CHAPTER 1

The Threat Environment

The major-event environment faces threats from both deliberate and accidental dispersal of hazardous substances. Safety and security efforts for major events are aimed at preventing acts from occurring, whether they are deliberate or accidental. The response efforts are aimed at combating the *adverse effects*. To put the situation bluntly, the threat to major events is not the substance or material but the effects caused by its dissemination. For example, the purpose of the major-event security and safety effort is not to prevent or react to employment of chlorine gas. It is to keep people healthy and safe. I have seen too many CBRN and HAZMAT specialists, myself included, get bogged down in the mechanics in the middle of the situation while losing focus on the end state. Figure 1.1 shows the methodology I prefer to use.

This chapter summarizes the threat environment. Later on in the book, in Part V, I will use specific scenarios to illustrate the major subcategories of threat.

ADVERSE EFFECTS

For both planning and response purposes, it is far more useful to analyze the CBRN/HAZMAT threat environment from the viewpoint of actual effects to people and property. I think that it is far more effective to plan for dealing with large numbers of sick and injured people than it is to conduct planning for specific categories of chemical substance. It is a better use of resources and intellectual capital to have one very good general-purpose plan for sick, injured, and contaminated people than a number of specific plans for specific chemical substances.

I think that planners and responders are better served by considering the end states of CBRN/HAZMAT scenarios and working backwards from them. We can have literally 6000 scenarios and work through them to their conclusion, but this is really a waste of precious time, as there are really only a handful of outcomes. The thousands of available CBRN/HAZMAT substances can cause seven categories of damage.

Dangerous Substances × Means of Dissemination × Multipliers = Adverse Effects

FIGURE 1.1 The preferred methodology.

The adverse effects of CBRN/HAZMAT incidents or accidents include any combination of seven categories of problems, which will be considered individually. Thus, I feel that the "threat spectrum" is better portrayed as a number of conditions to be confronted, not as an A to Z list of toxic or harmful materials. The threat spectrum is composed of the seven adverse effects listed below:

1. Death (immediate or delayed)
2. Injury and illness (immediate or delayed)
3. Psychosocial effects (immediate or delayed)
4. Damage to property
5. Damage to the environment
6. Economic effects
7. Political effects

Death

CBRN/HAZMAT materials may cause people to die, either immediately or later on due to injury and illness. The overwhelming operational imperative of major-event planning will obviously be to reduce or eliminate death. It is important to understand that most CBRN/HAZMAT materials do not have much potential to cause instant lethality. While the small number of CBRN terrorist incidents in modern times have caused deaths, they have caused only a handful of immediate fatalities. Even the fastest-acting biological-warfare agents cause death hours or days after exposure. Even the most radioactive "dirty bomb" is likely to cause fatalities only through an explosive dissemination. Many chemical substances, including chemical-warfare agents (CWAs), are theoretically capable of rapidly killing exposed individuals, but field conditions, especially in terrorist or accident settings, rarely allow for the necessary concentrations to be present. Even some of the most deadly CWAs, such as mustard gas or phosgene, will produce only delayed lethality under most circumstances.

Injury and Illness

Illness and injury, which may or may not lead to eventual fatalities, are a more significant planning consideration. The vast majority of the CWAs and toxic industrial chemicals are far more effective at causing illness, injury, incapacitation, or serious discomfort than they are at killing people outright. Biological-warfare agents, such as pathogens and toxins, are designed to cause sickness, but not necessarily death. Indeed, rapid death of a host does not serve a useful evolutionary purpose for a disease-producing microbe. Psychosocial effects, discussed below, may lead to panic and disorder, which may result in conventional injuries.

It is very important to understand that many of the CBRN/HAZMAT threat materials do not cause immediate injury or illness. Many materials have latent periods because the mechanism of harm that they use takes time to take effect. In most conceivable radiation-exposure scenarios, radiation sickness and other effects will take a long period of time to develop. In many radiological situations, the long-term delayed effects are statistical in nature and may take years to become apparent. Aside from a handful of fast-acting toxins, biological-warfare agents tend to have delayed effects, as there are incubation periods involved. While many chemicals are fast acting, some are not. Phosgene is a dangerous industrial chemical and chemical-warfare agent, but it takes many hours for its effects to appear.

In the context of emergency planning and response, ill and injured people provide a far greater burden than dead victims. While dead people must be taken care of, the urgency is far less than with living victims who need rescue, decontamination, immediate first aid, and/or transport to definitive medical care.

Psychosocial Effects

CBRN/HAZMAT materials may cause many psychological and social effects. The psychological and emotional effects of CBRN warfare and terrorism have generally been less studied than the physical effects. For the most part, CBRN weapons are invisible. For many people, a threat that you cannot see produces far more fear and anxiety than a well-known or highly visible danger. Fear can be effectively contagious.[1] In addition, there is the possibility of psychogenic effects, where fear and anxiety may produce physical symptoms not unlike exposure to some of the threat materials. In other circumstances, people with existing mundane illnesses may mistake their symptoms for exposure. People with nausea may mistake it for acute radiation sickness and people with respiratory infections will think that they have anthrax. The term "worried well" is often used, and this phenomenon will be discussed in more detail in the section on medical preparedness.

Damage to Property

In many situations and scenarios, property may be contaminated and rendered unusable for its intended purpose. Sometimes actual contamination is not necessary for people to imagine that it might be present. If people think that an area or a building still poses a threat, they will not go there, causing businesses to suffer. The psychological taint may prove harder to remove than any physical taint. Because many major events occur in sites of unique cultural importance, the damage to property may assume more dimensions than merely economic.

Damage to the Environment

The vast majority of CBRN/HAZMAT materials would qualify as environmental contaminants in most regulatory regimes. The long-term environmental effects of dispersal of such materials could cause problems for decades. As with damage to property, some threats such as anthrax or radiation may induce such fear that people will assume that they are present long after they have decayed or been decontaminated.

Economic Damage

Both CBRN terrorism and HAZMAT accidents can be responsible for vast economic damage. Response to disasters costs money. The economic impact of conventional terrorism is well documented,[2] and the existence of materials that contaminate property will only serve to extend the economic impact of terrorist attacks. It is my opinion that indirect costs of CBRN/HAZMAT incidents will greatly exceed the direct costs. The loss of property and/or the extensive efforts to restore property to usable condition could be very expensive. Recovery efforts, including decontamination, could take a very long period of time and many resources. Businesses could lose revenue or close. Buildings and areas of cities may be isolated or abandoned for periods of time, having adverse effects on the economy. Indirect effects are possible too, as financial markets will react to terrorist events and major accidents.

Political Damage

CBRN/HAZMAT incidents can be damaging to the prestige and authority of civil leaders. We need only to look at the Fukushima nuclear disaster to understand that situations involving CBRN/HAZMAT can have wider-ranging political implications. At a fundamental level, the purpose of nation-states is to protect their citizens. The delay or cancellation of a major event due to a CBRN/HAZMAT incident may have political repercussions. Both deliberate and accidental releases of CBRN/HAZMAT substances mean that the state has failed in its duty to protect the public.

CAUSATIVE AGENTS: THE SPECTRUM OF CBRN/HAZMAT SUBSTANCES

We can approach the subject of the threat to major events in a number of different ways. I think that it would be counterproductive to attempt a vast catalog of possible materials that can cause death, illness, or injury by design or accident. It is not the author's intent to give a catalog of death and destruction, and such an attempt would fill a hundred redundant pages. There are many excellent reference works that can serve as the A-Z of CBRN and HAZMAT threats, and it will serve little purpose for me to try to retread the work of others. U.S. Army Field Manual 3-9,[3] available widely on the internet as a PDF, is a classic reference, as are Jan Medema's *Basic Principles of Chemical Defense*[4] and the various works of Frederick Sidell, particularly *Chemical Warfare Agents: Toxicology and Treatment*.[5] Rather than repeat the work done by many others, I will try to cut through to the information that is relevant to protecting major events. We should try to find a way to look at the threat that helps us decide where to prioritize our efforts.

We've already established that adverse effects are the threat. But we can examine the causes of the adverse affects. These are the causative agents. We can look at the "what"—the physical material that causes the threat—the "how"—the mechanism by which it is dispensed—and the "who" and "why"—who did it and for what purpose. Let us first examine the "what."

Chemical Warfare Agents

The term "chemical warfare agent" (CWA) broadly refers to the use of chemical substances that have been developed for use in warfare by nation-states. The CWAs are widely known in most countries by their "digraph"—a two-letter symbol (e.g. VX) originally developed many decades ago in the NATO countries. The world's various militaries historically classified the CWAs according to their mechanism of physiological action (in some cases a very dated approach to classification), and they include the following families of chemicals.

Nerve Agents

These are organophosphate compounds that cause lethal damage to the nervous system. Tabun (GA), sarin (GB), soman (GD), GF, and VX are the primary examples. The nerve agents are among the most deadly chemicals produced by man and are lethal in very small quantities. They are also noted for being lethal through dermal exposure (absorption of liquid agent through the skin) as well as through inhalation. The primary difference between the various nerve agents is not their method of action but the rate at which they evaporate. The term "nerve gas" is not really appropriate, as the nerve agents are all liquids at normal temperatures.

Blister Agents

Also known as vesicants, this family normally is composed of the mustard agents (HD, HN, H, etc.) as well as lewisite (L) and phosgene oxime (CX). These compounds provide significant damage to exposed skin, eyes, and respiratory tract. The mustard agents have effects that are delayed. While mustard was used to great effect in the First World War to cause casualties, it caused few battlefield deaths, and most of the injured victims who eventually died did so because they succumbed to complications that would have been treatable with access to modern medicine.

Cyanides

Hydrogen cyanide (AC) and cyanogen chloride (CK) were referred to historically and incorrectly as "blood agents." Arsine may also be considered in this category, but it was rarely used as a warfare agent. It should be noted that hydrogen cyanide is a rarity among the CWAs in that it is lighter than air. Despite the fact that hydrogen cyanide has been used for executions and genocide, it has a poor history of use in actual warfare. AC and CK need a very high concentration in order to cause lethality, which makes their use as weapons problematic. Hydrogen cyanide is used in industry as well.

Pulmonary Agents

This category of substances is also known under the older, less accurate term "choking agents." This family includes chlorine, phosgene, and diphosgene. Such agents are often considered "first generation" CWAs, as they were the first to be used in modern warfare. They kill by inducing pulmonary edema. The effects of phosgene and diphosgene are delayed. A majority of the chemical-warfare fatalities in the First World War were due to this category of agents,[6] principally phosgene. These chemicals, because of their use in industry, are often considered under the category of industrial hazardous materials. Many industrial chemicals have characteristics nearly identical to the military choking/pulmonary agents.

Chlorine often gets special attention in this category because of its widespread use in industry. In some instances, it is available in very large quantities for water purification. While its usefulness as a battlefield weapon was very poor, the near global availability of chlorine in large quantities gives some people concern. The scope of danger posed by chlorine in industrial quantities is well established in industry publications.[7]

Nonlethal Agents

This family comprises a wide variety of compounds that cause (generally) less-than-lethal effects. They are primarily used as incapacitants and riot-control agents. Some examples include the vomiting agent adamsite (DM), tear gases (like OC, CS, CR, CN), BZ (an unpredictable hallucinogen), and derivatives of fentanyl, a narcotic tranquilizer. While riot-control agents are not viewed as likely terrorist agents, they must still figure into planning, as they may still be of significance in a major-event setting. Some major events, such as political summits, may attract demonstrations and civil disorder. Police may use riot-control agents in public order operations, and the dispersal of such agents may have unexpected effects. I was personally involved in preparing White House staff for possible adverse effects of riot-control agents at several events, including a national political party convention and the G8 Summit in Genoa, Italy. Riot-control agents could also be used as a distraction accompanying some other form of terrorist incident. For example, tear gas could be used to start a panic and move large numbers of people in a certain direction for other more lethal attacks to take place. While "non-lethal" agents are designed to be incapacitating rather than lethal, there have been circumstances when serious injury or death has occurred from their use.

Industrial Chemicals/HAZMAT

Chemicals long ignored or given second billing by military authorities, industrial chemicals pose a far greater threat for terrorist use. Toxic materials may be stolen from industry. Terrorists could target industrial facilities for the purpose of causing a release of toxic materials. For example, during the wars that accompanied the breakup of Yugoslavia in the early 1990s, the chemical industry in Croatia was deliberately targeted.[8]

Many dangerous chemicals are routinely used in commerce and industry and are transported on the world's railroads, highways, and waterways in large quantities. Accidents involving such substances can pose as much a threat to a major event as a deliberate terrorist incident. We need only to look at the Union Carbide incident in Bhopal, India, to understand the potential for harm represented by industrial chemicals.

Many industrial and commercial chemicals have characteristics that make them more dangerous to the general public than some of the CWAs. Industrial chemicals can include have any of the following characteristics:

- Flammability
- Explosion risk
- Corrosiveness
- Reactivity to air or water
- Toxicity

Because commercial and industrial chemicals are much more freely available for purchase or theft in large quantities, I consider them to be much more accessible to the modern terrorist than the CWAs.

There has been ongoing debate, both in military and civil settings, about which industrial materials are the most likely to be used as a terrorist weapon. Bureaucrats make lists, and much effort has been made to come up with threat lists, based on the properties of the industrial chemicals and their general availability for theft or diversion. The most widespread military list is the North Atlantic Treaty Organization (NATO) International Task Force 25 list, which indicates the broad consensus on the most dangerous industrial chemicals. This list includes:

- Ammonia
- Arsine
- Boron trichloride
- Boron trifluoride
- Carbon disulfide
- Chlorine
- Diborane
- Ethylene oxide
- Fluorine
- Formaldehyde
- Hydrogen bromide
- Hydrogen chloride
- Hydrogen cyanide
- Hydrogen fluoride
- Hydrogen sulfide
- Nitric acid, fuming
- Phosgene
- Phosphorus trichloride
- Sulfur dioxide
- Sulfuric acid
- Tungsten hexafluoride

However, this is merely the tip of a pyramid. There are literally thousands of additional substances that we cannot ignore.[9] As only one example, the bureaucrats of the United States have been busy. They not only have lists of chemicals, but lists of lists. For example, the Environmental Protection agency has an excellent "metalist."[10] Europe also has its lists, with over 100,000 substances being listed in European Union regulations and directives.

The Department of Transportation (DOT) provides useful statistics on hazardous-materials accidents, particularly those involved in transportation accidents. It provides many rank-ordered lists, using a variety of schemes for weighting applicable variables to illustrate what substances are most commonly involved in accidents and what mechanisms caused the accidents.[11]

Chemicals considered dangerous to life, health, property, or the environment number in the many thousands. We can fill feet of shelf space merely cataloging the potential threat chemicals. The point here is that we cannot afford to get fixated on individual substances, as there are far too many. Because the options are simply too numerous, response plans against chemical threats cannot be too tied to the individual characteristics of single materials.

Biological Warfare

Biological warfare has been described as "public health in reverse."[12] It is the use of nature's germs and poisons to cause illness or death. Biological warfare is actually much older than chemical warfare. While many biological warfare agents (BWAs) are lethal, much of the research conducted in the Cold War was aimed at development of incapacitating agents. It was widely believed that making people ill for a long period of time may have had a greater strategic impact on war-fighting capability than merely killing people. This is because a sick soldier was felt to be more of a logistical burden than a dead soldier. Of course, this logic does not necessarily apply to terrorist selection of potential weapons.

Pathogens

Biological warfare agents include pathogens and toxins. Pathogens are disease-producing organisms. They include bacteria, viruses, fungi, rickettsia, and various parasites. Again, many good references exist.[13] Some examples of pathogens that have been cited as having potential as biological weapons include:

- Anthrax
- Smallpox
- Plague
- Tularemia
- Q-Fever
- Glanders
- Brucellosis

Pathogens may be developed in powder or liquid forms. It should be noted that pathogens are living organisms and they are often quite fragile. For example, UV radiation in normal sunlight is very destructive to most pathogens.

Toxins

Biological toxins are chemical poisons that are produced by plants and animals. Snake venom would be one example, albeit one not really suited for widespread terrorist usage. The toxins most cited as useful by terrorists are ricin, a poison extracted from castor beans, and botulinum toxin, produced by botulism bacteria. Ricin has been used for assassinations. The efficiency of toxins as area weapons, other than poisoning food or water, is somewhat speculative. In general terms, toxins are chemicals, and a situation involving toxins may more closely resemble a chemical incident than a pathogen incident. When encountered in liquid form, it is important to remember that toxins are usually large, complex, and heavy molecules that lack volatility. In other words, a puddle of toxin will not evaporate into a vapor form and pose a respiratory hazard.

Radioactive Materials

Radioactive isotopes can provide unhealthy levels of ionizing radiation to persons. Depending on the exact isotope, alpha particles, beta particles, gamma rays, and/or neutrons may be emitted. There are only a finite number of isotopes, and only a subset of them has properties and/or availability to make them viable as threats. Some materials exist for only fractions of a second in a laboratory or are available in such minute quantities that their threat is academic. While authorities vary, the Argonne National Laboratory[14] has developed the following useful list of radioactive materials thought to be useful for terrorism. These isotopes, listed because of their dangerous properties and their relative availability include:

- Americium 241
- Californium 252
- Cesium 137
- Cobalt 60
- Iridium 192
- Plutonium 238
- Polonium 210
- Radium 226
- Strontium 90

FIGURE 1.2 Industrial and medical radiation sources can be used for terrorism.
Source: U.S. Navy public-domain image www.msc.navy.mil.

Radioactive materials may be found as part of the nuclear fuel cycle or in a wide variety of scientific, medical, and industrial applications. The U.S. government has published an excellent primer on what types of radiation sources are likely to be encountered around the world called Technical Guide 238,[15] and I cannot attempt to do better than this excellent reference. Available for download, I consider Tech Guide 238 to be a veritable bible.

The primary concern about terrorist use of radioactive materials is that they would be disseminated in an explosive device, a so-called "dirty bomb" or radiation-dispersal device (RDD). A secondary concern with radioactive materials is that they may be covertly placed in a location that would expose people nearby to dangerous amounts of radiation, which is discussed both below and in one of the scenarios in Part V.

Except in extremely large quantities, radioactive materials typically produce a level of health hazard that is occupational or environmental rather than acute. It is difficult for a terrorist to cause acute radiation sickness with commercial or industrial materials except in some fairly constrained circumstances. However, the mere presence or suspicion of radioactive material is sufficient to cause panic.

Nuclear Devices

Nuclear devices are nuclear bombs, producing massive destruction through fission or fusion. Nuclear devices could be state-produced weapons or improvised nuclear devices (INDs). This is the least likely threat, due to the technical barriers involved. A poorly constructed IND may not function as intended and become a crude RDD, dispersing plutonium or uranium. However, a communicated threat or a hoax involving a nuclear device is certainly a credible possibility. As a general rule, an actual nuclear explosion is beyond the scope of this book.

MEANS OF DISSEMINATION

CBRN weapons and industrial HAZMAT rarely pose a widespread threat merely by their presence in a container. They require a means of dissemination in order to cause adverse effects over a wide area. Different means of dissemination have differing operational impacts. Some methods of dissemination are more effective than others. I am not going to impart detailed knowledge on what methods are more effective than others. Although this information is generally available to the reader who wishes to learn more, I am not going to do any potential perpetrators any favors. This section is designed to provide an overview of the methods of dissemination that I believe is of relevance to the major-event environment.

Munition Efficiency

With deliberate employment of CBRN/HAZMAT substances, there is a useful concept known as "munition efficiency." Munition efficiency was originally derived as a concept when nations were manufacturing chemical weapons for use on the battlefield. Munition efficiency is usually expressed as a percentage and is a measure of how much chemical or biological agent is actually disseminated in a form that is going to achieve the desired tactical effect. For example, it does not take much engineering knowledge to estimate that using explosive dissemination (such as in an artillery shell) of a highly volatile and highly flammable liquid is probably not going to result in effective dispersal, as most or all of the agent will burn up. In a similar example, the Soviet Union discovered that aerial sprays of hydrogen cyanide had little effectiveness, since the hydrogen cyanide vapor is lighter than air, and a chemical agent needs to be heavier than air to reach troops on the ground if dispersed at altitude.[16]

When evaluating potential threats, developing a planning threshold, or estimating the future course and harm of an incident, the munition efficiency of the dispersal means should be considered. Rarely, if ever, does an accident or incident provide a mechanism that results in 100 percent effective dissemination of a threat material. When discussing planning scenarios, I have often seen emergency planners make poor assumptions about terrorist device efficiency. Often, if 25 kg of chemical agent is in a device, planners assume that all 25kg of agent will be disseminated in a "useful" form. This is rarely, if ever, the case, even with sophisticated chemical munitions designed by the research and development program of a large nation-state, let alone an improvised device using homemade components.

Primitive or Bulk Dissemination

The most primitive methods of dissemination are generally to dump bulk agent or to have some kind of leak or drip. Such dissemination generally relies on the volatility of chemicals to evaporate from liquid into vapor state or on gravity to allow dangerous liquids to flow from the point of dissemination. The 1995 Tokyo subway attack was a very crude dissemination. The 2001 anthrax attacks had no real method of dissemination. Fine powder was simply put into envelopes, yet death, illness, and contamination of property was the result.

Covert Emplacement of a Radiation Source

Radioactive materials do not need to be inhaled or ingested. Radioactivity, particularly gamma rays and neutrons, can penetrate through many types of material and travel a long way in air. A radiation source, such as a commercial or medical source, could be placed in a location where people could be exposed to harmful amounts of radiation. Since radiation exposure is cumulative over a period of time, such an attack might be effective. Major events often force people to congregate in the same area for a long period of time, such as stadium seating or entry queues.

Contamination of Food or Water

Food and water could be contaminated by deliberate action by terrorists. An accident could expose food or water to industrial chemicals. Major events often have catering restricted to a handful of sources. While history has few actual incidents of bioterrorism, one that actually occurred was an incident in Oregon in 1984 when a religious cult made 751 people ill with a food-borne pathogen, *salmonella typhimurium*.[17]

Spraying

Both chemical and biological weapons are most effective as respiratory threats. Radiological particles that can be inhaled could also pose a threat. Devices and mechanisms that spray gas, vapor, or fine mists of droplets can be used as methods of dissemination by terrorists. Some accidents may involve leaks to pressurized containers, which are effectively the same as a spray device. The earliest military chemical weapons were chlorine cylinders that were taken to frontline trenches in the First World War and opened when the wind was in the correct direction. More sophisticated techniques such as aerial spray tanks were developed later. Correctly constructed, spray devices can achieve high munition efficiency.

Binary Devices

A device could be constructed to combine precursor chemicals in such a manner as to formulate a chemical weapon. Binary devices are an established military technology, and a few attempts have been made to use them as terrorist weapons.[18] As a rule of thumb, binary devices are actually less efficient than "unitary" devices of the same size. They sacrifice munition efficiency for safety among the handlers, which is not always a design criterion of interest in terrorism.

Explosive Dispersal

Most chemical weapons designed by the major nation-state participants in chemical weapons development were explosive dissemination devices, such as bombs, artillery shells, rockets, and missile warheads. Chemicals, biological agents, and radioactive material could all be disseminated with some sort of explosive charge. Munition efficiency can vary widely using this technique.

Vectors

Some pathogens are spread in nature by "vectors" such as insects or parasites. For example, mosquitoes spread yellow-fever virus. In practice, using vectors as a method of dissemination is likely to be very inefficient. However, the presence of unusual numbers or types of vermin at a major event bears examination.

Commercial and Transportation Accidents

Very dangerous chemicals are used in industry every day and are transported on roads, railways, and waterways in large quantities. It is my belief that accidents and incidents involving such materials near a major event are more likely and have more potential for harm (due to quantities involved) than many of the other threat mechanisms that I have discussed. A wide variety of mechanisms could be present during a transportation accident that might cause dispersal of hazardous substances.

The Bhopal disaster in India in 1984, where large quantities of a toxic methyl isocyanate vapor leaked, demonstrated firmly that industrial accidents in factories can kill thousands outside the factory perimeter. Industrial accidents or deliberate sabotage are a possible mechanism of dissemination. Major-event planners need to consider just what exactly is used, stored, or produced in significant quantities upwind of major-event venues.

Another concern pertinent to major-event security is the possibility of an accident or disaster involving nuclear-power facilities. Three Mile Island, Chernobyl, and

Fukushima are all in the public consciousness. While major events in the immediate precincts of large power stations are not likely, it is certain major events will be held within the downwind hazard area of commercial or military reactor facilities. Accidents or sabotage at such facilities are possible scenarios.

CAUSATIVE AGENTS: THE PERPETRATOR

Yet another aspect of the "causative agent" is the perpetrator. The psychology and dynamics of criminality and terrorism are worthy of study unto themselves, and I do not feel that a lengthy discussion is within the scope of this overview.

Accidents, Natural Disasters, and Incompetence

Not every incident is the result of terrorist activity. I am fairly certain that incompetence has killed more people than terrorism. Some of the greatest dispersals of radioactive material (Chernobyl, Fukushima) have been accidents brought about by incompetence or natural disaster. By their very nature, the effects of such causative agents will be random.

The Lone Perpetrator

Many violent or destructive acts have been perpetrated by single individuals. Not every lone perpetrator is necessarily a terrorist in the classic sense, as some incidents have been the result of mental illness rather than political, religious, or ideological motivation. A major event can easily present a logical target to someone with real or imagined grievances. There are practical limits to what a single person can accomplish, but we can look at some perpetrators in history (such as Eric Rudolph, the "Olympic Park bomber," or Theodore Kaczynski, the "Unabomber") to see that the limit is still quite high.

The Organized Group

An organized group of perpetrators can generally accomplish far more than a single individual. Much of the "cycle of terrorism" (see Chapter 9) is labor-intensive, and there is a finite limit to what a single perpetrator or even a small group can hope to accomplish.

The Nation-State

It is possible that a large and coherent conspiracy may be mounted by the efforts of a nation-state. While this is less likely than individual or group activity, the support of a nation-state greatly increases the resources available to a terrorist plot.

MULTIPLIERS IN THE MAJOR EVENT ENVIRONMENT

Multipliers are situations and conditions that serve to change the effects caused by the "causative agents." Multipliers can serve to make the adverse effects less or more. Here I will discuss the multipliers that serve as complicating factors in the major-event environment. In most cases, I am referring to situations, conditions, and factors that make the adverse effects more severe than they would otherwise be. Much of the existing knowledge of CBRN and HAZMAT situations is based on situations such as military battlefield scenarios, industrial accidents, or transportation accidents. The planning assumptions behind many of the tools and doctrines for these situations will be different than the relevant factors in play in major events. The following are some of the factors that may serve as multipliers that could change the overall ability of CBRN/HAZMAT to cause undesirable effects.

Population Density

Most major events are "major" because of the number of people at them, whether they are members of the public (as in sporting events, for example) or staff and dignitaries (such as an international summit). This will mean, for example, that a terrorist has a more densely packed group of targets, often packaged nicely in defined locations, such as convention halls or stadiums, rather than randomly spread across a city or battlefield. Density of potential victims will probably serve to increase the ability for materials to cause death or illness.

Motivation and Perpetrator Efficiency

The motivation of a perpetrator is an important multiplier. Depending on psychology and ideology, the perpetrator(s) of an incident may or may not be seeking to cause death or injury. Some perpetrators may just be seeking to bring attention to a cause. Others may be seeking to cause economic disruption as their primary goal. Some perpetrators may be mentally ill and have motivations that make no sense to anyone else. For example, environmental or animal-rights protesters may value human life and wish only to make a political statement or cause property damage in a way in which they believe will be helpful to their cause.

The extent to which the perpetrator desires to kill people or make them ill can be considered a "perpetrator efficiency" similar to the "munition efficiency" discussed above. Please remember that perpetrator efficiency is only one of many factors. It is possible that persons or groups without intent to kill or maim may end up causing death or injury. Acts designed to cause disruption, property damage, or political embarrassment may end up causing death or injury through miscalculation or ill-informed actions. As one example, the use of an irritating but generally nonlethal chemical could cause death among civilians with respiratory conditions or result in many deaths and injuries by causing a crowd to panic and stampede.

Urban Environment

Much of the military understanding of the behavior of CBRN weapons is based on battlefield scenarios, which are often in rural areas. Similarly, many of the transportation and industrial accidents that comprise the knowledge base of civil HAZMAT responders have occurred on highways, railroads, dockyards, and industrial areas. These are not the typical major-event venues such as stadiums, arenas, hotels, convention centers, and sites of cultural and historic importance. The nature of the built environment can either mitigate or aggravate the effects of CBRN/HAZMAT depending on the exact context.

Weather Effects

The study of weather is still largely a "macro" phenomenon, based on broad generalizations applicable over a large area. Modern cities, which are the location of most major events, provide for a large proliferation of micro climates. The varying topography of populated areas provides for ducting and channeling of winds, including the so-called urban wind-canyon effect.[19] A responder should consider himself very lucky if a CBRN/HAZMAT incident occurs exactly at the spot on the map where there is a weather station. The nature of built-up environments makes prediction of wind direction much more complex and efforts to conduct dispersion modeling of CBRN/HAZMAT incidents more complicated. The modeling and prediction issue will be discussed in detail elsewhere in this book.

Untrained or Unequipped Victims

It sounds odd to talk about "untrained victims," but it is a valid concept. Military scenarios generally involve military personnel, most or all of whom have some degree of training, equipment, and procedures for CBRN defense. If you attack a modern army's infantry battalion with a chemical weapon, most of the personnel will survive because they will take cover and put on their protective masks. Individuals with exposure to skin may have decontamination kits to provide for at least a basic emergency decontamination. Even in the civil sector, many commercial and industrial chemical incidents happen in workplaces with some level of response capability and some type of procedure to mitigate the problem. In major-event settings, we have an untrained and unprepared target.

Special Needs Victims

The classic military and commercial/industrial scenarios tend to involve participants who are adult, relatively healthy (at least fit enough to have a job), and (until relatively recently in many places) largely male. The potential pool of victims at major events can include a broad swath of all of humanity, with many types and classes of person who may require special considerations, such as the elderly, disabled, children, people who do not speak the local language, the mentally impaired, religious minorities who object to certain medical procedures, and others. Such a heterogeneous mix of potential victims will complicate planning and response efforts. Many of the "special needs" population will be more vulnerable to the effects of CBRN/HAZMAT. If you plan to have only healthy, compliant, and average adults in your decontamination line, then I can just about guarantee that you will be confronted with a blind person in a wheelchair, speaking only a foreign language, with a guide dog and wearing religious headgear that he is reluctant to remove.

Crowd Behavior

Crowds composed of members of the public do not act like trained infantry battalions. The large numbers of people at a major event may act in a random fashion or in ways that are detrimental to any response effort. Panic, sometimes to the point of stampedes, is a possible effect. Crowd behavior is likely to serve as a multiplier of the adverse effects.

Some people in crowds may exhibit anxiety symptoms that might mimic exposure to CWAs. It is easy to envisage scenarios in which a small number of chemical casualties in a crowded venue results in a large number of conventional injuries or deaths as the result of crowd stampedes.

Camera and Media Density

A practical consideration of major events is that they attract both formal and informal media attention. The typical major event has a high number of cameras and correspondents. Both the normal security effort and various response efforts will be available for scrutiny by the world, whether that is the intended effect or not. Terrorist events and accidents, whether they include CBRN/HAZMAT or not, will be widely documented. The rapid dissemination of information may serve as a multiplier to some of the psychosocial effects of CBRN/HAZMAT incidents by serving to spread fear, anxiety, and panic. Attempts to disseminate useful information to the public may be overwhelmed by the flood of information that will arise from a significant CBRN/HAZMAT accident or incident at a major event.

We should consider the informal media sector as well. We should not discount the proliferation of mobile devices and smartphones. The ability to instantly provide Twitter feeds and upload video footage onto websites such as YouTube™ means that most major events in the future will have large amounts of nearly real-time information posted onto the web for the entire world to see.

NUISANCES, HOAXES, AND COMMUNICATED THREATS

An important category of the threat spectrum is the category of "apparent and possible threats." This category includes a wide variety of nuisances, hoaxes, and the traditional "communicated threat," which I will address individually. Any major-event safety and security effort is likely to spend more time and effort addressing this category of threat than any actual employment of CBRN agents

Nuisances

I define nuisances as relatively harmless situations that are frequently mistaken for a CBRN incident or HAZMAT accident. Depending on the parameters of the event, the nuisance category may include such events and situations as:

- Malfunctions by sensors
- Overzealous security staff reporting every truck with a HAZMAT placard as a threat
- Abandoned parcels or items containing liquids or powders
- Substances mistaken for potentially hazardous materials or reported as such by well-meaning individuals
- Alarms by chemical sensors produced by cleaning chemicals or other routine causes
- Detection of benign radiation sources, such as legitimate nuclear-medicine sources or procedures

- Changes in natural background phenomena that cause alarms on biological or radiological sensors

Nuisances will increase in frequency commensurate with the effort to detect CBRN substances. Every sensor has some theoretical false-positive rate, even if quite low. Therefore, with an increase in the number of sensors that are employed, there will be a higher number of false alarms. Nuisances will also increase in number after an actual incident, as was shown in 2001 in the U.S. after the anthrax incidents. If an incident involving a powder occurs, the number of suspicious powders reported to authorities will greatly increase.

Hoaxes

The hoax is a situation contrived to imitate an actual CBRN/HAZMAT situation without the actual presence of CBRN materials. Some examples from recent years include:

- Benign powders purporting to be anthrax
- Liquids marked as containing HIV or another infectious diseases
- Liquids thrown onto VIPs
- Highly odorous gases or vapors
- Small, harmless radiation sources placed deliberately to cause an alarm

An important subcategory of the hoax is the "boosted" conventional device. This would be a conventional hazard or hoax, such as a real or fake IED that is accompanied by hoax materials in order to increase the psychological effect of the device or to complicate conventional EOD procedures. An example would be a pipe bomb attached to a barrel with hazardous-materials marking (thus mimicking a chemical IED), or a car bomb that is paired with small amounts of radioactive material, thus mimicking an RDD.

Hoaxes may be relatively harmless gestures by people seeking thrills or attention, or they may be more serious efforts to cause undesirable effects, such as panic or confusion. Planning considerations should include the possibility that hoaxes may be designed to deliberately confuse emergency-response efforts, waste resources, or demonstrate to observers what the response capability for a certain type of incident may be. Hoax perpetrators could conceivably range from disaffected youths all the way to serious terrorists with ill intent who merely lack the resources to conduct a more potent attack.

Communicated Threat

This category of threat includes situations where some form of direct or implied threat of employment of hazardous substances has been communicated through some means, such as email, a phone message, or a letter. The so-called "bomb threat" is a (generally) non-CBRN example. A telephonic claim to have parked a vehicle with a chemical or radiological device in a certain area is one example.

Communicated threats cannot be ignored as obvious hoaxes. It has been an established practice with some terrorist groups to give warning after placing a dangerous device. This has been a particular practice of Irish Republican extremist groups. While most communicated threats are nonsense or provocations, authorities cannot rule out the possibility that a real hazard lies behind the threat.

There is some overlap between these categories. The communicated threat may be linked to a nuisance situation, often a "target of opportunity" scenario. For example, there might be a puddle of liquid underneath the air conditioners of a building (water condensation), and someone could call the police to say that he spilled a chemical agent there. Likewise, a threat can be included with a hoax device or substance, such as a threatening letter with an unidentified powder.

CBRN/HAZMAT SUBSTANCES: CHARACTERISTICS SIGNIFICANT AS PLANNING CONSIDERATIONS

While the dedicated CBRN or HAZMAT specialist may have an in-depth understanding of the nature and characteristics of CBRN/HAZMAT substances, the officials with overall planning responsibility may not. It is important early on in this book to establish some general facts about CBRN and HAZMAT so that all of the readers are on a level playing field. While the veteran may already know most of these facts, even the seasoned professional may need a few reminders of some essential truths. For those readers who do not have much formal background in CBRN/HAZMAT, please consider this section as a bit of a glossary, as I will not always define these terms again throughout the book. Many of these words and concepts are widely abused in security and safety circles, so here is my chance to set the record straight. This is not a primer in hazardous-materials chemistry, but several good ones exist if you need one. I prefer Armando Bevelacqua's book as a good start.[20]

Physical State

CBRN/HAZMAT substances can exist in solid (including dust and particles), liquid, or gaseous states (true gases and vapors). Solids and liquids can be dispersed as aerosols, a fine suspension of small particles or droplets that may act much like a vapor or gas for a period of time. The chemical threat is generally liquid in form in its bulk state under normal conditions, with only a small minority of CBRN/HAZMAT existing primarily as gas or vapor. The biological threat is typically encountered in aerosol form. The radiological threat is generally in solid form. I recognize that these are crude generalizations, but they form a useful basis for general discussions of the subject. Physical state becomes particularly important in responding to incidents. Such decisions as to whether or not decontamination is important or how widespread an area may be affected by a certain dispersal of material depend on the physical state of the materials involved.

Melting Point and Boiling Point

The physical state (solid, liquid, vapor, gas) of a substance is important because it affects "agent transport"—how far and how fast it can spread. Chemical substances have melting points and boiling points, and many of these can be significant. The blister agent sulfur mustard (HD), for example, has a relatively high melting point of 58°F/14°C, which means that it is a solid in cool weather. This can have operational implications.

Volatility and Vapor Pressure

Volatility is the tendency of a liquid (or, rarely, a solid like dry ice) to assume a vapor state. For example, acetone, which evaporates very quickly, is more volatile than water.

Again, volatility is an important consideration in incident management. Some liquids that might be dangerous and ostensibly require decontamination may have evaporated by the time a response team is on the scene. Vapor pressure is a measurement of how much vapor comes from a solid or a liquid, and is usually measured in millimeters of mercury (mmHg), pounds per square inch (psi), or atmospheres (ATM). As an example, acetone has a room-temperature vapor pressure of 180 mmHg, compared to water at 25 mmHg. This tells us that, at room temperature, there will be more vapors from a pool of acetone than from a similar-sized pool of water. Vapor pressure increases with temperature, as we all understand that liquids evaporate faster when it is warmer.

Persistency

Persistency is a concept related to volatility, and you may have heard of its use in a military context. Persistency is the endurance of a particular substance in the environment after dispersal. Although exact definitions vary from one country to another, "persistent agents" are ones that have a tactically significant lifespan in liquid form in the environment. In other words, they can contaminate terrain, equipment, and personnel. Materials with high volatility have low persistency

Visibility

While it seems condescending to say this, CWAs and toxic industrial materials are rarely if ever a dark, dense cloud of green gas that you can see approaching like a fog bank. When I was at the Army Chemical School, we called this the Hollywood Gas Attack, and for good reason. Most of the threat materials will not be visible to the naked eye after

FIGURE 1.3 Most chemical attacks do not look like they do in the movies.
Source: U.S. Army public-domain image.

dispersal or may appear to be the finest possible wisp of vapor or dust. The only reason why I bring this up is that I have repeatedly encountered officers and managers who have the "purple cloud" concept of a chemical attack, which can lead to the dangerous "I don't see anything so there must not be a problem here" viewpoint that gets people hurt.

Warning Properties

Warning properties are characteristics of a material that give the human senses the ability to know that a dangerous condition exists. For example, the toxic gas hydrogen sulfide is said to have decent warning properties because of its rotten-egg smell at levels that are below danger thresholds. Many substances have no warning properties. Some, like hydrogen cyanide, have odors that only a portion of the population can smell.

Exposure

Exposure means that a substance has achieved contact with a person in a way that is conceivably harmful. For example, a person can be exposed to gamma radiation. A person's skin can come into contact with corrosive liquids (dermal exposure). Exposure is not the same as contamination.

Contamination

Contamination means that an undesirable substance is physically present. In effect, it means being dirty. Liquids and powders can contaminate skin, equipment, hair, building surfaces, soil, grass, etc. Exposure does not necessarily mean contamination is present. For example, someone can be exposed to a toxic vapor, leave the area where the vapor is present, and not be contaminated because no residue is on or about their person. Conversely, a person in chemical protective clothing can be heavily contaminated by a toxic chemical but not be exposed to it. "Exposure" and "contamination" are often misused.

Route of Entry and Route of Exposure

Toxic or infectious substances can enter the human body through various routes. While ingestion (eating and drinking) and percutaneous (absorption through the skin) entries are not inconsequential, the most worrisome route of entry for CBRN/HAZMAT is respiratory. The human skin is a reasonably protective barrier, and people can generally be told what they can and cannot eat and drink, but a person breathes several times a minute and the human lungs are designed specifically for exchange of gases. This makes vapor, gas, and aerosol forms of CBRN/HAZMAT the most troublesome for causing widespread effects in a timely manner.

Toxicity

Toxicity is a quantitative measurement of how much of a substance is required to cause an adverse effect, such as incapacitation or death. Asking whether or not a substance has toxicity is pointless, as most things are toxic at some level or through a nonstandard route of exposure. Oxygen is toxic under some conditions, for example. After a simple search-engine request, you can read that sarin (nerve agent GB) is "the most toxic substance known to man," but I have also read that ricin (a toxin extracted from castor beans), plutonium, and botulinum toxin are "the most toxic substance" or the "world's deadliest" substance. Such claims are meaningless without being put in the proper context. A figure or a qualitative claim for toxicity is meaningless unless it is paired with a route of exposure. Some substances are harmless if deposited on the skin but are highly lethal if inhaled. It is important to note that much of the published data on toxicity was estimated based on work with animals. In many cases, there are wide differences in toxicity depending on which book you read, due to the uncertainties in the way in which the figures are calculated. In many cases, if not most, the toxicity figures for chemical substances are based on animal studies and are extrapolated to humankind. The margin of error in many of these figures is quite high. Toxicity is reported using a variety of different measures, such as LD50, ICT50, IDLH, and others. The exact definitions are not relevant to the general discussion here, and they are well defined in various references.

Vapor Density

Most of the CBRN/HAZMAT threat materials are heavier than air. The exceptions, such as hydrogen cyanide, are fairly rare. When I write about building protection measures and evacuation planning later on in the book, the heavier-than-air nature of most respiratory hazards will have significant implications. Vapor density (also called relative gas density) is often expressed as a number in comparison with air. Vapor density of air is 1.0 and the vapor density of GB sarin nerve agent is about 4.9, meaning that GB vapors are nearly five times as heavy as air. You can do a rough calculation of vapor density if you know the molecular weight of the gas or vapor involved. Anything with a molecular weight under 29 is lighter than air.

Latency

You can think of latency as an "incubation period." Indeed, for biological pathogens, it is literally so. Latency is the period of delay between exposure and the onset of adverse effects. For all practical purposes, every biological and radiological threat of interest has latent onset of effects. Some chemical substances have latent periods. One example is phosgene, which can cause deadly swelling in the respiratory system (pulmonary edema), but the symptoms usually only appear some hours after exposure to the chemical. Latency is a useful concept to understand because some scenarios will require prompt medical care to save lives, while in other scenarios the only useful medical care will be needed later on.

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