AN INDIVIDUAL'S STRATEGY

Based on implementing the approach described in the preceding chapter, this chapter defines a strategy that an individual would adopt to respond to, and prepare for, large terrorist attacks involving unconventional weapons. The strategy focuses on four types of terrorist attacks: chemical, radiological, nuclear, and biological. In each case, the strategy begins by describing what an individual would need to know about the characteristics and dangers of each type of attack. We then present an individual's primary needs and overarching goals. This sets the stage for a description of the actions that an individual would take and why these are appropriate. Because an individual's instincts in responding to such terrorist attacks may run counter to the course that provides the best protection, the strategy includes a set of priorities that an individual should bear in mind. The final part of the strategy is a discussion of the preparatory steps that an individual would take to carry out the recommended response actions. Given their importance to the success of the individual's strategy, enabling government and business actions are also included at the end of this chapter.

CHEMICAL ATTACK

Attack Characteristics

Types of Attack. Chemical attacks entail the dispersal of chemical vapors, aerosols, liquids, or solids that have hazardous effects on people, animals, or plants. Chemical agents can be released by a variety of methods, including by bombs or by spraying from vehicles. They affect individuals through inhalation or exposure to eyes and skin. Their impact may be immediate (a few seconds) or delayed (several hours to several days), and some chemical agents are odorless and tasteless (FEMA, 2002).

Numerous chemical agents could be used in a terrorist attack, including both industrial chemicals and chemical warfare agents. A large number of industrial chemicals might be used, including various acids, ammonia, chlorine, hydrogen cyanide, pesticides, or phosgene. The main chemical warfare agents include nerve agents (e.g., sarin, tabun, soman, VX) and blister agents (e.g., lewisite, mustard) (CDC, 2000). Chemical attacks can occur outdoors or indoors, with this distinction having significant ramifications for the best response actions. The area affected by a chemical attack is likely to be fairly small, on the order of a square kilometer (0.4 square mile).

Timelines. Chemical weapons act very quickly, often within a few seconds, although symptoms can take longer to manifest themselves if concentrations are low. Individuals will have very little time to react to an attack unless they are warned that a cloud of vapor or gas is headed their way, which is unlikely. For an indoor release, the spread of the agent throughout the building will likely occur within minutes. Outdoors, the impact near the source will be immediate, with the lethal cloud reaching its maximum extent in about an hour.

Detection. While hazardous-chemical detectors are used routinely in many industrial environments, they are very rare in commercial or public areas. Consequently, the first signs of a chemical attack are likely to be the symptoms exhibited by other people or animals. In an indoor attack, events unfolding in one area could prompt an announcement over a public address system, giving those in other areas some additional warning. In some outdoor attack situations, if the chemical cloud is large and slow moving, media reports of the first casualties may provide some warning for those not yet affected.

Support from Officials/Governments. Because of the localized nature of chemical weapons and the lack of detectors, the government is not likely to play a role until after the dangers have largely subsided. At that point, it will provide emergency services to casualties and tell individuals when it is safe to go outside (if the attack was outdoors) or inside (if the attack was in a building).

Individual's Primary Needs. Fundamentally, in a chemical attack, an individual needs access to clean air within a few minutes or less. If exposed, individuals will also need access to medical care and may need to decontaminate themselves. Because official guidance will not be available until after the attack, individuals must act by themselves to minimize exposure.

Response Strategy: Chemical Attack

The response strategy is summarized in Box 3.1 (next page) and discussed in more detail below.

Critical to an individual's response will be knowing whether the chemical attack has occurred indoors or outdoors and then taking actions in light of where one

Box 3.1

Overarching Goal

Find clean air very quickly.

Specific Actions

1. *If attack is outdoors and you are outdoors, take shelter quickly in the closest building, close all windows/doors, and shut off the flow of air. If inside, stay inside. Then, to the extent possible, move upstairs, find an interior room, and seal the room. Remain inside until told it is safe to leave and then ventilate and vacate the shelter immediately.*
2. *If attack is indoors, follow chemical attack plans specific to your building. If these are not available, open windows and breathe fresh air. If open windows are not accessible, evacuate (using escape hood if available) by stairs to street or roof.*
3. *Once protected from chemical agent exposure, decontaminate by removing clothes and showering.*
4. *When conditions are safe to move about freely, seek medical treatment.*

is in relation to that release. Key characteristics of chemical attacks are that they are fast-acting but are of short duration and cover a small area. The length and time scales are limited by the fact that dangerous concentrations of chemical agents are quickly diluted through diffusion and degradation by ultraviolet radiation. Consequently, these are localized and transient events. Response actions are therefore biased toward achieving rapid implementation over long-term protection. As a result, the individual's overarching goal, as noted earlier, would be to find clean air very quickly.

Recommended Actions

1. **If the attack is outdoors and you are outdoors, take shelter quickly in the closest building, close all windows/doors, and shut off the flow of air. If inside, stay inside. Then, to the extent possible, move upstairs, find an interior room, and seal the room. Remain inside until told it is safe to leave and then ventilate and vacate the shelter immediately.**

If the chemical attack is outdoors, finding shelter inside is the most critical action an individual should take. Individuals already inside should stay inside. Individuals outside should get inside the *closest* building as quickly as possible.

Such sheltering provides protection by blocking the chemical agent out of a space that contains uncontaminated air. It is an attractive action for a number of reasons. First, it can be implemented very quickly. In an urban environment, an individual can probably move indoors in less than one minute.

Second, it requires very little information. There is no need to determine the location of the source or direction or speed of the chemical cloud. Third, and most important, it provides very good protection. Technical evaluations indicate that such basic sheltering can reduce chemical exposure by 75 percent or more compared to the exposure outside the shelter.[1] These results are consistent with the outcomes of the aerosolized sarin attack by the Aum Shinrikyo group in a residential area in Matsumoto, Japan, in June 1994. In that incident, all seven people who died had their windows open. All of those individuals who had closed their windows—including many people closer to the source, those in units adjacent to buildings in which fatalities occurred, and those on the lower floors of these buildings—survived the attack (Yanagisawa, 1995).

Because of the variability and uncertainties in the barrier capacity of shelters, individuals should always attempt additional expedient measures. These include moving upstairs, into an interior room, and sealing windows, doors, vents, and other openings with duct tape and plastic sheeting or any other available materials. These steps reduce the infiltration rate of the outside agent into a shelter. Because most chemical agents are heavier than air, they will sink, and the highest concentrations will form at the lowest points. Thus, moving upstairs will take a person into an area where the outside concentration is lower, thereby reducing the infiltration rate into the shelter. Moving to an interior room puts more doors and walls between a person and the outside, which also reduces the infiltration rate. Finally, taping and sealing a room, as detailed in Rogers et al. (1990) and Sorensen and Vogt (2001a), will improve the barrier capacity of the shelter and reduce infiltration.[2]

Because shelters do not provide perfect protection, the chemical agent will leak into the shelter. After some time, the chemical agent outside the shelter will dissipate and the concentration will drop to a level below that inside the shelter. While the concentration inside the shelter will also begin to decrease at this

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[1] Rogers et al. (1990) examined the effectiveness of various forms of sheltering in protecting the occupants against passing clouds of different chemical warfare agents. The barrier capacity of shelters for chemical agents is often characterized in terms of the number of air changes per hour (ACH), which Rogers et al. found ranged from 1.5 for "fairly leaky units" to 0 for a completely sealed shelter. Subsequent studies found that typical homes near Oak Ridge, Tennessee, and Edgewood, Maryland, have ACH values of 0.21 to 0.45 (Sorensen and Vogt, 2001a), suggesting that an ACH value of 0.5 may be appropriate for a typical shelter. Simulations conducted by Rogers et al. show that the cumulative exposure in a shelter with ACH = 0.5 ranges from 75 percent to 95 percent less than the exposure outside the shelter. The actual exposure reduction in any situation will vary depending on the exposure received in the time it takes to reach the shelter and the leakiness of the shelter.

[2] A final consideration is being unable to shut off the air circulation system in an unfamiliar shelter. In such situations, people should remain in the shelter and attempt to block air vents. Commercial air circulation systems typically use more than 80 percent recycled (i.e., drawn from the interior) air, depending on the season, so the barrier capacity can still be quite high with the air system running.

point, it will occur much more slowly than it does outside. If an individual remains in the shelter after this time, the reduction in his cumulative exposure relative to the outside begins to erode.[3] Thus, a general concern for sheltering is minimizing unnecessary chemical exposure by vacating the shelter as soon as it is safe. This will require a combination of observation from inside as well as guidance from emergency officials.[4]

2. **If attack is indoors, follow chemical attack plans specific to your building. If these are not available, open windows and breathe fresh air. If open windows are not accessible, evacuate (using escape hood if available) by stairs to street or roof.**

For a suspected indoor chemical release, an individual should first try to verify that the source of the chemical release is really indoors. The simplest test is to look outside and see if people or animals are succumbing to the agent. Generally, if a chemical agent is detected in dangerous concentrations inside a building, it is very likely to be coming from inside, since only an enormous outdoor release would permeate indoor spaces in large quantities. Thus, while individuals should attempt to verify the source of the release, little time should be wasted in deliberations. If the result is unclear, an individual should assume that the release is indoors.

Responding to an indoor chemical attack is complicated by two important uncertainties. First, building air ventilation systems differ widely in their design and operation, making predicting how the chemicals will spread and concentrate difficult. Given this uncertainty, a response strategy designed for all buildings is necessarily generic and may not be ideal for all buildings. As such, the first action to take in an indoor chemical attack is to follow response plans for chemical release/attack specific to your building, if such plans exist.

The second important uncertainty is the risk that evacuating a building, particularly in large structures, could take an individual into harm's way: The danger from the chemical agent along an evacuation route could be greater than

[3]In fact, in some of the Rogers et al. (1990) simulations, there is a time after which the cumulative exposure of someone inside the shelter actually exceeds that of someone outside in the direct path of the cloud. However, such an extreme situation is unlikely and will only occur at exposures far above lethal.

[4]A related consideration is the habitability of a shelter. In terms of the duration of the air supply in a sealed shelter, 80 cubic feet of air (a 10-square-foot area in a room with eight-foot ceilings) contains enough air to support a person for 1.5–4.8 hours, depending on the level of activity (Rogers et al., 1990). This is comparable to the expected maximum duration of the hazard in a chemical attack of a few hours. Note that 10 square feet (3.3×3.3 feet) is a very small area and available shelter even in crowded areas is likely to provide more space than this. Because the event duration is on the order of a few hours, food, water, or other emergency supplies are not major concerns. A shower or source of running water would be useful for decontamination. Also, plastic bags would be useful to seal in contaminated clothes after they have been removed.

where someone is currently situated. For this reason, the initial action in our recommended strategy is one that supersedes evacuation.

The quickest way to access fresh air in an indoor chemical release would be to open a window or door to the outside and breathe the outside air. This action is simple and quick and is recommended in any situation in which it is possible to do so safely. Major drawbacks are that outside windows are not readily accessible in many work environments and that many windows, particularly in newer buildings, do not open. However, while we recognize that this action is likely to be impossible for many, whether an individual will be able to take this action can be established with reasonable certainty ahead of time. Thus, an important consideration for this action is to determine its feasibility in advance so that valuable time is not lost ascertaining its feasibility during an attack.

For individuals who cannot access open windows or doors, evacuation is the other course of action. The dangers to an individual in evacuating the building could be reduced if they have rapid access to respiratory protection. For individuals in work environments who spend large amounts of time at or near a fixed location (e.g., a desk), respiratory protection stored at that location could be donned within a minute or less, which is fast enough to be effective. Among the different types of chemical respirators available, the relatively recently introduced "emergency escape hood"[5] may be the most practical and effective for the general public. When a chemical attack occurs, an individual would immediately don the escape hood and evacuate the building.

While using escape hoods can be very effective for certain indoor chemical attacks, two important factors limit their overall attractiveness as part of an individual response strategy. First, escape hoods, like all types of chemical respiratory protection, can have adverse health effects if not used properly. As a result, they should not be purchased or issued without also providing proper training on their use, limitations, storage requirements, and other aspects of

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[5]An emergency escape hood is a soft-sided pullover hood with an elastic neck seal. These hoods provide chemical and biological air filtration for 15–60 minutes to enable the wearer to exit dangerous environments. Because they lack face seals, hoods require no fit-testing and are compatible with eyeglasses and facial hair. As with any respiratory protection, users should be trained on proper use. No agency in the United States tests and certifies respirators for use by the general public. However, the National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), tests and certifies respirators for use by workers to protect against workplace hazards. Respirators certified by NIOSH will say "NIOSH-Approved" and may have a certification number. However, NIOSH only certifies respirators against specific hazards. NIOSH-certified respirators are supplied with Approval Labels that identify the hazards that the respirator is approved to protect against. NIOSH is currently developing certification standards for escape hoods for protection against chemical, biological, radiological, and nuclear respiratory hazards, and standards are expected to be finalized this year. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against (NIOSH, 2003).

their operation. Second, escape hoods are currently quite expensive ($100–$200) and must be replaced after a single use (whether exposed to a chemical agent or not). Thus, escape hoods are not readily accessible to all.

As a result, substantial expertise, cost, and time are involved in using escape hoods for which an individual cannot be expected to be responsible. For these reasons, we view acquiring escape hoods not as an action to be taken by an individual but rather as an action to be taken by a business or building operator. Escape hoods should only be used when issued as part of a workplace or other organizational safety program. Decisions about whether to supply escape hoods should entail considering such factors as the type of activities conducted in the building, cost, training requirements, and perceived threats to particular areas or buildings.

With or without an escape hood, an individual should evacuate the building by the stairs to the street or, if closer and known to be accessible, to the roof.[6] Moving through areas where the dangers could exist entails risk, but the alternative of sheltering in an interior space creates potentially more serious dangers (see the discussion below).

3. **Once protected from chemical agent exposure, decontaminate by removing clothes and showering.**

Individuals exposed to a chemical agent in an attack should always attempt decontamination. Individuals should only attempt decontamination after they have obtained a reliable source of uncontaminated air inside a shelter (for an outdoor attack) or outside a contaminated building (for an indoor attack). Outer clothing may absorb certain chemical agents and, hence, continue to present a hazard, particularly to the occupants inside a shelter. Exposed clothing should be removed and sealed in a bag or other container to avoid further contact with the chemical agent. Contact lenses and eyeglasses should be removed immediately (after washing hands) to avoid continued exposure to the eyes. If an individual is noticeably damp or otherwise contaminated beyond outer clothing, further decontamination by removing all clothing and rinsing with water may be required.

In some instances professional emergency responders may establish decontamination capabilities. These facilities should be used if accessible. However, in some cases (such as in a shelter), access to emergency responders may be delayed. In those cases, individual decontamination is an important action.

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[6]Note that roof access is very often blocked from inside, so evacuating to the roof should only be considered when an individual is very confident that the roof is accessible.

The danger posed by contaminated clothing may persist long after most acute health and safety risks have subsided, so contaminated clothing should be treated or disposed of in accordance with official guidance.

4. When conditions are safe to move about freely, seek medical treatment.

Given the range of potential medical effects of exposure to chemical agents, anyone potentially exposed should seek medical care. For many, this will mean emergency medical treatment on the scene. However, in some instances, the onset of symptoms from a chemical attack may be delayed by hours or days, so individuals with less-acute symptoms should not leave the scene before receiving instructions about where and when to seek medical care. Medical treatments can minimize or reverse the effects of some chemical agents, and the time scale for such treatments to be effective can range from minutes to days.

Actions Not Recommended

Based on our evaluation, the following actions are not recommended in a chemical attack.

- Evacuating the area of an outdoor attack.

For evacuation to be effective, an individual must move outside the dangerous area before being overcome by the chemical agent. While it may be possible for a person to successfully outrun the advancing cloud, this would require knowing fairly accurately which direction to run. Given the complex, small-scale wind patterns that can arise in an urban environment, there is no way to know with any certainty in which direction the cloud is spreading or whether the concentration decreases monotonically in that direction—pockets of high concentration may form downwind of lower concentrations. Even if the necessary evacuation direction is apparent, the local arrangement of streets and buildings may block that path.

We also do not recommend evacuating by car. While a car could allow for more rapid evacuation, the chemical protective capacity of a moving car is lower than that for buildings by a factor of 10 or more (Sorensen at al., 2002). Given the delay that may be incurred in getting into a car, as well as the uncertainties about which direction to take and whether an evacuating path is available, the potential dangers involved do not warrant taking this action when shelter is available.

Thus, given these formidable uncertainties, as well as the immediate protection provided by indoor shelter and the relatively short duration of a chemical attack, evacuation is not recommended. If, however, the release is in a large open area away from buildings, evacuation may be the only available course of action. In that case, an individual should move in a cross-wind direction and avoid low places where the gas could collect.

- Donning respiratory protection in an outdoor attack.

Because of the very rapid onset of the hazard in an outdoor chemical attack, respiratory protection would only be feasible if it were carried on the person and could be donned within a minute or less. This is considered impractical. Chemical respiratory protection stored in the home, workplace, or car would be of little use in an outdoor chemical attack because there will not be time to retrieve these items.

Expedient respiratory protective actions (e.g., covering nose and mouth with cloth) provide no protection from gases and only moderate filtration of aerosols (Rogers et al., 1990; Sorensen and Vogt, 2001b).[7] Many chemical agents that may be delivered as aerosols, such as sarin, are also quite volatile; hence, aerosol particles condensed onto filter materials may still release hazardous vapors. Implementing expedient respiratory protection will also cause a brief but nonetheless critical delay in an individual's effort to find shelter and will also hinder that effort by tying up one or both hands. These weaknesses outweigh the potential benefit. Thus, we do not recommend respiratory protection of any kind for an outdoor chemical attack.

- Donning protective clothing in an outdoor attack.

Similarly, there will be no time to don chemical protective clothing. Further, since the primary hazard for most chemical agents is respiratory or to the mucous membranes, protective clothing would not protect the user from the most dangerous threat. Thus, protective clothing is not recommended for any outdoor chemical attack.

- Sheltering in place for an indoor attack.

For indoor chemical attacks, sheltering in place has two serious flaws. First, since the agent is likely to be distributed through the building ventilation system, little chance exists of knowing whether a potential shelter space has already been contaminated. Second, sealing the shelter would require rapid and efficient sealing of the ventilation system because the agent is being forcibly introduced through a fan-driven air circulation system. Sealing a shelter with tape and plastic sheeting can be expected to take longer than the time

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[7]Although we have found no data examining the chemical agent protection capacity of particulate filter masks, such masks are expected to provide protection similar to that of expedient measures.

required for the chemical agent to infiltrate the building.[8] This action is therefore not recommended and should only be attempted if all evacuation routes are blocked. A predetermined and presealed shelter in a building would avoid some of these problems, but it would have to be located close enough that individuals could reach it in less than a minute. Therefore, one would be required on every floor.

RADIOLOGICAL ATTACK

Attack Characteristics

Types of Attack. A dirty bomb uses conventional explosives to disperse radioactive material across a wide area, although slower and less dramatic methods are possible and may escape detection.[9] The area affected by a radiological attack could be fairly small—a few blocks—or could cover hundreds of square kilometers with low-level radiation, depending primarily on the type and amount of radioactive material used. The hazards to individuals from the radiation are likely to be quite low and will manifest themselves only after many years, if they do so at all. For those close to the explosion, the hazards from the blast are much higher. While indoor attacks are also possible, outdoor attacks have the potential to affect more people, cause more social anxiety, and contaminate a larger area than indoor attacks.

The hazard from a radiological bomb results from two categories of exposure. The primary short-term exposure hazard is inhalation of radioactive material suspended with the dust and smoke from the explosion. Inhaled radioactive material can be deposited in the lungs and will continue to expose the individual to radiation for as long as the material remains in the lungs, which can be many years. A second, long-term external exposure hazard exists for individuals who remain in the contaminated areas over a period of years. Although there is considerable debate in the scientific community about the effects of low levels of radiation on individuals (e.g., Jones, 2000), it is likely that authorities will take steps to address this risk, either by limiting access or decontaminating the area (Levi and Kelly, 2002).

Timelines. The dispersal of radiological material by explosives is likely to be quick. Much of the material will be lofted into the air with the smoke cloud and then deposited on the ground within several hours of the explosion as the cloud

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[8]Rogers et al. (1990) estimate that sealing a shelter would take about 17 minutes, longer than the time required for a chemical agent to completely infiltrate a 10-story building (five to seven minutes; see Appendix A).

[9]Radiological dispersal devices (RDDs) aim to disperse radioactive materials. This goal can be achieved by methods other than using explosives (e.g., aerosol release).

passes overhead. Authorities may not know for an hour or more that the explosion dispersed radiological materials, and it could take a day or more to identify and characterize the contaminated area.

The key characteristic of radiological attacks is that the resulting levels of radiation will be quite low. Except for the individuals injured by the explosion, the health effects of both short- and long-term exposure will manifest themselves only after many years in the form of an elevated risk of cancer.

Detection. Because any immediately visible consequences of the radiation are unlikely, an individual will only become aware of a radioactive release from officials or media reports. Radioactive contamination is very easy to detect with relatively inexpensive equipment. First responders in some areas and most hazmat units are equipped with detectors and could confirm a radioactive release associated with an explosion soon after arrival on the scene. Some cities are reported to have installed monitoring systems that continuously sample the air (Department of Homeland Security, 2003c;Rashbaum, 2002), which could enhance detection capabilities. Determining the type of radioactive material may take a little longer, because it requires more-sophisticated instruments. If the material is released slowly, without an explosion, detection of contamination could be delayed significantly if the city does not have monitoring systems installed.

Support from Officials/Governments. Since detectors are required to signal the presence of radiological materials, the government will likely play a central role in the response to any such attack. However, because it could take an hour or more to detect the radiation, individuals within the cloud will not know that radiation is present immediately following the event, the period when the risk from inhalation is greatest.

Individual's Primary Needs. Fundamentally, an individual needs to avoid exposure to radiation, particularly through inhaling radioactive dust from the cloud. If exposed, an individual should also seek medical care as soon as it is safe

Response Strategy: Radiological Attack

The response strategy for a radiological attack is summarized in Box 3.2 (next page) and then discussed in more detail below.

Critical to an individual's response will be knowing where the radiological attack has occurred (outdoors or indoors) and then taking actions appropriate for where one is in relation to release of the radiation. The individual's overarching goal would be to avoid inhaling dust that could be radioactive.

Box 3.2

Overarching Goal

Avoid inhaling dust that could be radioactive.

Specific Actions

1. *If an explosion occurs outdoors or you are informed of an outside release of radiation and you are outside, cover nose and mouth and seek indoor shelter. If you are inside an undamaged building, stay there. Close windows and doors and shut down ventilation systems. Exit shelter when told it is safe.*
2. *If an explosion occurs inside your building or you are informed of a release of radiation, cover nose and mouth and go outside immediately.*
3. *Decontaminate by removing clothing and showering.*
4. *Relocate outside the contaminated zone, only if instructed to do so by public officials.*

Recommended Actions

1. **If an explosion occurs outdoors or you are informed of an outside release of radiation and you are outside, cover nose and mouth and seek indoor shelter. If you are inside an undamaged building, stay there. Close windows and doors and shut down ventilation systems. Exit shelter when told it is safe.**
2. **If an explosion occurs inside your building or you are informed of a release of radiation, cover nose and mouth and go outside immediately.**

The primary safety and health hazard in a radiological attack is inhalation of radioactive particulate matter generated from an explosion or other type of release (e.g., aerosol). A simple and effective way to prevent this is to take shelter in a structure that blocks the infiltration of particulates. This action is attractive because it is simple, quick, and effective. The onset of the exposure hazard in a radiological attack initiated with a bomb is expected to be immediate, and the exposure is greatest in the first few hours, while the particulate matter is still airborne.

For individuals outside when such an attack occurs, sheltering in a nearby building will provide good protection and should be attempted immediately. The closest shelter not damaged or endangered by the explosion should be sought because the goal is to minimize exposure to suspended particulate matter. Individuals already indoors should remain there as long as their building has not been damaged and is not threatened by fires or other consequences of the attack.

The primary complication with this action is that it is unlikely to be apparent that any radioactive material has been released for some time. However, this action is generally advisable in response to any explosion event because many types of nonradioactive dust present health hazards and should be avoided as well. In addition, sheltering will help counter the tendency for people to gather at an explosion site, thus decreasing the impact of any secondary device that may target those who gather at the scene. As a result, finding shelter should be the goal in any explosion. Once emergency responders begin to understand the type and extent of radioactive contamination, they can provide guidance about when and how to vacate shelters.

Respiratory protection should be used to prevent inhalation of radioactive particulate matter. As with sheltering, a complication of this action is that the release of radioactive material is unlikely to be apparent for some time. However, for the same reasons as with sheltering, this action is beneficial in the response to any explosion event, whether radioactive material is present or not.

There are two primary variations of respiratory protection: expedient and particulate filter[10] equipped facemasks. Expedient respiratory protection refers to using available materials, such as clothing or towels, as filter material. For individuals outside when such an attack occurs, expedient respiratory protection will be necessary, because the onset of the hazard is expected to be so rapid that effective use of a filter mask will be either impractical (i.e., it will have to be carried at all times) or too slow (because an individual would need to travel to a car or other storage space to retrieve it).

Evaluation of expedient respiratory protection shows that a wide variety of common materials have similar filtration efficiencies, with the efficiency increasing with the number of layers used (Guyton et al., 1959; Sorensen and Vogt, 2001b). According to those sources, wetting the material makes it no more effective and also increases breathing resistance and so should not be done. Given that most likely expedient filtration materials have similar protective capacities, the primary concern is obtaining a good seal around the nose and mouth. Thus, while understanding that options may be very limited, one should strive to use soft cloth and fold, cut, or tear it so that it can be handled in such a way as to hold it tightly over the nose and mouth. If tape is available, the material should be taped to the face to improve the seal. A substantial short-

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[10]The Occupational Safety and Health Administration (OSHA) and NIOSH rate particulate filter masks. The most relevant of nine ratings are N95, P95, N100, and P100, which are based on whether the filters have been tested to filter out 95 percent or 99.97 percent of particles 0.3 microns in diameter and whether they can (P) or cannot (N) function in the presence of petroleum fumes. Human lungs do not retain particles smaller than about 1 micron in diameter, so these percentage ratings are highly conservative. The efficiency of N95 respirators reaches approximately 99.5 percent or higher at about 0.75 microns (Qian et al., 1998).

coming of expedient respiratory protection is that it requires at least one hand to hold it in place, thereby decreasing agility and mobility. In addition to improving the seal, taping the mask to the face can eliminate this problem. In any case, one should keep in mind that the respiratory hazard increases with the cumulative inhalation exposure, so even if expedient respiratory protection must be temporarily removed, it should be replaced as soon as possible.

Individuals indoors should evacuate the premises if the attack occurs indoors or damages or threatens their building enough to undermine its sheltering capacity. In this situation, a particulate filter mask may be appropriate. Regular building occupants could store a filter mask in their work space for rapid retrieval and donning in the event of a radiological attack or other explosion. These masks are much more effective than expedient measures, are inexpensive, are widely available, are compact, have long shelf lives, have minimal maintenance requirements, and are simple to use. We therefore recommend their use for anyone indoors in a potential indoor radiological attack.

3. Decontaminate by removing clothing and showering.

Radioactive particulate matter trapped on a person's clothing, hair, or skin can pose an exposure hazard that remains even after direct contact from suspended particulate matter has been eliminated. Therefore, anyone who has been exposed to radioactive material should undergo decontamination once safely sheltered from the source of radioactive material. Decontamination should initially focus on removing any respirable dust, which would entail removing outer clothing and securing it in a bag or other container. While the hazard is primarily respiratory, contact of radioactive material with skin and eyes should be minimized by rinsing exposed skin, removing contact lenses, and showering as soon as possible. The danger posed by contaminated clothing may persist for long durations, so contaminated clothing should be treated or disposed of in accordance with official guidance.

4. Relocate outside the contaminated zone, only if instructed to do so by public officials.

Although contamination levels from a radiological weapon are likely to be quite low, long-term exposure may be high enough in some areas that authorities will ask individuals to leave their homes or businesses for some period of time. Relocation does not need to be done quickly because it is the exposure over many years that is the concern; the relocation could happen over weeks or months. Individuals may be allowed to return within a few months if the area is to be decontaminated, but it may also be many years before individuals will be allowed to return. Individuals will have to rely on authorities for information about whether relocation is called for and how long it is likely to last.

Actions Not Recommended

Based on our evaluation, the following actions are not recommended in a radiological attack.

- Evacuation.

The protection goal in a radiological attack is to avoid inhaling radioactive particulate matter. Evacuation could provide protection by enabling the individual to get outside of the range of the suspended material. While this action is attractive in some respects (e.g., it is effective, simple, and applicable to all locations), it suffers from slow implementation speed and requires more information than is likely to be available. Furthermore, the risk to an individual's health from external exposure to the radiation is likely to be quite low. The greatest exposure hazard is in the initial minutes and hours after the attack, when the concentration of suspended material is highest. This is the time during which evacuation is least effective because it takes time to clear the contaminated area. Thus, individuals could incur more exposure during evacuation than by staying indoors. Also, individuals will have little way of knowing the direction or extent to which the radioactive contamination is distributed, so it may not be clear where or how far to evacuate. For those outdoors or inside an unaffected building, evacuation is not recommended.

NUCLEAR ATTACK

Attack Characteristics

Types of Attack. A nuclear detonation has several immediate effects: a powerful blast that knocks over buildings, high-energy prompt radiation from the nuclear reaction, a strong flash of light and heat, and an electromagnetic pulse that may interfere with electronic equipment. The distance those effects are felt from the detonation depends on the size of the weapon and how high above the ground the detonation occurs. In the Cold War, attacks were expected to have involved many strikes with very large weapons (hundreds of kilotons). While it is not possible to predict the characteristics of future terrorist attacks, they are probably more likely to use a single smaller weapon that ranges from less than a kiloton to 10 kilotons and are likely to detonate the nuclear device on the ground, not in the air.[11] A ground burst will have reduced blast effects but will produce a larger footprint on the ground of the highly radioactive fallout cloud, extending possibly tens of miles. This fallout could be lethal to those in its path who are not well protected. Nuclear attacks will also significantly damage infra-

[11]For a discussion of why this is the case, see U.S. Navy, 2002.

structure, not only to buildings but also to utilities, electronics, and other services.

Timelines. The prompt effects of nuclear weapons are essentially instantaneous—they last for a minute or less. The fires caused by the heat from the detonation start soon after but are not likely to become a broad fire for 20 minutes or more. Radioactive particles from the fallout cloud begin to fall to the ground 10–15 minutes after the detonation near the spot of the detonation. Farther away, the radioactive fallout begins to land soon after the cloud passes overhead. After about 24 hours, all the fallout is deposited. The radioactivity in the fallout is extremely high early on. However, after two days, it will have decreased in intensity significantly (by a factor of 100 compared to one hour after the blast).

Detection. A nuclear detonation will be unmistakable from the moment it occurs. The bright flash, the widespread physical destruction, the searing heat, and the mushroom cloud are unique. During the Cold War, the attack would have been detected as satellites tracked missiles on their 30-minute journey to the United States from Russia, which would have given individuals a chance to get to a fallout shelter. Terrorists are much more likely to deliver the weapon surreptitiously, perhaps by a truck or ship, rather than by missile. Hence, there would be little chance for early detection and warning.

Support from Officials/Governments. Government officials would be unlikely to provide support until well after the detonation. Initial activities would include providing medical care to survivors, rescuing people from areas that are safe enough to enter briefly, and informing individuals when the fallout radiation was low enough that individuals could leave their shelters and the contaminated fallout area.

Individual Primary Needs. If the nuclear detonation occurs without warning, individuals inside the blast zone will have absorbed whatever prompt radiation they were exposed to seconds after the blast. Because the effects of radiation are cumulative, an individual's primary need then is to protect against any further exposure. Because government support is unlikely to be available inside the fallout zone, possibly for days after the attack, individuals will need to act on their own to minimize such exposure.

Response Strategy: Nuclear Attack

The response strategy for a nuclear attack is summarized in Box 3.3 (next page) and discussed in more detail below.

Box 3.3

Overarching Goal

Avoid radioactive fallout: evacuate the fallout zone quickly or, if not possible, seek best available shelter.

Specific Actions

1. *Move out of the path of the radioactive fallout cloud as quickly as possible (less than 10 minutes when in immediate blast zone) and then find medical care immediately.*
2. *If it is not possible to move out of the path of the radioactive fallout cloud, take shelter as far underground as possible, or if underground shelter is not available, seek shelter in the upper floors of a multistory building.*
3. *Find ways to cover skin, nose, and mouth, if it does not impede either evacuating the fallout zone or taking shelter.*
4. *Decontaminate as soon as possible, once protected from the fallout.*
5. *If outside the radioactive fallout area, still take shelter to avoid any residual radiation.*

In a surprise attack, an individual cannot avoid the initial effects of a nuclear detonation—blast, heat, and prompt radiation. However, the dangers from exposure to the radioactive fallout from the cloud that will form shortly thereafter can be reduced significantly. This will require that an individual locate the area of this radioactive cloud and act quickly. The individual's overarching goal would be to avoid fallout by either quickly evacuating the fallout zone or seeking the best available shelter.

Recommended Actions

1. Move out of the path of the radioactive fallout cloud as quickly as possible (less than 10 minutes when in immediate blast zone) and then find medical care immediately.

Individuals can best protect themselves by evacuating the area where the radioactive fallout is likely to land. This is the case because evacuation provides protection that is full and indefinite and is appropriate for wherever the attack occurs and for different variations in an attack. It makes possible access to medical care, which will be critical to individuals in the blast zone who may have absorbed a high dose of prompt radiation from the detonation or sustained injuries from the blast and heat. It is also low in cost and requires little preparation. The fallout zone is defined as that area in which the fallout will generate 100 rad over 24 hours.[12] See Figure 3.1.

Evacuation affords such protection because the onset of the radioactive fallout is not immediate but is expected to begin 10–15 minutes after the detonation in the vicinity of the blast and extend for hours as the radioactive cloud moves downwind.[13] Thus, a shortcoming of evacuation in attacks involving chemical or radiological weapons—that it cannot be done quickly enough to provide adequate protection—does not hold in this case. Evacuation also protects against the hazard of large fires that may emerge in the blast zone within 20 minutes or so after the detonation and could endanger individuals in shelters.

The distances an individual must travel to evacuate the fallout zone are not large. Even for a 10-kiloton weapon, a person located anywhere in the region between the blast site and up to about 10 kilometers (6 miles) downwind of the blast site would need to travel less than 2 kilometers (1.2 miles) to evacuate the most dangerous fallout area. Even where the radioactive cloud is at its widest, some 20 to 50 kilometers (10 to 30 miles) downwind, an individual would only need to travel at most about 5 kilometers (3 miles). In this latter case, more than 10 minutes would be available for evacuation because it would take some time for the cloud to reach that distance. Because roads are likely to be impassable for automobiles in many areas because of damage, debris, or traffic, individuals should evacuate on foot.

The primary considerations for this action are knowing whether one is in an area that may become contaminated by radioactive fallout and, if so, knowing which direction to take. Fallout is likely to cover a portion of the blast zone (Figure 3.1). Thus, anyone in the blast zone, which will be characterized by severe damage and broken windows even at its outer periphery, is in danger of contamination from radioactive fallout. The fallout zone will extend some 20–80 kilometers (10–50 miles) downwind, depending on the weapon's size and the local winds. The downwind fallout zone will be less clearly delineated than the blast zone, but its approximate location can be determined by observing the mushroom cloud and the direction in which the wind seems to be blowing.

To evacuate from the blast zone, individuals should move directly away from the blast center until they are clear. The location of the center will be apparent

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[12]As discussed in Appendix A, short-term radiation doses below about 200 rad (or rem) are nonfatal when treated. Thus, people receiving 100 rad or less in the few days after the blast will suffer no acute effects.

[13]By contrast, the immediacy of the hazard in chemical or radiological attack makes evacuation unattractive.

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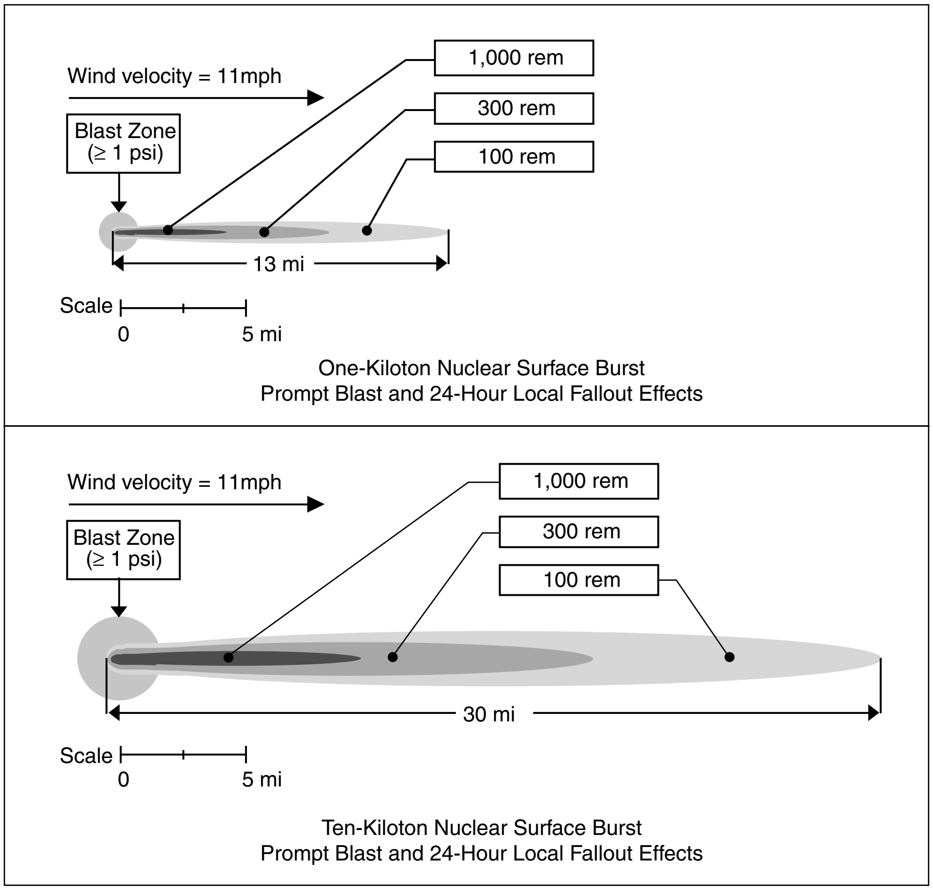

Figure 3.1—Blast Zone and Radioactive Fallout Contours for a One-Kiloton and a Ten-Kiloton Nuclear Explosion

from the initial bright flash and subsequent vertical rise of a mushroom cloud. If the location of the detonation cannot be determined quickly, individuals should walk in the direction of less damage, where more buildings are standing and where there are fewer broken windows.

Individuals outside the blast zone who are in the radioactive cloud path (including those who evacuated in a downwind direction from the blast zone) should move in a cross-wind direction until out from underneath the path of the developing radioactive cloud. To determine the wind direction, individuals should look for the direction that the mushroom cloud or smoke from fires is going and go perpendicular to it. If they can feel the wind, they should walk with the wind in their ears.

Although individuals may not feel any symptoms, those in the blast zone may have absorbed a high dose of prompt radiation from the detonation. Thus, we highly recommend that such individuals receive immediate medical care once outside the fallout area because such care could be essential for survival.

2. **If it is not possible to move out of the path of the radioactive fallout cloud, take shelter as far underground as possible or if underground shelter is not available, seek shelter in upper floors of a multistory building.**

If evacuation is impossible, shelter is essential for anyone remaining in the path of the radioactive fallout cloud. Radiation from local fallout can be intense, delivering a lethal dose to an unprotected person in an area up to 8 kilometers (5 miles) downwind of the detonation within an hour, depending on the size of the weapon. To protect against this radiation, individuals should get as much solid material (dirt, concrete, or masonry) and space as possible between themselves and the fallout, which collects on the ground and roofs of buildings.[14] The best shelter is well below ground level, in the sub-basement of a building, a subway tunnel, or the lowest level of an underground garage. These shelters can reduce exposure levels by factors of 1,000 or higher, as shown in Table 3.1.[15]

If an individual cannot get to an underground shelter within the timelines of the arrival of the radioactive fallout, the next best shelter would be in the upper floors of a multistory building (greater than 10 stories) but at least three stories

Table 3.1

Radiation Protection Factors for Different Shelter Types

Structure	Protection Factor
Under three-feet of earth, sub-basements of multistory buildings	1,000 or greater
Central areas of upper floors (excluding top three floors) of multistory buildings	100–1,000
Basements of houses	10–20
Frame house	1.5–3

SOURCE: Glasstone (1962), Glasstone and Dolan (1977).

[14]The radiation doses that could be absorbed as a result of a nuclear detonation are several orders of magnitude greater than in the case of a dirty bomb. Thus, shielding is critical to an individual's survival in the nuclear detonation case.

[15]Individuals should try to limit their total exposure to no more than 100 rem and preferably far less. (See Appendix A for discussion about the effects of radiation on people.) In the close-in zones, where exposures for unprotected people could exceed 10,000 rem over 48 hours, protection factors of 100 or higher will be essential. Such shelters could be required up to 15 miles downwind of the blast site for a 10-kiloton weapon. Outside of that zone, where 48-hour exposures would be 1,000 rem or less without protection, typical house basements, with protection factors of 10–20, would be sufficient.

below the roof to avoid the fallout deposited there.[16] Protection is best as far as possible from the outside walls. Such a shelter can provide protection factors of 100 or higher, but it could be significantly less if the windows or structures have been damaged.

Ordinary house basements provide inadequate protection in areas of intense radioactive fallout because they provide protection factors of only 10–20. However, at distances greater than about 25 kilometers (15 miles) from the detonation, where the levels of radiation will be much less, they could be sufficient.[17] Nevertheless, because it could be difficult to know where you are in relation to the detonation and because the yield of the weapon is not known, the more shelter the better. In all cases, once inside the shelter, shut off all air circulation systems and close off doorways and windows. The room should not be sealed completely, because enough air will be needed to breathe for at least 48 hours. Individuals should remain in the shelter and await guidance from officials about when it is safe to leave, which could take 24 to 48 hours. Individuals should attempt to gain access to their emergency supply kit for use while in the shelter, but it is better to reach a good shelter in time without the kit. The ideal shelter would be prestocked with supplies to support occupants for two to three days.

3. **Find ways to cover skin, nose, and mouth, if it does not impede either evacuating the fallout zone or taking shelter.**

Although radioactive fallout will not begin to land in the blast zone and surrounding areas for at least 10 minutes, some radioactive particles and dust are likely to be present from the detonation. Therefore, individuals should take the precautionary step of protecting themselves from this radiation. Respiratory protection can be achieved by using particulate filter masks or other expedient measures, such as covering the nose and mouth with clothing or towels. (See the discussion in radiological attack section.) It is important to note that, in contrast to a radiological bomb, the primary hazard from radioactive fallout is radiation absorbed from outside the body. Respiratory protection steps, therefore, will provide only limited protection. As a result, we recommend that respiratory protection be retrieved and donned but only if this causes no more than a few moments delay in evacuating the fallout zone or finding shelter.

[16] In a building surrounded by neighboring buildings with roofs that are somewhat lower, the safest place is three stories below those lower roofs.

[17] Individuals would know that they are at least 15 miles away from the detonation point if at least 75 seconds go by between the flash from the detonation and the arrival of the blast wave. This is the same method commonly used to estimate the distance of a lightning strike during a thunderstorm: Count the time (in seconds) between the arrival of the flash and the arrival of the thunderclap and divide that time by five to get the distance in miles from the detonation.

The radiation in nuclear fallout consists primarily of gamma emitters but also includes beta radiation. Protective clothing provides no protection from gamma radiation, although it can provide significant protection from beta radiation. We therefore recommend covering exposed skin but again only if it does not impede evacuating or taking shelter. In this context, any clothing that covers exposed skin and the head is considered protective clothing. Thus, most fully dressed individuals would only need a hat or hood. Protective clothing has the additional advantage of facilitating decontamination by providing a layer that can be quickly removed to dispose of any fallout material that may have accumulated on a person during evacuation or prior to sheltering.

4. Decontaminate as soon as possible once protected from the fallout.

Decontamination can provide protection for anyone who has spent time in the area of the nuclear blast or the radioactive fallout zone by eliminating exposure from radioactive particulates (dust) that have adhered to the body. Decontamination should initially focus on removing outer clothing, including shoes, and securing it in a bag or other container. Individuals should minimize contact of radioactive material with skin and eyes by rinsing exposed skin, removing contact lenses, and showering as soon as possible. Contaminated clothing should be treated or disposed of in accordance with official guidance.

Decontamination should be undertaken as quickly as possible but only after an individual is protected from exposure to fallout by evacuation or sheltering.

5. If outside the radioactive fallout area, still take shelter to avoid any residual radiation.

Because uncertainty exists about exactly where the radioactive cloud will travel and where the fallout will land, it is important for individuals outside the apparent fallout zone to take shelter. House or building basements should provide sufficient protection.

BIOLOGICAL ATTACKS

Characteristics

Types of Attack. Biological attacks can involve two basic types of biological agents: contagious and noncontagious. Contagious agents spread from person to person and include such agents as smallpox, plague, ebola, and dengue fever. Noncontagious agents do not spread from person to person; the primary threat is posed from the initial release of the agent. Such agents include anthrax and tularemia as well as biological toxins.[18] Some agents have the potential to survive in the environment for extended periods of time and cause further risk of exposure if the agent is resuspended into the air. Left untreated, some of the diseases caused by either type of agent have the potential to kill a sizable fraction of those exposed to them. Because biological attacks may not be noticed for several days or weeks, there is no real difference for the individual whether the attack occurs indoors or outdoors. Some general characteristics of some biological agents are listed in Table 3.2.

Timelines. Each disease has its own timeline that depends on the clinical and epidemiological characteristics of the biological agent. When compared to other types of potential weapons, most biological agents possess the unique feature that the consequences of the attack might not be realized for several days to weeks after the attack has occurred. This duration correlates with the incubation period of the disease, some of which are listed in Table 3.2.

Anthrax. Based on data from the 1979 anthrax release at Sverdlovsk, the mean time between infection with inhalational anthrax and the onset of symptoms is 10 days, with the earliest and latest appearance of symptoms being 3 days and about 40 days after the release (Meselson et al., 1994). The large variation is thought to result from the ability of anthrax spores to remain in the body for long durations before germinating to produce the toxic vegetative form of the anthrax bacteria (Dixon et al., 1999; Inglesby et al., 2002). In a large attack, initial symptoms will likely begin to appear in the first week. If the release is undetected, it may take another two days or more before anthrax is suspected and another day before it has been confirmed. After the attack, anthrax spores can

Table 3.2

Selected Properties of Potential Biological Agents

Agent	Contagious	Incubation Period	Potential for Long-Term Contamination of Environment	Fever
Smallpox	Yes	12–14 days	No	Yes
Anthrax	No	3–40 days	Yes	Yes
Plague	Yes	2–4 days	No	Yes
Tularemia	No	3–5 days	No	Yes

SOURCE: Henderson et al. (1999); Inglesby et al. (2000, 2002); Dennis et al. (2001).

[18]We include biological toxin agents, such as botulinum toxin or ricin, under biological attacks because, while their effects in the body are chemical in nature and they do not contain organisms or viruses, the consequences of the attack might not be realized for hours or even a few days and so the steps an individual would take would be similar to those for an attack involving noncontagious biological agents. See Ostroff (2000) for more discussion of biological agents that may be used in a terrorist attack.

remain on the ground and other surfaces indefinitely and, if of high weapon quality, could potentially be resuspended and inhaled, posing further risk of infections. The risk of infection from resuspended spores is highly uncertain but thought to be much less than the risk from exposure of the initial release (e.g., Davids and Lejeune, 1981; Birensvidge, 1992; Weis et al., 2002).

Smallpox. The incubation period for smallpox averages 12–14 days (Henderson et al., 1999). After incubation, those infected with smallpox will begin to exhibit the initial flu-like symptoms (e.g., high fever). Roughly two days later, a characteristic rash begins to emerge on the extremities of the body. Smallpox will likely be confirmed a few days later, at which point the outbreak will be announced to the public. This announcement is expected to occur about 16 days after the attack. It could take public health efforts many weeks to stop the spread of smallpox.

Detection. A biological attack may be perpetrated in a number of ways. If an attack is detected while a biological agent is still being released, measures can be taken to prevent exposure and infection (e.g., moving away from the release and early prophylaxis). At this point, however, government officials are likely to detect an attack only after those who are initially infected report to health care facilities and are diagnosed with the disease.[19]

Support from Officials/Governments. Because of the gradual nature of biological weapons effects, the government will play a central role in helping the individual. The medical and public health systems will be instrumental in diagnosing any illness caused by biological weapons, as well as in estimating the time and location of attack. They will investigate whether cases of illness may result from a bioterrorism attack; coordinate the medical response; provide vaccinations and/or antibiotics; and inform the public about when and where to get medical treatment, how to minimize exposure, and whether to relocate. This includes informing the public about whether the biological agent used is contagious or noncontagious.

Individual's Primary Needs. Fundamentally, an individual needs access to an environment free of infection-producing agents. If potentially exposed, individuals will also need access to medical evaluation and treatment. Individuals can expect guidance about where to go and what to do. Note that guidance in this area is expected to evolve with time as officials learn more about bioterrorist threats, effective treatments, and public responses.

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[19] A recent proposal to monitor cities around the country for potential biological warfare agents may give warning after a day or two if it is implemented and proves effective (Bender, 2002; U.S. Department of Homeland Security, 2003c; CDC, 2003c).

Response Strategy: Biological Attack

The response strategy for a biological attack is summarized in Box 3.4 and discussed in more detail below.

Although great uncertainty exists about how a biological agent might be delivered, many plausible delivery methods could easily go undetected. As a result, the strategy involves actions designed to occur as part of official activities that will have been put into place. Nevertheless, an individual will be required to act quickly. Thus, learning in advance what these actions will be, and gaining confidence in government plans, will be important. Moreover, the government will face many challenges in providing appropriate medical care, especially when many essential services will be disrupted. Individuals will therefore need to be ready to act on their own, even in covert attacks, to achieve the overarching goal: to get medical aid and minimize further exposure to agents.

Critical to an individual's response will be knowing whether the biological agent is contagious and then whether he or she has been exposed. Based on current government planning for biological attacks identified through clinical diagnosis, individuals can expect the following in terms of guidance about how to achieve this goal.

Box 3.4

Overarching Goal

Get medical aid and minimize further exposure to agents.

Specific Actions

1. *If symptomatic, immediately go to medical provider specified by public health officials for medical treatment.*
2. *If informed by public health officials of being potentially exposed, follow their guidance.*
    - *For contagious diseases, expect to receive medical evaluation, surveillance, or quarantine.*
        - *— If "in contact" with persons symptomatic with smallpox, obtain vaccination immediately.*
    - *For noncontagious diseases, expect to receive medical evaluation.*
        - *— For anthrax, obtain appropriate antibiotics quickly.*
3. *For all others, monitor for symptoms and, for contagious diseases, minimize contact with others.*
4. *Leave anthrax-affected area once on antibiotics if advised to do so by public health officials.*

Recommended Actions

1. **If symptomatic, immediately go to medical provider specified by public health officials for medical treatment.**

Getting medical treatment if symptoms arise is an important action for improving one's chances of recovery. An individual can expect guidance from officials about the likely symptoms for the specific kind of biological attack that has occurred. Because anthrax is caused by a bacterium, antibiotics are required for treatment and anthrax can be countered with aggressive antibiotic treatment (Dixon et al., 1999; CDC, 2001a; Inglesby et al., 2002). While it is important to begin antibiotic treatment in these cases as soon as possible, we do not recommend that individuals self-medicate with home supplies of antibiotics for reasons discussed later in this chapter. Although no cure for smallpox exists, chances of survival improve with medical care (Henderson et al., 1999; Brenan and Henderson, 2002). In the event of a bioterrorist attack, special treatment facilities may be established, and individuals should follow the guidance of public health officials about where to seek medical treatment.

2. **If informed by public health officials of being potentially exposed, follow their guidance.**

   - **For contagious diseases, expect to receive medical evaluation, surveillance, or quarantine.**

     — **If "in contact" with persons symptomatic with smallpox, obtain vaccination immediately.**

   - **For noncontagious diseases, expect to receive medical evaluation.**

     — **For anthrax, obtain appropriate antibiotics quickly.**

Those individuals *potentially* exposed in a biological attack are those not showing symptoms but who were either present in the area of the attack or, in the case of a contagious agent, exposed to those who were. The primary concern for these individuals is the heightened probability that they may have been infected but are not yet showing symptoms. These individuals will be identified by public health officials. How precisely this group can be defined will depend on the ability of public health officials to pinpoint the time and place of the attack.

Contagious Diseases. For contagious diseases, individuals should expect and closely follow guidance from public health officials about the possible need for medical evaluations, medical surveillance, or quarantine. Doing so helps ensure that if they become symptomatic they are treated quickly for their own safety and that they do not infect others.

Individuals potentially exposed to smallpox include two groups: those "in contact" with persons infected with smallpox and those present in the release area at the time of the attack or over the next two days. Because smallpox is thought to be contagious from the time a patient develops a rash until scabs have formed—a period of approximately 12 days that begins 12–16 days after infection (Henderson et al., 1999)—individuals "in contact" with those persons will be offered a smallpox vaccination and should get vaccinated as quickly as possible. A "contact" is an individual who has come into close contact[20] with an infected person while that person is contagious, as well as household members of those contacts (CDC, 2003a). Because there is some uncertainty about exactly when a smallpox patient is contagious, public health officials may specify a different period during which contacts are vulnerable.[21]

Contact vaccination is effective because smallpox is the only known potential biological weapon for which postexposure vaccination has proven value (World Health Organization, 2001). Postexposure vaccination can be an effective response because production of protective antibodies in response to the vaccine have been detected as early as 10 days after vaccination, which is shorter than the incubation period. Thus, if given within three to four days after exposure, vaccination could offer complete or partial protection against smallpox (Henderson and Moss, 1999; Henderson et al., 1999). Vaccination four to seven days after exposure likely offers some protection from disease or may modify the severity of disease (CDC, 2003a).

In the case where a smallpox attack is identified more than seven days after the exposure, vaccination is unlikely for the second group of individuals (those in the area at the time of attack) because their exposure will have occurred too long ago for vaccination to be effective.

The CDC, in conjunction with state and local governments, has developed procedures for vaccine distribution and administration designed to vaccinate large populations anywhere in the United States on the order of days (CDC, 2002a).

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[20]Close contact is defined as living in the same home as someone who has smallpox or spending at least three hours in the same room with someone who has smallpox (CDC, 2003a).

[21]The CDC goes on to recommend that direct contacts should be vaccinated regardless of any contraindications to the vaccination. If a household member of a contact has vaccine contraindications, that household member should not be vaccinated and should avoid physical contact with the primary contact until the incubation period of the disease has passed (18 days) or all vaccinated persons in the household are noninfectious for vaccinia virus (after the scab at the vaccine site has separated, 14 to 21 days after vaccination).

Noncontagious Diseases. For noncontagious diseases, individuals should expect and closely follow guidance from public health officials about the possible need for medical evaluations. This helps ensure that if they become symptomatic, they are treated quickly.

Individuals potentially exposed to anthrax include those present in the release area at any time since the attack. This group should begin antibiotic therapy as soon as possible because antibiotics are useful for prevention of anthrax in those who have been infected with anthrax spores (e.g., Dixon et al., 1999; CDC, 2001a; Inglesby et al., 2002).[22] As a postexposure step to prevent the development of inhalational anthrax, the CDC recommends that individuals take a 60-day course of preventive antibiotics because the incubation period for inhalational anthrax among humans may range up to 60 days (CDC, 2001a). Those who have been partially or fully vaccinated should receive at least a 30-day course of antibiotics and continue with the vaccination regimen (CDC, 2002b).

Through the National Pharmaceutical Stockpile (NPS), the federal government has developed a plan for delivering needed supplies (including antibiotics) into a region when an incident requires a response larger or more sustained than the local community can handle. The NPS consists of an initial stockpile that can be distributed immediately, as well as a vendor-managed inventory component that is to be shipped to arrive at 24 and 36 hours after activation.[23]

Anthrax vaccine exists, but it is available only for preexposure protection to those at high risk and is not licensed for postexposure use in preventing anthrax. Distributing anthrax vaccine is therefore currently not part of the government's terrorism response plan. However, because of a potential preventive benefit of combined antimicrobial and vaccine postexposure treatment and the availability of a limited supply of anthrax vaccine for civilian use, the CDC's Advisory Committee on Immunization Practices has endorsed making anthrax vaccine available in combination with antibiotics under an Investigational New Drug application for persons at risk for inhalational anthrax (CDC, 2002b). What action the government may actually take in another anthrax attack is therefore unclear. In addition to helping prevent the contraction of anthrax, use of the vaccine may reduce the need for long-term antimicrobial therapy,

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[22]We restate here that, while it is important to begin antibiotic treatment quickly, individuals should not self-medicate with home supplies of antibiotics for reasons discussed later in this chapter.

[23]The NPS vendor-managed inventory component consists of packages that can be delivered from one or more pharmaceutical manufacturers or prime vendors and that can be tailored to provide medications, supplies, and/or products specific for the suspected or confirmed agent(s). Anthrax is one of the biologic agents that has been given a high priority to guide the purchasing decisions for the NPS (CDC, 2002c).

with its associated problems of nonadherence and possible adverse events (CDC, 2002b).

3. **For all others, monitor for symptoms and, for contagious diseases, minimize contact with others.**

Given the uncertainties surrounding who may have been infected in a biological attack, even individuals who are not symptomatic and who have no reason to believe they have been exposed to a biological agent should monitor themselves and their family members for signs of infection and be prepared to seek treatment. A common symptom of almost all potential biological agents is the presence of a fever. Thus, if officials announce that a biological attack has occurred in a particular area, it would be prudent for individuals in this group to monitor their temperature daily or as instructed by officials.

The CDC's current Smallpox Response Plan consists of isolating confirmed and suspected smallpox cases and vaccinating primary contacts of cases and family members of contacts, but it does not include postexposure vaccination of the general public (CDC, 2003a). While some studies indicate that mass vaccination during an outbreak may be effective, the net benefit of such a policy is still under debate (e.g., Kaplan, Craft, and Wein, 2002; Halloran et al., 2002; Bozzette et al., 2003).

In the case of such contagious agents as smallpox, these individuals should also minimize contact with potentially infected persons by "shielding" with their families at home (e.g., Critical Incident Analysis Group, 2002). Shielding entails minimizing unessential trips and possibly using a particulate mask when outings (e.g., going to and from work, shopping for food, or seeking medical treatment) are necessary.

4. **Leave anthrax-affected area once on antibiotics if advised to do so by public health officials.**

Considerable uncertainty exists about the extent to which anthrax spores released in the air can become resuspended again after they have settled on the ground, thereby presenting a continuing health hazard (Davids and Lejeune, 1981; Birensvidge, 1992; Weis et al., 2002). If long-term environmental dangers are possible, officials may call for individuals in the affected area to relocate to housing in other areas. If they do call for relocation, it would not have to be done immediately; individuals would have time to secure their homes, but, to prevent spreading spores, they would probably not be allowed to take their belongings with them. For those moving in or out of the affected area, N95 particulate filter masks could be useful if officials believe the risk of infection from resuspension of the spores is significant (CDC, 2001c).

Actions Not Recommended

Based on our evaluation, the following actions are not recommended for a biological attack.

- Evacuation.

Individuals will not improve their chance of survival in attacks involving contagious biological agents by leaving their homes. No place will be safer than any other, given the uncertainties about who has been exposed, beyond those in the general area where the attack has occurred. Furthermore, by remaining in the region of the attack, individuals are more likely to have access to specialized medical care and national resources and will help to contain the spread of the disease.

- Smallpox vaccination of the general public.

Preexposure smallpox vaccination is currently available only to individuals at high risk, such as health care workers and emergency responders. Because of the potentially serious side effects of the smallpox vaccine and because there is no information that a biological attack is imminent, the federal government does not recommend vaccination for the general public as a preventive measure at this time (CDC, 2002a).

- Active respiratory protection and sheltering.

Because biological attacks will most likely be undetected for many days, the threat of being infected by airborne particulate matter from the initial attack is long past by the time individuals become aware of an attack. Thus, no practical benefit occurs when protecting oneself by taking shelter or pursuing forms of respiratory protection (e.g., wearing particulate masks). Masks may be useful, however, to avoid contracting a contagious disease from someone who has been infected. If an attack were, however, identified at the time, such respiratory protection and sheltering would provide effective protection.

For sheltering and respiratory protection to be useful in a covert attack, they would need to be in place at the time, before an individual becomes aware of the attack. Wearing masks all the time is impractical. However, other possibilities for passive, "always-on" sheltering or respiratory protection can be useful as a preparatory action. Recommendations on these actions are included later in this individual's strategy.

- Self-administering antibiotics.

Certain antibiotics can be very effective in preventing the contraction of and treating anthrax. While it is important to begin antibiotic treatment quickly, the extent to which the effectiveness of antibiotics decreases with the duration of the interval between either initial inhalation or contraction of anthrax and the initiation of antibiotics is unclear (e.g., Inglesby et al., 2002). This uncertainty has fueled a debate over the merits of individuals' storing and self-administering antibiotics.

We do not recommend such an action for a variety of reasons. First, in the case where an attack is not detected and is only identified days afterward, the government has plans to provide the appropriate antibiotics and they could be available from one's personal physician. So an individual need not already have them. Second, anthrax does not necessarily respond to all antibiotics, and indiscriminate use of incorrect antibiotics could be dangerous and may cause a person to delay in obtaining the correct prescription. Third, antibiotics have a limited shelf life, which means that individuals risk taking ineffective or dangerous medications if they neglect to replenish their stocks periodically. Fourth, after initiation of antibiotics, standard blood cultures appear to be sterilized, which might hinder confirmation of an anthrax infection and thereby raise the risk that an individual would not get the appropriate medical treatment (Inglesby et al., 2002).

PRIORITIES FOR RESPONSE ACTIONS

In responding in these ways to potential terrorist attacks, individuals need to act with a set of clear priorities. A critical part of the individual's strategy for catastrophic terrorism is to understand what these priorities are and why they are appropriate. Box 3.5 presents those priorities, which are discussed below in more detail.

Our analysis and focus group sessions suggest that an individual's initial instincts in responding to catastrophic terrorist attacks may not be the right ones.[24] This is why we have included in this strategy the priorities that should guide an individual's actions.

Box 3.5

1. *Act first to ensure your own survival.*
2. *Take steps to decontaminate yourself.*
3. *Help others if it is safe to do so.*
4. *Make contact with family/friends.*

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[24]See Appendix C for a description of the structure, purposes, and results of these focus groups.

Stopping to help others or acting to contact family and friends is a natural reaction. However, such actions could put at risk an individual's own survival in chemical, radiological, and nuclear attacks, where taking the recommended actions (evacuation or sheltering) must happen in a matter of minutes. Even in a biological attack, which is identified long after the event, the sooner an individual obtains preventive medical treatment the better.

Given the dangers to an individual's body of chemical agents, radiological dust, and radioactive fallout, an individual's next priority needs to be to take decontamination steps. These need to be tailored to the particular attack and timed not to interfere with those immediate actions necessary to survival.

In the case of helping others, most individuals will not be qualified medically to provide treatment in these types of terrorist attacks. However, once the dangers of radiation and chemical agents are over and it is safe, there may be ways in which individuals can help others or assist the emergency responders.

Only after individuals have ensured their own safety should they attempt to contact family members or friends. Giving priority to one's survival and decontamination will take time, measured in hours but not days, except in the case of sheltering in a nuclear attack. Thus, making contact with families and friends is delayed, but not for too long.

PREPARATORY ACTIONS

To accomplish the actions necessary to respond to the different types of terrorist attacks discussed above, an individual will need to take preparatory steps, shown below in Table 3.3. Note that the steps shown in Table 3.3 address terrorist attacks involving unconventional weapons only. Focusing on these in no way suggests that it is not also important to take steps to prepare for other emergencies.

These steps center around educating oneself about the potential attacks and what to expect (and not expect) authorities to do, making plans and gathering information to facilitate the response actions, preparing appropriate emergency supplies, and implementing permanent "passive" actions to protect against biological attacks.

Understand Requirements of Individual Response Actions

The more prepared an individual can be for what will happen in a terrorist attack and what will be required the better. Preparedness calls for an individual to learn about the characteristics, dangers, and effects of each type of attack

Table 3.3

Preparatory Actions

Preparatory Action	Chemical	Radio-logical	Nuclear	Biological
Gain understanding of what will be required to accomplish response actions in each type of terrorist attack				
Learn to recognize characteristics, dangers, and effects	X	X	X	X
Understand individual response strategy	X	X	X	X
Prepare to act without official guidance	X	X	X	
Facilitate response actions by making plans and gathering information in advance				
Develop family plans for communicating and gathering	X	X	X	X
Plan for long-term shelter		X	X	X
Learn about appropriate kinds of medical treatment from medical professionals				X
Discover what plans exists for evacuation in building you occupy frequently	X	X		
Find potential shelters near home, school, or workplace	X	X	X	
Ensure general emergency kit accounts for terrorist attacks				
Dust mask		X	X	X
Battery-powered radio	X	X	X	
Duct tape and plastic sheeting	X			
Enhance protection through passive steps				
Weatherize home				X
Install good-quality particulate filters				X

and then the appropriate responses, as described in the strategy above. In doing this, individuals will also need to understand when they will be acting on their own (chemical, radiological, and nuclear attacks) and when they can expect guidance from government officials (e.g., biological attacks).

Critical to responding successfully will be understanding in advance the signs and symptoms of each type of terrorist attack. The symptoms in a chemical attack include difficulty breathing, eye irritation, blurred vision, salivation, nausea, and convulsions (FEMA, 2002). Although these chemical attack symptoms could be mistaken for a number of individual maladies, more than one person exhibiting them simultaneously may signal a chemical release. Dead or dying birds or people collapsing could be another sign (Price et al., 2003).

In the case of a radiological attack, there are likely to be no immediate recognizable effects of the radiological component to the attack, and an individual might not be aware that radioactive material was released until notified by officials. By contrast, an individual will certainly recognize a nuclear attack from a number of characteristic features. There will be a bright flash, a loud explosion, widespread destruction, intense heat, strong winds, and the development of a rising mushroom cloud.[25]

For smallpox, the symptoms will be a rash, high fever, itching, malaise, head and body aches, and sometimes vomiting (CDC, 2002d). In the case of inhalation anthrax, the initial symptoms often mimic those of the common cold or influenza (CDC, 2001b).

Gather Information and Develop Plans in Advance

A family plan is recommended for all emergencies, including those involving terrorist attacks, so that family members can arrange in advance how to get in touch with an individual in case he or she is separated (FEMA, 2002). This would involve having in place a communications plan (e.g., a family member or friend is designated outside of one's area who can be the point of contact to let others know about their situation and where they can be reached). Identifying predetermined meeting places near one's home or outside of the neighborhood to gather one's family could also be important, if one is prevented from returning home or is separated from other family members. For the possibility that individuals will be called on to relocate away from affected areas in anthrax, radiological, and nuclear attacks, it will be useful to locate potential long-term shelters, such as places to stay with a friend or relative and/or shelter locations (National Disaster Education Coalition, 1999).

Individuals will want to consult with their medical providers about what treatments will be appropriate for different types of terrorist attacks and what makes sense for themselves and their family, especially for those who have preexisting medical conditions or allergies that might put them at high risk for certain types of treatments (e.g., vaccine for smallpox, certain antibiotics for treatment of anthrax).

It will also benefit individuals to learn in advance about evacuation plans in buildings they often frequent. In an indoor chemical release, the most appropriate actions to take may depend on the characteristics of the building's ventilation system or other design features. In some cases, building operators may have instituted specific terrorism response plans that are consistent with these features. Building occupants should familiarize themselves with these plans and be prepared to execute them. Individuals also should identify in advance

[25]For a nuclear attack, the individual should know the signs and symptoms of acute radiation syndrome, including headache, fatigue, weakness, nausea, diarrhea, skin damage, or hair loss. These symptoms may take minutes or weeks to appear depending on the radiation dose received (American Public Health Association, 2002).

the preassembly areas that have been designated for key buildings to know where they should congregate in the event of an indoor chemical release so that individuals can be accounted for, triaged and/or treated, or decontaminated.

Finally, individuals should put together a list of potential shelters near their homes, schools, or workplaces. For outdoor chemical and radiological attacks, this would be in buildings that are close by. For nuclear attacks, it would include underground basements, parking garages, subways, and other tunnels.

Augment General Emergency Preparations

Currently available general emergency preparedness guidelines provide very important advice about storing emergency supplies and sustaining oneself in the absence of some essential services (e.g., FEMA, 2002; U.S. Department of Homeland Security, 2003a). These guidelines are appropriate for responding to some of the secondary effects of potential terrorist attacks. However, given that these guidelines provide a large amount of information about numerous supplies and other preparatory actions that apply to needs that range from the most urgent to the most mundane, it is important to identify and highlight steps critical to surviving terrorist attacks using unconventional weapons.

Specifically, individuals will need to include in their disaster preparedness kits supplies for the different response actions discussed above. One key item is a dust mask with an N95-rated particulate filter, which would be useful in protecting against radioactive dust and fallout, as well as infection from biological agents. These masks are inexpensive and stored easily, and it is reasonable to have a mask at home, at work, and in the car.

A battery-operated radio could be useful in any type of emergency, it could be a critical tool in gaining information about when it is safe to vacate shelters following a nuclear, radiological, or chemical attack and for receiving other instructions from government officials.[26]

Finally, in the event of a chemical release, duct tape and plastic sheeting can be used to seal openings in a shelter that could admit chemical agents. An emergency preparedness kit should therefore include these or other similar materials.

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[26]Since detonation of a nuclear weapon can generate an electromagnetic pulse that may damage equipment connected to power sources or antennas, battery-operated radios are recommended since they generally will not be affected.

Enhance Protection Against Biological Attack

Protection against biological attacks must be in place at the time of an attack and *before* an individual is even aware that it is needed. Consequently, effective protection requires a "passive" or "always on" approach. Protection against the inhalation of biological agents can be enhanced through *barrier* or *filtering* strategies.

Ordinary buildings can provide good barrier protection against particulate biological agents. Individuals who work indoors spend approximately 80 percent of their time indoors on work days (Rogers et al., 1990) and are thus *ideally* protected against 80 percent of biological attacks. However, the particulate barrier capacity of buildings varies considerably and depends on such factors as the degree of weatherproofing and whether the air system draws outside air.

By way of a baseline, an average residential home with an air exchange rate of about one air change per hour (Rogers et al., 1990; Sorensen and Vogt, 2001a) would reduce the indoor exposure level by about 83 percent for a cloud of biological agent that engulfed the building for 10 minutes. Thus, simply being indoors provides substantial protection against biological agents dispersed outside. The barrier capacity of residential homes can be increased to about 0.5 air changes per hour by implementing some of the standard weatherizing steps designed to improve energy efficiency, such as weather stripping (Rogers et al., 1990).

Most new commercial buildings are sealed fairly well and draw some fraction of air from the outside (make-up air). The barrier capacity of such buildings can be made very high by maintaining a slight positive pressure and using high-quality particulate filters (e.g., N95) on the outside air intakes (U.S. Army Corps of Engineers, 2001; Price et al., 2003). Such filter materials are effective at removing most potential biological contaminants.

A barrier strategy can be supplemented with a filtering strategy, which removes particulates that have penetrated the barrier. N95 particulate filters can be installed in internal forced-air systems in residential and commercial buildings or in commercially available stand-alone indoor air filtration units (air purifiers). The effectiveness of such steps depends on the fraction of time that the air system is running and the flow rate of the system. Home heating and air conditioning systems typically move roughly 1,000 cubic feet per minute (cfm), which would cycle the air volume of a 1,500-square-foot home in about 30 minutes for a system running 50 percent of the time. However, such a system provides no protection when it is not running. Commercial air purifiers filter about 300 cfm and are typically designed to filter a single room. Depending on the home design, three to five units would be required to protect a 1,500-

square-foot home. These systems are designed to run all the time, and four units would cycle the air volume of a 1,500-square-foot home about once every 10 minutes.

Barrier and filtering strategies can provide effective protection for biological attacks that occur outdoors and for some forms of indoor attacks.[27] Thus, weatherizing homes is a practical and inexpensive action and is recommended. While the protective capacity of installing high-quality particulate filters on residential forced-air systems is highly variable, this is also a relatively inexpensive step and so is also recommended.[28] Commercial air purifiers provide greater protection but are also more expensive.[29] While this action can provide additional protection, weatherizing, which provides greater protection and is less expensive, should be pursued first.

A barrier strategy involving filtering outside air intakes and maintaining positive internal pressure provides the greatest protection.[30] Most residential homes do not draw outside air, making it impossible to maintain a positive pressure without fairly substantial and expensive retrofitting. In other settings, such as apartment complexes and commercial and industrial buildings, this is not an action that can typically be taken by an individual and so is not included in our recommended strategy. However, it is an area that is highly recommended for businesses. See U.S. Army Corps of Engineers (2001) and Price et al. (2003) for more discussion.

ENABLING ACTIONS BY GOVERNMENT AND BUSINESSES

Our individual's strategy emphasizes actions that can be taken by an individual in the context of current individual knowledge, societal practices, and available technology. This section explores how the ability of an individual to carry out this strategy or the strategy itself could be improved, perhaps significantly, through various enabling actions on the part of governments and businesses. These potential actions are organized into four categories:

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[27]For the smallpox scenario described in this report, the barrier strategy is not effective because the release occurs indoors. Further, because the virus is delivered by terrorists moving close to people in the arena, a filtering strategy is expected to be ineffective as well because the virus is expected to be transferred immediately to the victims without passing through any filtration systems. For a variation in which the smallpox is released into the air handling system of a building, such as is described for the indoor chemical release scenario, the filtering strategy would be effective.

[28]Before taking this step, it is important to ensure that the air system can handle the increased air resistance created by high quality particulate filters.

[29]Four medium-priced units would cost about $1,500.

[30]Most residential homes do not draw outside air, making it impossible to maintain positive pressure without fairly substantial and expensive retrofitting.

- Informing individuals about official terrorism response plans.
- Designing education and training programs to explain and practice response actions.
- Implementing terrorist attack detection and warning systems.
- Regulating and providing usage guidelines for retail equipment marketed for terrorism response.

Inform Individuals About Official Terrorism Response Plans

One important enabling action on the part of governments would be to communicate actively and clearly their plans for preparing and responding to terrorist attacks. Indeed, learning about the government's plans is an explicit component of our recommended individual's strategy.

For biological attacks, the most important of these involves plans for the administration of vaccinations, antibiotics, and other preventive treatments and medications and then descriptions of where and how emergency medical treatment and decontamination would be provided. Plans need also to be developed and communicated with respect to what kinds of relocations could be called for in nuclear and radiological attacks and how these might be undertaken. Governments also need to be prepared with event-specific details about how such plans will be conveyed if an attack occurs.

The principal value of such communication would be to better prepare individuals to respond in an appropriate manner in the event of a terrorist attack. For example, it would minimize their uncertainty about whether to take a certain action or await official guidance. In addition, clear communication ahead of time would facilitate an individual's willingness and ability to comply with government actions and recommendations when they are put into play after an attack. Clearly and convincingly communicating plans for dispensing antibiotics, for example, is particularly important for assuaging people's urge to stockpile antibiotics and take them without medical supervision.

An additional benefit of being informed of government plans and abilities is that such knowledge can increase an individual's confidence that the government's capabilities and their own actions can really help protect their safety and health in a terrorist attack. Such confidence could have the effect of a person treating both the individual and government preparation and response strategies more seriously than they would otherwise. Taking the strategies more seriously may, in turn, have several positive effects, including increasing an individual's willingness to undertake the strategy, improving the ability of an individual to carry out the strategy, and reducing the negative effects of stress and anxiety, both before and after an attack.

Given that government plans are evolving as agencies continue to examine their options and gain new knowledge from research and exercises, there may be a tendency to wait until the "final plans" are developed rather than present citizens with too many changes. While too frequent changes can invite criticisms, waiting too long for the perfect final plan can paralyze the process. The best currently available information can be made available today, along with declarations that there will be updates as plans and knowledge improve.

Design Education and Training Programs

Another government or business enabling action is to develop and implement education and training programs. The goal of such programs would be to familiarize individuals with the various preparation and response actions involved in the strategy. The Department of Homeland Security has taken an important step in launching its preparedness campaign entitled "Preparing Makes Sense. Get Ready Now." A description of the various activities in this campaign can be found on its web page: www.ready.gov (U.S. Department of Homeland Security, 2003a). As noted in the individual's strategy, one's instincts in responding to a terrorist attack may lead to actions that are dangerously wrong in some situations. Education and training would help instill in individuals the appropriate actions to take in different circumstances and would mentally and physically prepare them to carry out the actions.

Both government and private industry could spearhead this effort, perhaps in combination. For example, the federal government could develop a general curriculum that could then be tailored by local governments or individual businesses to reflect considerations specific to particular locations or types of facilities. Education and training could be delivered in a number of different formats, including distributing booklets or videos for self-administered instruction, conducting drills in schools, and providing seminars and classes in workplaces and community centers. These materials could usefully be integrated into current region-specific disaster preparedness programs.

Implement Detection and Warning Systems

Individual responses to catastrophic terrorist attacks may be greatly improved with information that could be provided by detection systems. Current and potential future sensors and communication technologies could be leveraged to relay critical information to individuals, which could provide some warning, supply information about the nature of the dangers, and guide individuals out of contaminated areas.

A number of sensors to detect the effects of potential terrorist weapons are available or in development. These include sensors capable of detecting chemical agents, biological agents, and radiological materials (see, e.g., National Institute of Justice, 2001). These sensors can be installed in such strategic locations as public buildings, symbolic sites, subway stations, office buildings, and heavily trafficked outdoor areas.[31]

Detection and warning systems have numerous potential applications in responding to terrorist attacks. One application is detecting the presence of a potentially hazardous chemical substance in a building. In addition to providing warning to building occupants, such systems could be used to initiate automated responses, such as adjusting air circulation systems to purge the agent from the affected areas. Another potential application is to use radiation detectors to sense the presence of a radioactive material that may be released in a bomb attack or covert release. A third type of application is to provide early identification of a biological attack. Although reliable real-time biological agent sensors have yet to become commercially available, detection time scales on the order of days, which are currently possible, can still provide critically important information in a biological attack. If air samples could be collected and analyzed on a time scale that is short relative to the incubation period of potential biological agents, biological attacks could be detected early enough for victims to be protected by postexposure prophylaxis.

Although sensors and warning networks have great potential for reducing the casualties from unconventional attacks, there are some significant challenges to achieving that potential. First, sensors are expensive to develop, purchase, and operate. They must be carefully maintained and operated by trained people who know their strengths and limitations and are able to keep them calibrated. Moreover, any warning system must be designed to minimize false alarms or it will be useless, or worse. For example, having a sensor network that could detect radioactive materials could quickly become a public nuisance if the thousands of people who are receiving certain types of radiation treatments for cancer were stopped and detained by the police every time they entered the subway system or a public building (Buettner and Surks, 2002, p. 2687). People would ignore alarms that went off frequently when no attack took place, even when a real attack occurred. Finally, an early warning network would only be

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[31]Note that such systems are beginning to be deployed (e.g., see U.S. Department of Homeland Security, 2003c; Rashbaum, 2002).

useful if the people and organizations that must respond to a warning know what to do and can act on it in a timely way.

While undeniably a technologically challenging and costly approach, detection and warning systems could provide enormous benefits in a terrorist attack in the form of early detection and rapid response. Many industrial environments using hazardous materials already have extensive detection and communication systems, and lessons learned from these applications may be useful for developing systems appropriate for terrorism. Although many important differences exist between the two applications, experience from industrial applications may nonetheless be helpful in determining certain requirements, such as necessary sensor densities, response times, or sensitivities; education and training; reliability; and costs.

Regulate Retail Equipment Marketed for Terrorism Response

A final area of government and business activity that can enable an individual’s response is ensuring that products marketed for terrorism preparedness and response are safe and effective. Since the September 11 terrorist attacks and the anthrax attacks in fall 2001, the amount of merchandise intended to help individuals respond to a terrorist attack has sharply increased. In some cases, this merchandise consists of existing equipment previously marketed for other purposes, such as respirators and emergency supply kits. In other cases, new products have been developed expressly for terrorism, such as portable shelters.

Given that these products are designed to protect a user’s safety and health in potentially life-threatening situations, these items may need to be scrutinized to ensure that they live up to their advertised claims and are safe to use. Among the areas that deserve to be explored are whether and how the government and businesses should:

- set standards for the design and performance of different classes of equipment;
- test new products to ensure that they perform as stated and are not themselves dangerous for use;
- provide guidelines about when and how equipment should be used; and
- provide warning labels to notify users about limitations of the product’s capabilities and potential adverse health effects.

Private industry can play an important role in the nation’s efforts to prepare for terrorism, and providing individuals with equipment to help them in a terrorism response is a valuable contribution. As with any new business area, however, the development of terrorism response products will likely encounter unforeseen complications and uncertainties that may warrant government oversight.