

Naturally Occurring Anthrax in the Environment

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Anthrax is found naturally in the soil worldwide and is associated with sudden death of grazing animals. Anthrax causes severe illness in animals and humans.

The anthrax organism (*Bacillus anthracis*) has the ability to form spores and become resistant to adverse conditions. Pasteurization or ordinary disinfectants may destroy anthrax organisms in the laboratory, but if the carcass of an animal that died from anthrax is opened and the organisms are exposed to air, the bacilli will form spores.

Sporulated anthrax organisms are highly resistant to heat, cold, chemical disinfectants and drying. The anthrax spore may live up to five years in surface soil (top 6 inches) of a contaminated pasture or yard and indefinitely in deeper soils, depending on soil type.

Herbivores – Cattle, bison, sheep, horses, swine and wild ruminants such as deer and elk are susceptible to anthrax. Dogs and cats are susceptible when exposed to contaminated blood; the most common source is a recently necropsied carcass.

Most birds are naturally resistant to anthrax because of their higher body temperature. Ostriches and rheas can be affected by anthrax because of their lower body temperature.

Susceptible species:

- cattle
- horses
- elk
- bison
- swine
- dogs
- sheep
- deer
- cats

Sources of Infection

Outbreaks typically occur when livestock are grazing on neutral or slightly alkaline soil. Infection in animals usually is the result of grazing on contaminated pastureland.

The organisms mainly enter through the mouth, and occasionally enter via nose or skin injury. Following ingestion or inhalation, the organisms spread rapidly throughout the entire body.

Dead animals that are opened and not burned or buried provide an ideal source of new spores to contaminate the soil.

Cremating diseased carcasses (burning them to ashes) to stop the contamination of the soil is imperative. If cremation is not possible, the carcasses should be buried deep in the ground.

Flooding pastures with contaminated water or dumping infected carcasses in streams or ponds also may spread anthrax spores.

Flooding readily contaminates low-lying ground or marshy areas, and resultant stagnant water holes may serve as a source of infection.

Hay infested with spores may account for anthrax outbreaks during the winter months. However, anthrax is predominantly a warm-weather disease and is rarely diagnosed in North Dakota during the winter.

The safest use of soil potentially contaminated with the anthrax organism is to raise cultivated crops. Any animals grazing this land should be vaccinated annually. Heavy rains can cause spores buried deep in the soil to move closer to the surface.

Anthrax also may be spread by insects through wounds from dehorning or castration that attract blood-sucking insects that previously visited an infected carcass or through bites from tabanid flies that previously fed on an ill or freshly dead carcass.

Outbreaks have occurred because of contaminated feed, particularly through bone meal, meat scraps and other animal protein products. Current regulations regarding the manufacture and importation of such animal products virtually eliminate these as a source of infection.

Humans may become infected through contact with infected animals or contaminated animal products, such as by handling contaminated hides or wool or by handling infected carcasses. Transmission can occur when a person breathes in anthrax spores, consumes contaminated food or water or gets anthrax spores in a cut or scrape in the skin. Most human cases of anthrax infection are the cutaneous (skin) form.

Symptoms

Symptoms associated with anthrax depend to a certain degree on the species involved and the route of infection. When the anthrax organism enters the animal's body through the mouth or nostrils, the symptoms occur soon after infection (acute form) and death follows rapidly.

When infection occurs through the skin (cutaneous form) because of injury or insect bites, it appears localized at the site of injury in the initial stage. The affected area is initially hot and swollen and becomes cold and insensitive. Later, the infection can become generalized.

Animal anthrax is usually a fatal disease with no symptoms observed. Some animals may stagger, have difficulty breathing, tremble, collapse and die. Edema and swelling may be seen over the body, particularly at the brisket. Upon or near death, blood oozes from the body openings. This blood is heavily laden with anthrax organisms. The carcass has a marked bloating and decomposes rapidly.

Illness is observed for one or two days, but it may last five days; symptoms are preceded by fever, with a period of excitement in which the animal may charge anyone nearby. This is followed by depression in cattle or sheep. In horses, colic may be observed.

Sometimes the anthrax organism localizes itself in the throat area. The tongue, throat and neck are extremely swollen and a frothy blood-tinged discharge comes from the mouth. Although this is the typical form of anthrax observed in swine, it also may occur in cattle and sheep.

Diagnosis of Anthrax

Not all cases of "sudden death" are anthrax, but if a veterinarian or livestock owner suspects anthrax, they need to have a confirmatory laboratory test. Acceptable sample types and shipping requirements may vary by veterinary diagnostic laboratory and test method used; contact the laboratory for more details.

If anthrax is suspected, do not perform a necropsy. Using aseptic technique, a veterinarian can collect a jugular sample of venous blood or swab blood observed at body openings. Samples can be sent or delivered to a veterinary diagnostic laboratory that performs anthrax testing. The sample is sent on an ice pack in a sealed, sturdy, leak-proof container with an accompanying history identifying it as an anthrax suspect. Needles must never be sent to the laboratory. The North Dakota State University Veterinary Diagnostic Laboratory performs anthrax PCR testing. Visit vdl.ndsu.edu for current submission and shipping guidance.

It is important to collect samples as soon as possible after the death of animal. Isolation of the anthrax organism becomes very difficult if the animal has been dead for 48 hours or more. Saprophytic bacteria may overgrow *Bacillus anthracis*. Therefore, having a false negative diagnosis from an animal that has died from anthrax is possible.

Treatment and Control

Anthrax is highly fatal, and treating affected animals is difficult. Penicillin is the antibiotic of choice.

Response to treatment may vary; best results are obtained when drugs are administered early during an outbreak. If using antibiotics, vaccination with an anthrax vaccine should be delayed for two to five days, depending on the antibiotic used.

The vaccine is a spore vaccine and antibiotics may interfere with proper immunization of the animal. However, when faced with an outbreak situation, administering an antibiotic and a vaccine concurrently has been effective. Consult your local veterinarian for a recommendation.

An effective vaccine (nonencapsulated, Sterne 34F2 strain) is available. Because anthrax is a reportable disease, details on the use of the vaccine should be coordinated through the office of the state veterinarian. It is relatively safe and provides effective protection for most species of livestock.

Use caution when administering it to horses. Cases of Clostridial infections have been reported in horses at the injection site where the horses were vaccinated during a rainfall or when the horses had wet hair coats.

If using the anthrax vaccine, follow all label directions for proper withdrawal times, including withholding of milk and meat products from the market.



Disposal

The carcass and all materials associated with the carcass should be destroyed and the ground should be disinfected. This can be very difficult. The preferred method of destruction is incinerating the carcass. If incineration or cremation is not possible, burying the carcass deep (at least 6 feet) is acceptable.

■ The following are general recommendations for burning a 1,000-pound carcass:

Dig a pit about 2 feet deep and exceeding the length and breadth of the carcass by about 1 foot on each side (**Figure A**). Dig a trench 1 foot by 1 foot along the length of the center of the pit, extending beyond the ends of the pit by about 3 feet; this serves as an air duct for the fire under the carcass (**Figure B**). Fill the trench and cover the bottom of the pit with straw and soak it with an accelerant (kerosene or diesel fuel) (**Figure C**).

Wood, such as trees or pallets that have been cut to fit across the trench and within the sides of the pit, then should be placed on top of the straw. Add other pieces of wood (or coal) until the pit is filled to the level of the ground surface. Saturate all of this with accelerant.

If you have questions regarding what other types of materials are acceptable to use in the burn, contact the North Dakota Department of Environmental Quality, Division of Air Quality at 701-328-5188.

The carcass can then be lifted or drawn onto the pyre (combustible heap). Pour further accelerant over the carcass. Ignite the fire at

either end of the trench. Once the incineration is well under way (probably after the first hour), cover the pyre with corrugated metal or other metal sheeting to retain heat but not lose ventilation.

If blood and body fluids have contaminated the ground and material under the animal, they should be incinerated as well. Remove soil deep enough to collect any blood and body fluids that have seeped into it. This could be up to 6 inches. This material can be placed on top of the carcass prior to igniting the pyre (**Figure C**).

The approximate quantities of fuel that will be needed are 100 pounds of straw, 2½ gallons of accelerant and 2 tons of wood or ½ ton of wood and ½ ton of coal.

If soil and other related materials cannot be incinerated, they can be disinfected with a 5% formaldehyde solution at 50 quarts per square yard.

After incineration, cover ashes and contaminated soil with soil removed from the pit.

Personnel Protection

If producers suspect anthrax, have a veterinarian aseptically collect a jugular's blood or swab of blood observed at body openings for laboratory testing. Check the website of the veterinary diagnostic laboratory for acceptable sample types and shipping instructions.

Do not necropsy the animal.

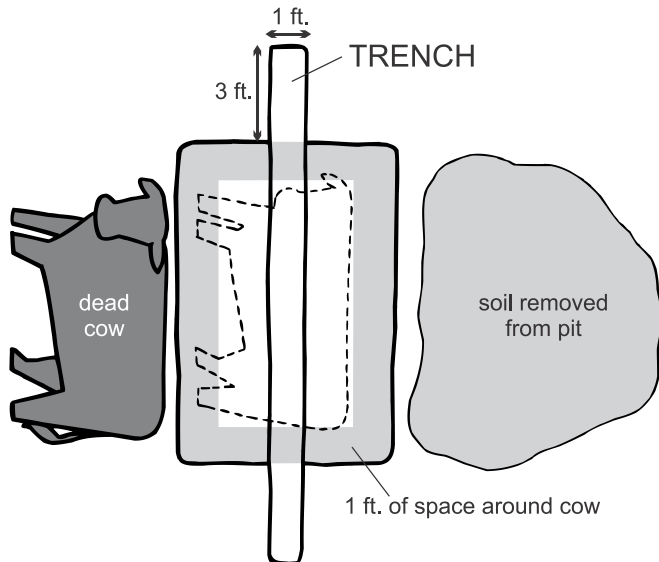
The vegetative *Bacillus anthracis* organisms range from 0.5 to 5 micrometers and the spores 1 to 2 micrometers in size. Although the risk of respiratory infection is extremely small, veterinarians and producers collecting specimens, conducting soil remediation and disposing of animal carcasses should wear respirators with a high-efficiency particulate air (HEPA) filter.

Producers should take every precaution to avoid skin contact with the potentially contaminated carcass and soil. They should use protective, impermeable clothing and equipment such as rubber gloves, rubber apron and rubber boots with no perforations. Do not expose any skin, especially any that is compromised with wounds or scratches.

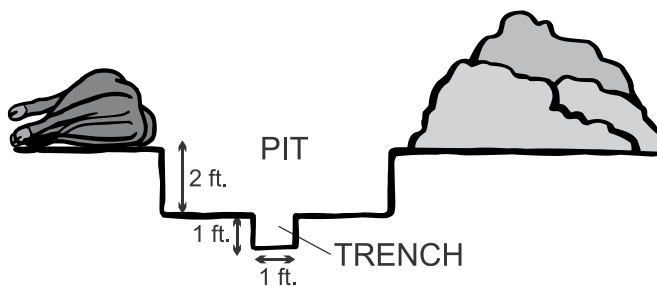
Disposable personal protective equipment is preferable, but if not available, wash any exposed equipment in hot water and detergent to achieve decontamination. Burn and bury disposable personal protective equipment with the carcass.

To clean equipment used for digging the pit and moving the carcass, remove dirt, blood, hair and other materials with water (preferably hot) and detergent. Divert the wash water from the equipment into the pit for incineration. A diluted bleach solution (one part bleach to 10 parts water) made fresh each day for use can be sprayed on the clean equipment to further decrease the likelihood of anthrax being present. Allow this solution to remain on the equipment for at least an hour (should remain wet with bleach solution) before rinsing with plain water. Note that the presence of soil, blood or other materials may diminish the effectiveness of the bleach solution.

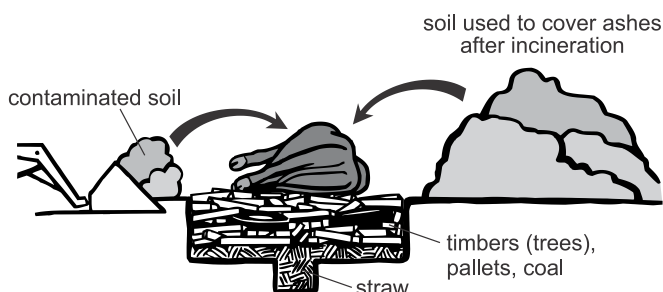
The risk of anthrax being spread via equipment used to dig the pit is unknown, but most likely, it is very small. The site where the animal died is not necessarily where the animal acquired the infection.



■ **Figure A. Top view.**



■ **Figure B. Cross section.**



■ **Figure C. Cross section of pit ready for burning.**

Human Implications

Anthrax is a zoonotic disease (disease that can affect humans and animals). Anthrax in humans can take four forms: cutaneous, respiratory, intestinal and injection.

The cutaneous or skin form is the most common type of human infection and occurs when anthrax spores inoculate a cut or abrasion. Initially, the site will itch, which is followed by swelling and discoloration of the affected area. Pain usually is not present. If left untreated, cutaneous anthrax eventually can become septicemic and lead to death. Antibiotic therapy is very effective for the cutaneous form of anthrax.

The respiratory form of anthrax occurs when the spores are inhaled and then infect the lung tissue. Initial symptoms are mild and may resemble the flu or common cold. The disease usually starts in the lymph nodes in the chest before spreading to the rest of the body, causing severe respiratory distress and shock. Without treatment, inhalation anthrax is almost always fatal.

The intestinal form of anthrax occurs when spores are ingested, primarily through consumption of contaminated meat that is raw or undercooked.

It is a very rare condition in North America and may occur when slaughtering and processing occurs outside of typical meat-processing regulations. These cases are usually reported from developing countries where people sometimes salvage dead animal carcasses for human food. Symptoms include fever, abdominal distress, shock and death.

Injection anthrax has been reported in heroin-injecting drug users in Europe, but this form of anthrax infection has not been reported in the U.S. Symptoms are similar to cutaneous anthrax, but the infection may be deep under the skin or in the muscle where the drug was injected.

Welder's anthrax is a newly recognized form of the disease caused by *Bacillus cereus*, which produces the anthrax toxin. It is rare and associated with welding and metalworkers.

For additional information about human anthrax exposures, contact the North Dakota Department of Health and Human Services.

Regulation Pertaining to the Control of Anthrax

NDCC § 36-14-19.

Disposition of carcass of animal dying from contagious or infectious disease.

Any animal that is found dead must be presumed to have died from a contagious or infectious disease until the contrary is shown unless another cause of death is apparent. The owner or person in charge of any domestic animal or nontraditional livestock that dies within this state from or on account of any contagious or infectious disease shall dispose of the carcass of such animal as follows:

1. If the animal died of anthrax, as determined by a licensed veterinarian, the carcass must be completely burned at the place where it died if possible. If the carcass must be moved, it may not be dragged over the ground but must be moved only on a suitable conveyor and all body openings in the carcass must be plugged with cotton saturated with a strong antiseptic solution.

Additional species-specific regulations concerning anthrax can be found in North Dakota Administrative Code Title 48.1.



This publication was authored by Charles L. Stoltenow, DVM, DACVPM, former Assistant Director, Agriculture and Natural Resources, 2005.

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