Chapter 6

CBRNE

Objectives

- Understand the definition of WMD according to Title 50, US Code.
- Describe the different classes of WMD.
- Discuss why terrorists might resort to using WMD.
- Compare and contrast the various capabilities of different classes of WMD.

Introduction

The growing proclivity toward violence appears to be evidence of a portentous shift in terrorism, away from its traditional emphasis on discrete, selective attacks toward a mode of violence that is now aimed at inflicting indiscriminate and wanton slaughter. The implication, therefore, is that terrorism is now on an escalation spiral of lethality that may well culminate in the indiscriminate use of CBRN weapons.[1]

Weapons of Mass Destruction

"CBRN" refers to Chemical, Biological, Radiological, and Nuclear weapons which are generally classed as weapons of mass destruction. Just as there is no single definition for "terrorism", there are multiple interpretations of WMD. Title 50 of the U.S. Code, "War and National Defense", defines WMD:

> *"Any weapon or device that is intended, or has the capability, to cause death or serious bodily injury to a significant number of people through the release, dissemination, or impact of—(A) toxic or poisonous chemicals or their precursors; (B) a disease organism; or (C) radiation or radioactivity."*
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> *—Title 50, United States Code, Chapter 40, Section 2302*

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The term "WMD" was first applied in 1937 to describe the effects of aerial bombardment on civilian populations. Most definitions agree that WMD are "weapons designed to kill large numbers of people."[2] Consequently, more recent U.S. laws, official statements, and documents define WMD as including additional types of weapons.[3] Both the terrorist attacks of September 11th 2001, and the Oklahoma City bombing, April 19th 1995 used conventional explosives to inflict mass casualties. As a result, the definition of WMD has been expanded to include any form of high explosives, thus CBRNE.

Motives and Rationales

If, in fact, we are approaching a new era of "super" CBRNE terrorism, why would groups seek to escalate to this level? One can identify five possible motivating rationales.

First, and at the most basic level, may be simply the desire to kill as many people as possible. CBRNE weapons could give a terrorist group the potential ability to wipe out thousands, possibly even hundreds of thousands, in a single strike. The following statement of a former FEMA director gives an indication of the potential killing power of these agents compared to conventional high explosives (HE): "To produce about the same number of deaths within a square mile, it would take 32 million grams of fragmentation cluster bomb material; 3.2 million grams of mustard gas; 800,000 grams of nerve gas; 5,000 grams of material in a crude fission weapon; 80 grams of botulinal toxin type A; or only 8 grams of anthrax spores." Such weapons would provide terrorist with the perfect means to seek revenge against, even to annihilate, their enemies, however defined, categorized, or otherwise determined.

A second reason for groups to seek to escalate to the CBRNE level could be to exploit the classic weapon of the terrorist—fear. Terrorism, in essence, is a form of psychological warfare. The ultimate objective is to destroy the structural supports that give society its strength by showing that the government is unable to fulfill its primary security function and, thereby, eliminating the solidarity, cooperation, and interdependence on which social cohesion and functioning depend. Viewed in this context, even a "limited" terrorist attack involving CBRNE agents would have disproportionately large psychological consequences, generating unprecedented fear and alarm throughout society. The 1995 Aum sarin nerve gas attack, for instance, which resulted in 12 deaths, not only galvanized mass panic in Tokyo, it also shattered the popular perception among the Japanese people, who, hitherto, had considered their country to be among the safest in the world. Moreover, it served to galvanize American attention to CBRNE terrorism, despite taking place overseas.

A third possible rationale for resorting to CBRNE weapons could be the desire to negotiate from a position of unsurpassed strength. A credible threat to use a chemical, biological, or nuclear weapon would be unlikely to go unanswered by a government and could therefore, provide an organization with a tool of political blackmail of the highest order.

A fourth reason, with specific reference to biological agents, could derive from certain logistical and psychological advantages that such weapons might offer terrorists. A biological attack, unlike a conventional bombing, would not likely attract immediate attention, and could initially go unnoticed, only manifesting itself days or even weeks after the event. This would be well suited to groups that wish to remain anonymous, either to minimize the prospect of personal retribution or to foment greater insecurity in their target audience by appearing as enigmatic, unseen, and unknown assailants.

Fifth, a group may wish to use CBRNE weapons, and more specifically biological agents, to cause economic and social damage by targeting a state's or region's agricultural sector. On several previous occasions in other parts of the world, terrorists have contaminated agricultural produce or threatened to do so. Between 1977 and 1979, more than 40 percent of the Israeli European citrus market was curtailed by a Palestinian plot to inject Jaffa oranges with mercury. In 1989, a Chilean left-wing group that was part of an anti-Pinochet movement claimed that it had lanced grapes bound for U.S. markets with sodium cyanide, causing suspensions of Chilean fruit imports by the Untied States, Canada, Denmark, Germany, and Hong Kong. In the early 1980s, Tamil separatists in Sri Lanka threatened to infect Sri Lankan rubber and tea plantations with nonindigenous diseases as part of a total biological war strategy designed to cripple the Sinhalese-dominated government.[4]

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Biological Attack

Among weapons of mass destruction, biological weapons are more destructive than chemical weapons, including nerve gas. In certain circumstances, biological weapons can be as devastating as nuclear ones—a few kilograms of anthrax can kill as many people as a Hiroshima-size nuclear weapon.[5]

Terrorism involving biological weapons—referred to along with chemical weapons as "the poor man's nuclear weapon"—can range from putting deadly substances in the nation's food supply to the aerosolized release of a contagious virus over a city the size of New York or San Francisco.

The Biological Weapons Convention, signed in 1972, prohibits the manufacture, stockpiling and use of biological weapons. But there are several countries that continue to make and study them. Former President Nixon banned the production and use of biological warfare agents in 1969, ending the U.S. biowarfare program. The Soviet Union's biowarfare program, Biopreparat, lasted until the 1990s.

Anthrax, botulinum toxin, plague, ricin, smallpox, tularemia and viral hemorrhagic fevers are on the top of the Centers for Disease Control and Prevention's list of biological weapons, considered "Category A" weapons most likely to be used in an attack.

"Category B" weapons are second-highest priority to the CDC, because they are fairly easy to disseminate, cause moderate amounts of disease and low fatality rates. But these weapons require specific public-health action such as improved diagnostic and detection systems. These agents include: Q fever, brucellosis, glanders, ricin, Enterotoxin B, viral encephalitis, food safety threats, water safety threats, meliodosis, psittacosis and typhus fever.

"Category C" weapons, described by the CDC as "emerging infectious disease threats," are fairly easy to obtain, produce and disseminate and can produce high rates of disease and mortality. These include the Nipah virus and Hantavirus.

Other agents some nations may use as weapons include: aflatoxin, trichothecene mycotoxins, multi-drug tuberculosis, bacteria such as trench fever and scrub typhus, viruses such as influenza and various forms of hemorrhagic fever, fungi and protozoa.

Agricultural bioterrorism could produce famine or widespread malnutrition. These include foot-and-mouth disease, mad cow disease, swine fever and karnal bunt of wheat.[6]

The United States is unprepared to deal with a biological attack. Over the past several years, preparedness strides have been made, especially in the largest cities. However, much of the needed equipment is not available. Pathogen sensors are not in place to detect that a biological attack has taken place. New medicines are needed. In combating terrorist attacks, treatment is a more practical approach than prevention, yet many biological agents are extremely difficult to treat with existing medicines once the symptoms appear. In addition, many of the most important prophylactic drugs have limited shelf lives and cannot be stockpiled. Moreover, their effectiveness could be compromised by a sophisticated attacker.

Biological weapons can range in lethality from salmonella used to temporarily incapacitate to super bubonic plague engineered for mass casualties. Biological weapons include ricin, which an extremist may use to assassinate a single local official, as well as pathogens with high transmissibility and broad potential impact. Biological agents may be used to kill or disable humans or to attack plants or animals to harm a nation's economy Given that broad scope, biological attacks have already taken place and continue to be a distinct probability for the foreseeable future. However, of greatest concern is the capability to deliver a sizable lethal attack against a population center.

Making biological weapons requires art as well as science. Such weapons are not readily adaptable to "cookbook" type recipes that can be implemented by novices. Nevertheless, technical expertise and sophistication about biological processes have become much more widespread. Moreover, even though technical expertise is required to produce high-quality, military-grade biological weapons and reliable means of dissemination, terrorist applications are less demanding.

Making biological weapons requires sample cultures; the means to grow, purify, and stabilize them; and the means to reliably disseminate them. All these tasks pose substantial but not insurmountable challenges. More than 1,500 biological culture libraries worldwide, as well as numerous research institutions and natural sources, maintain cultures. Growth media and fermenters to multiply the sample cultures are widely available. Purifying, concentrating, and stabilizing agents is demanding and dangerous but not a great technical challenge. Freeze-drying the product and milling it into particles of uniform desirable size requires even more technical capabilities. A state sponsor may be needed to do it, although companies and institutes regularly spray dry and mill commercial microbes. Moreover, a respirable aerosol of germs can be achieved through other high-pressure devices.

Biological production and weapon-producing facilities can be small, inexpensive, and inconspicuous. Equipment to develop biological arms may have legitimate commercial and research purposes, as well as nefarious ones. Unlike nuclear weapons, biological weapons do not require unique ingredients that are ready objects of arms control.[7]

Chemical Attack

Chemical warfare is the use of non-explosive chemical agents (that are not themselves living organisms) to cause injury or death.[8]

The first major use of chemical weapons in modern times came when Germany launched a large-scale poison gas attack against French troops on the battlefield of Ypres in 1915. Allies responded with their own chemical weapons. By the end of the war, chemical warfare had inflicted over 1 million casualties, of which around 90,000 were fatal.

The 1925 Geneva Protocol prohibits "the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare." But it didn't prohibit the manufacturing and stockpiling of these weapons.

A UN working group began work on chemical disarmament in 1980. On April 4, 1984, U.S. President Ronald Reagan called for an international ban on chemical weapons. U.S. President George H. W. Bush and Soviet Union leader Mikhail Gorbachev signed a bilateral treaty on June 1, 1990 to end chemical weapon production and start destroying each of their nation's stockpiles. The multilateral Chemical Weapons Convention (CWC) was signed in 1993 and came into effect in 1997. The Organization for the Prohibition of Chemical Weapons declared that at the end of 2003, 8000 metric tons of chemical agent had been destroyed worldwide from a declared stockpile of 70,000 metric tons. For its part, by 2003, the United States had destroyed 23% of its total chemical arsenal, although doubts existed whether it could reach total elimination by the treaty deadline of 2012 due to technical difficulties and environmental regulations.

Chemical agents are classified according to the symptoms they cause, such as blistering and nerve agents. Mustard gas, sarin (GB), VX, soman (GD) and tabun are blistering and nerve agents that were weaponized for military purposes. Other forms of chemical agents include: blood agents, including cyanide, arsine, cyanogens chloride and hydrogen chloride; choking agents, including chlorine, phosphane and phosgene; other nerve agents; and vesicants such as distilled mustard, ethyldichlorarsine, mustard-lewsite mixture and forms of nitrogen mustard.[9]

Chemical weapons are made from readily available material used in various industrial operations. The most common types of hazardous materials used in toxic weapons are irritants, choking agents, flammable industrial gas, water supply contaminants, oxidizers, chemical asphyxiates, incendiary gases and liquids, industrial compounds and organophosphate pesticides.[10]

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On March 20, 1995, members of Aum Shinkrikyo released sarin gas on several lines of the Tokyo Subway, killing 12 people and injuring some 6000 more. The attack was initiated at the peak of Monday morning rush hour on one of the world's busiest commuter transport systems. Five teams of two-men were issued plastic bags containing approximately one liter of liquid sarin each. A single drop of sarin the size of the head of a pin can kill an adult.

Sarin is classified as a nerve agent. It was discovered in 1938 by two German scientists while attempting to create stronger pesticides. At room temperature, sarin is both odorless and colorless. Its relatively high vapor pressure means that it evaporates quickly. Its vapor is also odorless and colorless. Sarin attacks the nervous system of the human body. Initial symptoms following exposure are a runny nose, tightness in the chest and dilation of the pupils. The victim will begin to lose control of bodily functions and eventually become comatose and suffocate as a consequence of convulsive spasms.

Carrying their packets of sarin and umbrellas with sharpened tips, the perpetrators boarded their appointed trains; at prearranged stations, each perpetrator dropped his package and punctured it several times with the sharpened tip of his umbrella before escaping to his accomplice's waiting get-away car.

Passengers began to be affected immediately. Those nearest the release were overcome by symptoms and began to drop causing others to panic and press the emergency stop buttons. Witnesses have said that subway entrances resembled battlefields. In many cases, the injured simply lay on the ground, many unable to breathe. Incredibly, several of those affected by sarin went to work in spite of their symptoms. Most of these left and sought medical treatment as the symptoms worsened. Several of those affected were exposed to sarin only by helping passengers from the trains (these include passengers on other trains, subway workers and health care workers).

The sarin gas attack was the most serious terrorist attack in Japan's modern history. It caused massive disruption and widespread fear in a society that had been considered virtually free of crime.

Shortly after the attack, Aum lost its status as a religious organization, and many of its assets were seized. However, the Diet of Japan rejected a request from government officials to outlaw the sect altogether because the officials could not prove that the Aum posed a 'threat to society'.

About twenty of Aum's followers, including its leader, Shoko Asahara, are either standing trial or have already been convicted for crimes related to the attack. As of July 2004, eight Aum members have received death sentences for their roles in the attack.[11]

Nuclear Attack

Nuclear weapons produce devastating and long-term effects on human and animal life, as well as the environments in which they live. These are the hardest of all types of weapons to make because the critical nuclear elements—plutonium and/or highly enriched uranium—are hard to come by, and are very expensive.

Limited access to fissile materials—the essential ingredients of nuclear weapons—is the principal technical barrier to nuclear proliferation in the world today.

The United States dropped one atomic bomb on Hiroshima and Nagasaki in 1945, bringing an end to World War II. The Soviet Union became the next country to develop atomic weapons, igniting an arms race and a global interest in nuclear fission devices.

Decades of arms control have greatly reduced the number of nuclear weapons around the world. Since 1991, the U.S. Nunn-Lugar Cooperative Threat Reduction program has deactivated 6,032 nuclear warheads and has destroyed 491 ballistic missiles, 438 ballistic missile silos, 101 bombers, 365 submarine-launched missiles, 408 submarine missile launchers, and 25 strategic missile submarines. It has sealed 194 nuclear test tunnels.[12]

The key question is whether or not terrorists could build a nuclear explosive device. Weapons experts at the Nuclear Control Institute say the answer is "yes." They conjecture that a crude nuclear device could be constructed by a group not previously engaged in designing or building nuclear weapons. Successful execution would require efforts of a team having knowledge and skills additional to those usually associated with terrorist groups, but could be accomplished relatively quick with careful preparations and the right materials. The completed device would probably weigh more than a ton, but still be small enough to fit within the back of a truck. According to the experts, an implosion device could be constructed with reactor-grade plutonium or highly enriched uranium providing a nominal yield of 10 kilotons, equivalent to the atomic bombs used over Hiroshima and Nagasaki in World War II.[13]

Limited access to fissile materials—the essential ingredients of nuclear weapons—is the principal technical barrier to nuclear proliferation in the world today. Global stockpiles of such material are large and widespread. A decade after the end of the Cold War, there are still some 30,000 nuclear weapons in the world (more than 95% of them in the U.S. and Russian arsenals). The world's stockpiles of separated plutonium and highly enriched uranium (HEU), the essential ingredients of nuclear weapons, are estimated to include some 450 tons of military and civilian separated plutonium, and over 1700 tons of HEU. These stockpiles, both military and civilian, are overwhelmingly concentrated in the five nuclear weapon states acknowledged by the Nonproliferation Treaty, but enough plutonium for many nuclear weapons also exists in India, Israel, Belgium, Germany, Japan, and Switzerland. In addition, as of estimates made in 2000, a total of more than 2,772 kilograms of civilian HEU existed in research reactors in 43 countries, sometimes in quantities large enough to make a bomb.

Most of these weapons and materials are reasonably well secured and accounted for. But this is by no means universally the case. Levels of security and accounting for both the military and civilian material vary widely, with no binding international standards in place. Some weapons-usable material is dangerously insecure and so poorly accounted for that if it were stolen, no one might ever know.

Today, the problem is most acute in the former Soviet Union, where the collapse of the Soviet state left a security system designed for a closed society with closed borders, well-paid nuclear workers, and everyone under close surveillance by the KGB facing a new world it was never designed to address. Nuclear weapons, which are large and readily accountable objects, remain under high levels of security—though even there, scarce resources for maintaining security systems and paying nuclear guards raise grounds for concern. For nuclear material, the problem is more urgent. Many nuclear facilities in Russia have no detector at the door that would set off an alarm if someone were carrying plutonium in a briefcase, and no security cameras where the plutonium is stored. Nuclear workers and guards protecting material worth millions of dollars are paid $200 a month. As a result, there have been a number of confirmed cases of theft of kilogram quantities of weapons-usable material in the former Soviet Union. Russian officials have confirmed as recently as 1998, there was an insider conspiracy at one of Russia's largest nuclear weapons facilities to steal 18.5 kilograms of HEU—one that was stopped before the material actually left the gates. These are conditions that led a distinguished U.S. bipartisan panel to warn in 2001, that "the most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons-usable material in Russia could be stolen and sold to terrorists or hostile nation states."

The problem of insecure nuclear material, however, is by no means limited to the former Soviet Union. Many analysts have expressed concern that the current anti-terrorist campaign could create instabilities in South Asia that could put nuclear stockpiles and facilities at risk. In the United States itself, which has among the toughest physical protection regulations in the world, there have been repeated scandals going back decades over inadequate security for weapons-usable nuclear material. In countries around the world, there are research facilities with fresh HEU fuel that simply do not have the resources to sustain effective security for this material over the long haul. The problem was highlighted by the 19.9% enriched uranium seized in 1998 from criminals trying to sell it in Italy, which appears to have been stolen from a research reactor in the Congo. Theft of insecure HEU and plutonium, in short, is not a hypothetical worry: it is an ongoing reality, not only from the former Soviet Union but from other states as well.

At the same time, tens of thousands of people worldwide have critical knowledge related to the manufacture of nuclear weapons and their essential ingredients, which must be controlled, and many thousands of these are seriously underemployed and underpaid, creating some serious proliferation risks. In 1998, for example, a weapons expert from one of Russia's premier nuclear weapons laboratories was arrested on charges for spying for Iraq and Afghanistan—in this case on advanced conventional weapons. In October 2000, an official of Russia's Security Council confirmed that Russia had blocked Taliban efforts to recruit a former Soviet nuclear expert from a Central Asian state. A knowledgeable expert from a major state weapons of mass destruction program could substantially accelerate a proliferator's weapons of mass destruction program, or make it possible for a terrorist group to achieve a nuclear capability that would otherwise be beyond their reach.[14]

Radiological Attack

Radiological weapons are thought by many to be the likely choices for terrorists. Unlike nuclear weapons, they spread radioactive material, which contaminates equipment, facilities, land and acts as a toxic chemical, which can be harmful, and in some cases fatal.

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A "dirty bomb" is the likely choice for terrorists and can kill or injure people by exposing them to radioactive materials, such as cesium-137, iridium-192 or cobalt-60.[15]

According to Dr. Henry Kelly, President of the Federation of American Scientists, "Radiological attacks constitute a credible threat." Radioactive materials that could be used for such attacks are stored in thousands of facilities around the US, many of which may not be adequately protected against theft by determined terrorists. Some of this material could be easily dispersed in urban areas by using conventional explosives or by other methods.

While radiological attacks would result in some deaths, they would not result in the hundreds of thousands of fatalities that could be caused by a crude nuclear weapon. Attacks could contaminate large urban areas with radiation levels that exceed the Environmental Protection Agency's health and toxic material guidelines.

Materials that could easily be lost or stolen from US research institutions and commercial sites could contaminate tens of city blocks at a level that would require prompt evacuation and create terror in large communities even if radiation casualties were low. Areas as large as tens of square miles could be contaminated at levels that exceed recommended civilian exposure limits. Since there are often no effective ways to decontaminate buildings that have been exposed at these levels, demolition may be the only practical solution. If such an event were to take place in a city like New York, it would result in losses of potentially trillions of dollars.

Because of the resultant high economic impact compared with the expected low loss of life, a "dirty bomb" is sometimes referred to as a "weapon of mass disruption." Radiological weapons have the advantage over nuclear weapons in as much as they don't require large quantities of restricted materials or specialized expertise for their fabrication. In fact, the required materials are readily available and used extensively throughout government and industry.

The radiation produced by radioactive materials provides a low-cost way to disinfect food, sterilize medical equipment, treat certain kinds of cancer, find oil, build sensitive smoke detectors, and provide other critical services to our economy. Radioactive materials are also widely used in university, corporate, and government research laboratories. As a result, significant amounts of radioactive materials are stored in laboratories, food irradiation plants, oil drilling facilities, medical centers, and many other sites.

Radioactive sources that emit intense gamma-rays, such as cobalt-60 and cesium-137, are useful in killing bacteria and cancer cells. Gamma-rays, like X-rays, can penetrate clothing, skin, and other materials, but they are more energetic and destructive. When these rays reach targeted cells, they cause lethal chemical changes inside the cell.

Significant quantities of radioactive material have been lost or stolen from US facilities during the past few years and thefts of foreign sources have led to fatalities. In the US, sources have been found abandoned in scrap yards, vehicles, and residential buildings.

Plutonium and americium also serve commercial and research purposes. When plutonium or americium decay, they throw off a very large particle called an alpha particle. Hence, they are referred to as alpha emitters. Plutonium, which is used in nuclear weapons, also has non-military functions. During the 1960s and 1970s the federal government encouraged the use of plutonium in university facilities studying nuclear engineering and nuclear physics. Americium is used in smoke detectors and in devices that find oil sources. These devices are lowered deep into oil wells and are used to detect fossil fuel deposits by measuring hydrogen content as they descend.

With the exception of nuclear reactors, commercial facilities do not have the types or volumes of materials usable for making nuclear weapons. Security concerns have focused on preventing thefts or accidents that could expose employees and the general public to harmful levels of radiation. A thief might, for example, take the material for its commercial value as a radioactive source, or it may be discarded as scrap by accident or as a result of neglect. This system works reasonably well when the owners have a vested interest in protecting commercially valuable material. However, once the materials are no longer needed and costs of appropriate disposal are high, security measures become lax, and the likelihood of abandonment or theft increases.

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In almost all cases, the loss of radioactive materials has resulted from an accident or from a thief interested only in economic gain. In 1995, however, Chechen rebels placed a shielded container holding the cesium-137 core of a cancer treatment device in a Moscow park, and then tipped off Russian reporters of its location.

Gamma rays pose two types of health risks. Intense sources of gamma rays can cause immediate tissue damage, and lead to acute radiation poisoning. Fatalities can result from very high doses. Long-term exposure to low levels of gamma rays can also be harmful because it can cause genetic mutations leading to cancer. Triggering cancer is largely a matter of chance: the more radiation you're exposed to, the more often the dice are rolled. The risk is never zero since we are all constantly being bombarded by large amounts of gamma radiation produced by cosmic rays, which reach us from distant stars. We are also exposed to trace amounts of radioactivity in the soil, in building materials, and other parts of our environment. Any increase in exposure increases the risk of cancer.

Alpha particles emitted by plutonium, americium and other elements also pose health risks. Although these particles cannot penetrate clothing or skin, they are harmful if emitted by inhaled materials. If plutonium is in the environment in particles small enough to be inhaled, contaminated particles can lodge in the lung for extended periods. Inside the lung, the alpha particles produced by plutonium can damage lung tissue and lead to long-term cancers.

Long-term exposure to low levels of gamma rays can also be harmful because it can cause genetic mutations leading to cancer. Triggering cancer is largely a matter of chance: the more radiation you're exposed to, the more often the dice are rolled. The risk is never zero.

Impact of the release of radioactive material in a populated area will vary depending on a number of factors, many of which are not predictable. Consequences depend on the amount of material released, the nature of the material, the details of the device that distributes the material, the direction and speed of the wind, other weather conditions, the size of the particles released (which affects their ability to be carried by the wind and to be inhaled), and the location and size of buildings near the release site. Assuming the material is released on a calm day, and the material is distributed by an explosion creating a mist of fine particles to spread downwind in a cloud, then people will be exposed to radiation in several ways.

First, they will be exposed to material in the dust inhaled during the initial passage of the radiation cloud, if they have not been able to escape the area before the dust cloud arrives. If this material is plutonium or americium (or other alpha emitters), the material will stay in the body and lead to long term exposure.

Second, anyone living in the affected area will be exposed to material deposited from the dust that settles from the cloud. If the material contains cesium (or other gamma emitters) they will be continuously exposed to radiation from this dust, since the gamma rays penetrate clothing and skin. If the material contains plutonium (or other alpha emitters), dust that is pulled off the ground and into the air by wind, automobile movement, or other actions will continue to be inhaled, adding to exposure.

In a rural area, people would also be exposed to radiation from contaminated food and water sources.

The EPA has a series of recommendations for addressing radioactive contamination that would likely guide official response to a radiological attack. Immediately after the attack, authorities would evacuate people from areas contaminated to levels exceeding these guidelines. People who received more than twenty-five times the threshold dose for evacuation would have to be taken in for medical supervision.

In the long term, the cancer hazard from the remaining radioactive contamination would have to be addressed. Typically, if decontamination could not reduce the danger of cancer death to about one-in-ten-thousand, the EPA would recommend the contaminated area be eventually abandoned. Decontaminating an urban area presents a variety of challenges. Several materials that might be used in radiological attack can chemically bind to concrete and asphalt, while other materials would become physically lodged in crevices on the surface of buildings, sidewalks and streets. Options for decontamination would range from sandblasting to demolition, with the latter likely being the only feasible option. Some radiological materials will also become firmly attached to soil in city parks, with the only disposal method being large scale removal of contaminated dirt. In short, there is a high risk that the area contaminated by a radiological attack would have to be deserted.

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Consider if a medical gauge containing cesium was exploded in Washington, DC in a bomb using ten pounds of TNT. The initial passing of the radioactive cloud would be relatively harmless, and no one would have to evacuate immediately. But what area would be contaminated? Residents of an area about five city blocks, if they remained, would have a one-in-thousand chance of getting cancer. A swath about one mile long covering an area of forty city blocks would exceed EPA contamination limits, with remaining residents having a one-in-ten thousand chance of getting cancer. If decontamination were not possible, these areas would have to be abandoned for decades. If the device was detonated at the National Gallery of Art, the contaminated area might include the Capitol, Supreme Court, and Library of Congress.

Now imagine if a single piece of radioactive cobalt from a food irradiation plant was dispersed by an explosion at the lower tip of Manhattan. Typically, each of these cobalt "pencils" is about one inch in diameter and one foot long, with hundreds of such pieces often being found in the same facility. Again, no immediate evacuation would be necessary, but in this case, an area of approximately one-thousand square kilometers, extending over three states, would be contaminated. Over an area of about three hundred typical city blocks, there would be a one-in-ten risk of death from cancer for residents living in the contaminated area for forty years. The entire borough of Manhattan would be so contaminated that anyone living there would have a one-in-a-hundred chance of dying from cancer caused by the residual radiation. It would be decades before the city was inhabitable again, and demolition might be necessary.

A device that spreads materials like americium and plutonium would present an entirely different set of risks. Consider a typical americium source used in oil well surveying. If this were blown up with one pound of TNT, people in a region roughly ten times the area of the initial bomb blast would require medical supervision and monitoring. An area 30 times the size of the first area (a swath one kilometer long and covering twenty city blocks) would have to be evacuated within half an hour. After the initial passage of the cloud, most of the radioactive materials would settle to the ground. Of these materials, some would be forced back up into the air and inhaled, thus posing a long-term health hazard. A ten-block area contaminated in this way would have a cancer death probability of one-in-a-thousand. A region two kilometers long and covering sixty city blocks would be contaminated in excess of EPA safety guidelines. If the buildings in this area had to be demolished and rebuilt, the cost would exceed fifty billion dollars.[16]

Explosives Attack

An explosive is any material that, when ignited by heat or shock, undergoes rapid decomposition or oxidation. This process releases energy that is stored in the material in the form of heat and light, or by breaking down into gaseous compounds that occupy a much larger volume than the original piece of material. Because this expansion is very rapid, large volumes of air are displaced by the expanding gasses. This expansion occurs at a speed greater than the speed of sound, and so a sonic boom occurs. This explains the mechanics behind an explosion. Explosives occur in several forms: high-order explosives which detonate, low order explosives, which burn, and primers, which may do both.

High order explosives detonate. A detonation occurs only in a high order explosive. Detonations are usually incurred by a shockwave that passes through a block of the high explosive material. The shockwave breaks apart the molecular bonds between the atoms of the substance, at a rate approximately equal to the speed of sound traveling through that material. In a high explosive, the fuel and oxidizer are chemically bonded, and the shockwave breaks apart these bonds, and re-combines the two materials to produce mostly gasses. T.N.T., ammonium nitrate, and R.D.X. are examples of high order explosives.

Low order explosives do not detonate; they burn, or undergo oxidation when heated, the fuel(s) and oxidizer(s) combine to produce heat, light, and gaseous products. Some low order materials burn at about the same speed under pressure as they do in the open, such as black powder. Others, such as gunpowder, which is correctly called nitrocellulose, burn much faster and hotter when they are in a confined space, such as the barrel of a firearm; they usually burn much slower than black powder when they are ignited in unpressurized conditions. Black powder, nitrocellulose, and flash powder are good examples of low order explosives.

Primers are peculiarities to the explosive field. Some of them, such as mercury fulminate, will function as a low or high order explosive. They are usually more sensitive to friction, heat, or shock, than the high or low order explosives. Most primers perform like a high order explosive, except that they are much more sensitive. Still others merely burn, but when they are confined, they burn at a great rate and with a large expansion of gasses and a shockwave. Primers are usually used in a small amount to initiate, or cause to decompose, a high order explosive, as in an artillery shell. But they are also frequently used to ignite a low order explosive; the gunpowder in a bullet is ignited by the detonation of its primer.[17]

The production, storage, and distribution of explosive materials is regulated under Title 15 of US Code. Various regulatory organizations are responsible for enforcing the law. The Occupational Safety & Health Administration (OSHA) assures the safe and healthful working conditions for workers handling explosives in construction and manufacturing work. The Mine Safety & Health Administration (MSHA) protects the safety and health of miners while handling explosives, and enforces storage and record keeping rules at mining operations (surface and underground). The Department of Transportation (DOT) protects life and property against inherent risks of transporting hazardous materials in commerce. The Bureau of Alcohol Tobacco Firearms and Explosives (ATF) protects commerce and the public from the misuses and unsafe or insecure storage of explosives. The ATF investigates thefts, losses, and unexpected explosions to determine whether it was an accidental or criminal act. State and local fire and police authorities may also regulate explosive storage, transportation, and use.[18]

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"The Terrorist's Handbook", available on the internet, includes recipes for twenty-three different types of explosives including impact, low order, high order, and other types of explosives. The handbook details methods for acquiring and fabricating materials, both legally and illegally.

For example, the handbook describes ammonium nitrate as a high explosive material that is often used as a commercial "safety explosive" because it's very stable, and difficult to ignite with a match. It explains how ammonium nitrate is used in "Cold-Paks" or "Instant Cold", available in most drug stores. To get the ammonium nitrate, simply cut off the top of the outside bag, remove the plastic bag of water, and save the ammonium nitrate in a well sealed, airtight container. The handbook also notes ammonium nitrate is the main ingredient in many fertilizers.[19] Indeed, Timothy McVeigh used ammonium nitrate found in fertilizer to build a truck bomb killing 168 people in the Alfred P. Murrah Federal Building, in Oklahoma City, Oklahoma, April 19, 1995.[20]

The handbook also describes methods for acquiring explosive materials illegally. Colleges, according to the handbook, are the best places to steal chemicals.

> *"Many state schools have all of their chemicals out on the shelves in the labs, and more in their chemical stockrooms. Evening is the best time to enter lab buildings, as there are the least number of people in the buildings, and most of the labs will be unlocked. One simply takes a book bag, wears a dress shirt and jeans, and tries to resemble a college freshman. If anyone asks what such a person is doing, the thief can simply say he is looking for the polymer chemistry lab, or some other chemistry-related department other than the one they are in. One can*

usually find out where the various labs and departments in a building are by calling the university... as a rule, college campus security is pretty poor, and nobody suspects another person in the building of doing anything wrong, even if they are there at an odd hour."

— The Terrorist's Handbook

The First Amendment of the Constitution protects the existence of sources such as "The Terrorist's Handbook." Even if they could be eliminated, it wouldn't eliminate the threat from high explosives. The fact of the matter is that many common items can be made into high explosive devices. Consider that the terrorist attacks of September 11th 2001 used commercial aircraft as weapons of mass destruction by hijacking heavily fueled aircraft and ramming them into large buildings. Any other aircraft, train, ship, or truck could serve a similar purpose.

Conclusion

The knowledge, technology, and materials needed to build weapons of mass destruction are spreading. These capabilities have never been more accessible and the trends are not in our favor. If terrorist enemies acquire these weapons and the means to deliver them, they are likely to try to use them, with potential consequences far more devastating than those suffered on September 11.

Biological weapons, which release large quantities of living, disease-causing microorganisms, have extraordinary lethal potential. Biological weapons are relatively easy to manufacture, requiring straightforward technical skills, basic equipment, and a seed stock of pathogenic microorganisms. Biological weapons are especially dangerous because we may not know immediately that we have been attacked, allowing an infectious agent time to spread. Moreover, biological agents can serve as a means of attack against humans as well as livestock and crops, inflicting casualties as well as economic damage.

Chemical weapons are extremely lethal and capable of producing tens of thousands of casualties. They are also relatively easy to manufacture, using basic equipment, trained personnel, and precursor materials that often have legitimate dual uses. As the 1995 Tokyo subway attack revealed, even sophisticated nerve agents are within the reach of terrorist groups.

Nuclear weapons have enormous destructive potential. Terrorists who seek to develop a nuclear weapon must overcome two formidable challenges. First, acquiring or refining a sufficient quantity of fissile material is very difficult—though not impossible. Second, manufacturing a workable weapon requires a very high degree of technical capability—though terrorists could feasibly assemble the simplest type of nuclear device. To get around these significant though not insurmountable challenges, terrorists could seek to steal or purchase a nuclear weapon.

Radiological weapons, or "dirty bombs," combine radioactive material with conventional explosives. They can cause widespread disruption and fear, particularly in heavily populated areas.

Terrorists, both domestic and international, continue to use traditional methods of violence and destruction to inflict harm and spread fear. They have used knives, guns, and bombs to kill the innocent. They have taken hostages and spread propaganda. Given the low expense, ready availability of materials, and relatively high chance for successful execution, terrorists will continue to make use of conventional attacks.[21]

Questions

1. What is the definition of WMD according to Title 50, US Code?
2. What are the different classes of WMD?
3. Describe three different motives or rationales for terrorists to use WMD.
4. Of the various forms of WMD, which do you think is most destructive, and why?
5. Of the various forms of WMD, which do you think is most likely to be used, and why?