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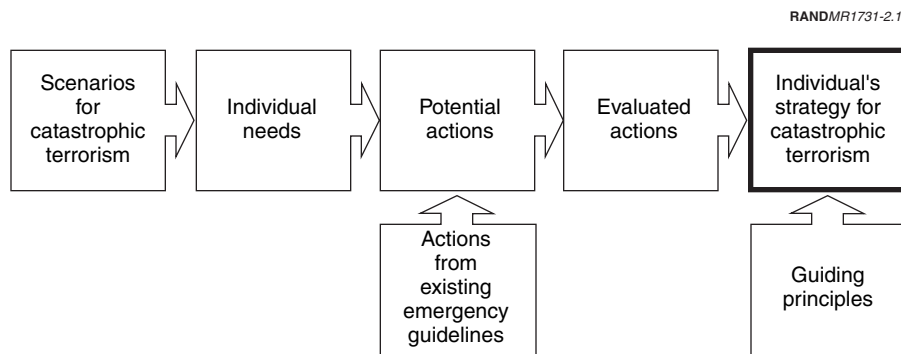
**SCENARIO APPROACH TO DEVELOPING AN  
INDIVIDUAL'S STRATEGY**

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In defining an individual's strategy for catastrophic terrorism, we developed an approach consisting of five steps:

- Develop scenarios for chemical, radiological, nuclear, and biological terrorist attacks.
- Define the needs of individuals in each scenario, with a focus on those that are primary to their safety and health.
- Identify potential actions to meet those needs.
- Evaluate the potential actions to determine their ability to prevent, protect against, or minimize injury from the attack.
- Assemble effective actions into a strategy that an individual could adopt to prepare for, and respond to, catastrophic terrorist attacks.

Figure 2.1 shows the five steps.



**Figure 2.1—Overview of Approach**

The remainder of this chapter describes, in turn, each of these five steps, including the information we collected or created in carrying out these steps and the most important findings that emerged for the design of an individual's strategy.

## **STEP 1: DEVELOP TERRORIST ATTACK SCENARIOS**

### **Rationale for a Scenario-Driven Approach**

We begin by developing catastrophic terrorist attack scenarios for two important reasons. The first reason is to discover whether individuals can take any actions in such situations that will make a difference in terms of their ability to survive. Only by evaluating the effectiveness of individual actions in these catastrophic terrorist attacks can this most fundamental question be answered. As their point of departure, the current U.S. government guidelines for terrorist attacks argue that preparing makes sense, suggesting that their recommendations will save lives. However, they offer no supporting analysis or evidence. (U.S. Department of Homeland Security, 2003a.)

Second, only by defining the specific situations and the resulting individual needs in catastrophic terrorist attacks can one discover what preparation and response actions are appropriate for an individual. Guidelines designed for other types of emergencies or emergencies in general (e.g., emergency kits and evacuation plans) are useful. However, in the context of terrorist attacks involving unconventional weapons, this general guidance may not address an individual's specific needs. Even though the effects of the covert release of the smallpox virus and the spread of a naturally occurring contagious disease may be nominally similar, an individual's needs may not be the same. Similar situations may hold for chemical attacks compared to hazardous material releases, for radiological attacks compared to leaks of nuclear reactor fuel, or for terrorist nuclear explosions compared to Cold War strategic nuclear attacks.

What emerged is a strategy that individuals can adopt that will help them survive and one tailored to the specific types of terrorist attacks, rather than one designed for emergencies in general, sometimes referred to as an "all hazards" approach.

### **Scenario Design Criteria**

The scenarios developed in our approach span the range of unconventional weapons—chemical, radiological, nuclear, and biological—and were designed to produce large effects (i.e., attacks that yield large numbers of casualties, put at risk the survival of significant number of individuals, and affect substantially

different types of services and/or infrastructure). Estimates of the major effects of these scenarios are summarized in Table 2.1.

Future terrorist attacks could vary in many different ways, such as the agents or weapons employed, the size of an attack, the kind of release, the location (rural or urban), and whether it occurs inside a building or outdoors. For the scenarios to be useful in designing an individual's strategy, they need to be as representative as possible of the broad spectrum of potential types of terrorist attacks.

To achieve this, the chemical scenarios employed both a chemical weapon (sarin) and a chemical (hydrogen cyanide) that can be fashioned from readily available industrial chemicals; they involved attacks both outdoors and inside a

**Table 2.1**  
**Scenario Effects<sup>a</sup>**

Scenario	Exposed	Injuries/ Infections	Fatalities	Time to Decontamination of Environment
Chemical				
Sarin	30,000	3,000	100	Hours
Hydrogen Cyanide	1,000	0	300	Hours
Radiological <sup>b, c</sup>				
Americium 241	10,000	Indeterminate		Months–Years
Cesium 137	Indeterminate	Indeterminate		Years
Nuclear <sup>c</sup>	100,000	20,000	10,000	Months–Years
Biological				
Anthrax				
Small	5,000	3,000	2,500	Weeks–Years
Large	500,000	300,000	250,000	Weeks–Years
Smallpox	20,000	1,000–2,000	200–400	Hours–Days

<sup>a</sup>These are very rough estimates of the scenario effects. They do not make any assumptions about individual or official responses, except for the smallpox scenario (where medical treatment reduces the infections from the second generation forward) and for the hydrogen cyanide scenario (which accounts for individuals who will evacuate the building).

<sup>b</sup>It is difficult to estimate the effects on individuals in a radiological attack because they are in the form of increased cancer risks in the long term and, thus, not predictable. Immediate casualties would occur only from the effects of the conventional explosives and possibly a small number of radiation injuries from radioactive shrapnel. Therefore, what makes these types of attacks potentially catastrophic is not the projected casualties but rather the potential long-term health and environmental effects of the radiation.

<sup>c</sup>Note that the definition for exposed differs between the radiological scenario (0.25 rem absorbed dose) and the nuclear scenario (100 rem).<sup>1</sup>

<sup>1</sup>A rad is a unit of absorbed dose from ionizing radiation that has the dimensions of energy per unit mass. A rem is a unit of biologically absorbed radiation dose and is equal to the dose equivalent to when the total dose multiplied by dimensionless factors that account for the efficacy of transfer of

building. The radiological scenarios involved commercially available or potentially orphaned radioisotopes (Americium 241 and Cesium 137) and were designed to maximize respectively the short-term radiation hazard over a small area and long-term contamination of a large area with low-level radiation. Variations in weapon yield were included in the nuclear scenario. The biological scenarios were defined to demonstrate the effects on individuals of both a noncontagious (anthrax) and a contagious (smallpox) agent.

There are many other possibilities for catastrophic terrorist attacks. Other types of contagious biological agents include plague, ebola, and dengue fever. Terrorists could also develop a chemical agent that had longer-term, more persistent effects, such as VX. In addition, terrorists could seek to release chemical or radioactive materials through attacks on industrial or nuclear facilities, respectively. These would each have different effects on individuals, but for designing an individual's strategy, we conclude that the characteristics of the needs of individuals are similar enough in these other possibilities not to require developing additional scenarios or defining actions specific to such attacks.

### Scenario Descriptions

The scenarios in our approach are intended to give a reasonable order of magnitude for the effects of such terrorist attacks. The precise effects, of course, are unknowable. Our goal was to have sufficient confidence to be able to define appropriate and effective individual response actions.

Many uncertainties surround what terrorists may be able or willing to do in carrying out attacks involving unconventional weapons. The risks of such attacks may be small compared with those from conventional attacks or even from natural disasters. However, one's view of the terrorist threat or the potential risks is really not germane to what actions individuals should take if a catastrophic terrorist attack were actually to occur. Only when substantial costs to undertaking actions in advance are involved might some consideration of the potential risks be appropriate. Thus, while we considered that such attacks as those modeled in the scenarios were possible, we made no judgment about the probability of any of them occurring.

For our analysis, we assumed that the terrorist attacks occurred without warning. This may or may not be the worst case, but the result of this assumption is that it produces very challenging situations for individuals.

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radiation energy into biological materials is equal to one rad. For the type of radiation that is created by a nuclear weapon, the two units can be considered as equivalent.

For each scenario, we described in detail the method of attack and the time scales (i.e., when the attack would be identified and how long its dangerous effects would be expected to last). Moreover, in each case, we made assumptions about what individuals could expect in terms of official actions (i.e., what kinds of information, guidance, and services they would likely receive from officials). We also estimated the number of individuals who would be potentially exposed to the attacks. Finally, and most important, we defined the effects on individuals. In contrast to many other efforts defining terrorism scenarios, we were exhaustive in describing the potential effects, covering not just casualties but also the damage to infrastructure and the disruptions in the various kinds of services. Some key scenario characteristics are summarized in Table 2.2. Detailed descriptions of each of the scenarios and their effects are provided in Appendix A.

**Chemical Attack.** For chemical terrorist attacks, we designed two scenarios. One scenario involves the outdoor release of 100 kilograms of aerosolized sarin sprayed from a truck. The material forms a cloud that spreads downwind from the release point. The cloud reaches its maximum dimension of approximately 2.5 by 1.5 kilometers (1.6 by 0.9 miles) in about an hour, after which it rapidly disperses. About 30,000 people are potentially exposed to lethal concentrations of sarin.

**Table 2.2**  
**Characteristics of Scenarios**

Type	Weapon	Release	Identification/ Duration	Official Actions
Chemical	Sarin	Outdoors/ aerosolized	Immediately/ four hours	Unlikely to give warning; announce danger is over
Chemical	Hydrogen Cyanide	Indoors/ vapor	Immediately/ one hour	Unlikely to give warning; announce danger is over
Radiological	Americium 241	Outdoors/ explosive	One hour/ long-term	Identify/announce attack; determine radioisotope; characterize contaminated area
Radiological	Cesium 137	Outdoors/ explosive	One hour/ long-term	Identify/announce attack; determine radioisotope; characterize contaminated area
Nuclear	Low yield	Outdoors/ ground-burst	Immediately/ long-term	Unlikely to give warning; announce danger is over
Biological	Smallpox	Inside/ aerosolized	16 days/ 70 days	Identify/announce attack; provide treatment
Biological	Anthrax	Outdoors/ aerosolized	7 days/ 50 days	Identify/announce attack; provide treatment

The second chemical scenario involves the release of 34 kilograms of hydrogen cyanide into the air ventilation system of a 10-story building. In less than 10 minutes, the gas would be dispersed throughout all floors, potentially exposing the 1,000 occupants to lethal concentrations of the vapor.

In both cases, an individual will become aware of the attack by seeing its effects on other people, animals, and/or themselves. However, while the presence of a chemical agent would be immediately evident, the type would not likely be identified until after the fact. Because of the rapid onset of the dangers in both these scenarios, no warning or coherent announcement of the attack can be expected. The dangers in these scenarios are immediate but are likely to last for only a few hours at most. Officials should be in a position to announce when the dangers are over. The duration of the dangers in these chemical scenarios is one to four hours.

**Radiological Attack.** We designed two radiological attack scenarios using commercially available or potentially orphaned radioisotopes. In each attack, the isotopes are dispersed by a 100-pound conventional explosive. In the first scenario, 50 curies of Americium 241 are used to represent the short-term (few hours) hazards posed by inhaling radioactive dust in a small area, about one square kilometer. In the second scenario, the attack employs 10,000 curies of Cesium 137 to represent the long-term (years) hazards posed by contaminating a large area (approximately 500 square kilometers). Individuals would become aware of a radiological component to the attack shortly after emergency responders with detection equipment arrive on the scene, although determining the type, amount, and aerial extent of radiation would take significantly longer. The health effects in the form of elevated risk of cancer in individuals would manifest themselves only after many years. The biggest problem from these weapons will be long-term contamination that could make areas potentially uninhabitable for months or even years.

**Nuclear Attack.** For a nuclear terrorist attack, we designed a single scenario involving a one-kiloton nuclear surface burst in a medium-size city.<sup>2</sup> The immediate effects of this ground burst would involve blast damage, heat, and prompt radiation in an area extending a little over one kilometer (0.6 mile) around the detonation point. Approximately 10 minutes later, radioactive debris would begin to fall from the cloud forming above the detonation and would be deposited on all surfaces in its path. Debris would continue to fall from the cloud as it moved downwind. Eventually, the radioactive fallout would cover an area a few kilometers wide and extend some 21 kilometers (13 miles) downwind. The debris would continue to fall for up to 24 hours, and the levels

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<sup>2</sup>The size of a medium city is defined as 1 million to 5 million people.

of radiation would remain high enough to pose an immediate hazard for several days, even for short exposures. Some 100,000 people would be potentially exposed. We also explored the effects of variations on the size of the nuclear weapon. In the case of a 10-kiloton weapon, the distances of the blast effects would be roughly double and the downwind extent (distance) of the fallout would more than double. Officials would not be in a position to provide guidance in the critical minutes before the fallout begins, but they should be in a position to announce when the dangers from the cloud's radiation are over.

**Biological Attack.** We developed two biological attack scenarios. The first involves the aerial release of 50 kilograms of aerosolized anthrax over a medium-size city. We examined two variations: one with an efficient dispersal under ideal weather conditions and another with an inefficient dispersal under less favorable weather conditions. The release forms an invisible cloud and occurs undetected. Under ideal conditions with an efficient dispersal, the anthrax spreads over some 300 square kilometers (115 square miles), potentially exposing 500,000 people and infecting about 300,000 people. Under less than ideal conditions, the anthrax spreads over 30 square kilometers (11 square miles) potentially exposing 5,000 people and infecting about 3,000 people.

The second biological scenario involves a covert release of aerosolized smallpox virus in an enclosed arena. The virus is released by individuals through portable nebulizers and potentially exposes both those in the arena at the time of the release and those who enter the arena over the following two days. Of the more than 20,000 people in the arena, 300 are initially infected and begin a chain of infections that results in 1,000–2,000 smallpox infections before the epidemic is brought under control. During this period an undetermined number of individuals are at risk of becoming infected. In both biological scenarios, the attack is not identified until days after, when symptoms appear and are recognized by the medical and public health communities. At that point, officials would be in a position to offer guidance about the appropriate kinds of medical treatment and whether there would be a need for quarantine or relocation. The duration of the dangers in these biological scenarios is 50–70 days.

## **STEP 2: DEFINE INDIVIDUAL NEEDS**

Some of the effects of terrorist attacks are so lethal or will happen so quickly that an individual can do very little about them (e.g., the blast and immediate radiation effects in a nuclear attack). However, other effects can be avoided or ameliorated by individual actions. We focused on individual needs in these situations. Notwithstanding the horrific character of these terrorist attacks, starting with scenarios led us to discover that the needs that affect an individual's ability to survive across a wide range of attacks (primary needs) are few and that

they tend to fall into two areas: clean environment and medical care. Beyond meeting their primary needs, individuals may also require access to emergency response services in the cases of fires or releases of hazardous material or experience losses in terms of infrastructure and utilities. While these needs are important, they are secondary and generally do not represent significant health or safety hazards. Addressing these needs is also well covered in the currently available general emergency preparedness and response guidelines. Consequently, these secondary needs are not addressed in our individual's strategy.

Acting to meet these primary needs forms the basis for a set of overarching goals that individuals—on recognizing their exposure to the dangers—would seek in responding to each of these terrorist attacks. These goals, shown in Table 2.3, differ depending on the type of terrorist attack. Given how fast chemical agents spread in chemical attacks, the overarching goal is to find clean air quickly. Dust is always a danger in conventional weapon explosions and if infused with radiation it becomes an even greater danger. Thus, the overarching goal in a radiological attack is to avoid inhaling dust that could be radioactive. In a nuclear attack, radioactive fallout is a very serious danger that arises after the occurrence of the immediate blast effects. Thus, the individual's overarching goal is to avoid this fallout by evacuating the area quickly or seeking the best available shelter. The main danger to an individual in biological attacks arises from exposure to, and infection from, the agents. Thus, getting medical treatment and minimizing further exposure is the overarching goal.

By using this scenario-driven approach, we were also able to identify the situational factors (listed in Table 2.4) that are critical in dictating what course of action an individual should take to achieve these overarching goals. For chemical and radiological attacks, the critical factors are whether the release is inside a building or outdoors and where an individual is in relation to that release. In nuclear attacks, the critical factors involve where the radioactive fallout cloud spreads and whether an individual can move out of this area before it becomes contaminated. In the case of biological attacks, the critical factors involve whether the agent is or is not contagious and whether an individual is exposed or infected.

**Table 2.3**  
**Overarching Individual Goals**

Chemical attack	Find clean air quickly
Radiological attack	Avoid inhaling dust that could be radioactive
Nuclear attack	Avoid radioactive fallout: evacuate the fallout zone quickly or seek the best available shelter
Biological attack	Get medical aid and minimize further exposure to agents

**Table 2.4**  
**Critical Factors in Determining an Individual's Response Actions**

Chemical attack	Whether release inside or outside and where an individual is in relation to release
Radiological attack	Whether release inside or outside and where an individual is in relation to release
Nuclear attack	Where radioactive fallout cloud spreads and whether an individual can move out of the area
Biological attack	Whether agent is contagious and whether an individual is exposed or infected

### STEP 3: IDENTIFY POTENTIAL ACTIONS

In the next step, we defined a suite of potential actions that individuals could take to fill their primary needs in light of the different situations in which they might find themselves. This step in our approach involved an iterative process that matched actions to individual needs in the specific scenarios. In collecting potential actions, we sought to be as comprehensive as possible, regardless of an action's actual merit. The potential actions are summarized in Table 2.5.

In this step, we drew heavily on the actions recommended in current U.S. government guidelines for responding to both terrorist attacks and other kinds of emergencies. We began by reviewing more than 200 currently available guidelines that include those prepared by approximately 30 federal agencies, departments, and national institutes, as well as those drawn from the websites of various state and local governments, universities, nonprofit organizations, private disaster relief organizations, and professional associations.<sup>3</sup> We also surveyed publicly available emergency guidelines in other countries (United Kingdom, Israel, Japan, Switzerland, Canada, and Australia) that have had experience in preparing for terrorist attacks and, in the case of Israel, for chemical weapons attacks.

In the winter of 2002–2003, the Department of Homeland Security launched the Ready campaign that focuses on preparing for terrorist attacks (U.S. Department of Homeland Security, 2003a). Its guidance suggests ways in which an individual should prepare for, and respond to, attacks involving conventional explosions and biological, chemical, radiological, and nuclear

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<sup>3</sup>In this effort, we discovered that many of the guidelines closely resemble each other and are based largely on those developed by the American Red Cross and the Federal Emergency Management Agency (FEMA). A complete list of guidelines reviewed in this stage is provided in Appendix B.

**Table 2.5**  
**Potential Actions**

Medical treatment	Obtain medical care if injured, infected, or potentially exposed Undertake preventive medical treatment Self-medicate Minimize contact with others
Respiratory protection	Cover nose and mouth Use particulate mask Use chemical respirator
Shelter	Move indoors, close windows and doors, shut off air circulation systems (normal) Normal, plus sealing windows and doors Normal, plus weatherized structure Filtered-pressurized
Evacuation	Immediately move out of affected area Relocate over time to avoid long-term hazards
Decontamination	Remove contaminated clothing Dispose of contaminated clothing Shower thoroughly

weapons. These more recent guidelines became an additional source of potential actions in our approach, although they were largely drawn from previously existing guidelines.

We catalogued the individual actions into a database, where they were grouped into preparation and response actions and then further classified them according to a number of dimensions, ranging from information needs to taking shelter. They were also categorized according to the type of emergency (e.g., chemical, biological, nuclear, radiological, or natural disaster) or hazard they were designed to address.

#### **STEP 4: EVALUATE POTENTIAL ACTIONS**

The suite of potential actions for each type of catastrophic attack was then subjected to an evaluation process to determine how well each action would contribute to preventing, protecting against, or minimizing injury. A number of different criteria, intended to span the range of issues relevant to the overall effectiveness of an action, helped guide the evaluation. These criteria are listed in Table 2.6. The criteria were drawn primarily from a technical evaluation of protective actions for residents near chemical weapons repositories (Rogers et al., 1990). While these criteria were derived to address chemical protection actions, they are sufficiently general to evaluate actions in all our scenarios.

The extent to which technical data are available to evaluate the different actions varies considerably. In some cases, good measurements have been made, but

in many cases, no relevant technical evaluations were available and we relied on our judgment. The evaluation process was thus somewhat subjective. Nonetheless, it provided an opportunity to examine a potential action in the context of the range of factors that influence its effectiveness.

In our evaluation, we paid particular attention to how the potential action fared in terms of its effectiveness for variations in the scenarios and in where an individual was located. We did this to ensure that the actions chosen would be appropriate for the various types of terrorist attacks—chemical, radiological, nuclear, and biological—and would not be specific to the scenario or an individual's location. What emerges from our evaluation of the suite of potential actions is an appreciation of how important it is to match the individual action to the type of terrorist attack. For example, sheltering can be useful in all but an undetected biological attack. However, the form of sheltering differs significantly. Individuals need to move inside in both chemical and radiological attacks that occur outside; however, in a chemical attack, even more protection is called for (i.e., closing down air flows). Shelters against fallout from a nuclear attack need to be far underground.

**Table 2.6**  
**Evaluation Criteria for Potential Actions**

Criterion	Explanation
Protection capacity	Ability of action to provide protection in a technical capacity, regardless of other factors
Implementation speed	The ability, based on both info from the scenario as well as the action itself, of being able to implement the action in time to help
Protection duration	Ability of action to provide protection for the duration of the event
Appropriateness for all populations	Children/infants, physically impaired, vaccine contraindicated
Appropriateness for all locations	Home, office, school, out and about, car
Maintenance	Extent of attention required when action not in use (i.e., before attack)
Cost	Investment or sustainment cost
Information limitations	Difficulty of obtaining information needed to know whether to execute
Training or education needs	Training, education, skill required to prepare for or execute action
Intrusiveness	How much it intrudes on daily life prior to event or activity during event
Scenario specificity	Extent to which the action is appropriate only for the specific scenario being considered
Discouraged by professionals	Extent to which action may be harmful to others or goes against professional recommendations
Potential for adverse health effects	Potential to introduce other problems even while protecting against threat

## STEP 5: DEVELOP AN INDIVIDUAL'S STRATEGY

Our final step was to assemble those actions that proved effective into an individual's strategy for catastrophic terrorism. The strategy begins with actions an individual would take to respond to each of the four types of terrorist attacks. It then describes the priorities an individual should have in such responses, given that one's initial reactions might not always be right. Our individual's strategy concludes with recommendations for the specific steps an individual should take to prepare for future catastrophic terrorist attacks, deriving these preparatory steps from the recommended response actions.

The development of this strategy was governed by a number of guiding principles. These emerged from our analysis of the effects of the scenarios and the resulting individual needs, from our review of the current U.S. government terrorism preparedness guidelines, and from the insights of citizens who participated in our focus groups.<sup>4</sup> Based on this, the individual's strategy should:

- Focus on primary effects to personal health and safety.
- Require individuals to make as few choices and decisions as possible.
- Present the actions as clear and simple rules.
- Define the actions so they are appropriate for a range of variations in scenario details and individual locations.
- Provide the context and rationale for the actions to allow for variations if the terrorist attacks were to occur.
- Include actions for attacks when official guidance will be available, not just in situations where it will not be available.

Because of the horrific nature of the effects of terrorist events involving unconventional weapons, an individual must not be distracted in the critical minutes of an attack by less important needs or in their preparations by a laundry list of measures. Thus, the strategy focuses on the primary needs of individuals to ensure their survival. Given how quickly an individual will need to act and the enormous psychological strain that will accompany such events, the strategy aims to leave an individual with as few choices and decisions as possible to make at the time. The actions are also designed to be triggered by some information that an individual can reasonably be expected to possess during an attack.

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<sup>4</sup>See Appendix C for a description of the structure, purposes, and results of these focus groups.

The response actions in the strategy have been defined so that they are appropriate for a range of variations in potential terrorist attacks, as well as for wherever an individual might be at the time—at home, work, or play. At the same time, we recognize that it will not be possible to predict all the possibilities for future terrorist attacks. Thus, the strategy and ensuing discussion provide the context and rationale for the actions to allow for refinements on the part of individuals at the time.

Only in the case of an attack using biological weapons does our strategy suggest that individuals will need to rely on government actions. This is because individuals are unlikely to identify such an attack on their own or have the medical resources to provide for their own health and safety. Therefore, the strategy suggests actions that an individual would take in those situations where guidance will be available from government officials or emergency responders. This is intended to help an individual understand why certain actions will be required and to gain confidence in what is being planned. At the same time, the government will face many challenges in providing appropriate medical care, especially when many essential services will be disrupted. So individuals will need to be ready to act on their own, even in covert biological attacks, to get medical aid and minimize their further exposure to biological agents.