B, and C designations are empirical and, depending on evolving circumstances such as intelligence-based threat assessments, the priority rating of any given microbe or toxin could change. The CDC classification system also largely reflects the severity of illness produced by a given agent, rather than its accessibility to potential terrorists.

CATEGORY A AGENTS

ANTHRAX

See also Chap. 175.

***Bacillus anthracis* as a Bioweapon** Anthrax may be the prototypic disease of bioterrorism. Although rarely, if ever, spread from person to person, the illness embodies the other major features of a disease introduced through terrorism, as outlined in Table 261e-1. U.S. and British government scientists studied anthrax as a potential biologic weapon beginning approximately at the time of World War II (WWII). Offensive bioweapons activity including bioweapons research on microbes and toxins in the United States ceased in 1969 as a result of two executive orders by President Richard M. Nixon. Although the 1972 Biological and Toxin Weapons Convention Treaty outlawed research of this type worldwide, the Soviet Union produced and stored tons of anthrax spores for potential use as a bioweapon until at least the late 1980s. At present, there is suspicion that research on anthrax as an agent of bioterrorism is ongoing by several nations and extremist groups. One example of this was the release of anthrax spores by the Aum Shinrikyo cult in Tokyo in 1993. Fortunately, there were no casualties associated with that episode because of the inadvertent use of a nonpathogenic strain of anthrax by the terrorists.

The potential impact of anthrax spores as a bioweapon was clearly demonstrated in 1979 following the accidental release of spores into the atmosphere from a Soviet Union bioweapons facility in Sverdlovsk, Russia. Although total figures are not known, at least 77 cases of anthrax were diagnosed with certainty, of which 66 were fatal. These victims were exposed in an area within 4 km downwind of the facility, and deaths due to anthrax were also noted in livestock up to 50 km further downwind. Based on recorded wind patterns, the interval between the time of exposure and development of clinical illness ranged from 2 to 43 days. The majority of cases were within the first 2 weeks. Death typically occurred within 1–4 days following the onset of symptoms. It is likely that the widespread use of postexposure penicillin prophylaxis limited the total number of cases. The extended period of time between exposure and disease in some individuals supports the data from nonhuman primate studies, suggesting that anthrax spores can lie dormant in the respiratory tract for at least 4–6 weeks without evoking an immune response. This extended period of microbiologic latency following exposure poses a significant challenge for management of victims in the postexposure period.

In September 2001, the American public was exposed to anthrax spores as a bioweapon delivered through the U.S. Postal Service by an employee of the United States Army Medical Research Institute for Infectious Diseases (USAMRIID) who had access to such materials and who committed suicide prior to being indicted for this crime. The CDC identified 22 confirmed or suspected cases of anthrax as a consequence of this attack. These included 11 patients with inhalational anthrax, of whom 5 died, and 11 patients with cutaneous anthrax (7 confirmed), all of whom survived (Fig. 261e-1). Cases occurred in individuals who opened contaminated letters as well as in postal workers involved in the processing of mail. A minimum of five letters mailed from Trenton, NJ, served as the vehicles for these attacks. One of these letters was reported to contain 2 g of material, equivalent to 100 billion to 1 trillion weapon-grade spores. Based on studies performed in the 1950s using monkeys exposed to aerosolized anthrax demonstrating that ~10,000 spores were required to produce lethal disease in 50% of animals exposed to this dose (the LD_{50}), the contents of one letter had the theoretical potential, under optimal conditions, of causing illness or death in up to 50 million individuals. The strain used in this attack was the Ames strain. Although it was noted to have an inducible β-lactamase and to constitutively express a cephalosporinase, it was susceptible to all antibiotics standard for *B. anthracis*.

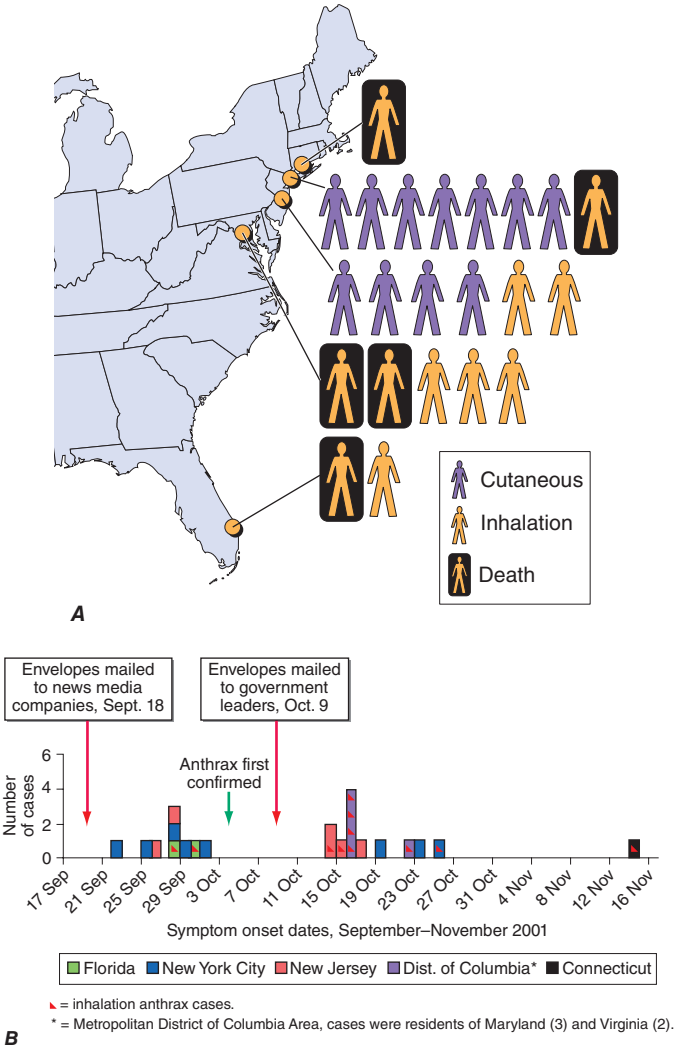

FIGURE 261e-1 Confirmed anthrax cases associated with bioterrorism: United States, 2001. ***A.*** Geographic location, clinical manifestation, and outcome of the 11 cases of confirmed inhalational and 11 cases of confirmed cutaneous anthrax. ***B.*** Epidemic curve for 22 cases of anthrax. *(From DB Jernigan et al: Emerg Infect Dis 8:1019, 2002; with permission.)*

Microbiology and Clinical Features Anthrax is caused by *B. anthracis*, a gram-positive, nonmotile, spore-forming rod that is found in soil and predominantly causes disease in herbivores such as cattle, goats, and sheep. Anthrax spores can remain viable for decades. The remarkable stability of these spores makes them an ideal bioweapon, and their destruction in decontamination activities can be a challenge. Naturally occurring human infection is generally the result of contact with anthrax-infected animals or animal products such as goat hair in textile mills or animal skins used in making drums. While an LD_{50} of 10,000 spores is a generally accepted number, it has also been suggested that as few as one to three spores may be adequate to cause disease in some settings. Advanced technology is likely to be necessary to generate a bioweapon containing spores of the optimal size (1–5 μm) to travel to the alveolar spaces.

The three major clinical forms of anthrax are gastrointestinal, cutaneous, and inhalational. *Gastrointestinal anthrax* typically results from the ingestion of contaminated meat; the condition is rarely seen and is unlikely to be the result of a bioterrorism event. The lesion of *cutaneous anthrax* typically begins as a papule following the introduction of spores through an opening in the skin. This papule then evolves to a painless vesicle followed by the development of a coal-black, necrotic eschar (Fig. 261e-2). It is the Greek word for coal (*anthrax*) that gives the organism and the disease its name. Cutaneous anthrax was ~20% fatal prior to the availability of antibiotics. *Inhalational anthrax* is the