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Common and Reportable Infectious Diseases of Small Ruminants

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COMMON AND REPORTABLE INFECTIOUS DISEASES OF SMALL RUMINANTS

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Abstract

Keeping a herd healthy is the goal of every livestock producer. Deviation from a normal state of health leads to disease. It can have more than one cause, vary in severity, and differ from one animal to another. Of the three major categories that diseases are commonly grouped in, infectious diseases make up the largest. These are caused by "agents" and are capable of being transmitted from one animal to another, or from animals to man. While each disease can have its own clinical signs, failure to diagnose and prevent its spread can lead to catastrophic consequences to a livestock producer's herd. This paper presents information about the clinical signs, general treatments and approaches to the prevention of some common and reportable infectious diseases of small ruminants. They include several of the important foreign animal diseases and diseases that must be reported to state officials.

Keywords: Infectious Diseases, Clinical Signs, Prevention, Small Ruminants, Ruminants

Introduction

This paper focuses on common infectious diseases and reportable infectious diseases. The former group includes Blue Tongue, Caprine Arthritis Encephalitis, Foot Rot, Johne's Disease, Leptospirosis, Listeriosis, Malignant Edema, mastitis, Navel Ill, Overeating Disease, Pink Eye, Pneumonia, Q-Fever, Scours, Sour Mouth, Tetanus, and Warts. The latter group includes Anthrax, Brucellosis, Contagious Caprine, Pleuroneumonia, Foot and Mouth Disease, Peste des Pestis Ruminants, Pseudorabies, Rabies, Scrapie, Sheep and Goat Pox, Tuberculosis, and West Nile Virus.

Common Infectious Diseases

Bluetongue (sore muzzle, ovine catarrhal fever): An infectious, non-contagious viral disease, transmitted by biting flies, and other vectors

- ***Clinical signs***: After an incubation period of 4–6 days, a fever of 105°–107.5°F (40.5°–42°C) develops. The common signs are a blue tongue, congestion, hemorrhage, inflammation, and necrosis with depression, rapid and extreme weight loss, red mucous membranes of the mouth which turns purple to blue, frothing, lip ulcers, discharge from the eye and nose, weakness, red bands at the top of the hooves, lameness, and wool loss. Clinical signs in young lambs are more apparent, and the mortality rate can be high (up to 30%). Approximately 2 days after onset of fever, additional clinical signs may be seen, such as edema of lips, nose, face, eyelids, and sometimes ears; congestion of mouth, nose, nasal cavities, conjunctiva, and coronary bands; and lameness and depression. The congestion of the nose and nasal cavities produces what is commonly referred to as "sore muzzle". On examination of the mouth, small hemorrhages and ulcers will be seen. Some affected sheep have severe swelling of the tongue, which may become cyanotic ('blue tongue") and even stick out from the mouth. Animals walk with difficulty as a result of the inflammation of the hooves. A purple-red color is easily seen as a band at the junction of

the skin and the hoof. In most affected animals, abnormal wool growth resulting from dermatitis may be seen.

- ***Treatment***: There is no specific treatment for bluetongue except for rest, soft food, and good husbandry. If secondary infections appear they too should be treated appropriately.
- ***Prevention***: A modified-live virus vaccine is available for use in sheep in the USA. Use of vaccines with different serotypes does not provide consistent cross-protection. do not vaccinate ewes during the first two months of pregnancy.

Caprine arthritis encephalitis (CAE): CAE is a disease of the nervous system, caused by a virus, for which there is no vaccine or treatment. The type of virus that causes CAE is called a slow virus (retrovirus), meaning it takes a long time for the clinical signs to appear. It is transmitted (from mother to offspring) through the colostrum and milk of lactating does. It can cause an inflammation of the brain (encephalitis), or paralysis of the hind limbs in young animals, arthritis, and chronic pneumonia in older animals. With younger, does you may see hardening of the udder. It is transmitted from doe to kids early in life through infected colostrum and milk.

- ***Clinical signs***: Young kids (≤5 months) develop weakness in the hind legs, stumble, and finally lay down. Otherwise, they appear normal. The rear legs atrophy, the affected kid is unable to nurse, and soon dies from malnutrition. In older goats (≥1-2 years), the condition is presented as swollen leg joints (stifle, hock) that are painful and warm. Animals will eventually be unable to walk, or they will walk on their knees. It can also cause hard mammary.
- ***Treatment***: Treating the clinical signs (anti-inflammatory drugs, extra bedding, and foot trimming) can be effective, but it is not advisable as the disease could spread and persists in the herd.
- ***Prevention***: Blood test can diagnose the condition (even in animals which show no clinical signs) and if an animal tests positive it should be culled from the herd. Isolating kids at birth from positive mothers and bottle-feeding may help avoid transference.

Caseous lymphadenitis (CL, cheesy gland): This condition is a highly contagious, chronic disease, spread by a bacterium (*Corynebacterium pseudotuberculosis)* that causes abscesses to form in certain lymph nodes throughout the body (under the jaw, ear, flank, and udder). They are frequently seen in the nodes around the head and neck but can be found anyplace there are lymph nodes. The abscesses contain pus, which has a thick, cottage cheesy-like consistency, and a greenish-white to gray, or yellow color. Once seen, abscesses will grow until they rupture and seep the pus onto the ground, which will contaminate the pasture. There is a higher incidence in the west and south. Infections spread through wounds caused by head butting, punctures and shearing, by ingestion, inhalation, or penetration through intact skin. The survival of the bacteria is increased by contact with wooden (rather than metal) troughs, posts, and feed bins. There can also be incidences of abscesses that appear without an apparent cause or idiopathic CL. In this case, the abscesses are found within the goat's body (lungs, digestive system, etc.) and are hard to identify. As the organism is a common soil contaminant, abscesses can appear at any time, thus, all-new animals must be quarantined for at least 30 days or longer (if possible).

- ***Clinical signs***: Hard swellings around the head, leg, neck, or udders that gradually grow, become softer, and split open. In the case of idiopathic (unusual) lymphadenitis, the only clinical signs your will see maybe weight loss, a chronic cough, or difficulty breathing. Once the animal dies, if you do a necropsy, you will see abscesses throughout the body. In

sheep, you will find the abscesses most often internally (visceral form), while in goats the superficial form is what you will come across. Sheep exhibit similar clinical signs.

- ***Treatment***: When the abscess becomes soft and seems ready to burst, it can be lanced with a razor or scalpel blade and flushed out with an antiseptic or disinfectant. Lance abscess in an area away from the primary herd and discard all materials in a sealed bag. Give a shot of a broad-spectrum antibiotic to prevent secondary infections.

- ***Prevention***: Once established in your herd, this condition is hard to get rid of. Culturing the blood of an animal can expose the presence of the bacteria in the herd and that animal can be culled if you desire. A vaccine is available, but it does not prevent new infection, it only reduces the incidence and it causes side effects in goats, so it is not advisable for use in goats.

Foot rot (hoof rot): This contagious disease of the hoof is caused by two bacteria (*Dichelobacter nodosus, Fusobacterium necrophorum*) that exist in the soil. If the animal has had any injury to the hoof or has overgrown hooves, it is susceptible to contracting foot rot. A normal hoof is not red or swollen or crusty. Once established in your pen, it can be spread quickly throughout the herd. Although the animal will not usually die from foot rot, you will lose productivity of that animal, time for treatment, and materials used to treat it, so it is best to avoid foot rot. Quarantine new animals until you are sure they do not have foot rot.

- ***Clinical signs***: Lameness, foul odor, redness, warm feeling and swelling on the skin between the cleft of the toes and around the coronary band, foul odor in chronic cases. Also, you may see animals spending a lot of time on their knees. The hoof may separate from the bone with extreme inflammation and involving the sole of the foot.
- ***Treatment***: After trimming the feet, several different formulas can be used for a foot bath below: (also see Table 1 for different treatment regimens).
    - 10% zinc sulfate (8 pounds zinc: 10 gallons water), or
    - Copper sulfate (8:10) and formalin (1-gallon formaldehyde: 19 gallons water) at least twice weekly (but daily is preferable) for 30-60 minutes (**Copper sulfate toxic to sheep), or
    - Copper sulfate (10%) in vinegar - 1/4 (0.25) pound in one-quart vinegar, or
    - Copper sulfate in pine tar - 2 parts $CuS0_4$ in one-part pine tar, or
    - Oxytetracycline solution in alcohol - one 25.69-gram package to 1/2 cup water, then add alcohol to bring solution to 2 quarts, or
    - Penicillin in alcohol - 5 million units of potassium penicillin G with 10 milliliters of water, then add to 1-quart alcohol.
    - Apply a topical medication (Zinc sulfate (10%) - 1/4 (0.25) pound in one quart of water.

  A vaccine is available to control the condition, when all other conditions are met (trimming). Check infected animals every 3-5 days.
- ***Prevention***: Never buy animals from a farm with a history of foot rot, avoid buying animals from a livestock market, quarantine new or infected animals; disinfect tools and areas that have been exposed to the disease. Run new animals through a foot bath, and always disinfect transport vehicles. Vaccines for *Bacteroides nodosus* are approved for use in the U.S. They may range in effectiveness from 0-100%; most users report from 60-80% success.

Johne's (pronounced Yo-nees) disease (Wasting disease, Paratuberculosis): While rarely recognized in goats (as compared to sheep), this can have devastating effects on a herd (Ensminger, 2002). It is a silent killer, caused by a bacterium (*Mycobacterium paratuberculosis*) that is spread in feed, but there is some evidence that animals can be born with the disease or pick it up from the mother's milk. The bacterium causes the lining of the intestine to become

Table 1. Effectiveness of Different Treatments for Foot Rot

Study One		
	Treatment	%Cure
Group 1	Soak	38.9%
Group 2	Soak and feed antibiotic	36.3%
Group 3	Vaccinate	36.5%
Group 4	Vaccinate and soak	62.5%
Study Two		
	Treatment	% Cure
Group 1	Soak and pare	85.5%
Group 2	Footbath and pare	66.5%
Group 3	Vaccinate and pare	94.0%
Group 4	Vaccinate, pare, and clean	100.0%
As presented by W. Dee Whittier, Virginia Cooperative Extension, 2009		

thick, thus decreasing the animal's ability to absorb nutrients and the animal starves to death. These animals are also more susceptible to chronic parasite infection.

- ***Clinical signs***: Usually in animals 3-5 years old, progressive weight loss where clinical signs do not appear until the final stages, rough hair coat, decreased milk production, anorexia, and depression. Diarrhea can develop in the last stages of life in goats but not in sheep. There are no specific signs in sheep though there is considerable variation in its course. In some animals it progresses fast with death occurring a few months after wasting first appears while in others death may not occur for a long period of time (see Figure 2). Stress speeds up the progression.
- ***Treatment***: None.
- ***Prevention***: Test all new animals (fecal culture 40-60% effective, blood test good when animals symptomatic), cull exposed animals, avoid fecal to oral transmission ("All manure is suspect"). Tests include culturing fecal material for the organism (takes 6 weeks to 4 months to complete and can give false negatives). Fecal tests can also tell how the organism is being shed from that animal. Blood tests are quicker but can give false positives. For every animal that tests positive, there are probably 10 or more who are infected, also shedding, but do not show any clinical signs. Lambs born to ewes diagnosed with the disease should be culled as they are probably also infected (via feces or in utero). There is a vaccine (cattle vaccine can be used in sheep), and although it does not prevent infection it can reduce the number of bacteria excreted (recognize that some vaccinated animals can shed bacteria in the feces). There is no vaccine approved for goats in the United States. In Europe and Australia, a vaccine developed for sheep (Gudair®) is used in small ruminants which have been found to decrease the number of deaths in animals that develop

clinical Johne's disease and reduces the amount of shedding. It does not appear to change the rate that goats get infected.

Leptospirosis: Leptospirosis is caused by a bacterium that damages the liver, kidneys and other organs of animals and humans. It is spread through the urine of infected animals. Rats, mice and other wildlife can spread the bacteria. Humans contract the bacteria from infected urine, or through contact with water, soil or food that has been contaminated.

- ***Clinical signs***: Fever, anorexia, jaundice, diarrhea, abortions, stillbirth, or weak newborns.
- ***Treatment***: Antibiotics and supportive care.
- ***Prevention***: A vaccine is available for cattle, pigs and dogs. Isolate and treat infected animals. Fence off contaminated environments and keep wildlife from encountering domestic livestock.

Listeriosis (Circling disease): Though this condition is more prevalent in cooler climates, it may occasionally crop up in our temperate area. The route of transmission of the bacteria (Listeria monocytogenes) will affect how the clinical signs appear. Main route of contamination is usually consuming silage contaminated with soil. The bacterium is hardy and can survive in soil, silage, manure, milk, urine, and drainage from the eyes and nose, so it can be inhaled, swallowed, or transmitted via the eyes. This disease is also transmitted to humans and can be deadly; has severe consequences to pregnant women (encephalitis of the newborn, or abortion). Biosecurity is vital when dealing with infected animals.

- ***Clinical signs***: Rapid course with death within 24-48 hours after onset of signs. Abortion (at any stage of pregnancy), uterine infection, circling, fever, anorexia, red conjunctiva, blindness, paralysis on one side of the face, drooping ear or eyelid, convulsions (in encephalitic form), and depression.
- ***Treatment***: Treatment of animals that encountered the affected animals may prevent further infections, but the main tool is to avoid further feeding contaminated feed.
- ***Prevention***: Isolate sick animals, dispose of spoiled silage.

Malignant edema (Gas gangrene): While not commonly seen, this is also a Clostridial disease, and must be differentiated from other diseases like abscesses, bruising, and other conditions caused by clostridium. It starts when a wound is infected, and the toxin produced by the bacteria (e.g., *Clostridium perfringens* type A, C, *C. septicum type* C) kills the tissue surrounding the wound. Death can occur rapidly. Human wounds can be infected with the organism.

- ***Clinical signs***: Swollen or infected wound, with fever, depression, and anorexia. The infection will spread rapidly, and death generally occurs within 1-2 days after initial signs. In sheep, a condition commonly known as big head occurs in rams 6 months to 2 years of age with swelling under the eyes and the whole head in addition to the wound swelling.
- ***Treatment:*** Aggressive antibiotic therapy early on with removal of dead and dying tissue can halt progression.
- ***Prevention:*** In endemic areas, vaccination may help (must be done before castration; two doses 2-3 weeks apart and then annually). Revaccination is also suggested after an injury.

Mastitis: An inflammation of the mammary gland that can appear in different ways and is caused by the invasion of several kinds of bacteria (*Staphylococcus, Streptococcus*, etc.). Whatever the invasive organism, the causes vary from unclean milking equipment to rough

Table 2. Mastitis Causes and Treatment

Organism	Clinical signs	Drug of Choice
Hemolytic *Staphylococcus aureus*	Gangrenous mastitis and blood tinged fluid.	Penicillin, Ampicillin
Non-hemolytic *Staph. aureus*	Usually non-clinical. Hard lumps in udder.	Penicillin, Ampicillin, cloxicillin
Streptococcus agalactiae	Swelling, tenderness, normal-looking milk or small white flecks, watery.	Penicillin, Ampicillin, tetracycline
Corynebacterium pyogenes	Large lump in groin area above udder, swollen, thick, foul smelling milk, abscesses may develop in udder, decreased milk that is watery.	Penicillin, tetracycline
Klebsiella species (Coliform mastitis)	Udder is extremely hot, red and swollen, clear to yellow-brown fluid from udder. Fever is also a sign, and milk secretion may stop in one gland only. Animal will also be depressed, stop eating, have diarrhea, and lose weight.	Several antibiotics (penicillin-streptomycin combination, Oxytetracycline, Ampicillin) are effective but may be useless because of toxins produced from the dead bacteria and the damage done to the udder may kill the goat. Prolonged nursing care required. If the animal survives, the udder tissue returns to normal.

treatment of the udders by man or other animals. This will injure the udder and make it more susceptible to the bacteria.

- ***Clinical signs***: The udder is hot, painful, and swollen. There may or may not be a color change in the milk, or the milk may contain flecks, blood, or be thick or watery. The infected udder's color can range from slightly pinker to bright red. A black, cold udder is indicative of gangrenous mastitis, which can lead to loss of the udder (after tissue dies) and the death of the animal. With subclinical mastitis, there may not be any clinical signs, but milk production can drop at least 25%.
- ***Treatment***: Intramammary infusion of antibiotics is the first step to a cure. Always wash the teat with soap and water and wipe with alcohol before inserting anything into the udder. In serious cases, injectable antibiotics should be given. Remove any kids but milk the udder out 3 times daily. Bathing the udder in warm water helps to reduce swelling and pain. For the most effective treatment use a drug that will attack the specific organism. Table 2 gives you an idea of the type of mastitis you are dealing with, but the only sure way to know is to culture some of the milk for bacterial growth.
- ***Prevention***: Proper maintenance of equipment is essential (if used) as the organism can be spread from animal to animal. Goats with mastitis should be the last ones to be on a milking machine, after which it should be washed out and disinfected. If a goat has had a mastitis problem, use a dry doe treatment 2 months before she is ready to kid. Ensure that you have removed any physical hazards from your facility. The California Mastitis Test, a kit that contains all the reagents needed to test for the disease, is a good way to screen your herd and root out problems early. The only downside to this test is that the milk from healthy goats will sometimes show a reaction. It is best to cull repeaters of this disease.

Navel ill (Omphalophlebitis, Joint ill, Polyarthritis): A bacterial infection of the joints that is due to an infected navel cord. It can also be seen with an infection after castration or dehorning.

- ***Clinical signs***: High fever, failure to nurse, swollen, hard and tender navel. If treatment is not given, the bacterium enters the bloodstream and localizes in the joints. The joints will be hot and painful, mild fever, failure to stand, and seizures can occur.
- ***Treatment***: For animals recognized early (2 weeks or less) a broad-spectrum antibiotic can be effective. If the clinical signs have been going on for one or two months, treatment may be useless.
- ***Prevention***: Clean surroundings before kidding, clean hands if assisting during delivery, and dip navel cord in iodine.

Overeating Disease (Enterotoxemia, Pulpy kidney disease): This is an "auto-intoxication" of the gastrointestinal tract of goats caused by a Clostridial organism (types C and D). Type C affects adults, while type D affects younger animals. Type D is common in animals on a high grain diet or lush pasture. The overeating of feed, milk, or grass may slow down or stop the normal motility of the gut and leads to an overgrowth of the normal bacteria in the gut. These bacteria produce deadly toxins that get into the blood (Thedford, 1983).

- ***Clinical signs***: Sudden death of the best-conditioned young animal should always lead you to think of *Clostridium* type D. Those that survive the first 24 hours will have a fever, be anorexic, depressed, and colicky, have hemorrhagic diarrhea, have convulsions, and soon die. Some of those animals may have shown clinical signs of excitement, "star gazing," tooth grinding, incoordination, and convulsions. If autopsied, the gastrointestinal tract will be full of feed and the kidneys mushy. Diarrhea may or may not develop. With type C, there may also be sudden death with no clinical signs. Others will have a smelly, watery, blood-tinged diarrhea and death within a few days. Animals may also have abdominal pain, tremors and convulsions. Less severe cases recover after several days.
- ***Treatment:*** Intravenous injection of the antitoxin as early as possible, antibiotics and supportive care.
- ***Prevention***: Two doses of the vaccine, avoid overfeeding young animals, sudden diet changes, and allowing undernourished animals to gobble down their food.

Pinkeye: This is seen as an inflammation of the eye and can be caused by a variety of bacterial (*Mycoplasma conjunctiva* in goats and sheep*)* (*Chlamydia psittaci* in sheep) and viral agents. It is generally seen as a problem during the warmer, drier months, and can be readily spread with the wind, by insects or through the high grasses. It spreads quickly throughout the herd and can lead to blindness if not treated. Recovered animals can become asymptomatic carriers.

- ***Clinical signs***: Watery eyes, redness of the membranes around the eyes, excessive blinking, white cloud over the cornea, or corneal ulceration. Corneal opacity (the white cloud) can lead to loss of vision. *Chlamydia psittaci* can also cause abortion and polyarthritis in sheep.
- ***Treatment***: Antibiotic drops, shield animal from sunlight and isolate from the rest of herd.
- ***Prevention***: Isolate affected animals, keep insects down to a minimum (if possible), cut excessively tall grasses, and keep dust down in holding pens.

Pneumonia: Pneumonia is a general term, referring to inflammation of the lung and airways. It is usually accompanied by increases in the rate and depth of respiration. There are many different causes (infectious or noninfectious), including bacteria, viruses, parasites, allergens, or fluid aspirated into the lungs after drenching. *Mannheimia haemolytica* (*Pasteurella* haemolytica) is one of the organisms that can be a direct cause in sheep. The condition can show up acutely (short

term) with a quick death or be chronic (long term). Other conditions in sheep, Ovine progressive pneumonia (OPP) and maedi-visna are caused by a virus. There is also a very serious respiratory disease in goats that is a reportable foreign animal disease (see below).

- ***Clinical signs***: Fever, runny nose, dry or wet coughs, rapid or labored breathing, anorexia, breathing through the mouth, grunting when breathing. Stress and poor ventilation in the goat house can make the clinical signs worse. In many cases, signs are not noticed and the animal is found dead. OPP is seen mostly in sheep over 4 years old. Signs are respiratory distress and chronic wasting.
- ***Treatment***: Symptomatic care, antibiotics, proper ventilation, fresh food and water. There is a vaccine.

Q-Fever: Although Q-Fever is more of a problem in sheep, the bacteria (*Coxiella burnetii*) can infect goats. Its importance is in its ability to transfer from goats to humans. Cattle, cats, pigs, and dogs may be non-symptomatic carriers. Wild birds, rodents, and rabbits may also be carriers. Ticks may harbor the bacteria and then infect wild animals. In sheep and goats, the predominant sign of an infection is abortion (in the last week of pregnancy), and birth of stillborn and weak, live offspring. Humans contract the bacteria by encountering birthing fluids of infected animals, from the air, or by drinking contaminated milk. Stress can exacerbate the condition and should be avoided (www.sheepandgoat.com).

- ***Treatment***: Antibiotics for 2-4 weeks. In known infected herds, segregating pregnant animals indoors, burning or burying reproductive offal, or administering tetracycline prophylactically in the water before parturition may reduce the spread of the organism.
- ***Prevention***: Minimize contact with infected animals and practice biosecurity: 1) proper sanitation – good hygiene, especially when working with animals giving birth; 2) segregated kidding/lambing areas; 3) removal; 4) manure management; 5) control of ticks on livestock; and 6) restricting the movement of animals that have just given birth off the farm.

Scours (Diarrhea, Colibacillosis, Salmonellosis, White scours, Black scours): More than likely due to a bacterial (*E. coli*), or viral infection, seen in very young animals (<2 weeks of age) where environmental conditions are not ideal, they missed their colostrum, were overfed, had a vitamin A deficiency, or were heavily parasitized. It can lead to death within the first 30 days of life, and mortality can be as high as 50%. Black scours (Bloody scours) is caused by *Salmonella and* can be shed by carrier animals without clinical signs. With this type of scours, you must be careful when handling the animal, because it can be transmitted to humans.

- ***Clinical signs***: Watery diarrhea, rapid dehydration, depression, weight loss, anorexia, the skin is cold and clammy. With Salmonellosis, there will be blood-streaked or black tar-like diarrhea and is most common in young kids. They will have a high fever and may pass a stringy-like material. Several types of the *Salmonella* group have been associated with death and abortion in sheep. Deaths in neonates may also occur with few signs in lambs over 1 week old.
- ***Treatment***: Treatment should be tackled on three fronts: 1) replace fluids, 2) correct the electrolyte imbalance, and 3) kill the organism. Replace milk with a fluid formulated to replenish the animal's electrolytes (at a level of 10% of body weight for daily usage plus the amount lost due to dehydration) and give an oral antibiotic. Clean and disinfect the

environment to kill the organism. Treatment for a Salmonella infection will follow the same course.
    - Example of a fluid replacement solution: give the percentage of fluid lost plus 10% of the body weight per day. For example, if a 10 lb. kid has 10% dehydration, it needs at least 500 ml. of fluid just to replace the amount lost. To give 10% of its weight in fluids each day, it needs 1 liter per day. A quick solution to make is 10 grams of salt and 10 grams of baking soda in 2.5 liters of water.
- ***Prevention***: Good sanitary practices, isolation of sick animals, colostrum, good vaccination program

Sore mouth (Orf, Contagious ecthyma, Contagious pustular dermatitis (CPD): A viral disease that affects the lips, gums, and udders of young animals (less than one year). Older animals can be affected but lesions are mostly seen on the udder. This condition is contagious to man, gloves should be worn when working with infected animals. There have been cases in dogs that have eaten the carcass of infected animals. It is common in the late summer, fall, and winter.

- ***Clinical signs***: The lesions begin as small bumps (papules) that progress into blisters, and pustules, before they burst and scab. They are usually seen on the gums and lips but may also be seen on the hairless areas on the udders or on the feet (between the toes). Udder lesions are painful and if the doe will not allow the kid to nurse it may lead to mastitis. Kids may show lesions on the rear legs. A venereal form has been seen after rams are turned out with lesions on the skin-vaginal mucosa junction and the preputial orifice. The disease is self-limiting, i.e., it lasts 1-4 weeks. When the scabs have fallen off and healed, the animal will be fine and have developed immunity.
- ***Treatment***: Softening ointment on the lesions may help but treatment is usually ineffective. Antibiotics can be effective in treating secondary infections.
- ***Prevention***: A live virus vaccine is available but should be used cautiously because of the possibility of vaccine "breaks" and the possible contamination of uninfected areas. Isolate vaccinated animals from the herd until inoculation scabs have fallen off.

Tetanus: Poisons produced by another Clostridial bacterium also cause lockjaw; it affects the nervous system and can lead to death. The bacteria enter living tissue from a wound that closes quickly sealing the infection in.

- ***Clinical signs***: Appear 7-14 days after infection, stiffness, soreness, and hardness of muscles. 24 to 48 hours later, the animal is totally stiff. If it can stand, it assumes a "sawhorse" stance, the neck and head are extended, and the tail is erect. If disturbed, the animal will go into violent convulsions, nostrils will flare, eyes open wide, and the third eyelid (from the middle of the eye) will protrude across the eye. Eventually, the animal will not be able to stand and will die (with 4-7 days).
- ***Treatment***: Usually unsuccessful. Administer large doses of penicillin (injected into the muscle) and sedatives.
- ***Prevention***: Two doses of tetanus toxoid (30 days apart), and a yearly booster. If the animal is wounded, give a booster. Tetanus antitoxin can also be given if wounded (1,500 IU – 30-day protection).

Warts (Papillomatosis): In sheep and goats, the wart virus affects different areas of the skin. It is a self-limiting disease, i.e., clinical signs eventually subside with no ill effects for the animal.

Warts are spread by direct contact from animal to animal. They can also be spread when contaminated equipment such as shearing, ear tagging, or tattooing instruments are not cleaned properly between animals.

- ***Clinical signs***: Warts can be found on the head, neck, teats, ears, and penis. The lesions are white to grey, firm and raised. These lesions are harmless in almost all situations, except where mastitis or pain is involved and are most common in animals under 2 years of age.
- ***Treatments***: Many of the warts found in sheep and goats are often left alone. Treatments have had a varying degree of success; this is also true of vaccines (as the virus that causes the lesions is species-specific). If the lesion is offensive it can be removed surgically, but this should be done after it has stopped growing or it may come back. This can take many months.
- ***Prevention***: When an animal has a wart infection, it should be isolated from other animals. Any infected animal should also be kept from rubbing on feeders and posts that may be used by other animals. Good biosecurity as with all diseases must be carried out. That includes cleaning, shearing, tagging, and tattooing equipment with a broad-spectrum antiseptic/disinfectant like chlorhexidine.

Reportable Infectious Diseases

Reportable diseases are those designated dangerous and transmissible that can seriously impact animals and sometimes people. Outbreaks of these diseases can in many cases have major economic and public health consequences so surveillance programs have been established so that any incidence of the disease can be eradicated quickly. Some of the diseases do not exist in the U. S. but with the increase in animal imports and international travel, everyone must be diligent in keeping foreign animal diseases out of the country. All citizens are responsible for reporting cases of a suspected disease to a State or Federal Health Official. While these diseases are seldom (or never) seen in a normal healthy herd, a producer should be familiar with the clinical signs indicative of an outbreak.

Anthrax: Caused by a bacterium (*Bacillus anthracis*), this old but deadly disease can destroy a herd and can be transmitted to man. The spores of the anthrax bacilla are very difficult to kill and can survive in the soil for years. They are spread from animal to animal, through contaminated feed, grazing on contaminated land, drinking contaminated water, eating animal by-products or poorly cooked meat. It can kill an animal in 2-6 hours or take up to 48 hours after clinical signs appear. In man, there is the skin form (malignant carbuncle or pustule), the pneumonic form (from inhaling spores), and the intestinal form (from eating infected meat). If you suspect anthrax, contact your veterinarian and state health officials.

- ***Clinical signs***: High fever (107º), depression, dark red-purple lining of the mouth and eyes, bloody diarrhea, rapid breathing (shallow), and a rapid and weak heartbeat. The milk or urine is blood-tinged, the tongue, throat, flanks, and area around the anus and vulva are swollen. If the animal dies, you will see blood seeping from the body openings and a lack of stiffness to the carcass.
- ***Treatment***: None.
- ***Prevention***: If this is prevalent in your area, you may consider vaccination. Vaccination after an outbreak is the only way to stop the spread. Consult your veterinarian. Also, consult your state health officials to determine the best way to dispose of carcasses, but NEVER OPEN A CARCASS IF YOU SUSPECT ANTHRAX.

Brucellosis (Bangs disease, contagious abortion): Most species of Brucella are primarily associated hosts specific; though, infections can also occur in other species, particularly when they are kept in close contact. The species that causes this disease in sheep and goats is *Brucella melitensis*. Most breeds of goats are readily infected, but the susceptibility in sheep breeds vary greatly. B. melitensis infections are also been reported occasionally in cattle, camels and dogs, and rarely in horses and pigs. Transmission is through contaminated feed or aborted fetuses or uteri, and infections can spill over into wild ruminants. When seen in humans, Brucellosis has been traced back to drinking unprocessed goat milk or milk products.

- ***Clinical signs***: The clinical signs can be silent (mastitis, lameness, slightly loose stool), or there can be abortion in the final stages of pregnancy (4-6 weeks before kidding). Animals that abort may retain the placenta. Sheep and goats usually abort only once, but reinvasion of the uterus and shedding of organisms can occur during later pregnancies. Some infected animals carry the pregnancy to term but shed the organism. Milk yield is drastically reduced in animals that abort, as well as in animals whose udder becomes infected after a normal birth. However, clinical signs of mastitis are rare. The male may have swollen joints or testicles (see Figure 3) which can result in infertility. Arthritis is seen occasionally in both sexes. Many non-pregnant sheep and goats remain asymptomatic.
- ***Treatment***: None.
- ***Prevention***: Check new animals, a blood test can diagnose the condition. Vaccinations, though relatively new, have proven effective in goats; however, they have not been approved for use in the U. S.

Contagious Caprine Pleuropneumonia (CCPP): This one of the most severe diseases of goats. This disease, which affects the respiratory tract, is extremely contagious and frequently fatal; with mortality rates reaching 100%. It causes major economic losses in Africa, Asia and the Middle East, where it is endemic. It is caused by a bacterium (*Mycoplasma capricolum*).

- ***Clinical signs***: Death can occur acutely with no signs within 1-3 days. Animals may have a fever (106º-109ºF), be lethargic, anorexic, have a cough and labored breathing. When the animal is close to death, it will not be able to move and show the familiar signs of pneumonia. Pregnant animals may abort. Most animals die within a week to 10 days. Some animals can be chronic carriers.
- ***Treatment:*** If given early, antibiotics can be effective, but that animal may continue to be a carrier.
- ***Prevention***: Quick response in an outbreak prevents further infection. Infected animals must be quarantined. A vaccine does exist.

Foot and Mouth disease (FMD): FMD occurs worldwide, and while not seen in the United States in over 70 years, this disease is of major risk to the livestock industry. You are required to report any suspicious condition that may be FMD to your local veterinarian and state animal health officials. It is caused by a virus that can be spread from animal to animal, in feed, on your shoes and clothes, or carried by the wind.

- ***Clinical signs***: Goats are depressed, have a fever, and small blisters will break out on the mouth and tongue. When these blisters pop they will leave small ulcers. Blisters will also appear between the toes and on the feet. Those turn pale and peel off, leaving erosions and sores. The animal will be lame; they will secrete excess saliva and stop eating. You should

differentiate FMD from Goat Pox (not common in the United States), and Sore Mouth. Signs are generally mild in adult sheep with the first sign observed is lameness. The most common site for erosions is on the dental pad. In the early signs, milk production decreases.

- ***Treatment***: None.
- ***Prevention***: All exposed animals should be immediately destroyed, and strict biosecurity precautions taken. There is one vaccine approved for use in the U. S., but it requires approval from state or federal authorities.

Peste des Pestis Ruminants (PPR, Pseudorinderpest of Small Ruminants): This is a foreign animal disease (mostly West Africa) caused by a virus that is transmitted by direct contact with sick animals.

- ***Clinical signs***: Sudden rise in temperature with restlessness. The muzzle is dry but has a clear discharge and reddening around the eyes. Diarrhea, dehydration, and anorexia sometimes are seen. Pneumonia develops; most animals die within 10 days.
- ***Treatment***: None.
- ***Prevention***: A vaccine is available for cattle but is not used in the United States. This disease is reportable in the United States.

Pseudorabies (Aujeszky's disease, mad itch): Pseudorabies is a highly contagious, disease of pigs. Other species may be infected when they encounter infected pigs (especially feral pigs), resulting in a fatal CNS disease. Clinical signs in pigs may vary depending on the age of the animal affected. Piglets usually have a fever, stop eating, and show neurological signs (seizures, paralysis), dying within 24-36 hours. Older pigs may show similar symptoms, but may often have respiratory signs (coughing, sneezing, difficulty breathing) and vomiting, are less likely to die and generally recover in 5-10 days. Pregnant sows can abort or give birth to weak, trembling piglets. Feral pigs can be asymptomatic carriers of the virus and transmit it to other animal species.

- ***Clinical signs***: In cattle and sheep, the disease is almost always fatal within a few days. The first symptom is intense itching concentrated in a patch of skin; this is usually manifested as severe licking, rubbing or gnawing. Self–mutilation is common. Affected animals become progressively weaker. Convulsions, bellowing, teeth grinding, cardiac irregularities and rapid, shallow breathing are common.
- ***Treatment***: None
- ***Prevention***: Control feral pig access to livestock.

Rabies (Hydrophobia): It is important to list this condition because it can be transmitted to your goats from domestic animals or wildlife. It is caused by a virus and can affect all warm-blooded mammals and man. It can be contracted through a bite or by saliva from an infected animal by entering an open wound.

- ***Clinical signs***: Confusion, depression, loss of milk production, loss of appetite, chewing on foreign objects, inability to swallow, drooling, excessive bleating, dilated pupils.
- ***Treatment***: None
- ***Prevention***: While there are no vaccines available specifically for goats, there are some vaccines for other animals that are effective. Consult your veterinarian.

Scrapie: A chronic, fatal disease of the nervous system that is more common in sheep than goats. A unique organism called a prion causes Scrapie. It can take up to two years (after infection) for

clinical signs to appear. While similar disease conditions exist in humans and other animals (Table 3), no link has been shown between eating meat from Scrapie affected animals and similar diseases in humans. With that said, it is still recommended that the meat from positive animals not be used for human consumption. Clinical signs of Scrapie may mimic other nervous conditions (fine tremors, head pressing, and stargazing).

- ***Clinical signs***: The early clinical signs are of a nervous animal, with muscle tremors, and a wobbly gait. Animals will bite at their legs, smack their lips, wobble or stumble, shake and jump at normal sounds, press its head on things for a long time, stare up at the sky, cannot get up, and eat but stay thin. Constantly itch, pull out their wool, bunny hop, step high with their front feet, sway in back, rub on things a lot. Goats differ from sheep in that the classic sign of intense itching is not as prevalent. It takes a long time for clinical signs to appear (up to five years), and 1-6 months for them to progress to the point where the animals eventually lay down and die.
- ***Treatment***: None.
- ***Prevention***: Many farmers will have their herds tested; so that they can be assured that they are Scrapie free. The disease may occur in "families," so siblings and parents of an infected animal should be tested.

Sheep and Goat Pox: This is an acute and chronic foreign animal disease, endemic in Africa, the Middle East, India and Asia which is characterized by pox lesions throughout the skin and mucous membranes. Signs also include persistent fever, enlarged lymph nodes, (sometimes) and pneumonia. A virus causes it and cattle can be carriers (but show no signs) (www.vet.uga.edu, 2004).

- ***Clinical signs***: Clinical cases vary from severe to subclinical. Initially, there may be fever, depression, and inflammation of the conjunctiva, tearing, and inflammation of the nasal cavity. After a few days, pox lesions appear (they feel like a nodule), mostly on the hair-free parts of the body. These lesions start as small, reddened papules, with the center becoming depressed and gray (necrosis). Within a month of the appearance of the first signs, the lesions dry up and a scab forms. Secondary infections, like pneumonia, may occur. With this disease, you can have up to an 80% occurrence in the herd, with 50% mortality.
- ***Treatment***: None
- ***Prevention***: In endemic areas, vaccination is the only effective means of prevention. Control is through confirmation and quarantine, and culling of affected animals, followed by disinfection of the premises.

Tuberculosis: Though not talked about much anymore, Tuberculosis, a chronic respiratory disease, does exist in animals and can occur in goats, though it is rare in sheep. *Mycobacterium bovis* (the cattle species) is the species that causes progressive disease in most warm-blooded vertebrates, including people. *M. caprae*, an organism closely related to the cattle species has been isolated from people, goats, cattle, and several other species in Europe. Transmission is through inhalation of infected droplets expelled from the lungs (from manure, urine, bedding), although ingestion, particularly via contaminated milk or water, also occurs. Transmission to humans can occur from the drinking of raw milk or other dairy products (made from unpasteurized milk), by inhaling bacteria shed by infected animals, or from contamination of unprotected cuts on the skin while handling infected animals.

- ***Clinical signs***: Signs are not specific; there can be a loss of appetite, reduced milk yield, or respiratory signs (such as a chronic cough). Lesions, like those seen in cattle, can be seen in the lungs and lymph nodes of sheep and goats and these may be the only indication of herd infection.
- ***Treatment***: None
- ***Prevention***: The intradermal skin test is commonly used for diagnosis. The responses should be observed at 48 and 72 hr. for hardening and swelling. Test and slaughter and good biosecurity measures in the event of an infection are the best methods to control the disease.

West Nile Virus: West Nile virus (WNV) is an infectious disease that first appeared in the United States in 1999. Infected mosquitoes spread the virus that causes it. Birds contract the virus initially; mosquitoes become infected when they feed on infected birds. When the mosquito bites an animal or human they can then transmit the West Nile virus. If you have had dead birds

Table 3. Scrapie like Diseases in other Species

Scrapie	Sheep, goat
Chronic wasting disease (CWD)	Deer (white-tailed, mule), Elk
Bovine spongiform encephalopathy (BSE)	Cattle, bison, kudu, oryx, eland
Transmissible mink encephalopathy (TME)	Farmed mink
Feline spongiform encephalopathy (FSE)	Domestic cat, puma, cheetah, lion, panther, ocelot
Kuru	Man
Creutzfeldt-Jakob disease (CJD)	Man

in your area and your goats are exhibiting clinical signs related to encephalitis check with your local veterinarian just to differentiate it from other diseases (e.g., Polioencephalomalacia, Listeriosis, and Rabies).

- ***Clinical signs***: Affected goats, sheep, alpacas, reindeer and white-tailed deer may show neurological signs.
- ***Treatment***: Supported care
- ***Prevention***: A vaccine is available for horses and alligators. Mosquito control is important on-farm.

NOTE: While general treatments have been pointed out in this paper, animals with any of the conditions listed above should be under the care of a veterinarian as a lot of the treatment regimens need drugs that are not approved for use in small ruminants and would have to be used Off-label.

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