Bioterrorism:
Class A Agents and Their Potential Presentations in Immunocompromised Patients

Jessica L. Richard, RN, MSN, ANP-C, and Deanna E. Grimes, DrPH, RN, FAAN

A bioterrorism attack would be particularly challenging for medical professionals caring for patients with cancer who often have weakened immune systems. Knowledge of the class A agents and the potential variable presentations in immunocompromised patients is key to early recognition of an outbreak and prompt reporting. The purpose of this article is to present the class A agents: *Bacillus anthracis* (anthrax), botulinum toxin (botulism), variola virus (smallpox), *Yersinia pestis* (pneumonic plague), and *Francisella tularensis* (tularemia). The variable signs and symptoms that may be present in immunocompromised patients with cancer will be discussed with a focus on assessment and early recognition of an outbreak. The availability of vaccines and the implications for patients with cancer receiving these vaccines also will be discussed.

The attacks of September 11, 2001, alerted the United States to the threat that the country faces from terrorism. With the anthrax attacks on Florida and New York City, the risks associated with the dissemination of a biologic weapon and the ease of doing so became evident. The Centers for Disease Control and Prevention ([CDC], 2001a) recommended heightened surveillance for any unusual disease occurrence or increased numbers of illness that might be associated with a bioterrorism attack. Surveillance begins with every healthcare worker who is in contact with patients. Oncology nurses must stay informed of bioterrorism and its implications for their patients. Because oncology nurses work in a variety of settings (e.g., urban and rural, inpatient and outpatient), knowledge about bioterrorism agents and disease presentation and ability to recognize clusters of outbreaks is essential to identifying a potential attack (Buehler, Berkelman, Hartley, & Peters, 2003). Rapid identification is the first line of defense; it can prevent further exposure and offer early treatment to affected patients.

The World Health Organization (2004) defined a biologic agent as one that produces its effect through multiplication within a target host and is intended for use in war to cause disease or death in human beings, animals, or plants. In 1999, the CDC reclassified biologic agents into classes A, B, and C. Class A agents have a moderate to high likelihood for large-scale dissemination or a heightened general awareness that could cause mass fear and civil disruption. Class B agents generally cause less illness and death and therefore would be expected to have lower medical and public health impact. Class C agents are not believed to present a high bioterrorism risk to public health (Rotz, Khan, Lillibridge, Ostroff, & Hughes, 2002). This article will focus on the five class A agents that have the greatest potential for mass casualties: *Bacillus anthracis* (anthrax), *Clostridium botulinum* toxin (botulism), *Francisella tularensis* (tularemia), *Variola major* (smallpox), and *Yersinia pestis* (plague). Class A agents have a moderate to high likelihood for large-scale dissemination or a heightened general awareness that could cause mass fear and civil disruption (Rotz et al.). The class A agents’ modes of transmission, incubation periods, and infection control precautions are presented in Table 1.

A bioterrorism attack would be particularly challenging for medical professionals caring for patients with cancer who often have weakened immune systems secondary to malignancy.
intensive chemotherapy, corticosteroid use, and/or stem cell transplantation (Hicks, Chemaly, & Kontoyiannis, 2003). Cancer and its treatment often cause a variety of side effects and comorbidities that could be mistaken for a common disease presentation; therefore, exposure to a biologic agent can be misdiagnosed easily. The literature regarding bioterrorism-related disease presentation and manifestation in immunocompromised patients is speculative and scarce. However, an attack that includes immunocompromised populations would cause death rates and complications much greater than those in the general population (White, Henretig, & Dukes, 2002).

### Class A Agents

#### Anthrax

Inglesby et al. (1999) identified *B. anthracis* as a biologic agent capable of causing a great number of deaths and disease. The organism commonly is found in the environment, causing disease in warm-blooded animals as well as humans. Although anthrax has three forms (inhalation, gastrointestinal, and cutaneous), this article focuses on inhalation anthrax because it is the most lethal form and therefore the most likely to be used in a biologic attack.

**Clinical manifestations:** During the anthrax attacks of 2001, two postal workers died after exposure to the agent. One worker presented with predominantly gastrointestinal symptoms and the other presented with flu-like symptoms, myalgias, and malaise (Borio et al., 2001). Patients exposed to inhalation anthrax typically present with nonspecific symptoms that cannot be distinguished easily from more common illnesses (Swartz, 2001). Common presentations of anthrax are similar to influenza and influenza-like illnesses and bacterial diseases such as *Legionellosis* and pneumonias caused by *Chlamydia pneumoniae*, *Streptococcus pneumoniae*, and *Mycoplasma* (CDC, 2001a). In a study conducted to develop an evidence-based anthrax-screening protocol, Hupert, Bearman, Mushlin, and Callahan (2005) identified several symptoms that were associated with a greater likelihood of inhalation anthrax versus other respiratory infections: nonheadache neurologic symptoms such as confusion or loss of consciousness, gastrointestinal symptoms such as nausea and vomiting, and dyspnea. Sore throat and rhinorrhea were associated less often with anthrax.

Data regarding the clinical presentation of an anthrax infection in an immunocompromised host are scarce; therefore, the information in Table 2 has been extrapolated from data collected from the literature on common respiratory infections found in immunocompromised patients. The clinical manifestations of

### Table 1. Mode of Transmission, Incubation, Communicability, and Infection Control Precautions of Class A Agents

<table>
<thead>
<tr>
<th>CLASS A AGENT</th>
<th>MODE OF TRANSMISSION</th>
<th>INCUBATION</th>
<th>COMMUNICABILITY PERIOD</th>
<th>PRECAUTIONS AND QUARANTINE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bacillus anthracis</em> (anthrax)</td>
<td>Inhalation of aerosolized spores; no human-to-human transmission (except cutaneous)</td>
<td>1–7 days; up to 60 days possible</td>
<td>Items and soil contaminated with spores remain infective for years</td>
<td>Standard precautions for all aspects of patient care</td>
</tr>
<tr>
<td>Botulinum toxin (botulism)</td>
<td>Infected food or water or aerosolized (most likely in bioterrorist attack); no human-to-human transmission</td>
<td>12–72 hours*</td>
<td>Excreted in stool for weeks to months but no instance of secondary human-to-human contact has been documented</td>
<td>Standard precautions for all aspects of patient care</td>
</tr>
<tr>
<td><em>Yersinia pestis</em> (pneumonic plague)</td>
<td>Aerosolized inhalation of plague bacilli; human-to-human contact likely if within close proximity (six feet)</td>
<td>1–4 days</td>
<td>Highly communicable under appropriate climatic conditions and in facilities with overcrowding</td>
<td>Strict isolation with respiratory D precautions (droplet); house- hold or face-to-face contacts should be treated prophylactically and placed under surveil- lance for seven days.</td>
</tr>
<tr>
<td>Variola virus (smallpox)</td>
<td>Respiratory droplets (inhalation) or contact with exudates from skin lesions</td>
<td>7–19 days, commonly 10–14 days to onset of illness and 2–4 days more to onset of rash</td>
<td>From the time of development of the earliest lesions to disappearance of all scabs; about three weeks</td>
<td>Strict isolation with respiratory A (aerosol) precautions; patients should be placed in negative-pressure rooms with particulate air filtration.</td>
</tr>
<tr>
<td><em>Francisella tularensis</em> (tularemia)</td>
<td>Aerosolized inhalation of <em>F. tularensis</em> bacteria; no direct person-to-person transmission</td>
<td>3–5 days, but ranges from 1–14 days</td>
<td>The infectious agent may be found in the blood of untreated patients during the first two weeks of disease and in lesions for a month or more.</td>
<td>Standard precautions for all aspects of patient care</td>
</tr>
</tbody>
</table>

* Time to onset of inhalation botulism is not known with certainty because few cases have been documented. Data were based on three known cases of inhalation botulism in humans.

Note. Based on information from Dennis et al., 2001; Henderson et al., 1999; Heymann, 2004; Inglesby et al., 2000.
inhalation anthrax are variations that may be seen in immunocompromised patients.

**Nursing implications:** Immunocompromised patients often are admitted for respiratory conditions such as influenza-like illnesses and pneumonia. The clinical manifestations of inhalation anthrax, influenza-like illnesses, and pneumonia are similar, making identification of inhalation anthrax based on presentation alone difficult. Identification of inhalation anthrax would require a high level of suspicion. Nurses should be alert to similar patterns and clusters of illnesses in their patients. A sudden appearance of multiple severe flu-like illnesses with a fulminate course and high mortality should alert healthcare providers to a potential outbreak (Inglesby et al., 1999). A thorough history, including potential exposure, is extremely important. Anthrax infection is treatable and the chances of survival increase with early identification. Keys to successful management of anthrax include identification of potential exposures and early initiation of antibiotic treatment; the CDC (2001b) has recommended antibiotic treatment with ciprofloxacin or doxycycline.

A protective vaccine has been developed for anthrax, but it currently is recommended only for high-risk populations (Center for Infectious Disease Research and Policy [CIDRAP], 2005a). The vaccine is being offered to the U.S. military on a volunteer basis but is contraindicated in patients with acute illnesses, who are pregnant, or who are receiving immunosuppressive therapy.

**Botulism**

Botulinum toxin has been identified as the most lethal substance known to man (Cherington, 1998). As reported by Arnon et al. (2001), botulinum toxin poses a threat for use as a weapon because of its potency; the ease of production, transport, and misuse; and the need for long-term treatment of affected patients. From 1990–1995, the Japanese cult Aum Shinrikyo attempted to use aerosolized botulinum toxin as a bioweapon multiple times. Although the terrorists’ attempts were not successful, they accentuated the threat and ease of the toxin’s use (Arnon et al.).

The three forms of naturally occurring botulinum toxin are foodborne, wound, and intestinal. A fourth form is man-made that could result in aerosolized botulinum toxin. Arnon et al. (2001) reported that no instances of waterborne botulism have been reported and such contamination is unlikely. Foodborne botulinum toxin has always been a threat, especially in association with home-preserved foods.

**Clinical manifestations:** The clinical manifestations of all types of botulism are similar (see Figure 1). Patients present with flaccid paralysis and prominent bulbar palsies: dysphonia or defective voice, and dysphagia or difficulty swallowing (Arnon et al., 2001). In foodborne botulism, patients often present with gastrointestinal complaints such as nausea, vomiting, diarrhea, and abdominal cramping (Caya, Agni, & Miller, 2004). The presentation in immunocompromised patients would not likely vary.

| **Table 2. Inhalational Anthrax:** Clinical Manifestations by Patient Population |
|-------------------------|-----------------|-----------------|
| **STAGE**               | **GENERAL POPULATION** | **IMMUNOCOMPROMISED PATIENTS** |
| I                       | Lasts hours to days; patients present with nonspecific, flu-like symptoms (e.g., dyspnea, fever, chills, malaise, myalgias, profuse diaphoresis, nausea, vomiting, abdominal pain, mental status changes, acute symptoms of respiratory distress). They usually do not present with upper respiratory symptoms but have a mild cough and chest pain or discomfort. After a brief period of recovery, stage II begins. |
| II                      | Within hours, patients progress rapidly to death. They develop a sudden fever, dyspnea, diaphoresis, massive lymphadenopathy, and stridor. A chest x-ray reveals mediastinal widening (key finding), often pleural effusion, and rarely infiltrates. Patients may progress to stage II more rapidly than the general population. Chest x-ray results are the same as in general population, but they may have more diffuse, bilateral infiltrates and larger effusions. |

* Patients are diagnosed by gram-positive bacilli on unspun peripheral blood smear or cerebral spinal fluid. Aerobic blood culture growth of large, gram-positive bacilli provides preliminary identification of the *Bacillus anthracis* species.

**Note.** Based on information from Couch et al., 1997; Heymann, 2004; Hicks et al., 2003; Inglesby et al., 1999; Tamm, 1999.

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**Clinical Manifestations**

- Neurologic symptoms present in the form of descending paralysis (from head to toe), ultimately leading to respiratory failure. This descending paralysis is the clinical hallmark of botulism.
- Patients initially present with difficulty seeing, speaking, and/or swallowing. Marked fatigue, weakness, and vertigo are followed by blurred vision, dysphoria, ptosis, enlarged or sluggishly reactive pupils, and dry mouth.
- Vomiting, diarrhea, constipation, and abdominal swelling may occur, especially in foodborne illness.
- Patients will not be confused or obtunded but will have four bulbar palsies: dysphoria, dysarthria, dysphonia, and dysphagia.

**Diagnostic Findings**

- **Gram-positive bacilli** will be noted on unspun peripheral blood smear or cerebral spinal fluid.
- Aerobic blood culture growth of large, gram-positive bacilli provides preliminary identification of *Bacillus* species.

**Figure 1. Botulism: Clinical Manifestations and Diagnostic Findings for All Patients**

*Note. Based on information from Arnon et al., 2001; Cherington, 1998; Heymann, 2004.*
Nursing implications: Early recognition of an outbreak of botulism will depend on heightened clinical suspicion. A large number of patients with flaccid paralysis and prominent bulbar palsies should alert nurses to a potential outbreak. In patients with cancer, many disorders can mimic botulism, but key distinguishing features can help clinicians make the distinction (see Table 3). Nurses should take a thorough history and focus on patients’ travel, activity, diet, and known contact with individuals complaining of similar symptoms.

The healthcare team should be prepared for the clinical sequelae that accompany a botulism infection. Patients typically become symptomatic 2–36 hours after being infected with the toxin and should be monitored for disease progression, which may rapidly lead to respiratory failure requiring mechanical ventilation (Cherington, 1998). Supportive care may include airway monitoring and protection, mechanical ventilation, treatment of superimposed infections, cardiovascular monitoring and support, fluid and electrolyte management, and nutritional and psychological support (Caya et al., 2004).

Because of the rarity of the condition and the small volume of available botulinum toxoid, immunization is not recommended for the general public. The CDC has recommended immunization only for laboratory workers and military personnel who are at risk for exposure to botulinum toxin (CIDRAP, 2004).

### Pneumonic Plague

Inglesby et al. (2000) identified *Y. pestis*, the agent that causes pneumonic plague, to be one of the most likely agents to be used as a bioweapon. The risk is associated with the availability of *Y. pestis* around the world, the capacity for its mass production and aerosol dissemination, the difficulty in preventing such activity, the high fatality rate of pneumonic plague, and the potential for the secondary person-to-person spread during an epidemic. An intentional release of aerosolized *Y. pestis* would cause an epidemic of massive proportion, placing great strain on the medical infrastructure of the United States.

Human plague most commonly occurs as a result of the bites of infected fleas or exposure to infected rodents (Heymann, 2004). Bubonic plague is the most common form of the disease; however, in a bioterrorism attack, the aerosolized form of *Y. pestis* most likely would be used, resulting in pneumonic plague that has an almost 100% mortality rate (Inglesby et al., 2000).

**Clinical manifestations:** Clinical manifestations of pneumonic plague are similar to any severe rapidly progressing pneumonia (Inglesby et al., 2000). The similarity to common pneumonias would make diagnosis based on clinical signs and symptoms alone very difficult. Data regarding the presentation in immunocompromised hosts are not available in the literature. However, an immunocompromised host likely would present with similar signs and symptoms as an immunocompetent host, but the onset may be more rapid and the presentation potentially more severe (see Figure 2).

**Nursing implications:** Pneumonic plague is rare, so any suspicion of diagnosis must be reported immediately to the hospital infection control practitioner and health department. Nurses should be alert to a sudden increase in admissions of patients presenting with fever, cough, a fulminant course of pneumonia, and rapid mortality (Heymann, 2004). A thorough history, including the potential exposure, is extremely important. Common features that might suggest that *Y. pestis* has been used as a biologic weapon include an increase in admissions within a short time period of previously healthy patients with severe, aggressive, multilobar pneumonia accompanied by hemoptysis and gastrointestinal symptoms; patients presenting in urban areas with no prior history of travel to plague endemic areas; the absence of bubonic skin lesions; and patients presenting without risk factors for plague exposure (CIDRAP, 2005b).

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>DISTINGUISHING FEATURES FROM BOTULISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central nervous system tumor</td>
<td>Paralysis often is asymmetric; images of the central nervous system will be abnormal.</td>
</tr>
<tr>
<td>Central nervous system infections</td>
<td>Mental status changes will be noted; patients may present with a fever. Cerebral spinal fluid and electroencephalogram will have abnormalities.</td>
</tr>
<tr>
<td>Viral syndromes</td>
<td>Bulbar palsies and flaccid paralysis will be absent.</td>
</tr>
<tr>
<td>Intoxication with depressants</td>
<td>History of exposure will be noted, and excessive drug levels will be detected.</td>
</tr>
</tbody>
</table>

*Note.* Based on information from Arnon et al., 2001.
Nurses caring for patients with pneumonic plague can play a vital role in preventing transmission through effective patient and staff education, which is particularly important on nursing units caring for immunocompromised patients. Patients, visitors, and healthcare providers participating in patient care should be educated on the importance of respiratory precautions and nurses should ensure compliance. Strict isolation should be maintained for 48 hours after the start of effective treatment with streptomycin to which the patient has responded favorably. Individuals who have been in physical proximity to patients diagnosed with pneumonic plague should be treated and placed under surveillance for seven days. If treatment is refused, the person should be maintained in strict isolation for seven days (Heymann, 2004). Nurses should reinforce the importance of treatment of family members, significant others, and close contacts of patients to avoid potential spread to others. The production of the plague vaccine was discontinued in 1999, so it is no longer available (Inglesby et al., 2000).

**Variola: Smallpox**

The last naturally acquired case of smallpox occurred in 1977 in Africa, and global eradication was certified two years later (Heymann, 2004). In 1980, the World Health Organization recommended that all countries cease vaccination for smallpox and that all laboratories destroy their stocks of the variola virus or transfer them to one of two World Health Organization reference laboratories. At that time, all countries reported compliance (Henderson et al., 1999); however, the virus may exist, perhaps in the hands of terrorists. The variola virus is relatively stable and extremely infectious in small doses. As a result, the release aerosolized variola virus would disseminate widely and cause an epidemic disease of massive proportion.

The variola virus, commonly known as smallpox, is a species of orthopoxvirus. Variola major smallpox has four types: ordinary (the most frequent type, accounting for greater than 90% or more of cases), modified (mild and occurring in a previously vaccinated person), flat, and hemorrhagic. The latter two forms are rare, very severe, and usually fatal (Fishman, 2003).

**Clinical manifestations:** Smallpox was eradicated before many immunodeficiencies were understood; however, a modern day smallpox epidemic would be devastating to immunocompromised patients (Amorosa & Isaacs, 2003). In their review of the potential manifestations of smallpox in patients with HIV, Amorosa and Isaacs reported that host rather than viral factors play an important role in whether a patient would present with ordinary smallpox or a more deadly form (see Table 4). In immunodeficient patients, the smallpox virus most likely would present as the flat or hemorrhagic type. Fishman (2003) predicted that, in patients with deficient cell-mediated immunity, the flat type of smallpox may be more common and patients with defective humoral immunity may present with the hemorrhagic type. In the flat type, Fishman suggested that the smallpox lesions would develop more slowly, would remain soft and flattened, and may be more confluent, warm, and tender. The lesions may not scab but proceed to desquamation. The potential variability of the presentation in immunocompromised patients would make identification difficult. Because of the increasing concerns about the potential for deliberate use of smallpox, healthcare providers must be familiar with its clinical and epidemiologic features and how it can be distinguished from chickenpox (see Table 5).

**Nursing implications:** If healthcare providers suspect a nonvaricella, smallpox-like case, they must communicate immediately with local and national health authorities. A thorough clinical presentation of the characteristic rash that is centrifugal in distribution is highly suggestive of smallpox. Differentiating malignant and hemorrhagic smallpox based on clinical presentation is difficult, but an astute clinician will note presentation with outbreak in community.

![Table 4. Smallpox: Clinical Manifestations by Patient Population](image)

*Fluid from lesions can be confirmed by rapid polymerase chain reaction tests. Clinical presentation of the characteristic rash that is centrifugal in distribution is highly suggestive of smallpox. Differentiating malignant and hemorrhagic smallpox based on clinical presentation is difficult, but an astute clinician will note presentation with outbreak in community.*

**Note:** Based on information from Fishman, 2003; Henderson et al., 1999.
The CDC has recommended a pre-exposure vaccine only for laboratory or medical personnel working with non-highly attenuated orthopoxviruses (CIDRAP, 2005e). If the intentional release of smallpox virus did occur, vaccinia vaccine would be recommended for certain groups, including personnel involved in the direct medical or public health evaluation, care, or transportation of patients with confirmed or suspected smallpox. The Advisory Committee on Immunization Practices and the

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**Table 5. Distinguishing Features of Smallpox and Chickenpox**

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>SMALLPOX</th>
<th>CHICKENPOX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rash description</td>
<td>Begins on oral mucosa, spreads to face, and expands in a centrifugal pattern (starts peripherally and migrates centrally); lesions are denser on the face and distal extremities and often appear on the palms and soles.</td>
<td>Begins on the trunk and expands in a centripetal pattern (develop centrally and migrate peripherally); lesions are denser on the trunk and rarely develop on the palms and soles.</td>
</tr>
<tr>
<td>Timing of lesion occurrence</td>
<td>Generally emerge over one to two days and then progress at the same rate.</td>
<td>Occur in &quot;crops&quot; and are at different stages of development.</td>
</tr>
<tr>
<td>Depth of lesions</td>
<td>Extend into dermis.</td>
<td>Superficial</td>
</tr>
<tr>
<td>Evolution of rash</td>
<td>Progress over several days from macules (day 1) to papules (day 2), vesicles (days 3–5), pustules (days 7–14), and scabs (day 14–20).</td>
<td>Progress quickly over about 24 hours from macules to papules, vesicles, and crusted lesions.</td>
</tr>
<tr>
<td>Severity</td>
<td>Patients appear toxic and have a high fatality rate.</td>
<td>Patients often do not appear severely ill, and the illness rarely is fatal.</td>
</tr>
<tr>
<td>Rash distribution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Note.** Based on information from Centers for Disease Control and Prevention, n.d.; Heymann, 2004.

Healthcare Infection Control Practices Advisory Committee have recommended that acute care hospitals identify healthcare workers who can be vaccinated and trained to provide direct medical care for the first patients with smallpox requiring hospital admission and to evaluate and manage patients suspected of having the disease (CDC, 2003). Healthcare personnel who receive the vaccination and are providing direct patient care should keep their vaccination sites covered with gauze or a similar absorbent material and a semipermeable dressing to absorb exudates and provide a barrier for containment of the vaccinia virus to minimize the risk of transmission. The vaccinia virus can shed from the vaccination site from days 2–21, with maximal shedding from days 14–21. The vaccinia virus can be carried on the skin, oropharynx, clothes, blankets, and equipment (Fishman, 2003). During the interval in which virus is shed, inadvertent inoculation can occur from the vaccination site to other areas of the body—most commonly the face, eyelids, nose, lips, genitalia, and anus. Patients with contraindications to the vaccine, including those who are immunocompromised, are more likely to develop secondary vaccinia (see Figure 3). Infection control precautions, including meticulous hand washing, are essential for vaccinated healthcare providers. To avoid potential transmission, recently vaccinated healthcare workers should avoid caring for immunocompromised patients during the maximal shedding period.

**Tularemia**

Dennis et al. (2001) identified tularemia, *F. tularensis*, as one of the most infectious pathogenic bacteria known; it requires as few as 10 organisms to cause disease. In North America, naturally occurring tularemia is common in rabbits, moles, muskrats, and even some domestic animals. The bacteria frequently are transmitted by bites from infected fleas and ticks (Heymann, 2004). For many years, tularemia has been considered a potential biologic weapon in its aerosolized form (Dennis et al.).

**Clinical manifestations:** In early stages, patients infected with tularemia would present with flulike symptoms and respiratory complaints that, similar to anthrax and plague, would be difficult to distinguish from community-acquired pneumonia or

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- History or presence of eczema or atopic dermatitis
- History of acute, chronic, or exfoliative skin conditions
- Conditions associated with immunosuppression
- Pregnant or breastfeeding
- Individuals who are younger than one year
- Individuals who have a serious allergy to any component of the vaccine.
- Individuals with household contacts of the following people
  - History or presence of eczema or atopic dermatitis
  - Who have other acute, chronic, or exfoliative skin conditions
  - Who have conditions associated with immunosuppression
  - Who are pregnant

**Figure 3. Contraindications for the Smallpox Vaccine**

*Note. Based on information from Centers for Disease Control and Prevention, 2003.*
influenza (see Table 6). Sarria, Vidal, Kimbrough, and Figueroa (2003) indicated that immunocompromised patients are at greater risk for more severe forms of the disease, which may progress more rapidly to death. They also suggested that disease presentation may be variable but that the association in neutropenic patients is likely to be more severe and with a higher mortality.

**Nursing implications:** The disease presentation of tularemia is similar to that of the plague and anthrax. Dennis et al. (2003) implied that tularemia generally would be expected to progress more slowly and would be associated with a lower case fatality than inhalation anthrax or pneumonic plague. The plaque most likely would progress rapidly to severe pneumonia with watery and/or purulent sputum, hemoptysis, respiratory insufficiency, sepsis, and shock. Inhalational anthrax could be differentiated by its characteristic chest radiograph finding, symmetric mediastinal widening, and absence of bronchopneumonia. In addition, patients with advanced anthrax would be expected to develop fulminating, toxic, and often fatal illnesses despite antibiotic treatment.

As is the case with anthrax, identification of patients with tularemia and prompt treatment will improve overall survival. Nurses should inquire about potential occupational exposure, tick bites, or animal contacts. Patients should be asked about any contact with individuals experiencing similar symptoms (Heymann, 2004).

Until recently, a live attenuated vaccine was used in the United States to protect laboratory workers at high risk for *F. tularensis* exposure. The vaccine currently is not available and is under review by the U.S. Food and Drug Administration (Dennis et al., 2001).

### Table 6. Tularemia*: Clinical Manifestations By Patient Population

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>GENERAL POPULATION</th>
<th>IMMUNOCOMPROMISED PATIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flulike</td>
<td>Acute-onset influenza-like illness with high fever, chills, fatigue, general body aches, headache, and nausea</td>
<td>High fever (100°F−106°F), chills, myalgias, headache, malaise and anorexia, cough, chest pain, or discomfort</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Dry or slightly productive cough, substernal chest pain or tightness, pharyngitis, bronchiolitis, pneumonitis, and pleuritis</td>
<td>Rapid onset of an extremely dramatic infection, with acute prostration and rapid death</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Nausea, vomiting, and diarrhea</td>
<td>Same as in general population</td>
</tr>
</tbody>
</table>

*Small, gram-negative coccobacilli are found in a direct stain of respiratory secretions, sputum, tracheobronchial secretions, and blood. Peribronchial infiltrates exist in one or more lobes, often with pleural effusion and enlarged hilar nodes. Signs may be absent or minimal, with one or several small, discrete pulmonary infiltrates or scattered granulomatous lesions.

Note. Based on information from Heymann, 2004; Hicks et al., 2003; Sarria et al., 2003.

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**Conclusion**

The events of September 11, 2001, made Americans acutely aware of the potential for terrorism in the nation. An attack using class A agents is a real possibility. Oncology nurses would be challenged if such an event should occur. Immunocompromised patients’ variable presentations would make the clinical identification of exposure to class A agents particularly difficult. To be adequately prepared, nurses should be knowledgeable about the class A agents and their potential presentations, possess a high index of suspicion, be knowledgeable in the steps to take to protect themselves and the ones they care for, and be knowledgeable of the contact information for the appropriate authorities to report a potential outbreak (see Figure 4). Surveillance and identification should begin at the bedside with an astute clinician prepared to identify an outbreak. Will nurses be ready to recognize it?

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**References**


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