VDH VIRGINIA DEPARTMENT OF HEALTH

Virginia Department of Health
Anthrax: Guidance for Healthcare Providers
Key Medical and Public Health Interventions after Identification of a Suspected Case

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1. Epidemiology

Anthrax is a zoonotic disease caused by the aerobic, gram-positive, spore-forming, rod-shaped bacterium *Bacillus anthracis* (*B. anthracis*). Fully virulent *B. anthracis* has two plasmids: pX01, which carries toxin genes, and pX02, which encodes capsule genes. In the early 2000s, there were reports of anthrax-like disease in animals caused by non-*B. anthracis* bacteria. Scientists have discovered that certain strains of *Bacillus cereus* can express anthrax toxin genes (i.e., contain pX01 and/or pX02). *B. cereus* strains that carry both pX01- and pX02-like plasmids are called *B. cereus* biovar anthracis. *B. cereus* biovar anthracis has since been identified in multiple species of wildlife in sub-Saharan Africa, including non-human primates, duikers, an elephant, goats, mongooses, and porcupines. Although *B. cereus* biovar anthracis has not been identified in humans as of this writing, scientists believe that humans are susceptible to infection and development of anthrax-like disease.

B. anthracis is designated as a Category A bioterrorism agent (i.e., one that can be easily disseminated or transmitted with a higher rate of mortality than a Category B agent). Both *B. anthracis* and *B. cereus* biovar *anthracis* are designated as Tier 1 select agents, which means they could be developed as bioterrorism agents and that possession, use or transfer of these organisms requires registration with the Centers for Disease Control and Prevention (CDC) or the U.S. Department of Agriculture (USDA). The *B. anthracis* Pasteur strain is also designated as a select agent, but not as a Tier 1 agent.

In Virginia, anthrax is a rapidly reportable disease. If anthrax is suspected or confirmed, the local health department MUST be notified immediately so that a public health investigation can be initiated.

Anthrax can affect many species of animals, but primarily affects herbivores, such as cattle, sheep, goats, antelope, and deer. These animals become infected by ingesting anthrax spores found in vegetation, water, or soil. Humans, who are considered incidental hosts, become infected by direct contact with infected animals, animal products (e.g., meat, hide, or wool), or items made with these products (e.g., drums made with goatskin, wool clothing). Once spores enter the body, they become activated, leading to bacteria multiplication, toxin production, and illness.

Anthrax is found worldwide but is most common in agricultural regions in Central and South America, sub-Saharan Africa, Central and Southwestern Asia, southern and Eastern Europe, and the Caribbean. In the United States, anthrax in humans is rare, with only 0–2 reported cases per year. Anthrax in animals is also relatively rare in the United States; however, since 2006, more than 500 cases have been identified in white-tailed deer in Texas. Cases in livestock have also been reported in Arkansas, California, Louisiana, Mississippi, Nebraska, and South Dakota. The primary risk factor for herbivores is ingestion of anthrax spores, which can persist in alkaline soil. Suitable alkaline soils exist in a corridor from Texas to Colorado, including the Dakotas and Montana.

Anthrax in humans can present as one of four clinical forms depending on how the spores enter the body: cutaneous, gastrointestinal, inhalation, and injection. Cutaneous anthrax accounts for 95% of all naturally occurring cases of anthrax and occurs when spores enter the body through breaks in the skin. Eating meat from infected animals may result in gastrointestinal anthrax. Inhalation anthrax can occur when a person inhales spores that are aerosolized by industrial processing of contaminated materials, such as hides or wool, or by working with infected animal carcasses, contaminated animal hides, or wool in a way that can aerosolize dust and spores; it could also result from a bioterrorism event. Injection anthrax has been reported among people who inject drugs (e.g., heroin) in several European countries. Anthrax in humans is not generally considered to be contagious. Person-to-person transmission through contact with a cutaneous anthrax lesion is theoretically possible, but very rare.

Travelers to endemic areas might acquire anthrax through direct or indirect contact with carcasses of animals that died from anthrax. Cases of cutaneous, gastrointestinal, and inhalation anthrax have been reported among people who have handled or played drums made with contaminated goat hides from countries where anthrax is endemic or who have been present at events where those drums have been played. Cases have also been reported among people making drums from contaminated goat hides imported from countries endemic for anthrax, as well as members of their households exposed to environments contaminated by the drum-making process.

People at risk for developing anthrax include those who process hides, wool, hair (especially from goats), bone, and bone products imported from endemic regions; veterinarians and agriculture and wildlife workers who handle infected animals; laboratory workers who work with anthrax; and military personnel who work in areas where anthrax could be used as a bioweapon.

2. Clinical Manifestations

Cutaneous Anthrax

- **Incubation period**: Usually 1–7 days, with a range of 1–12 days. However, in 1979, during an outbreak of cutaneous anthrax, cases were reported with an incubation period of up to 13 days (Meselson M, Guillemin J, Hugh-Jones M, et al). In 1983, an outbreak of cutaneous anthrax was reported in Algeria with a median incubation period of 19 days (Abdenour D, Larouze B, Dalichaouche M, et al).
- **Symptoms**: The skin infection begins as a small papule or vesicle that ulcerates with central necrosis and drying. Painless, localized nonpitting edema surrounds the ulcerated area, which progresses to a dark, leathery eschar. Extensive nonpitting edema, regional lymphadenopathy, lymphangitis, fever, and malaise may be present. Lesions tend to occur on exposed areas of the body (e.g., face, hands, arms, neck).
- **Case fatality rate:** The case fatality rate (CFR) of cutaneous anthrax is less than 1 percent with appropriate antibiotic therapy. Without appropriate therapy, the CFR can be as high as 20% (Quinn CP and Turnbull PCB). A systematic review of reported cases among adults hospitalized for cutaneous anthrax during 1950–2018 found that presenting clinical features significantly associated with overall mortality included constitutional symptoms (e.g., fever, chills, and anxiety), specific dermatologic issues (e.g., skin trauma, thoracic edema, and malignant pustule edema), diastolic hypotension, nausea and vomiting, headache and other neurologic signs (e.g., cranial nerve and other focal signs and seizures), and evidence of a coagulopathy. Lymphadenopathy was associated with fatal outcomes within the first 3 days of hospitalization, and abdominal pain was associated with later fatal outcomes. Bacteremia noted at any point throughout hospitalization was associated with overall mortality.

Gastrointestinal Anthrax

- **Incubation period:** Usually 1–7 days.
- **Symptoms:** Gastrointestinal anthrax follows the consumption of raw or undercooked contaminated meat and can present as either oropharyngeal or intestinal forms. Gastrointestinal anthrax is associated with severe abdominal distress followed by fever and severe signs of septicemia. The intestinal form is characterized by nausea, vomiting, loss of appetite, and fever, progressing rapidly to bloody diarrhea and sepsis. The oropharyngeal form results in lesions at the base of the tongue, sore throat, dysphagia, fever, bilateral neck swelling (caused by regional lymphadenopathy), edema, and sepsis. Ulcerations can occur anywhere along the gastrointestinal tract.
- **Case fatality rate:** Even with antimicrobial therapy and modern intensive care, the CFR of gastrointestinal anthrax is estimated to be more than 40% (Beatty ME, Ashford DA, Griffin PM, et al).

Inhalation Anthrax

- **Incubation period:** Usually 1–7 days, but incubation periods up to 60 days are possible.
- **Symptoms:** The first stage of illness is characterized by a nonspecific prodrome of malaise, myalgias, fever, headache, nonproductive cough, nausea, and abdominal pain. Some patients have a brief period of apparent recovery before progressing to the second stage. The second stage of illness develops abruptly with sudden fever, dyspnea, diaphoresis, shock, stridor in some cases, with massive lymphadenopathy and widening of the mediastinum on chest radiography. Widening of the mediastinum is due to mediastinitis and is considered a classic radiographic finding of inhalation anthrax. Other chest radiographic abnormalities include pulmonary infiltrates, pleural effusion, and hilar abnormalities.
- **Case fatality rate:** Even with antimicrobial therapy and modern intensive care, the estimated CFR for inhalation anthrax is 45% (Hendricks KA, Wright ME, Shadomy SV, et al).

Injection Anthrax

- **Incubation period:** Usually 1–4 days.
- **Symptoms:** Symptoms may be similar to those of cutaneous anthrax, but there may be infection deep under the skin or in the muscle where the drug was injected. Patients may present with edema around the injection site, often leading to compartment syndrome or necrotizing fasciitis. Classical signs (e.g., papules, vesicles, or eschars) are often missing, whereas complications such as septic and cardiovascular shock, meningitis, and death despite antimicrobial therapy, occur more often than with cutaneous anthrax (Grunow R, Verbeek L, Jacob D et. al).

Anthrax meningitis has a mortality rate that approaches 100% and is a common complication of anthrax. Meningitis can either be primary (i.e., have no obvious route of transmission) or secondary (i.e., develop as a complication of any other form of anthrax). Depending on the route of transmission, 14%–37% of patients with injection, ingestion, systemic cutaneous, or inhalation anthrax develop meningitis. Thus, all patients with symptoms or signs of systemic disease should be evaluated for meningitis. Obesity, diabetes, hypertension, chronic obstructive pulmonary disease, former and current smoking, and former alcohol use were all associated with likely meningitis in a Kyrgyz Republic case series. (Kutmanova et al.)

Multiple other clinically relevant complications might occur in association with anthrax. In 2023, CDC published the results of multiple systematic reviews of the literature in their updated guidelines for the treatment of anthrax, including a description of common complications. Sepsis developed in approximately 70% of patients with systemic disease. Evidence of coagulopathy was reported in approximately one third of adults with ingestion, inhalation, and injection anthrax and those with primary meningitis. Arrhythmias occasionally were observed, most commonly in adults with inhalation anthrax (7%). Respiratory failure requiring ventilation often occurred in adults with injection anthrax (32%) and inhalation anthrax (23%). Severe disease was associated with diabetes, obesity, hypertension, and chronic obstructive pulmonary disease in patients with cutaneous anthrax.

Like adults, complications of anthrax in children vary by site of initial infection. Sepsis developed in 60%–84% of children with inhalation, ingestion, and systemic cutaneous anthrax. Secondary meningitis was observed in

25% of children with systemic disease associated with cutaneous anthrax, 40% with inhalation anthrax, and 30% with ingestion anthrax. Coagulopathy occurred in approximately 40% of inhalation and ingestion cases.

Many adults developed clinically relevant fluid collections. Although pleural effusion was most commonly a complication of inhalation anthrax (76%), it also occurred in 3%–10% of patients with ingestion, systemic cutaneous, and injection anthrax and primary anthrax meningitis. Ascites was observed in 52% of adults with ingestion anthrax; in 4% of those with inhalation anthrax; and in one person each with injection anthrax, systemic cutaneous anthrax, and primary anthrax meningitis. Ascites is also thought to serve as a reservoir for lethal factor. Pericardial effusions were noted in 21% of patients with inhalation anthrax.

3. Laboratory Testing and Diagnosis

Notification when Anthrax is Suspected
If anthrax is suspected, the healthcare provider should immediately report the case to the local health department per Virginia's disease reporting regulations. The local health department will discuss options for public health testing. If VDH approves public health testing, specimens may be sent to the Division of Consolidated Laboratory Services (DCLS). The health department will facilitate notification and shipment to DCLS. Specimens potentially containing *B. anthracis* (or *B. cereus* biovar anthracis) should **never** be shipped to DCLS without prior approval.

Laboratory Biosafety
Laboratory personnel must be alerted if anthrax is suspected so that they can take appropriate precautions. Nonclinical specimens (e.g., environmental or animal specimens) should be forwarded to DCLS. For clinical specimens, biosafety level 2 (BSL-2) precautions should be followed unless processing involves working with high concentrations of *B. anthracis* or aerosol-generating procedures; for these latter situations, BSL-3 precautions should be used. Subcultures should be performed in a biosafety cabinet (BSC) and additional testing should be performed in the BSC while wearing gloves. Because of the highly infectious nature of *B. anthracis* and *B. cereus* biovar *anthracis*, consultation with DCLS is strongly recommended. The DCLS Emergency Officer can be reached 24 hours a day/7 days a week at 804-335-4617. For additional information, refer to the American Society for Microbiology's Sentinel Level Clinical Laboratory Guidelines for Suspected Agents of Bioterrorism and Emerging Infectious Diseases: *Bacillus anthracis* and *Bacillus cereus* biovar *anthracis*.

Diagnostic Testing and Sample Collection
Different diagnostic tests can be used to identify *Bacillus anthracis*. Standard culture and sensitivity testing in a clinical specimen can identify *B. anthracis* and determine antibiotics that the organism is susceptible to. Molecular testing can be used, and serologic testing may also be helpful. Testing for anthrax toxins can also be done. If inhalation anthrax is suspected, chest radiography or computed tomography (CT) scans can identify if the patient has mediastinal widening and/or pleural effusion(s), the classic thoracic imaging findings in patients with inhalation anthrax.

Diagnostic tests also involve polymerase chain reaction (PCR) testing, culture, and serology. DCLS can perform confirmatory testing which can include PCR and conventional culture testing, and CDC can perform additional testing (e.g., serology) if needed. Positive PCR results on a culture isolate is considered a confirmatory result and no additional testing will be needed for identification. If VDH approves public health testing, the healthcare provider should follow the information below for the appropriate samples to be collected based on the clinical form and Table 1 for sample collection instructions. If possible, specimens should be collected before initiating antimicrobial therapy. Because of the highly infectious nature of this organism, consultation with DCLS about specimen collection and handling is strongly recommended. The DCLS Emergency Officer can be reached 24 hours a day/7 days a week at 804-335-4617.

For diagnostic testing of patients with suspected cutaneous anthrax

- For vesicular lesions, two swabs of vesicular fluid from an unopened vesicle, one for culture and the second for real-time PCR (DO NOT place swabs in transport media)
- For eschars, the edge should be lifted, and two swab samples rotated underneath and submitted, one for culture and the second for real-time PCR (DO NOT place swabs in transport media)
- For ulcers, the base of the lesion should be sampled with two saline moistened swabs and submitted, one for culture and the second for real-time PCR
- Blood culture isolates obtained prior to antimicrobial therapy if the patient has evidence of systemic symptoms. DCLS cannot accept blood culture bottles for testing.
- A full thickness punch biopsy of a papule or vesicle including adjacent skin should be obtained from all patients with a lesion being evaluated for cutaneous anthrax, to be submitted in 10% formalin for histopathology, special stains, and immunohistochemistry (IHC)
- In patients not on antimicrobial therapy or on therapy for <24 hours, a second biopsy specimen should be submitted for culture and real-time PCR
- Acute serum samples for testing for anthrax lethal toxin, and acute and convalescent serum samples for serologic testing

For diagnostic testing of patients with suspected inhalation anthrax

- Blood cultures obtained prior to antimicrobial therapy
- Pleural fluid, if present, for culture, real-time PCR, and testing for anthrax lethal toxin
- Pleural and/or bronchial biopsies for IHC
- Cerebrospinal fluid (CSF), in patients with meningeal signs, for culture and real-time PCR
- Acute serum samples for testing for anthrax lethal toxin, and acute and convalescent serum samples for serologic testing
- Autopsy tissues from fatal cases for histopathology, special stains, and IHC

For diagnostic testing of patients with suspected gastrointestinal anthrax

- Blood culture isolates obtained prior to antimicrobial therapy. DCLS cannot accept blood culture bottles for testing.
- Ascites fluid for culture and real-time PCR
- Stool or rectal swabs for culture and real-time PCR
- Oropharyngeal lesion, if present, for culture and real-time PCR
- Acute and convalescent serum samples for serologic testing
- Autopsy tissues from fatal cases for histopathology, special stains, and IHC

Case Definitions used by Public Health

The current CDC case definition for anthrax is available on CDC's National Notifiable Diseases Surveillance System (NNDSS) webpage. Note that a case definition is a set of uniform criteria used to define a disease for public health surveillance. Case definitions enable public health to classify and count cases consistently across reporting jurisdictions and should not be used by healthcare providers to determine how to meet an individual patient's health needs.

4. Treatment

Primary treatment of anthrax includes antimicrobial therapy with antitoxin added for systemic infections, as described below. All types of anthrax infection are treated with antimicrobials, but the production of toxin, potential for antimicrobial drug resistance, frequent occurrence of meningitis, and presence of latent spores must be considered when determining the treatment regimen. Depending on the situation, hemodynamic support, mechanical ventilation, adjunctive corticosteroids, and surgical interventions can be considered. All patients suspected of having systemic anthrax should undergo a lumbar puncture, unless it is medically contraindicated or diagnostic capabilities are limited, to evaluate for meningitis. All patients with systemic anthrax should be hospitalized and bactericidal antibiotics should be included as part of the antimicrobial regimen.

During a mass casualty event, traditional diagnostic capabilities to identify meningitis in people with anthrax may be limited. CDC has developed and validated a screening tool to identify probable meningitis (Figure); sensitivity is 86% (95% CI = 71%–100%) and specificity is 92% (95% CI = 85%–99%), with only 2.5% of adults in need of further testing.

Anthrax meningitis is often accompanied by destruction of the blood-brain barrier and intracranial bleeding and swelling. Subarachnoid hemorrhage is a common complication. Nimodipine is the only drug approved by the Food and Drug Administration (FDA) for aneurysmal subarachnoid hemorrhage and reduces the incidence of poor neurologic outcome by 40%. Patients with anthrax meningitis might benefit from standard treatment for intracerebral hemorrhage.

Certain antimicrobial drugs demonstrated to have neuroprotective effects in other diseases or models might be useful for anthrax meningitis, as well. For example, minocycline is a highly lipophilic second-generation tetracycline that readily crosses the blood-brain barrier and has been observed in vivo to have neuroprotective effects against subarachnoid hemorrhage, intracerebral bleeding, and blood-brain barrier disruption. Other antimicrobial drugs with in vivo neuroprotective effects for certain meningitides include ß-lactams, clindamycin, and daptomycin. For further information on treating anthrax meningitis, please see the CDC Guidelines for the Prevention and Treatment of Anthrax, 2023.

Antitoxins

For any patient known or suspected to have noncutaneous systemic anthrax, an antitoxin against *B. anthracis* should be used early during treatment with antimicrobial drugs. Currently, there are three FDA-approved anthrax antitoxins: raxibacumab (Abthrax), Anthrax Immunoglobulin Intravenous (AIGIV or Anthrasil), and obiltoxaximab (Anthim). These antitoxins were approved by FDA for treatment of inhalational anthrax based on animal studies. The monoclonal antitoxins (raxibacumab and obiltoxaximab) are preferred over the polyclonal antitoxin (AIGIV). If antitoxin supplies are likely to be limited, reserving their use for patients developing signs of hemodynamic instability or respiratory compromise is warranted.

Each of the three FDA-approved antitoxins carries a black box warning. Anthrax immunoglobulin has a warning about the possibility of thrombosis and potential interaction with glucose monitoring systems. Obiltoxaximab and raxibacumab have warnings about possible hypersensitivity with the drugs. Despite the known adverse effects of these drugs, it is felt that the benefit of antitoxin therapy outweighs the possible risks.

When standard therapies (antimicrobial drugs and anthrax vaccination) are not available after exposure to *B. anthracis*, obiltoxaximab and raxibacumab may be considered for postexposure prophylaxis (PEP) to help prevent inhalational anthrax.

Antimicrobials

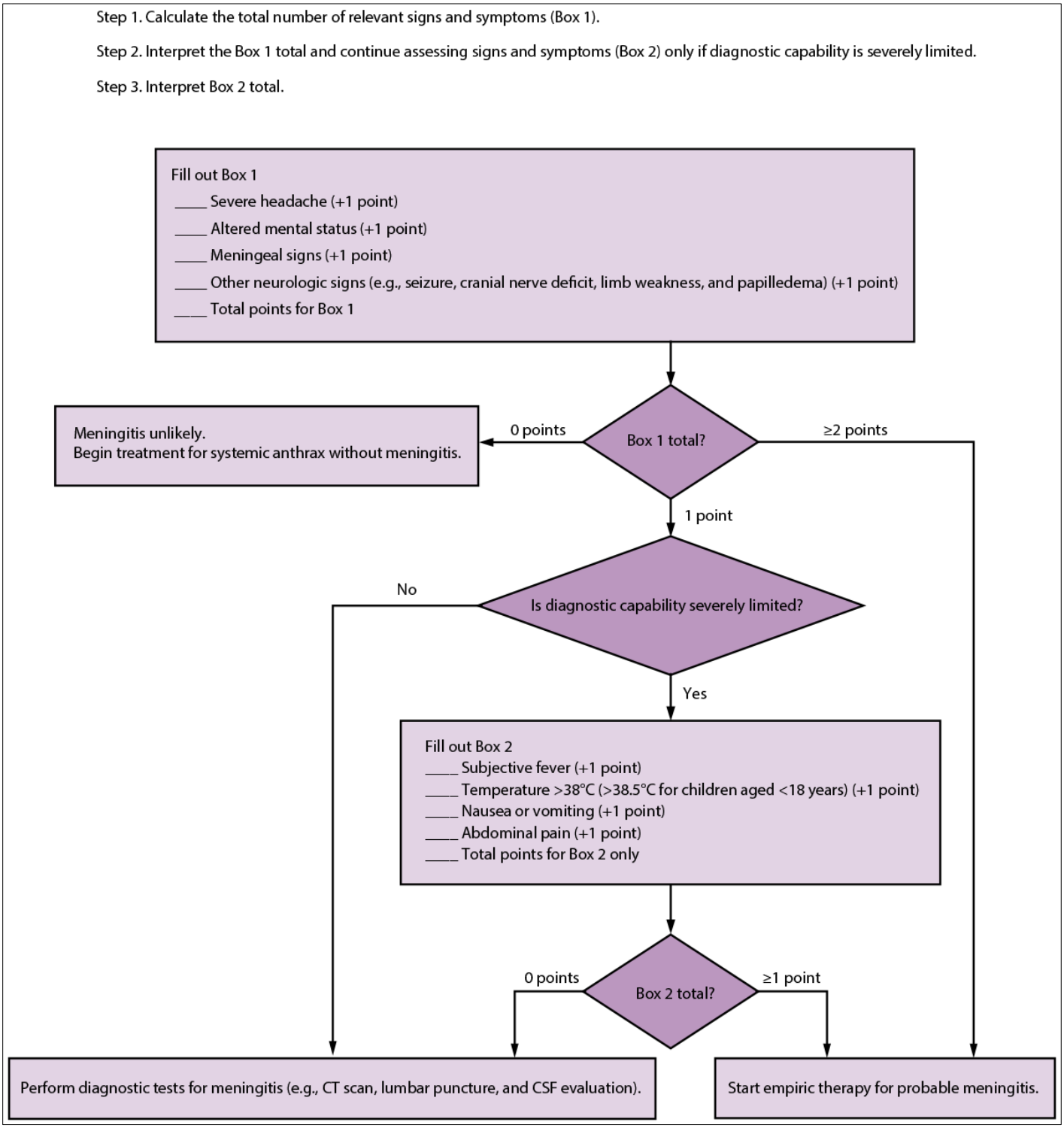
Previously, all *B. anthracis* strains from a naturally occurring source or an intentional release were thought to be susceptible to the recommended first-line antimicrobial drugs (except for penicillins). However, over the past few decades, studies have demonstrated that antimicrobial-resistant *B. anthracis* strains can be created with relative ease through serial passaging on selective media. Consequently, bioterrorists could mass produce a multidrug-resistant strain capable of evading previously recommended first-line antimicrobial medical countermeasures.

In 2023, CDC released updated guidelines for postexposure prophylaxis (PEP) and treatment recommendations that include numerous antimicrobial drugs from multiple classes. The antimicrobial drugs recommended as first-line agents are expected to address most scenarios. The alternative antimicrobial drugs provide contingencies for contraindications, intolerances, unavailability, and natural or genetically engineered resistance. In the updated guidance, CDC provides separate treatment recommendations for nonpregnant adults, pregnant and/or lactating adults, children aged ≥1 month to <18 years, and neonates.

Early diagnosis of anthrax and initiation of appropriate treatment are critical to improving survival. Although empiric treatment of anthrax or prophylaxis after exposure is needed to save lives, antimicrobial drug susceptibility testing is vital; antimicrobial drug choices might need to be modified based on the results. Data indicate penicillin-class antimicrobial drugs are as effective as other bactericidal agents for PEP and treatment

and might be preferred in certain populations. However, although <10% of naturally occurring *B. anthracis* isolates are reported to be resistant to penicillin-class antimicrobial drugs, these drugs should only be used if the strain is known to be penicillin susceptible. In vitro data demonstrate that cephalosporins, trimethoprim/sulfamethoxazole, and aztreonam are ineffective against *B. anthracis.* If liquid formulations are not available for children or adults who cannot swallow pills, instructions are available for preparing oral suspensions of moxifloxacin and doxycycline.

Figure. Screening tool to identify potential anthrax meningitis cases by presenting signs and symptoms after a mass casualty event when diagnostic capability is limited — CDC, 2023



Source: CDC MMWR: Guidelines for the Prevention and Treatment of Anthrax, 2023.

Treatment Tables in this Guidance Document by Population and Clinical Manifestation

	Cutaneous anthrax without signs and symptoms of meningitis	**Systemic anthrax** with or without meningitis
Nonpregnant Adults Aged ≥18 years	Table 2	Table 3
Pregnant or Lactating Adults Aged ≥18 years	Table 4	Table 5
Children Aged ≥1 month to <18 years	Table 6	Table 7
Neonates Preterm and full-term neonates 32–44 weeks' postmenstrual age (gestational age + chronologic age)	Table 8	Table 9

Treatment tables are adapted from the CDC MMWR: Guidelines for the Prevention and Treatment of Anthrax, 2023. For further details about managing pediatric patients, refer to Bradley JS, Peacock G, Krug SE, et al. Pediatric Anthrax Clinical Management from 2014.

Adjunctive therapies
Glucocorticoids may be considered as adjunctive therapy for patients with anthrax meningitis, cutaneous anthrax with extensive edema involving the head and neck, or anthrax with vasopressor-resistant shock. Data supporting the use of glucocorticoids are limited and the benefit is unclear.

Pleural effusion and other fluid collections are common complications of anthrax. Hypothetically, draining pleural fluid or ascites might reduce the amount of lethal factor, thereby reducing illness severity and decreasing mortality. In addition, drainage of pleural fluid is believed to improve survival by decreasing mechanical lung compression. Early and aggressive drainage of any clinically or radiographically apparent pleural effusion is recommended; chest tube drainage is preferred over thoracentesis because many effusions will require prolonged drainage. Thoracotomy or video-assisted thoracic surgery might be required to remove gelatinous or loculated collections. Ascites should also be drained, if feasible, and monitored for reaccumulation; continuous drainage might be required.

5. Postexposure Prophylaxis (PEP)

PEP regimens for nonpregnant adults aged ≥18 years exposed to *B. anthracis* include either a single antimicrobial drug or, if antimicrobial drugs are not available, a single anthrax antitoxin. Both antimicrobial drugs and antitoxins are highly effective at preventing disease in animals. However, because antitoxins are administered intravenously and are somewhat (i.e., the monoclonals) to moderately (i.e., the polyclonal) less efficacious than antimicrobial drugs, all oral antimicrobial drugs are preferred over antitoxins. In addition, in a wide-area aerosol release of *B. anthracis* spores, antitoxins should be prioritized for treatment rather than PEP because they likely provide greater benefit as adjunctive treatments. If coadministration of anthrax vaccine and antitoxin is indicated, the only antitoxin that should be used is raxibacumab.

The Incubation period for inhalation anthrax in those who receive PEP regimens may be up to 60 days. To prevent anthrax after discontinuation of antimicrobials and/or antitoxin, the CDC Advisory Committee on

Immunization Practices (ACIP) recommends anthrax vaccine adsorbed (AVA), brand name BioThrax®, for adults aged 18–65 years in conjunction with a PEP regimen. AVA is administered subcutaneously at 0, 2, and 4 weeks postexposure; it can be administered intramuscularly if the subcutaneous route poses significant materiel, personnel, or clinical challenges. AVA can be used under an appropriate regulatory mechanism (e.g., investigational new drug or emergency use authorization) in persons aged <18 years and >65 years exposed to anthrax. In July 2023, a second-generation anthrax vaccine, anthrax vaccine adsorbed, adjuvanted, brand name CYFENDUS™, was approved by FDA for PEP against inhalation anthrax. Anthrax vaccine adsorbed, adjuvanted is administered by the IM route as a 2-dose series 2 weeks apart, in conjunction with a PEP antimicrobial regimen for adults aged 18–65 years. In persons aged >65 years, anthrax vaccine adsorbed, adjuvanted elicited a higher immune response compared with AVA. Anthrax vaccine use in older adults (aged >65 years), pregnant or lactating persons, and children (aged <18 years) would be guided by data available at the time of an anthrax event.

The updated CDC guidelines for the prevention and treatment of anthrax provide separate PEP recommendations for nonpregnant adults aged ≥18 years, pregnant or lactating persons aged ≥18 years, children aged ≥1 month to <18 years, and preterm and full-term neonates 32–44 weeks' postmenstrual age (gestational age plus chronologic age). These tables can be found at the end of this document, and quick links to each table can be seen on the next page.

In each population, empiric PEP regimens include either a single antimicrobial drug or a single antitoxin and are summarized as follows:

1. **Antimicrobial drug: Choose a single antimicrobial drug.**

    - Antimicrobial drugs are listed in descending order of preference in the table. Listed drugs joined by "or" are considered equivalent.
    - Continue or switch antimicrobial drug based on susceptibility testing once available.
    - Only choose a "PCN-S only" antimicrobial drug after the strain has been determined to be penicillin susceptible.
    - For children aged ≥1 month to <18 years:
        - If the strain is found to be penicillin susceptible, a penicillin-class antimicrobial drug is preferred for first-line therapy.
        - For penicillin-resistant strains of anthrax, the benefits of therapy with fluoroquinolones and tetracyclines for pediatric anthrax far exceed the potential toxicities.

2. **Antitoxin: Choose a single antitoxin if no antimicrobial drugs are available.**

The duration of PEP varies by population, type of exposure, and whether the person exposed to anthrax also received anthrax vaccine. The duration of PEP in each of these scenarios is summarized on the next page.

PEP Tables in this Guidance Document and Duration of PEP by Population and Type of Exposure

Population	PEP Table in this Document	Aerosol Exposure (i.e., Bioterrorism-related incident or animal skin drum-related event)		Nonaerosol Exposure (i.e., cutaneous, ingestion)
		Receives **PEP only** (No vaccine is given)	Receives **both PEP and Vaccine**	Receives **PEP only** (No vaccine is needed)
Nonpregnant Adults Aged ≥18 years, **AND** Aged <66 years, **AND** Immunocompetent	Table 10	**60 days**	Antimicrobial drugs can be stopped **42 days after the first dose or 2 weeks after the last dose of vaccine**, whichever occurs later	**7 days**
Nonpregnant Adults Aged ≥66 years, **OR** Immunocompromised		**60 days**	**60 days**	**7 days**
Pregnant or Lactating Adults Aged ≥18 years	Table 11	**60 days**	**60 days**	**7 days**
Children Aged ≥1 month to <18 years	Table 12	**60 days**	**60 days**	**7 days**
Neonates Preterm and full-term neonates 32–44 weeks' postmenstrual age (gestational age + chronologic age)	Table 13	**60 days**	**Vaccine NOT indicated for this age group**	**7 days**

PEP tables are adapted from the CDC MMWR: Guidelines for the Prevention and Treatment of Anthrax, 2023.

Emergency use instructions for doxycycline and ciprofloxacin for PEP for anthrax are available; these include information for use during a public health emergency such as weight-based dosing, pill-crushing for those who cannot swallow pills, and dispensing medication without a prescription.

For more detailed information about anthrax vaccine, see Use of Anthrax Vaccine in the United States: Recommendations of the Advisory Committee on Immunization Practices, 2019 and the CDC Guidelines for the Prevention and Treatment of Anthrax, 2023.

6. Preexposure Anthrax Vaccination

Anthrax vaccine adsorbed (BioThrax®) is the only anthrax vaccine approved by FDA for at-risk adults before exposure to anthrax. It is not typically available for members of the public. The vaccine protects against cutaneous and inhalation anthrax, according to limited, but well-researched evidence. The vaccine does not contain any anthrax bacteria and does not cause anthrax. At-risk adults who are eligible to receive preexposure anthrax vaccine are those who are aged 18–65 years and might be at increased risk of anthrax exposure because of their occupation, including laboratory workers who work with anthrax, certain people who handle animals or animal products, such as some veterinarians, and some members of the United States military. These groups should get five shots of anthrax vaccine intramuscularly over 18 months to build up protection. Annual boosters are needed to sustain the immunity.

Certain people should not get the anthrax vaccine. These include people who have had a serious allergic reaction to a previous dose of anthrax vaccine, people who have severe allergies to any component of the anthrax vaccine, people who have a moderate or severe illness (people with mild illness can usually be vaccinated), and pregnant people.

At this time, emergency and other responders are NOT recommended for routine preexposure anthrax vaccination, but people engaged in response activities that may lead to exposure to aerosolized *B. anthracis* may choose to offer their employees pre-event vaccination on a voluntary basis as part of an occupational health program. Detailed information about AVA can be found at Bower WA, Schiffer J, Atmar RL, et al. Use of Anthrax Vaccine in the United States: Recommendations of the Advisory Committee on Immunization Practices, 2019. MMWR Recomm Rep 0019;68(No. RR-4):1–14.
DOI: http://dx.doi.org/10.15585/mmwr.rr6804a1.

7. Infection Control

Transmission of anthrax from person to person is extremely rare. It has not been reported for inhalation or gastrointestinal anthrax, and has only rarely been reported for cutaneous anthrax, where it requires direct contact with skin lesions. Isolation of patients is not indicated. Prophylaxis for patient contacts is not necessary unless the contacts were exposed to the same source of anthrax as the case-patient.

Standard Precautions should be followed for hospitalized patients with cutaneous, gastrointestinal, or inhalation anthrax. Contact Precautions should be implemented when draining cutaneous lesions cannot be contained. Non-disposable articles soiled with discharge from lesions should be disinfected. Diluted sodium hypochlorite (i.e., a solution of 1 part household bleach to 9 parts water) should be used. Hydrogen peroxide, peracetic acid, or glutaraldehyde may be considered as alternatives.

In hazardous industries, especially those where raw animal material is handled, dust control procedures should be in place and work areas should be properly ventilated. Maintain medical supervision of employees and provide prompt medical care for all suspicious skin lesions. Workers should use appropriate personal protective equipment (e.g., gloves, boots, and impermeable gowns). Thoroughly wash, disinfect, or sterilize hair, wool, bone meal, or other feed of animal origin prior to processing. Use protocols that can eradicate *B. anthracis* spores.

8. Animal-related Illness Considerations

In endemic regions, livestock should be vaccinated annually. Appropriate measures should be taken in the event of incidents of livestock anthrax, including treatment of symptomatic animals and at-risk animals to stop all potential incubating infections. At-risk animals should be vaccinated 7–10 days after antibiotic therapy. Animals should be moved to a different pasture away from vegetation and soil that may have been contaminated by body fluids or tissues of infected carcasses. Correct disposal procedures of carcasses should be followed and decontamination of carcass sites and items in contact with infected carcasses or sites should be performed. If feed is suspected of contamination, it should be immediately removed. Symptomatic animals should not be used for food. Hides of animals exposed to anthrax should not be sold and their carcasses should not be used as food or feed supplements. it should be immediately removed. Symptomatic animals should not be used for food. Hides of animals exposed to anthrax should not be sold, and their carcasses should not be used as food or feed supplements.

If anthrax in an animal is suspected, necropsy should not be performed because of the risk for inducing sporulation and spreading the organism. Instead, aseptically collect a blood sample for smear or culture. If necropsy is inadvertently performed, autoclave, incinerate, or chemically disinfect or fumigate all instruments or materials used. Carcasses of infected animals should be incinerated at the site of death or moved to an incinerator or rendering plant. As an alternative, carcasses can be buried at the site of death as deeply as possible, without digging below the local water table level. Do not add lye or quicklime to a carcass or burial. Control effluents and wastes from rendering plants that handle potentially infected animals and from factories

that manufacture products from hair, wool, bones, or hides that may be contaminated. Decontaminate if appropriate. Vaporized formaldehyde may be used to disinfect contaminated workplaces.

9. Decontamination

In situations of intentional release of *B. anthracis* spores, people who are exposed should wash exposed skin thoroughly with soap and water and shower with soap and shampoo as early as possible. Contaminated clothing should be removed and double bagged. For cutaneous anthrax, clothing and bedding that are soiled with lesion fluid should be disinfected.

For disinfection, sodium hypochlorite (bleach) is sporicidal and can be used when organic matter is not overwhelming and the item is not corrodible. As an alternative, hydrogen peroxide, peracetic acid or glutaraldehyde can be used. Chlorine dioxide, formaldehyde, and ethylene oxide have also been used. Additional information from the Occupational Safety and Health Administration (OSHA) on decontamination of environments and facilities is available.

10. Postmortem Practices

If anthrax is suspected as a cause of death, the regional Office of the Chief Medical Examiner should be immediately notified. In the event of death, the body fluids of the deceased person should be assumed to have very high concentrations of *B. anthracis.*

Suitable over-clothing and gloves should be worn to place the body in a body bag. Serious consideration should be given to cremation. Bedding should be bagged and disposed of as medical waste rather than simply laundered or disinfected. Fumigation of the room may be needed, depending on the perceived level of contamination beyond bedding. If autopsies are performed, instruments and materials used during the process should be autoclaved or disposed of as medical waste. Additional recommendations are available in Nolte KB, Hanzlick RL, Payne DC, et al's Medical Examiners, Coroners, and Biologic Terrorism: A Guidebook for Surveillance and Case Management (2004).

11. Public Health Measures

- **Suspected or confirmed** anthrax cases should be reported immediately to the local health department.
- Laboratory specimens should be sent to the state public health laboratory (DCLS) for confirmation and other studies after VDH consultation and approval. For questions about specimen collection, the DCLS Emergency Officer can be reached 24 hours a day/7 days a week at 804-335-4617.
- Designated public health authority should begin an epidemiologic investigation. The activities include:
  - Collect detailed information from the patient to identify any possible sources of the exposure, maintaining high suspicion for those consistent with bioterrorism
  - Investigate contacts of the case-patient for compatible illness to identify a potential common exposure
  - Collect suspected food items (e.g., contaminated meat) for potential testing. VDH's Office of Epidemiology will work with the Virginia Department of Agriculture and Consumer Services (VDACS), FDA, or USDA, as appropriate, if commercially prepared food is implicated.
  - Notify VDACS and the Department of Wildlife Resources as appropriate if animal exposures are identified
  - Implement control measures to prevent disease and additional exposures. For laboratorians or others potentially exposed who might have worked with the agent before identification as *B. anthracis*, postexposure prophylaxis and monitoring might be recommended based on a risk assessment.
  - VDH will work with the CDC, the Federal Bureau of Investigation, and other federal agencies as necessary

12. References and Resources

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13. Tables

Table 1. Sample collection for suspected anthrax cases and testing at DCLS*

Samples	Amount	Type of Tests and Anthrax	Instructions
Vesicle or eschar	2 dry swabs; punch biopsy if patient on antimicrobials	Gram stain, PCR, and culture for cutaneous anthrax	▪ Collect eschar material by lifting the eschar's outer edge; insert a sterile dry swab, then slowly rotate for 2–3 seconds beneath the edge of the eschar ▪ If no vesicle or eschar present, swab base of ulcer using a sterile moist swab ▪ Specimens for culture, PCR, or both culture and PCR, should be shipped using ice packs and stored at 2 to 8°C
Ulcer	2 pre-moistened swabs		
Blood	10 mL in EDTA or Sodium Citrate	PCR and culture for inhalation, gastrointestinal (GI), and systemic cutaneous anthrax	▪ Blood for culture should be collected before antimicrobial therapy started. Ship on cold packs.
Serum	5 mL acute sera and 5 mL convalescent sera (10 mL blood yields ~ 5 mL of sera)	Serology and lethal toxin test for inhalation, gastrointestinal, and systemic cutaneous anthrax	▪ Separate serum from clot; serum should be frozen immediately following separation and stored frozen at -20°C or colder, and should be shipped frozen on dry ice, in labeled plastic screw cap vials
Pleural fluid	>1 mL	PCR and culture for inhalation anthrax	▪ Collect in sterile container and store at 2–8°C for ≤ 24h; ship using cold packs
Stool	>5 grams in an unpreserved, sterile container	PCR and culture for intestinal form of gastrointestinal anthrax	▪ Specimens for culture, PCR, or both culture and PCR, should be stored at 2 to 8°C and shipped using ice packs
Cerebrospinal fluid (CSF)	>1 mL CSF in a sterile container	PCR and culture for any anthrax with meningeal signs	▪ CSF specimens for culture and PCR should be shipped on cold packs
Biopsy of papule or vesicle	A full thickness punch	Histopathology, immunohistochemistry (IHC), special stains, PCR, and culture for cutaneous anthrax	▪ Obtain a full thickness punch biopsy of a papule or vesicle including adjacent skin and place into 10% formalin. Ship formalin fixed samples at room temperature and fresh samples using dry ice. ▪ For PCR and culture, specimens should be collected ≤24h after initiating antimicrobials
Pleural or bronchial biopsies	Small amount	IHC for inhalation anthrax	▪ Collect in sterile container. Store at 2– 8°C for no more than 24 hrs. Ship formalin fixed samples at room temperature and fresh samples using dry ice.
Ascites fluid	>1 mL	PCR and culture for GI anthrax	▪ Stored at 2– 8°C for no more than 24 hrs and shipped using cold packs
Oropharyngeal swab	2 dry swabs	PCR and culture for oropharyngeal anthrax	▪ Using a sterile dry swab, swab surface and edges of suspected lesions in the oropharynx, buccal cavity, tongue, tonsils, or posterior pharyngeal wall
Rectal swab	2 dry swabs	PCR and culture for intestinal anthrax	▪ Obtain using a sterile dry swab
Autopsy tissues	≥8 blocks of fixed tissue	Histopathology, IHC, and special stains for inhalation anthrax	▪ Ship paraffin-embedded tissue blocks and unprocessed tissues in 10% neutral buffered formalin

*Adapted from American Society for Microbiology's Sentinel Level Clinical Laboratory Guidelines for Suspected Agents of Bioterrorism and Emerging Infectious Diseases: *Bacillus anthracis* and *Bacillus cereus* biovar *anthracis* (2017). If anthrax is suspected, notify the local health department immediately to discuss the case and laboratory testing. If VDH approves public health testing, specimens may be sent to Division of Consolidated Laboratory Services (DCLS) with the DCLS Test Request Form; include the name of the test on the form. For questions about collecting specimens or for notifying DCLS when submitting specimens, contact the DCLS Emergency Officer available 24/7 at 804-335-4617.

Table 2. Empiric* treatment regimens for nonpregnant adults aged ≥18 years with cutaneous anthrax without signs and symptoms of meningitis, by descending order of preference- CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	Dosage
First-line antimicrobial drug	Doxycycline†,§	100 mg every 12 hours orally
	or	
	Minocycline†	200 mg x 1 dose orally, then 100 mg every 12 hours orally
	or	
	Ciprofloxacin†	500 mg every 12 hours orally
	or	
	Levofloxacin†	750 mg every 24 hours orally
	PCN-S only:	
	Amoxicillin¶,**	1 g every 8 hours orally
	or	
	Penicillin VK¶	500 mg every 6 hours orally
Alternative antimicrobial drug††	Amoxicillin/clavulanate¶	1:16 formulation (1 g/62.5 mg) in 2 tablets every 12 hours orally, **or** 1:7 formulation (875/125 mg) every 12 hours orally
	Moxifloxacin§,¶	400 mg every 24 hours orally
	Clindamycin¶	600 mg every 8 hours orally
	Ofloxacin¶	400 mg every 12 hours orally
	Omadacycline¶	450 mg every 12 hours orally x 2 days, then 300 mg every 24 hours orally
	Linezolid¶	600 mg every 12 hours orally
	Tetracycline†	500 mg every 6 hours orally
	Clarithromycin¶,§§	500 mg every 12 hours orally (only initiate after at least 3 days of treatment with any of the other antimicrobials listed)
	Dalbavancin¶	1 g x 1 dose IV, then 500 mg weekly IV
	Imipenem/cilastatin¶	2 g every 8 hours IV
	or	
	Meropenem¶	2 g every 8 hours IV
	Vancomycin¶	15 mg/kg every 12 hours IV over a period of 1–2 hours (target AUC_{24} of 400–600 μg x h/mL [preferred]; if AUC_{24} is not available, maintain serum trough concentrations of 15–20 μg/mL)
Antitoxin¶¶	Raxibacumab†††	40 mg/kg in a single dose IV
	or	
	Obiltoxaximab†††	16 mg/kg in a single dose IV
	AIGIV***	420 units IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviation: AIGIV = anthrax immunoglobulin intravenous; FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

§ If liquid formulations are not available for adults who cannot swallow pills, instructions are available for preparing oral suspensions of moxifloxacin (**Source:** Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (**Source:** CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

¶ Not approved by FDA for anthrax PEPAbx or treatment.

** Ampicillin 500 mg every 6 hours can be used as an alternative to amoxicillin, if available.

†† Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

§§ Clarithromycin is unlikely to be effective if the patient has bacteremia, thus a different antimicrobial drug must be used initially to clear bacteremia.

¶¶ Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins joined by "or" are considered equivalent.

†††Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.
*** An 840-unit dose of AIGIV can be considered for severe cases.

Table 3. Empiric* treatment regimens for nonpregnant adults aged ≥18 years with systemic† anthrax with or without meningitis,§ by descending order of preference — CDC recommendations, 2023

Regimen	Example
Regimen 1. Two bactericidal drugs from different antimicrobial drug classes plus a PSI or an RNAI	Ciprofloxacin plus meropenem plus minocycline¶
Regimen 2. One bactericidal drug plus a PSI	Meropenem plus doxycycline
Regimen 3. One bactericidal drug plus a second bactericidal drug from a different antimicrobial drug class	Meropenem plus ciprofloxacin
Regimen 4. One bactericidal drug plus an RNAI (rifampin should not be used as monotherapy)	Meropenem plus rifampin
Regimen 5. A PSI plus an RNAI (rifampin should not be used as monotherapy)	Minocycline or doxycycline plus rifampin
Regimen 6. Two PSIs from different antimicrobial drug classes	Minocycline plus clindamycin
Regimen 7. A single bactericidal drug	Meropenem
Regimen 8. A single PSI	Minocycline or doxycycline or clindamycin

Preference	Bactericidal drug		PSI	
First-line antimicrobial drug**	**Treatment (drugs joined by "or" considered equivalent)**	**Dosage**	**Treatment**	**Dosage**
	Meropenem††	2 g every 8 hours IV	Minocycline§§	200 mg x 1 dose IV, then 100 mg every 12 hours IV
	or			
	Ciprofloxacin§§	400 mg every 8 hours IV	Doxycycline§§	200 mg x 1 dose IV, then 100 mg every 12 hours IV
	or			
	Levofloxacin§§	500 mg every 12 hours IV		
	PCN-S only:			
	Penicillin G§§	4 million units every 4 hours IV		
	or			
	Ampicillin††	2 g every 4 hours IV		
	Imipenem/cilastatin††	1 g every 6 hours IV		
	or			
	Ampicillin/sulbactam††	3 g every 6 hours IV		

Alternative antimicrobial drug¶¶	Bactericidal drug		PSI/RNAI	
	Treatment	**Dosage**	**Treatment**	**Dosage**
	Piperacillin/tazobactam††	3.375 g every 4 hours IV	Omadacycline††,***	200 mg x 1 dose IV on day 1, then 100 mg every 24 hours IV
	Moxifloxacin††	400 mg every 24 hours IV	Eravacycline††,***	1 mg/kg every 12 hours IV
	Vancomycin††,***	15 mg/kg every 12 hours IV over a period of 1–2 hours (target AUC_{24} of 400 μg x h/mL [preferred]; if AUC_{24} is not available, maintain serum trough concentrations of 15–20 μg/mL). Consider a loading dose of 20–35 mg/kg for critically ill patients.	Clindamycin††	900 mg every 8 hours IV
			Linezolid††	600 mg every 12 hours IV
			Rifampin††,†††	600 mg every 12 hours IV
			Chloramphenicol††,§§§	1 g every 6–8 hours IV

-PLUS-Antitoxin¶¶¶	Treatment	Dosage
	Raxibacumab††††	40 mg/kg IV
	or	
	Obiltoxaximab††††	16 mg/kg IV
	AIGIV****	420 units IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: AIGIV = anthrax immunoglobulin intravenous; AUC_{24} = area under the concentration-time curve from 0 to 24 hours; FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax; PSI = protein synthesis inhibitor; RNAI = RNA synthesis inhibitor.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† "Systemic" was defined as one or more of the following using cutoffs for adults aged ≥18 years: hyperthermia or hypothermia, tachycardia, tachypnea, hypotension, or neutrophilia or neutropenia (Source: Katharios-Lanwermeyer S, Holty JE, Person M, et al. Identifying meningitis during an anthrax mass casualty incident: systematic review of systemic anthrax since 1880. Clin Infect Dis 2016;62:1537–45).

§ Refer to Figure for guidance on clinical signs and symptoms of anthrax meningitis. If meningitis is not suspected and susceptibilities are known, start at regimen 2.

¶ For anthrax meningitis, consider using antimicrobial drugs that have demonstrated potential neuroprotective benefits in vivo (e.g., minocycline, doxycycline, clindamycin, and ß-lactamase inhibitors).

** For highly bioavailable antimicrobial drugs (e.g., ciprofloxacin, doxycycline, and linezolid), if the IV formulation is not available, oral formulations can be considered for patients with an intact gastrointestinal tract where absorption is expected to be complete after oral administration.

†† Not approved by FDA for anthrax PEPAbx, treatment, or both.

§§ Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

¶¶ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

*** This antimicrobial drug does not cross an intact blood-brain barrier but might cross with meningitis because of breakdown of the barrier.

††† Rifampin is an RNAI and also bactericidal; however, it should not be used as monotherapy. Rifampicin is equivalent to rifampin and can be used if it is more readily available.

§§§ Chloramphenicol should not be used in combination with a bactericidal antimicrobial drug because the interaction might be antagonistic.

¶¶¶ Single dose as an adjunct to antimicrobial drug; listed antitoxins joined by "or" are considered equivalent.

††††Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

**** An 840-unit dose of AIGIV can be considered for severe cases.

Table 4. Empiric* treatment regimens for pregnant or lactating persons†,§ aged >18 years with cutaneous anthrax without signs and symptoms of meningitis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	Dosage
First-line antimicrobial drug	Doxycycline¶,**	100 mg every 12 hours orally
	or	
	Ciprofloxacin¶	500 mg every 12 hours orally
	or	
	Levofloxacin¶	750 mg every 24 hours orally
	PCN-S only:	
	Amoxicillin††,§§	1 g every 8 hours orally
	or	
	Penicillin VK††	500 mg every 6 hours orally
Alternative antimicrobial drug¶¶	Amoxicillin/clavulanate††	16:1 formulation (1 g/62.5 mg) in 2 tablets every 12 hours orally, **or** 7:1 formulation (875/125 mg) every 12 hours orally
	Moxifloxacin**,††	400 mg every 24 hours orally
	Ofloxacin††	400 mg every 12 hours orally
	Clindamycin††	600 mg every 8 hours orally
	Omadacycline††	450 mg every 24 hours orally x 2 days, then 300 mg every 24 hours orally
	Linezolid††	600 mg every 12 hours orally
	Clarithromycin††,***	500 mg every 12 hours orally (only initiate after at least 3 days of treatment with any of the other antimicrobial drugs listed)
	Dalbavancin††	1 g x 1 dose IV, then 500 mg weekly IV
	Imipenem/cilastatin††	2 g every 8 hours IV
	or	
	Meropenem††	2 g every 8 hours IV
	Vancomycin††	15 mg/kg every 12 hours IV over a period of 1–2 hours (target AUC_{24} of 400–600 μg x h/mL [preferred]; if AUC_{24} is not available, maintain serum trough concentrations of 15–20 μg/mL)
Antitoxin¶¶¶	Raxibacumab†††	40 mg/kg in a single dose IV
	or	
	Obiltoxaximab†††	16 mg/kg in a single dose IV
	AIGIV§§§	420 units IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: AIGIV = anthrax immunoglobulin intravenous; AUC_{24} = area under the concentration-time curve from 0 to 24 hours; FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† For pregnant adolescents, refer to pediatric guidelines for weight-based dosing (see Table 13).

§ Dosing recommended for pregnant persons regardless of trimester.

¶ Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

** If liquid formulations are not available for adults who cannot swallow pills, instructions are available for preparing oral suspensions of moxifloxacin (**Source:** Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (**Source:** CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

†† Not approved by FDA for anthrax PEPAbx or treatment.

§§ Ampicillin 500 mg every 6 hours orally can be used as an alternative to amoxicillin, if available.

¶¶ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

*** Clarithromycin is unlikely to be effective if the patient has bacteremia, thus a different antimicrobial drug must be used initially to clear bacteremia.

¶¶¶Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins joined by "or" are considered equivalent.

††† Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

§§§ An 840-unit dose of AIGIV can be considered for severe cases.

Table 5. Empiric* treatment regimens for pregnant or lactating persons aged ≥18 years†,§ with systemic¶ anthrax with or without meningitis, by descending order of preference — CDC recommendations, 2023

Regimen	Example
Regimen 1. Two bactericidal drugs from different antimicrobial drug classes plus a PSI or an RNAI	Ciprofloxacin plus meropenem plus doxycycline or omadacycline**
Regimen 2. One bactericidal drug plus a PSI	Meropenem plus linezolid or doxycycline
Regimen 3. One bactericidal drug plus a second bactericidal drug from a different antimicrobial drug class	Meropenem plus ciprofloxacin
Regimen 4. One bactericidal drug plus an RNAI (rifampin should not be used as monotherapy)	Meropenem plus rifampin
Regimen 5. A PSI plus an RNAI (rifampin should not be used as monotherapy)	Linezolid or doxycycline or clindamycin plus rifampin
Regimen 6. Two PSIs from different antimicrobial drug classes	Linezolid plus doxycycline
Regimen 7. A single bactericidal drug	Meropenem
Regimen 8. A single PSI	Linezolid or doxycycline or clindamycin

Preference	Bactericidal drug		PSI	
	Treatment (drugs joined by "or" considered equivalent)	**Dosage**	**Treatment**	**Dosage**
First-line antimicrobial drug††	Meropenem§§	2 g every 8 hours IV	Doxycycline¶¶	200 mg x 1 dose IV, then 100 mg every 12 hours IV
	or			
	Ciprofloxacin¶¶	400 mg every 8 hours IV		
	or			
	Levofloxacin¶¶	500 mg every 12 hours IV		
	PCN-S only:			
	Penicillin G¶¶	4 million units every 4 hours IV		
	or			
	Ampicillin§§	2 g every 4 hours IV		
	Imipenem/cilastatin§§	1 g every 6 hours IV		
	or			
	Ampicillin/sulbactam§§	3 g every 6 hours IV		
Alternative antimicrobial drug***	**Bactericidal drug**		**PSI/RNAI**	
	Treatment	**Dosage**	**Treatment**	**Dosage**
	Piperacillin/tazobactam§§	3.375 g every 4 hours IV	Omadacycline§§,†††	200 mg x 1 dose IV on day 1, then 100 mg every 24 hours IV
	Moxifloxacin§§	400 mg every 24 hours IV	Eravacycline§§,†††	1 mg/kg every 12 hours IV
	Vancomycin§§,†††	15 mg/kg every 12 hours IV over a period of 1–2 hours (target AUC_{24} of 400–600 μg x h/mL [preferred]; if AUC_{24} is not available, maintain serum trough concentrations of 15–20 μg/mL). Consider a loading dose of 20-35 mg/kg for critically ill patients.	Clindamycin§§	900 mg every 8 hours IV
			Linezolid§§	600 mg every 12 hours IV
			Rifampin§§,§§§	600 mg every 12 hours IV

-PLUS-Antitoxin¶¶¶	Treatment	Dosage
	Raxibacumab††††	40 mg/kg IV
	or	
	Obiltoxaximab††††	16 mg/kg IV

	AIGIV	420 units IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: AIGIV = anthrax immunoglobulin intravenous; AUC_{24} = area under the concentration-time curve from 0 to 24 hours; FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax; PSI = protein synthesis inhibitor; RNAI = RNA synthesis inhibitor.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Pregnant adolescents: refer to pediatric guidelines for weight-based dosing (see Table 14).

§ Dosing recommended for pregnant persons regardless of trimester. If meningitis not suspected and susceptibilities are known, start at regimen 2.

¶ "Systemic" was defined as including evidence of organ damage or any of the following: hyperthermia or hypothermia, tachycardia, tachypnea, hypotension, or leukocytosis or leukopenia (**Source:** Katharios-Lanwermeyer S, Holty JE, Person M, et al. Identifying meningitis during an anthrax mass casualty incident: systematic review of systemic anthrax since 1880. Clin Infect Dis 2016;62:1537–45).

** For anthrax meningitis, consider using antimicrobial drugs that have demonstrated potential neuroprotective benefits in vivo (e.g., minocycline, doxycycline, clindamycin, and ß-lactamase inhibitors).

†† For highly bioavailable antimicrobial drugs (e.g., ciprofloxacin, doxycycline, and linezolid), if the IV formulation is not available, oral formulations can be considered for patients with an intact gastrointestinal tract where absorption is expected to be complete after oral administration.

§§ Not approved by FDA for anthrax PEPAbx or treatment.

¶¶ Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

*** Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

††† This antimicrobial does not cross an intact blood-brain barrier but can cross with meningitis because of breakdown of the barrier.

§§§ Rifampin is an RNAI and also bactericidal; however, it should not be used as monotherapy.

¶¶¶ Single dose as an adjunct to antimicrobial drug; listed antitoxins joined by "or" are considered equivalent.

††††Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

**** An 840-unit dose of AIGIV can be considered for severe cases.

Table 6. Empiric* treatment regimens for children aged ≥1 month to <18 years with cutaneous anthrax without signs and symptoms of meningitis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	Dosage
First-line antimicrobial drug	Ciprofloxacin†	15 mg/kg every 12 hours orally (maximum 500 mg/dose)
	or	
	Levofloxacin†	<50 kg: 8 mg/kg every 12 hours orally (maximum 250 mg/dose) ≥50 kg: 750 mg every 24 hours orally
	or	
	Doxycycline†,§	<45 kg: 2.2 mg/kg every 12 hours orally (maximum 100 mg/dose) ≥45 kg: 100 mg every 12 hours orally
	or	
	Minocycline†,¶	4 mg/kg once orally (maximum 200 mg/dose), then 2 mg/kg every 12 hours orally (maximum 100 mg/dose)
	PCN-S only:	
	*Amoxicillin***,††*	25 mg/kg every 8 hours orally (maximum 1 g/dose)
	or	
	*Penicillin VK****	12.5–18.7 mg/kg every 6 hours orally (maximum 500 mg/dose)
	Amoxicillin/clavulanate**,§§	Aged ≥3 months: 7:1 formulation (200/28.5 mg or 400/57 mg) 22.5 mg/kg based on amoxicillin component every 12 hours orally (maximum 875/125 mg/dose) Aged ≥3 months and <40 kg: 14:1 formulation (600/42.9 mg) 45 mg/kg based on amoxicillin component every 12 hours orally Aged ≥3 months and ≥40 kg: 16:1 formulation (1,000/62.5 mg tablets) 2 g every 12 hours orally
	Clindamycin**	10 mg/kg every 8 hours orally (maximum 600 mg/dose)
Alternative antimicrobial drug¶¶	Moxifloxacin§,***,†††	Aged ≥3 to ≤23 months: 6 mg/kg every 12 hours orally (maximum 200 mg/dose) Aged 2 to <6 years: 5 mg/kg every 12 hours orally (maximum 200 mg/dose) Aged 6 to <12 years: 4 mg/kg every 12 hours orally (maximum 200 mg/dose) Aged ≥12 to <18 years and <45 kg: 4 mg/kg every 12 hours orally (max 200 mg/dose) Aged ≥12 to <18 years and ≥45 kg: 400 mg every 24 hours orally
	Ofloxacin***	11.25 mg/kg every 12 hours orally (maximum 400 mg/dose)
	Tetracycline†,¶	12 mg/kg every 6 hours orally (maximum 500 mg/dose)
	Linezolid**	Aged <12 years: 10 mg/kg every 8 hours orally (maximum 600 mg/dose) Aged ≥12 years: 600 mg every 12 hours orally
	Omadacycline¶,***	Aged >8 years: 450 mg every 24 hours orally x 2 days, then 300 mg every 24 hours orally
	Clarithromycin**,§§§	7.5 mg/kg every 12 hours orally (maximum 500 mg/dose; only initiate after at least 3 days of treatment with any of the other antimicrobial drugs listed)
	Dalbavancin**	Aged ≥3 months to <6 years: 22.5 mg/kg every week IV (maximum 1.5 g/dose) Aged ≥6 years to <18 years: 18 mg/kg every week IV (maximum 1.5 g/dose)
	Meropenem**	20 mg/kg every 8 hours IV (maximum 2 g/dose)
	Imipenem/cilastatin**	25 mg/kg every 6 hours IV (maximum 1 g/dose)
	Vancomycin**	20 mg/kg every 8 hours IV over a period of 1–2 hours (target AUC_{24} of 400 μg x h/mL [preferred]; if AUC_{24} is not available, maintain serum trough concentrations of 15–20 μg/mL)
Antitoxin¶¶¶	Raxibacumab††††	≤10 kg: 80 mg/kg as a single dose IV >10–40 kg: 60 mg/kg as a single dose IV >40 kg: 40 mg/kg as a single dose IV
	or	
	Obiltoxaximab††††	≤15 kg: 32 mg/kg as a single dose IV >15–40 kg: 24 mg/kg as a single dose IV >40 kg: 16 mg/kg as a single dose IV

	AIGIV****	>10 kg: 1 vial (approximately 60 units) IV 10 to <18 kg: 2 vials (approximately 120 units) IV 18 to <25 kg: 3 vials (approximately 180 units) IV 25 to <35 kg: 4 vials (approximately 240 units) IV 35 to <50 kg: 5 vials (approximately 300 units) IV 50 to <60 kg: 6 vials (approximately 360 units) IV ≥60 kg: 7 vials (approximately 420 units) IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: AUC_{24} = area under the concentration-time curve from 0 to 24 hours; FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

§ Instructions are available for preparing oral suspensions of moxifloxacin (**Source:** Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (**Source:** CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

¶ The use of tetracycline-class antibiotics during tooth development (i.e., last half of pregnancy, infancy, and childhood up to age 8 years) might cause permanent discoloration of the teeth (yellow, gray, or brown) and enamel hypoplasia. This adverse effect appears to occur less often with doxycycline but might occur more with longer durations of therapy.

** Not approved by FDA for anthrax PEPAbx or treatment.

†† Ampicillin 25 mg/kg every 6 hours orally (maximum 500 mg/dose) can be used as an alternative to amoxicillin, if available.

§§ To minimize potential side effects from clavulanate, the amoxicillin/clavulanate 875/125 mg every 12 hours orally and amoxicillin/clavulanate extended-release 2,000/125 mg every 12 hours orally treatments are preferred over 500/125 mg every 8 hours orally.

¶¶ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

*** Not approved by FDA for any pediatric indications. Not approved by FDA for anthrax PEPAbx or treatment.

††† For children aged 12–17 years who weigh ≥45 kg with risk factors for cardiac events, consider 200 mg twice daily.

§§§ Clarithromycin is unlikely to be effective if the patient has bacteremia, thus a different antimicrobial drug must be used initially to clear bacteremia.

¶¶¶ Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins joined by “or” are considered equivalent.

††††Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

**** Dose can be doubled for severe cases in patients who weigh >5 kg.

Table 7. Empiric* treatment regimens for children aged ≥1 month to <18 years with systemic† anthrax with or without meningitis,§ by descending order of preference — CDC recommendations, 2023

Regimen	Example
Regimen 1. Two bactericidal drugs from different antimicrobial drug classes plus a PSI or an RNAI	Ciprofloxacin plus meropenem plus linezolid or minocycline¶
Regimen 2. One bactericidal drug plus a PSI	Meropenem plus linezolid or doxycycline
Regimen 3. One bactericidal drug plus a second bactericidal drug from a different antimicrobial drug class	Meropenem plus ciprofloxacin
Regimen 4. One bactericidal drug plus an RNAI (rifampin should not be used as monotherapy)	Meropenem plus rifampin
Regimen 5. A PSI plus an RNAI (rifampin should not be used as monotherapy)	Doxycycline or chloramphenicol or linezolid plus rifampin
Regimen 6. Two PSIs from different antimicrobial drug classes	Doxycycline plus chloramphenicol
Regimen 7. A single bactericidal drug	Meropenem
Regimen 8. A single PSI	Doxycycline or chloramphenicol or linezolid

Preference	Bactericidal drug		PSI	
	Treatment (drugs joined by "or" considered equivalent)	**Dosage**	**Treatment**	**Dosage**
First-line antimicrobial drug**	Meropenem††	40 mg/kg every 8 hours IV (maximum 2 g/dose)	Minocycline§§,¶¶	4 mg/kg once IV (maximum 200 mg dose), then 2 mg/kg every 12 hours IV (maximum 100 mg/dose)
	or		Doxycycline§§	<45 kg: 2.2 mg/kg loading dose IV (maximum 200 mg/dose), then 2.2 mg/kg every 12 hours IV (maximum 100 mg/dose) ≥45 kg: 200 mg IV loading dose, then 100 mg every 12 hours IV
	Ciprofloxacin§§	10 mg/kg every 8 hours IV (maximum 400 mg/dose)		
	or			
	Levofloxacin§§	<50 kg: 10 mg/kg every 12 hours IV (maximum 250 mg/dose) ≥50 kg: 750 mg every 24 hours IV		
	PCN-S only:			
	Ampicillin††	50 mg/kg every 6 hours IV (maximum 3 g/dose)		
	or			
	Penicillin G§§	67,000 units/kg every 4 hours IV (maximum 4 million units/dose)		

Alternative antimicrobial drug***	Bactericidal drug		PSI/RNAI	
	Treatment	**Dosage**	**Treatment**	**Dosage**
	Imipenem/cilastatin††,††	25 mg/kg every 6 hours IV (maximum 1 g/dose)	Clindamycin††	13.3 mg/kg every 8 hours IV (maximum 900 mg/dose)
	Piperacillin/tazobactam††	75 mg piperacillin/kg every 6 hours IV (maximum 4 g piperacillin/dose)	Eravacycline¶¶,§§§	Aged >8 years: 1 mg/kg every 12 hours IV
	or		Linezolid††	Aged <12 years: 10 mg/kg every 8 hours IV (maximum 600 mg/dose)
	Ampicillin/sulbactam††	50 mg ampicillin/kg every 6 hours IV (maximum 2 g ampicillin/dose)		

				Aged ≥12 years: 15 mg/kg every 12 hours IV (maximum 600 mg/dose)
	Moxifloxacin§§§,¶¶¶	Aged ≥3 to ≤23 months: 6 mg/kg every 12 hours IV (maximum 200 mg/dose) Aged 2 to <6 years: 5 mg/kg every 12 hours IV (maximum 200 mg/dose) Aged 6 to <12 years: 4 mg/kg every 12 hours (maximum 200 mg/dose) Aged ≥12 to ≤18 years and <45 kg: 4 mg/kg every 12 hours IV (maximum 200 mg/dose) Aged ≥12 to ≤18 years and ≥45 kg: 400 mg every 24 hours IV	Rifampin**,****	10 mg/kg every 12 hours IV (maximum 300 mg/dose)
	Vancomycin††	20 mg/kg every 8 hours IV (target AUC_{24} of 400 μg x h/mL [preferred]; if AUC_{24} is not available, maintain serum trough concentrations of 15–20 μg/mL)	Chloramphenicol††,†† ††	25 mg/kg every 6 hours IV (maximum 1 g/dose)
-PLUS-Antitoxin (single dose as an adjunct to antimicrobial drug)	**Treatment**		**Dosage**	
	Raxibacumab§§§§		≤10 kg: 80 mg/kg as a single dose IV >10 to 40 kg: 60 mg/kg as a single dose IV >40 kg: 40 mg/kg as a single dose IV	
	or			
	Obiltoxaximab§§§§		≤15 kg: 32 mg/kg as a single dose IV >15 to 40 kg: 24 mg/kg as a single dose IV >40 kg: 16 mg/kg as a single dose IV	
	AIGIV¶¶¶¶		>10 kg: 1 vial (approximately 60 units) IV 10 to <18 kg: 2 vials (approximately 120 units) IV 18 to <25 kg: 3 vials (approximately 180 units) IV 25 to <35 kg: 4 vials (approximately 240 units) IV 35 to <50 kg: 5 vials (approximately 300 units) IV 50 to <60 kg: 6 vials (approximately 360 units) IV ≥60 kg: 7 vials (approximately 420 units) IV	

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: AIGIV = anthrax immunoglobulin intravenous; AUC_{24} = area under the concentration-time curve from 0 to 24 hours; FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax; PSI = protein synthesis inhibitor; RNAI = RNA synthesis inhibitor.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† "Systemic" was defined as including evidence of organ damage or any of the following: hyperthermia or hypothermia, tachycardia, tachypnea, hypotension, or leukocytosis or leukopenia (**Source:** Katharios-Lanwermeyer S, Holty JE, Person M, et al. Identifying meningitis during an anthrax mass casualty incident: systematic review of systemic anthrax since 1880. Clin Infect Dis 2016;62:1537–45).

§ If meningitis is not suspected and susceptibilities are known, start at regimen 2.

¶ For anthrax meningitis, consider using antimicrobial drugs that have demonstrated potential neuroprotective benefits in vivo (e.g., minocycline, doxycycline, clindamycin, and ß-lactam antimicrobials).
** For highly bioavailable antimicrobial drugs (e.g., ciprofloxacin, doxycycline, and linezolid), if the IV formulation is not available, oral formulations can be considered for patients with an intact gastrointestinal tract where absorption is expected to be complete after oral administration.
†† Not approved by FDA for anthrax PEPAbx or treatment.
§§ Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.
¶¶ The use of tetracycline-class antibiotics during tooth development (i.e., last half of pregnancy, infancy, and childhood up to age 8 years) might cause permanent discoloration of the teeth (yellow, gray, or brown) and enamel hypoplasia. This adverse effect appears to occur less often with doxycycline but might occur more with longer durations of therapy.
*** Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.
††† Increased seizure risk if meningitis/central nervous system anthrax is present.
§§§ Not approved by FDA for any pediatric indications. Not approved by FDA for anthrax PEPAbx or treatment.
¶¶¶ For children aged 12–17 years who weigh ≥45 kg with risk factors for cardiac events, consider 200 mg twice daily.
**** Rifampin is an RNAI and also bactericidal; however, it should not be used as monotherapy.
†††† Chloramphenicol should not be used in combination with a bactericidal antimicrobial drug because the interaction might be antagonistic.
§§§§ Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration; listed antitoxins joined by “or” are considered equivalent.
¶¶¶¶ Dose can be doubled for severe cases in patients who weigh >5 kg.

Table 8. Empiric* treatment regimens for preterm and full-term neonates 32–44 weeks' postmenstrual age (gestational age plus chronologic age) with cutaneous anthrax without signs and symptoms of meningitis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	32 to <34 weeks' gestational age		34 to <37 weeks' gestational age		Full-term infant	
		0 to <1 week	1–4 weeks	0 to <1 week	1–4 weeks	0 to <1 week	1–4 weeks
		Dosage	Dosage	Dosage	Dosage	Dosage	Dosage
First-line antimicrobial drug	Ciprofloxacin†	10 mg/kg every 12 hours orally	10 mg/kg every 12 hours orally	10 mg/kg every 12 hours orally	10 mg/kg every 12 hours orally	15 mg/kg every 12 hours orally	15 mg/kg every 12 hours orally
	PCN-S only§:						
	Amoxicillin¶,**	25 mg/kg every 12 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 8 hours orally
	Penicillin VK¶	25 mg/kg every 12 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 12 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 6 hours orally
	Amoxicillin/clavulanate¶	25 mg amoxicillin/kg every 12 hours orally	25 mg amoxicillin/kg every 8 hours orally	25 mg amoxicillin/kg every 12 hours orally	25 mg amoxicillin/kg every 8 hours orally	25 mg amoxicillin/kg every 8 hours orally	25 mg amoxicillin/kg every 8 hours orally
	Doxycycline†,††	5 mg/kg every 12 hours orally	5 mg/kg every 12 hours orally	5 mg/kg every 12 hours orally	5 mg/kg every 12 hours orally	5 mg/kg x 1 dose orally, then 2.5 mg/kg every 12 hours orally	5 mg/kg x 1 dose orally, then 2.5 mg/kg every 12 hours orally
	Clindamycin¶	7 mg/kg every 8 hours orally	7 mg/kg every 8 hours orally	7 mg/kg every 8 hours orally	7 mg/kg every 8 hours orally	9 mg/kg every 8 hours orally	9 mg/kg every 8 hours orally
	Levofloxacin†	10 mg/kg every 12 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 12 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 12 hours orally	10 mg/kg every 8 hours orally
Alternative antimicrobial drug§§	Moxifloxacin††,¶¶	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally
	Linezolid¶	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV
	Meropenem¶	13.3 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV
	Vancomycin¶,***	20 mg/kg loading dose IV, then 15 mg/kg every 12 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 12 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV
		Administer over a period of 1–2 hours. After dose 3 of vancomycin, adjust dosages to target AUC_{24} of 400 μg x h/mL [preferred]; if AUC_{24} is not available, maintain trough concentrations of 10–15 μg/mL. Check concentrations earlier if renal function is impaired. During the first 7–10 days, serum creatinine represents maternal concentration.					
	Omadacycline¶¶,†††	NA	NA	NA	5.5 mg/kg loading dose IV x 1, then 3.85 mg/kg every 24 hours IV	5.5 mg/kg loading dose IV x 1, then 3.85 mg/kg every 24 hours IV	5.5 mg/kg loading dose IV x 1, then 3.85 mg/kg every 24 hours IV

	Dalbavancin¶	NA	NA	NA	NA	NA	22.5 mg/kg x 1 dose IV
Antitoxin§§§ **(only use if antimicrobial drugs not available or not appropriate)**	Raxibacumab¶¶¶	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV
	or						
	Obiltoxaximab¶¶¶	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV
	AIGIV	1 vial (approximately 60 units) as a single dose IV	1 vial (approximately 60 units) as a single dose IV	1 vial (approximately 60 units) as a single dose IV	1 vial (approximately 60 units) as a single dose IV	1 vial (approximately 60 units) as a single dose IV	1 vial (approximately 60 units) as a single dose IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Source: Bradley JS, Nelson JD, eds. Nelson's pediatric antimicrobial therapy. 29th ed. Itasca, IL: American Academy of Pediatrics; 2023.

Abbreviations: FDA = Food and Drug Administration; IV = intravenous; NA = not applicable; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

§ Up to 10% of naturally occurring strains of anthrax are resistant to penicillin and amoxicillin; bioterror strains might be engineered to generate resistance to multiple antibiotics. Susceptibility results reported from CDC within 48–72 hours of initial isolation of anthrax.

¶ Not approved by FDA for anthrax PEPAbx or treatment.

** Ampicillin can be used as an alternative to amoxicillin, if available.

†† Instructions are available for preparing oral suspensions of moxifloxacin (**Source:** Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (**Source:** CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

§§ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

¶¶ Not approved by FDA for any pediatric indications. Not approved by FDA for anthrax PEPAbx or treatment.

*** Allergic reactions are rare in neonates, but neonates can release histamine that causes hypotension after rapid infusions of vancomycin; thus, it can be safest to pretreat with an antihistamine.

††† The use of tetracycline-class antibiotics during tooth development (i.e., last half of pregnancy, infancy, and childhood up to age 8 years) might cause permanent discoloration of the teeth (yellow, gray, or brown) and enamel hypoplasia. This adverse effect appears to occur less often with doxycycline but might occur more with longer durations of therapy.

§§§ Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins joined by "or" are considered equivalent.

¶¶¶Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

Table 9. Empiric* treatment regimens for preterm and full-term neonates 32–44 weeks' postmenstrual age (gestational age plus chronologic age) with systemic† anthrax with or without meningitis, by descending order of preference — CDC recommendations, 2023

Regimen	Example
Regimen 1. Two bactericidal drugs from different antimicrobial drug classes plus a PSI or an RNAI	Ciprofloxacin plus meropenem plus clindamycin§
Regimen 2. One bactericidal drug plus a PSI	Meropenem plus doxycycline
Regimen 3. One bactericidal drug plus a second bactericidal drug from a different antimicrobial drug class	Meropenem plus ciprofloxacin
Regimen 4. One bactericidal drug plus an RNAI (rifampin should not be used as monotherapy)	Meropenem plus rifampin
Regimen 5. A PSI plus an RNAI (rifampin should not be used as monotherapy)	Doxycycline plus rifampin
Regimen 6. Two PSIs from different antimicrobial drug classes	Linezolid plus doxycycline
Regimen 7. A single bactericidal drug	Meropenem
Regimen 8. A single PSI	Doxycycline or clindamycin

Preference	Treatment (drugs joined by "or" considered equivalent)	Mechanism of action	32 to <34 weeks' gestational age		34 to <37 weeks' gestational age		Full-term infant	
			0 to <1 week	1–4 weeks	0 to <1 week	1–4 weeks	0 to <1 week	1–4 weeks
			Dosage	Dosage	Dosage	Dosage	Dosage	Dosage
First-line antimicrobial drug¶	Ciprofloxacin**	C	7.5 mg/kg every 12 hours IV	12.5 mg/kg every 12 hours IV	12.5 mg/kg every 12 hours IV	12.5 mg/kg every 12 hours IV	12.5 mg/kg every 12 hours IV	12.5 mg/kg every 12 hours IV
	Levofloxacin**	C	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV
	Meropenem††	C	13.3 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV	20 mg/kg every 8 hours IV
	PNC-S only§§:							
	*Penicillin G**,¶¶ aqueous*	C	100,000 units/kg every 12 hours IV/IM	100,000 units/kg every 8 hours IV/IM	100,000 units/kg every 8 hours IV/IM	100,000 units/kg every 6 hours IV/IM	100,000 units/kg every 8 hours IV/IM	100,000 units/kg every 6 hours IV/IM
	Ampicillin††	C	50 mg/kg every 12 hours IV/IM	75 mg/kg every 12 hours IV/IM	50 mg/kg every 8 hours IV/IM	50 mg/kg every 8 hours IV/IM	50 mg/kg every 8 hours IV/IM	50 mg/kg every 8 hours IV/IM
	Vancomycin††,***	C	20 mg/kg loading dose IV, then 15 mg/kg every 12 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 12 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV	20 mg/kg loading dose IV, then 15 mg/kg every 8 hours IV
			Administer over a period of 1–2 hours. After dose 3 of vancomycin, adjust dosages to target AUC_{24} of 400 μg x h/mL [preferred]; if AUC_{24} is not available, maintain trough concentrations of 10–15 μg/mL. Check concentrations earlier if renal function is impaired. During the first 7–10 days, serum creatinine represents maternal concentration.					
	Doxycycline**	PSI	5 mg/kg every 12 hours IV	5 mg/kg every 12 hours IV	5 mg/kg every 12 hours IV	5 mg/kg every 12 hours IV	5 mg/kg x 1 dose IV, then	5 mg/kg x 1 dose IV, then

							2.5 mg/kg every 12 hours	2.5 mg/kg every 12 hours
Alternative antimicrobial drug†††	Moxifloxacin§§§	C	25 mg/kg every 24 hours IV	25 mg/kg every 24 hours IV	25 mg/kg every 24 hours IV	25 mg/kg every 24 hours IV	25 mg/kg every 24 hours IV	25 mg/kg every 24 hours IV
	Imipenem††,¶¶¶	C	25 mg/kg every 8 hours IV infused over 1.5 hours	25 mg/kg every 8 hours IV infused over 1.5 hours	25 mg/kg every 8 hours IV infused over 1.5 hours	25 mg/kg every 8 hours IV infused over 1.5 hours	25 mg/kg every 8 hours IV infused over 1.5 hours	25 mg/kg every 8 hours IV infused over 1.5 hours
	Dalbavancin††	C	NA	NA	NA	NA	NA	22.5 mg/kg x 1 dose IV
	PCN-S only†††:							
	Ampicillin/sulbactam ††	C	50 mg ampicillin/kg every 12 hours IV	50 mg ampicillin/kg every 12 hours IV	50 mg ampicillin/kg every 12 hours IV	50 mg ampicillin/kg every 12 hours IV	50 mg ampicillin/kg every 12 hours IV	50 mg ampicillin/kg every 12 hours IV
	Clindamycin††	PSI	7 mg/kg every 8 hours IV/IM	7 mg/kg every 8 hours IV/IM	7 mg/kg every 8 hours IV/IM	7 mg/kg every 8 hours IV/IM	9 mg/kg every 8 hours IV/IM	9 mg/kg every 8 hours IV/IM
	Linezolid††	PSI	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV	10 mg/kg every 12 hours IV	10 mg/kg every 8 hours IV
	Rifampin††,****	RNAI	10 mg/kg every 24 hours IV	10 mg/kg every 24 hours IV	10 mg/kg every 24 hours IV	10 mg/kg every 24 hours IV	10 mg/kg every 24 hours IV	10 mg/kg every 24 hours IV
	Omadacycline§§§,††††	PSI	NA	NA	NA	5.5 mg/kg loading dose orally x 1, then 3.85 mg/kg dose daily orally	5.5 mg/kg loading dose orally x 1, then 3.85 mg/kg dose daily orally	5.5 mg/kg loading dose orally x 1, then 3.85 mg/kg dose daily orally
Antitoxin (only use if antimicrobial drugs not available or not appropriate)	Raxibacumab§§§§		55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV
	or							
	Obiltoxaximab§§§§		32 mg/kg as a single dose IV	32 mg/kg as a single dose IV	32 mg/kg as a single dose IV	32 mg/kg as a single dose IV	32 mg/kg as a single dose IV	32 mg/kg as a single dose IV
	AIGIV		1 vial (approx. 60 units) as a single dose IV	1 vial (approx. 60 units) as a single dose IV	1 vial (approx. 60 units) as a single dose IV	1 vial (approx. 60 units) as a single dose IV	1 vial (approx. 60 units) as a single dose IV	1 vial (approx. 60 units) as a single dose IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47.
DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: AIGIV = anthrax immunoglobulin intravenous; Approx. = approximately; C = bactericidal; FDA = Food and Drug Administration; IM = intramuscular; IV = intravenous; NA = not applicable; PCN-S = penicillin-susceptible strains; PEPAbx = antimicrobial postexposure prophylaxis for anthrax; PSI = protein synthesis inhibitor; RNAI = RNA synthesis inhibitor.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† "Systemic" was defined as one or more of the following using cutoffs for adults aged ≥18 years: hyperthermia or hypothermia, tachycardia, tachypnea, hypotension, or neutrophilia

or neutropenia. (**Source:** Katharios-Lanwermeyer S, Holty JE, Person M, et al. Identifying meningitis during an anthrax mass casualty incident: systematic review of systemic anthrax since 1880. Clin Infect Dis 2016;62:1537–45).
§ For anthrax meningitis, consider using antimicrobial drugs that have demonstrated potential neuroprotective benefits in vivo (e.g., doxycycline, clindamycin, and ß-lactam antimicrobial drugs).
¶ For highly bioavailable antimicrobial drugs (e.g., ciprofloxacin, doxycycline, and linezolid), if the IV formulation is not available, oral formulations can be considered for patients with an intact gastrointestinal tract where absorption is expected to be complete after oral administration.
** Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.
†† Not approved by FDA for anthrax PEPAbx or treatment.
§§ Up to 10% of naturally occurring strains of anthrax are resistant to penicillin and amoxicillin; bioterror strains might be engineered to generate resistance to multiple antibiotics. Susceptibility results reported from CDC within 48–72 hours of initial isolation of anthrax.
¶¶ Penicillin G benzathine or procaine should never be administered intravenously.
*** Vancomycin does not cross an intact blood-brain barrier but might cross with meningitis because of breakdown of the barrier. Allergic reactions are rare in neonates; however, neonates can release histamine that causes hypotension after rapid infusions of vancomycin, thus it might be safest to pretreat with an antihistamine.
††† Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.
§§§ Not approved by FDA for any pediatric indications. Not approved by FDA for anthrax PEPAbx or treatment.
¶¶¶ If meningitis is confirmed, imipenem moves to a first-line antimicrobial drug.
**** Rifampin is an RNAI and also bactericidal; however, it should not be used as monotherapy.
†††† The use of tetracycline-class antibiotics during tooth development (i.e., last half of pregnancy, infancy, and childhood up to age 8 years) might cause permanent discoloration of the teeth (yellow, gray, or brown) and enamel hypoplasia. This adverse effect appears to occur less often with doxycycline but might occur more with longer durations of therapy.
§§§§ Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration; listed antitoxins joined by “or” are considered equivalent.

Table 10. Empiric* postexposure prophylaxis for nonpregnant adults aged ≥18 years after exposure to Bacillus anthracis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	Dosage
First-line antimicrobial drug	Doxycycline†,§	100 mg every 12 hours orally
	or	
	Ciprofloxacin†	500 mg every 12 hours orally
	or	
	Levofloxacin†	500 mg every 24 hours orally
	PCN-S only:	
	Amoxicillin¶,**	1 g every 8 hours orally
	Penicillin VK¶	500 mg every 6 hours orally
Alternative antimicrobial drug††	Minocycline†	200 mg x 1 dose orally, then 100 mg every 12 hours orally
	Amoxicillin/clavulanate¶	16:1 formulation (1 g/62.5 mg) in 2 tablets every 12 hours orally, or 7:1 formulation (875/125 mg) every 12 hours orally
	Moxifloxacin§,¶	400 mg every 24 hours orally
	Ofloxacin¶	400 mg every 12 hours orally
	Clindamycin¶	600 mg every 8 hours orally
	Omadacycline¶	450 mg every 24 hours orally x 2 days, then 300 mg every 24 hours orally
	Linezolid¶,§§	600 mg every 12 hours orally
	Tetracycline†	500 mg every 6 hours orally
	Clarithromycin¶,¶¶	500 mg every 12 hours orally (only initiate after at least 3 days of treatment with any of the other antimicrobial drugs)
	Dalbavancin¶	1 g x 1 dose IV, then 500 mg weekly IV
Antitoxin* ** (considered equivalent)	Raxibacumab†††	40 mg/kg as a single dose IV
	Obiltoxaximab†††	16 mg/kg as a single dose IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: FDA = Food and Drug Administration; PCN-S = penicillin-susceptible strains: PEP = postexposure prophylaxis; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

§ If liquid formulations are not available for adults who cannot swallow pills, instructions are available for preparing oral suspensions of moxifloxacin (Source: Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (Source: CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

¶ Not approved by FDA for anthrax PEPAbx or treatment.

** Ampicillin 500 mg every 6 hours orally can be used as an alternative to amoxicillin, if available.

†† Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

§§ Linezolid can be considered for PEP in scenarios when patients can receive regular monitoring for myelosuppression or neurotoxicity, which might occur within 14–28 days of use. If possible, switch to an alternative drug when available.

¶¶ Clarithromycin is unlikely to be effective if the patient has bacteremia, thus a different antimicrobial drug must be used initially to clear bacteremia.

*** Only to be used as PEP if antimicrobial drugs are not available or not appropriate; listed antitoxins are considered equivalent.

†††Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

Table 11. Empiric* postexposure prophylaxis for pregnant or lactating persons†,§ aged ≥18 years after exposure to Bacillus anthracis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	Dosage
First-line antimicrobial drug	Doxycycline¶,**	100 mg every 12 hours orally
	or	
	Ciprofloxacin¶	500 mg every 12 hours orally
	or	
	Levofloxacin¶	500 mg every 24 hours orally
	PCN-S only:	
	Amoxicillin††,§§	1 g every 8 hours orally
	Penicillin VK††	500 mg every 6 hours orally
Alternative antimicrobial drug¶¶	Amoxicillin/clavulanate††	16:1 formulation (1 g/62.5 mg) in 2 tablets every 12 hours orally, **or** 7:1 formulation (875/125 mg) every 12 hours orally
	Moxifloxacin**,††	400 mg every 24 hours orally
	Ofloxacin††	400 mg every 12 hours orally
	Clindamycin††	600 mg every 8 hours orally
	Omadacycline††	450 mg every 24 hours orally x 2 days, then 300 mg every 24 hours orally
	Linezolid††,***	600 mg every 12 hours orally
	Clarithromycin††,†††	500 mg every 12 hours orally (only initiate after at least 3 days of treatment with any of the other antimicrobial drugs)
	Dalbavancin††	1 g x 1 dose IV, then 500 mg weekly IV
Antitoxin§§§ (considered equivalent)	Raxibacumab¶¶¶	40 mg/kg in a single dose IV
	Obiltoxaximab¶¶¶	16 mg/kg in a single dose IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: FDA = Food and Drug Administration; IV = intravenous; PCN-S = penicillin-susceptible strains; PEP = postexposure prophylaxis; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† For pregnant adolescents, refer to pediatric guidelines for weight-based dosing (see Table 12).

§ Dosing recommended for pregnant persons regardless of trimester of infection.

¶ Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

** If liquid formulations are not available for adults who cannot swallow pills, instructions are available for preparing oral suspensions of moxifloxacin (Source: Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (Source: CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

†† Not approved by FDA for anthrax PEPAbx or treatment.

§§ Ampicillin 500 mg every 6 hours can be used as an alternative to amoxicillin, if available.

¶¶ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

*** Linezolid can be considered for PEP in scenarios when patients can receive regular laboratory testing to monitor for myelosuppression or neurotoxicity, which might occur within 14–28 days of use. If possible, switch to a different drug when available.

††† Clarithromycin is unlikely to be effective if the patient has bacteremia, thus a different antimicrobial must be used initially to clear bacteremia.

§§§ Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins joined are considered equivalent.

¶¶¶Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

Table 12. Empiric* postexposure prophylaxis for children aged ≥1 month to <18 years after exposure to Bacillus anthracis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment (drugs joined by "or" considered equivalent)	Dosage
First-line antimicrobial drug	Ciprofloxacin†	15 mg/kg every 12 hours orally (max 500 mg/dose)
	or	
	Doxycycline†,§	<45 kg: 2.2 mg/kg every 12 hours orally (max 100 mg/dose) ≥45 kg: 100 mg every 12 hours orally
	or	
	Levofloxacin†	<50 kg: 8 mg/kg every 12 hours orally (max 250 mg/dose) ≥50 kg: 500 mg every 24 hours orally
	PCN-S only¶:	
	*Amoxicillin***,††	25 mg/kg every 8 hours orally (max 500 mg/dose)
	*Penicillin VK***	12.5–18.7 mg/kg every 6 hours orally (max 500 mg/dose)
	Amoxicillin/clavulanate**,§§	Aged ≥3 months: 7:1 formulation (200/28.5 mg or 400/57 mg) 22.5 mg/kg based on amoxicillin component every 12 hours orally (max 875/125 mg/dose) Aged ≥3 months and <40 kg: 14:1 formulation (600/42.9 mg) 45 mg/kg based on amoxicillin component every 12 hours orally Aged ≥3 months and ≥40 kg: 16:1 formulation (1,000/62.5 mg tablets) 2 g based on amoxicillin component every 12 hours orally
	Clindamycin**	10 mg/kg every 8 hours orally (max 600 mg/dose)
Alternative antimicrobial drug¶¶	Moxifloxacin§,***,†††	Aged ≥3 to ≤23 months: 6 mg/kg every 12 hours orally (max 200 mg/dose) Aged 2 to <6 years: 5 mg/kg every 12 hours orally (max 200 mg/dose) Aged 6 to <12 years: 4 mg/kg every 12 hours orally (max 200 mg/dose) Aged ≥12 to <18 years and <45 kg: 4 mg/kg every 12 hours orally (max 200 mg/dose) Aged ≥12 to <18 years and ≥45 kg: 400 mg every 12 hours orally
	Minocycline†,§§§	4 mg/kg once (max 200-mg dose) orally, then 2 mg/kg every 12 hours orally (max 100 mg/dose)
	Ofloxacin***	11.25 mg/kg every 12 hours orally (max 400 mg/dose)
	Tetracycline†,§§§	12.5 mg/kg every 6 hours orally (max 500 mg/dose)
	Linezolid**,¶¶¶	Aged <12 years: 10 mg/kg every 8 hours orally (max 600 mg/dose) Aged ≥12 years: 600 mg every 12 hours orally
	Omadacycline***,§§§	Aged >8 years: 450 mg every 24 hours orally x 2 days, then 300 mg every 24 hours orally
	Clarithromycin**,****	75 mg/kg every 12 hours orally (max 500 mg/dose; only initiate after at least 3 days of treatment with any of the other antimicrobial drugs listed)
	Dalbavancin**	Aged ≥3 months to <6 years: 22.5 mg/kg every 2 weeks IV (max 1.5 g/dose) Aged ≥6 years to <18 years: 18 mg/kg every 2 weeks IV (max 1.5 g/dose)
Antitoxin†††† (considered equivalent)	Raxibacumab§§§§	≤10 kg: 80 mg/kg as a single dose IV >10 kg to 40 kg: 60 mg/kg as a single dose IV >40 kg: 40 mg/kg as a single dose IV

	Obiltoxaximab§§§§	≤15 kg: 32 mg/kg as a single dose IV >15 kg to 40 kg: 24 mg/kg as a single dose IV >40 kg: 16 mg/kg as a single dose IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: FDA = Food and Drug Administration; PCN-S = penicillin-susceptible strains; IV = intravenous; PEP = postexposure prophylaxis; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.

§ If liquid formulations are not available for children who cannot swallow pills, instructions are available for preparing oral suspensions of moxifloxacin (Source: Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (Source: CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).

¶ Up to 10% of naturally occurring strains of anthrax are resistant to penicillin and amoxicillin; bioterror strains can be engineered to generate resistance to multiple antibiotics. Susceptibility results reported from CDC within 48–72 hours of initial isolation of anthrax.

** Not approved by FDA for anthrax PEPAbx or treatment.

†† Ampicillin 25 mg/kg every 6 hours orally (maximum 500 mg/dose) can be used as an alternative to amoxicillin, if available.

§§ To minimize potential side effects from clavulanate, the amoxicillin/clavulanate 875/125 mg every 12 hours orally and amoxicillin/clavulanate extended-release 2,000/125 mg every 12 hours orally treatments are preferred over 500/125 mg every 8 hours orally.

¶¶ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.

*** Not approved by FDA for any pediatric indications. Not approved by FDA for anthrax PEPAbx or treatment.

††† For children aged 12–17 years who weigh ≥45 kg with risk factors for cardiac events, consider 200 mg twice daily.

§§§ The use of tetracycline-class antibiotics during tooth development (i.e., last half of pregnancy, infancy, and childhood up to age 8 years) might cause permanent discoloration of the teeth (yellow, gray, or brown) and enamel hypoplasia. This adverse effect appears to occur less often with doxycycline but might occur more with longer durations of therapy.

¶¶¶ Linezolid can be considered for PEP in scenarios when patients can receive regular laboratory testing to monitor for myelosuppression or neurotoxicity, which might occur within 14–28 days of use. If possible, switch to a different drug when available.

**** Clarithromycin is unlikely to be effective if the patient has bacteremia, thus a different antimicrobial drug must be used initially to clear bacteremia.

†††† Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins are considered equivalent.

§§§§Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.

Table 13. Empiric* postexposure prophylaxis for preterm and full-term neonates 32–44 weeks' postmenstrual age (gestational age plus chronologic age) after exposure to Bacillus anthracis, by descending order of preference — CDC recommendations, 2023

Preference	Treatment	32 to <34 weeks' gestational age		34 to <37 weeks' gestational age		Full-term infant	
		0 to <1 week	1–4 weeks	0 to <1 week	1–4 weeks	0 to <1 week	1–4 weeks
		Dosage	Dosage	Dosage	Dosage	Dosage	Dosage
First-line antimicrobial drug	***PCN-S only:†***						
	Amoxicillin§,¶	15 mg/kg every 12 hours orally	15 mg/kg every 8 hours orally	15 mg/kg every 8 hours orally	15 mg/kg every 8 hours orally	15 mg/kg every 8 hours orally	15 mg/kg every 8 hours orally
	Penicillin VK§	25 mg/kg every 12 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 12 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 8 hours orally	25 mg/kg every 6 hours orally
	*Penicillin G** aqueous*	25,000 units/kg every 12 hours IM	25,000 units/kg every 12 hours IM	25,000 units/kg every 12 hours IM	25,000 units/kg every 12 hours IM	25,000 units/kg every 12 hours IM	25,000 units/kg every 12 hours IM
	Amoxicillin/clavulanate§	25 mg amox/kg every 12 hours orally	25 mg amox/kg every 8 hours orally	25 mg amox/kg every 8 hours orally	25 mg amox/kg every 8 hours orally	25 mg amox/kg every 8 hours orally	25 mg amox/kg every 8 hours orally
	Ciprofloxacin**	7.5 mg/kg every 12 hours orally	12.5 mg/kg every 12 hours orally	12.5 mg/kg every 12 hours orally	12.5 mg/kg every 12 hours orally	12.5 mg/kg every 12 hours orally	12.5 mg/kg every 12 hours orally
	Clindamycin§	7 mg/kg every 8 hours orally	7 mg/kg every 8 hours orally	7 mg/kg every 8 hours orally	7 mg/kg every 8 hours orally	9 mg/kg every 8 hours orally	9 mg/kg every 8 hours orally
	Doxycycline**,††, §§	5 mg/kg every 12 hours orally	5 mg/kg every 12 hours orally	5 mg/kg every 12 hours orally	5 mg/kg every 12 hours orally	5 mg/kg x 1dose orally, then 2.5 mg/kg every 12 hours orally	5 mg/kg x 1 dose orally, then 2.5 mg/kg every 12 hours orally
	Levofloxacin**	10 mg/kg every 12 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 12 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 12 hours orally	10 mg/kg every 8 hours orally
Alternative antimicrobial drug¶¶	Moxifloxacin††,***	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally	25 mg/kg every 24 hours orally
	Linezolid§,†††	10 mg/kg every 8 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 8 hours orally	10 mg/kg every 8 hours orally
Antitoxin§§§ (considered equivalent)	Raxibacumab¶¶¶	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV	55 mg/kg as a single dose IV
	Obiltoxaximab¶¶¶	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV	16 mg/kg as a single dose IV

Adapted from: Bower WA, Yu Y, Person MK, et al. CDC Guidelines for the Prevention and Treatment of Anthrax, 2023. MMWR Recomm Rep 2023;72(No. RR-6):1–47. DOI: http://dx.doi.org/10.15585/mmwr.rr7206a1

Abbreviations: Amox = amoxicillin; FDA = Food and Drug Administration; IM = intramuscular; IV = intravenous; PCN-S = penicillin-susceptible strains; PEP = postexposure prophylaxis; PEPAbx = antimicrobial postexposure prophylaxis for anthrax.

* Definitive therapy should be directed by antibiotic susceptibility test results, when available.

† Up to 10% of naturally occurring strains of anthrax are penicillin- and amoxicillin-resistant; bioterror strains might be engineered to generate resistance to multiple antibiotics. Susceptibility results reported from CDC within 48–72 hours of initial isolation of anthrax.
§ Not approved by FDA for anthrax PEPAbx or treatment.
¶ Ampicillin can be used as an alternative to amoxicillin, if available.
** Approved by FDA for anthrax PEPAbx, treatment, or both, but specific uses (e.g., doses, dosing schedules, and patient populations) recommended in this report might differ from the FDA-approved labeling.
†† Instructions are available for preparing oral suspensions of moxifloxacin (Source: Hutchinson DJ, Johnson CE, Klein KC. Stability of extemporaneously prepared moxifloxacin oral suspensions. Am J Health Syst Pharm 2009;66:665–7.121) and doxycycline (Source: CDC. In an anthrax emergency: how to prepare doxycycline hyclate for children and adults who cannot swallow pills. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/anthrax/public-health/doxy-crushing-instruction-pamphlet.html).
§§ The use of tetracycline-class antibiotics during tooth development (i.e., last half of pregnancy, infancy, and childhood up to age 8 years) might cause permanent discoloration of the teeth (yellow, gray, or brown) and enamel hypoplasia. This adverse effect appears to occur less often with doxycycline but might occur more with longer durations of therapy.
¶¶ Alternative selections are for patients who have contraindications to or cannot tolerate first-line antimicrobial drugs or if first-line antimicrobial drugs are not available.
*** Not approved by FDA for any pediatric indications. Not approved by FDA for anthrax PEPAbx or treatment.
††† Linezolid can be considered for PEP in scenarios when patients can receive regular monitoring for myelosuppression or neurotoxicity, which might occur within 14–28 days of use. If possible, switch to a different drug when available.
§§§ Only to be used if antimicrobial drugs are not available or not appropriate; listed antitoxins are considered equivalent.
¶¶¶ Premedicate with IV or oral diphenhydramine within 1 hour before administration. Hypersensitivity and anaphylaxis have been reported after raxibacumab and obiltoxaximab administration.