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Epidemics of the Past: Bubonic Plague

Bubonic Plague

Epidemics of the Past

- Smallpox: 12,000 Years of Terror
- Bubonic Plague
- Influenza: A Twentieth-Century Epidemic

- *Ring around the rosy,*
- *A pocket full of posies,*
- *Ashes … ashes,*
- *We all fall down.*

A familiar nursery rhyme that children have recited as a harmless play song for generations ironically refers to one of Europe's most devastating diseases. The bubonic plague, better known as the "The Black Death," has existed for thousands of years. The first recorded case of the plague was in China in 224 B.C.E. But the most significant outbreak was in Europe in the mid-fourteenth century. Over a five-year period from 1347 to 1352, 25 million people died. One-third to one-half of the European population was wiped out!

The first symptoms of bubonic plague appeared within days after infection: fever, headache, and a general feeling of weakness, followed by aches in the upper leg and groin, a white tongue, rapid pulse, slurred speech, confusion, and fatigue. By the third day, a painful swelling of the lymph glands in the neck, armpits, and groin occurred, and these enlarged areas were called "buboes." Bleeding under the skin followed, causing purplish blotches. Dark-ringed red spots on the skin from infected fleabites, or "ring around the rosy," eventually turned black, producing putrid-smelling lesions. The victim's nervous system collapsed, causing extreme pain and bizarre neurological disorders. This was the inspiration for "Dance of Death" rituals. Fragile nasal capillaries led to excessive sneezing. By the fourth day, wild anxiety and terror overtook the sufferer. Finally, a sense of resignation registered as the skin blackened, giving rise to "The Black Death." The simplistic words in the famous nursery rhyme capture the essence of plague's horror.

Infectious Knowledge

The excessive sneezing of plague suffers led Pope Gregory VII to coin "God Bless You" as a holy response when someone sneezes.

The rhyme also describes highly aromatic flowers and herbs, the "pocket full of posies," that people carried with them and held near their faces to ward off the horrid odor associated with the plague. Many corpses were uncharacteristically cremated—the "ashes, ashes,"—and finally, death would come, and we would "all fall down."

Plague infects both people and rodents, with rodents helping to transmit it further within the population. Fleas feeding on infected rodents can transmit the disease to people as well. Once infected, people can infect others by coughing, sneezing, or close talking.

The origin of “The Black Death” dates to an outbreak in China during the 1330s. During this period, China was an important trading nation, and international trade via the Silk Road helped create the world's first pandemic. Plague-infected rats on merchant ships spread the disease to western Asia and Europe. In the fall of 1347, Italian merchant ships with crewmembers dying of plague docked in Sicily, and within days the disease spread to the city and the surrounding countryside. The disease killed people so quickly that the Italian novelist Giovanni Boccaccio, whose father and stepmother died of plague, wrote that “its victims ate lunch with their friends and dinner with their ancestors in paradise.” By August, the plague had spread as far north as England.

Infectious Knowledge

The English writer Daniel Defoe, the author of *Robinson Crusoe*, wrote graphically about the plague years 1664-1665. “It is scarce credible what dreadful cases happened in particular families every day. People in the rage of the distemper, or in the torment of their swellings, which was indeed intolerable, running out of their own government, raving and distracted, and oftentimes laying violent hands upon themselves, throwing themselves out at their windows, shooting themselves, mothers murdering their own children in their lunacy, some dying of mere grief as a passion, some of mere fright and surprise without any infection at all, others frightened into idiotism and foolish distractions, some into despair and lunacy, others into melancholy madness.”

For five years, the disease would disappear in winter, when fleas were dormant, and resume its killing spree each spring. The impact of the plague was enormous, as governments, trade, and commerce virtually ceased. Faith in religion decreased because many clergy died and prayer failed to prevent sickness and death. Because trade was difficult, the prices of goods were grossly inflated. A decimated work force required higher wages, leading to peasant revolts in England, France, Belgium, and Italy.

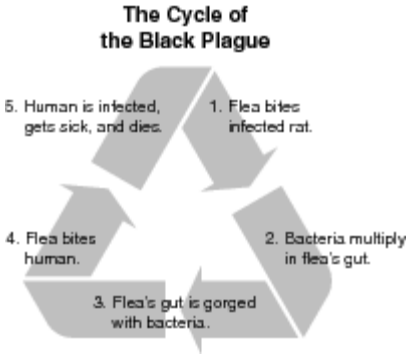
The disease receded in 1353, but never really went away. Smaller outbreaks continued for centuries, affecting all of European society, rich and poor. Two hundred years of recurring death immeasurably changed government, the arts, science, and religion.

Plague epidemics ravaged London in 1563, 1593, 1603, 1625, 1636, and 1665, reducing its population by 10 to 30 percent during those years.

The Italian plague of 1630 claimed between 35 and 69 percent of the population. The German plagues between 1709 and 1713 were equally devastating, and in 1720, plague reduced the population of Marseille by 40 percent. The bubonic plague is believed to have killed 137 million people during its 400-year reign of terror.

Solving the Plague Mystery

In 1894, two scientists, Alexandre Emile Jean Yersin and Shibasaburo Kitasato, seperately described organisms they found in the swollen lymph nodes, blood, lungs, liver, and spleen of dead plague patients. To confirm their findings, they used cultures taken from patient specimens to infect a variety of animals. All the animals died within days. The same rod-shaped organisms found in the original specimens were also found in the animal organs.



Life cycle of the Black Plague, as the bubonic plague is sometimes called.

On the island of Formosa, residents considered handling dead rats a risk for developing plague. These observations led P. L. Simond in the late 1890s to suspect that fleas might play a role in the transmission of plague. He observed that people contracted plague only if they were in contact with recently dead rats. They were not affected if they touched rats that were dead for more than 24 hours. Simond showed that the rat-flea transmitted the disease. In a now classic experiment, a healthy rat separated from direct contact with a recently killed plague-infected rat, died of plague after the infected fleas jumped from the first rat to the second.

Buboes: Signs of the Plague

Unlike smallpox, the plague is still a threat in some parts of the world. *Yersinia pestis*, the bacterium that causes bubonic plague, is transmitted through rat-tainted fleabites in densely populated cities and in countries with poor hygiene, or in the open country from infected wild rodents. The most common form of human plague is a swollen and painful lymph gland that forms buboes.

Bubonic plague should be suspected when a person develops a swollen gland, fever, chills, headache, and extreme exhaustion, and lives in a region with infected rodents, rabbits, or fleas. Infection of the lungs causes the pneumonic form of plague, resulting in a severe respiratory illness. This form of the disease can spread rapidly and is more highly fatal.

A person usually becomes ill with bubonic plague two to six days after being infected. When left untreated, the plague-causing bacteria invade the bloodstream and kill 50 to 90 percent of people who get it. Antibiotic therapy effectively treats bubonic plague.

Pneumonic plague is more difficult to treat, and even with antibiotics, victims can die from it. Pneumonic plague occurs when the infectious bacteria infects the lungs. The first signs of illness in pneumonic plague are fever, headache, weakness, and a cough that produces blood or watery sputum. The pneumonia progresses over two to four days and, without early treatment, death ensues.

Can I Catch the Plague?

Bubonic plague is still prevalent in more than 20 countries. In the United States, the last rat-borne epidemic occurred in Los Angeles in 1924-1925. Since then sporadic cases have occurred, mostly in western states. Sources of cases today are wild rodents, especially squirrels, prairie dogs, and other burrowing rodents.

Plague is found in parts of Russia and China and regularly occurs in Madagascar. Severe outbreaks have occurred in recent years in Kenya, Tanzania, Zaire, Mozambique, and Botswana. Plague also has been reported in western and northern Africa. In South America,

plague is found in parts of Bolivia, Peru, Ecuador, and Brazil. There is no plague in Australia, and Europe has not seen a case for more than 50 years.

Why Is Yersinia So Successful?

Potent Fact

The **genome sequence** is the entire complement of DNA in the cells of an organism. Mapping the genome sequence of the bug that causes plague was valuable because it helped researchers to learn about its evolution. The large number of genetic changes in the organism over time explain its ability to succeed as a disease-causer over hundreds of years.
Genome sequences are becoming available for more and more organisms. The human genome has been sequenced as well. There are many useful pieces of information that will help us fight all kinds of infectious and genetic diseases that come from sequencing of genomes.

A team of scientists recently mapped the entire genetic structure (or *genome sequence*) of *Yersinia pestis*, the plague-causing bacterium. The genome displays many irregularities due to genetic exchange with other microorganisms, and many of its genes appear to have been acquired from other bacteria and viruses. The evidence suggests that plague has undergone large-scale genetic change leading to rapid evolution, which makes it able to adapt to survive in many different environments.

Plague Vaccine

Plague vaccines have been used since the late nineteenth century, but their effectiveness is uncertain. Vaccination reduces the incidence and severity of disease resulting from the bite of infected fleas, but it isn't 100 percent effective. The plague vaccine is licensed for use in the United States and is available for adults at high risk—people who live in the western United States, people who will be in parts of the world where plague is still endemic, and people who are around rodents. Severe inflammatory reactions are common, and plague vaccine should not be given to anyone with a known hypersensitivity to beef protein, soya, casein, or phenol. Finally, the vaccination routine is complex and requires frequent boosters to maintain its effectiveness.

See also:

- *Epidemics of the Past: Influenza: A Twentieth-Century Epidemic*