

## **Anthrax: An Agent of Biological Warfare**

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As tensions with Iraq have increased, so has the U.S. government's concern about weapons of war that are based on biological or chemical agents. One such weapon is the agent of the disease called anthrax. It appears likely that Iraq has a store of this agent that might be used as a weapon.

What type of agent causes anthrax, and why is it so dangerous? Anthrax is the name of a disease caused by the bacterium, *Bacillus anthracis*. Anthrax is primarily a disease of cattle, sheep and horses. The rare human cases are typically found in people who handle infected animals. In humans the infection can take two forms. One is a skin infection (cutaneous) that forms a pustule and then an ulcer that can lead to infection through the bloodstream called septicemia. The other is infection of the lung (pulmonary), causing pneumonia with internal hemorrhaging and septicemia, which is often quickly fatal.

*Bacillus anthracis* was the first bacterium to be shown to cause an infectious disease. This pioneering work was done by Robert Koch in Germany in 1877, when he showed that the organism could be isolated from diseased animals, and that this same pure strain could cause the disease anthrax when it was introduced into healthy animals. The steps of this method for determining the infectious agent in a disease became known as Koch's postulates and are still valid today.

The infectious form of *B. anthracis* is usually the spore. The spore is a dormant form of this organism that survives heat, desiccation, and ultraviolet light. Spores are small spheres that can survive for many years in the environment. Spores enter a scratch or cut to cause skin infections. Once in the tissue, the spores quickly germinate to produce rapidly growing vegetative cells of *B. anthracis*. The vegetative cells multiply and spread to the bloodstream where the bacterial cells continue to multiply. These bacterial cells produce a toxin that, with other factors, kills the host. Inhalation anthrax is caused when spores from the hair or wool of infected animals germinate in the lungs to produce an infection that spreads throughout the body.

If anthrax is diagnosed early, many antibiotics, including penicillin, are effective in treatment of this disease. Despite the use of antibiotics, inhalation anthrax still has a high mortality rate.

A vaccine for anthrax has been available since the time of Louis Pasteur, who first developed an anthrax vaccine in 1881. Since humans are rarely exposed to anthrax, immunization against anthrax is not routine. However, because of the danger of biological warfare, the U.S. government has decided to immunize U.S. military personnel against this disease.

Anthrax is an effective biological weapon because the infectious agent is the spore form of the organism, which can be stored in a dry, concentrated form for decades. Spores can be released into the air where they may be inhaled to cause a lung infection, the most severe form of anthrax in humans. The spores can survive for years in the soil, where they may also cause infections in cattle. Although this disease can be treated with antibiotics, the disease must be diagnosed quickly, and antibiotics are not always effective for lung infections. Thus, anthrax remains a serious concern as an agent of biological warfare.