



## *American Veterinary Medical Association Zoonotic Disease Precautions for Hunters September 2, 2009*

This paper is intended to be a general guide about zoonotic diseases that hunters and their hunting dogs may encounter. Links to additional information have been provided where appropriate.

Hunters should always consult their physician if they are concerned they have been exposed to a disease or are showing symptoms of illness.

If there are any concerns that your hunting dog or any other companion animal may have contracted any of these diseases, please contact your veterinarian.

The American Veterinary Medical Association ([AVMA](http://www.avma.org)) website also provides additional scientific resources on zoonotic diseases, including [backgrounders](#) and [published manuscripts](#).

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## Introduction

There is an increasing awareness among hunters that there are medical risks associated with handling wildlife, and certain safety precautions should be taken. The American Veterinary Medical Association (AVMA) has the following advice on certain health concerns linked to hunting, both in North America and in other areas of the world. *This document is by no means intended to discourage people from hunting; instead, it is intended to inform hunters of the risks they face and steps they can take to reduce those risks.*

Hunters can be exposed to infectious diseases not only from infected animals, but also via insect vectors and contaminated soil and water. Diseases that are transmitted from animals to humans, either through direct contact with the animal or a contaminated surface or water, through ingestion of animal products (e.g., meat and milk) or through insect transmission from an animal are called zoonotic diseases. Insects such as mosquitos, ticks, flies, fleas or mites serve as vectors, capable of transmitting infection from an infected animal to another animal or a person.

## Protecting Hunters from Risk: Some Common Sense Guidelines

- Avoid hunting if you are feeling ill. People are more prone to disease if their immune systems are weakened by other illnesses or conditions.
- Take precautions to minimize insect bites.
- Do not handle or eat wild game or fowl that appeared ill or were acting in an abnormal manner before they were killed.
- Do not eat, drink or smoke while cleaning wild fowl or game.
- Always wear heavy rubber or latex gloves when field dressing wild game or fowl.
- Do not use the same utensils to clean different species.
- If there are any old wounds on the carcass, and especially if there is pus present, meat in this area should be removed and discarded. A large area of tissue around the wound and pus pockets should also be cut away with the wound, even if the tissue looks normal, because it can still harbor infection.
- If any abnormalities are seen in the chest or abdominal cavity of the carcass, consider disposing of the entire carcass.
- Minimize contact with brain or spinal tissues. When boning out the carcass, keep both the head and spine intact. Do not cut into the head of any antlered

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animal that showed abnormal behavior, even to remove the rack. When removing antlers from a healthy animal, use a hand saw rather than a power saw, and always wear safety glasses.

- If any intestinal contents of the game come into contact with meat, the meat should be considered contaminated and should be cut off and discarded. Do not feed the contaminated meat to other animals, or they may become infected.
- Large game should be shot with a clean, humane kill shot, preferably avoiding the abdomen, followed quickly by removal of the intestines; this minimizes the risk of intestinal contents contaminating the meat.
- If any of the intestines have an abnormal smell or discharge, or if pockets of blood are seen in the muscle unassociated with the bullet/shot/arrow wound, the flesh should be considered unfit for eating.
- The abdominal cavity should be cleaned, dried and cooled until the meat is processed. During warm weather (over 65° F, or 18.3 C), bags of ice should be placed in the body cavity to hasten cooling. The carcass should be protected against flies.
- Wash hands thoroughly with soap and water or an alcohol-based sanitizer immediately after handling wild game or fowl, including the tissues and meat.
- Wash tools, equipment and working surfaces (including tables and cutting boards) thoroughly with soap and water, followed by disinfection immediately after handling any wild game or fowl. Adding a minimum 1 tablespoon of bleach to 1 gallon of water is usually adequate for use as a cleaning/disinfecting solution.
- If you prepare your own ground meat, thoroughly clean and disinfect all equipment after use.
- Avoid eating raw or undercooked meat.
- Always cook wild meat until the juices run clear and the meat is no longer pink in color (generally 150-180°F, depending on the type of meat). This will reduce the risk of food-borne disease. Because the color of the meat is not always a reliable indicator of proper cooking, use of a meat thermometer is highly recommended for safety. Extra attention to the internal temperature should be used when cooking with a microwave oven.
- Cook wild birds thoroughly - any cooked bird should reach an internal temperature of 165°F or higher to make sure that organisms and parasites are killed and are no longer infective.
- Any uncooked game should be promptly frozen, refrigerated or disposed of properly.
- Keep uncooked wild game separate from cooked or ready-to-eat foods to avoid contamination.
- Meat should be properly wrapped and stored on bottom shelves of the refrigerator or freezer to avoid blood dripping on (and potentially contaminating) other foods.

- Meat should be refrigerated or frozen properly and should not be kept at room temperature.
- Freezing meat does not necessarily protect against disease.
- In the United States, hunters should report any signs of sick wildlife or wild bird die-off to the state's game and fish agency or wildlife agency.
- Make sure hunting dogs are up-to-date on their vaccines, especially rabies, prior to hunting season.
- Consult your veterinarian about proper preventive treatments, such as heartworm prevention, and use the products as recommended.
- Consult your veterinarian about regular stool exams of hunting dogs to check them for parasites, including those that can be passed to people.

**Tick-borne diseases** pose a hazard to both hunters and their dogs. They are usually transmitted to people through tick bites, but skin contact with the internal fluids of infected ticks also poses a risk of infection. Cases of tick-borne diseases, such as anaplasmosis, ehrlichiosis, Rocky Mountain Spotted Fever (RMSF) and others, have increased in the last decade. These diseases can be fatal. The symptoms of these diseases can be somewhat vague, making it difficult for physicians to diagnose the disease until it has become more severe. Hunters and their dogs are especially vulnerable to tick-borne diseases because of time spent in tick-infested environments. Preventing tick bites is the single most important step in preventing tick-borne diseases.

The following guidelines are recommended for hunters and their dogs to avoid tick-borne diseases:

- Apply tick repellants to exposed skin and clothing.
  - DEET (N, n-diethyl-*m*-toluamide) and picaridin are commonly used insect repellents. The CDC provides guidelines for [selecting the appropriate insect repellant](#).
    - If skin becomes wet from perspiration or water, towel off and reapply to dry skin.
  - Spray permethrin-containing products on outer clothing, including shoes. Permethrin is not an effective repellant for use on skin.
  - If chemical odors are a concern, there are unscented and neutral odor products available, such as [DeepWoods Off! Sportsmen](#).
- Avoid wearing the same clothes on consecutive days without washing them first to remove ticks. Wash clothes immediately after returning home.
- Wear long-sleeved shirts and long pants.
  - Tuck pant legs into socks.
- Conduct body checks immediately after returning from outdoor activities in tick-infested areas.
  - Use mirrors if necessary, but check all body areas and remove all ticks found.
  - Check children, especially behind the ears, back of the neck, around the waist, and in and along the hairline.

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- Remove attached ticks by using fine-tipped tweezers. If tweezers are not readily available, you can improvise by shielding your fingers with tissue paper, a foil-covered gum wrapper, or plastic sandwich bag and grasping the tick as close to the skin as possible, pulling upward with steady, even pressure.
- Do **not** twist the tick as you remove it – this may cause the tick’s mouthparts to remain in the skin, increasing the risk of infection.
- Do not attempt to suffocate the tick with alcohol-soaked cotton – this will cause the tick to regurgitate while its mouthparts are still in the skin, and can increase the risk of infection.
- Avoid direct contact with the tick’s body because its fluids may be infectious.
- Wash the affected area with soap and water, and disinfect the bite site and your hands. Ordinary household brands of 70% isopropyl (rubbing) alcohol, chlorhexidine (e.g., Hibiclens®, Nolvasan®, etc.) or povidone-iodine (e.g., Betadine®) are adequate skin-surface disinfectants.

To protect hunting dogs, hunters should consult their veterinarian, but basic guidelines include:

- Apply topical or systemic tick-control treatments. Consult your veterinarian about the appropriate product for your dog.
- If possible, limit access to tick-infested areas.
- Treat kennels as needed to kill ticks. Consult your veterinarian and/or a pest-control company about the safest and most appropriate alternative.
- Any ticks attached to dogs should be promptly and carefully removed, using the same guidelines as posted above for tick removal from human skin.

People involved in outdoor activities, such as hunters, are naturally more exposed to the threat of being bit by mosquitos that can carry diseases such as West Nile virus and encephalitis viruses. For [protection against mosquito-borne diseases](#), hunters should always:

- Use insect [repellant lotions and sprays](#) with DEET, Picaridin, oil of lemon eucalyptus, or IR3535 on exposed skin. The expected duration of exposure to mosquitos determines the [concentration of the product](#) needed.
- If odorless mosquito protection is desired, consider the use of Area Repellant Systems such as [Thermacell®](#).
- Spray permethrin-containing products on outer clothing and footwear.
- Wear long-sleeved shirts and long pants tucked into socks. Both clothing and shoes should be treated with permethrin or another insect repellant.
- In areas with heavy mosquito infestation (such as marshlands), increased protective gear is suggested (jacket, heavy pants and a fine-mesh “bug suit”).

### **A note on lead poisoning**

While not a zoonotic disease, lead poisoning may be another risk associated with hunting using lead-containing ammunition. *There is conflicting information regarding the level of risk associated with residual lead in the meat of wild game.* Lead is known to cause damage to the brain and central nervous system, especially in young children and pregnant women. The risk may be based on the amount and frequency of game consumption. There is a possibility that lead may be overlooked in processing game – lead fragments may be located far from the wound and may be overlooked during cleaning and processing.

Lead poisoning is a known cause of death in birds of prey, and certain states and hunting areas no longer allow the use of lead ammunition when hunting certain game. For regulations, consult the state’s wildlife department.

## **Zoonotic Diseases**

### **Anaplasmosis**

[Anaplasmosis](#) is a tick-borne disease caused by the *Anaplasma phagocytophilum* bacteria (and less commonly by *Anaplasma platys*). It is spread by tick bites, primarily by the blacklegged and western blacklegged ticks.

Anaplasmosis is a reportable disease—this means that physicians must report any cases of anaplasmosis to the Centers for Disease Control and Prevention (CDC). In 2008, [1,009 cases of anaplasmosis](#) were reported in the United States; the majority of the cases were reported in the eastern and Central U.S. The bacteria is considered endemic (established in the environment) in endemic in the upper Midwest, East and Northeast regions of the United States, as well as the Western coastal regions.

Symptoms of anaplasmosis in humans generally appear 5-21 days after a bite from an infected tick, and include headaches, fever, chills and muscle aches, and may be confused with flu symptoms. While some people may only experience mild symptoms and recover without medical attention, elderly or immunocompromised people may develop a more severe illness.

Dogs with anaplasmosis may show signs of lameness and joint pain, and some may also develop vomiting, diarrhea, coughing or labored breathing. It can be difficult to distinguish anaplasmosis from Lyme disease because the signs of disease are very similar and they occur in essentially the same areas of the country.

As with all tick-borne diseases, preventing tick bites is essential to preventing the disease.

### **Avian Influenza**

There are many different strains of the avian influenza virus, most of which are considered of “low pathogenicity” (less likely to cause disease) and are not zoonotic. Worldwide, the highly pathogenic H5N1 strain of avian flu has received much attention in the media because of its ability to infect people who come in close contact with

infected birds; H5N1 has not yet been detected in wild or domestic birds in North America to date, but precautions are highly recommended for hunters to reduce the risk of contracting any wildlife disease.

A 2006 report of 39 bird hunters and 68 wildlife professionals in Iowa found antibodies to a strain of avian influenza virus in the blood of one of the hunters and two of the wildlife professionals, indicating past exposure to a less common (and less infectious) type of avian flu. Although it involved a small number of test subjects, this study suggests that human exposure to avian influenza virus when handling wild waterfowl may occur more commonly than expected, and these fowl are capable of transmitting the disease to humans. The investigators did not determine if any of the people had become ill as a result of the virus. The study's results suggest that handling wild waterfowl, especially ducks, may be a risk factor for direct transmission of avian influenza virus to humans. (Gill 2006 EID)

Infection with the avian influenza virus may not cause illness at all, or may cause flu-like symptoms. Illness in dogs due to avian influenza has not been reported.

## **Babesiosis**

[Babesiosis](#) is a relatively unknown, malaria-like disease that is caused by *Babesia* parasites. It is transmitted by ticks – the same species of ticks that can carry Lyme disease and ehrlichiosis. It can also be transmitted by blood transfusion from an infected blood donor.

It is found mainly in Northeastern states, as well as Minnesota, Wisconsin and Washington state. Symptoms are flu-like and it can be difficult to diagnose.

[Babesiosis in dogs](#) can also be difficult to diagnose because of the variety of signs that may be observed. Infected dogs may appear normal, or they might suddenly go into shock from rapid destruction of their blood cells – these dogs show signs of fever, weakness, depression, swollen lymph nodes and very pale gums.

## **Brucellosis**

[Brucellosis](#) is most commonly caused by the *Brucella abortus* or the *Brucella suis* bacteria. Bison, elk, reindeer and caribou can become infected with the bacteria and develop brucellosis, but their role in transmission of the infections to livestock remains under debate. Brucellosis is one of the most serious diseases of livestock, can cause significant economic losses in production, and can infect people. As a result, the United States Department of Agriculture's Animal and Plant Health Inspection Service developed a [brucellosis eradication program](#) to eliminate the disease from our nation's herds. Controversy continues in the Greater Yellowstone Ecosystem regarding what role the bison and/or elk that wander outside Yellowstone National Park's borders play in infecting domestic cattle. Brucellosis is a reportable disease – this means that physicians must report any cases of brucellosis to the Centers for Disease Control and Prevention (CDC).

There was one suspected, but not confirmed, human case of brucellosis linked to the use of deer and elk urine as a scenting agent during hunting in 1996. Many of these wildlife lures consist of urine, ground-up scent glands, and various other ingredients that

may be contaminated by bacteria. There is a possibility that disease organisms could be transmitted from infected animals to humans, so it is recommended to follow basic sanitary measures when handling these lures, including avoiding ingestion, inhalation or direct skin contact.

Currently, human brucellosis due to *Brucella suis* in the U.S. is primarily associated with exposure to infected [feral \(wild\) boars/hogs](#).

Hunters may become infected with the *Brucella* bacteria during the cleaning of carcasses. Protective equipment, such as gloves and protective eyewear, is recommended.

Brucellosis in dogs is more commonly caused by *Brucella canis*, which is generally not spread to humans. Contact with or ingestion of infected milk, fetal membranes (placenta) or aborted fetuses from infected animals can result in infection with *B. abortus* or *B. suis*. Infection with *B. abortus* or *B. suis* rarely causes signs of disease in dogs but can cause abortion in pregnant bitches. Dogs infected with *B. abortus* or *B. suis* can infect humans.

## **Campylobacteriosis (*Campylobacter jejuni*)**

[Campylobacteriosis](#) is a disease caused by *Campylobacter jejuni* or *Campylobacter coli* bacteria. It affects the intestinal tract and, in rare cases, the bloodstream. It is one of the most commonly reported causes of bacterial diarrhea.

*Campylobacter* bacteria are generally spread by eating or drinking contaminated food or water, unpasteurized milk, and by direct or indirect contact with stool from an infected person, animal or pet. Many animals, including pigs (including wild pigs), cattle, dogs, moose, hares and birds, can carry the bacteria in their intestines.

Most infected animals will not show signs of disease, but they can develop diarrhea.

## **Chronic Wasting Disease (CWD)**

[CWD](#) is a transmissible spongiform encephalopathy, in the same class of diseases as bovine spongiform encephalopathy (BSE – more commonly known as “mad cow disease”). These diseases are caused by prions, which are infectious proteins. The diseases affect the brain and spinal cord, causing signs such as weakness, incoordination and abnormal behavior. How CWD is spread from animal to animal is not fully understood, but it is believed to be transmitted through direct animal-to-animal contact or when an animal eats soil contaminated by saliva or manure from an infected animal. [CWD prions have been found in elk antler velvet](#), suggesting a possible route of transmission from elk to elk.

To date, only 4 species are known to be naturally susceptible to CWD: mule deer, white-tailed deer, Shiras moose and Rocky Mountain elk.

Signs of a possibly infected animal include stumbling, lowered head, droopy ears, weakness, a wide stance (as if trying to balance themselves), excessive salivation and emaciation (“wasting”).

Hunters need to be aware that many states ban importation of whole carcasses and animals from states in which CWD has been reported; in fact, some states have check

stations at their borders. For more information about the regulations for each state, visit the [USDA's CWD pages](#).

According to the U.S. Centers for Disease Control and Prevention (CDC), there is [no current evidence that CWD passes to humans](#). However, simple cautionary measures should be taken by any hunter handling deer, moose and elk. To date, data from an ongoing [multi-year study](#) suggests CWD may not be spread to people through consumption of meat from infected animals; however, eating meat from an obviously ill animal is not recommended.

Hunters should check with the state fish and game agency about any reported outbreaks of CWD, and the following simple precautions should be taken when handling any deer, moose or elk:

- Do not shoot, handle or consume any animal that is acting abnormally or appears to be ill. Contact your state fish and game agency if you see or harvest an animal that appears ill.
- Wear latex or rubber gloves when field dressing deer, moose or elk. When skinning the animal, use extra caution around the anus and other areas that may be soiled by stool.
- If removing antlers, use a saw specifically kept for this purpose and dispose of the blade afterward.
- Remove bones from the animal by separating them at joints instead of sawing through the bones and avoid cutting through the brain or spinal cord except to remove the head. Use a knife specifically kept for this purpose to minimize the risk of contaminating meat.
- Minimize handling of all brain and spinal tissues.
- Wash hands and tools thoroughly after field dressing is completed.
- Avoid consuming the brain, spinal cord, eyes, spleen, tonsils and lymph nodes of harvested animals. Normal field dressing, coupled with boning out a carcass, will remove most, if not all, of these body parts. Cutting away all fat and connective tissue will remove any remaining lymph nodes.
- If your deer has been chosen to be sampled for CWD, do not eat any meat until test results have been returned. In some states, this may take weeks to months, so if there is any concern, dispose of the carcass.
- If you have your deer, moose or elk commercially processed, request that your animal is processed individually, without meat from other animals being added to the meat from your animal.

To date, there is no evidence dogs can become infected with CWD. However, it is best to avoid feeding brain and spinal cord tissues from killed game to dogs.

## **Cryptosporidiosis**

[Cryptosporidiosis](#) is an illness caused by a simple, one-celled parasite named *Cryptosporidium* (there are several different species of the parasite that are capable of infecting animals and people), which is shed in the stool of wild and domestic animals.

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Infection generally occurs by contact with the stool of infected animals, contaminated surfaces or by drinking water or eating uncooked food contaminated with stool from infected animals. Although some people may not become ill after being infected, the most common symptoms of infection are extreme diarrhea, along with stomach cramps, nausea, vomiting, fever, headache and decreased appetite. People with weakened immune systems can develop severe disease if infected with *Cryptosporidium*. Cryptosporidiosis is a reportable disease – this means that physicians must report any cases of cryptosporidiosis to the Centers for Disease Control and Prevention (CDC).

The best way to prevent infection is by using good hygiene. Avoid drinking untreated water; water can be made safe by heating it to a rolling boil for at least 1 minute or by using a [filter that has an absolute pore size of 1 micron \(µ\) or smaller, or has been NSF rated for “cyst removal.”](#)

Infected persons can shed the organism in the stool for several weeks after infection, emphasizing the need for good hygiene.

Dogs can become infected with *Cryptosporidium* but generally do not show signs of illness. Mild diarrhea may develop. To date, there is little evidence that dogs can readily infect their owners with *Cryptosporidium*; however, proper hygiene is always recommended when handling dog stool.

## Deer Parapoxvirus

[Deer Parapoxvirus](#) has been reported in red deer in New Zealand, but human infections have occurred in the United States. The virus is related to the orf virus, which affects sheep and goats, and the pseudocowpox virus, which affects cattle. The deer parapoxvirus causes scabby, crusty lesions on the muzzle, lips, face, ears, neck and antlers of affected deer.

There have been two confirmed cases of deer parapoxvirus infection in humans in the U.S., both of whom were deer hunters on the East Coast of the U.S. Both patients had nicked their fingers while dressing the deer carcasses and later developed pox lesions (scabby crusts) on their hands. One hunter also developed swollen lymph nodes. Both hunters reported that the deer had not shown any signs of illness at the time they were dressed.

The CDC continues to investigate deer parapoxvirus cases in the U.S. More information will be provided as it is obtained.

## Hydatid Tapeworms (Echinococcosis)

Hunters and their dogs can be infected by several species of tapeworms. [Echinococcus multilocularis](#) infects rodents (including field mice), and coyotes, wolves, foxes and dogs can become infected by eating infected rodents; the worms develop in the animal's intestines, and their eggs can infect people who come into contact with the infected animal's stool (or anything, including the animal's fur, that is contaminated with stool).

[Echinococcus granulosus](#) tends to cycle between canine species (coyotes, foxes, wolves, dogs, etc.) and larger grazing animals (sheep, goats, cattle, deer, elk, moose, caribou, etc.). Hunting dogs can become infected when they eat infected organs; the

worms grow inside the dog's intestines and begin to shed eggs that pass in the stool and can continue the cycle of infection. Infected dogs do not usually show any signs of disease.

Although rare, hydatid tapeworms can be transmitted to humans from dogs, and the eggs eventually grow into cysts in the lungs, liver or other internal organs. These cysts can cause permanent damage.

## **Ehrlichiosis**

[Ehrlichiosis](#) is a disease caused by bacteria that belong to the *Ehrlichia* species. There are several types of the bacteria that can cause illness. The disease is transmitted via the bite of an infected tick. It is a reportable disease – this means that physicians must report cases to the Centers for Disease Control and Prevention (CDC).

Symptoms usually occur within 1 to 3 weeks after exposure and can range from mild to severe. Common symptoms include fever, muscle pain, headache and chills. Occasionally, symptoms may include nausea/vomiting, a sharp drop in weight, mental confusion, cough and skin rash.

In dogs, the disease has 3 distinct phases. During the initial phase of infection, which generally lasts 1 to 3 weeks, the signs are nonspecific and include fever, loss of appetite, weight loss, depression and swollen lymph nodes. If the disease is not detected or treated during the initial phase, the dog may again appear normal. Chronic infection can develop, however, and can be life-threatening. Signs of severe ehrlichiosis include dramatic weight loss and loss of muscle tone, swollen lymph nodes, high fever, and bleeding.

## **Equine Encephalitis Viruses**

[Equine encephalitis viruses](#), including the Eastern equine encephalitis virus (EEE), Western equine encephalitis virus (WEE) and Venezuelan equine encephalitis virus (VEE), are transmitted by mosquitoes. As with West Nile Virus (WNV), the reservoir hosts for the encephalitis viruses are primarily wild birds.

Human infection with encephalitis viruses often causes symptoms such as fever, flu-like illness, muscle pain, vomiting and neurologic signs including seizures and convulsions. Infection with equine encephalitis viruses can be fatal. Infection with any of the equine encephalitis viruses is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

Although dogs can become infected with the viruses (particularly VEE), they do not usually develop illness.

## ***Escherichia coli* Infection (*E. coli*)**

[Escherichia coli, or E.coli](#), is a bacteria that causes diarrhea and stomach pain in people and is the leading cause of hemolytic uremic syndrome, a rare kidney disorder that can cause kidney failure. Many types of *E.coli* are harmless, but certain types can cause severe disease.

Although most cases of *E. coli* infection come from eating contaminated beef or drinking unpasteurized, contaminated milk products, it is possible for white-tailed deer to

become infected when they graze in cow pastures contaminated with the bacteria. Disease-causing *E.coli* has been found in cattle, goats, sheep, deer, elk, pigs and birds. Infection can also occur if a person drinks or swims in contaminated water. The bacteria are spread through fecal-oral transmission; an infected person or animal sheds the bacteria in their stool, and others are infected by accidentally eating the bacteria after they have touched a contaminated surface or had contact with infected stool. The bacteria are invisible to the naked eye, and people can become infected even if they don't see the contamination.

Dogs can become infected with *E. coli*. Intestinal infection often causes diarrhea and abdominal pain. *E. coli* infection in dogs can also cause urinary tract infections, uterine infections, ear infections and other problems.

Because the bacteria live in the animal's intestines, shooting a deer through its abdomen can increase the risk of contamination of the muscle (meat) by the intestinal fluids. The risk of infection is also related to how the carcass is handled, dressed, processed, preserved, stored and cooked.

## Hantavirus

[Hantaviruses](#) have worldwide distribution. [Rodents \(such as deer mice\)](#) are the natural hosts for these viruses. The viruses can be found in the rodents' urine, feces, and saliva, and when these substances have been deposited and dried, the viruses can become airborne and infect humans when they breathe in the airborne particles. Another way to get infected, although not as common, is via a rodent bite or drinking or eating food or water contaminated by rodents. Hantavirus pulmonary syndrome (respiratory disease due to hantavirus infection) is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

The illness that develops in humans depends on the type of hantavirus. There is a severe illness known as *hantavirus pulmonary illness* that was first reported in the Southwestern U.S. in the early 1990s. This syndrome starts with fever, body aches, headache, nausea, vomiting, diarrhea and a dry cough. The major symptoms that indicate more serious illness are shortness of breath and difficulty breathing. This may lead to respiratory failure (which happens about 4 days after the symptoms first appear), when the lungs fill up with fluid and results in death in about 50% of infected patients.

Preventive measures to reduce the risk of hantavirus infection include:

- When hunting, avoid rodents and try not to disturb rodent nesting areas or burrows.
- Avoid contact with rodent feces, urine or saliva. If contact happens, wash hands thoroughly with soap and water.
- If camping:
  - Avoid sleeping on bare ground; pitch camps away from woodpiles
  - Avoid sleeping in cabins or other structures that are currently, or have recently been, infested with rodents.
  - Keep food in rodent-proof containers and do not drink untreated surface water.

To date, hantavirus infections in dogs have not been reported.

## Leptospirosis

[Leptospirosis](#) is caused by *Leptospira* bacteria. The bacteria are found worldwide. Many species of both wildlife and domestic animals can spread leptospirosis. It is transmitted through an infected animal's urine.

Hunters and their dogs become exposed to *Leptospira* bacteria when they wade in contaminated waters or swamps; walk through contaminated soil, mud and wet plants; by direct contact with infected animals; or by eating food or meat or drinking water contaminated with the bacteria. The bacteria can also infect people and their dogs through open wounds or if contaminated water or food comes into contact with mucous membranes (e.g., linings of the nose, mouth and eyes). Person-to-person transmission is rare.

Symptoms of leptospirosis in humans range from mild to severe. The symptoms usually appear 5-14 days after infection, with a mild fever, chills, muscle ache and headache. Symptoms may progress to abdominal pain, vomiting, diarrhea and skin rash. The most severe cases develop liver and kidney problems, heart dysfunction and mental confusion. These severe cases are more common in older people and can result in death.

The signs of leptospirosis in dogs vary and can be vague. Infected dogs might not show any signs of disease, or they may exhibit fever, vomiting, diarrhea, loss of appetite, weakness and depression, stiffness or infertility. Younger animals may be more likely to develop the disease.

## Lyme Disease (Lyme borreliosis)

[Lyme disease](#) is an illness caused by a bacterium, *Borrelia burgdorferi*, which is a "spirochete" (a bacterium that has a worm-like, spiral-shaped form). Deer ticks are the primary carriers of the bacteria.

In humans, often the earliest indication of infection is a "bullseye" rash at the site of the tick bite – so named because it resembles a target. As the infection develops, symptoms include fever, headache, fatigue, and muscle and joint pain. The disease can progress to cause chronic joint problems as well as heart and neurological problems. Lyme disease is not contagious from one person to another. Lyme disease is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

Dogs infected with Lyme disease may not show signs for 2-5 months, at which time they usually develop fever, loss of appetite and lameness. It can be difficult to distinguish Lyme disease from anaplasmosis because the signs of disease are very similar, and they occur in essentially the same areas of the country.

Because it can be a difficult disease to diagnose, it is best to prevent infection by taking appropriate measures to prevent tick bites.

## Plague

[Plague](#) is a disease caused by infection with *Yersinia pestis* bacteria, the same bacteria responsible for the "Black Death" that killed millions of people in the 1300s. The bacteria is still present in the environment in several regions of the nation, and the disease has recently been reported in mountain lions, rodents, rabbits, squirrels and other

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carnivorous animals. There are two common forms of plague – pneumonic plague, which involves the lungs and is more life-threatening; and bubonic plague, which is more common and less severe.

Plague can be transmitted to hunters and their dogs through bites of infected fleas or by direct contact with infected animal tissues when skinning or handling wild game. The highest risks of exposures come from infected blood and tissues. The disease is more commonly found in areas with high populations of prairie dogs or other rodents.

The symptoms of plague in humans include high fever, chills, weakness, headache, nausea, and often a painful enlarged lymph node (in the groin area or armpit). Plague is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

Signs of infection in dogs are usually open sores around the head and neck, and a veterinarian should be consulted immediately. Do not allow hunting dogs or pets near established prairie dog colonies, because they may become infested with plague-carrying fleas and may become ill and/or bring the infected fleas into your home or onto your property, increasing the risk of human infection.

## Q fever

[Q fever](#) is a disease caused by the *Coxiella burnetii* bacteria. Cattle, sheep and goats are the primary reservoirs of *C. burnetii*, but cats, dogs, some wild mammals, birds and ticks are also natural reservoirs. The bacteria can be present in high numbers in the birth tissues (e.g., amniotic fluid, placenta and uterus) of infected animals and in lower numbers from their milk, urine, vaginal mucus, semen and manure/feces. The nesting sites of infected animals pose a high risk for infection. The bacteria most often infects humans and animals through an aerosol route – as the infected fluids dry, the bacteria remains in the dust. Infection can also develop following ingestion of contaminated, unpasteurized dairy products.

Both hunters and hunting dogs can become infected with Q fever. In humans, Q fever is often mistaken for a flu or cold; symptoms include fever, chills, headache, muscle pain, weakness and severe sweats, usually lasting 2 weeks. There is a possibility of complications involving the lungs, nervous system or heart. Q fever is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

Many animals do not exhibit signs of the disease, but infected dogs can shed the bacteria in their urine or milk and serve as sources of infection of their owners.

## Rabies

[Rabies](#) is caused by different variants (similar to strains) of the rabies virus. The virus is transmitted primarily through bites and causes severe damage to the brain. Non-bite transmission of the rabies virus is very rare but can occur through scratches, abrasions, open wounds or mucous membranes contaminated with saliva or other potentially infectious material (such as brain tissue) from a rabid animal. Once clinical signs of rabies are observed, it is 100% fatal in animals and almost 100% fatal in humans.

In the United States, rabies is most common in raccoons, foxes, skunks and bats. The virus can infect any mammal, and there are documented cases of rabies in many wildlife and domestic species.

The symptoms of human rabies cases can vary, but early symptoms may include fever, headache, sore throat, tingling at the site of the bite and fatigue. As the disease progresses, infected humans can develop disorientation, paralysis, hallucinations, seizures, coma and death.

Rabies is a reportable disease – this means that physicians must report any cases of rabies to the Centers for Disease Control and Prevention (CDC) as well as their state health department.

The first clinical signs of rabies seen in animals are usually nonspecific and may include lethargy, vomiting, fever and anorexia (loss of appetite). Signs rapidly progress and in days may include restlessness, confusion/disorientation, ataxia/incoordination, lameness, hypersalivation, weakness, paralysis, aggression, self mutilation, tremors, seizures, choking, or difficulty breathing or swallowing. Contrary to popular belief, rabid dogs are more likely to exhibit lethargy and paralysis than aggression.

Common sense guidelines for avoiding exposure to rabies include:

- Don't hunt any animal that behaves in an abnormal or uncharacteristic manner, such as:
  - aggressive animals
  - animals that display no fear of humans
  - animals that appear disoriented or are wandering aimlessly
  - animals showing any signs of sickness or paralysis
- Don't touch or tag any animal you find dead, unless less you specifically killed the animal and it appeared healthy beforehand.

Do not take any extraordinary risks if you do see a potentially rabid animal – the presence of a potentially rabid animal should be reported to the proper authorities. If it is necessary to kill the animal before the proper authorities can be contacted or can arrive, avoid killing the animal by a head shot or causing any trauma to the animal's head – the brain must be intact for rabies to be confirmed. Do not handle any potentially rabid animals without proper protection (e.g., gloves), and avoid any contact with the animal's mouth, eyes and nose.

If you are bitten or come into physical contact (scratches or direct contact with the brain or saliva) with a potentially rabid animal, **immediately** wash the area with soap and water. Contact your physician immediately; rabies is almost always fatal if not treated immediately. Also contact the local or state health department.

View the [AVMA's rabies brochure](#) for more information.

## **Raccoon Roundworm (*Baylisascaris procyonis*)**

The [raccoon roundworm](#), *Baylisascaris procyonis*, is a large parasitic worm that lives in the intestines of raccoons, although over 90 species of mammals, including dogs, rabbits, rodents, birds and humans can become infected with it. It is a common parasite in raccoons and has been reported throughout the U.S. (mainly in the Northeast, midAtlantic, Midwest and West Coast states).

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The adult worms shed millions of microscopic eggs that are passed through the infected animal's stool into the soil, where the eggs can survive for months or even years. Humans become infected through accidentally eating eggs in contaminated food or water, or through contact with raccoon feces or objects that have been contaminated with raccoon feces. Because raccoons tend to use specific "latrine" areas, there can be a very high number of infective eggs in the soil in these areas.

While the worm does not cause harm to raccoons, it can cause serious illness in humans. Symptoms include nausea, lethargy, liver enlargement and loss of muscle control, eventually resulting in coma and blindness. Deaths are rare, but permanent liver, eye or brain damage can occur.

Dogs can be infected with the raccoon roundworm by contact with the stool of infected raccoons (or soil or water contaminated by the stool) or by contact with (or eating) the intestinal contents of an infected raccoon. Signs of illness include fatigue, blindness, incoordination and other nervous system problems. It is possible that an infected dog could shed eggs that can infect its owner. It has been suggested that monthly heartworm preventives may decrease the risk of infection in dogs.

## **Rocky Mountain Spotted Fever (tick-borne typhus fever) and other spotted fevers**

[Rocky Mountain Spotted Fever](#) (RMSF) is caused by the *Rickettsia rickettsii* bacteria and can be transmitted to hunters via tick bites. Person-to-person transmission does not occur.

Symptoms of RMSF usually appear within 3 to 14 days after the bite of an infected tick, with moderate to high fever (which may last for 2 to 3 weeks), severe headache, fatigue, muscle aches, chills and skin rash. The rash looks like blood spots or heavy freckles, explaining the "spotted fever" part of the name, and begins on the legs and arms and may include the soles of the feet and palms of the hands, spreading rapidly to the rest of the body. It is important to note that not everyone who has RMSF will develop a rash. RMSF is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

In dogs, the first sign observed is usually a high fever, occurring 4-5 days after a bite from an infected tick. Blood spots (pinpoint or larger in size) may be seen on the lips, gums and nonhaired (or shorthaired) areas of the dog's skin. The dog's legs may swell, as well as the lips, ears and sheath. In the late stages of the disease, or sometimes during recovery, the damage in the legs can be severe enough that sloughing of the skin and tissues can occur.

There are [new spotted fevers](#) being detected worldwide that are similar to RMSF, and these are also transferred via tick bites. In the United States, the most frequently diagnosed rickettsial infection associated with hunters returning from international travel is African tick bite fever.

## **Salmonellosis (*Salmonella* species)**

[Salmonellosis](#) is a bacterial infection caused by *Salmonella* species. There are many *Salmonella* species that can cause infection and illness. Many species of animals,

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including pets, livestock, reptiles, birds and wildlife, can be infected and can spread *Salmonella*.

These bacteria usually infect the intestinal tract but also can be found in urine, blood or in other body tissues.

*Salmonella* bacteria are spread through fecal-oral transmission; an infected person or animal sheds the bacteria in their stool, and others are infected by accidentally eating the bacteria after they have touched a contaminated surface or have had contact with infected stool. The bacteria are invisible to the naked eye, and people can become infected even if they don't see the contamination.

Symptoms in humans and animals may include mild to severe diarrhea, stomach pain, fever and vomiting. Infections in the bloodstream are rare but potentially can be very dangerous. Salmonellosis is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

## **Sarcoptic mange**

[Sarcoptic mange](#) is a skin disease caused by sarcoptic mange mites, which have a nationwide distribution. This mange can be found in feral swine, foxes, coyotes and wolves, as well as in big game (e.g., moose, elk, caribou, lions and water buffalo). It is spread by contact from animal to animal or from an infected environment to an animal and becomes more common when animal populations are high and contact is more likely.

Sarcoptic mange mites burrow through the top layer of the dog's skin and cause intense itching. Clinical signs include generalized hair loss, a skin rash and crusting. Skin infections may develop secondary to the intense irritation. It usually appears first in the hind end and tail regions, and gradually expands up along the back to the head.

People who come in close contact with an affected dog may develop a skin rash and should see their physician. When hunters come across an infected carcass, they should burn or bury the carcass, and as always, when dealing with a wild animal carcass, gloves should be worn and the workplace disinfected afterwards. If a hunting dog comes in contact with a mange-infested carcass, prompt use of mite-killing topical products can prevent infection. Consult your veterinarian for a product recommendation.

## **Toxoplasmosis**

[Toxoplasmosis](#) is caused by *Toxoplasma gondii*, a single-celled parasite.

A person can get toxoplasmosis by eating raw or undercooked meat, especially venison, lamb or pork, or from consuming unpasteurized milk or milk products. Humans can also get toxoplasmosis by consuming food, water, or soil contaminated with cat feces.

Healthy people rarely develop toxoplasmosis. If illness occurs, symptoms include fever and swollen lymph nodes. Eye problems can also occur. Less common symptoms include skin rash, fatigue and muscle pain, and serious cases (usually in persons with weakened immune systems) develop pneumonia and central nervous system (brain or spinal cord) disorders. If a pregnant woman becomes infected, it may result in severe birth defects or death of the baby.

Dogs can become infected with *T. gondii*, but it is uncommon for them to develop illness. Illness is more likely to develop in dogs with weakened immune systems, and the signs of illness include incoordination, weakness and seizures.

Preventive measures include thoroughly cooking meat and using proper food hygiene (washing hands and utensils after contact with raw food, washing fruit before eating it, etc.) Avoid eating raw eggs or unpasteurized milk.

## Trichinellosis (trichinosis)

[Trichinellosis](#), also called trichinosis, is caused by a parasite called *Trichinella spiralis*. Unlike many other parasites that can infect people, this parasite lives in the muscle tissue of animals (including the tongue and diaphragm, both of which are specialized muscles). Because the meat of the animal is actually its muscle tissue, the parasite can infect people who eat the meat of an infected animal.

*T. spiralis* is found worldwide, in a wide range of birds and mammals. In North America, it is common in the cougar and the grizzly bear but has also been reported in black bear, wolf, red fox, coyote, lynx and wild hogs.

Although it is considered to be a relatively minor disease in wildlife, causing only minor behavioral changes (e.g., less activity, increased predation and decreased reproductive activity), trichinosis can be fatal in humans. As they burrow into the muscle cells, the muscle cells serve to “protect” the larvae, so they can live for years in an animal. They only become reactivated when the meat they have been living in is eaten by a carnivore or hunter.

Symptoms include stomach pain and fever, muscle aches, and swelling around the eyes. Thirst, sweating, chills, weakness and fatigue may follow. Chest pain can occur if the parasite has infected the diaphragm. The onset of illness depends on the number of parasites and the amount of meat eaten. Trichinellosis is a reportable disease—this means that physicians must report any cases of trichinellosis to the Centers for Disease Control and Prevention (CDC).

*Trichinella spiralis* can infect dogs that eat raw meat infected with the parasite. Infected dogs may not show any signs of illness or they may develop mild diarrhea.

The main course of prevention against trichinellosis is the proper handling and cooking of meat. Smoking, freezing or curing game meat *may* kill the larvae, but this is not the case for all strains of *Trichinella*. Low-temperature smoking will not kill the larvae. In addition, livestock should never be served the meat or offal of wildlife.

## Tuberculosis

*Mycobacterium bovis*, a bacteria, causes bovine tuberculosis (TB). This is a different disease and different bacteria than human tuberculosis. *M. bovis* infection has been reported in wild boars, white-tailed deer, mule deer, elk, bison, badgers, possums, water buffalo, wapiti and other species. *M. bovis* poses a minimal risk to people, but can easily infect domestic cattle herds. For this reason, there are federal and state eradication programs. When field dressing an elk or deer, hunters should look for tan or yellow pea-sized lumps in the wall of the rib cage or in the lungs. If these lumps are present, the

hunter should immediately stop handling the carcass, attach a game tag, and contact the local fish and wildlife agency.

*Mycobacterium tuberculosis*, the cause of human TB, has been reported in meerkats and mongoose in South Africa, but the significance of free-ranging wildlife in the spread of human TB remains unknown.

Tuberculosis is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

## Tularemia

Tularemia is caused by infection with *Francisella tularensis* bacteria, commonly found in the United States in rabbits, squirrels, muskrats, beavers, prairie dogs, cats, bobcats, deer and sheep. Rabbits are the most common source of tularemia in the United States. It is a potentially fatal disease. It can be spread to animals and people by deerflies and other insects. Tularemia is a reportable disease—this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC).

Historically, people that work outdoors (landscapers, etc.) have been more likely to be infected with tularemia. Hunters are at risk of exposure because of the amount of time they spend outdoors and in their handling of game species prone to infection.

Routes of exposure may include:

- Exposure of skin or mucous membranes (e.g., eyes, nose and mouth) with blood or tissue when handling or dressing infected game.
- Via infected flea or tick bites.
- Handling/eating undercooked infected meat. Rabbit meat can remain infective even after being frozen several years.

Less common routes may include:

- A scratch or a bite from a cat.
- Drinking contaminated water.
- Inhaling dust from contaminated soil.
- Handling contaminated animal pelts.

Symptoms of tularemia in people usually include skin lesions and swollen glands. If the infection is caused by eating infected meat, symptoms may include sore throat, intestinal pain, diarrhea and vomiting. Inhalation of the bacteria may produce a fever or may also cause a pneumonia-like illness. While the symptoms may appear anywhere from 2-10 days after exposure, they usually appear after 3 days. Simple measures can be taken to minimize the risk of tularemia, including the following:

- Wear rubber gloves when handling or dressing game (especially rabbits).
- Always thoroughly cook rabbit and/or squirrel meat.
- Use protective clothing and insect repellants and check for ticks frequently.
- Avoid drinking untreated water.
- Avoid handling any sick animals or any dead animals that you have not shot.

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Dogs can be affected by tularemia, but the signs observed may be mild and nonspecific. The signs that may be observed are related to the mode of transmission and include fever, depression, mucopurulent (mucus with pus) discharge from the nose and/or eyes, pustules at the sites of contact, swollen lymph nodes, and loss of appetite. In most cases, the disease is self-limiting with supportive treatment.

## West Nile Virus

African mosquitoes carrying the [West Nile virus \(WNV\)](#) first arrived in New York City in 1999. The virus has since spread throughout North America. The virus infects wild birds, and mosquitoes then transfer the virus to other animals and to humans.

Approximately 20% of people who are exposed to the virus via mosquito bites develop symptoms. Approximately 1% develop encephalitis (inflammation of the brain) or meningitis (inflammation of the linings of the brain or spinal cord) that can lead to death. West Nile Virus infection is a reportable disease – this means that physicians must report any cases to the Centers for Disease Control and Prevention (CDC). Since 1999, there have been 17,000 reported cases and more than 650 deaths due to West Nile virus infection.

Sudden bird die-offs can indicate the presence of West Nile virus in the area. Hunters should report any noticeable increase in dead birds to the [state or local agencies](#).

Hunters should [avoid handling dead birds](#) they encounter that have not been shot during the hunt. Follow the state or local health department's instructions regarding what to do with the dead bird. If instructed to dispose of the bird, hunters should use gloves or protect their hands with a plastic bag to place the bird carcass in a garbage bag and dispose of it in the trash.

Dogs are [not likely to show signs of disease](#) when infected with the West Nile virus.

## Specific Risks Associated with International Hunting

Many of the same risks associated with hunting in North America may also be present worldwide, but there are additional risks with international hunting. These risks include diseases unique to the area. It is recommended that hunters find out the health situation in each destination country as they are determining where they will hunt. The World Health Organization's (WHO) [International travel and health](#) site provides basic information, as well as advisories on safe food, health regulations and other topics. The U.S. Centers for Disease Control and Prevention also maintains a [Traveler's Health](#) section with advice and information.

Below are a few of the zoonotic diseases unique to international destinations.

### Chikungunya

[Chikungunya fever](#) is caused by the chikungunya virus, which is transmitted to humans via the bite of an infected mosquito.

Big game hunters in Africa and Asia need to be especially aware of this virus, as it has been the cause of many epidemics in both these continents. The mosquito that carries the virus, *Aedes aegypti*, is known to be an aggressive daytime biter that appears to be attracted to humans. This mosquito also transmits the virus between humans. It is suspected that monkeys and possibly other wild animals serve as reservoirs for this virus. Lately, the *Aedes albopictus* mosquito (Asian tiger mosquito) has also been recorded as transmitting the virus to humans in Asia, Africa and Europe. There are also certain African forest-dwelling mosquitoes that have been found to be infected with the virus.

Rarely, a person can have chikungunya without any symptoms. A primary symptom of chikungunya is severe joint pain. It may progress to a more serious illness, with fever, headache, fatigue, nausea, vomiting and rash. Acute chikungunya usually lasts from a few days to several weeks, but some people can experience fatigue or joint pain for a longer period of time.

To date, chikungunya infection in dogs has not been reported.

## **Crimean Congo hemorrhagic fever**

[Crimean-Congo hemorrhagic fever](#) (CCHF) is a tick-borne disease caused by a Nairovirus. It is found in Eastern Europe, Africa, Northwest China, Central Asia, the Middle East, India, the Mediterranean and Southern Europe. Ixodid (hard) ticks are the transmitters of the CCHF virus. Both wild and domestic animals, such as cattle, goats, sheep and hares, may be infected with these ticks. Transmission to hunters may occur through tick bites or the infected blood of an animal. CCHF can be transmitted from one infected human to another by contact with infected blood or body fluids. The first signs of CCHF are sudden, with headache, high fever, back and joint pain, stomach distress, red eyes, flushed face, sore throat, and red spots in the mouth. Rare symptoms include jaundice, and in severe cases there are mood swings and changes in vision and hearing. Severe bruising and nosebleeds also occur.

## **Rift Valley Fever virus**

[Rift Valley Fever](#) (RVF) is caused by the Rift Valley Fever virus (RVFV), a mosquito-borne virus that has been associated with widespread outbreaks of severe disease in livestock and humans in Africa, and more recently, the Arabian peninsula. Infections in livestock cause 10-20% deaths in adults and 100% in newborns. Infections in humans usually consist of mild illness, but in 1-2% of human cases, RVF can progress to liver problems, blindness, severe bleeding and death. Epidemics always occur during heavy rainfall seasons, when the infected mosquitoes are present in high numbers. RVF is considered a serious threat, and recent studies, while not yet confirmed, have indicated that certain wildlife species may be reservoirs for this virus between outbreaks, including African buffalo, lesser kudu, black rhinos, white rhinos and impala. These studies also suggest that, during a RVF outbreak in a region, any wildlife meat, if not properly handled, may pass the RVF infection on to humans.

**We would like to thank the AVMA's Committee on Environmental Issues for their participation and advice on this project.**

**Additional resources:**

**American Veterinary Medical Association (AVMA)**

[Animal health backgrounders](#)

[Animal health topics](#)

[Public health topics](#)

[Zoonosis updates](#)

**Centers for Disease Control and Prevention (CDC)**

[Avian influenza among waterfowl hunters and wildlife professionals](#)

[Protect yourself from tick bites](#)

[Tickborne rickettsial diseases](#)

[What you need to know about mosquito repellent](#)

[Wildlife, Exotic Pets, and Emerging Zoonoses](#)

**The Wisconsin Department of Agriculture, Trade, and Consumer Protection**

[Common Sense: Handling and processing venison](#)

[Zoonotic Diseases Fact Sheets](#)

**US Centers for Disease Control and Prevention (CDC)**

[Traveler's Health](#) pages

**World Health Organisation (WHO)**

[International travel and health](#)

**US Department of Agriculture (USDA)**

[Freezing and Food Safety](#)