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Planning and Response to the Detonation of an Improvised Nuclear Device: Past, Present, and Future Research

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Planning and Response to the Detonation of an Improvised Nuclear Device: Past, Present, and Future Research

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Abstract:

While the reality of an improvised nuclear device (IND) being detonated in an American city is unlikely, its destructive power is such that the scenario must be planned for. Upon reviewing the academic literature on the effects of and response to IND events, this report looks to actual responders from around the country. The results from the meetings of public officials in the cities show where gaps exist between theoretical knowledge and actual practice. In addition to the literature, the meetings reveal areas where future research needs to be conducted. This paper recommends that local response planners: meet to discuss the challenges of IND events; offer education to officials, the public, and responders on IND events; incorporate "shelter-first" into response plans; provide information to the public and responders using the 3 Cs; and engage the private sector (including media) in response plans. In addition to these recommendations for the response planners, the paper provides research questions that once answered will improve response plans around the country. By following the recommendations, both groups, response planners and researchers, can help the country better prepare for and mitigate the effects of an IND detonation.

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Introduction

The scenarios we discuss today are so hard for us to contemplate and so emotionally traumatic that it is tempting to push them aside. However, now is the time to have this difficult conversation.
—Joseph Lieberman[1]

Following the events of September 11, a litany of imaginable horribles was trotted out before an anxious and concerned public. To date, government agencies and academics are still grappling with how to best respond to such catastrophes, and as Senator Lieberman's quote says above, now is the time to plan and prepare for such events. One of the nation's worst fears is that terrorists might detonate an improvised nuclear device (IND) in an American city. With 9/11 serving as the catalyst, the government and many NGOs have invested money into research and development of response capabilities throughout the country. Yet, there is still much to learn about how to best respond to an IND event. Understanding the state of knowledge, identifying gaps, and making recommendations for how to fill those gaps, this paper will provide recommendations for both the response community and the research community on how to move forward to create a more integrated and informed response plan to IND events.

The risk of an IND detonation may seem unlikely; and while this is hopefully true, due to its destructive capability, IND events must be prepared for.[*] Many people still live under the Cold War mentality that if a city is attacked with a nuclear weapon, there is little chance of survival. This assumption, while perhaps true in the case of multiple, thermonuclear weapons exchanges, does not hold for the current threat. If a single IND were detonated in the United States, there would be many casualties at the point of impact; however, there would also be many

[*] For more, see: US Congress, Office of Technology Assessment: Proliferation of Weapons of Mass Destruction: Assessing the Risks. *Office of Technology Assessment, Document OTA BP. ISC:559* 1993.

survivors and the initial response by two major groups will mean the difference between life and death for many people. These groups are the first responders and the public. Understanding how these two groups prepare, react, and interact will improve response to nuclear terrorism.

In order to study these two groups and their interaction, this report is divided into three parts: research review, meetings reports, and recommendations. The research review seeks to establish the state of knowledge regarding response to IND events. Much work has been dedicated to studying this issue, yet more is needed. The academic community has reached some conclusions on how to best respond to an IND detonation and these should be collected and noted. During the summer of 2008, the Homeland Security Institute held meetings in various US cities to discuss each city's level of preparation and understanding of nuclear terrorism. The meeting reports section summarizes what was observed and learned at the meetings and illustrate how the academic community's knowledge has (or has not) been integrated into response planning at the local level. The final section, recommendations, aggregates the recommendations derived from the academic community and the local meetings, providing both response planners and researchers a guide for moving forward.

Research Review

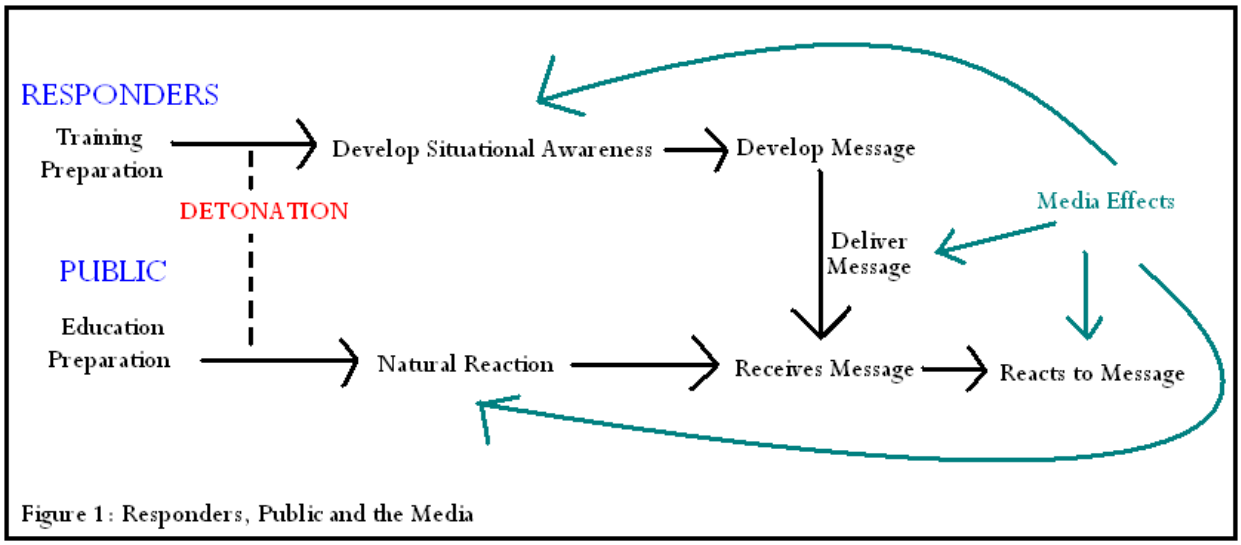

Figure 1: Responders, Public and the Media

Figure 1 provides a visualization of the response timeline of an IND event. For the purposes of this assessment, it is assumed that to accurately inform the public, three functions need to be fulfilled by response personnel, namely planning, developing situational awareness, and messaging. Planning varies widely from city to city, and to date no comprehensive study has been completed to assess how individual cities are progressing with preparation plans. Developing situational awareness about an IND detonation has been well researched over the years, yet it is far from fully understood. While messaging is an integral component to response, it is one that suffers from a dearth of knowledge. The public will have a certain level of education and preparation. After the detonation the public will respond naturally and upon receiving the responders' message will react to the message and may modify their behavior accordingly. Reviewing the nodes under both headings, responders and public will help better prepare the country to meet the challenges of an IND attack.

Responders

Training and Preparation:

While the detonation of an IND in the United States is unlikely, it is clear that preparing for the unexpected is necessary in today's world. The G-7 declared that "special attention should be paid to the threat of utilization of nuclear, biological and chemical materials, as well as toxic substances, for terrorist purposes."[2] In 2001, before 9/11, a Department of Energy task force found that "the most urgent unmet national security threat for the United States today" is the threat that weapons of mass destruction could be stolen from Russia and sold to terrorists desiring to attack "American troops abroad or citizens at home."[3] Moreover, there is a corollary to preparing for an IND event: if a locality prepares for an IND, they also prepare for any event that would require coordination of regional response, time critical decisions, responses to mass casualties, communication during times of crisis, and resource prioritization.[4] Because of these benefits, it is necessary that response plans are created and understood by local authorities. Developing national guidelines, while potentially beneficial, should not supplant local meetings and preparations, since each community has unique needs that only local authorities know about.

Developing Situational Awareness:

Responders developing an accurate and effective situational awareness will ascertain what the situation is, where they are within the situation, and what their role should be for the remaining crisis period. Establishing situational awareness quickly can allow responders to respond effectively and save as many lives as possible. Because an IND event will cause massive destruction, it is beneficial to understand the conditions responders will face on the ground after an IND detonation.[5]

Prompt Effects	Delayed Effects
Blast Overpressure Ionizing Radiation Thermal Radiation Others: Glass Breakage Flash Blindness	Fallout (Residual Radiation) Others: Fires

Figure 2: Effects of an IND Detonation

If a 10kt IND (roughly equivalent to 5,000 truck bombs) were detonated in a major city, there would be near total destruction within half of a kilometer of ground zero.[6] Beyond that range though, there is potential for survival, which many citizens and responders themselves do not realize.[7] Those people that do survive the initial detonation would have varied types and degrees of injuries caused by the effects of the IND detonation. With a nuclear detonation, there are two broad categories of effects: prompt and delayed (See Figure 2). The prompt effects are those which occur in concordance with the initial detonation and include blast overpressure, ionizing radiation, and thermal radiation.[†] For each of these effects, as the distance from ground zero increases the intensity of the effects decreases. The majority of injuries that result from an IND will be "missile injuries" and "about half of the patients seen will have wounds of their extremities. The thorax, abdomen, and head will be involved about equally."[8] Burns from thermal radiation will complicate these trauma related injuries. Third degree burns could be seen as far away as 1.5 km for a low yield nuclear detonation.[9] In addition, to these classic prompt effects there may be other health effects associated with prompt effects, including flash blindness

[†] For more on the effects of a nuclear weapon see "The Effects of Nuclear War." *Office of Technology Assessment*. 1979. Available at http://www.fas.org/nuke/intro/nuke/7906/index.html

and glass breakage. During the 1995 Oklahoma City bombing, most of the injuries were caused by glass breakage.[10] In addition, a significant number of victims of the 1945 Nagasaki bombing presented at field hospitals with glass-related injuries.[11]

The second broad category of effects from a nuclear weapon detonation is delayed effects. The most important delayed effect in a nuclear attack is fallout. The nuclear detonation will create "a large cloud of radioactive dust & water vapor which fall back to earth contaminating horizontal surfaces." These contaminated particles will give off penetrating radiation that can injure unprotected people.[12] Thus, beyond the challenges of a normal emergency, following a nuclear detonation, responders will have to monitor and be aware of radiation levels.

How to respond to a mass medical emergency, like the one an IND would create, has been well studied in Israel due to the high number of suicide bombings that occurred there in the 1990s. Studies found that the most effective method of response to the attacks under study was "scoop and run," a method where the injured are collected and evacuated to the nearest hospital triage point where the victims are then sent to other hospitals. In addition, Israel's emergency response system features a flexible hierarchy that functions well, allowing the most senior responders on the scene to decide where victims should be taken for treatment.[13] While Israel provides a good model to follow, there are additional considerations one must make when designing a response system. William Bell and Cham Dallas point out that "there is an ominous pattern where these fatalities and casualties geographically fall in relation to the location of hospital and administrative facilities." In their article "Vulnerability of Populations and the Urban Health Care Systems to Nuclear Weapon Attack," Bell and Dallas demonstrate that "a staggering number of the main hospitals, trauma centers, and other medical assets are likely to be in the fatality plume, rendering them essentially inoperable in a crisis."[14] More should be done to

study specific cities' public health and emergency response vulnerabilities to ensure that response is optimal.

Beyond the challenges of a normal emergency, following a nuclear detonation, responders will have to monitor and be aware of radiation levels (e.g. from fallout, ground contamination, etc). The Department of Homeland Security Preparedness Directorate provides a guideline for how much exposure is acceptable for emergency responders. Borrowing from the EPA's Manual, the Department of Homeland Security (DHS) advises that up to 5 rem is within a normal range of exposure; up to 10 rem is acceptable if all precautions are taken to minimize risk and the operation is to protect valuable property or save lives; and up to 25 rem is only an acceptable exposure if it is to save lives.[15] Tools are becoming available to assist responders in developing situational awareness and translating raw observations and radiation measurements on the ground into assessments of burst parameters (i.e. yield and height of burst).

Health Care Workers' Ability and Willingness to Report to Duty During Catastrophic Disasters (n=6,428, 47 facilities)

	Willing	**Able**
Snow Storm	80%	49%
Bioterrorism (smallpox)	61%	69%
Chemical Terrorism	68%	71%
Explosion Incident (MCI)	86%	83%
Environmental Disaster	84%	81%
Radiological Terrorism	**57%**	**64%**

Figure 3 (Derived from Qureshi et al.)

Another important aspect to consider when studying initial response is the willingness of first responders and health care professionals to actually respond. While research in this field is nascent, initial findings suggest that responders may not be as willing to respond to emergencies as previously thought. Qureshi et al. surveyed health care workers in New York City and found that 86% of health care workers were willing to respond when there was a snow storm. That high percentage of willing responders contrasts sharply with the 57% of health care workers willing to respond to a radiological incident (See figure 3).[16] This finding may indicate a need to increase health care worker training about the true risks of radiation.

The most comprehensive study of response to a radiological event to date was conducted by Tammy Taylor et al. and entitled "Radiological Community Preparedness." The study had several focus groups of experts discuss and brainstorm what information is known and not known and how well the nation is prepared for a radiological dispersion device or IND. The law enforcement focus group identified the fact that there is no guidance afforded to law enforcement to determine if the incident is nuclear or not. They recommended that equipment be standardized and a guidebook be produced for law enforcement agencies. Another focus group discussed the important decision of whether to shelter or evacuate. They pointed out that there were no procedures to evaluate the hazards of both decisions nor were there protocols to make the decision. In addition, the study found that there is a need for modeling escape routes and how they may be affected by the detonation of an IND.[17]

Messaging:

Assuming that situational awareness has been obtained, it is necessary to develop and deliver a message to the public. Within this task there are three elements. First, a standard message must be developed before the event occurs. Next, officials must determine the best

means by which to deliver the message. Finally, estimating natural public response and public response to the message is necessary to craft an effective event-specific message and approve it for dissemination. Following a process, such as the one Fischhoff has developed, would be very helpful in developing messages for IND events. Fischhoff's model begins with developing an expert model, then developing an open-ended protocol, and then conducting open-ended interviews. Following that process, a structured questionnaire is created and administered leading to the creation of a communication. Finally, a questionnaire is administered following the communication to evaluate the communication's effectiveness. [18] While this sort of method would be impractical *during* an IND event, it is necessary that this method or a similar one be followed when creating a message *before* an event occurs that can be used as a guide during a real event.

The first step in communicating with the public is deciding on what information is correct. The major debate in IND response planning over the past decades has been over whether to shelter or evacuate the public. Today, the scientific community is coalescing around a shelter and then staged and informed evacuation strategy. [‡] According to Cham Dallas, "The natural inclination is to flee . . . [but] most people should not flee because they won't be affected." Karen Law et al., after assessing four models of sheltering and evacuation in their study "Shelter-Evacuate Strategies and Consequences Following an Urban Nuclear Detonation," determine that sheltering immediately and then conducting an informed evacuation was the way to maximize the number of survivors in their model. They do admit, however, that there are many complicating factors that could change the advice including weapon characteristics, modeling uncertainties, base surge, and contamination dispersal.[19] It is therefore necessary to incorporate this information into response plans. Moreover, it is likely that the public will not receive any

[‡] There are those who disagree. Chief among them is the Rand Corporation which says to "avoid radioactive fallout: evacuate the fallout zone quickly."

official information within the first minutes of a disaster; therefore, it is necessary to educate the public before an IND event occurs so that they know how to react immediately.

Looking at risk communication failures of the past, one finds that one of the most damning mistakes is to send mixed, or worse, conflicting, messages to the public during a crisis. In a study looking at communications aspects of disasters, LeVerle Berry et al. found that during the 1979 Three Mile Island (TMI) nuclear power plant emergency "utility spokesmen offered explanations that were confused and often at odds with the views of the Nuclear Regulatory Commission." These "conflicting statements brought swarms of reporters to TMI to probe what looked like an industry cover-up."[20] The study found that the conflicting reports contributed to the public's sense of helplessness and confusion. Thus, it is imperative that during the crisis the public is given clear and consistent information.

Synthesizing the findings from both historical and experimental research by others[§], reveals that there are three fundamental aspects to communicating with the public. The three Cs (Clear, Correct, Constant) can be used as a shorthand for response planners to evaluate and develop messages so that messages are effective in informing the public. Clear means that the information provided is easy to understand and unambiguous. Constant refers to two important aspects of risk communication during crisis. First, official information needs to be issued continually in regular updates. Second, information issued needs to be consistent. Correct means that the information is as accurate as reasonably possible and represents expert opinion. By following these three Cs of risk communication during a crisis, responders can more effectively provide citizens with pertinent information.

One successful example of officials using these three Cs, although unknowingly, in communicating risk was in London in 2006. Following the 2006 murder of former KGB agent

[§§] This information has been synthesized from the findings of Dennis Mileti in "Evidence-Based Guidance for Public Risk Communication and Education." START. September 2006.

Alexander Litvinenko with polonium-210, London officials strove to communicate with the public that only those in the contaminated areas may be at risk. A study carried out by Rubin and his colleagues explored the effect that these communications had on public perception of the risk posed by the attack. After administering a survey, Rubin et al. found that nearly three-quarters of London respondents agreed with the statement "if you have not been in one of the areas known to be contaminated with polonium 210, then there is no risk to your health."[21] Rubin et al.'s study shows that it is possible to convey necessary and important information effectively following a radiological incident. After an IND detonation, getting cogent information about areas affected and areas not affected to people in the immediate area would be of utmost concern. As Rosa reminds us, "Involving the public does not guarantee success, but not involving the public just about guarantees failure."[22] **

** For more information on public trust see: Becker, Steven. "Meeting the Threat of Weapons of Mass Destruction Terrorism: Toward a Broader Conception of Consequence Management." *Military Medicine*. 166 Suppl. 2: 13, 2001.

Public

Preparation and Education:

The first node under the Public heading is preparation and education. Individual preparation for an attack of this scale differs significantly. Looking at why an individual may not follow the advice of Homeland Security in developing a shelter with proper supplies, H. Keith Florig and Baruch Fischhoff, find that building or preparing a shelter could be cost-prohibitive or not worth the money.[23] Hurricane Katrina serves as a real life example of what can happen if individuals are not prepared and the government is not aware of the unpreparedness. Following Hurricane Katrina, it was discovered that numerous individuals had not developed an evacuation plan prior to the emergency.[24] It is unclear how many people are truly prepared for an IND, and a study should be conducted to ascertain this information, as it would be beneficial for the government to know approximately how many people are prepared and why others are not prepared.

Education programs on IND events are few and far between. One of the few studies that looked at the public's beliefs about radiological events found that the public is very ignorant about radiological events. Administering a questionnaire about terror risk communications, Fischhoff et al. found that 90% of people believe that if a dirty bomb were detonated the best thing to do would be to "get away as fast as humanly possible."[25] As was established above, the best response would be to shelter and then evacuate as authorities determine the proper way and method of evacuation. At the very least, studies need to be conducted to learn what the public knows and what it does not.

Natural Response:

Another piece of the response puzzle following an IND detonation is how the public will respond. Thomas Glass's "Understanding Public Response to Disasters" provides a relatively clear picture of how the public responds to emergencies and how best to deal with that public response. Glass finds that following an emergency the public is very resourceful and saves the majority of survivors. These two points of interest, the public's resourcefulness and the fact that the public often plays the role of first responder, leads Glass to recommend that EMS be trained how to work with the public instead of trying to work against them. Also according to Glass and other empirical evidence from many historical disasters[26], completely irrational behavior (i.e. panic) in an emergency is rare. [27] However, if the public does not trust the authorities, people may act differently than authorities expect. Looking at the Three Mile Island accident of 1979 (TMI), Erickson found that the "evacuation shadow" phenomenon can be a very important aspect of a catastrophe. Two days after the news broke of an accident at TMI, an evacuation advisory was issued for pregnant women and young children within a five mile radius of the nuclear power plant. In reality, "for every person advised to leave home, almost 45" people actually evacuated. [28] This shadow evacuation effect is one that should be understood as not only a result of faulty communications but also a reaction of an uninformed, confused, and frustrated public.

Important, though often ignored effects of an IND detonation are those under the heading of psychological and social effects. Baratta points out that incidents involving invisible agents (such as the radiation associated with an IND detonation) can produce disasters whose primary effects are social, psychological, and economic.[29] Several researchers agree that the public's reaction to an IND event could be quite different than expected because of these psychological and social issues. Baratta and Becker, for example, believe that the public will demand more decontamination efforts following an IND than are currently planned. This could prove to be a source of tension in response efforts.[30, 31]

Every day, people naturally self-select themselves into certain groups or communities (e.g. parents, first responders). Following a disaster, an individual's concerns and actions will be affected by what group they are in. For example, if you are a parent, you belong to a community of parents that have special concerns that others outside the community will not (i.e. children). If an individual identifies with more than one community (e.g. a firefighter with children would belong to the first responder community and the parent community) the group which evokes the strongest emotions will dictate which community with which the individual will identify. So, in the firefighter with children example, the individual is probably going to have stronger feelings as a parent and thus that individual will likely self-select into the parent community rather than the first responder community. Because people will identify with particular groups it is important to understand how each community will react to the event. However, there is very little research on special-needs communities with regard to IND events and more needs to be done.

One of the few studies has been done on special-needs communities was on the parent community by Stephen Becker. Becker's focus groups elicited guttural responses from parents on how they would react if a radiological incident occurred in their city. One mother said, ""I'm not gonna stay in the house. I'm gonna try and find my kids." Another said, "I would still go get my children no matter what. Because to me that is everything." Finally, a nurse said, "If you have kids, the first thing you do is to get your kids." This last comment reiterates the fact that responders may not respond to an IND event. More statistical studies should be carried out in order to determine the effect that not only the parent community but other communities as well will have on response.

Long-term psychological issues caused by an IND event can include post-traumatic stress disorder (PTSD), radiation stigma, and psychological syndromes like the Informed Radioactive Contamination Syndrome (IRCS) discussed below. While PTSD is being studied and is often

included in long term response planning, the radiation stigma and ICRS that an IND could produce is often omitted from planning and, as Baratta argues, "First responders and health care workers need to be educated in how to deal with the psychosocial dimensions of a nuclear terrorism event."[32] The presence of radiological stigma has been seen following radiological disasters (e.g. Goiania, Fernald[33]). This stigma can develop against individual people who have been exposed and those who were near the area of contamination. A study conducted by Green at al. looked at individuals living around the Fernald nuclear facility during the late 1980s. Residents who found out that they had been exposed to radiation experienced a very unique psychological experience. They exhibited symptoms paralleling those of post-traumatic stress disorder; yet, unlike PTSD, in these cases the stressor was ever-present, leading to the naming of IRCS. This research shows how important the lasting effects of an IND can be on individual psyches.[34]

Not only individual psyches will be affected long term. Communities, neighborhoods and even the entire nation will be affected by an IND detonation. Research suggests that entire geographical locations can garner a radiological stigma. Easterling et al. found that following the TMI disaster, there was a five-million dollar loss in tourism in the first month alone.[35] It is also likely that large amounts of people would have to be relocated following an IND event. Mass relocation can fragment both the community being relocated and the communities that absorb the refugees. It is, as yet, unclear how an IND detonation would affect the nation as a whole and research on this aspect of the effects of an IND event should be conducted. It is important that studies be conducted to understand how an attack would affect citizens' confidence in authorities and future economic and social activities. By understanding the potential effects, steps can be taken to mitigate those effects.

Receiving and Reacting to Messaging:

Much of the literature regarding reaction to messaging has already been discussed; however, there is another important and often neglected aspect of communicating with the public. Lindell, argues that ethnicities and social groups can respond to the same message in different ways. In his study comparing Mexican-American responses to those of white Americans, Lindell found that Mexican-Americans were "more skeptical than whites about believing warning messages, no matter how specific the message." Mexican-Americans also "interpreted the same warning messages as indicating lower levels of personal danger" than white Americans. Lindell's study shows that it is necessary to study ethnic and community responses to warnings to ensure that messages are crafted for optimal efficacy.[36]

Following an attack, the psychological effects can be far reaching. Roxane Cohen Silver found in her "Nationwide Longitudinal Study of Psychological Responses to September 11" that psychological effects are not limited to those individuals that experience the disaster directly. Rather, anyone witnessing, or even hearing about the attack can have severe psychological reactions.[37] Another study that focused on individual responses to terrorism was conducted by Harold Koenig. In his study of religious responses to terrorism and catastrophe, he found that many people turn to their clergy in a time of confusion, uncertainty, and fear. Koenig found that clergy were unprepared to respond to disasters or give advice on what to do in the face of a disaster.[38]

Media Effects

The media can aid first responders in developing their situational awareness by providing coverage or information directly to the responders. The media also affects how the public will naturally react. Many citizens will hear about the nuclear catastrophe from the media first, and how that presentation is made can determine how individuals perceive the risks involved. Once responders have developed the message for the public, the media will be instrumental in the delivery of that message. Television and radio being the primary means of information dissemination, those outlets will have an integral role to play in the crisis. The media's reaction to the official message can then have a profound effect on how the public reacts to the message. The media may cast doubt on the message causing the public to doubt the message, or the media may offer its unconditional support for the message. With all of these interactions in mind, it is necessary to look at the media and crisis communications in some detail.

Matthew Dombroski et al. found in their study "Predicting Emergency Evacuation and Sheltering Behavior: A structured Analytical Approach" that compliance with official instructions during a disaster can be affected by the media's level of support. They found that in a radiological emergency 70-80% of individuals would comply with an evacuation order and 60-70% of people would comply with a sheltering order. The study found also that if the media were skeptical of the order, compliance with either recommendation could decrease by 10%.[39] The media must also be understood in terms of interacting with the event and the public directly. Two minutes after the Alfred P. Murrah Federal Building in Oklahoma City was bombed, media were covering the story. [40] The media's role must be recognized in disaster situations for the media can both aid and impede response. During the 1993 World Trade Center bombing, the media served as an emergency line to people still in the Towers. When the buildings' communications failed, people inside the buildings turned on battery power televisions and radios and even called local

media to find out what was happening. On the whole, the media was helpful to those trapped. The New York Times reported that "throughout the afternoon and evening, New York City newscasters gave out emergency phone numbers, urged calm on those trapped inside, and praised the work of the city's emergency crews."[41]

Media can also hinder rescue efforts though. During the 1993 World Trade Center Bombing, one reporter told people in the building to break out their windows to get fresh air. Some listened and acted resulting in "inch-thick splinters sharp as knives [falling] toward the sidewalks . . . at fifty miles per hour."[42] The media have an important role to play in response to any disaster; however, their actions can be useful or detrimental. More needs to be studied when it comes to the media's relation to the public and emergencies. The media's message is likely to be the first source people hear following a disaster and by engaging the media beforehand and working with them during the disaster the government can ensure that the proper message is delivered.

The State of Knowledge on IND Response

The state of knowledge in responding and communicating is a mixed bag. Some aspects of an IND attack are well understood, some are not, but much is left to synthesize. The effects of an IND would be devastating, yet much can be done to mitigate those effects through education, preparation, and research. A major current gap in knowledge is how to effectively communicate with the public before an attack. Little research on the effectiveness of public education has been done, but it is likely that educating the public about the effects of an IND and how to best protect oneself could save many lives.

Response to an IND also needs to be synthesized and organized. Response during the first few hours after an IND detonation is critical since the severely injured could be saved during this time and the uninjured would be confused and looking for official information and advice. Realizing the fact that federal assistance may be days away, local responders should develop response plans that can effectively save lives in the first few hours. Much information exists about how to best respond, but it seems that little has been done to utilize the information that has been found. While this review of findings serves as a crucial first step in that synthesization, local communities will need to take the lead in taking research findings and putting them to use in response plans, for they are the only ones that can do it. Each community is different and as such their needs for response planning are different. Nevertheless, all cities share one common element in response planning and that is the *necessity* to plan. The effects of an IND would be devastating; however, much can be done to mitigate those effects through education, preparation, and planning.

Findings from the Meetings Held by HSI

The Homeland Security Institute (HSI) has been funded by The Department of Homeland Security's (DHS) Office of Health Affairs to develop a communications strategy for an IND event that will include three important facets. The first is pre-event education. HSI has been working closely with a marketing agency to develop public service messages and commercial-like television spots to educate the public on the realities of IND events. The second facet of the DHS project is to develop prepared messages that leaders can use immediately following the IND detonation. HSI conducted focus groups of responders to narrow in on what sort of messaging should come from each level of government (i.e. local, state, and national). The findings were then synthesized and will be developed into actual messages in the very near future. The last and probably most important aspect of the HSI project is to develop messages that first responders can use during the crisis. The HSI team created a message matrix that contained the message themes that would be conveyed in the areas around the detonation at key time periods following the detonation of the IND.

In order to test out all aspects of DHS's project, HSI held meetings throughout the country that gathered city officials, members of HSI, fire and rescue personnel, first responders, and subject matter experts and began a dialogue about the myriad issues involved with responding to an IND event. These meetings uncovered numerous gaps and warrant exploration and reflection. However, in order to elicit candid responses, the cities, responders, and subject matter experts were guaranteed anonymity with regard to their opinions and preparation levels. Thus, there will be no attribution in this report. What follows is an account of the meetings, the lessons, and how those lessons can be utilized by other cities in planning for an IND attack.

While the issue of an IND going off is seldom discussed, many responders at the meetings proved knowledgeable and relatively prepared to handle the situation. Some communities proved to be very adept at modifying their current disaster planning to the IND situation. Yet, at the beginning of many meetings, some participants admitted they believed that there is nothing that can be done to respond to a nuclear attack. They revealed that much of the planning for such an event has relied on hoping that the event would never occur. While comforting and easy to do, this technique is not the most effective way to deal with the potential threat. As other cities proved, through simple augmentation and adaptation of preparations and response for other types of disasters, a plan can be developed to deal with the aftermath of an IND attack. When reviewing the existing material on response to disasters, it became clear that earthquakes were the focus of many communities' disaster education program. While this focus is understandable from a priority standpoint, preparing for an earthquake offers crossover opportunities with IND preparation. Thus, using earthquake preparations as a starting point for IND preparation could prove a very successful model.

A major gap in knowledge among most of the attendees was the character and effects of an IND detonation. The groups seemed unclear on the level of destruction and the hazards associated with an IND. There was also some false information shared. One member claimed that radiation would not be a concern within the first 24 hours and that the real danger from radiation would arrive 48 hours later. One of the worst things to have during a crisis is conflicting information coming from public officials. If there is confusion amongst officials about the effects and dangers of an IND event, conflicting information is likely to reach the public and that can contribute to the public's anxiousness. [††] Officials need to be aware of the

[††] The 1979 Three Mile Island nuclear power plant incident provides anecdotal evidence of what happens when the public receives contradictory information.

characteristics of an IND and understand the prompt and delayed effects of an IND detonation in order to better respond.

An area of conflict that arose during the meetings was the debate over whether to shelter or evacuate. While the scientific community disagrees on which method is preferable following an IND, city officials must make decisions about this issue within minutes of the attack; therefore, officials must be able to commit to the decisions they make and make the decisions with confidence despite uncertainty in the scientific community. Moreover, this issue needs to be resolved before an IND detonation and communicated to the public and private sector.

All groups agreed that the public was not well educated with regard to an IND detonation and its effects. While it is desirable that the public be educated in this matter, one group presented an important corollary to this belief. Education about an IND event would need to be a national project, for if a single community started an education program about IND detonations it may cause undue worry on the part of the public. People may think that the city is at greater risk for an IND attack if public officials suddenly start a preparedness program about IND events. Another way to educate the public, without fear-mongering, would be to combine information on IND attacks with other hazard-education (e.g. earthquakes).

The private sector was also brought up in many discussions. Some communities' officials were very comfortable with trusting private businesses to develop emergency plans. While it may be true that private businesses have emergency plans in place, this fact needs to be verified, at the very least. One group which would be significantly affected by the private sector's preparations is the tourist community. Tourists play an important role in many communities' economy. The communities at most risk for an IND event are frequented by thousands of tourists each day and because of their large numbers they represent an large group that will be affected by an IND detonation in a major US city. Tourists are not in a mindset of preparedness when

they are on vacation; therefore, it will fall to the casinos and hotels to give tourists the information they need. Thus, the private sector must be engaged in the planning process. While there are pilot programs discussing emergency response with some hotels and resorts around the country, more still needs to be done. In addition to being 'on vacation,' tourists are unfamiliar with the area they are visiting. Not living in the area, tourists will be unfamiliar with escape routes and available resources. Tourists are likely unfamiliar with the risks that exist in the town they are visiting and how to prepare and deal with those risks. During and after the emergency, tourists will also be under heightened stress because they will likely be away from family members and friends. Moreover, getting tourists home after an event will prove challenging. All of these issues can and should be dealt with before an event however. Studies need to be conducted to collect and process information on how to best protect visitors during and after an IND event.

The media is another group which some communities have neglected in its preparation for an IND event. The media will undoubtedly be on the scene within minutes of the attack. As the January 25, 2008 Monte Carlo Casino fire showed, media (even national media) respond within minutes of an incident occurring. Shortly after the first 911 calls came in and Fire Station No. 11 was dispatched, media helicopters were on the scene. The media was relatively cooperative in this latest incident and while that is encouraging to see, more can be done to improve media relations and to prepare to utilize the media's capabilities in a time of crisis.[43]

Another concern that was raised at several meetings was the confusion over the federal government's role. City officials seemed unclear about the role that the federal government would play following the detonation of an IND. The role could be similar to a natural disaster, but then the federal government may want more control since it would be an act of terrorism. Federal agencies could help local governments in planning if there were defined roles that the

federal government would be expected to play. After Hurricane Katrina struck the Louisiana coast in 2005, the federal government was harshly criticized for its handling of the situation.[44] Establishing specific roles could lessen future criticism of the federal government's response because local authorities would know exactly what to expect from the federal government.

During nearly every meeting, officials raised the concern about parents trying to get to their children who are in school. Parents trying to retrieve their children from school could present several hazards. First, having hundreds if not thousands of worried parents trying to get to a single school to get their children would create severe traffic jams potentially impeding rescue efforts. In addition, the school and the roads leading to the school could be in the path of nuclear fallout. In this case, parents could expose themselves and their children to fatal doses of radiation. The logistics of assuring that children are picked up by the correct people could also be a challenge during a crisis. Clearly, there are multiple aspects of this problem and, to date, none of these have been critically studied. It would be helpful if a study were done to define the scope of the problem and suggest ways to mitigate its effects.

When speaking about messaging for the public, one working group came up with a question whose answer could prove to be very useful in crafting public messages following a catastrophe. The group theorized that message content should be tied directly to the means of dissemination. For example, when giving information over the television, which would be for a mass audience, calm reassuring messages should be issued. Those messages delivered through bullhorns and fliers should be targeted messages for those areas to which they are being delivered. This idea is one which other cities should think about and one which could prove to be very useful in providing valuable information to those who need it.

The HSI-hosted meetings were instructive in many ways. It not only allowed the cities to learn where gaps in their preparations were, but also offered valuable lessons for other cities

around the country and helped provide a guide for future research. Following these cities' model of holding meetings to discuss response to disasters, cities throughout the country can better prepare for an IND emergency. It is ever more important, with the confluence of ability and desire in the terrorist community to inflict mass injury, that preparations be made for all contingencies, including IND events. Following these recommendations, and holding meetings of their own, cities around the country can better prepare for an IND event.

Recommendations

A number of common, overarching recommendations derive from both the literature and the meeting reports. While these recommendations are important, there are limits to their efficacy. The most important consideration when following any of these recommendations is that each community has different populations, geography, and needs. The individual aspects of every community could not be covered in a single report. Thus, it is up to the local response planners to hold meetings to uncover these important local-specific aspects of planning for an IND event. In addition to each locality being different, these recommendations are limited by the efficacy and ability of current research. For example, while it may be desirous to have a complete picture of what the effects of an IND detonation are, the scientific community does not currently have the technological ability to get a complete and accurate picture of every type of IND that could be detonated in every particular city. In addition there is always the real concern of budgeting. Each recommendation, especially under the research recommendation heading would require a generous level of funding that may not be available. With these limitations in mind, it is time to turn to what can be done in both the response communities and the research communities to better prepare the country for an IND detonation.

Recommendations for Response Planners:

Number	Recommendation
1	Individual communities should **meet** to discuss and plan for an IND event.
2	The public, responders, and public officials need **education** on the effects and injuries associated with an IND event.
3	**Sheltering** strategies need to be incorporated into planning and messaging models for IND events. The public needs to be informed of these actions.
4	Information should be provided to responders and the using the **3 Cs**
5	The private sector (i.e. **businesses and media**) should be engaged in preparation activities.

Figure 4

The first recommendation that overrides all others is that individual communities meet to discuss and plan for an IND event. No federal or national plan could possibly apply to every community because each community has its own needs. Individual communities are the only ones that can prepare plans which take into consideration all idiosyncratic attributes of the community. This recommendation is not to suggest that the federal government has no role to play in response planning. As the meetings show, some communities are unsure of the federal government's role following the detonation of an IND. Therefore, it is necessary for the federal government to define its role and perhaps have a representative at the local meetings to help convey that information and establish a nexus between the local responders and the federal support. Finally, meetings at the local level serve a second purpose. Not only can meetings uncover gaps in IND preparations, they allow individuals who will work together during an emergency to meet and establish rapport which can prove to be extremely helpful to the responders and the public during the actual crisis.

The second recommendation derives from both the research literature and the meetings. It became clear that education in IND effects and response is lacking at all levels. Thus, it is necessary to establish several initiatives regarding pre-event education. First, public officials must be educated about the effects and injuries associated with an IND event. As some meetings showed, public officials have many misconceptions about IND effects and these must be corrected if effective planning is to be done. Second, a public education model needs to be created. From both meetings, it is clear that local communities are concerned that a locally initiated pre-education program could inspire fear in the local communities. Thus, it is recommended that a public education program on the effects and response to IND events be instituted nationally. Another way to get information to the public before the event would be to incorporate the information into preexisting education efforts like those in place for earthquake preparedness. By following one of these tactics, fear-mongering would likely be avoided. Last, responders are currently unaware of the psychological effects of an IND event. Because these effects can be so devastating, responders should be educated on the potential radiological stigma that can develop against those who are exposed and psychological effects that an IND could cause.

Third, response needs to be standardized at a basic level. Because the majority of the scientific community agrees that the most effective immediate response to an IND detonation is to shelter, the model of "shelter first followed by informed, staged evacuation" needs to be incorporated into planning and messaging models for IND events. Moreover, because information may not reach citizens immediately following an IND detonation, a catch phrase which individuals can easily remember and recall should be popularized by incorporating it into education models so that citizens know how to respond *a priori* authorities' instructions. The phrase "Go in, Stay in, Tune in" is this report's recommended phrase, however others may be

developed. Other concerns do arise when talking about immediate response. Localities should plan for the likely event that many hospitals and administrative facilities may be destroyed by an IND detonation. Also, the public will be able to help following an IND detonation; thus, they should be engaged during response while always being kept as safe as reasonably possible.

The fourth recommendation comes from the research on risk communication and is reinforced by the meetings. From the research that was reviewed, a concept of 3Cs of communication were developed, namely Clear, Correct, Constant. These three Cs should apply to all messaging during an IND event because they represent the foundations for effective messaging during a crisis. Following on the heels of this communications recommendation is the recommendation that cities plan for the media. The media will respond quickly and begin broadcasting within minutes of an IND detonation. The media should be engaged before, during, and after an IND event.

The final recommendation for response planners regarding IND preparation is that the private sector be engaged in planning. Businesses can be an important partner in the preparation and response to an IND event. The private sector should not be left to develop its own response, but instead integrated into the whole plan. An additional consideration regarding the private sector is the tourist community. Many cities need to plan for this special subset because the cities at most risk for an IND attack are those which hosts many tourists annually. This recommendation means that response planners should engage hotels, casinos, and other places which cater to tourists in response planning.

Recommendations for the Research Community:

Number	Research Question to be Answered
1	What does the **public believe** about IND events and how can misinformation be corrected?
2	How will the entire **nation** and unaffected communities react to an IND event?
3	With regard to their children, how will **parents** react to an IND event?
4	Will a **radiological stigma** develop against those who are exposed to radiation following an IND detonation?
5	Should message content be directly tied to the **means of dissemination**?

Figure 5

More research needs to be conducted to answer important questions regarding IND response. First, the research community needs to establish what the public believes about IND information and how any misconceptions can be corrected. What private citizens know and think they know about IND events needs to be established so that education can accurately target information gaps and misconceptions. This research will allow education to be informative while not wasting the public's time telling them information they already know.

Second, the research community needs to assess how the entire nation and unaffected communities react to an IND event. Policy makers will want to know how the rest of the nation is going to react after an IND is detonated in a city. Research needs to be completed prior to an IND event so that this information is available.

Researchers need to explore how parents will naturally react to an IND event. With regard to their children, how parents react to an IND event could be an important, under-examined aspect of IND response. Researchers should find the potential problems that exist when parents try to retrieve their children from school during an emergency. This issue could profoundly confound response to an IND event.

More research needs to be done on the radiological stigma that can develop against those who have been exposed to radiation. Additional research should be conducted to learn how this effect could be reduced. Also, research should be conducted on the economic effects of an IND

event regarding the radiological stigma that may result. A radiological stigma could develop against an entire area of the country and any products flowing from there following an IND detonation.

The final recommendation for the research community is to determine if message content should be directly tied to the means of dissemination. For example, should television messages be general information and bullhorn or flyer messages provide area-specific information? Answering these types of questions could change how crisis communication is done and make it more effective.

Conclusion:

This report has reviewed past and present research regarding planning and response to an IND event, and has also provided steps forward for both the response and research communities. Past research proves to hold useful insights into both disaster planning and behavior and how people respond and react to disasters. Studies show how responders can most effectively respond and help people following a disaster. Moreover, research on people's feelings on the subject of radiation and how people have reacted to radiological disasters in the past offer valuable lessons on how to best help communities in these difficult situations.

By first dividing those people affected by an IND event into two groups (responders and public) who act and then interact, this paper then divided research into specific sections that offer key insights into each area. Beginning with the responder community, the first area discussed was training and preparation. By preparing for an IND event, local communities prepare for many other catastrophic, no notice disasters. However, many response communities have not begun preparation for an IND event. To improve situational awareness, the research community has developed a very good understanding of the earmarks of a nuclear event; and because a nuclear event needs to be recognized quickly, it is necessary to ensure that the response community is aware of the defining characteristics of an IND detonation and know how to best respond. Developing a message is the next step for responders and much research exists on risk communication. Upon reviewing that research, several aspects come forth. Along with testing messages before they are used, messages should be crafted so that they follow the three Cs of communication.

The first node under the public heading is preparation and education. Individual preparation for an attack of this scale differs significantly and education programs on IND events are few and far between. Thus, much more needs to be done in both preparation and education.

The second node is how the public will actually respond. According to many studies, the public is unlikely to panic; however, there are numerous psychological concerns including post-traumatic stress disorder, radiation stigma, and Informed Radioactive Contamination Syndrome. The public's receipt and reaction to the responders' messaging can be one of the most important aspects of a crisis communications plan. Research suggests that individual communities react to the same messages differently. This finding underscores the necessity for testing of messages before they are used. Finally, the media's role in a crisis is an important, modern consideration because the media can aid or hinder first responders' efforts. Engaging the media before a crisis can provide immeasurable payoff during the crisis.

After reviewing past research, this report looked at nascent, ongoing research by the Homeland Security Institute. HSI held meetings across the country of first responders and local officials. The HSI-hosted meetings were instructive in many ways. The meetings allowed the cities to learn where gaps in their preparations were, offered valuable lessons for other cities around the country, and provide a guide for future research. From the meetings, several findings, recommendations, and questions arose.

The final section of this report synthesized the past and current research in order to offer five recommendations for the response community and five questions to be answered by the research community. These recommendations and questions represent the next steps forward for both communities. The recommendations for the response community are individual communities should meet to discuss and plan for an IND event; the public, responders, and public officials need education on IND events; sheltering strategies need to be incorporated into planning and messaging models; information should be provided to responders and the public in a "Clear, Correct, Constant" manner; and the private sector (i.e. businesses) should be engaged in preparation activities. The five questions that the research community should be looking at are

what does the public believe about IND events and how can misinformation be corrected? How will the entire nation and unaffected communities react to an IND event? With regard to their children, how will parents react to an IND event? Will a radiological stigma develop against those who are exposed to radiation following an IND detonation? And should message content be directly tied to the means of dissemination?

Preparing for an IND event is not easy or clear. What is clear, however, is that preparation must take place. Research is well underway in the area of IND response and response planners should take note of the findings. Response planners need to meet to discuss issues particular to their community and develop a plan. Researchers need to continue their hard work in answering those questions which are posed in this report and those posed by individual communities. Following the recommendations that have been set forth in this report, both communities, responders and researchers, can improve response capabilities for an IND event. By working together, the response and research communities can accomplish their goal: to develop strategies which will make response more effective and save more lives.

End Notes

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