnel must obtain, prioritize, interpret, and disseminate situational awareness. The IND incident will require a much broader set of situational awareness reports in order to allow field units and command to develop effective operational plans and maintain a level of safety for personnel. Sources of situational awareness must be expanded to include

those from all typical and atypical resources. Data that will assist command and control with incident planning should include

- Radiation reports, with location
  - Radiation levels (dangerous fallout zone, hot zone, or cold zone)
  - Arrival time of the fallout
  - Time of maximum radiation level (time fallout ceases to fall at that location)
- Status of response assets equipment/personnel
- Status of
  - Critical infrastructure
  - Critical facilities (Buddemeier, 2011; NSTec/CTOS, 2013a,b,c)

How Do Neighboring and/or Affected Jurisdictions Coordinate with the State?

In an IND response, all of the ICPs in the region are expected to be requesting state and federal resources. The local EOC in each jurisdiction serves as the conduit to the state EOC, which will coordinate and resolve these competing requests for resources. To accomplish this, the local and state EOCs could use a Multiagency Coordination (MAC) system.

Multiagency Coordination (MAC) System

A MAC system is a combination of facilities, equipment, personnel, procedures, and communications integrated into a common system with responsibility for coordinating and supporting domestic incident management activities (USFA, 2006).

The regional or state MAC system will play a pivotal role in the coordination of resources for various commands. This formal group will ensure effective interagency and inter-jurisdictional operation support. Regional planning can be achieved with the adoption of joint power agreements (JPAs) or memoranda of understanding (MOUs). The MAC system can be activated early in the incident, allowing for quicker resource support to local incident commands. Because an IND response will require a large-scale deployment of state and federal assets, the MAC system function would also be established at those levels to support operations. See Figure H-1.

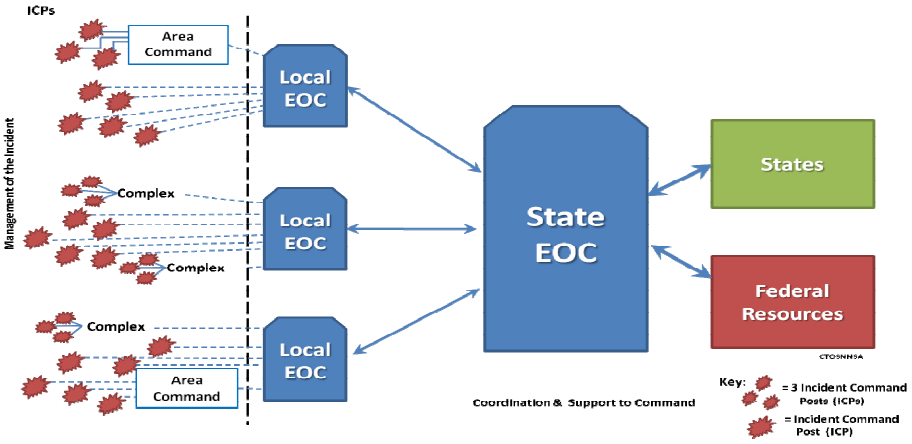

FIGURE H-1 Multiagency Coordination (MAC) system.
Graphic Credit: NSTec/CTOS.
NOTE: EOC = emergency operations command.

If the Target Area's Command and Control Infrastructure Is Destroyed or Disabled, How Could Neighboring Jurisdictions Assist with Command and Control of the Targeted Jurisdiction?

Following an IND detonation, the targeted city may be unable to establish some of its basic command and control functions. In this situation, surrounding jurisdictions may need to temporarily assume or assist in those operations until the target city is able to establish and restore its operations.

Establishing critical command and control functions for a neighboring jurisdiction cannot be efficiently accomplished without preplanning and agreements prior to the incident. During the planning phase for a response to an IND detonation, regional planners should consider the potential of the targeted jurisdiction needing this type of assistance. The support may be in the form of incident command, emergency management, and/or communications.

During the planning phase, in order to enhance the ability to execute delegation of authority documents, jurisdictions should include the adoption of JPAs or MOUs that allow for a quick transfer or the initial establishment of duties.

How Would Public Health and Medical Services Fit into the Command and Control Structure?

Involvement of public health and medical services early in the preplanning and response phase for an IND will be a key factor in successful command and control operations.

When comparing impacts on response disciplines, the medical community will be shouldering one of the largest and most significant roles during the response and recovery phases of an IND detonation. Local command and control must partner with and support the medical community from the inception of the incident in order to develop a plan of action to render care to a hundred thousand plus individuals who will require varying degrees of assistance after the incident. Although most current models for public health and emergency medical services conclude public safety's involvement when the patient is transferred to hospital care, an IND response will require a whole-community approach throughout the incident to effectively treat the impacted population. Senior staff representatives from public health and local health care should be included in the unified incident command structure, planning section, and the emergency operations center.

Local, state, and federal resources from throughout the response community, including NGOs and atypical volunteers, will be needed to triage, decontaminate, treat, and transport the victims of the IND detonation.

Local command staffs and emergency managers should work closely with the medical community to

- Provide timely care and assistance to the population requiring urgent care
- Screen the population to determine required actions
- Transport and transfer patients—focus will be on basic care in the first hours or days because of limited or no access to higher care facilities and transport capabilities

It may be more important for local agencies to coordinate and prepare for the movement of patients prior to the arrival of the assets/resources required for the operation. These assets/resources may include air, military, and civil reserve, transport strike teams, and federal disaster medical assistance team (DMAT). Triage, stabilization, contamination, and decontamination issues required for treatment and transport should

be developed and agreed upon by transport providers, receiving facilities, and cities.

A policy should be developed that ensures that when there is a demand for service and a lack of resources that no longer allow conventional patient care, CSC methods be implemented. Additionally, consideration should be given to a new algorithm for patient triage that includes evaluation of traumatic injuries and radiation dose, along with availability of definitive care and the time to access it (Casagrande et al., 2011; Coleman et al., 2011). This scaled approach, based on patient numbers and resource capability, should be adopted across all disciplines that will have patient contact.

How Can Preplanning and Common Policies Improve Coordination and Response Effectiveness?

No single agency, jurisdiction, region or even state will have the capabilities needed to mount a comprehensive response to an IND. Planning and the adoption of policies and procedures will serve as the basis to executing an effective response operation.

Preplanning

A concern that seems to be shared by many in the response and planning community is that, immediately following an IND detonation, various local resources and capabilities would be lost, ineffective, or immediately overwhelmed, regardless of planning. Even though resources are expected to be overwhelmed, extensive regional planning and preparation become the foundation for success by averting otherwise uncoordinated response activities that might result in thousands of preventable injuries and deaths.

Planning that clearly defines roles, responsibilities, and expectations for individuals, job positions and agencies will provide the additional benefit of improved response to other more common catastrophic incidents experienced by jurisdictions throughout the nation. A useful tool employed by many jurisdictions involves the use of playbooks based on specific positions within the ICP and EOC. Playbooks clearly define the duties and responsibilities of each position. They have proved to be very beneficial to individuals such as administrative staff and elected officials

who do not have the advantage of frequent emergency operations. Jurisdictions should be encouraged to incorporate newly developed response plans and policies into "everyday operations" to increase operational preparedness and capabilities.

Pre-incident planning, specific to command and control (e.g., identifying, training, and equipping facilities and personnel throughout the jurisdiction and across all disciplines) should maximize the jurisdiction's options and ability to establish a Unified Command structure immediately following an incident.

Planning concerns that should be addressed are

- Providing multiple levels of redundancy and expanding the COOP
- Making use of uniformed and non-uniformed staff within public safety agencies to establish command and control for an incident
- Addressing the need to rapidly establish command in the least affected and most operational district/area
- Planning for immediate or rapid expansion to Unified Command
- Identifying critical assets throughout the area required for the management and command of a catastrophic incident, including suitable ICP and EOC (may be temporary until personnel are able to access better equipped and sized facilities capable of supporting the incident)
- Exercising advanced ICS/NIMS principles
- Merging local command with larger command groups such as the Type 1 incident management teams (IMTs) and area commands (NSTec/CTOS, 2013b)

Planners should assume the worst when faced with the potential of widespread communication failures. Procedures for pre-established notifications, messaging, and initial actions should be formulated. A communications issue not directly related to command and control during the operation is a pre-incident public education program. This program will relieve the strain being placed on public safety. It will prove beneficial to both the first responders and command and control group. Individuals in communities that have received pre-incident guidance on preparation, sheltering, evacuation, and self-protective actions, including decontamination, will be better prepared to take care of themselves and their families.

Regulatory Issues

A significant area to be addressed in the planning efforts should be the requirement to deal with regulatory and policy concerns. As described in the DHS *National Preparedness Goal*, legal, policy, and regulatory waivers/exemptions/exceptions will be required to achieve many of the operational targets selected by command and control. Development of policy through the consensus process will be required. Local, state, and federal agencies must adopt action levels for operations, PPE requirements, and contamination levels that are achievable, scalable, and realistic.

To be most effective, these standards should be universally accepted on a national basis as new norms by all agencies and disciplines, such as

- NGOs operating shelters and reception centers
- Federal and civilian agencies performing transport of patients and general population
- First responders including specialized teams from throughout the nation
- Medical providers and facilities
- Receiving states' radiation health offices

Without the adoption and acceptance of these operating standards, continuity of operations will be negatively impacted and will result in delays and road blocks to providing timely and effective care to the citizens who need it most.

Regulatory issues addressing radiation exposure limits and acceptable contamination levels for first responders and the general population must be discussed. Command and control functions can be streamlined if operational action levels and waivers are developed and adopted prior to the incident. The action levels and waivers would be determined by occupational and enforcement agencies using a scaled approach based on resource capability. Specific regulatory areas that should be examined are

- Action Levels for Contamination
  - A consensus on action levels for contamination on people, vehicles, equipment, and cargo should be developed to allow organizations, agencies, and facilities to maintain efficient operations

  - The concept of "clean enough for now" should be considered in order to maintain the flow of patients, commerce, and response operations to support the incident
  - Different decontamination requirements between medical facilities, transport providers, and emergency medical services could prevent the efficient transfer or transport of patients from one facility to the next
  - Equipment or vehicles that would normally be thoroughly decontaminated before reuse will need to be used with limited or no decontamination, especially if the risk from the contamination is offset by the gain in continuing the operation
  - In the early days of the response, low-level cross contamination from people, vehicles, and equipment leaving the contaminated areas will be widespread and should not prevent or stop necessary operations
  - Consistent guidelines should be adopted before the incident
  - These guidelines should include scalable action levels for contamination that become more stringent as the urgency decreases and resources increase
- Personal protective equipment (PPE); a framework for assessing the need for and the selection of PPE for responders, public health, private-sector workers, and volunteers should be developed, to include
  - Minimum standards for respiratory protection related to radiation and debris dust issues
  - Discipline-specific needs
  - Job-specific needs
- Action levels for dose, including first responders, public health, and other response assets that will participate in an IND response
- Action levels for dose rate
  - Planning Guidance for Response to a Nuclear Detonation (EOP, 2010) and NCRP Report No. 165, Responding to Radiological and Nuclear Terrorism: A Guide for Decision Makers (NCRP, 2010) both recommend zone boundaries of 10 mR/h for the hot zone and 10 R/h for the dangerous fallout zone (DFZ)
  - Additional guidance regarding operations in areas higher than 10 R/h should be provided (NSTec/CTOS, 2013a,c)

The adoption of PPE standards should include language allowing for a scaled approach. These standards would provide command and planning staffs the flexibility to establish a response and refine operations as time and resources allow.

Finally, through the preplanning process, planners should identify and adopt agreements and/or contracts with agencies providing resources that will be required for the IND response, such as

- Medical care facilities and agencies
- Preplanned radiation, triage, treatment, and transport (RTR) sites
- Warehousing areas to handle incoming supplies
- Public and private critical transportation assets
- Pre-established evacuation centers
- Pre-established distribution points, Types 1, 2, 3
- Emergency response staging and base camp areas for 300 to 2,000 personnel
- Airports: type, capacity, available space; that is, empty hangars and ramp space
- Food, medicine, equipment, all-purpose department/grocery stores, road construction companies, private utilities/water, private air assets, private transportation assets, and private security firms
- Each contract or agreement will be documented in the Appendix using the format identified by the IND working group
- Community Emergency Response Teams (CERTs)
- Atypical community resources
  - Faith-based groups
  - Civic organizations
  - Spontaneous volunteer groups, NGOs (NSTec/CTOS, 2013b)

Imagine the impact and delays if the organization at each step has different policies/requirements/action levels for triage system, stabilization, contamination action level, and decontamination requirements (see Figure H-2).

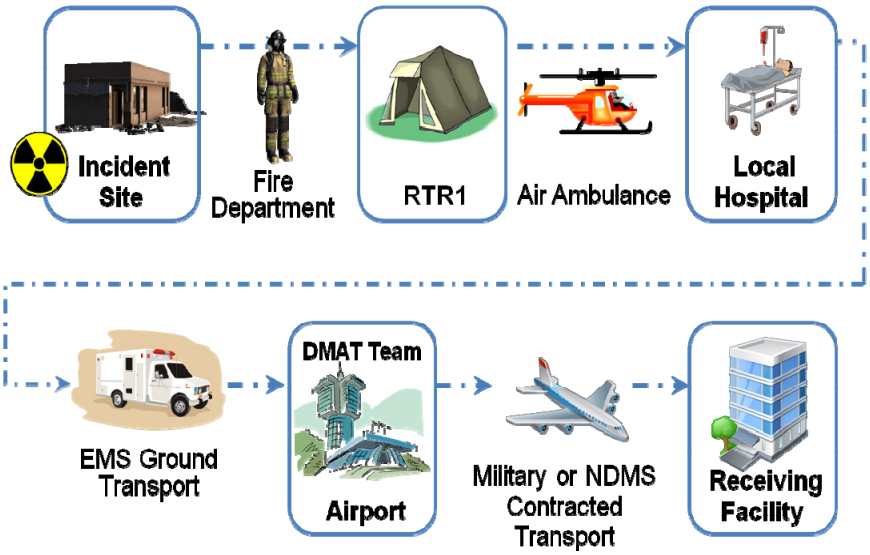

FIGURE H-2 Example of victim/patient flow.
Graphic Credit: NSTec/CTOS.
KEY: DMAT = Disaster Medical Assistance Team; EMS = Emergency Management Services; NDMS = National Disaster Medical System; RTR = Radiation Triage, Transport, and Treatment Site.

Where Can Public Health Officials Get Federal Guidance on Radiation, Contamination, and Other Health and Safety Issues for IND Response Planning and Operations?

In order to avoid having many jurisdictions make similar requests to multiple federal contacts for guidance, advice, and recommendations, the state and local public health officials can work with the federal agencies to identify and resolve gaps and likely questions in advance. After an actual IND incident, the state and local public health officials can request guidance, advice, and recommendations from the Advisory Team for Environment, Food, and Health, using the EOCs as the conduit.

Pre-Incident

In order to avoid delays in making critical decisions in the aftermath of an IND detonation, the public health officials should determine their current gaps in policies and procedures regarding contamination and ra-

diation health and safety issues for an IND response. Once solutions are determined, they should be incorporated into jurisdiction policies and procedures. The policies and procedures should be coordinated with partners at the local, regional, state, and federal levels. It would be best to work out questions and solutions in advance and have them adopted throughout region and nationwide. If adopted, trained, and exercised by the responder and public health agencies in their jurisdiction, these standardized action levels and procedures could be rapidly implemented during an actual IND response and avoid the delays in submitting questions, getting responses, and disseminating guidance.

Many of the current knowledge and capability gaps for IND response are being worked on by the National Improvised Nuclear Device Response and Recovery Forum, co-sponsored by the FEMA Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives (CBRNE) Branch and the DHS Office of Infrastructure Protection (IP). If a gap or issue identified by state and local public health is not already being worked on, this forum might be able to address the question.

Also, a pair of documents is under development to aid in IND response planning, training, and operations: the *Health and safety planning guide for first responders following a nuclear detonation* and the *Health and safety handbook for first responders following a nuclear detonation.* This guide is directed at incident commanders, safety and radiation safety officers, police and fire chiefs, etc., at all levels who are likely to be responsible for leading emergency response operations following the detonation of an improvised nuclear device. The guide is designed to be used in pre-event planning and training, as well as be available for reference at the scene of an event. The handbook is aimed directly at the responders themselves, and is designed to provide guidance for the first 72 hours until the Federal Incident Command team is assembled and prepared to provide coordinated assistance to local jurisdictions. The handbook is recommended for use in pre-event responder training, as well as in on-the-spot briefings for emergency response personnel prior to entry into the response areas.

During the IND Response

During the IND response, questions and requests for guidance, recommendations, and advice on health and safety can be directed to the Advisory Team for Environment, Food, and Health (Advisory Team).

Rather than having multiple ICPs and EOCs sending similar questions to many different federal agency contacts, questions and requests for advice/recommendations can be routed through the state EOC to the Advisory Team. As the Advisory Team provides responses, the state EOC can distribute the information to all operational EOCs.

The Advisory Team includes representatives from the Environmental Protection Agency, the Department of Agriculture, the Food and Drug Administration, the Centers for Disease Control and Prevention, and other federal agencies as needed (DHS, 2008). The Advisory Team develops coordinated federal advice and recommendations on environmental, food, health, and animal health matters for the Incident Command/Unified Command (IC/UC), DHS, the Joint Federal Office (JFO) Unified Coordination Group, and/or state, tribal, and local governments as appropriate. A key point about the Advisory Team is that they can provide not just information on federal guidance but can also offer advice and recommendations to the state and locals. They do not make policy decisions or issue commands to the state and locals. The Advisory Team will be available remotely within 2 hours (CRCPD, 2009) of the IND detonation and, when they arrive on scene, will integrate into the planning section at the ICP and/or collocate with the Federal Radiological Monitoring and Assessment Center. The Advisory Team will also provide liaisons at state and local EOCs.

Conclusions

The response to a detonation of an IND in an American city will result in one of the largest emergency responses in our nation's history. If we are to provide our citizens with an appropriate level of response we must be willing to plan for, develop, and adopt the new norms that will be required for success.

One of the keys to an effective response to an IND is preplanning with the partners throughout the region, state, and federal government, including the atypical whole community partners. "Those who lead emergency response efforts must communicate and support engagement with the whole community by developing shared goals and aligning capabilities to reduce the risk of any jurisdiction being overwhelmed in times of crisis. Layered, mutually supporting capabilities of individuals, the private sector, NGOs, and governments at all levels allow for coordinated planning in times of calm and effective response in times of crisis."

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I

Role of Regional Health Care Coalitions in Managing and Coordinating Disaster Response

A white paper prepared for the January 23–24, 2013, workshop on Nationwide Response to an Improvised Nuclear Device Attack, hosted by the Institute of Medicine's Forum on Medical and Public Health Preparedness for Catastrophic Events together with the National Association of County and City Health Officials. The author is responsible for the content of this article, which does not necessarily represent the views of the Institute of Medicine.

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The cars come crawling toward the District. The backup from the west on Route 66 inside the beltway (7 miles to GZ) contains the usual mix of single commuters and slugs looking to settle into another day of work in the city. From the south comes the line of cars slowly making its way past the Occoquan (20 miles to GZ), transitioning from the outer suburbs into Fairfax County. Interstate 95 is full of cars and trucks headed south from Baltimore toward DC, and as it meets the Beltway (12 miles from GZ), cars can either head east or west around the road that

rings the city. There is no quick and easy way into the city during rush hour.

On this beautiful, crisp, clear winter morning, life around the city is shaping up much like any other day in the Nation's Capital. Kids are off to school. Congressional hearings are an hour or so from starting. Offices are coming to life, and talk inevitably, turns back to the successes and failures of the Redskins.

First comes the intensely bright flash. It is brighter than the flash of a million flashbulbs all going off at the very same time. Many of those on the highways headed into town are blinded, their retinas seared by the intense light. Cars driving at speed plow into others that are already slowing because of the start again–stop again rush hour traffic. The highways are instantly made impassable, with hundreds of mangled cars littering the roadways. Where the flash is not seen, close in to the city, there is an eerie howl, followed immediately by breaking glass and flying debris. Closer to ground zero, there is utter devastation. Buildings are collapsed in the immediate vicinity of the explosion. Many of those that are standing are on fire. An ill-defined plume of smoke, ash, and dust begins to rise over the city. 1600 Pennsylvania Avenue is no more.

There have been a number of significant planning efforts focused on response to and recovery from the terrorist use of an improvised nuclear device (IND). The White House Office of Science Technology Policy led the creation of a first and second national planning guidance for IND response. **[1,2]** The National Labs contributed key inputs related to important mitigation steps that could save thousands of lives—a message so simple it may be easy to deliver but hard to convince. **[3]** HHS/ASPR brought together subject matter experts to help describe many of the key health and medical response elements that will need to be implemented **[4],** illustrated the basic approach to the spontaneous formation of triage and treatment areas, **[5]** and has continued to promote the development of crisis standards of care as part of a systems approach to catastrophic disaster response. **[6,7]** The intent of this paper is to highlight the role that health care coalitions will play in an event of this magnitude. "A primary purpose for any health care coalition is to promote optimal situational awareness for its member organizations through the collection, aggregation, and dissemination of incident information." **[8]**

This paper will explore a number of issues related to catastrophic disaster event planning and response. The IND detonation scenario represents one of the most compelling examples of a sudden onset, no-

notice catastrophic event. The public health and health care issues and challenges that are forced upon the "collar communities," those areas that are located outside of the blast zone but are geographically adjacent to the affected region, will require close coordination and prioritization of available resources within the emergency response system. The decade-long history of coalition development in the National Capital Region (NCR), with different efforts and approaches in each of the three jurisdictions, Maryland, DC, and Northern Virginia, will be reviewed. Description of the optimal framework for coordinating response between existing health care coalitions and emergency management infrastructure, including emergency operations centers and community reception centers, will be detailed. Finally, the paper will explore how coalitions that organize to form regional networks can improve communications of resource needs and provide situational awareness. The goal of such networks will be to enhance the response regarding management of the unstructured intake of arriving patients as well as providing for the intensive medical support irradiated patients will need under such circumstances. How can the "collar community" outlying health care coalitions coordinate with each other across jurisdictional lines in order to relieve the sudden surge in demand for care while helping those communities most severely impacted by the attack to begin the important process of recovery?

CREATING THE COALITION MODEL−DEVELOPING COALITIONS IN DC, MARYLAND, AND VIRGINIA

In the immediate aftermath of the 9/11 and anthrax attacks, the need for better coordination and cooperation among hospitals, EMS agencies and public health departments across the Washington, DC, metro region was quickly recognized. Prior to the 2001 attacks, planning efforts related to disaster preparedness and response within the three distinct jurisdictions was occurring at a varied pace. In the few years preceding that fateful fall, planning efforts focused on regional response were promoted in part by some of the initial Nunn-Luger-Domenici WMD grant funding. These efforts were encouraged by strong personalities and leaders whose vision for improved processes and procedures for hospital disaster response were being slowly heeded. Front and foremost were the efforts of the DC Hospital Association (DCHA) which was responsible for developing and implementing a city-wide hospital mutual aid radio system

(HMARS), developed what became the prototypical hospital mutual aid agreement that linked DC hospitals as response partners in event of an overwhelming crisis, **[9]** and commissioned one of the first municipal bioterrorism response plans in the nation, completed in August 2001. **[10]**

The events of 2001 changed everything. Hospitals across the region recognized the importance of planning for disaster. The anthrax attacks proved that large-scale disaster could essentially present as a public health and health care delivery event, with significantly less response actions required of the traditional first response agencies. And from this, the notion of developing a "coalition" of response agencies was born. How would public health, health care institutions, and the traditional first responder agencies, police, fire, and EMS, coordinate their efforts to enact a uniform and unified response to such events?

In the immediate aftermath of the events of the fall of 2001, an effort to promote these interdisciplinary linkages in northern Virginia was initiated. The Northern Virginia Emergency Response Coalition (NVERC) was created in October 2001, driven by the need to unify response efforts among the many hospitals and public health agencies affected by the surge in demand for screening and care related to inhalational anthrax cases. In addition, there was great interest in and concern regarding the need for specific training and expertise required for the response to future disaster events. It was developed under the auspices of the existing regional EMS council. Efforts that took hold in northern Virginia were indeed modeled directly upon the very successful planning and coordination efforts spearheaded by the DCHA. Three foundational elements of the DC effort can be seen in hospital coalitions that have developed across the country in the ensuing 10 plus years since the Northern Virginia effort crafted its own approach to coordinating hospital planning and response for disaster events. DCHA involved each of the District hospitals in their effort, including participation of the Veterans Hospital (VAMC) and the flagship Army military treatment facility (Walter Reed Medical Center) with the private institutions and public hospital (DC General) located across the city. They pursued the development of HMARS in the mid-1990s, a radio system that linked all of the DC hospitals in real time, and developed a protocol for daily testing and information exchange. And in the context of intense health care business competition, DCHA developed and implemented a Hospital Memorandum of Understanding that governed the exchange of resources in times of crisis—it went so far as to assign "buddy" hospitals across the city so

that no single institution was left unpaired. This DC hospital memorandum of understanding (MOU) became the prototype for the MOU shared across the nation by the American Hospital Association. The coordination of planning efforts across private and public institutions, the development of an MOU, and the establishment of a linked radio system were some of the first efforts in the United States to coordinate hospitals in the context of disaster planning and response, and were the foundations for the efforts that followed in northern Virginia.

Northern Virginia

The Northern Virginia Hospital Alliance (NVHA) was formed in October 2002, an effort initiated by two of the three recognized leaders of the NVERC. Although the NVERC "coalition" focus was deemed vitally important and was very successful during its relatively brief duration, it became clear that specific needs of the northern Virginia hospitals regarding planning and response required a different approach than that required by their municipal public health, law enforcement, fire, and EMS partners. NVHA is comprised of 14 member hospitals and 6 freestanding fully functional emergency departments in the northern Virginia suburbs of Washington, DC. It includes facilities that serve a population of more than 2.5 million residents over 3,000 square miles—ranging from suburban to exurban to rural communities. The hospitals have more than 3,500 acute care beds, and provide more than 700,000 ED visits and more than 170,000 hospital admissions (2009 data). As a conglomerate, the NVHA member hospitals have over 40,000 employees, making them the largest private-sector employer in northern Virginia. **[11]**

The organization was conceived as both a planning and response entity, with an initial focus placed on creating the sort of real-time information sharing and management system that was noted to be sorely lacking during the 2001 attacks. A regional hospital coordinating center (RHCC) was developed, and an 800 MHz radio system was put in place as the result of a public/private partnership entered into with northern Virginia's largest municipality, Fairfax County. Other key efforts included development of a regional focus on chemical event preparedness, with coordinated purchasing of a regional cache of personal protective equipment (PPE), development of an integrated approach to surge capacity and capability that has included an element of telemedicine to assure immediate availability of medical expertise and oversight, and a robust

pharmaceutical and materials acquisition, storage, and logistics plan, including the development of a warehouse capacity, to ensure availability of key resources separate from state or federal stockpiles. The NVHA remains a robust and vital planning and response organization to the present time, led by an Executive Director and governed by an active Board of Directors comprised of the CEOs or senior most administrators of each of the region's 14 hospitals.

In the aftermath of the 9/11 and anthrax attacks, Arlington County, Virginia, which was one of the last of the original 120 MMRS-funded "cities," brought forward the recommendation to expand its MMRS program to include some of its northern Virginia neighboring jurisdictions. In 2005, the Northern Virginia Emergency Response System (NVERS) was created, representing 25 towns, cities, and counties with approximately 2 million residents. NVERS supports "a regional approach to coordinated preparedness, response, mitigation and recovery across jurisdiction and discipline boundaries during day-to-day emergencies and multi-jurisdictional and/or multi-disciplinary incidents through strategic planning, priority-setting, information sharing, training, exercises, equipment acquisition and policy-making." **[12]** It provides for coordination on planning and integration of response capabilities across law enforcement, fire and rescue, emergency medical services, hazardous materials, emergency management, hospitals, public health, public information and information technology. It coordinates closely with its state partners in the Commonwealth of Virginia, as well as with its regional partners in the State of Maryland and the District of Columbia, and partners closely with many of those same entities who help to comprise the Metropolitan Washington Council of Governments.

Suburban Maryland

The focus on planning and response to disaster events in the State of Maryland preceded those outlined for the District of Columbia and the Commonwealth of Virginia. The Maryland Institute for Emergency Medical Services System (MIEMSS), founded by the Governor of Maryland in 1973, placed emphasis on the development of a "system" that coordinates the delivery of emergency pre-hospital and hospital-based care. The central role played by MIEMSS in organizing out-of-hospital and hospital emergency capabilities has led to a different approach to the development of regional hospital coalitions. In the years prior to the 9/11

attacks, these efforts developed in parallel with the hospital-specific planning efforts of the DCHA and EMS focused disaster planning occurring in northern VA. MIEMSS created a seamless statewide radio network linking the state's hospitals that has been in operation for nearly three decades. The state Emergency Medical Resource Center (EMRC) was founded in 1974, representing one of the first systems in the nation to emphasize and develop coordination of EMS and hospital communications, for use both day-to-day and during disaster events. In the aftermath of the region's experience with the 9/11 attacks, an information management platform focused on facility resources data collection an information sharing system was put into place.

Given the strong state influence on planning, efforts at coalition building have been somewhat limited compared with the DC and VA efforts. In 2004, the Bethesda Hospitals' Emergency Preparedness Partnership (BHEPP) was established, creating a planning and response link among the local community hospital, which is an accredited Level 2 trauma center, and the federal medical facilities at the National Institutes of Health (NIH) and the National Naval Medical Center (formerly Bethesda Naval Medical Center, now renamed the Walter Reed National Military Medical Center). **[13]** In addition, the National Library of Medicine, co-located on the NIH campus, is an active member of the partnership. This geographically concentrated effort has conducted and participated in numerous exercise events focused on coordinating municipal, regional, and federal emergency response agencies. By coordinating their response capabilities, they have effectively developed a significant capacity to manage a sudden influx in patient care needs. They have been an active and engaged partner in planning efforts occurring across the National Capital Region.

More recently, the Suburban Maryland Hospital Coalition has been established, comprised of the 10 hospitals located in the close in Maryland suburbs of Washington, DC, located in Montgomery and Prince George's Counties (and incorporating the three aforementioned hospitals comprising the BHEPP). This entity is a planning group only, focused on the coordination of ASPR/HPP-related funding opportunities. However, the central Maryland area hospitals signed a regional sharing agreement for the first time in 2012, including four hospital signatories from the suburban Maryland region, in order to support a disaster event affecting Baltimore hospitals. The voluntary Baltimore Health Care Facilities Regional Mutual Aid System's MOU has formalized the process of collaborating in the event that one hospital becomes overwhelmed during a

disaster. This agreement allows all participating hospitals to work together during an emergency to share staff, beds, equipment, and supplies. **[14]**

District of Columbia

As previously described, the DCHA played a crucial role with regard to coordinating the DC hospitals for disaster planning and response. However, 5 years after the 2001 attacks, the leadership provided by DCHA in the emergency preparedness efforts of the DC hospitals transitioned to the DC Emergency Health Care Coalition (DCEHC), which was funded by an ASPR grant in 2007. Membership includes seven acute care hospitals and a combination of 40 skilled nursing facilities and community health centers. DCEHC was developed along the parameters established in the Medical Surge Capacity and Capability Health Care Coalition in Emergency Response and Recovery handbook. **[15]** It is staffed by a Health Care Coalition Response Team (HCRT), Senior Policy Group, and has created a Coalition Notification Center (CNC) which utilizes an on-call Duty Officer. The CNC rotation among three DC hospitals facilitates information exchange to Coalition members and external partners by use of the HMARS radio system and a health information management platform. By doing so, the DCEHC has come into sync with the NVHA and its Regional Hospital Coordination Center (RHCC) and the State of Maryland's EMRC, in being able to communicate in real time among and between the three regional health care partners of the NCR during day-to-day alerts, and in support of response to disaster events (see Table I-1).

TABLE I-1 NCR Health Care Coalition Communications Network

Coalition	Operational Coordination Center	Communications Capabilities	On-Call	Linkages
DCEHC (regional)	Coalition Notification Center (CNC)	Hospital Mutual Aid Radio System (HMARS); Health Information System	Duty Officer	Coordinates with DC Dept. of Health, DC Fire/EMS, Emergency Management (EOC)
NVHA (regional)	Regional Hospital Coordination Center (RHCC)	MEDCOMM Radio Network; Virginia Health Care Alerting and Status System (VHASS)	Incident Commander and Operations Chief	Coordinates with Virginia Dept. of Health Communications Centers, local jurisdictional emergency management (EOCs)
MIEMSS (state)	Emergency Medical Resource Center (EMRC)	Radio and microwave linkages; HC Standard platform	Field Operations Support Team	Coordinates with EMS, Hospitals, 911 centers, Maryland Joint Operations Center (MJOC) Serves as contact point for CNC and RHCC

NOTE: An HMARS Radio unit and antennae are located and monitored at both Inova Fairfax Hospital Medical Campus and the Northern Virginia RHCC, ensuring additional redundancy to the communications networks that link the three DC regional health care coalitions.

Coordinating Across the NCR

Because so many planned events occur in the Nation's Capital—the presidential inauguration every 4 years, the yearly State of the Union presidential address, and July 4 celebration—and because Washington's buildings and their occupants remain high threat targets for terrorists seeking to inflict damage, coordinating communications and response activities across the NCR is of critical importance. FEMA's after-action report detailing the planning and response activities related to the 2009 Presidential Inauguration of Barack H. Obama highlighted, among other items, the unprecedented degree of planning coordination and cooperation that occurred in support of this historic event, particularly in the public health and medical sectors:

> *Hospital coalitions and individual institutions took a wide range of steps to plan and prepare for the Inauguration. The DC Emergency Health Care Coalition (DCEHC), the DC Hospital Association (DCHA), and the Northern Virginia Hospital Alliance (NVHA) developed plans and worked with their members to prepare for the Inauguration. These entities developed emergency operation plans, incident action plans and other documents to coordinate their members' response activities. Northern Virginia hospitals integrated their planning activities to a degree that exceeded their previous efforts. Further, the DCEHC led efforts to create a NCR hospital incident information sharing procedure for the Inauguration.* **[16]**

In addition to coordinating the planning efforts, the operational elements required to ensure close synchronization of response efforts were also put into place. The DC Department of Health Health Emergency Coordination Center (HECC) was utilized during the Inauguration weekend to serve as a coordinating point for information relevant to the NCR hospitals and public health agencies, and was staffed by members comprising the DC, MD, and northern VA hospital coalitions, health departments, and EMS agencies. The recommendation from the FEMA report was that "NCR hospital and EMS partners should identify opportunities to institutionalize these processes in order to prepare the region for large-scale, no-notice events." **[17]** Similar efforts will have been used in

coordinating planning and response to this year's 2013 Presidential Inauguration.

One area in which the FEMA report noted a need for improvement was in developing consistency among NCR hospitals with regards to sharing a common set of terms and definitions to describe their ability to accept patients. The three different jurisdictions each utilized words and phrases that were not in use by the other jurisdictions: "Open, Special Diversion, and Closed"; "Green, Yellow, and Red"; and "Baseline, Stressed, and Overwhelmed" were all used to describe hospital surge capacity status. As a result, "during the Inauguration, officials unfamiliar with the terminology disseminated an announcement predicated on an erroneous understanding of hospital status. This incident illustrates how officials unfamiliar with the differing terminology may make erroneous assumptions and conclusions about hospital status." **[18]**

As a direct result of this experience, the NCR coalition partners have undertaken efforts to standardize hospital terminology throughout the region, and have drafted an "NCR Hospital Event Information Sharing Procedure." It is intended to provide guidance to the hospital coordination centers located in DC, suburban Maryland, and northern Virginia in the procedures required to facilitate effective information sharing during planned events and major incidents. This draft policy establishes the notification criteria that would warrant region wide information sharing (see Box I-1). **[19]**

BOX I-1
Notification Criteria for National Capital Region Hospital Information Sharing, from "NCR Hospital Event Information Sharing Procedure," Draft Document, June 19, 2012

- Judgment by Health Care Coordinating Center leadership that notification of the other NCR Coordinating Centers (VA–RHCC, MD–EMRC, DC–CNC) is warranted.
- A single, mass casualty event that involves 40 or more patients that will require transportation to specialty hospitals (pediatrics, trauma) throughout the NCR and/or where hospitals outside of the host jurisdiction will receive patients.
- A single HAZMAT event involving 30 or more patients that will/may require decontamination.

- An event involving a suspected or confirmed Category A biological agent.
- A fire/EMS agency has activated a Mass Casualty Unit, Task Force or equivalent, for an event occurring in the NCR.
- An agency or health care facility has accessed and/or requested a CHEMPACK or MMRS pharmaceutical cache.

BUILDING THE EMERGENCY RESPONSE SYSTEM—A FRAMEWORK FOR CATASTROPHIC DISASTER RESPONSE

The examples of health care and hospital coalition development in the NCR over the past two decades serve as useful illustrations of how the emergency response system has evolved over time. The progress represented by these concrete efforts has been purposefully orchestrated by leaders in the NCR who recognize the importance of implementing a "systems approach" to emergency preparedness and response. Indeed, these efforts are the substrate necessary for developing the optimal framework required for coordinating response between existing health care coalitions and the emergency management infrastructure. A large-scale event, especially a no-notice event such as that posed by an IND detonation, will require coordination amongst local, regional and state emergency operations centers (EOCs). Furthermore, specific to the IND event, the utilization of community reception centers, where evacuating patients will be initially assessed or reassessed, re-triaged and if needed, referred for more definitive medical assessment and care, will require an entire community's emergency response system to be able to implement. While the health and medical functions will be of paramount importance in helping to manage the expected casualties resulting from such an attack, the overarching coordination of such events will be managed through respective emergency management agencies, and the exchange of critical information is going to occur in EOCs. In addition, the establishment of community reception centers, or "assembly centers," for those patients who are ambulatory and evacuating from the site of the detonation or its fallout, will require significant logistical support, spearheaded by emergency management authorities.

Including Health as Part of the Emergency Response System

As described in the IOM report detailing the development of crisis standards of care, coordination of the entire emergency response system is required in order to best mitigate the consequences arising from a catastrophic disaster event. **[20]** This "system" includes those elements traditionally considered to be a part of emergency response—police, fire, and EMS agencies, but must also include other partners, as well. Hospitals, public health agencies, and the private practice medical community are also key components. Early planning efforts funded under the Metropolitan Medical Response System grants of the late 1990s, followed by the weaknesses exposed by the 9/11 and anthrax attacks of 2001, highlighted the importance of bringing health and medical entities to the table as full partners in planning and response. Thus, the emergency response system is now intended to be inclusive of public health agencies and strives to include those elements involved in the delivery of acute medical care—hospitals, clinics, and the private practice community. However, inclusion of the private practice health care practitioners in the emergency planning and response process remains mostly elusive. **[21,22]** Nonetheless, as exemplified by the NCR coalition development experience, the transition to a comprehensive systems approach to preparedness and response is slowly occurring in communities across the nation.

Health care coalitions may be in the best position to help broker such change. The intent of federal grant funding, particularly that coming from the ASPR/Hospital Preparedness Program, is focused to ensure that such connectivity continues to be developed and planned for. The enhancement and maturation of such connections are vitally important to the success of any response to a catastrophic event. As the National Guidance for Health Care System Preparedness document highlights, "health care coalitions, in coordination with health care organizations, emergency management, ESF (emergency support function) # 8, relevant response partners and stakeholders (must) develop a plan to ensure health care organizations are represented in incident management decisions during an incident." **[23]**

The health care coalition may be uniquely able to plan for disaster response needs irrespective of the jurisdictional issues that can often hamper planning within many of the municipality-based emergency response agencies. Coalition membership is often comprised of health care systems that have their facilities located in more than one jurisdiction. As a result, these are often organizations that are used to routinely coordi-

nate basic public health, EMS, and related public safety issues among multiple jurisdictional agency partners. Given that the health care coalitions also chiefly represent private-sector entities, more latitude in the procurement process can often hasten acquisition of key planning resources. Many times such resources may be provided by "in-kind" contributions, of both personnel and resources, which further helps to promote the planning effort. For example, the RHCC in Northern Virginia is co-located within Inova Health System's eICU telemedicine nerve center, providing a location for a command center that takes advantage of additional functionality provided by the broadband connectivity needed for this critical care service.

Given this potential benefit, the health care coalition can help to serve as a convener of emergency response entities, much the way the DCHA and the original NVERC, and later the NVHA, did in the National Capital Region. Planning must be based upon known or perceived hazards, and must focus on the steps needed to ensure safe, timely, and evidenced-based responses to the identified risks. Such planning must take into account the ability to surge in demand for health care services, and must include plans that recognize the potential shift in care delivery across the surge spectrum from conventional to contingency to crisis surge response. **[24]** Across the varied risks that might be planned for, the health care coalition must be prepared to help manage and promote not only communications, information sharing, and situational awareness, as previously described, but other key issues, as well. Key attributes and functions of a robust health care coalition are described in Table I-2.

TABLE I-2 Core Functions and Capabilities for Health Care Coalition Development

Core Mission Areas	Examples
Regional planning and collaboration	Serves as multiagency coordinating center focused on acute care hospitals and health care organizations
Communication and information management	Interoperable voice and data communications systems to share situational awareness; bed status board; resource tracking board; mass notification and alerting; patient tracking

Core Mission Areas	**Examples**
Training, education, and exercises	Focus areas: incident command; media and crisis communications; active shooter; decontamination procedures; burn and trauma care; radiological response, others
Personal protective equipment (PPE)	Regional acquisition of biological (N-95 masks, elastomeric masks, gowns, gloves) and chemical (powered air purifying respirators [PAPR], chemical protective clothing, boots) PPE; interchangeable across coalition
Critical infrastructure protection	Water system resiliency, including emergency water pumping and potable water storage systems; electrical power system resiliency, including installation of emergency generator transfer panels ("quick connect"), ensure adequate backup generator power and fuel to support generators
Decontamination and detection	Decontamination showers (fixed facilities represent preferred approach, when possible); radiation detection portals
Surge capacity and capabilities	Development of "immediate bed availability" surge plans, utilizing strategies including implementation of reverse triage protocols, establishment of "discharge lounges" and implementation of telemedicine solutions; exploration of regional staffing models
Pharmaceuticals and materials management	Acquisition of key equipment, supplies and pharmaceuticals used to support surge response efforts including: temporary beds, EMS/transport ventilators, portable vacuum suction units, IV pumps, "crash" carts,

Core Mission Areas	Examples
	HEPA air scrubbers; colocation of CHEMPACK cache
Security	Augmentation of security protocols and information sharing among coalition members
Mass fatality management	Procurement of materiel and equipment to support mass fatality management, coordinated planning to help mitigate placement of decedents in setting of large numbers of casualties
Organization and leadership	Leadership, both administrative and clinical (with incorporation of subject matter experts to help lead policy development); focus on fiduciary goals and fiscally prudent and defensible decisions

Development of a regional health care operations policy, one that details the allocation and sharing of key resources, and plans for their utilization across the rainbow of potential scenarios, will be an important step taken in the direction of codifying the basic procedures that will govern a response to mass-casualty, mass-exposure, and public health emergency. The purpose of such a plan ought to be to describe the systems, tools, and organizational structure by which the health care coalition will execute its basic responsibilities. As noted previously, these include facilitating communications, information sharing, and response between coalition partners and other relevant response partners at the local, regional, and state level (i.e., law enforcement, fire/EMS, public health, emergency management, and others); coordinating the management and distribution of patients from a mass casualty incident to receiving hospitals with the public safety and EMS agencies, both municipal and private; promoting coordinated and consistent strategies and tactics across the responding coalition members; and facilitating resource support to the coalition members, to include mutual aid/cooperative assis-

tance, deployment of regional stockpiles (see Table I-3), governmental assistance, and the management of spontaneous volunteers or donations.

THE ROLE OF REGIONAL HEALTH CARE COALITIONS IN IND RESPONSE

> *As the region begins to take account of what has happened—buildings in downtown DC collapsed and on fire, glass from high-rise offices and apartments blown out for miles around, roads and highways made impassable by the twisted steel of multiple car crashes, large snow-like dust particles beginning to settle back down to the ground—public safety radios may begin to crackle, text messages may begin to flow, WTOP may or may not be on the air. Most people will have no idea what has occurred, nor what is in store. Many thousands are dead; many more thousands are critically injured. Tens of thousands are at risk for radioactive exposure, and if they are not directed to shelter immediately, the number of casualties from this explosive event will be significantly larger. Patients will begin to come to hospitals, clinics, and other acute care facilities. The ability to deliver stabilizing care will become quickly overwhelmed. Many more will begin to attempt to evacuate the city and close-in suburbs seeking care elsewhere. The exodus has begun.*

TABLE I-3 Example of Health Care Coalition Resource Stockpiling (from NVHA Regional EOP)

Personal Protective Equipment: N95 respirators, procedural masks [adult and pediatric], replacement filters for elastomeric respirators, protective gowns
Temporary Hospital Beds: portable hospital beds that can be deployed and used to augment surge capacity at hospitals or alternate care sites managed by local authorities.
Linen and Staff Scrubs: disposable linen to include blankets, pillows, hospital sheets, patient gowns [adult and pediatric sizes], diapers, and staff scrubs.

Basic Medical Supplies: suture kits, splints, bandages, dressings; divided into 5 identical "caches" that are each subdivided into rolling hospital carts for improved mobility and deployment.

Ventilator Supplies: ventilator circuits that can be used to support the disaster EMS/transport ventilators deployed to coalition member hospitals.

Hydration Fluid and Supplies: 12,000 1 liter bags of normal saline and IV starter kits/catheters [in a variety of gauge sizes].

Drinking Water: 25,000 individual 1-gallon bottles of drinking water.

Decontamination Supplies: filters, breathing hoses for PAPRs and spare Level-C DECON suits.

Building health care coalitions into the matrix of emergency response "systems" is critically important, particularly in helping to mitigate the health and medical consequences arising from a catastrophic event such as that caused by a nuclear detonation. Those coalitions that are in the immediate impact zone will have particular challenges as they begin to mount a response to the sudden disaster. In the context of an attack in downtown DC, it is likely that the DCEHC may simply cease to function. The NVHA and Maryland coalitions are more likely to be able to respond immediately, and their ability to respond will also likely trigger the activation of protocols by health care coalitions adjacent or otherwise virtually connected to them (i.e., the other five health care coalitions located across the Commonwealth of Virginia, and the notification of the entire emergency response system in the State of Maryland). Coalitions will need to focus on key functions related to their role as a member of the emergency response system, although these implementation priorities may not all be easily accomplished, given the circumstances at hand (see Table I-4 at the end of the paper). The key functions that are described will be required of those coalitions close to the impact zone as well as those located farther away from ground zero. Given the sudden onset, no-notice circumstances under which such efforts must be mounted, it is likely that the farther away from the impact zone, the better organized the health and medical response will be, given mostly to the opportunity to implement established protocols and the distance that separates those outlying communities from the chaos and confusion wrought by the terrorist attack.

In their description of the RTR system for spontaneous coordination of an improvised response to an IND detonation or other acute radiological emergency, Hrdina et al. note the importance of establishing not only

spontaneously located triage and treatment sites, but based upon their location, utilizing predetermined assembly sites based on geographical proximity to render more definitive stabilizing care and initiate transport to definitive medical facilities. **[25]** This conceptual approach to developing a spontaneous response to events as disruptive as an IND detonation can be implemented only with coordination of all of the emergency response system elements described previously. Emergency management agencies will need to help coordinate the "reception" of incoming casualties, most of whom are evacuating under their own power, some of whom will require medical attention, treatment, diagnosis, and management. Law enforcement presence will be important to coordinate people movement and to keep order. EMS transport units will be necessary to help move more severely affected patients to definitive care sites. Medical personnel will be required to initiate life stabilizing and sustaining care. Public health authorities will be needed to help track patient exposures, get contact information for sharing of further public health information, particularly information related to potential exposure concerns. Emergency management leadership will likely be needed to help coordinate the colocation of such services, helping to identify the sites, and the resources required to manage the delivery of care under such circumstances. This is particularly important, as one of the key early actions required of emergency management will be coordination of messaging regarding the importance of shelter-in-place strategies that are anticipated to be able to save thousands of lives and contribute to limiting the absolute number of patients who may ultimately require health and medical evaluation and treatment.

By being linked into this emergency response system, the health care coalition will be able to take advantage of the information management and communications tools utilized by emergency management. In addition to using these platforms to share actionable information with the affected population, direct coordination with the EOC will also be important in helping to procure the additional resources needed to respond to the catastrophic event. It is important to emphasize that by coordinating such messaging, the EOC, which will already be overwhelmed with information and data input, can better prioritize the request for resources that come as "bundled" requests from health care coalitions, and not as disparate requests for the same types of resource needs repeated by hospital after hospital in any given region. Linkages to the EOC, where there will also be public health participation and representation, can be used to broadcast early information regarding special medical considerations,

such as describing the specific needs of suspected or confirmed irradiated patients. Such information would be particularly important to share with outlying communities who are likely to see the migration of patients away from the epicenter of the event and toward those communities, and could begin to prepare for the arrival of irradiated patients.

It would also serve as the opportunity to begin to mobilize other "specialty network coalitions," coalitions of response organizations that can provide specific surge capability, for example those related to burn care and radiation injury management. Two regional burn consortia that could provide assistance to the NCR include the Eastern Regional Burn Disaster Consortium, based at the Burn Center at St. Barnabas Hospital (New Jersey), which includes 27 burn centers along the East Coast located from Maine to DC/Maryland **[26]** and the Southern Burn Disaster Program, operationally based in Birmingham, Alabama, and incorporating burn facilities located from Virginia to Texas. **[27]** In addition, the Radiation Injury Treatment Network (RITN), which provides comprehensive evaluation and treatment of radiation injured patients, and has been extensively engaged in IND planning and response efforts, would also be activated. **[28]**

Whereas the close-in health care coalitions would likely be overwhelmed with patient care delivery, acquisition of needed resources, and protection of existing infrastructure, the ability to relay this situational awareness to the State EOC would help to facilitate activation of the aforementioned coalitions, and would likely trigger the request for activation of the National Disaster Medical System (NDMS) and invoke the participation of the Federal Coordinating Center (FCC) to assist in the receipt, triage, staging, tracking, and transport of victims of this large-scale catastrophic event. **[29]**

Assisting Response and Recovery—"Network-Centric" Coalitions

The IND detonation scenario will result in infrastructure damage limited to a circumscribed geographical area and, depending on prevailing weather conditions, creation of a dangerous fallout zone that will extend for a much larger distance, posing danger to many more citizens who will quickly be at risk for radiation exposure. Given that the characteristics of such an event will change rapidly over time, and in light of the importance of public messaging described earlier, a very important aspect of the response, and recovery, will be how effectively critical in-

formation will be authenticated, broadcast, and updated. The progression of health care coalition development and cross-jurisdictional coordination, as exemplified in the progress being made by the DC, suburban Maryland, and northern Virginia health care coalitions, demonstrates the importance of pursuing the concept of "networks of networks" in achieving the capabilities required for robust and resilient community response to catastrophic disaster.

Network centric, or "netcentric," refers to the development of a "continuously-evolving, complex community of people, devices, information and services interconnected by a communications network to optimize resource management and provide superior information on events and conditions needed to empower decision makers." **[30]** A concept of network centric warfare was introduced to the Department of Defense in the mid- to late 1990s. **[31]** There are four distinct components of this approach: (1) A robustly networked force improves information sharing; (2) information sharing and collaboration enhance the quality of information and shared situational awareness; (3) shared situational awareness enables self-synchronization; and (4) the above dramatically increase mission effectiveness. The deemphasizing of traditional hierarchical command and control approaches to incident management, and the recognition that spontaneous decision making will be effective in the setting of horizontal information flow, matches well with the potential role that health care coalitions could and should play in response to an IND event.

Health care coalitions that organize to form regional networks can improve communications of resource needs and provide situational awareness. The goal of such networks will be to enhance the response regarding management of the unstructured intake of arriving patients as well as providing for the intensive medical support irradiated patients will need under such circumstances. In the first hour to hours, during which time event characterization will be important, effort will be focused on projecting the location and direction of the fallout plume and sharing this information with the public. Hours after the detonation, to the first day or days, information provided to those who require radiation screening, or more definitive medical attention, will become most important. While this information will be of significant importance in the close-in communities affected by the blast, because of the forecast population movement anticipated as occurring as a result of such an attack, the surrounding communities will play an increasingly important role in supporting the needs of this migrating population.

Those close-in communities that are geographically adjacent to the ground zero impact zone will struggle to accomplish the emergency response functions related to security, fire suppression, search and rescue, patient care delivery, and other fundamental response efforts. Those communities that are farther away from ground zero, the unaffected "collar communities," will have an enormous responsibility to support command and control functions, both hierarchical and vertical, and to support the lost infrastructure in the affected communities. This may include not only the communications infrastructure, but much of the emergency response mechanism that may either be directly impacted by the event or consumed by the enormous response that is likely to be required. Collar-community health care coalitions may be able to broaden their network of communications capabilities, coordinating communication and allocation requests that accommodate the needs of the impact communities. Perhaps most importantly, collar-community coalitions will be required to ramp up procedures for managing the influx of surge patients (trauma, radiation, combined, non-affected but requiring "routine" emergency care, etc.) that are certain to present seeking medical care and attention. As patients, care needs become better defined, and the stratification of care is conducted along the surge capacity framework ranging from conventional surge to contingency and crisis surge responses, the outlying health care coalitions will be able to prioritize information shared with the state EOC and federal government regarding resource allocation needs. This coalition-to-coalition networking and coordinated response, as well as coalition-to-state coordination, is only possible with the development of robust, mature health care coalitions that are fully integrated partners in their community emergency response system.

CONCLUSION

A catastrophic emergency, of which an IND detonation may be the prototypical example, demonstrates the importance of developing robust emergency response systems that have the capacity and capability to manage a complex set of response requirements. In this type of event, the impact area affected by the detonation will be surrounded by an intact infrastructure. The role of the health care coalitions will be particularly important in helping to coordinate information flow supporting real-time situational awareness, and interpreting data pertaining to resource utilization and initiating the request for resource needs. Acquiring and sharing

such data will need to occur with the support of affiliated emergency management agencies. Such efforts will be critically important to the public health and health care response faced by communities that are geographically situated immediately outside of the blast zone following an IND attack.

Lessons learned from the decade-long maturation of health care coalition development in and around the National Capital Region—in the District of Columbia, northern Virginia and the close in suburbs of Maryland—highlights the attributes of such coalitions and establishes some of the benchmarks that may be useful to other communities seeking to develop the same level of capability and coordination. In the event of catastrophic attack or natural disaster that disrupts civil society, the priority to return to normalcy, or at least a "new normalcy," will be of utmost importance. And the attempt to minimize the adverse health care consequences related to such an event will make the difference between whether or not a response is viewed as successful. Strong, robust, and well-managed health care coalitions will play an important role in enhancing the response to any catastrophic event, and may be uniquely positioned to be able to coordinate key response actions that cross jurisdictional lines. By doing so, they will be immensely useful in assisting to relieve the burden on those areas most severely impacted.

TABLE I-4 Health Care Coalition Functions, Roles, and Challenges in IND Response

Core Coalition Functions	Implementation Priorities in IND Response	Potential Challenges
Regional planning and collaboration	Establish situational awareness amongst coalition members, and across regional boundaries to include neighboring coalitions; coordinate strategic and tactical health/medical response plans	Early priorities will include participation of emergency response system partners in assisting coalition members—assistance from public safety agencies to manage surge response and security needs; assistance from Public Health authorities to establish patient registry and contact tracing mechanism; emergency management for assistance in

Core Coalition Functions	Implementation Priorities in IND Response	Potential Challenges
		resource procurement via coordination with local/regional/state EOCs; local/regional/state government leadership in establishing key crisis messaging regarding life-saving and sustaining actions
Communication and information management	Report bed, staff and resource availabilities; coordinate with local, regional and state EOCs	Communications networks for both voice and data may be significantly impaired
Personal protective equipment (PPE)	Establish uniform protocols for staff protection from radiological hazards; coordinate with other members of emergency response system (public safety agencies)	Relatively limited supplies of PPE may be rapidly exhausted; tactical decisions regarding greatest need for PPE may occur amongst emergency response system partners, possibly resulting in reassignment of available resources
Critical infrastructure protection	Ensure safety of drinking water sources; implement backup power support; assess structural integrity of health care facilities located closest to impact area	Water pressures likely to be low; widespread power outages expected, requiring sustained operations with limited water and requirement for backup power generation; resupply of water and fuel not likely; lack of fuel will significantly hamper responder relief efforts, including the need to transport patients to outlying facilities
Decontamination and detection	Decontaminate incoming patients per established protocols; implement radiation detector capabilities at	Water may not be available for decontamination; health care facilities have limited capability to provide dry decontamination; few health

Core Coalition Functions	**Implementation Priorities in IND Response**	**Potential Challenges**
	health care institutions (portal or hand-held); ensure that staff are appropriately decontaminated, and prioritize public safety staff decontamination, if needed	care facilities have portal radiation detectors, hand held survey monitoring will be time consuming
Surge capacity and capabilities	Implement surge response strategies accounting for crisis standards of care response—transition to contingency and crisis surge response protocols	Health care facilities will face unprecedented demands for service care delivery, yet must also maintain services to existing patients and those who present with other emergencies unrelated to the immediate effects of the detonation event
Pharmaceuticals and materials management	Access and distribute available local/regional equipment, supplies and pharmaceuticals; initiate requests for additional materiel based on actual and projected patient care needs	Transportation infrastructure may impede physical movement of materiel from central warehouse to health care facilities; ability to develop demand forecasting based on projected needs limited
Security	Need to establish security of health care facilities; need to promote passage of hospital staff, both direct health care providers and non-health care support service employees, across police lines to be able to report to work	Limited personnel will not be able to be augmented by law enforcement agencies, which will be otherwise engaged in the response; staff without proper credentialing may have difficulty crossing police lines; spontaneous volunteers will require management and coordination, including credentialing (numbers of volunteers may be limited due to concern

Core Coalition Functions	Implementation Priorities in IND Response	Potential Challenges
		regarding potential exposure to radiation)
Mass fatality management	Prepare for mass fatalities that result from IND attack	May be overwhelming demand for external service support; health care facilities will have to be prepared to store and catalogue decedents from an event, including those that may have radiological contamination, on site

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