HISTORY
of Biological, Chemical, and Radiation Emergencies

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GOAL OF THIS SECTION

To put the current and potential use of biological, chemical, and radiological weapons into historical context.

WHAT THIS SECTION INCLUDES

- **A brief summary of the history of biological, chemical, and radiation emergencies**
- **Examples of chemical and radiological accidents and their effects**

WHAT THIS SECTION DOES NOT INCLUDE AND WHY

Extensive detail on any one event is not provided due to the large number of events, weapons, and issues described here.

The first public health emergencies were epidemics. With technological advances came the potential to harness biological, chemical, and radiological agents for military and terrorist ends. This section highlights the evolution of the relevant biological, chemical, and radiological technologies and their use as agents of war or terrorism. This section also gives examples of chemical and radiological accidents.

BIOLOGICAL WEAPONS

TIMELINE

14th–15th centuries: Armies use rotting and contaminated bodies to transmit infection to the enemy.

18th century: British troops use smallpox as a weapon against American Indians.

1914–1918 (World War I): Germans infect livestock with glanders and anthrax to disrupt the food supply of Allies.

1925: Geneva Protocol prohibits the use of biological and chemical weapons.

1928: USSR launches its bioweapons program.

1932–1945: Japan conducts bioweapons research and tests on human subjects.

1939–1945 (World War II):

- Japan attacks 11 Chinese cities with anthrax, cholera, and the plague.
- Allies experiment with anthrax.

1950s: The United States and the Soviet Union research new ways of dispersing bioagents.

1969–1970: President Nixon orders the dismantling of the U.S. bioweapons program.

1972: Biological Weapons Convention bans biological weapons.

1970s and 1980s: The Soviet Union continues to research and produce bioweapons.

1980s and 1990s: Iraq, Iran, North Korea, and other nations develop bioweapons.

1984: The Rajneeshee Cult contaminates salad bars in Oregon with *Salmonella*.

2001: An unknown terrorist(s) attacks with anthrax via the U.S. Postal Service.

THE PREMODERN ERA

In the 14th and 15th centuries, armies used rotting and infected human and animal bodies to transmit infections to both civilian and army populations. This tactic met with mixed success.

Medieval lore has it that, in the 14th century, Kaffa (which is now Feodossia, Ukraine) was under siege by Tartars. During that siege, bubonic plague broke out among the invaders. The invaders then used catapults to hurl plague-infected bodies into the city. The spread of the disease caused the city's fall, but it is impossible to know whether the outbreak actually resulted from this primitive practice of biowarfare.

During the 18th century, the British used smallpox as a bioweapon. In 1763, British troops took blankets and handkerchiefs from smallpox patients and gave them to Delaware Indians at a peace-making parley. Also, after an outbreak of smallpox at Fort Pitt during the French and Indian War, British officers took blankets from a smallpox hospital and gave them to American Indians.

BIOWEAPONS IN THE ERA OF MICROBIOLOGY

The nature of biowarfare changed in the mid-19th century. Before that time, the use of biowarfare depended on an existing epidemic. Along with germ theory and the ability to use vaccines to control and prevent epidemics, scientists also learned to isolate disease-causing germs in a form that was easy to use and produce. With these advances, more sophisticated tools for biowarfare became available.

Early efforts to use bioweapons during World War I met with little success. German agents infected livestock with glanders and anthrax (glanders is an infectious disease that typically affects horses, donkeys, and mules). These animals were then shipped through neutral countries to the Allies. The goal was to disrupt the food supply and transportation in countries that used animals for transport. A few thousand animals died as a result of this program. Its impact was small compared to the millions killed during World War I.

After World War I, in an effort to limit the use of biological and chemical weapons, the 1925 Geneva Protocol (http://www.state.gov/www/global/arms/treaties/geneva1.html) prohibited the use of chemical and biological agents but did not bar research and development on those agents. The treaty, however, was not fully enforced for many years. The United States signed the protocol, but Congress failed to ratify it for 50 years. Japan also failed to ratify the treaty until 1970.

Prior to and during World War II, the Japanese were adept at developing and using bioweapons. Between 1932 and 1945, a staff of more than 3,000 scientists conducted bioweapons research in Manchuria, near the town of Pingfan. Japanese scientists used human subjects to test a number of bioagents, killing hundreds, if not thousands, in the process.

During World War II, Japan conducted 12 large-scale field trials of biological weapons. Japan attacked at least 11 Chinese cities with anthrax, cholera, and the plague. The Japanese contaminated food and water supplies. They also released contaminants and plague-infected fleas from aircrafts. Each attack of plague-infected fleas may have involved the release of as many as 15 million fleas.

The Japanese troops were themselves unprepared for their own use of bioweapons. One bioattack on Changleh in 1941 resulted in illnesses in 10,000 Japanese soldiers and 1,700 deaths, mostly from cholera.

These Japanese field trials came to a halt in 1942, after Franklin D. Roosevelt publicly denounced them. However, basic research continued until the end of the war.

The Soviet Union launched its bioweapons program in 1928 and expanded it significantly during World War II. The Soviets built their first anthrax factory in 1946 and their first smallpox factory in 1947. During World War II, they captured a number of Japanese experts who had worked on their country's bioweapons program. These experts helped Soviet researchers advance the Soviet bioweapons program.

France, Canada, Great Britain, and the United States also had significant bioweapons programs during World War II. These countries wanted to be prepared to retaliate against any German bioattack. Allied experiments with anthrax contaminated Guinard Island, near the Scottish Coast. The island was decontaminated with formaldehyde and seawater in 1986.

The United States had stockpiled thousands of anthrax bombs during World War II, but many considered these weapons to be impractical. The production facility in Terre Haute, Indiana, lacked necessary engineering safety features. Tests of the plant's fermentation and storage processes revealed contamination of the plant and nearby area. This discovery led to limitations on the production of bioweapons.

The bioweapons research programs in the United States and the Soviet Union flourished during the Cold War. Researchers studied many bioagents. They also developed more sophisticated delivery systems—for example, dispersing agents as fine-mist aerosols, packing them in bombs, and launching them in missiles. From 1950 to 1953, the United States, having learned a lesson from the Terre Haute plant, built a new facility with better biosafety measures in Pine Bluff, Arkansas. At Fort Detrick, Maryland, scientists studied the effectiveness of different bioagents and various delivery systems. They also studied vaccines and other defensive measures.

DISMANTLING BIOWEAPONS PROGRAMS

By the late 1960s, the tide had turned against bioweapons. In 1969 and 1970, President Nixon ordered the dismantling of the U.S. bioweapons program. But efforts to improve defensive measures continued. The U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) continued to develop medical defenses against bioattacks. USAMRIID has since focused on defensive measures, such as detection capabilities, personal protective equipment, vaccines, diagnostics, and therapies.

In 1972, the Biological Weapons Convention (http://www.state.gov/t/ac/trt/4718.htm#treaty) called for the destruction of existing stocks of bioweapons and an end to bioweapons research. Seventy-two countries ultimately signed the convention (http://www.state.gov/t/ac/trt/4718.htm#signatory), and it went into effect in 1975.

However, not all bioweapons development stopped with the ratification of the Biological Weapons Convention. The Soviet Union continued to operate at least six research facilities and five production facilities in the 1970s and 1980s. The Soviet Union employed up to 55,000 scientists and technicians in these facilities and actually expanded its program during this period. The sudden outbreak of anthrax in Sverdlovsk in 1979 revealed the existence of a nearby Soviet bioweapons research facility.

It was only in 1991, when the Soviet Union broke up, that the rest of the world learned how massive the Soviet bioweapons program was. The Soviets had been manipulating genes to make anthrax and smallpox bioweapons more lethal. Now disbanded, the Soviet program has left the bioweapons poorly guarded and stored. The location of remaining stockpiles of weapons is uncertain.

BIOWEAPONS TODAY

It is unclear at this time which countries have active bioweapons programs. In addition, the threat of bioattacks from non-state-sponsored terrorists remains. In 1984, the Rajneeshee Cult tried to influence voter turnout by contaminating salad bars in Oregon with *Salmonella*. A total of 750 people became ill, though none fatally.

CHEMICAL WEAPONS AND EMERGENCIES

TIMELINE

600–200 B.C.: Athenian, Spartan, and Carthaginian forces use poisons and smoke to quell enemies.

1618–1648: Smoke projectiles come into use in the Thirty Years War.

1914–1918 (World War I):

- **1915:** Germany uses chlorine against French troops.
- **1917:** Both sides use mustard gas for the first time.

1925: Geneva Protocol prohibits the use of biological and chemical weapons.

1935–1936: Italy uses chemical weapons in Ethiopia.

1939–1945 (World War II):

- Japan uses chemical weapons in China.
- The German army uses chlorine, mustard gas, and phosgene gas.

1980s: Iraqi army uses chemical weapons against Iraqi Kurds.

1981–1988: Mustard gas and nerve gas are used extensively during the Iran-Iraq war, mainly by Iraq.

1992: Chemical Weapons Convention bans chemical weapons.

1995: The Aum Shinrikyo Cult stages a sarin attack on the Tokyo subway system.

2003–2004:

- Ricin appears in the Dirksen Senate Office Building on Capitol Hill.
- London police discover a ricin plot.
- Ricin appears in a mailed parcel in South Carolina.

As with bioweapons, military use of chemicals has a long history. But unlike bioweapons, chemical weapons have a limited range and their impact resembles that of conventional weapons.

THE PREMODERN ERA

Dating back to ancient times, armies reportedly used a number of chemical agents in wartime. In 600 B.C., Solon of Athens was said to have put roots of hellebore (a poisonous plant) in the drinking water of Kirrha. During the Peloponnesian War, in 429 and 424 B.C., the Spartan forces used noxious smoke and flames against Athenian cities. And around 200 B.C., the Cathaginians attempted to sedate the enemy by leaving mandrake root in wine.

There were also isolated instances of reported use of chemical agents during the 17th–19th centuries—for example, smoke projectiles during the Thirty Years War.

THE MODERN ERA OF CHEMICAL WEAPONS

Developments in the chemical industry in the 18th and 19th centuries made possible the extensive use of chemical weapons that began in World War I. Chlorine, which is an asphyxiant, was first used in 1915. During the battle of Ypres in Belgium in 1915, Germany exploded canisters filled with chlorine gas, killing 5,000 French troops and injuring 15,000. The French troops were unprepared for these chemical weapons attacks. After that, troops began using respirators. However, other chemical agents were in use at that time, including chloropicrin, which could penetrate the respirators. The use of mustard gas on both sides began in 1917. It resulted in 91,000 deaths and 1.2 million injuries during World War I. By the end of that war, mustard gas had caused 80 percent of the casualties resulting from chemical attacks. The use of chemical weapons during World War I caused 3 percent of the total war casualties.

The 1925 Geneva Protocol covered chemical as well as biological weapons. But despite the Geneva Protocol, the use of chemical weapons continued. Italy used them in 1935 and 1936 in Ethiopia. Japan used them in China during World War II. New and more effective chemical agents were developed: The Germans developed tabun, the first nerve gas, in 1936. Sarin, soman, and VX followed. When World War II began, phosgene and mustard gas were considered superior to alternative chemical weapons, such as chlorine and tear gas. During the war, Germany began manufacturing tabun. Sarin later emerged as the preferred nerve gas for military purposes because it could be produced in large quantities.

Experts believe that more than 20 countries in the Middle East, Asia, Europe, and North American now have chemical weapons capabilities. During the 1981–1988 Iran-Iraq War, mustard gas and nerve agents were used extensively, mainly by Iraq. Iraq's chemical weapons killed more than 25,000 Iranians during this conflict. Most experts believe that the Iraqi army also used chemical weapons against the Iraqi Kurds in 1988. The discovery of mustard gas and sarin in Kurdish territory soil samples confirms these claims. The Aum Shrikyo Cult also used sarin in its attack on the Tokyo subway system in March 1995. That attack left 12 dead and 5,500 injured.

Large amounts of ricin have been discovered in caves in Afghanistan. And it was ricin, injected by means of a specially rigged umbrella, that caused the death in 1978 of Bulgarian writer and journalist Georgi Markov.

After lengthy negotiations, the Chemical Weapons Convention (http://www.state.gov/www/global/arms/treaties/cwctext.html) passed in 1992. This chemical-disarmament agreement makes it illegal to acquire, develop, produce, or stockpile chemical weapons.

Nevertheless, the threat of chemical warfare persists. At the time of the development of this guide, the most recent incident was the 2004 discovery of ricin on Capitol Hill.

CHEMICAL ACCIDENTS

In 1979, Union Carbide began to manufacture methyl isocyanate in its plant in Bhopal, India. Methyl isocyanate is a poisonous gas used to make pesticides. Since it is heavier than air, it does not rise when it escapes into the atmosphere.

On December 23, 1984, water seeped into one of the methyl isocyanate storage tanks at the Bhopal factory. The water then reacted with the methyl isocyanate, resulting in the release of 40 tons of methyl isocyanate into the atmosphere. The methyl isocyanate spread over a city of nearly 900,000 people, and thousands died as they slept. Hundreds of thousands were injured or maimed.

Numerous safety problems were present in the plant:

- Gauges were faulty
- The facility lacked temperature control
- Devices for neutralizing escaping methyl isocyanate were turned off for maintenance
- Warning systems were inadequate
- The tank was above its recommended capacity

Because of the Bhopal incident and later chemical accidents in U.S. factories, the U.S. Congress enacted a law that directed the Environmental Protection Agency (EPA) to develop a program to prevent and prepare for chemical accidents. In response to this directive, EPA created the Risk Management Program in June 1999. The goal of this program is to prevent releases of chemicals that could cause immediate, serious harm to human health and the environment and to communicate accident and prevention information to the public. Chemical facilities regulated under this program must develop and implement a risk management program and submit a summary of this program, called a "Risk Management Plan," to EPA a minimum of every 5 years. Due to concern that one part of the Risk Management Plans, the Offsite Consequences Analysis section, could be misused by terrorists, Congress passed the Chemical Safety Information, Site Security, and Fuels Regulatory Relief Bill in August 1999. This law created certain restrictions on public access to the Offsite Consequences Analysis section of the reports.

NUCLEAR WEAPON DEVELOPMENT AND TESTING

TIMELINE

1940: Scientists based in Britain first report that the production of a nuclear bomb is possible.

1941: British nuclear weapons research begins.

1943: Americans join the research effort with the "Manhattan Project."

1945: The United States drops atomic bombs on Hiroshima and Nagasaki, Japan.

1949: The Soviet Union conducts its first nuclear explosion test.

1968: Treaty on the Non-Proliferation of Nuclear Weapons is developed.

Nuclear weapon development and testing has been conducted by many countries since the 1940s. Because leaders of the allied nations during World War II were concerned that Germany was producing nuclear weapons, the Manhattan Project was born. The project brought together many of the world's leading scientists. The project was unable to produce a fission-based weapon before the surrender of Germany in 1945 but was able to produce two weapons later that year that were used in the U.S. atomic bombings in Japan (see next section).

In 1949, the Soviet Union conducted its first nuclear explosion test, which marked the beginning of the Cold War. The United Kingdom, France, and the People's Republic of China also demonstrated nuclear capabilities during the Cold War. It is thought that since 1949 there have been around 2,000 nuclear test explosions throughout the world.

In 1950, President Truman announced a program to develop a hydrogen or fusion bomb in response to the Soviet Union's nuclear testing. The first bomb tested by the United States on a remote island in 1952 was 450 times the power of the bomb that fell on Nagasaki. Other countries, including the Soviet Union, France, the United Kingdom, and the People's Republic of China, also developed similar devices in the years to follow.

Since the late 1950s, a number of treaties have been developed and signed by various countries in an attempt to control nuclear testing and proliferation. In 1968, the Treaty on the Non-Proliferation of Nuclear Weapons was developed to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy, and to further the goal of achieving nuclear disarmament (United Nations Department for Disarmament Affairs 2002). In 1995, this treaty was extended indefinitely, and to date, 187 parties have joined the treaty, including the five countries mentioned previously that were active in nuclear development and testing. However, the nuclear threat is not over. Experts know that some countries, such as India and Pakistan, have active weapons programs, and it is suspected that a number of other countries also have active weapons programs or are pursuing the development of nuclear weapons.

RADIATION EMERGENCIES

THE ATOMIC BOMB

The first radiological public health emergency followed the use of the atomic bomb during World War II. The United States dropped the first bomb on Hiroshima, Japan, on August 6, 1945, resulting in about 60,000–70,000 deaths. When that failed to persuade Japan to surrender, the United States dropped a second bomb, on Nagasaki, on August 9. That bomb resulted in about 40,000 deaths. Five hours after the second bomb dropped, the Japanese surrendered unconditionally. Most of the damage from these bombs resulted from the flash, shockwave, and subsequent fire.

THREE MILE ISLAND

The threat of accidental radiological contamination became real to Americans with the Three Mile Island accident on March 28, 1979, near Middletown, Pennsylvania. Equipment malfunction and human error combined to cause one of the reactor cores to melt down and release radioactive gases into the atmosphere. In the following few days, additional radioactive releases took place. There was a precautionary evacuation advisory for pregnant women and young children within a 5-mile radius of the plant. Most of the radiation was contained; therefore, offsite releases were minimal and no apparent injuries resulted. The major health effect for portions of the nearby population was mental stress.

The plant experienced significant damage. The cleanup process raised health concerns because of the radioactive material trapped in the containment and auxiliary buildings. This accident was a close call. The scope of what could have happened served as a wakeup call for regulators who subsequently tightened and heightened the plant's safety oversight.

Several factors contributed to the accident: inadequate training of Three Mile Island operators, unclear operator instructions, and design flaws in the control room instructions and layout. The following are some measures that regulators and the nuclear industry took to improve U.S. nuclear plant safety after the accident:

- Upgraded plant and equipment design
- More rigorous plant operator training
- Better emergency preparedness
- Regular scrutiny of plant performance
- More frequent plant inspections
- Establishment of the industry's self-regulatory group, the Nuclear Energy Institute, which serves as a unified voice for the nuclear energy industry and advises the Nuclear Regulatory Commission on relevant regulatory issues
- Improved coordination among various federal and state agencies that are responsible for responding to such an emergency

CHERNOBYL

The most severe radiological accident to date occurred at the Chernobyl Nuclear Power Plant in the former Soviet Union on April 25–26, 1986. A reactor exploded, releasing massive amounts of radiation into the environment. The local population of about 135,000 within an 18-mile radius of the plant was evacuated. The accident caused 31 deaths, but the extent of delayed health effects is uncertain. The Chernobyl reactor would not have met Western safety standards. Fourteen such reactors are still operational in the former Soviet Union.

The chances of a Chernobyl-type accident occurring in the United States are small, because U.S. plants do not have the same design features and they all have concrete and steel containment structures to keep radiation inside. But the Nuclear Regulatory Commission staff looked at this incident for ideas about how to improve plant operations, staff training, and emergency preparedness in the United States, and many new reactor safety measures have been developed and implemented as a result.

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