

Zoonoses of Importance in Wildlife Rehabilitation

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Zoonoses are infections or infestations shared in nature by humans and other vertebrate animals. Because wildlife rehabilitators work with animals that have unknown health histories, may be ill, and may be more susceptible to disease due to the stress of captivity, there is a risk of exposure to zoonotic diseases. Although infection of wildlife with most zoonotic diseases is uncommon in Colorado, it is prudent to follow precautions when housing, handling, and treating wild species. In general, most problems can be avoided by using common sense and good hygiene practices.

Prevention of infection with zoonotic diseases should be a major emphasis in protocols for rehabilitation of wildlife. In addition to specific control and prevention guidelines listed below for each group of diseases, some general guidelines should be followed in all cases. First, isolation of the wild animal is important both for the animal and to minimize exposure of humans to potential pathogens. Second, good personal hygiene is important. Handwashing after handling animals or animal facilities is extremely important. People should not consume food or drink in the animal facilities. Additional precautions may include wearing protective clothing (lab coat, coveralls), boots, gloves, and/or dust mask depending on the situation. Because children are more susceptible to some zoonotic diseases, particular emphasis should be placed on protecting children. Third, animal facilities and equipment should be kept clean. This includes removing feces, urine, and other possible sources of contamination regularly. The refuse should be disposed of promptly, ideally in a landfill. Disinfectants, such as antibacterial soaps, quaternary ammonium compounds (e.g., Roccal-D®), phenolic compounds (lysol®), gluteraldehyde, and chlorine, can be used on animal facilities, equipment, and in foot baths. Food and water sources should be clean and changed regularly. Additionally, facilities and food sources should be protected from infestation with pest species. Fourth, ectoparasites and endoparasites should be controlled. Fifth, general safety procedures should be followed to avoid bites and scratches from animals. Lastly, diagnostic procedures should be used to identify pathogens producing disease in animals and postmortem examination should be performed on animals dying while in rehabilitation.

Our purpose here is to introduce the wildlife rehabilitator to zoonotic diseases that may occur in wildlife in Colorado. Although the primary goal is prevention, identification of zoonotic disease in animals and humans is important as well. Wildlife rehabilitators should inform their family physician of any potential exposure to zoonotic disease and use the physician as a source of information. In addition, state and local health departments, the Centers for Disease Control and Prevention (CDC), and veterinarians are valuable sources of information that can be contacted in the event of potential exposure to, or illness from, a zoonotic disease.

Enteric Diseases

Campylobacter enteritis

Causative agent: *Campylobacter jejuni* is a not uncommon cause of human bacterial diarrheal illness, while *C. fetus* uncommonly affects humans with a systemic illness. Numerous domestic and wild species, including ruminants, small mammals, and birds, are potential reservoirs of *C. jejuni*.

Recognition in humans: The enteric form (*C. jejuni*) is most commonly transmitted in feces or raw milk from infected animals or by fomites. After an incubation period usually lasting 2-5 days, symptoms commonly include bloody diarrhea, vomiting, abdominal pain, and fever. *Campylobacter enteritis* may be treated with antibiotics.

Diagnosis in animals: Submit fresh fecal sample, or rectal swab from a symptomatic animal, for specific culture of *Campylobacter*. Selective media and specific environmental factors are required for success culture. Examination of feces under dark-field microscopy can aid in a presumptive diagnosis. Typing of isolates aids in epidemiologic investigation.

Control and Prevention: See Salmonellosis.

Cryptosporidiosis

Causative agent: The protozoan *Cryptosporidium parvum* is responsible for cryptosporidiosis. The organism can be spread in water (lakes, rivers, pools, and drinking water), in feces, and on contaminated food and other objects. We will discuss only infection transmitted in the feces of animals. Cryptosporidiosis occurs primarily in neonatal animals (< 6 mo old). Although *C. parvum* from domestic calves (and potentially wild ruminants) is infectious to humans, species of *Cryptosporidium* that infect birds, rodents, reptiles, and fish are not generally infectious to humans.

Recognition in humans: Oocysts are infective when passed in feces. Symptoms of cryptosporidiosis appear 2-10 days after infection and include acute, self-limiting diarrhea, nausea, abdominal cramps, and low grade fever. Symptoms generally persist ≤ 2 weeks. Asymptomatic infections may also occur. No effective treatment is available for cryptosporidiosis.

Diagnosis in animals: Submit fresh fecal sample for parasitology examination for oocysts. Acid fast staining of the small oocysts aids in diagnosis.

Control and Prevention: See Salmonellosis.

Giardiasis

Causative agent: *Giardia lamblia* is a common intestinal parasitic infection. Human cases of giardiasis commonly originate from other humans (directly or via contaminated water), but may result from contact with infected pet animals or wild small mammals.

Recognition in humans: Cysts are infective when passed in feces. Infection with giardia is frequently subclinical in humans and other animals. After a 1-4 week incubation, symptoms may include abdominal pain, diarrhea, steatorrhea, and weight loss. Treatment with quinacrine or metranidazole is effective against giardia.

Diagnosis in animals: Submit fresh fecal sample (keep refrigerated) for parasitology examination for cysts or trophozoites. Sampling should be repeated 3 times before considered negative.

Control and Prevention: See Salmonellosis.

Salmonellosis

Causative agent: Numerous serotypes of *Salmonella* are pathogenic to humans and other mammals, birds, and reptiles. The bacteria are spread in feces of animals with diarrhea or with subclinical infections. Treatment with broad-spectrum antibiotics (especially oral) may increase the incidence of bacterial shedding and illness in animals and may contribute to development of bacterial strains with increased antibiotic resistance.

Recognition in humans: Salmonellosis is generally transmitted by infected feces or tissues or via fomites. Infections can be subclinical. After a 6-72 hr incubation period, symptoms commonly include diarrhea, vomiting, and a low grade fever. Severe dehydration can result. Enterocolitis can be followed by septicemia or focal infection. Antibiotic treatment may be used, but use is debatable in less severe cases due to the possibility of prolonged bacterial shedding.

Diagnosis in animals: Mammals infected with *Salmonella* may be asymptomatic or exhibit diarrhea and/or systemic illness. Birds infected with *Salmonella* may be asymptomatic or may show nonspecific signs of illness or death. Infected birds such as grosbeaks, crossbills, and pine siskins commonly have lesions present in a feed impacted crop. A fresh fecal sample or rectal swab from a symptomatic animal or a sample of tissue lesions from postmortem specimens can be submitted for bacterial culture. Typing of isolates aids in epidemiologic investigation.

Control and Prevention of enteric diseases: *Escherichia coli* (0157:H7) and *Clostridium perfringens* are also among the potentially zoonotic enteric diseases. In general, transmission of enteric diseases can be greatly reduced through strict

sanitation practices (e.g., isolation, disinfection, hand washing). Good hygiene practices should always be used, even in animals with normal stools, because shedding of many enteric pathogens is increased during periods of stress (e.g., captivity, injury). Unpasteurized milk fed to neonates may be another potential source for enteric bacterial infections. Once infected, humans can transmit these enteric diseases to others.

Vector-borne Diseases

Arthropod-borne viral encephalitides

Causative agent: This class of viral infections include two diseases that occur in Colorado, western equine encephalitis (WEE) and St. Louis encephalitis (SLE). Mosquitoes transmit these encephalitides after acquiring the virus from primarily infected birds. Humans, horses, and some bird species can acquire clinical disease. Clinical cases of WEE and SLE are related to a complex cycle of virus amplification in host species that occurs about every 10 years in Colorado.

Recognition in humans: For the more common encephalitides of the United States, infection is acquired from the bite of an infected mosquito. Symptoms vary in severity and rate of progression based on the species of virus involved and host immunity. Infection can be inapparent, mild with a febrile headache, or severe with acute onset headache, high fever, and CNS signs. The young and old are most severely affected. A vaccine is available against EEE and WEE.

Diagnosis in animals: Not applicable here.

Control and Prevention: See Rocky Mountain Spotted Fever.

Colorado Tick Fever

Causative agent: Colorado tick fever is caused by an RNA virus in the genus *Orbivirus*. The infection is spread by ticks, primarily *Dermacentor andersoni*. Small mammals, especially chipmunks and ground squirrels, are the main reservoirs of the disease.

Recognition in humans: About 3-6 days after the bite of an infected tick, there is a sudden onset of fever, chills, headache, and body aches. A brief remission is usual, followed by reoccurrence of symptoms.

Diagnosis in animals: Not applicable here.

Control and Prevention: See Rocky Mountain Spotted Fever.

Lyme Disease

Causative agent: Lyme disease is caused by the spirochete *Borrelia burgdorferi*. The bacteria exist in a cycle involving ticks and small mammals. Infected ticks spread infection among rodents and to other animals and humans. Although deer are resistant to Lyme infection and are not directly involved in the life cycle, they do provide blood meals and a means of transportation for adult stage ticks. The most important ticks in the transmission of Lyme disease in other regions of the United States are the deer tick and the black-legged tick. These ticks do not occur in Colorado; however, positive ticks of the species *Ixodes spinipalpis* have been found in Colorado. Lyme disease is rare in Colorado.

Recognition in humans: Lyme disease is usually transmitted by the bite of infected ticks. Most patients exhibit erythema migrans 3-30 days after the bite. Other "flu-like" symptoms include fever, malaise, and aches and pains. Patients treated appropriately with antibiotics early in the disease usually recover completely; however, if untreated, damage may occur to the heart, joints, and nervous system.

Diagnosis in animals: Not applicable here.

Control and Prevention: See Rocky Mountain Spotted Fever.

Relapsing Fever

Causative agent: Tick-borne relapsing fever is caused by spirochetes of *Borrelia* spp. The organism is transmitted by soft ticks of the genus *Ornithodoros*. Many wild and domestic mammalian hosts, but primarily small rodents, serve as a reservoir for the disease.

Recognition in humans: Infection is acquired by the bite of an infected tick; however, because of the biology of *Ornithodoros*, patients are rarely aware of having been bitten. After an incubation period of 5-15 days, a sudden onset of high fever and headache occur. Symptoms subside, but reoccur within days. Numerous relapses generally occur. Relapsing fever can be treated with antibiotics.

Diagnosis in animals: Not applicable here.

Control and Prevention: See Rocky Mountain Spotted Fever.

Rocky Mountain Spotted Fever

Causative agent: *Rickettsia rickettsii*, the organism responsible for Rocky Mountain Spotted Fever (RMSF), is ordinarily spread by the bite of an infected tick. The most important ticks in the transmission of RMSF are *Dermacentor variabilis*, *D. andersoni*, and *Amblyomma americanum*. Unlike the name suggests, RMSF is more common in the eastern and southern United States than in Colorado.

Recognition in humans: RMSF is usually transmitted by the bite of infected ticks. Symptoms include a sudden onset of headache, fever, and malaise followed in a few days by a rash which begins on the extremities. If untreated, RMSF can cause death. RMSF is generally treated with tetracycline.

Diagnosis in animals: Not applicable here.

Control and Prevention of vector-borne diseases: Prevent mosquito bites through use of protective clothing and chemical repellents, and installation of mosquito netting and screens to exclude mosquitoes. To avoid exposure to ticks, wear protective clothing and use a repellent containing DEET (apply minimum effective dose) when entering tick habitat. Remove ticks attached to the skin immediately using tweezers to grasp the tick as close to the skin as possible and then applying slow steady traction.

Bacterial Diseases

Brucellosis

Causative agent: Brucellosis is caused by the bacterium *Brucella*. There are several species of *Brucella* depending on whether the infection originated in pigs (*B. suis*), cattle (*B. abortus*), sheep (*B. ovis*), goats (*B. melitensis*) or dogs (*B. canis*). *Brucella ovis* is not zoonotic and *Brucella melitensis* is the most virulent to humans.

Recognition in humans: Brucellosis is usually acquired by ingesting unpasteurized dairy products from infected animals or through skin breaks or mucous membrane contacts with infected animal products (meat, blood, tissues from abortion). Although wild ruminants can be infected with brucellosis, it has not been diagnosed in free-ranging animals in Colorado. Symptoms of brucellosis are non-specific, flu-like and generally sudden in onset following a one week to several month incubation period. Clinical signs include chills, intermittent fever spells, impotence, general aches, joint pain, and headaches. The disease can be treated by a physician, but relapses may still occur. The disease is also called undulant fever due to the recurring fever spells.

Diagnosis in animals: Animals infected with *Brucella* generally show no clinical signs of disease except an increase in spontaneous abortion or decreased reproductive potential. The organism can be isolated from tissues, e.g., aborted fetus. Serological tests can also be used to test for exposure to the bacteria.

Control and Prevention: Use pasteurized milk or use good sanitation practices when handling unpasteurized milk (e.g., milk from a domestic animal fed to a wild neonate). Use good sanitation practices when handling aborted fetuses and placentas and disinfect potentially contaminated areas.

Leptospirosis

Causative agent: Leptospirosis is caused by the spirochete *Leptospira interrogans*, which is divided into numerous serovars. The pathogenicity of serovars varies. Many species of domestic and wild mammals may serve as asymptomatic carriers of the bacteria.

Recognition in humans: Leptospirosis is generally acquired through contact (through abraded skin, mucous membranes, or ingestion) with infective urine or water contaminated with infective urine. After an incubation period of about 10 days, symptoms may include fever, headache, chills, nausea, general aching, and eye problems. Occasionally, the disease progresses to include jaundice, renal disease, and hemorrhages in the skin and mucous membranes. Antibiotic therapy should be initiated promptly.

Diagnosis in animals: In animals, infection is often subclinical, but abortion may occur. Although most animals do not show clinical signs of illness, infected carriers may shed the organism in urine. Diagnosis may be made through urine culture or exposure determined using serologic tests.

Control and Prevention: Avoid contact (wear gloves) with animal urine. Use good sanitation measures to avoid contamination of water. Control rodents which may serve as carrier hosts.

Plague

Causative agent: Plague is caused by *Yersinia pestis*. The bacterium is transmitted from rodent to rodent, and to other species of mammals, by fleas in the western United States. Rock squirrels are the most common source of human plague in Colorado, although numerous other rodent species and cats have been implicated in human cases.

Recognition in humans: Infection with plague is commonly from the bite of infected fleas; however, infection may also occur through exposure to infected animal tissues or from inhaling infected droplets. Plague in humans can take 3 forms: bubonic, septicemic, and pneumonic. Bubonic plague generally results from the bite of an infected flea or through contact with infective tissues through a break in the skin. Symptoms occur 2-6 days after exposure and include a very painful, swollen lymph node (bubo), fever, and exhaustion. Bubonic plague may progress to a septicemic form if not treated. Septicemic plague may also occur by direct entry of the bacteria into the blood without lymph node involvement. Pneumonic plague occurs when bubonic or septicemic plague progress or when primary infection occurs through inhalation of infective droplets exhaled by animals with plague pneumonia. The incubation period for primary pneumonic plague is 1-3 days. Antibiotic treatment and isolation of patients should begin as soon as possible. Preventive therapy with antibiotics is recommended in the event of close exposure to pneumonic plague. State and local health departments must be notified.

Diagnosis in animals: Suspect animals should be reported to the state or local health department. Carcasses should be submitted to the health department, or with approval, to the CDC or a state diagnostic laboratory. For submission, the carcass should be treated with an insecticide and placed in a secure bag that is clearly labeled. Tissues used in diagnosis include the spleen, bone marrow, and needle aspirate of buboes or abscesses. A presumptive diagnosis of plague can be made on the observation of gram-negative, bipolar staining ovoid bacteria on microscopy.

Control and Prevention: To minimize the risk of plague infection, wild rodents can be treated with an insecticide prior to initial handling. Other small animals should also be routinely examined for fleas and treated as necessary. Small mammals exhibiting respiratory signs, lymphadenopathy, or abscesses should also be considered potential sources of plague and personal safety measures (gloves, mask) should be followed. A vaccine is available for humans, but it is not generally recommended.

Tetanus

Causative agent: Tetanus is caused by a exotoxin produced by *Clostridium tetani*. Tetanus spores are widespread in soil and in feces of animals, especially herbivores.

Recognition in humans: *C. tetani* generally grows anaerobically in wounds. After an incubation period usually lasting 3-21 days, symptoms include painful muscle contractions followed by tetanic spasm and often death.

Diagnosis in animals: Laboratory confirmation is often impossible. Animal infection is not associated with human infection.

Control and Prevention: Immunization with tetanus toxoid. Cleanse wounds.

Tuberculosis

Causative agent: Bovine tuberculosis (TB) is caused by bacterial infection with *Mycobacterium bovis*. Tuberculosis has been diagnosed very rarely in free-ranging wild animals. It is mainly confined to herds of cattle, bison, and domestically raised elk and deer, although it is uncommon in these species as well.

Recognition in humans: TB is spread through inhalation of the bacteria expelled from the lungs of infected animals and via secretions or excretions (especially pus) from infected animals. Symptoms of TB occur after quite a long incubation period. Infection in humans can take several forms that affect primarily the lungs (pulmonary), lymph nodes, or other organs. Skin tests are available to identify infected humans.

Diagnosis in animals: TB is generally characterized by chronic pneumonia. In advanced cases there is severe respiratory distress and weight loss; however, infected animals may appear normal and healthy for long periods of time even though they are infectious. In elk and other cervids, lesions are often confined to lymph nodes of the head and neck and are sometimes noticeable externally as swellings or abscesses. Conversely, animals with extensive lesions may appear clinically normal.

Control and Prevention: Skin tests are available to test ruminants for bovine tuberculosis. Affected animals must be euthanized. Good sanitation practices should be followed when lancing abscesses (especially cervical abscesses in adult ruminants) and care should be taken when working with animals (especially adult cervids) with pneumonia of unknown origin. Wild ruminants should be housed separately from domestic ruminants.

Tularemia

Causative agent: Tularemia, caused by *Francisella tularensis*, produces a plague-like disease in wild lagomorphs and rodents (especially muskrat and beaver); however, a variety of other mammals and birds are also susceptible. Jellison type A strains are common in lagomorphs and are more virulent than the Jellison type B strains found in other species.

Recognition in humans: *F. tularensis* can be transmitted by a variety of ectoparasite vectors (e.g., ticks, deerflies), by direct contact with infected animals, or through contact with environmental contamination. The course of the disease varies with route of infection. Entry through a break in the skin (directly or via a vector) is the most common route of infection and is characterized by a sudden onset of fever, chills, headache, and malaise accompanied by a necrotizing ulcer at the site of infection and regional lymphadenitis. Enteritis or pneumonia can result from other routes of infection. Antibiotic therapy is effective in treating tularemia. A vaccine is available for humans, but it is not generally recommended.

Diagnosis in animals: Diagnosis can be made by culturing *F. tularensis* on special media or by fluorescent antibody test on blood or the nodular lesions found in the liver, spleen, or lymph nodes.

Control and Prevention: Avoid exposure to biting insects as described under *Control and Prevention of vector-borne diseases*. Use protective masks and gloves when handling potentially infected tissues or animals. Practice good hygiene when handling all small mammals.

Chlamydial and Rickettsial Diseases

Psittacosis

Causative agent: Psittacosis is caused by *Chlamydia psittaci*. Although the rate of infection is low in wild birds, most avian species are likely susceptible, especially during stressful periods (e.g., captivity).

Recognition in humans: Infection is usually acquired from inhalation of *C. psittaci* from desiccated droppings and secretions of infected birds in an enclosed space or directly from infected birds. Symptoms may vary (flu-like fever, body aches, anorexia) and appear 4-15 days after infection. A severe pneumonia with relatively mild clinical respiratory signs may occur. The disease is generally more severe in older individuals and those with underlying respiratory disease. Treatment with tetracycline is generally effective.

Diagnosis in animals: Psittacosis causes diarrhea and pneumonitis in birds. Chlamydia may be shed in excreta or be found in spleen, liver, heart, or intestine of infected birds, however, diagnosis of chlamydial infection can be difficult.

Control and Prevention: Good sanitation, ventilation, and reduction of stress can minimize the likelihood of chlamydial infection. Infected birds can be treated with oral chlortetracycline which will relieve clinical signs and reduce, but not eliminate, shedding of the organism.

Q Fever

Causative agent: Q fever is caused by the rickettsial organism *Coxiella burnetii*. The organism typically infects domestic ruminants, especially sheep. Cats may also be infected. Although infection has been documented in a variety of wildlife species, little is known about the disease in wild animals. Ticks are important in the spread of infection between non-human animals. The organism can also remain viable in the environment for extended periods of time.

Recognition in humans: Human infection with *C. burnetii* is classically acquired from inhalation of aerosols or dust contaminated with placenta, blood, or excreta from infected animals. Infection may also be from direct contact with infected animals or contaminated materials. After a 2-3 week incubation period, symptoms may include fever, chills, sweats, weakness, and retrobulbar headache (pain behind the eyes). Pneumonitis occurs in many cases as well. Antibiotic therapy is usually successful.

Diagnosis in animals: Infected domestic animals are usually asymptomatic, but may shed large numbers of organisms at parturition. Less is known about the disease in wildlife. Exposure to the disease is usually determined using serologic tests. The organism may also be isolated from milk, blood, tissues, or ticks.

Control and Prevention: Use good sanitation practices when handling animal placentas. Avoid inhalation of aerosol from potentially infected animals. Control ticks on animals. Although a vaccination is available, it is not commonly recommended.

Parasitic and Fungal Diseases

Baylisascaris infection

Causative agent: The raccoon roundworm, *Baylisascaris procyonis*, is rarely a cause of disease in the normal host; however, the parasite can cause disease in aberrant hosts (i.e., humans, small mammals, birds). Eggs are shed in the feces of infected raccoons and communal latrine sites used by raccoons are a source of infection for raccoons and other animals. Eggs can persist for years in the environment. Eggs ingested by abnormal hosts hatch in the gut and may undertake an aberrant larval migration.

Recognition in humans: Infection occurs from ingestion of eggs of *B. procyonis*. Although most infections are asymptomatic, clinical disease associated with aberrant larval migration can occur, especially in children. Symptoms are generally associated with larval migration through the CNS which cause tissue destruction as a result of direct damage and inflammatory reaction.

Diagnosis in animals: A high percentage of raccoons are infected with *B. procyonis*. A fecal sample can be submitted for parasitology examination for eggs.

Control and Prevention: Captive raccoons should be routinely treated with an anthelmintic such as pyrantel pamoate (10-20 mg/kg PO). Caging used for raccoons should not be used for other species. Good sanitation procedures should be used when cleaning caging and when handling raccoons. Children are especially at risk and should not be allowed to handle raccoons or potentially contaminated objects.

Hydatid Disease

Causative agent: Hydatid disease is caused by larval cysts of the tapeworm *Echinococcus multilocularis*. Eggs produced by adult tapeworms are shed in the feces of the domestic or wild (foxes, coyotes) canid host. Small rodents are the usual intermediate host. Clinical disease is generally not noted in the normal hosts. *E. multilocularis* is not known to occur in Colorado, but risk from importation of canids does exist.

Recognition in humans: Infection is acquired through ingestion of tapeworm eggs. Symptoms vary with size and location of cyst development within the body, but the liver is the most common organ affected.

Diagnosis in animals: Submit fecal sample from canids for parasitology examination for eggs.

Control and Prevention: Captive canids may be treated with praziquantel (5-10 mg/kg, PO or SQ). Good sanitation procedures should be used when cleaning caging and when handling canids.

Ringworm

Causative agent: Ringworm is a fungal infection of the skin affecting a number of different species of animals including humans. There are several types of ringworm and they are for the most part adapted to specific hosts. A similar disease in animals and humans is caused by the fungus-like organism *Dermatophilus congolensis*.

Recognition in humans: Transmission occurs by contact with fungal hyphae and their spores either directly or indirectly in bedding, feed, and on other objects. Clinical ringworm infection is characterized by expanding areas of red, itchy inflamed skin in the shape of a ring. It may also be characterized by thickening and crusting in the involved area and hair loss.

Diagnosis in animals: Animals with ringworm infections may show no visible signs and these inapparent carriers act as reservoirs of infection. Clinical ringworm is most common in young and debilitated animals. Diagnosis can be made by microscopic examination of a scraping from the lesion placed in 10% potassium hydroxide or through fungal culture.

Control and Prevention: Avoid contact (wear gloves) with lesions on animals. Although ringworm is rarely a serious condition, it will heal more rapidly with the use of antifungal drugs. Oral griseofulvin and/or topical antifungal treatments may be used in animals.

Sarcoptic Mange (Scabies)

Causative agent: Mange is caused by a mite. Infections with *Sarcoptes* mites have been reported in humans and a wide range of domestic and wild animals; however, wild and domestic ruminants are more commonly affected with other species of mites. *Sarcoptes* are fairly host specific; although cross infections do occur, they are usually temporary due to lack of reproduction in the unnatural host. Zoonotic cases of scabies are self-limiting after removal of the infective animal source.

Recognition in humans: Infection typically occurs by direct transfer of mites from an infected animal. Mites burrow into the skin and cause papules or vesicles. Itching is intense, and secondary bacterial infections may occur as a result of scratching.

Diagnosis in animals: Mange infections in animals are characterized by oily skin, crusting, hair loss, and scab formation. Infections typically begin on elbows and ears and can progress to involve large areas of the body. Affected areas are pruritic and often there is severe self trauma from scratching and rubbing the affected area. Mange in wildlife species predominately affects young animals and is more prevalent when populations are high.

Control and Prevention: Avoid contact (wear gloves) with infected animals. Acaricides can be used to treat infected animals. Treatments often have to be repeated over several weeks.

Toxoplasmosis

Causative agent: Toxoplasmosis is caused by the coccidian protozoan *Toxoplasma gondii*. Although infection with *T. gondii* can be found in a variety of mammals and birds (which serve as intermediate hosts), the protozoan requires a felid host for the sexual stage of its life cycle.

Recognition in humans: Infection can occur by ingestion of oocysts excreted in cat feces or through ingestion of bradyzoites in undercooked meat from infected intermediate host animals. Infections are commonly asymptomatic; however, fever and lymphadenopathy, or more rarely systemic disease, can occur. The infection is chiefly of concern to pregnant women because primary infection during pregnancy can result in fetal abnormalities or death.

Diagnosis in animals: Submit fecal sample from felids for parasitology examination for oocysts.

Control and Prevention: Good sanitation procedures should be used when cleaning caging and when handling felids. Serologic titers may be determined to predict susceptibility.

Viral Diseases

Hantavirus Pulmonary Syndrome

Causative agent: Rodents are the primary reservoirs of hantavirus. Each hantavirus appears to have a preferred rodent host, but other small mammals can also be infected. The deer mouse is likely the preferred host and reservoir for the newly recognized hantavirus in the southwestern United States; however, serologic evidence of infection has also been found in pinon mice, brush mice, and western chipmunks.

Recognition in humans: Hantavirus can be transmitted to humans through saliva, urine, feces, or tissues of infected rodents. Infective materials may be inhaled as aerosols produced directly by the animal or in the form of dust or they may be introduced through broken skin, conjunctiva, or possibly through ingestion. Symptoms of hantavirus may include fever, muscle aches, headache, and cough that progress rapidly to severe lung disease.

Diagnosis in animals: No clinical disease is known to occur in non-human animals. Infected rodents do not show clinical signs of illness.

Control and Prevention: CDC has issued recommendations for rodent-proofing dwellings and reducing rodent populations through habitat modification and sanitation. CDC has also issued precautions for workers in affected areas who are regularly exposed to rodents. These precautions include collection of a baseline serum sample, the wearing of a respirator and gloves when working around rodents, strict sanitation, and good education about hantavirus infection.

Contagious ecthyma (Orf)

Causative agent: Contagious ecthyma (CE) is caused by a parapoxvirus. Domestic and wild ruminants are the usual species affected.

Recognition in humans: CE is acquired by direct contact with lesions of an infected animal. Clinical signs of CE are usually localized to the part of the body coming into contact with the source of infection and arise after a 3-6 day incubation period.

Lesions of CE are confined to the skin and include vesicle formation that progresses to a weeping nodule and occasional regional lymph node swellings. Although secondary bacterial infections may occur, the lesions are generally self-limiting.

Diagnosis in animals: In ruminants CE is manifested as vesicles on the lips, ears, nostrils, and teats. Diagnosis can be made by electron microscopy or virus isolation.

Control and Prevention: Avoid contact (wear gloves) with lesions on animals. Wash exposed areas with soap and water after handling potentially infected animals.

Rabies

Causative agent: Rabies virus is an RNA virus in the family Rhabdoviridae. Rabies can occur in, and is likely fatal to, all mammals. Rabies vector species (RVS) of wildlife (and associated strains of rabies) vary with region within the United States, but include raccoons, skunks, bats, foxes, and coyotes. In Colorado, bats have been the only endemic RVS for about 20 years.

Recognition in humans: Most exposures to rabies result from the bite of an infected animal or by contact with the virus through other breaks in the skin or mucous membranes. Rabies is very rare in the United States, but many people receive treatment to prevent it each year. Disease in humans is characterized by CNS signs and death usually from respiratory failure.

Diagnosis in animals: In animals, rabies may present as either a furious or paralytic form. Wild animals may lose their fear of humans or exhibit other unusual behaviors in addition to the typical clinical signs of rabies. Brain or head from suspect animals should be submitted for examination using direct FA.

Control and Prevention: A pre-exposure rabies vaccination series with demonstrated titers is suggested for all animal health professionals and is required for individuals involved in rehabilitation of bats, hog-nosed skunks, or spotted skunks in Colorado (rehabilitation of striped skunks is prohibited). Care (protective clothing and good sanitation) should be used when handling all RVS and animals exhibiting abnormal behavior or excessive salivation. If a bite or serious scratch occurs, wash the wound thoroughly with soap and water and contact your physician and state or local health department.

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Glossary of Terms

Abscess - a circumscribed collection of pus

Anaerobic - without oxygen

Arthropod-borne - carried by "insects" (Insecta, Arachnida, etc.)

Asymptomatic - without symptoms of disease

Bradyzoite - an encysted form of the Toxoplasma organism

Canid - member of the dog family

Cervid - member of the deer family (deer, elk, moose)

CNS signs - signs of disease related to the central nervous system. Signs may include behavior changes, circling, loss of balance, etc.

Cyst - infectious "egg" of a protozoan parasite

Cyst (larval) - an abnormal sac containing fluid and larva

Ectoparasite - a parasite that lives on the surface of the host body

Encephalitis (plural encephalitides) - inflammation of the brain

Endoparasite - a parasite living within the body of its host

Enteric - relating to the intestines

Enteritis - inflammation of the intestines, especially the small intestine

Enterocolitis - inflammation of the small and large intestines

Epidemiology - the study of the prevalence and spread of disease in a human community

Erythema - inflammatory redness of the skin

Exotoxin - a toxin liberated to the extracellular area

Febrile - relating to a fever

Felid - member of the cat family

Fomite - a substance (clothes, equipment) capable of transmitting infectious agents

Herbivore - a animal that eats primarily vegetation as its food source

Hyphae - the branches of filamentous fungi

Lagomorph - member of the rabbit family

Lymphadenitis - inflammation of a lymph node or nodes

Lymphadenopathy - a disease process involving the lymph nodes

Malaise - a feeling of general discomfort or uneasiness

Oocyst - "egg" of a protozoan parasite

Papule - a small, circumscribed, solid elevation on only skin

Pneumonitis - inflammation of the lungs

Pruritic - itchy

Septicemia - systemic disease caused by the multiplication of microorganisms in the circulating blood

Serovar - a subdivision of a species or subspecies

Spore - a resistant stage of the tetanus bacteria or an asexual reproductive body

Symptomatic - relating to the symptoms of a disease

Subclinical - prior to the appearance of clinical signs of an infection

Tetanic spasm - a sustained muscular contraction

Trophozoite - asexual form of certain protozoan parasites

Vesicle - a small, circumscribed elevation of the skin, containing serum

Virulent - extremely disease provoking; markedly pathogenic

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