Chapter 8

PSYCHOLOGICAL ISSUES IN A RADIOLOGICAL OR NUCLEAR ATTACK

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INTRODUCTION

Among the most complex and challenging threats facing the United States and other nations in the 21st century is the possibility of a radiological or nuclear attack. Humankind's most powerful armaments, nuclear bombs, are the very definition of a weapon of mass destruction. They have the capacity to cause widespread and horrendous physical devastation and staggering numbers of casualties, as can be seen in photographs taken shortly after the atomic bombings of Hiroshima and Nagasaki.

Radiological weapons do not involve a nuclear detonation; rather, they either disperse radioactive materials to contaminate people (a radiological dispersal device [RDD]) or place a radiation source with the aim of intentionally exposing people (a radiation exposure device). In terms of fatalities, the consequences of a radiological attack would be many orders of magnitude smaller than a nuclear weapon detonation,[1] but in no sense does this mean that an attack involving a radiological weapon would not be serious. For example, a "dirty bomb," which combines conventional explosives and radioactive material, could kill dozens or even hundreds of people immediately (mainly from the conventional explosive), injure many, and put others at increased risk of becoming ill, depending on the location and the type and size of the attack. However, radiological weapons lack the capacity to cause the kind of massive, area-wide destruction and huge numbers of fatalities associated with an atomic bomb.

Although radiological and nuclear weapons differ in terms of how they work and impart their physical effects, what they share is the capacity to produce widespread and profound social, psychological, and behavioral impacts. These can include transient and longer-lasting individual mental health effects, as well as deep community and societal impacts.[2] Furthermore, in either a radiological or nuclear event, people's behavior (eg, whether or not populations undertake appropriate protective actions) can be one of the principal factors affecting the number of casualties. Thus, the psychological dimension of a radiological or nuclear attack needs to be a central consideration in planning, training, preparedness, and response. This chapter examines some of the potential behavioral effects and challenges posed by a radiological or nuclear attack in the contemporary context and traces out a strategy for enhancing resilience and preventing and reducing psychological impacts.

EVOLVING THREATS, NEW SCENARIOS

The psychological challenges posed by a radiological or nuclear attack (and the populations likely to be most affected) are influenced to a substantial degree by the nature of the threat and the type of scenario encountered. Thus, it is useful to begin this examination of psychological issues by considering how threats and scenarios have evolved in recent decades and how they might further change in the future. For much of the second half of the 20th century, the world faced a continuous threat of nuclear war. Cold War tensions, and sometimes even direct clashes, between the communist Eastern Bloc and the nations of the West made the risk of a highly destructive nuclear confrontation an ever-present part of daily reality. One possibility involved a tactical nuclear exchange between armies in the field, or what was sometimes referred to as a "limited nuclear war." In this scenario, shorter-range, generally smaller-yield, nuclear weapons (eg, nuclear artillery shells and landmines) would have been employed to augment conventional weapons in battlefield or theater-level military conflict. Although such nuclear combat was characterized as limited in scope, its effects would undoubtedly have been physically and psychologically devastating, both to military personnel and civilians in nearby areas. Furthermore, such a scenario would have also carried with it the risk of escalation to an even larger nuclear war.

The other danger, and the one that motivated the massive civil defense efforts of the 1950s and 1960s in the United States and Union of Soviet Socialist Republics, was the possibility of a "global" or strategic nuclear war between nations. This would have involved the use of long-range, larger-yield weapons delivered by intercontinental ballistic missiles, submarine-launched ballistic missiles, and long-range bombers. The potential impacts of such an all-out nuclear war would have been horrific, with infrastructure, command and control centers, military bases, industrial facilities, commercial centers, and perhaps entire major urban areas completely obliterated. The combined effects of blast, heat, fire, radiation, and radioactive fallout would have killed tens, perhaps hundreds, of millions of people.

During the Cold War period, consideration of the psychological issues posed by nuclear conflict focused largely on how soldiers might be affected by the limited use of nuclear weapons in the battlefield, or how civilian populations and nations as a whole might act or be affected by an all-out nuclear war.[3–8] With the fall of the Berlin Wall and the end of the Cold War, the possibility of this type of global nuclear war decreased

significantly but did not disappear. Meanwhile, in recent years, a range of new threats has emerged, posing daunting challenges for emergency planners, medical and mental health professionals, the homeland security community, and the uniformed services.

Nuclear Proliferation

The list of nations possessing nuclear weapons has grown, bringing with it new perils and new possibilities for nuclear conflict. One very troubling example is North Korea, which conducted its first nuclear test in 2006 and another in 2009. The tightly controlled dictatorship, which has had very tense relations with its neighbors and the United States and regularly issues threatening statements, is also engaged in developing ballistic missiles. Both the nuclear weapons and missile programs have been the object of United Nations Security Council condemnation and targeted sanctions. Another particularly troubling example is Iran, which appears to be moving aggressively to develop nuclear weapons and delivery systems despite United Nations Security Council resolutions calling for a halt to the country's uranium enrichment activities, and despite intense diplomatic efforts and sanctions by the United Nations, the United States, the European Union, and others. Meanwhile, the list of countries seeking nuclear weapons is likely to grow longer in coming years.

Terrorism

There is now also a serious and growing possibility that nonstate actors (groups rather than nations) will obtain nuclear weapons. Among those attempting to add nuclear weapons to their arsenals are terrorist organizations. Terrorists could try to acquire or steal a weapon from a nation that possesses nuclear weapons, particularly a country experiencing serious political or social instability. Generally speaking, however, the extensive security measures surrounding nuclear armaments would make it difficult for terrorists to secure a stockpile weapon. Alternatively, terrorists could seek to create a crude nuclear bomb, known as an improvised nuclear device.[1] Despite various control efforts, proliferation of nuclear know-how and nuclear technology has continued globally. Experts disagree about precisely how difficult it would be to acquire the necessary fissile material, or exactly how long it would take to create a working, usable bomb. Whether a terrorist organization has assistance from a state sponsor or supporter could certainly affect the equation. But in no sense is the threat just a hypothetical one; rather, as nuclear researcher Matthew Bunn has warned, it is a "real and urgent danger." Terrorists are "actively seeking nuclear weapons and the materials to make them."[9]

Undoubtedly, the best-known example of a terrorist group trying to acquire or develop a nuclear bomb is Al Qaeda. As far back as the early 1990s, the organization showed a clear interest in nuclear weapons. Since that time, Al Qaeda has had contact with nuclear scientists, attempted to acquire nuclear materials and designs, and even issued religious justifications for the use of weapons of mass destruction. The organization's top leadership has "demonstrated a sustained commitment to buy, steal or construct" a weapon of mass destruction.[10] But according to Graham Allison, director of Harvard's Belfer Center for Science and International Affairs, Al Qaeda may not be the only terrorist organization with an interest in acquiring nuclear weapons:

> If we awaken tomorrow to news of a nuclear terrorist attack, Al Qaeda will certainly be the most probable perpetrator. Unfortunately, however, the list of potential attackers does not stop there. There exists a rogues' gallery of other terrorist groups that have actively explored the nuclear options or, on current trend lines, could do so in the next few years.[11]

Furthermore, for some groups, traditional deterrence and the fear of retaliation would not be effective in stopping them from using a nuclear weapon against the United States or its allies. As Robert Gallucci has pointed out, "some of today's adversaries value their own lives less than our deaths."[12]

Impacts of an Improvised Nuclear Device

Most experts assume that a nuclear device created by a terrorist organization would be smaller and cruder than a military weapon, and that its effects would be smaller as well. Typical analyses discuss an improvised nuclear device that is 10 kilotons or smaller. That is the size, for example, considered in the Institute of Medicine's examination of medical preparedness for a nuclear event, and in the US National Planning Scenario created to help guide national, state, and local preparedness activities for a nuclear attack.[13] But even a 10-kiloton device would have immense destructive power, both in terms of physical damage and the psychological toll it would take. According to Bunn, "With enough plutonium or highly enriched uranium (HEU), a sophisticated and well-organized terrorist group could potentially make at least a crude nuclear bomb that could incinerate the heart of any major city."[9]

A RAND study of the effects of a 10-kiloton detonation in the Port of Long Beach, California, found that

"within the first 72 hours, the attack would devastate a vast portion of the Los Angeles metropolitan area," including the power grid and infrastructure.[14] Some 60,000 people might be killed, 150,000 others might be exposed to hazardous radiation levels, 600,000 homes would be lost, and several million people would be displaced. Other estimates of the effects of an improvised nuclear device detonation on the US mainland are equally sobering. For example, the Nuclear/Radiological Incident Annex of the National Response Framework states that "even a small nuclear detonation in an urban area could result in over 100,000 fatalities (and many more injured). . . ."[15] Studies of detonations in the most densely populated US urban areas (eg, New York City) have indicated a potential for even higher casualty tolls. Regardless of which estimate is used, it is clear that the medical, mental health, economic, and social impacts of a nuclear attack would be shocking. Indeed, every American would be affected in some way and left to wonder whether additional attacks would occur in the future.

Radiological Weapons

Another important change in the threat environment involves the emergence of radiological weapons. Although the general idea of spraying or spreading radioactive materials to cause harm and contaminate an area is not new,[16,17] it took a combination of the widespread availability of radioactive sources, a thriving illicit trade in radioactive materials, and the emergence of modern terrorism to make radiological weapons a realistic 21st-century threat. Creating an RDD weapon, such as a dirty bomb, would require only modest financial resources and technical skills. Furthermore, only a limited geographic reach would be needed. According to Ferguson et al:

> Widespread access to radioactive sources essentially obviates the need for a multinational network. An RDD may be effectively delivered via a conventional bomb packed with radioactive material or through other dispersion modes.…The relative ease of delivery of an RDD makes it a viable option for smaller groups with limited financial resources and technical know-how.[1]

The ease of creating a radiological weapon is one reason several expert assessments have concluded that a radioactive dirty bomb or other form of radiological terrorism could be close to the top of the list of likely attacks in the future.[18,19] As noted earlier, the capacity of a dirty bomb or other form of radiological terrorism to cause fatalities is limited. However, because radiological weapons can spread radioactive materials and expose people to radiation, they have the potential to sow fear, engender terror, create mass disruption, and leave enormous economic, social, and psychological impacts in their wake (Figures 8-1 and 8-2).[1]

PSYCHOLOGICAL CHALLENGES IN A COMPLEX THREAT ENVIRONMENT

In the 21st century, the terrain has shifted. Now, even as the possibility of global nuclear war has decreased but not disappeared, new dangers have emerged. The need for the nation to prepare for these challenges is reflected in the responsibilities given to the Department of Defense under the National Response Framework. Along with its traditional national defense role, the Department of Defense, when directed to do so, is now also responsible for providing support to the Department of Homeland Security and other federal, state, and local government agencies.

Today's threat environment is highly complex and includes a broad range of circumstances with varying psychological issues and implications. The following situations are among the specific possibilities that need to be taken into account in preparedness and planning.

Figure 8-1. Buildings damaged and cars burning in TOPOFF (top officials) 2 "dirty bomb" national level exercise, Seattle. Reproduced from: Seattle Municipal Archives Photograph Collection. Collection Record Series 0207-01 (Fleets and Facilities Imagebank). Item number 13861.

Nuclear Attack by a Rogue Nation or a Terrorist Group on Overseas US Forces or Facilities

Such an attack could, for example, be directed against US forces engaged in combat operations or

Figure 8-2. Destroyed bus after mock radiological dispersal device attack, TOPOFF (top officials) 2 exercise, Seattle. Reproduced from: Seattle Municipal Archives Photograph Collection. Collection Record Series 0207-01 (Fleets and Facilities Imagebank). Item number 138618.

peacekeeping operations, or it could be directed against an overseas base. In addition to the direct and indirect effects on military and civilian personnel in the targeted area, there would be a tremendous psychological impact on the host country, on US service members' families and communities back home, on personnel at other facilities around the world, and on the United States as a whole.

Nuclear Attack on US Forces Inside the Continental United States

A nuclear attack targeting the home base and community of a US military unit would have enormous pyschological impacts. In addition to the effects on military and civilian personnel, military families, and civilians in the targeted area, there could be substantial psychological impacts on other personnel overseas, on people working and living at or near other bases, on military communities, and on the nation as a whole.

War Between Regional Nuclear Powers

Although a conflict may not directly involve the United States, it may affect US military and civilian personnel based overseas (eg, through the spread of radioactive fallout). Such a situation would create considerable concerns about potential immediate and longer-term health effects, likely requiring substantial medical, psychological, and other follow-up programs. In addition, a continuing communication and information effort would be needed to address the many questions, concerns, and information needs of the potentially affected military and civilian personnel, their units, and their families and communities back home.

A Series of Coordinated "Dirty Bomb" Attacks on Critical Infrastructure

A series of coordinated RDD attacks on key commercial, governmental, or military buildings inside the United States would result in direct civilian and military casualties as well as radioactive contamination left by the attacks. This, coupled with people's apprehensions about potential and perceived dangers, could lead concerned individuals to flood medical facilities, hobble administrative and business centers, and even paralyze entire sections of cities.

A Terrorist Nuclear Detonation in a US City, Followed by Deployment of US Forces

Such forces might not only have to contend with their own concerns about radiation, other dangers, and personal safety, but could also encounter almost unimaginable and gruesome sights, including widespread destruction, large numbers of corpses, and people with horrific, disfiguring burns (Figure 8-3). This point was driven home in Lifton's writings on Hiroshima,[20] in which people who had been in the city at the time of the bombing reported their reactions and experiences. "Everything I saw," commented a young university professor who had been about a mile and a half from the blast, "made a deep impression—a park nearby covered with dead bodies waiting to be cremated…very badly injured people…" and most of all, "very young girls…with their skin peeled off." For soldiers, even combat veterans, experiencing death on the battlefield is difficult enough; responding to a nuclear event and seeing widespread death and destruction on the US mainland would tax psychological resources even more. Meanwhile, there would be a tremendous psychological impact on survivors of the attack, and potential impacts on people residing anywhere near the event, the families of those deployed to render aid, and individuals across the nation.

This range of potential threats and scenarios is remarkably wide; so, too, is the array of groups that could be psychologically affected. Planning and preparedness activities related to the psychological dimensions of a radiological or nuclear attack need to take these varying possibilities into account; some of the aforementioned possibilities have received only scant attention to date in preparedness efforts.

RESPONSES AND REACTIONS TO A RADIOLOGICAL OR NUCLEAR ATTACK

Planning and preparedness efforts also need to take into account ways that people might respond or react to a situation in which radiological or nuclear weapons are used. Yet making predictions about people's psychological and behavioral responses is complicated. Despite evidence of various terrorist plots and plans, as of this writing, the world has thus far been spared a successful radiological terrorism attack. With respect to nuclear weapons, comments made by Iklé in 1958 still hold true:

> The only empirical evidence of the effect of nuclear weapons on society must come from mankind's only actual experience with nuclear bombings of cities—at Hiroshima and Nagasaki. Firsthand knowledge of man's reaction to nuclear bombs is therefore—and most fortunately—very limited (Figure 8-4).[21]

The Myth of Widespread Panic

One important finding from the two atomic bombings of Japan is that there was an absence of mass panic in the population. According to Iklé, "findings from Hiroshima, Nagasaki…and other areas of large bombings in World War II do not indicate that serious mass panic occurred at any time."[21] Indeed, contrary to what is seen in many disaster movies, the literature on disasters of all types suggests that panic is actually a relatively rare phenomenon. This does not mean that it never occurs; there have been instances involving panic, particularly when people are trapped. But on the whole, "reports from very large disasters in the past fail to show any significant mass panic among the afflicted population."[21] In general, people try to "cope with the threat and apply corrective measures using their best knowledge and capabilities."[22]

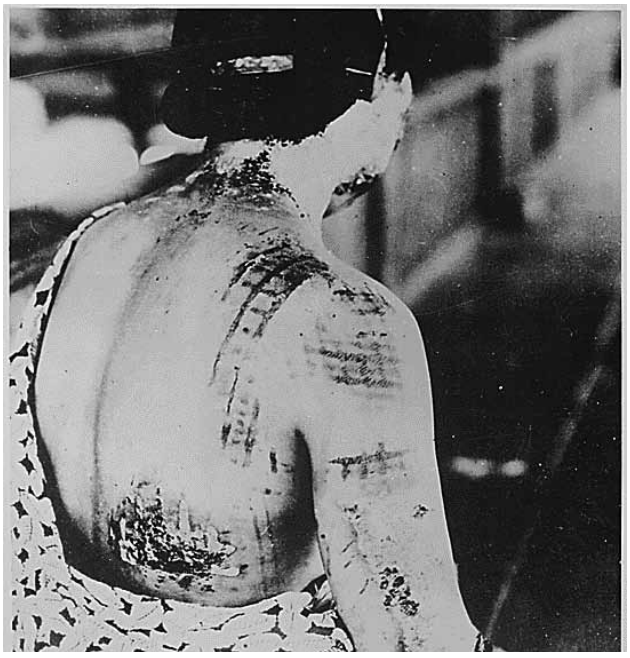

Figure 8-3. An atomic bomb survivor's skin is burned in a pattern corresponding to the dark portions of a kimono worn at the time of the explosion.
Reproduced from: National Archives and Records Administration. RG 77. Photo no. 77-MDH-6.55b (World War II Collection).

The same pattern appears to hold true in large-scale terrorist bombings. Drawing on survivor and witness accounts, Drury et al,[23] examined people's reactions and responses to the series of four coordinated bombings of the London public transportation system carried out by Islamist terrorists on July 7, 2005. The blasts, one on a bus and three on the London Underground, killed 57 people and wounded more than 700 others. The circumstances were terrifying for individuals trapped underground on bombed subway trains: "Those in the bombed underground trains were not reached by emergency services immediately, and were left in the dark, with few announcements, and with no way of knowing whether they would be rescued, or whether the rail lines were live."[23] Although it was not uncommon for people to use the word "panic" or "panicky" to describe their feelings during the event, and although many people reported experiencing fear, descriptions of people's behavior during the event tended to emphasize that they were mostly calm and that the evacuation was orderly.

Similarly, there was no evidence of mass panic during the Al Qaeda terrorist attacks on the World Trade Center in New York and the Pentagon in Washington on September 11, 2001, when hijacked commercial jets were intentionally crashed into the buildings. Accounts of people's responses suggest that behavior was generally orderly. Remarkably, more than 14,000 people were able to successfully evacuate the twin towers in New York.[24] According to Kathleen Tierney, "the rapid, orderly, and effective evacuation of the immediate impact area—a response that was initiated and largely managed by evacuees themselves, with a virtual absence of panic—saved numerous lives."[25]

Helping Behavior in Disaster

Not only was behavior following the September 11, 2001, attacks generally orderly and without mass panic; many people also engaged in helping

Figure 8-4. A dense column of smoke rises more than 60,000 feet into the air over the Japanese port of Nagasaki, the result of an atomic bomb dropped on August 8, 1945.
Reproduced from: National Archives and Records Administration. "Atomic Cloud Rises Over Nagasaki, Japan, 08/09/1945–08/09/1945." RG 208. Photo no. 208-N-43888 (World War II Collection).

behaviors. Tierney writes that, with the assistance of emergency workers, "occupants of the World Trade Center and people in the surrounding area helped one another to safety, even at great risk to themselves."[25] Similarly, in London, "selfish behaviors were found to be rare; mutual helping was more common."[23] These and other historical experiences suggest that in most calamities, people are less likely to experience mass panic and more likely to behave in an orderly manner and engage in prosocial helping behaviors, even in the face of danger.

Complicating Factors

When considering a large-scale radiological or nuclear attack, several factors have the potential to complicate the situation. For example, there are important limitations in extrapolating from the atomic bombings of Japan. The weapons that hit Hiroshima and Nagasaki were new, and the resulting devastation was unprecedented. People had little or no information about nuclear weapons, and they did not understand the nature or causes of the mysterious illnesses and aftereffects that occurred. Today, with the world having not only witnessed the effects of the atomic bombings in 1945 but also having experienced the Cold War, people have strong attitudes and perceptions regarding nuclear threats. In addition, they have virtually instant access to information and pictures about nuclear subjects through the Internet, social media, and the mass media. All of this has the potential to significantly affect how people understand and interpret a situation, and how they react and respond.

Perceptions, Attitudes, Fatalism

The literature on risk perception provides useful insights into how people view nuclear threats. Slovic has suggested that people assess risks on the basis of two broad dimensions: "dread risks" and "unknown risks."[26] Among the perceived characteristics of dread risks are catastrophic potential, fatal consequences, uncontrollability, inequitable distribution of risks and benefits, involuntariness, and a high risk to future generations. People's perceptions and attitudes, notes Slovic, are closely related to the dread risk factor: "the higher a hazard's score on this factor, the higher its perceived risk."[26] Nuclear weapons score higher than any other risk in terms of dread. In a study carried out by Slovic et al,[27] people were asked to rate the risk associated with 90 different activities, substances, and technologies. Nuclear weapons topped the list. Commenting on the study, Rosa and Freudenberg concluded that "nuclear risks are perceived to be the riskiest—and are the most dreaded."[28]

Complementing the risk-perception research are numerous studies of people's attitudes and expectations regarding nuclear war. Perhaps not surprisingly, in studies of the images people have of nuclear war, the dominant themes were exceedingly bleak: "physical destruction (long-term, short-term, and immediate), death, injury, weapons, politics, hell, oblivion, nothingness, pain, contamination, radiation, end of civilization, and genetic damage. Dominant emotional images included fear, terror, worry, and sadness."[29,30] A review by Fiske of more than 50 studies carried out over 4 decades found a high degree of consistency in public conceptions, attitudes, images, and perceptions of nuclear war.[31] One clear finding is that people expect a nuclear conflict to result in annihilation, and "included in that annihilation is the self."[31] In other words, people do not expect to survive. Fiske writes that, "even abstract references are clear in that respect (utter destruction, nobody

left, annihilation). Moreover, when specifically asked whether they personally would expect to survive, people on average rate their chances as poor."[31]

More recent research also shows evidence of fatalism regarding radiological and nuclear terrorism, particularly among minority populations.[32,33] For example, when considering the possibility of an attack, it is not uncommon to hear comments such as "I don't think we'd have a chance" or "there is nothing you can do." In addition, studies indicate that there is some confusion about radiological and nuclear threats, and a clear pattern of low self-efficacy in the population. In surveys discussing potential terrorism threats, people say they know the least about how to protect themselves from radiological agents; only about half the population says it knows the difference between a dirty bomb and an atomic bomb; and people report lower confidence in their abilities to respond to a radiological or dirty bomb than to an earthquake or tornado, explosion or bomb, or hazardous materials accident, such as a chemical release.[34–36]

Fear of Radiation

Finally, looming large as a possible behavioral factor is the extraordinary, and perhaps unique, potential for situations involving radiation to "produce widespread fear, a profound sense of vulnerability, and a continuing sense of alarm and dread."[32] A combination of many perceived characteristics is thought to contribute to radiation's power to create apprehension and anxiety: the agent is invisible, odorless, colorless, and unable to be "apprehended by the use of the unaided senses," making it more terrifying[37,38]; it can lead to long-term contamination of an area; there are frightening historical associations and images (eg, the atomic bombs at Hiroshima and Nagasaki, the disaster at Chernobyl Nuclear Power Plant); the agent is viewed as having the potential to cause hidden and irreversible damage and as having the capacity to produce forms of illness and death that arouse particular dread (eg, cancer); it is seen as representing special dangers to young children and pregnant women; it is in many ways unfamiliar and the risks are perceived to be involuntary and even unnatural, triggering more concern than other sorts of risks[39,40]; and it is seen as posing an unbounded or open-ended threat. Because long-term health consequences may take years to develop, the danger is seen as having no end. There is a continuing sense of vulnerability and concern, and people can remain in a "permanent state of alarm and anxiety."[37]

POTENTIAL POPULATION BEHAVIORS

Population Flight

Fear is not only significant as an individual emotional reaction; as Gray and Ropeik have pointed out, it also has "powerful public health implications."[41] In situations where information is scarce, unavailable, or confusing, "fear can translate into responses that put people at risk and make managing the incident even more difficult."[42] Population flight, or spontaneous evacuation, is one important possibility. During the 1979 accident at Three Mile Island Nuclear Power Plant in Pennsylvania (Figure 8-5), for example, people received inadequate and conflicting information from authorities. Against a background of already heightened fear, a large number of people fled the area. Officials had advised pregnant women and preschool-aged children within a 5-mile radius of the reactor to leave the area. Others were told to stay indoors. Based on this advice, approximately 3,500 people should have evacuated.[43] However, for every person officially advised to evacuate, nearly 45 actually did. In all, some 150,000 people fled the area (social scientists, recognizing the trend for this sort of mass evacuation, refer to the gap between expected and actual evacuation as an "evacuation shadow").[37,44]

Chronic Stress and the Overwhelming of Healthcare Facilities

Another behavioral response that has been observed is chronic stress in unexposed people, and the overwhelming of healthcare or screening facilities by people concerned about potential health effects. The best example of this phenomenon is the 1987 radiological accident in Goiânia, Brazil,[32] when two individuals discovered a radiotherapy unit in an abandoned and partially demolished clinic. The two did not know what the machine was, but thought it may have scrap value. While trying to dismantle the unit, they ruptured the source capsule, revealing 100 g of (what was later determined to be) cesium 137. The source assembly was sold to a junkyard, and the radioactive material, which glowed blue in the dark, was spread around by curious workers and children. The incident resulted in four deaths, around 260 people and 800 acres of land showing signs of contamination, and 49 people requiring medical treatment.[45–48]

"When measured in terms of fatalities and injuries alone," Petterson observed, the event "hardly seems to be of international significance—certainly no more than any other industrial accident."[45] But because ra-

Figure 8-5. The Three Mile Island nuclear power plant near Middletown, Pennsylvania, the site of a serious accident on March 28, 1979. Inadequate, ambiguous, and conflicting information increased people's fears and likely contributed to a large spontaneous evacuation. For every person advised to leave, about 45 actually did. In all, some 150,000 people fled the area. Reproduced from: The Centers for Disease Control and Prevention Public Health Image Library. http://phil.cdc.gov/phil.

diation was involved, ripples of worry and attendant secondary impacts extended far from the epicenter of the event. Over 112,000 people, concerned about potential exposure, voluntarily sought examinations. "The fear was so intense that some people fainted in the queues, as they approached the moment of monitoring,"[49] wrote psychologist Ana Bandeira de Carvalho. Significant numbers of people also exhibited stress-induced symptoms that mimicked radiation exposure (fatigue, nausea, vomiting, diarrhea, or reddened skin).[49]

Social Stigma

A third type of fear-based behavioral response to radiation involves social stigma and discrimination against people and products from an affected area. Widespread and long-lasting stigma was powerfully evident after the atomic bombings of Hiroshima and Nagasaki. In accounts by survivors, individuals related how they were seen as tainted and as people to be avoided.[50] Survivors were seen as unacceptable as potential marriage partners. A young man breaking off his engagement with his fiancée explained: "My father says he doesn't care who I marry as long as it isn't you. To tell the truth, my father and I both prefer not to have the blood of an atomic bomb victim in the family."[50] This stigma affected not just survivors, but succeeding generations as well. According to Mikihachiro Tatara, "knowledge that an individual comes from a Hibakusha family raises the specter that there may be 'bad blood.'… As a result, the Hibakusha Nisei [second generation] may be socially rejected out of fear that their genes will taint marriages and families."[51]

Similar reactions have also been seen after a wide variety of other situations involving radiation. Schoolchildren who were relocated from contaminated areas as a consequence of the 1986 nuclear accident at Chernobyl reported being shunned, and adolescents reportedly hid their identities as Chernobyl survivors because they feared discrimination in further education, work, and marriage.[52] After a 1999 nuclear criticality accident in Tokaimura, Japan, some residents reported that when they or their family members visited resorts, springs, or hotels in other parts of the country, they were asked not to use the public baths.[53] Products were also stigmatized after the Tokaimura accident, despite tests showing that

field and agricultural products were not radioactively contaminated. In particular, it became difficult to sell one of the area's main crops, dried potatoes, under the Tokai name.[53]

The 1987 radiological accident in Goiânia "sparked fears throughout Brazil" and resulted in numerous manifestations of stigma.[54] Throughout the country, even far from the incident, "Goiânia was regarded as a place to be avoided."[32] The number of visitors to the area dropped significantly, agricultural products would not sell, and conventions planned for the city were canceled.[32,54,55] People from Goiânia faced far-reaching discrimination.[32] For example, hotels in some parts of Brazil refused Goiânia residents and some airline pilots refused to fly with them aboard, and cars with Goias license plates were stoned.[56] As a result of the discrimination, around 8,000 residents were given official certificates declaring them uncontaminated.[32]

Reactions such as flight, stress in unexposed populations, overwhelming of healthcare facilities, and stigma are not inevitable outcomes of a radiological or nuclear terrorism situation, but given the tremendous fear of radiation, they are a possibility that must be considered. Some research suggests a high propensity for population flight.[57,58] A random-digit-dial telephone survey of 800 households in the greater Washington, DC, area found that people's expressed likelihood of leaving the area immediately was higher for radiological and nuclear terrorism events than for natural disasters, technological disasters, or chemical terrorism.[57] For a radiological event, 76% indicated they were very or somewhat likely to leave immediately; for a nuclear event, the corresponding figure was 83%.[57] Households with children under 18 were the most likely to say they would leave.

The disaster literature and past disaster experiences suggest that the reaction to a radiological or nuclear attack is likely to include a great deal of calm, organized behavior, and a host of efforts to help others, even at personal risk and in the face of danger. But perceptions, concerns, and fears about radiation may also produce other kinds of behavioral responses that could inhibit helping behaviors, reduce social support, and slow recovery processes. A 2003 Department of Homeland Security report concluded, "public fear of a terrorist attack involving radioactive materials is likely to be high and could produce responses that endanger physical and mental health as well as the economic viability of affected communities."[59] Such responses are most likely when information is unavailable, inadequate, contradictory, or confusing. Thus, a crucial component of any effort to address psychological issues in a nuclear or radiological attack involves having an effective communication and information strategy and the means to implement it.

Emergency Responders

It is important to note that uneasiness about radiation and radioactive materials incidents is not limited to the public; emergency responders can also be affected. A growing body of focus group, interview, and survey research has begun to provide important insights into the views, perceptions, and concerns of front-line personnel in relation to radiological and nuclear attacks. Among the groups included in such studies are police officers, firefighters, emergency medical technicians, public health professionals, physicians, nurses, and hospital personnel.

One clear and consistent finding is that responders of all types have a high level of dedication to duty and a strong commitment to professional responsibilities. Responders consistently emphasize that their work is not just about doing a job; it is also about a powerful devotion to duty, helping, and service, which would factor into the response to a radiological or nuclear attack.[32,60–62] However, many responders are concerned about radiological and nuclear incidents in ways they are not with other emergency situations. Many responders have doubts about individual and organizational readiness for responding to this "new" challenge. Although first responders appear to have a higher level of confidence than either public health workers or hospital-based healthcare providers, all responder groups express preparedness concerns. Responders also express a lower comfort level with radiation compared to many other threats, and for some this lack of familiarity translates into greater apprehension.[32,60–62]

Survey research studies have found that responders express a lower willingness to be involved in dealing with radiological and nuclear events than with most, or sometimes even all, other types of incidents.[63–68] Furthermore, the difference in willingness to respond to radiological or nuclear incidents as compared to other events is striking. A large majority (87%) of 1,711 hospital personnel surveyed in five states indicated a willingness to work in response to a fire, rescue, and collapse mass casualty incident. The figures were also high for a flood (81%), earthquake (79%), hurricane (78%), tornado (77%), ice storm (75%), and even an influenza epidemic (72%). But only 57% expressed a willingness to report for duty following a radiation event.[68] This is consistent with other surveys, where expressed willingness to report for a radiological or nuclear incident tends to hover around the 50% mark.

There is considerable uncertainty about the implica-

tions of these and other related findings.[69] Some experts have recommended that planners assume fewer first responders and health personnel will come to work after a radiation event because they will either fear contamination or will stay near home to care for their families.[70] Exactly what percentage of workers this might affect is difficult to predict because what people say in focus groups and surveys may not always mirror what occurs in an actual event; people's expressed behavioral intentions are not always good predictors of what they will actually do. In the case of emergency responders, a high level of dedication to duty could override other factors. On the other hand, there have already been real-world situations in which concerns about contamination have affected response and recovery efforts and responders' willingness to carry out certain work. This was the case after the May 2000 Cerro Grande wildfire in New Mexico, which spread to areas around the Los Alamos National Laboratory.[60] Some laboratory property was destroyed, resulting in staff evacuations and temporary closure. However, even though fires came close to critical facilities, laboratory officials declared that all major structures had been secured and no releases of radiation had occurred. In the aftermath of the fire, hundreds of professional wildland firefighters were brought in to assist with efforts to reseed burned land and rehabilitate affected areas. Approximately 100 of the firefighters asked to be released from their duties. The firefighters were concerned that they might be exposed to radioactive contaminants or other hazardous materials, despite the assurances of laboratory officials.[71–77]

In the Los Alamos event, willingness to carry out certain work was reduced by a combination of concerns about contamination and lack of trust in authorities and their assurances about safety. However, even a real-world clean-up and recovery operation is not the same thing as an unfolding radiological or nuclear attack in which people are desperate for help. In such a situation, the powerful commitment to duty and service that motivates responders would likely translate into higher levels of willingness to report than have been expressed in research studies. Responders face danger and save lives every day, and they do so with professionalism, courage, and heroism. Still, the research findings should be a red flag. They indicate that many responders have deep concerns and apprehension about situations involving radiation, and that these may dramatically increase responder stress and make it harder for them to do their jobs. The findings also suggest that responder concerns, if left unaddressed, could result in reduced capacity for agencies to respond to a large-scale radiological or nuclear incident.[61]

Military Personnel

At the time of this writing, published, peer-reviewed "ability and willingness" studies of the type carried out with emergency responders have not been performed with military personnel. But there are indications that military personnel, like their counterparts in the emergency response community, are not always clear about radiation issues. Pastel carried out a pilot study of pretest–posttest results from military medical personnel who took the 3-day Armed Forces Radiobiology Research Institute's Medical Effects of Ionizing Radiation course. He concluded, "this pilot study suggests that the understanding of radiation and radiation exposure risks is surprisingly limited among a selected highly trained, well-educated population."[78]

Undoubtedly, there are personnel and units (eg, specialized units that have been trained to respond to a radiological or nuclear event) that are both knowledgeable and comfortable dealing with radiation issues. There are also those who live with or deal with radiation on a daily basis (eg, those serving on a nuclear-powered submarine). However, the majority of uniformed personnel likely share some of the same concerns and apprehensions that have been identified in the emergency responder community. Civilian employees assigned to military bases and other facilities may also harbor the same perceptions, attitudes, and concerns as the general public. Thus, it is possible for some of the same behavioral reactions and responses identified earlier to occur.

It is essential that appropriate training, informational materials, and emergency messages be developed and tested well in advance of a nuclear event to properly prepare the military community. Information about radiation, health effects, and related issues should be clear and credible. Input from uniformed personnel and civilian employees about potential concerns and information needs can help make communication strategies and tools more responsive and effective. It is also vital to have mechanisms in place to provide information about family and address family concerns in the event of a nuclear emergency.

SPECTRUM OF MENTAL HEALTH IMPACTS

A broad spectrum of mental health effects can result from an attack involving radiological or nuclear weapons, including the stress reactions that commonly result from all disasters (eg, natural disasters, techno-

logical disasters, terrorism).[2,53] The effects can be emotional, physical, cognitive, or interpersonal (Exhibit 8-1). Such reactions, which are highly prevalent in the emergency and early postimpact phases of a disaster, represent a normal reaction to a highly abnormal situation.[53] Disasters are:

> highly stressful, disruptive experiences. People are exposed to situations that are well outside the bounds of everyday experience, and such situations place extraordinary demands—both physical and emotional—on people. It would be remarkable, then, if individuals who experience such extreme situations did not exhibit some physiological or emotional response.[79]

Following a major disaster, large numbers of people can experience stress reactions.[79] However, human beings are often remarkably resilient, and mild or moderate stress reactions are usually transient.[53] According to Hartsough and Myers, "relief from stress and the passage of time usually lead to the reestablishment of equilibrium, but information about normal reactions, education about ways to handle them, and early attention to symptoms can speed recovery and prevent long-term problems."[80]

When considering a radiological or nuclear attack, however, the picture becomes somewhat more complicated, because exposure to invisible contaminants can produce a chronic state of alarm.[2] Even concern about the possibility of exposure can be enough to cause significant chronic stress reactions, as was demonstrated in a study by Collins and de Carvalho carried out 3 ½ years after the Goiânia radiological accident in Brazil. The study examined the behavioral responses of three groups: (1) people who had been exposed to radiation as a result of the accident, (2) people who had not been exposed but were concerned about potential exposure, and (3) a control group. The study found that people who had been exposed and people who were concerned about potential exposure showed

EXHIBIT 8-1

COMMON STRESS REACTIONS TO DISASTER

Emotional Effects
Shock
Anger
Despair
Emotional numbing
Terror
Guilt
Grief or sadness
Irritability
Helplessness
Loss of pleasure derived from regular activities
Dissociation (eg, perceptual experience seems "dreamlike," tunnel vision," "spacey," or on "automatic pilot"

Cognitive Effects
Impaired concentration
Impaired decision-making ability
Memory impairment
Disbelief
Confusion
Distortion
Decreased self-esteem
Decreased self-efficacy
Self-blame
Intrusive thoughts and memories
Worry

Physical Effects
Fatigue
Insomnia
Sleep disturbance
Hyperarousal
Somatic complaints
Impaired immune response
Headaches
Gastrointestinal problems
Decreased appetite
Decreased libido
Startle response

Interpersonal Effects
Alienation
Social withdrawal
Increased conflict within relationships
Vocational impairment
School impairment

Reproduced with permission from: Young BH, Ford JD, Ruzek JI, Friedman MJ, Gusman FD. *Disaster Mental Health Services: A Guidebook for Clinicians and Administrators*. Washington, DC: National Center for Posttraumatic Stress Disorder; 1998.

Figure 8-6. The Chernobyl Nuclear Power Plant, where an explosion and fire in the number 4 reactor caused a large release of radioactive materials and a major disaster on April 26, 1986. In the aftermath of the disaster, populations in affected areas have been gripped by a deep sense of fatalism.

similar psychological, behavioral, and cardiovascular-neuroendocrine effects.[81] This included more fear than controls, declines in performance on speed and accuracy tests, and significantly higher blood pressure. In other words, concern about potential exposure can produce stress levels similar to those caused by actual exposure to radiation. This means that psychological stresses and mental health impacts from a radiation incident can extend far beyond the immediate area of impact.[2,53]

In the aftermath of an incident involving radiation and radioactive contamination, many people are left with a continuing sense of vulnerability and a pervasive feeling of uncertainty that can last for years after the event. Whether the immediate source of danger is removed from the community or people are relocated away from the danger zone, many individuals may continue to have serious concerns about the longer-term implications of the incident.[2] Thus, although the immediate emergency may officially be over and considerable time may have passed, the incident continues to act as a powerful and persistent stressor.[82] People can become hypervigilant with respect to their own health, fearful that any symptom could be an indication of radiation-related health effects. The point is powerfully illustrated in Lifton's interviews with atomic bomb survivors. One man in his 30s who had been at Hiroshima noted, "even when I have an illness which is not at all serious—as for instance when I had very mild liver trouble—I have fears about its cause."[20] Another survivor emphasizes the constant nature of the fear, saying, "even those who look no different from the people around them live in constant fear that someday the dreaded symptoms will appear."[50]

People's concerns (and their sense of guilt) can be especially strong with relation to their children, as well. They may worry, as some Hiroshima survivors did, that their future children will inherit a radiation-related disease from them.[20] Mental health, as it relates to a survivor's children, may also be impacted after nuclear accidents. Studies carried out more than 6 years after the Chernobyl disaster found a high preva-

lence of psychological distress and psychiatric impact (mainly milder psychiatric syndromes) in the severely contaminated Gomel region (Figure 8-6). Significantly higher levels of psychiatric morbidity were found in the exposed population compared to a control region. Although the effects were mainly at a subclinical level, mothers with children under 18 years of age had a significantly higher risk of psychiatric disorders. Researchers speculate that "psychiatric symptoms among these women are fostered by genuine concern about the health of their children."[83,84] Similar findings about mothers with children were found after the incident at Three Mile Island. Studies carried out by Bromet and colleagues found that the accident had a long-term adverse effect on the mental health of mothers of young children years after the accident.[85] Therefore, following a radiological or nuclear attack, mothers with young children should be seen as a high-risk group warranting special services and assistance.[2,53]

More generally, chronic stress after a radiological or nuclear incident may be an important public health problem, as it can lead to conditions such as high blood pressure, cardiovascular problems, and digestive disorders. In terms of mental health, excessive worrying over a loved one on a daily basis affects one's present attitude and hopes for the future.[53] Since the Chernobyl disaster, for example, chronic stress has contributed to a deep sense of fatalism that affects significant portions of the region's population.

A smaller portion of the population is at risk for more serious and persistent mental health problems following a nuclear or radiological attack.[2] These problems can include depression, anxiety disorders, substance abuse, and posttraumatic stress disorder (PTSD). PTSD, a "prolonged post-traumatic stress response,"[86] can result in a persistent reexperiencing of a traumatic event; persistent avoidance of stimuli associated with the trauma and a numbing of general responsiveness; and persistent symptoms of increased arousal, such as irritability, outbursts of anger, or exaggerated startle response.[2,87]

Unlike the transient stress reactions that often occur after disasters, PTSD results in higher levels of impairment and dysfunction. It typically—but not always—appears in the first few months after a trauma. There can also be variations in its intensity and duration.[79] Among the most important factors associated with the PTSD development is the nature of the trauma. Individuals "exposed to life threat and perhaps, in those exposed to terror, horror, and the grotesque,"[82] which could all be factors in a nuclear attack, are at greater risk for developing PTSD. Comparing the effects of a nuclear detonation to those from the massive conventional bombing raids of World War II, Iklé concluded that an "atomic bombing causes more severe emotional reactions than a conventional raid."[21] Psychologist Irving Janis concluded, "apparently it was not simply the large number of casualties but also the specific character of the injuries, particularly the grossly altered physical appearance of persons who suffered severe burns, that had a powerful effect upon those who witnessed them."[21] It is important to note that those with secondary exposure to trauma (eg, spouses or children of those who experienced it firsthand) may also develop PTSD.[2,79]

Although the likelihood of a situation involving nuclear combat is thought to be significantly lower today than it was in the past, such a situation cannot be ruled out. Troops operating in a nuclear environment would face both the enormous psychological stresses posed by combat and those resulting from the special challenges of dealing with radiation and radioactivity. Factors that are thought to increase the level of combat stress include surprise, lack of combat experience, poor unit cohesion, lack of preparation, prevalence of direct casualties, poor or tired leadership, and especially intense battles.[22] With respect to the radiological issues, stressors may include having to wear special protective equipment and being exposed to substantial radiation levels.[88–90]

For those in positions of command, difficult decisions about acceptable level of risk would be an additional stressor. Tradeoffs between accomplishing immediate objectives and long-term health risk may weigh heavily on commanders. More generally, concern about both immediate and future health effects would be a continuing stressor for all those operating in a nuclear environment.

Another highly stressful situation for members of the armed forces would be responding to the area affected by a nuclear detonation to render assistance to civilians. One factor would be the large numbers of bodies. According to Sullivan and Bongar, "witnessing large numbers of dead or injured people can demoralize or shock even those not directly exposed to the attack."[70] This would be dramatically amplified by seeing the bodies of dead children, including children with burns and other grotesque injuries.

The inability to help save some people would weigh heavily on personnel deployed to render assistance. Lifton cites the case of a young male social worker who was in military service at the time of the Hiroshima blast who saw a dead mother with a child still alive next to her. The social worker, who had to return to his unit, was unable to do more than provide the

child with some water, which the child was too weak to drink. The image of that child, remarked the social worker, "stayed on my mind and remains as a strong impression even now."[20]

Finally, the involvement of terrorism (eg, a series of terrorist dirty bomb attacks) could also amplify psychological effects and increase the number of people severely psychologically affected for the long term, in part because of the intentionality of the act. According to Butler et al, "Many elements of terrorism are very distinct from other forms of trauma. The most obvious and salient is the element of intent—the purpose of terrorism is widespread infliction of psychological pain."[91] The possibility of additional attacks would also likely exacerbate the psychological impacts.[91]

Clearly the psychological dimension is one of the most important aspects of a radiological or nuclear incident. Reviewing 2 decades of research on the short- and long-term health, environmental, and socioeconomic consequences of the 1986 Chernobyl disaster, an international consortium of scientists concluded that the mental health impact of Chernobyl "is the largest public health problem caused by the accident to date."[92]

PREVENTING AND REDUCING THE PSYCHOLOGICAL IMPACTS OF A RADIOLOGICAL OR NUCLEAR ATTACK

Regardless of the type of nuclear threat or nuclear incident, the guiding principle in relation to psychological impacts should be prevention. According to the Institute of Medicine, "efforts must be expanded beyond treatment for individuals who are most severely affected to comprehensive prevention and health promotion."[91] This point was also emphasized by the National Council on Radiation Protection and Measurements in *Management of Terrorist Events Involving Radioactive Material,* the first comprehensive report on radiological and nuclear terrorism:

> It is far more effective to intervene early to prevent social and psychological problems from developing than it is to have to address serious problems once they have arisen. What this implies is the need to have plans, infrastructure, resources and trained personnel already in place. In other words, the social and psychosocial component cannot be an afterthought.…The cost of inadequate preparedness is greater morbidity and more long-term effects.[2]

Thus, what is needed is a comprehensive, integrated approach that enhances preparedness, fosters people's natural resilience and helping behaviors, and endeavors to prevent and reduce psychological impact. This approach includes a number of key components.

Integrating Psychological, Social, Behavioral, and Risk-Communication Issues into Response Plans

The complex psychosocial dimension must not be overlooked when preparing for a radiological or nuclear attack.[93] This not only means it is vital to make psychological issues an organic part of the planning process; it also means considering the full range of potential scenarios, including the uncomfortable and disconcerting ones identified earlier in this chapter. Furthermore, effective planning requires that the psychological component be addressed on multiple levels: individual mental health, unit-level impacts, and broader behavioral responses, such as flight and stigma. In addition, it means addressing the possibility that large numbers of concerned individuals could flood healthcare facilities. Estimates of the kinds of numbers that could be involved vary widely. Jarrett suggests that in a nuclear attack, "everyone who 'saw the flash' would be convinced" that he or she had received a significant radiation injury.[94] Sullivan and Bongar argue that:

> public health authorities should expect that for every person actually exposed…many (perhaps hundreds) more will seek medical screening. A significant percentage of nonexposed individuals seeking screening will present with psychosomatic symptoms that mimic those of victims who were actually exposed.[70]

Whatever the estimate, such an outcome should not be ignored in plans, nor should it be considered automatic or inevitable. Plans for dealing with radiological and nuclear attacks need to include robust components for reducing (via emergency messaging and public information efforts) and addressing (eg, through triage, alternate care sites, and related approaches) this challenging issue.[95–97]

Including and Practicing Psychosocial Issues in Drills and Exercises

Drills and exercises can be invaluable in improving preparedness, but, as the National Council on Radiation Protection and Measurements pointed out a number of years ago, drills and exercises are "only useful to the extent that they are similar to the conditions likely to be faced by responders."[2] Although there have undoubtedly been improvements in recent years in including psychosocial content, the vast majority of drills

and exercises remain lacking in this key area. Having a small number of mock psychological casualties is useful but is not enough; rather, drills and exercises need to grapple with such challenges as population flight, stigma, chronic stress in the unaffected population, triage, the overwhelming of healthcare facilities by concerned and anxious individuals, adapting standard mental health interventions for contamination situations, counseling pregnant women about radiation effects, assisting high-risk groups (such as women with young children), and radiation risk communication for service personnel, civilian employees, decision makers and commanders, and the broader population. Furthermore, the various radiological and nuclear attack scenarios, including those identified earlier in this chapter, need to be exercised.

Individual Detection and Recording Devices

A key finding of research conducted during the 2006 London polonium incident (in which Alexander Litvinenko, a Russian émigré living in London, was poisoned with radioactive polonium-210 and subsequently died) was that people concerned about potential contamination are not satisfied with general assurances. Most people concerned about a radiation event want more than abstract explanations; they want specific, individual information about the level of exposure and the likely consequences.[98–100] Thus, it is advisable for all personnel who are expected to be in radiation areas to have individual dosimeters.[101] Having the kind of individual-level information that a personal dosimeter can provide is valuable as a radiation protection measure, a means of facilitating long-term follow-up, a way of providing specific answers to health concerns, and as a measure to help prevent psychological impacts. Blanket statements, and even group-level or unit-level radiation readings, are simply not a substitute for such individual-level data. Furthermore, not having such individual-level information is a recipe for chronic uncertainty and apprehension about potential future health effects.

Identifying Groups at Greater Risk for Psychological Effects

For all personnel affected by, or responding to, a radiological or nuclear event, the use of peer support, buddy care, psychological first aid, and the fostering of unit cohesion and similar approaches can help improve individual resilience and coping. At the same time, it is important to be aware of groups that may be at elevated risk for psychological effects and that may require additional support and attention. As in all disaster situations, individuals with preexisting mental illness are at increased risk. So, too, are those who suffer physical injuries, lose family in the event, suffer disruption of social support, directly witness the deaths of others, or handle dead bodies.[70]

As noted, research from the incidents at Chernobyl and Three Mile Island has identified mothers with young children as being at the greatest risk of psychiatric morbidity in radiation accidents. This finding is likely to be relevant in a radiological or nuclear attack as well. In scenarios where families of service personnel are in the affected area, special attention might need to be devoted to female service members who have young children. This could be especially important given the rapidly growing role of women in the armed services, particularly the reserves (women are now estimated to make up about 25% of the Army Reserve).[102]

Special attention will also be needed for pregnant women and persons with reproductive and fertility concerns. In the aftermath of a radiological or nuclear attack, such individuals could experience extraordinary stress about potential radiation-related health impacts on the developing fetus. Some women may also feel pressure to terminate pregnancies out of fear of giving birth to a malformed child. Thus, in any radiological or nuclear attack scenario, it will be important to have accurate information and appropriate reproductive counseling available so that informed decisions can be made and emotional support can be provided.

Depending on the scenario (eg, an attack on a military base and surrounding community in the United States), many children could also be affected. In any disaster situation, children have unique vulnerabilities. They may be exposed to the same frightening sights, sounds, smells, and dangers as adults, but not have the coping skills, resources, emotional maturity, and life experience to understand and deal with what is going on around them.[103] As Danieli and Dingman have noted, children in disaster situations may experience worry, fear, nightmares, separation anxiety, and somatic complaints, as well as concern about personal safety and security.[104] Other reactions can include changes in sleep and appetite, decreases in school performance, increased sensitivity to sounds (eg, sirens), heightened startle response, and decreased interest in pleasurable activities.[104] As younger children cope, they may "engage in posttraumatic play and ask questions or talk about the event repeatedly."[104] Older children might express concerns about their safety, security, and futures, while adolescents may respond

with withdrawal, substance abuse, risk-taking behaviors, or fascination with death or suicide.[104]

Healthcare professionals, service providers, parents, teachers and others will need to be aware of these potential impacts. Mental health professionals have cautioned that "extensive viewing of media coverage appears to negatively affect children of all ages."[104] Triage, radiological screening, and other processes will need to have pediatric-specific zones that can address the physical and emotional needs of children. In addition, there is a need for specialized, age-appropriate materials to answer children's questions and explain key aspects of the situation.[105]

A radiological or nuclear attack may even create a cohort of orphans, as was the case after the atomic bombings in Japan. Because of the conventional bombings that had already occurred, thousands of children had been taken out of urban areas. Their parents, however, still spent considerable time in the cities. Thus, when the atomic bombs were dropped, a large number of children suddenly became orphans.[106] If the central business district of a large US city were destroyed during a weekday by a nuclear weapon, when most children would be located at schools further from the city center, it is possible that a similar outcome could occur.

An Integrated Approach to Service Delivery

In providing services to an affected population, it is vital for the medical and psychosocial components of the response effort to be well integrated in terms of approach and personnel.[53] Authorities should ensure that those fearing they have been exposed to radiation or radioactive contaminants should be given requested medical examinations as soon as possible, and their concerns and symptoms should be taken seriously.[53] Likewise, pejorative terms such as "radiophobia" or "worried well" should be avoided when discussing people's concerns about radiation, since they could easily be seen as dismissive.[53]

In cases where people have been exposed to radiation, the best way to prevent psychological effects is to provide exposed individuals with care "that will enable them to maintain a sense of control over their health."[107] Healthcare professionals and those affected will need to collaborate in this process, matching vigilance programs to individual needs. Among other things, strategies for reducing overall risk through lifestyle change may be useful.[53]

Efforts to provide long-term assistance and compensation to affected populations should include a psychosocial component and should also take into account key lessons from current programs, such as the Radiation Exposure Screening and Education Program set up by Congress in 1990 and amended in 2000.[108]

Focus on the Crucial Role of Information and Risk Communication

If there is one factor that is crucial in a strategy for preventing social, psychological, and behavioral impacts, it is the availability of information. Sullivan and Bongar note that "inconsistent or incomplete information . . . can heighten anxiety and deplete trust."[70] Similarly, Pastel and Ritchie note that health risk communication is important for both acute and long-term risks, and that insufficient knowledge and poor public communication can increase psychological ill effects.[109] Noy concludes, "the most salient factor in a prevention program is the dissemination of knowledge."[22] There are several components in a communication strategy aimed at reducing psychological effects.

Prebriefing

Those going into a setting affected by a radiological or nuclear attack should be briefed in advance on what they are about to experience. No amount of preparation can completely mitigate the effects of seeing large numbers of dead bodies (including children), many with severe burns and mutilating injuries, but prebriefing personnel so that they know in advance what they are likely to encounter may help prepare them emotionally. Once on the scene, efforts to reduce exposure to trauma whenever possible are also helpful.

Just-in-Time Training

Just-in-time training is now an important part of preparation for a range of low-probability, high-consequence events where there is a rapid surge in workforce requirements.[110,111] Many people may need at least a minimal level of training on an urgent basis, and others who have had more extensive training in the past may require a quick refresher. The training should be highly practical, focused on essentials, and short enough to be completed soon before going into the field or otherwise responding to an event. It should also be developed and ready in advance so that it can be "on the shelf" should an event occur. Topics should include information on what to do, who does what, how to recognize dangers and protect against them, and how to assist others. Just-in-time training not only has the potential to increase operational effectiveness; it may also help familiarize personnel with key practi-

cal issues, helping manage fear and increasing a sense of efficacy.

Information About Family

Depending on the scenario, personnel could have deep concerns about the fate and well-being of family members. It is essential to develop lines of communication between families, friends, and the community to prevent unnecessary stress.[112]

Radiation Risk Communication

Those affected by, or responding to, a radiological or nuclear attack will have many concerns, questions, and fears regarding radiation and health effects. They may also have critical decisions to make regarding what actions they will take. The information they have can have a crucial impact on those decisions. For example, Sullivan and Bongar suggest that "effective preparation and official communication are critical to preventing unplanned evacuations."[70]

With respect to a radiological or nuclear attack, it is essential that people's information needs be anticipated and proactively addressed. Waiting until the time of an event to prepare messages and materials is already too late; rather, these items need to be crafted and professionally tested in advance to ensure that messages and materials are responsive and effective and that the communication resources are ready should an incident occur.[32] Materials should be scientifically accurate, clear, forthright, and credible, communicating "in a way that neither inappropriately minimizes effects nor creates unwarranted fear."[101] They should also emphasize actions that people can take to protect themselves. In addition to having messages and materials for military personnel and emergency responders, it is important that the information needs and concerns of other key audiences (eg, civilian employees on a base, families of service personnel) be anticipated and addressed.

SUMMARY

One of the most serious threats facing the United States today is the possibility of a large-scale attack involving radiological or nuclear weapons. Furthermore, the risk of an attack could grow in the coming years, due in part to factors such as the global illicit trade in radioactive materials, the proliferation of nuclear know-how and technology, and the continuing efforts of rogue nations and terrorist groups to produce or obtain radiological or nuclear weapons. Potential scenarios that need to be considered include an attack on a US city or port, the targeting of a US military base or the home community of a military unit deployed overseas, an attack on key commercial or governmental facilities in the continental United States, and the targeting of US personnel or interests overseas.

In addition to its physical effects, an attack involving radioactive materials has the capacity to produce widespread social, psychological, and behavioral impacts. These could range from transient or longer-lasting individual mental health effects to deep community impacts, such as stigma. Among those who could be affected are civilians, military personnel and their families, emergency responders, and others in the vicinity of the incident. Depending on the type of attack, psychosocial impacts could also ripple outward, touching the lives of people far from the site and across the nation. It is crucial, therefore, for social, psychological, and behavioral issues and challenges to be a central component of preparedness and response efforts.

When considering psychosocial impacts, the guiding principle at all levels—individual, community, and societal—should be prevention. This requires a comprehensive, integrated approach that enhances preparedness, ensures that assistance efforts are responsive, and fosters resilience. Specific measures include making social, psychological, and behavioral issues an organic part of response plans and the overall planning process; better incorporating psychosocial issues in training, drills, and exercises; providing realistic training and prebriefing to personnel and ensuring they have information about their families; identifying and providing additional support and attention to groups at elevated risk for psychological effects; taking people's health concerns seriously and integrating the medical and psychosocial components of the response effort; and fitting personnel expected to be in radiation areas with individual detection and recording devices. Finally, the importance of communication and information cannot be overstated as part of a strategy of prevention. Ambiguous, inconsistent, or insufficient information can greatly exacerbate psychosocial impacts and hamper recovery efforts. Thus, making people partners in the communication process and rapidly, candidly, and effectively addressing people's information needs are essential factors in the prevention or reduction of psychosocial impacts.

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