



Sheep and Goat Management in Alberta Health



Alberta Lamb Producers

Alberta Goat Breeders Association



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Alberta Lamb Producers

Agriculture Centre,
97 East Lake Ramp NE
Airdrie, Alberta T4A 0C3

Phone: (Rite) 403-948-8533

Fax: 403-912-1455

Email: info@ablamb.ca

or

Alberta Goat Breeders Association

Box 330
Hay Lakes, AB T0B 1W0

Phone: 780-878-3814

Fax: 780-878-3815

Email: info@albertagoatbreeders.ca

The Alberta Lamb Producers and Alberta Goat Breeders Association would like to acknowledge and thank the author of this publication



Chris Clark VetMB, DipACVIM, PhD

Western College of Veterinary Medicine

University of Saskatchewan

Saskatoon, SK

**Dr. Kathy Parker (Chapter 20, C.Ovis) and
Jennifer Woods (Appendix 2, Euthanasia)**

as well as the members of the Advisory Committee:

Dr. Kathy Parker on behalf of ALP,

Jackie Dunham on behalf of AGBA and

Tamara Taylor B.S.A. on behalf of AGBA.

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Publishers

Alberta Lamb Producers and
Alberta Goat Breeders Association

This publication has been made possible by funding from the Diversified Livestock Fund of Alberta.

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**DIVERSIFIED
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1. Disease

Traditional definitions of disease run along the lines of “a derangement of normal physiology.” That is to say, the normal function of the body has been disrupted. The definition of disease in modern agriculture has been slightly altered, to:

“Failure to produce at expected levels, given a suitable environment and adequate nutrition.”

This definition is much broader and includes potential problems such as reduced growth rate or fertility difficulties.

Why Bother with Disease?

Disease is important in any livestock operation for three main (and equally important) reasons:

Economics

Disease costs money. When most producers think of disease, they usually think of losses due to dead animals and costs incurred for treatment such as drugs and veterinary bills. These are the expenses that are up front and directly out of pocket. In reality, disease problems are often more costly than this due to reduced production, wasted time and decreased product quality. **Control of disease in all forms makes good economic sense.**

Animal Welfare

Any animal that is sick for any reason is assumed to be suffering. Animal agriculture is under increasingly intense scrutiny by the media

and general public to be sensitive to animal welfare issues. It is vital that disease is controlled and animal suffering minimized to ensure that the general public (or consumers) maintains a high regard for the industry.

Food Safety

Food safety programs, also known as On-Farm Food Safety, (OFFS) serve to control potential hazards to human health that could possibly develop when agricultural products are eaten. Possible hazards could be chemical, physical or biological.

Anyone who has seen the news in the past five years will appreciate how serious a food scare associated with contaminated animal products can be. It is vital for everyone in the industry to have control measures in place to avoid food scares and maintain consumer confidence in our food products.

The Management Diary

Do you know what your production targets are or should be? If you do not measure it, you cannot manage it. It is best to keep notes or information on animal performance in a central location; this could be as simple as a diary about performance or health changes or as complex as a computer program where you can record daily weights and production observations. Such systems enable you to analyze the information for disease incidence and mortality patterns.

Causes of Disease

When people think of disease, they usually think of infectious diseases, especially those caused by bacteria. In reality, given our new definition of disease, there are many causes of disease.

Disease can be split into two distinct types: **Infectious** and **Non-infectious**.

Infectious Disease

Infectious disease is caused by any infectious agent that enters the body, reproduces, disrupts normal physiology and then spreads to another host either horizontally or vertically. Horizontal transmission occurs between two independent individuals, for example, bacterial pneumonia spreading among a pen of feeder lambs. Vertical transmission occurs between two dependent individuals, for example, a ewe and her developing fetuses as in the case of border disease virus (BDV). Some diseases can spread both horizontally and vertically. Knowing how a particular organism spreads is important when you are designing control and treatment protocols.

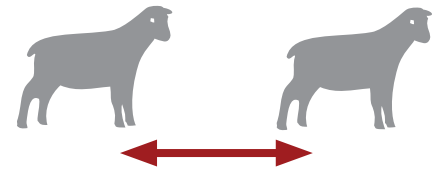
A number of different types of organisms can cause infections.

Bacteria

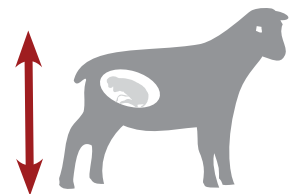
Bacteria are microscopic cells that are able to reproduce in the body and in the environment. There are many different types of bacteria. The specific type of bacteria determines:

- The type of disease caused and the tissues affected
- If a toxin is produced
- How well the bacteria can survive outside the body in the environment
- How resistant the bacteria are to disinfectants
- Which antibiotics will be effective in treating the disease

Note: Antibiotics are used to treat bacterial diseases only. There are several antibiotics available, each with **specific** disease impact abilities. To treat a specific infection effectively, an antibiotic needs to be aligned with the corresponding infecting bacteria. The **wrong** antibiotic will not be effective in controlling or curing bacterial infection.



Horizontal transmission occurs between two independent individuals



Vertical transmission occurs between two dependent individuals, for example, a ewe or doe and her fetus

Antibiotics have no effect against viral diseases.

A mycotoxin is a toxin produced by bacteria or a fungus. Mycotoxins can affect pre-harvested forage and grains, whereas toxic moulds can affect post harvested forages and grains.

A number of bacteria, such as *E. coli*, *Salmonella* and *Listeria*, can cross species barriers readily, presenting a challenge to food safety and animal health protocols.

There are also some specific sub-types of bacteria that may act differently than classic bacteria do. These include mycoplasma and rickettsia. Examples of diseases caused by these microorganisms are would be acute pneumonia (mycoplasma) and Q-fever or infectious abortion (*Rickettsia*).

Viruses

Viruses are single-celled organisms. Unlike bacteria, they cannot grow outside the host animal but can persist in the environment given the right conditions. Viruses need to enter a cell in the body to be able to multiply. Once inside, they hijack the cellular machinery to produce new viruses before killing the host cell, which causes the disease.

There are many types of viruses. The exact type of virus influences which cells are affected and how long the virus can survive in the environment.

Generally, viruses are animal species specific but there are exceptions, for example, influenza.

Fungi

Fungi are a large family of organisms ranging from moulds to mushrooms. Fortunately they rarely cause disease in healthy animals. Some moulds that grow on feed can produce mycotoxins that can cause disease; others (such as *Aspergillus*) may infect animals by contaminating their forage.

Fungal diseases need very specific drugs to be effective. Treatment is rarely undertaken and in most cases, problems can be handled by improving feed and bedding quality.

Parasites

Parasites can be broadly divided into three families:

1. Insects
2. Worms
3. Protozoa (single-celled organisms)

Each family can be further sub-divided:

1. Insects, including flies, lice and arachnids (the latter have eight legs and include mites and ticks), and
2. Worms, including roundworms, tapeworms and flukes.

4 Disease

It is important to recognize that not all parasites belong to the same family and that there is no anti-parasite drug that treats all of the different families. Different parasite families also have different life cycles; understanding a parasite's lifecycle is critical to any control program. Consequently, control measures must be specific for each parasite family and strategically planned to maximize their effectiveness. Comprehensive control programs include both management and pharmaceutical considerations.

Non-infectious Causes of Disease

Genetic Diseases

Some animal diseases are caused by defects in the genetic code of the parents, which are passed on from generation to generation. There is a wide variety of such diseases, which are often specific to certain breeds. Some may be present at birth while others may show up later in life.

For some diseases, there are genetic markers which can be used to identify those individuals that are either carrying the undesirable gene or are free from it, for example, the spider gene in Suffolk sheep. If the heritability pattern is understood for a genetic disease then it is possible to select against the disease.

Congenital Disease

A congenital disease is any disease that is present at birth. Congenital disease may either be **inheritable** (have a genetic basis) or **non-inheritable** (caused by **maternal** disease during pregnancy or **fetal** exposure to toxins, for example).

Maternal—relating to the dam or mother of the fetus/progeny

Fetal—relating to the fetus

Nutritional Diseases

Some diseases may be due to imbalances in the diet or deficiencies of key nutrients such as vitamins or minerals. Disease can also occur when certain of these nutrients are consumed in very large amounts (toxicity). The diagnostic work up for nutritional disease may include:

- A complete ration and feed analysis
- Water quality analysis, both chemical and biological
- Submission of tissue samples for analysis

Toxins

Toxins can cause a wide variety of diseases. Toxins may be:

- Natural (from plants)
- Farm chemicals such as pesticides, herbicides and fertilizer
- Drugs such as antibiotics and parasite control products
- Excessive doses of nutrients such as copper
- Discarded junk such as old truck batteries

Toxin identification can be very difficult and usually requires laboratory assistance. A successful toxic incident investigation must include a complete history and assessment of the animal's environment.

Trauma

Certain disease conditions occur simply as a result of physical damage, such as dog bites, fly strike and hanging.

Neoplasia (Cancer)

Cancer occurs when there is a loss of control of normal cell division in a tissue resulting in overgrowth of the cells, typically causing a lump or tumour. There are "well behaved" forms of cancer and "downright nasty" forms of cancer, each associated with very different treatment options and prognoses. Some lumps or swellings can be malignant (cancerous) while others are benign (non-cancerous). It is impossible to determine what kind of growth you are dealing with simply by looking at it; laboratory evaluation is required to make a successful diagnosis.

Although neoplasia is rare in sheep and goats, these animals can suffer from cancers of any body system, just like any other species.

Degenerative Conditions

Some disease conditions, such as arthritis, occur simply because body tissues wear out over time.

Degenerative disease can be aggravated by conformational defects that cause excessive wear and tear on joints, such as an animal being sickle hocked or malformed.

Allergic Situations

Some disease conditions occur when the body develops an allergic response to a substance that has either been consumed, inhaled, injected or applied. For example, an anaphylactic reaction in an animal following an antibiotic injection is a type of allergic reaction.

Anaphylactic Reaction
– an unusual or exaggerated response to foreign protein.

Iatrogenic Diseases

These are diseases that are caused by humans, either producers or veterinarians. Iatrogenic disease can occur by direct action, for example, rectal prolapse occurring because tails were docked too short, or indirectly by poor management.

Sporadic Diseases

Disease conditions occasionally occur that are out of the producer's control. This could include an animal being hit by lightning.

Identifying the cause of any particular disease "outbreak" always starts with a review of the management diary and a discussion with someone who can help sort out the details.

Some of the questions to be answered may include:

- What animals got sick and when?
- Who died and when?
- How old was the animal at the time of death?
- What preventative health protocols were in place?
- When were new animals introduced to the flock?
- What were the post-mortem results?
- What did laboratory reports say?

After these factors have been determined, a treatment plan and disease management strategy can be worked out. Strategies can be developed once you know the "enemy". More often than not, these strategies are not complicated.



2. The Immune System

The world is full of infectious agents seeking some animal site where they can colonize. Fortunately, all mammals have a series of defences to prevent this from happening.

Infectious disease occurs when these defences are overcome.

Defences can be broadly split into two types: **Innate** and **Acquired**.

Innate Defences

Innate defences are those with which animals are born. They are, in most cases, simple, basic and very effective.

The Skin

Skin is an effective barrier to most infectious agents. The outer surface of skin is dead and does not support the growth of many bacteria. There are, however, specific bacterial populations that thrive on the skin. This “natural” bacterial population tends to exclude disease-causing organisms. Most infectious agents need a preformed break in the skin in order to enter the body. Tail docking or cuts from feeders or fences could provide such a skin break.

The Intestines

Similar to skin, the intestines are lined by a barrier and have their own “natural” bacterial population that keeps the “bad bacteria” in check. In addition, the contents of the intestines are always moving through, so most invaders will simply be swept away with the flow. In addition,

Abomasum

– true or fourth stomach.

Pathogenic

– disease causing.

Cornea

– the surface of the eye.

the abomasum is full of acid and enzymes which may serve to control some of the infectious agents that are eaten.

Any change in feed will disrupt the normal bacterial population of the intestines. This disruption may create a window of opportunity for pathogenic organisms to develop a foothold, leading to disease.

The Lungs

The first defence for the lungs is the nose. Air is filtered by the hairs in the nose; the shape of the nasal passages also causes most particles to be “spun” out of the air and captured in the nasal mucus. The lower airways are also lined with mucus which rests on a carpet of fine hairs (cilia). The hairs wave in unison, continually moving the mucus out of the lungs towards the throat, where it can either be swallowed or coughed out. Finally, the lungs contain a resident population of immune cells to deal with invaders.

Many viruses attack the upper airways, damaging the cilia and making it easier for bacteria to penetrate the lungs, where they can cause severe pneumonia.

Cold air and lowered body temperature reduce the activity of the cilia in the airways, making it harder to move the mucus and protect the lungs.

The Eyes

Similar to skin, the cornea is a barrier to micro-organism invasion. In addition, tears continually wash the eye and contain anti-bacterial compounds. Damage to the surface of the eye from a foreign body, such as a piece of sand, can allow bacteria to colonize, resulting in disease. Some diseases affect the cornea directly without the need for injury to occur first.

The Mammary Gland

The entrance to the mammary gland is protected by a tight muscular ring (sphincter) which prevents bacterial entry at the end of the teat. In addition, the skin lining the sphincter does not support bacterial growth and is continually shed to prevent bacteria colonizing the area. The flow of milk should always be “one way” out of the mammary gland; if bacteria should enter the gland they are immediately flushed out. Finally, milk contains immune cells and anti-bacterial factors that can prevent bacterial growth.

10 The Immune System

Mastitis, or inflammation in the mammary gland, tends to occur when there is damage to the end of the teat, which could be caused by frost-bite or trauma. These injuries can disrupt the normal defence mechanisms of the mammary gland. Udder health can also be affected by udder and teat conformation problems.

Following good procedures for cleaning the teat end before using any intra-mammary preparation is critical to maintaining udder health.

The Uterus

The entrance to the uterus (cervix) is a tight muscular sphincter that keeps most disease out. It is only open at breeding and birth. Most problems of the uterus occur during an assisted birth when the stock person has to manipulate the lamb or kid. It is vital to clean the back of the animal with mild disinfectant soap (such as Hibitane) before attempting any fetal manipulation. After washing the perineal area (back side) of the ewe or doe, wipe washed area with a paper towel to ensure that as much of the contaminated wash water as possible is cleaned from the area. Clean hands thoroughly before assisting with a birth, to avoid infection of the uterus. Ideally, it is best to wear disposable OB gloves during obstetrical manipulations to protect both the ewe or doe and producer from disease. **These obstetrical gloves should not be reused; they are meant to be used once and then disposed of.** If the gloves are used over and over they tend to be a serious vector for the spread of disease between birthing females.

The Urinary System

The urinary system is protected by a number of muscular sphincters. Urine flow is normally one way away from the bladder to the outside, which results in a continual washing action of the urinary system. Urinary infections are much more common in females because the female urethra is much shorter than the male urethra. Problems with fully expelling urine (often caused by retained placentas), damage to the vaginal floor (for example, during fetal manipulation) or the presence of sugar in urine make urinary infections more likely in the female.

In the male urinary tract disease can be caused by calculi (stones) causing obstruction to urine outflow, or trauma to the urethra from poor banding techniques.

Overall, it is possible to influence the quality of innate immunity of stock by providing them with adequate nutrition and adopting good husbandry practices. This is where management skill really pays for itself.

Urethra
- Membranous tube conveying urine from the bladder to the exterior of the body.

Acquired Immunity

When the innate immune defences have been overcome, the acquired (or learned) immune system is the second and last line of defence.

When the body is exposed to a foreign organism, the body's immune system is able to recognize it as foreign and attack it.

There are two broad systems involved:

1. Antibodies
2. Cell-Mediated Immunity (CMI)

Antibodies

Antibodies (or immunoglobulins) are specialized proteins able to bind closely to the invading micro-organism's surface, like a key fitting into a lock. Each antibody identifies only one type of invading micro-organism. When an antibody finds a foreign organism, it signals the immune system to come and destroy the invader.

When the first antibodies produced by the body recognize an invader, the body starts to make more of them and improve upon their design. The process by which antibody production is increased takes time, typically several days, and may take three weeks to complete. It is during this time, when the immune system is learning, that the animal may show signs of sickness. When sufficient antibodies have been produced, the immune system can destroy the invaders and the animal can recover.

After the animal recovers, the antibodies continue to circulate through the body. If the animal is exposed to the same organism again, the antibodies allow the organism to be destroyed before it can cause disease.

Types of Antibody

Antibodies can prevent disease in three main ways:

1. The antibody binds to the invading organism and signals the immune system to destroy the entire organism.
2. Some bacteria produce toxins that cause disease, for example, blackleg. Antibodies bind to the toxin, inactivating it and therefore preventing disease. These antibodies are known as anti-toxins.
3. Many invading organisms have specific proteins on the surface that allow them to bind to host cells and "hang on" to prevent their being swept away, for example, in the intestines. Some antibodies can bind these attachment proteins so that the bacteria become detached and therefore cannot cause disease.

Antibody levels can be measured by laboratories and are reported as a titre. The higher the ratio, the higher the animal's titre, for example, a titre of 1:1000 is higher than a titre of 1:2.

Antibodies are also supplied by colostrum to the newborn (refer to *Chapter 2, Young Animals*.)

Cell-Mediated Immunity (CMI)

Some bacteria and viruses have developed very complex techniques for hiding from antibodies. Often this involves entering animal cells and using the cells' inner machinery for its own replication. In such cases another arm of the immune system, involving very specialized "killer" cells "learn" to recognize and destroy the infected cells. CMI in an animal can only come from exposure to disease or vaccination.

Why Do Animals Get Sick from Infectious Disease?

In many cases, the first time an animal is exposed to an invading organism, the time lag for the immune system to learn is too long. This allows the invader to gain a foothold, resulting in disease which persists until the invader is removed.

Other factors that affect an animal's susceptibility to disease include:

- Age—the young and the old are at increased risk.
- Body condition—thin animals are at greater risk.
- Concurrent disease—animals dealing with subclinical disease that affects overall condition, for example, Johne's disease.
- Physiologic state—females during periods of heavy lactation are at increased risk.
- Crowding—too many animals in a too small pen, affecting access to water, feed, bedding.
- Environmental stress—muddy, wet corrals (animals past their ankles in mud).
- Nutritional stress—protein and energy deficiency adversely affect the animals' ability to respond effectively to infectious agents.

In some cases, the disease may be so vicious and so fast that the animal may die before the immune system can develop an adequate response.

Other invading organisms have developed highly complex methods of evading the immune system, allowing them to go on colonizing the body and cause disease, despite the best efforts of the immune system.

Stimulating the Immune System

Since the immune system takes time to learn, it would be ideal to “teach” it about a disease before it is expected to defend the animal from the agent. This is the basis of vaccination (or immunization).

An ideal vaccine should stimulate a fully effective immune response without causing disease.

Types of Vaccines

Killed or Inactivated Vaccine

Whole Cell Bacterin

These vaccines are made by growing the disease causing agent in the laboratory. The agents are then killed and preserved, forming the basis of the vaccine.

Advantages:

1. These vaccines are usually economical and very safe.
2. They are also fairly stable, with a long shelf life.

Disadvantages:

1. Because the agent is dead and not reproducing, you need to give a large dose, typically with a booster, and then repeat every year.
2. Some of the bacterins contain endotoxin that is released when the organism is killed to make the vaccine. This endotoxin may make the vaccinated kids/lambs lethargic for a few days after vaccination. While this is not a fatal condition, it is important to realize that it happens so that the producer is aware of why the lambs/kids look “off colour.”

Sub-Unit Vaccines

These vaccines are made by identifying the protein on the bacterial or viral cell wall that the immune system recognizes to initiate the production of antibodies, and concentrating that unit into the vaccine. These vaccines are very specific to a particular infectious agent.

Advantages:

1. These vaccines are very safe and usually come in lower volume dosages.
2. They usually contain significantly lower levels of endotoxins than whole cell bacterins.
3. The adverse effect on lambs/kids following vaccination is lessened.

Disadvantages:

1. These products may cost more than whole cell bacterins.

Toxoids

Toxoids are made by including in the vaccine an inactivated form of the bacterial toxin that produces disease. The vaccinated animal then produces antibodies to the specific bacterial toxin and is protected from disease.

The majority of bacterins and toxoids contain adjuvanted products. To identify a product as adjuvanted means that there are other substances included in the formulation that serve to increase the immune system's reaction to the vaccine. Some adjuvants are very irritating, causing injection site reactions, while others are far less reactive.

Live Vaccines

These vaccines are made by modifying or altering the live agent in such a way that it can no longer cause disease but still replicates in the vaccinated animal. Modification has traditionally been performed by growing the agent in the laboratory and by repeated tissue passages reducing the virulence (ability to cause disease) of the agent while maintaining its ability to stimulate the immune system.

Newer vaccines have been made by genetically engineering organisms.

Advantages:

1. These are very effective vaccines that typically require one small dose, because the organism actually grows in the host after vaccination.
2. They are not adjuvanted, so are not usually reactive.

Disadvantages:

1. Live vaccines are typically freeze-dried and need to be reconstituted before use.
2. Live vaccines are very sensitive to storage and handling conditions; they must be refrigerated and protected from freezing.
3. Once mixed, vaccines must be used immediately (within one hour) and protected from light.
4. There is a theoretical risk that an agent may reactivate and cause clinical disease, but this risk is low.

Adjuvant
- A substance that, when mixed with an antigen, enhances the ability of the animal's immune system to respond to the administered vaccination.

Young Animals

All young animals are born with a fully functional immune system, yet with no antibodies. Unless the fetus has been exposed to an infectious agent in utero, the neonate's immune system is inexperienced. The uterus is a sterile environment, so the young animal that has never been exposed to the multitude of organisms found in the outside environment is born immunologically naive. Pre-colostral antibody titres can be a valuable tool in investigating infectious disease causing neonatal death. If exposed to an infectious agent, the defenceless neonate can easily be overwhelmed and succumb to death.

Nature has found a way to help prevent this from happening. In the last weeks of pregnancy, the mammary gland of the mother starts to accumulate antibodies from her blood and store them in the mammary gland as it forms the first milk. The first milk is called colostrum and differs from regular milk in a number of key ways:

1. Although normal milk contains some antibodies, the level of antibodies in colostrum is staggering.
2. Colostrum is very high in energy, especially fat.
3. Colostrum contains key nutrients not found in milk, for example, vitamin A.

The gut of the newborn animal differs from that of any other animal. First, the newborn stomach does not secrete acid. This means that the newborn is not able to digest protein, and antibodies in the colostrum can therefore pass through the stomach without being broken down. The intestines are also different. In the adult, the wall of the intestines is designed to absorb very small molecules such as amino acids (the building blocks which form protein). In the newborn, the gut is able to absorb whole protein antibodies. Consequently the antibodies pass from the blood of the mother into the colostrum, are suckled by the newborn, pass through the stomach and are absorbed into the bloodstream of the newborn. This provides the newborn with its mother's immune system memory and is referred to as maternal immunity.

Supplementing colostrum to newborns is commonly done by producers either by bottle or stomach tube. Cleanliness of the bottles, stomach tubes, milk pails, etc. is critical to the newborn's health because while the intestinal wall is capable of absorbing whole proteins, it is also capable of allowing whole bacteria to pass directly from the intestine into the bloodstream of the lamb or kid and cause disease.

This process is slightly different in humans; the different structure of the human placenta allows antibodies to pass directly from the mother's bloodstream to the baby.

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3. Treating the Sick Animal

Which One Is Sick?

Each time that you enter a group of animals or look over the fence, take the time to notice animals showing any of the following behaviours:

1. Animals that are not eating. Sheep are notorious for standing at the feed bunk and looking normal but not eating.
2. Animals that are not chewing their cud (also known as ruminating).
3. Animals that are separated from the group or are slow to get up.
4. Animals that are depressed, as shown by:
 - Head hanging down
 - Ears droopy
 - Eyes dull
 - Hunched stance (back arched with front feet and back feet placed close together beneath the animal)
 - Sudden lack of maternal interest (she loved her babies this morning and now couldn't care less about them)
5. Animals that look empty or shrunken (flanks are sunk in and hook bones are easily seen).
6. Animals with manure stains on their wool indicating diarrhea, with or without blood.
7. Animals that look "too full," especially on the left side, which may indicate bloat.
8. Animals with noisy breathing, coughing, snotty noses, or grunting respiration.

9. Animals with odd gaits, either staggering or circling, or those that are holding their heads in an abnormal position.
10. Animals that are reluctant to move readily; they may show signs of lameness or stiffness.

In short, to be successful at treating small ruminants you must be sensitive to the details, those subtle changes that tell you that a particular individual just “ain’t feelin’ right.”

Picking out animals affected by any of the above will become second nature to you if spend the time to realize what is “normal.” In fact, eventually, picking out “abnormal” animals will become second nature. Disease detection in small ruminants is all about being sensitive to subtle changes from normal. Walk the pen, not just at feeding time; listen and look. The sick ones are trying to tell you, but you have to be paying attention.

Remember that our new definition of disease includes production loss. Animals that are suffering from sub-clinical disease do none of the above; they eat readily, get up and run away normally when approached, do not cough and have nothing whatsoever running from their noses. These are the tough ones to pick out, the ones that cost you money but look healthy. It is only by reviewing your production records that these animals can be picked out, their underlying diseases identified, and subsequently addressed by management. Here is where the money is made and lost.

What Is Making It Sick?

It is perhaps stating the obvious, but in order to treat a sick animal, you need to know exactly what the problem is. Unfortunately, this can be very tricky. In addition, you need to define the cause of the problem. For example, there is no one treatment for pneumonia; the treatment for bacterial pneumonia (antibiotics) is different from the treatment for parasitic pneumonia (dewormer), which is in turn different from maedi-visna (no treatment).

It is always best to narrow down the cause of disease before deciding on a treatment plan. Some basic information that you can collect to help make your decision includes:

1. Age of affected animal or group of animals. Some diseases are more common in certain age groups.
2. Sex of the animals affected and their physiologic state (for example, male feeders versus female feeders).
3. Rectal temperature. Normal for an adult sheep and goats is 101.3 to 103.3°F (38.6 to 39.7°C). If body temperature is normal you may consider a metabolic disease; if it is high, consider an infectious agent.
4. Respiratory rate can be measured by watching the animal's flank move up and down (counts as one respiration); normal is approximately 20 per minute.
5. Does the abdomen look full or empty?
6. What is the animal's body condition score? (Refer to the nutrition module for body condition scoring guide.)

Consult with a veterinarian if you are unsure. Sometimes further investigation into what is causing the disease is warranted and samples will be submitted for laboratory analysis. Lab tests cost money, but it is better to get correct information first rather than waste time and money on a misdirected treatment plan that will not work.

Using Drugs to Treat Sheep and Goats

The legal situation is as follows:

1. Drugs used to treat sheep and goats in Canada are licensed by the Canadian government for use in food-producing animals.
2. All drugs fall into two broad categories:
 - Pesticides**—identified by a Pest Control Products (PCP) number and
 - Veterinary Pharmaceutical Drugs**—identified by a Drug Identification Number (DIN)

Note: Some pesticide drugs such as Ivomec are actually licensed as drugs, not pesticides.

Veterinary pharmaceutical drugs can be further classified as:

1. Over the Counter Medications (OTC)
2. Prescription Drugs

Over the Counter Medications (OTC)

These drugs can be bought without a prescription from a veterinarian or a feed dealer as long as the producer follows the label on the product **exactly**. Using OTC drugs in any other manner than that described on the label constitutes ELDU (extra label drug use) and requires a veterinarian's prescription.

Prescription Drugs

These can only be obtained from a veterinarian. In addition, a veterinarian can only dispense the drugs to a producer if there is a valid veterinary-client relationship. This means the veterinarian must do your routine veterinary work and visit your farm at least one to two times per year. Failure to comply with these regulations may cost a veterinarian his or her license.

If you look at the label of any veterinary drug, you will find that it specifies which species the drug may be used in. Unfortunately, there are almost no drugs licensed for use in goats and very few drugs which are licensed for use in sheep in Canada. See *Reading a Veterinary Drug Label* on the next page.

The law states that a drug may not be used in a species other than those listed on the label, without a veterinary prescription.

For example, you cannot use Trivetin in sheep or a short-acting oxy-tetracycline product in goats without a prescription from a veterinarian.

The reason for the law is that part of the drug licensing procedure is not only to ensure that the drug is safe but also to determine how long

ELDU
Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

PEN G INJECTION **1**
Citadel
Penicillin G Procaine Injectable Suspension USP
DIN 01939793
Sterile
Veterinary Use Only

ACTIVE INGREDIENT: **2**
Penicillin G Procaine 300 000 IU/mL
Preservative:
Methylparaben 0.1 % w/v

INDICATIONS:
As an aid in the treatment of the following infections caused by bacteria susceptible to penicillin:
Cattle: Bacterial pneumonia, calf diphtheria, foot rot, metritis, wound infections.
Sheep: Bacterial pneumonia, metritis, wound infections.
Swine: Bacterial pneumonia, erysipelas, wound infections.
Horses: Bacterial pneumonia, metritis, strangles, wound infections. **3**

DOSAGE: Shake well before using.
Cattle and Sheep: 21,000 IU/kg (7mL/100 kg or 0.7 mL/10 kg) of body weight intramuscularly once daily until 2 days after clinical signs disappear. Do not exceed 5 days of treatment. Do not exceed 15 mL per injection site in cattle and 5 mL per injection site in sheep.
Swine: 15,000 IU/kg (1 mL/20 kg) of body weight intramuscularly once daily until 2 days after clinical signs disappear. Do not exceed 5 days of treatment. Do not exceed 10 mL per injection site. **4**
Horses: 21,000 IU/kg (7mL/100 kg) of body weight intramuscularly twice daily (at 12 hour intervals) until 2 days after clinical signs disappear or, in the case of respiratory infections, until 5 days after clinical signs disappear. Do not exceed 15 mL per injection site. Rotate injection sites for succeeding doses.

Note: If animals do not respond within 48 hours of administration of first dose, consult a veterinarian.

CAUTION:
In case of anaphylactic reaction (acute respiratory distress, mouth breathing, recumbency), administer epinephrine immediately to prevent death.
In pigs, administration of this product may occasionally cause a fever, vomiting, shivering, listlessness, incoordination and possibly, death. In pregnant sows and gilts, it may -result in abortions.
In horses, procaine penicillin G is occasionally associated with excitement and may cause pain at the site of injection. Repeated use of the same injection site may intensify these side effects. **5**

WARNING:
To avoid illegal residues, do not inject subcutaneously.
Cattle and Sheep: Treated animals must not be slaughtered for use in food for at least 10 days after latest treatment with this drug. Milk taken from treated animals during treatment and within 96 hours after the latest treatment must not be used in food. **6**
To avoid illegal residues in milk: Do not use in dairy animals with clinical or subclinical mastitis and do not exceed the recommended dosage. The use of on-farm tests for detecting subclinical mastitis prior to treatment (C.M.T. or other tests) and/or for detecting residues prior to marketing milk from treated animals is recommended.
Swine: Treated animals must not be slaughtered for use in food for at least 8 days after latest treatment with this drug.
Horses: This drug is not to be administered to horses that are to be slaughtered for use in food.

STORAGE:
Store below 15°C. Keep from freezing. Protect from excessive heat and light.

PRESENTATION:
100 mL, 250 mL and 500 mL vials.
Manufactured by: Citadel Animal Health, Cambridge ON, N3C 2W4
Distributed by: Vétquinol N.-A. Inc., 2000, ch. Georges, Lavaltrie, QC, CANADA J5T 3B5

	Code	
100 mL	1PEN003	BMTC 8PEN002 8PEN20C-203
250 mL	1PEN001	BMTC 8PEN003B 8PEN201-107
500 mL	1PEN002	BMTC 8PEN004B 8PEN202-107

NAC No.: 12320213

A typical drug label

1. The drug's trade name
2. The drug's chemical name
Note: For this drug they are the same but in most cases they are different for example, Excenel (trade name), ceftiofur (chemical name).
3. **Indications:** The species and the medical conditions that the drug is licensed to treat.
4. **The Dosing Information**
Note: You need to know the weight of the animal. Ensure that you dose via the correct route and watch for limits on injection volumes at one site.
5. **Important** information regarding possible side effects and what to do if the drug does not work.
6. The **withdrawal** information vital for food producing animals. **Note:** If you use a different species or a different dose, the withdrawal information does not apply.

it takes the drug to leave the body, so that no drug remains when the animal is slaughtered or the milk consumed. This is known as withdrawal time. Fortunately for the industry, veterinarians are allowed to use drugs in ways other than that described on the label. Veterinarians have access to literature (typically from other countries) regarding the safe use of drugs in sheep and goats. They can also make use of the Global Food Animal Residue Avoidance Databank (gFARAD) to estimate appropriate withdrawal periods for unlicensed drugs in Canada. Withdrawal times approved in another country are not necessarily accepted in Canada. When a veterinarian prescribes drug use outside of that dosage acceptable by the *Food and Drug Act* and *Veterinarians Dispensing Prescription Drugs Guidelines*, it is known as "extra label drug

use (ELUD).” The veterinarian is then responsible for any residues that might be detected in an animal’s tissues.

This legislation makes it difficult for anyone to develop treatment protocols for sick sheep or goats without the assistance of a veterinarian, but adds a level of protection for the public.

For the list of drugs licensed for use in sheep and drugs licensed for goats, refer to Appendix 1.

Protocol for Vet Drugs

1. Store all drugs in accordance with the directions on the label.
2. Dispose of any drugs that have passed their expiry date, according to municipal regulations.
3. Ensure all drugs are given by the correct route:

Administration Route	Abbreviation
Oral	po
Subcutaneous (under the skin)	sc
Intramuscular	im
Intravenous	iv

4. **Read the label!**
5. If you are going to use the drug in a manner other than as described on the label, get a prescription from your flock veterinarian **before** you use it.

Banned Drugs

– are those that are forbidden for use in food producing animals. They are:

- *chloramphenicol or its salts or derivatives;*
- *a 5-nitrofurantoin compound;*
- *clenbuterol or its salts or derivatives;*
- *a 5-nitroimidazole compound; or*
- *diethylstilbestrol or other stilbene compounds.*

Principles of Antibiotic Treatment

1. Antibiotics treat bacterial diseases only. You need to be relatively sure you are dealing with a bacterial disease before starting a treatment plan using antibiotics. If necessary, get a prescription from your flock veterinarian.
2. Use an antibiotic that is effective for treating the most likely bacterial cause of disease.
3. Use an appropriate dose. Read the label and weigh the animal; do not under dose.
4. Make sure that the infection is completely cleared to avoid antibiotic resistance developing. Most bacterial infections require antibiotic treatment for at least three to five days and in some cases much longer.
5. Ensure that all withdrawal periods are followed.
6. Complete your treatment record (Management Diary) with the following:
 - Animal Identification (ID)
 - Date of treatment
 - Weight of animal
 - Disease being treated
 - Name of drug administered
 - Dose given and how
 - Withdrawal time to be honoured
7. When in doubt, contact your veterinarian.

Safe Dosing Techniques for Sheep and Goats

Before using any medication:

- Read the label
- Ensure the product is not past its expiry date
- Confirm the dose required

Oral

Young Animals

Small Volumes—many of these products come in a pump dispenser; simply place the nozzle in the mouth over the tongue and gently depress the pump (for example, antibiotic solutions.)



Stomach tubing a lamb

18F

- refers to feeding tube size. In this case, the size is 18 French.

Larger Volumes—restrain the animal (some people prefer to hold the animal between their knees, see illustration. Pass an 18F stomach tube through the side of the mouth. Gently advance the tube and allow the animal to swallow it. The animal should not struggle or cough; you must be able to feel the tube going down the esophagus. If you cannot feel the tube, then it is in the trachea; remove it and try again. Advance the tube into the stomach. Attach a syringe to the tube. Some prefer to use the syringe like a funnel and allow fluids to flow in under gravity. However, for thick fluids like colostrum it may be necessary to use the syringe plunger. When all the fluids are in, gently remove the tube.

Note: Be very careful when passing a stomach tube in an animal too weak to lift its head. It may not swallow the tube and the tube may enter the lungs. It also helps to pre-measure the length of tube that you will need so you know that you are in the stomach. You need to measure from the mouth to the last rib. Simply pinch the tube at that point, then feed it into the lamb's mouth; when your fingers touch the lips you should be in the stomach.

Older Animals

Large Volumes—restrain the animals and place a "Y" shaped mouth gag in the mouth. Pass the stomach tube through the gag and over the tongue. Allow the animal to swallow the tube and then pass it into the rumen. When the tube enters the rumen you should be able to smell rumen gas. Administer the fluids through the tube. When all the fluids are in, blow through the tube to clear it and then gently remove the tube.

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Small Fluid Volumes—these fluids are typically deworming drenches and are best administered with a drenching gun. Place the tip of the gun into the mouth at the corner of the lips. Move the gun tip over the back of the tongue and slowly depress the trigger.

Injections

Subcutaneous Injections—subcutaneous means you are injecting below the skin, but not so deep as to be in the muscle. Whenever possible give injection by this route. For an adult animal, use an 18g, 1 inch aluminum hub needle; for smaller animals (under 15 kilograms or 30 pounds body weight) use a 20g, 1 inch aluminum hub needle. Pick up a fold of skin over the ribs behind the elbows. Insert the needle at a 45 degree angle through the skin. Draw back to ensure you are not in a blood vessel and inject. If the injection is too difficult you may have split the skin with the needle; remove the needle and replace it.

Intra muscular Injections—for an adult animal use an 18g, 1-½ inch aluminum hub needle. For young animals use a 20g, 1 inch aluminum hub needle.

For young animals some prefer to give the injection into the thigh muscles above the knee joint in the hind leg. This muscle mass is easy to identify and does not contain any major nerves. Flex the hind leg and push the needle through the skin into the muscle. Draw back to ensure you are not in a blood vessel and slowly inject.

For adults inject into the muscles in the side of the neck. Aim for a point just in front of the shoulder blade about halfway between the upper and lower sides of the neck.

Injection Technique Protocol

It is important to follow some simple rules to ensure that all injections are done to minimize pain to the animal, prevent injection site reactions, and get the most value from your injection:

1. Plastic hub needles are designed for single use and blunt quickly; aluminum hubbed ones are stronger and can be used for multiple injections. Change needles regularly. Discard into biohazard container.
2. Never reuse a needle that has been dropped.

g = gauge
- a measurement of the outside diameter of a needle. As the outside diameter of a needle decreases, the gauge number increases.

3. Avoid injecting in areas of the skin that are contaminated by feces.
4. Always draw back before injecting to ensure you are not in a blood vessel.
5. Do not use a needle that has been previously used for injecting an animal to draw out of a multi-dose bottle.

Intravenous Injections—these are tricky to perform. You should get your veterinarian to train you how to do these safely.

Methods of Euthanasia

Refer to Appendix 2.



4. Neonatal Health

Each year many, many lambs and kids die needlessly. Some studies around the world have estimated that average lamb deaths may be as high as ten percent from birth to weaning. Certainly there are farms where the death rate (independent of abortion) may reach twenty percent.

With good management it should be possible to keep total lamb and kid mortality below five percent.

Neonatal animals are vulnerable for two main reasons:

1. They are prone to hypothermia from exposure. Refer to *Chapter 5, Acquired Health Disorders of Newborns*. Lambs and kids are small with a large surface area and lose heat rapidly. All neonates have very little fat to provide insulation and also have very limited energy reserves that are quickly exhausted after birth.

In order to survive newborns need:

- To be dried off by the mother soon after birth
- To be kept sheltered and warm by their mother
- To be fed regularly to have enough energy to stay warm

Obviously, good mothering is critical to preventing exposure. It is also vital that the livestock manager provides an environment which is sheltered and suitable for newborns.

2. **Lambs and kids are born with an inexperienced immune systems.** This means that they are very susceptible to infections. Ensuring that all neonates receive adequate colostrum as

Hypothermia
– a state of
low body
temperature.

soon as possible after birth is critical to their survival. Refer to *Chapter 5, Young Animals*.

Managing a Lambing/Kidding Season

Extensive Management

In these situations, the dams give birth at pasture. This has several advantages:

1. The animals are widely spread out; this decrease in population density means that common areas do not become excessively contaminated by manure.
2. Diseases spread more slowly because of low population density.
3. The increased space gives the dams a chance to separate from the rest of the flock/herd and give birth with some degree of privacy. This allows the dam an opportunity to clean the newborn, ensures that the newborn suckles colostrum and also ensures that a strong bond develops between the dam and the offspring.

Extensive management systems can be low input and low risk provided the weather is fair, predators are controlled and the dam has good maternal instincts. However, a spell of bad weather, marauding predators or inexperienced dams can spell disaster for an inexperienced livestock manager.

Intensive Management

In an intensive system, animals are brought into barns or corrals and give birth in a confined, sheltered area. The presence of many animals in a small space can rapidly lead to contamination of the environment and to the spread of disease. It is vital that the area be well drained and well bedded.

Another problem with intensive systems is that the animals lack any privacy when birthing. Animals close to birthing have a strong maternal drive and will often congregate around an animal in labour. This can easily result in mis-mothering, where the dams and offspring become confused as to who belongs to whom. Unfortunately, if there is any doubt, most dams will reject the offspring. This can easily result in animals failing to be cleaned and dried and, more importantly, failing to ingest sufficient colostrum. Personnel should always be on the lookout for animals that are going into labour. Animals should be monitored; when they have finished giving birth they should be taken to a small maternity pen (1.5 by 1.5 metre or 4 feet by 4 feet lambing jugs).

Maternity pens should be well bedded and have free access to food and water for the dam. Ideally, animals should remain in maternity pens for 36 to 48 hours to allow a strong maternal bond to develop. Personnel should identify and check all newborns every 6 - 8 hours to ensure that they always have a full belly (see illustration). If a newborn does not look full, immediately assess the dam to ensure that the mammary gland is healthy and providing sufficient milk. Ensure that the dam is not running a fever and that there is no mastitis. If a newborn is less than 12 hours old and has not sucked it **must** be given colostrum. Ideally, the colostrum should come from its own mother and be given via a stomach tube. (See illustration.) (Refer to *Safe Dosing Techniques for Sheep and Goats, Young Animals, Larger Volumes* in this chapter.) If the mother does not have colostrum, use some from your colostrum bank.

Remember, if the dam does not have colostrum it is unlikely that she will have milk!

Colostrum Bank

All producers should consider forming their own stored colostrum supply. The source of the colostrum could be ewes/does that gave birth to a stillborn lamb/kid or young ewes with only one offspring; either milk all or half the colostrum as appropriate. The colostrum that is collected **must** be the **first milk** collected on the **first** day. Dams who have leaky teats or have allowed other neonates to nurse on them before giving birth are poor candidates to be colostrum donors. Collected colostrum can be put into small containers of approximately 100 millilitres (100 mL) in the household freezer (old yogurt pots are ideal). The colostrum will survive with all the antibodies intact in a **chest freezer (not** a refrigerator freezer) for at least one year.

Frozen colostrum must be thawed with care because if it gets too hot the antibodies will be destroyed. The best way to thaw colostrum is by placing the small container in a bath of warm water. Warm colostrum to at least 38.5°C but not over 40°C. **Never** heat colostrum directly and do not put it in the microwave. All lambs/kids require an absolute minimum of 100 mL (3.5 ounces) of colostrum (200 mL would be even better over two feedings within the first 12 hours of life). If you **do not** get



A lamb with a full belly. Note the “teardrop” shape of the abdomen, which is wider than the ribs.



Stomach tubing a lamb

the colostrum into the lamb or kid in the first 12 hours of life there is no point in wasting it on them. Intestinal uptake will cease and the antibodies will never be absorbed.

Colostrum Alternatives

Obviously managing and using a colostrum bank is a lot of work, which is why many people have tried alternatives, most commonly either bovine colostrum from a local farm or a bovine colostrum replacer. These are probably better than nothing, but that is about all. Bovine antibodies are for bovine disease and do not interact well with the sheep or goat immune systems. In addition, some cows produce antibodies against sheep red blood cells, which can lead to a disastrous disease in the lamb consuming the colostrum, in which the neonate's red blood cells are destroyed. Small ruminant colostrum from a local dairy would be better, but nothing is as good as colostrum from animals on your own farm. Every effort should be made to ensure every newborn gets enough colostrum. The rule is:

“As much colostrum as possible as soon as possible”

Things to remember when out-sourcing colostrum:

- 1.** Colostrum is an excellent way to introduce Johne's into your flock. Know the Johne's disease status of the donor flock before purchasing colostrum from them.
- 2.** You will have no guarantee regarding the quality of the colostrum unless you collect it yourself. There is only **one** first milking!
- 3.** Source colostrum from older ewes/does and not maidens. Mature females in the prime of their lives are more likely to produce higher quality colostrum.
- 4.** The source herd should have a health status and vaccination program closely aligned with your own.

It may be easier and safer to bank your own colostrum after all!

The goal is to select females with more than adequate milking capacity so that if you need it you can go to Momma for the colostrum even if you have to stomach tube the newborn.

Health Checks

Every newborn animal should ideally be checked three to four times in the first 24 hours of life. The main reason for repeatedly checking animals is to ensure that they are suckling and getting enough colostrum. The same person should do the checks through the day so that the subtle changes telling you a newborn needs attention can be picked up. No two people see things the same way and with newborns the window of opportunity for intervention is narrow; you do not want to miss it. Fortunately, it is easy to assess whether lambs and kids have nursed. If an animal is picked up by the front legs, the abdomen should be wider than the chest. **If the abdomen is narrower than the rib cage the animal needs to nurse.** (See illustration.)



A lamb with a full belly. Note the “teardrop” shape of the abdomen, which is wider than the ribs.

If you find an “empty” lamb or kid consider the following:

- Does the neonate know how to nurse?
- Can the newborn get up to nurse?
- Does the dam have milk?
- Will the dam let all of the neonates nurse?
- Have the teat plugs been removed?
- Can the lambs or kids actually get the teats in their mouths to nurse?

If the neonate is less than 12 hours old it **must** get colostrum soon if you expect it to survive. Those that are older than 12 hours and have yet to get colostrum are at **much** greater risk of dying. By 24 hours of age, if the lamb or kid has not received adequate colostrum, the likelihood of the lamb’s or kid’s surviving is grim; the game is over.

Other important things to check include:

- The navel for swelling or signs of infection.
- The eyes for entropion. Refer to *Chapter 5, Entropion*.
- The anus to ensure that feces are being passed.
- General mental status.
- The area around the mouth for drooling.
- Stretching. Get sleeping babies up and watch if they stretch. Sick neonates do not stretch.

Depending on previous disease experience and in consultation with your veterinarian you may decide to treat the navels of newborn animals with tincture of iodine solution. This may be sprayed on, or the navel can be dipped in a small container. The idea is to disinfect the navel and reduce the possibility of navel ill. (Refer to *Chapter 5, Acquired Health*

Disorders in Newborns.) It is best if the umbilical cord breaks off at least a few inches long. That way the vessels that enter the abdomen will be closed off as the cord dries. If the cord breaks off at the abdominal wall, then that protective mechanism is gone and the neonate is much more likely to become infected with bacteria from the birthing environment.

Lamb/Kid Processing

There are a number of procedures that may need to be performed on newborns. In general, all procedures should wait until the animal is 24 hours old. This allows a strong maternal bond to form and gives ample time for colostrum absorption.

Castration

If you have never castrated lambs/kids before you should be trained by someone with experience. Most males are castrated using “elastator rings.” (See illustrations on the next page.)

Method

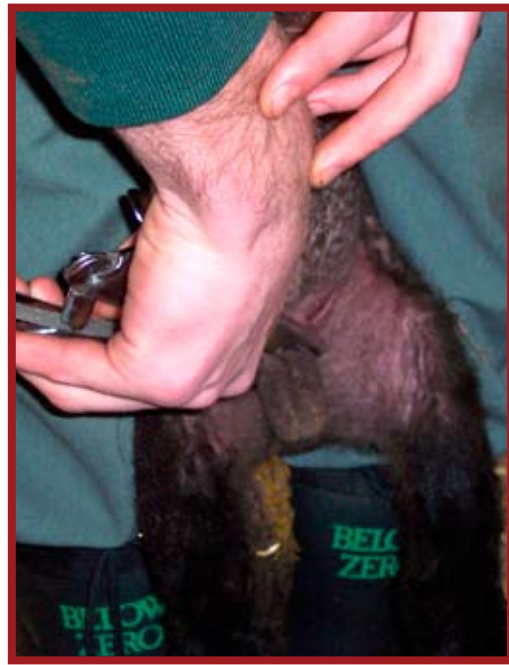
1. Place a ring on the elastator. Store rings so as to keep them clean before use.
2. Pick up the male and either restrain him between your legs or have an assistant hold him.
3. Palpate the scrotum to ensure both testicles are present.
4. Place the ring over the scrotum and push towards the abdominal wall. Slowly release the handles.
5. Palpate the scrotum to ensure both testicles are present below the ring.
6. **Ensure that the rudimentary teats are above the ring.**
7. Roll the ring off the elastator.
8. Palpate the scrotum once more to ensure the testicles remain below the ring.

If, for some reason, placing the ring should fail, a ring can be easily removed by placing a blunt object (for example, handle of a teaspoon) under the ring and cutting the ring off with a knife. Immediately replace the ring.

If one or both of the testicles cannot be palpated, **do not** place a ring on the scrotum. Record the animal’s identification number and let him go. You can try again a day later or he will have to be sold intact; do not keep for breeding.



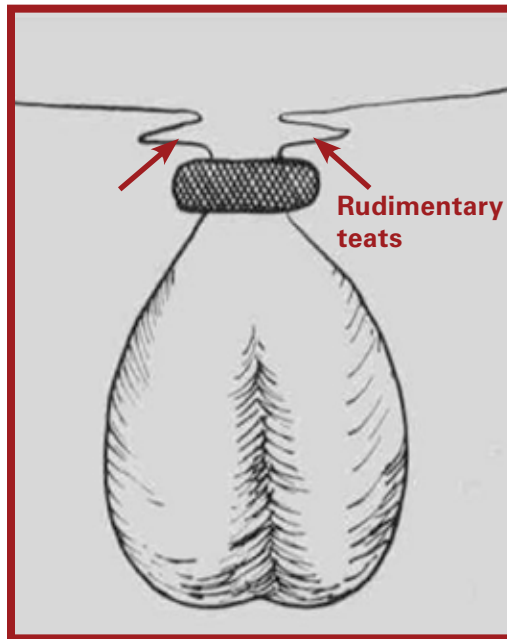
Pick up the male and either restrain him between your legs or have an assistant hold him. Palpate the scrotum to ensure both testicles are present.



Place the ring over the scrotum and push towards the abdominal wall. Slowly release the handles.



Palpate the scrotum to ensure both testicles are present below the ring. Ensure that the rudimentary teats are above the ring.



Tail Docking

Sheep should generally have their tails docked to prevent their becoming matted with feces and pre-disposed to fly strike.

Ring Tail Docking Method

1. Place a ring on the elastrator.
2. Either restrain the animal between your legs or have it restrained by an assistant.
3. Ensure that the tail is free from excessive fecal contamination. Wash if necessary.
4. Place the ring over the tail.
5. Ensure that sufficient tail is left, enough to cover the vulva of a female lamb, and ensure the ring does not touch the tail folds on a male.
6. Release the handles and roll the ring off the elastrator.

Hot Iron Tail Docking Method

The process is similar to using a rubber ring. (See illustration below.)

1. Place a slotted wooden paddle over the perineum to protect the anus.
2. Position the docker as above with the ringing protocol.
3. Use the hot iron tail docker to cut the tail off slowly.
4. Examine the stump.
5. If there is any bleeding use the hot iron to sear the vessels.



Tail docking with a hot iron

36 Neonatal Health

Disbudding Goats

Some management systems prefer that goats have their horns removed. This is most easily achieved in the first one to two weeks of life before the horn starts to grow. If you have never disbudded a goat before you should be trained by a veterinarian or an experienced producer to avoid injuring either the animals or yourself.

Restraint

Goat kids can either be manually restrained or placed in a dehorning box.

Analgesic (Pain Control)

Ideally goat kids should have some form of pain control during the procedure. Unfortunately this can be problematic. Nerve blocks with Lidocaine are possible, but goats are unlike cattle in that there are two nerves to block on each side and because of the animal's small size there is risk of Lidocaine toxicity. Alternatively, they can be sedated with Xylazine (speak to your veterinarian about this). If necessary, goats may have a full general anaesthetic.

Methods

Disbudding Paste—many people have had little success using dehorning paste for this procedure. It is problematic, inconsistent, and cannot be used on kids nursing their mothers. If the paste is applied incorrectly, serious injury to the kids (even blindness) can be caused.

Hot Iron Disbudding—a commercial electric or propane disbudding iron for calves or goats is appropriate to use. The iron must be hot enough to burn a pine board before it is used on the animal. It is helpful to clip all hair from



Disbudding using a commercial iron



When disbudding is complete, the bud area will take on a copper coloured hue

around the horn buds before using the disbudding iron. Apply the iron over the horn bud in a rotating motion. Continue the process until the area takes on a copper colored hue. After the procedure,

the horn cap should be easy to remove (refer to the illustrations on the previous page).

The two most common errors with this technique are:

1. Insufficient heating of the tissue, so that not all the tissue is destroyed. This results in the growth of abnormal horns.
2. Overheating. In this case the heat is transmitted through the skull, causing brain damage.

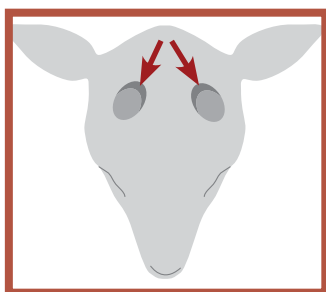
Dehorning Goats

If a goat is older than two to three weeks of age or if a previous disbudding has failed, it will be necessary to dehorn the animal. This is a more complex procedure than disbudding. There is often significant bleeding; the wounds take a long time to heal and can easily become infected.

This process must be done with an anesthetic by a veterinarian.

Horn Tip Removal

A simple alternative to full dehorning in adults with problem misshapen horns is to remove the tip of the horn using embryotomy wire. "Tip of the horn" means just that; stay well away from the skull. This is simpler and there is often little blood loss if it is done correctly. The disadvantage of this procedure is that the horn will continue to grow and the process will need to be repeated.



Scent glands are positioned behind the horn buds in a young buck.

Descending Goats

The smell of a mature buck is obnoxious to people. It is possible to reduce the intensity of the smell (but not completely eliminate it) by removing the scent glands on the head. They are positioned behind the horns in a young buck (see illustration) and they can be cauterized during dehorning. Alternatively, a veterinarian can surgically remove the glands.

Animal Identification

It is very hard (if not impossible) to manage a flock when you cannot individually identify each animal. At the very least, young animals should be marked with an aerosol marker approved for sheep, so they can be matched with their dams. (This means that the dams need eartags too.)

It is much better to mark them permanently with an ear tag at this time. Individual identification ensures that animals can be consistently identified, making all management processes more effective.

Practical Tagging and Record Keeping Suggestions for Lambs

1. At birth, give all lambs a metal #3 Kurl-Lock tag and a tattoo (the latter is not necessary if you have a commercial flock). Place the metal tag on top of the ear and close to the head (in the first third). Make sure that the numbers are up so that you can read them. The #3 Kurl-Lock tags are available from Canadian Co-operative Wool Growers (CCWG). They can be bought pre-numbered for example, 1-100, or you can get them customized. Use the tags in sequence to make recording information a lot easier.
2. Record the number (along with any other pertinent information) in your management diary.
3. For all the lambs that make it past the culling phase, give them a dangle tag. Place the tag so it can be read from the back of the ear. (It seems that sheep are always running away when you are trying to read their tags, so this works well.) Consider using the UFA medium sheep tags and write on them with an Allflex pen. (Allflex pens work better than permanent markers.) Go over the numbers several times to ensure they will be readable for a long time. If you want something more permanent, consider the engravable tags. These tags have the advantage of a smaller button, which does not catch and rip out as easily as the Allflex tags.

What to put on the dangle tag? A few suggestions for a numbering system are described below and apply to **only** those lambs that are not culled:

901 The first lamb born in 2009. If you have more than 100 lambs in any year, you will have to use another system as the size of the tag will limit the number of characters you can print on it.

1W—First lamb born in 2009. The year letters are standardized within the Canadian Livestock Records and are used for registered animals. (This works well, although with registered animals, it may be difficult to distinguish between animals on eartags alone, especially if you have purchased others that were similarly tagged.)

Eartag colour—For a single breed flock you can have a specific color for a specific sire group, for example 47N is blue, 4P is purple. By doing this, retaining replacement ewe lambs, keeping the breeding groups straight and planning the breeding groups (to control line breeding) is easier.

Refer to the Canadian Sheep Federation website (<http://www.cansheep.ca/>) for the most current national policies on ear tagging.

4. No matter what tags you use, the cleaner they are kept the less infection you will have. Keep your tags, metal or plastic, in re-sealable plastic bags to make sure that they do not get dirty before being placed. Pay special attention to the buttons and keep them clean. If you drop the tagger or the button on the ground while tagging, remove the tag and button, wash it and allowing it to dry completely before re-using.
5. Maintain a cross reference between the metal tag and the dangle tag numbers in an Excel spreadsheet. The spreadsheet can also serve as your current flock inventory record. As individuals leave the flock, move their record to a second page within the document and record where they went. Do not place a CSIP tag in them until they move off of the farm for whatever reason. Place this tag in the sheep's right ear, number up and close to the head (match the position of the Kurl-Lock tag).
6. Finally, protect your records from the curious moms and babes, otherwise they may be reduced to bubble gum. Never leave your records in the barn; store away where they are safe and dry.

Practical Tagging and Record Keeping Suggestions for Kids

Kid identification and records can be managed in a manner similar to that described above for lambs, however do not apply a CSIP tag to kids. Any identification tags applied to kids should be for management purposes only, as goats do not yet have a national identification program in place, and national sheep identification policies do not apply to goats.

One tag is usually sufficient. A plastic dangle tag is the most common choice for goats. Dairy kids are often identified with neck or leg bands for the first few weeks, instead of tags, and mature does often wear their tag on collars, rather than having ear tags.

Tattooing is typically limited to kids eligible for registration, and as such, must comply with registry standards, although tattoos may be used in commercial herds for management purposes if desired.

LaMancha dairy goats are tagged and/or tattooed in the tail web rather than the ear.

Refer to the Canadian National Goat Federation website (<http://www.cangoats.com/>) for the most current policies on tagging and identification.



5. Common Diseases of Neonates

Congenital Diseases

These are diseases are present at birth. They may or may not have a genetic basis.

Unless otherwise stated the following defects or diseases affect both lambs and kids.

Hairy-Shakers (Border Disease)

Refer to *Chapter 6, Border Disease*.

Cause

Dam is infected with the border disease virus (BDV) during early pregnancy. The virus is passed to the fetus through the placenta and results in birth defects. The BDV is closely related to the bovine virus diarrhea virus (BVDV) of cattle and is a concern when cattle and sheep are co-mingled.

Clinical Signs

Can be highly variable. Newborns are typically weak. The coat appears hairy and the neonates shake all the time. There may also be developmental problems, with the eyes being either too small or containing obvious cataracts.

Diagnosis

Confirmed by finding the lesions typical of the disease in nervous system tissues. Virus isolation and serology (testing for titres) are also important tools in confirming the diagnosis.

Treatment

None. These lambs/kids are typically poor doers. In addition, they are often permanently infected with border disease virus, which is shed in the feces and through the respiratory tract. It is best to humanely euthanize such animals. There is no vaccine available for this disease.

Considerations for Management Team

Lambs/kids that are clinically affected at birth may have no fleece or show tremor abnormalities by one to two months of age. Permanent identification of stock becomes necessary so that persistently affected individuals can be culled from the flock.

Atresia Ani

Cause

Unknown.

Clinical Signs

There is no anus present. The anal area is simply covered with smooth skin. (The anus is the sphincter at the end of the rectum.)

Diagnosis

Neonates will have abdominal distension and may strain to have a bowel movement. You will not be able to take the lamb's/kid's temperature as the rectum is not open.

Treatment

In some cases, the defect is simply a thin skin covering over the anus, making it possible for you to palpate the meconium (first feces) under the skin. Make an opening with a 14 g needle or by cutting an "X" in the skin over the spot where the anus should be. In most cases, the defect involves the skin and the terminal portion of the intestines; that is, a piece of bowel is also missing. These animals should be humanely euthanized.

Considerations for Management Team

Early identification of affected individuals and prompt treatment of the affected lamb/kid are most desirable. This disease has no genetic component, so culling of the parents producing the affected newborn is not necessary.

Umbilical Hernia

Cause

In the fetus there is a natural hole in the body wall to allow the vessels of the umbilical cord to pass through. Normally the hole is very small and closes right after birth. In some cases, the opening is too big for the size of the animal, allowing the abdominal contents to exit through it. Sometimes the abdominal contents are contained under the skin; in other cases they are exposed.

Clinical Signs

In the early stages there may be slight swelling at the navel; in most cases the swelling is entirely under the skin. However, in some cases the intestines may start to protrude. The situation may be made worse by the ewe or doe continuing to lick the area. The umbilical area in a neonate should never be swollen. The umbilical stalk may feel round and firm, not painful and soft.

Diagnosis

Palpation of the umbilical area of the newborn. Some hernias do not become evident until the lamb/kid is older.

Treatment

If the swelling is under the skin, simply try to gently push the intestines back into the abdomen and seek veterinary advice. If the intestines are protruding, in the early stages it may be possible to repair the site surgically. A clean dressing should be placed over the navel and veterinary assistance should be sought **immediately**.

If an animal is treated for any form of umbilical hernia it should not be kept for breeding because of the strong suspicion that there is a genetic basis for this defect. The heritability pattern for this, however, is not clear. Umbilical hernias do seem to occur more frequently in family groups with a past history of umbilical hernias; this suggests a hereditary basis for the defect.

Considerations for Management Team

Cull the affected animals and do not repeat the mating if possible.

Flexural Deformity

Cause

This condition is usually associated with contracted tendons. The actual cause is unknown but may be due to abnormally positioning of the neonate in the uterus.

Clinical Signs

The neonate is unable to fully straighten the front legs and knuckles over. Some neonates may be able to walk on their knuckles, while others are unable to stand. In severe cases the hind legs are affected as well.

Diagnosis

The newborn will have considerable difficulty in getting up. The herdsman will not be able to straighten the legs out by palpation.

Treatment

Careful application of a well padded splint to straighten the joints can be very effective. The splints should be changed every 24 to 48 hours to prevent sores from developing. It would be wise to get veterinary advice on how to apply this splint so that no further damage is done during the application process. Often the affected newborn will need to be bottle fed. Animals should be encouraged to walk as much as possible. In severe cases your veterinarian may administer a high dose of oxytetracycline antibiotic to encourage the tendons to relax.

Considerations for Management Team

This is usually an individual problem and no consideration should be given to culling the dam producing such lambs/kids, as the defect has no genetic basis.

Entropion

Cause

The cause of this disease seems to be genetic; however, the heritability pattern is unclear.

Clinical Signs

The young have watery eyes with a mild discharge. The condition is commonly mistaken for an eye infection. Close examination will reveal that the lower eyelid is rolled in so the eye lashes are rubbing on the surface of the eye, causing severe irritation. Left untreated, this condition will result in severe ulceration and infection of the eye leading to blindness. Lambs/kids will have difficulty nursing. Some cases are not apparent at birth and may not show up until the lambs/kids are a month old.

Diagnosis

This is based on close examination of the affected eyes and confirmation that the lower eyelids are, in fact, rolled in. Often the affected eyelid margin, when it is rolled out with gentle digital pressure, will look less pigmented than the surrounding skin.

Treatment

In mild cases all that is required is to roll the eyelid out and flatten it with your fingers. Severe cases require a stitch to be placed in the lower lid to anchor the eyelid out. The stitch should be removed in seven days. Contact your veterinarian to learn how to perform these procedures.

Consideration for Management Team

Cull affected individuals. If possible do not repeat the mating.

Premature Birth

Cause

Often this is the result of a late term abortion or illness in the dam. Lambs and kids born more than two to three days premature rarely survive.

Clinical Signs

Signs include small size, weakness, un-erupted teeth and a domed skull. Hair or wool cover is often sparse.

Diagnosis

Review breeding records and do a newborn viability assessment.

Treatment

Premature animals require careful nursing. These animals must receive colostrum and, if necessary, regular feeding by stomach tube. When tube feeding, remember that these individuals are smaller than term newborns so feeding portions should be small and frequent. Animals must also be kept warm using an infrared lamp as they are unable to maintain their own body temperature. The lungs of premature lambs and kids are often poorly developed, resulting in pneumonia-like symptoms and death.

Considerations for Management Team

It is important to record all births to enable you to do a record analysis to determine the incidence of premature births in the flock. Rarely do premature births happen in small ruminant flocks without a reason. Determining why this is happening is important to successful flock management. If any of these lambs/kids go on to die, consider submitting them for laboratory evaluation. The information collected may be critical to formulating management strategies in the future. Dams that repeatedly produce premature newborns should be culled.

Malocclusions

Cause

There is a genetic basis for this condition but the real reason may not be evident at birth. The severity of the problem will become more apparent as the jaws develop.

Clinical Signs

Basically, overshot and undershot jaws are the source of the problem of this condition. Often the first sign is starvation. Closer examination will reveal that the lower and upper jaws do not meet in the area of the incisors. (See illustration.)

Diagnosis

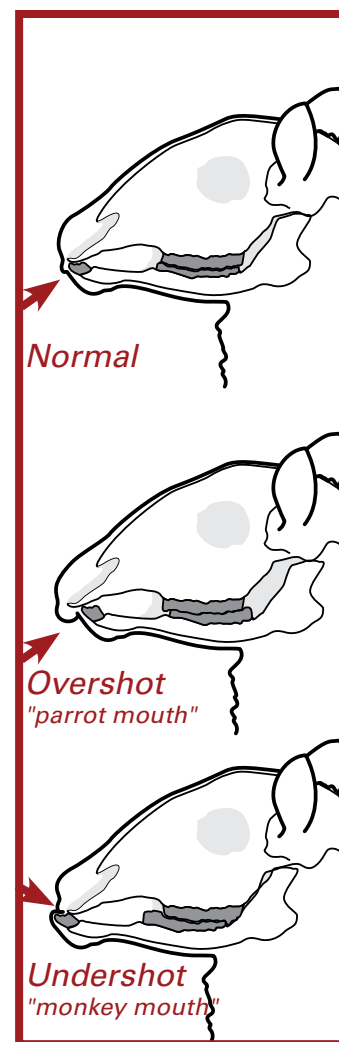
Examination of the mouth needs to be done. If the newborn has the defect, check the sire and dam as well.

Treatment

There is no treatment for any of these conditions. Some newborns with under- or overshot jaws will learn to suck in time. Most animals should be humanely euthanized. Surviving animals should **never** be kept for breeding.

Considerations for Management Team

When purchasing or retaining your own breeding stock make sure to check that their mouths are normal. Cull any that are not.



Cleft Palate

Cause

This condition is a defect in embryonic development. There is no genetic basis for the problem.

Clinical Signs

You may notice milk coming from the nose when the animal is suckling. When the mouth is opened you will see a hole in the top of the mouth. The animal will eventually starve, if it is left long enough.

Treatment

There is no treatment. These newborns will simply starve if nothing is done. The most humane thing to do is euthanize animals with this condition.



Cleft Palate - you may notice milk coming from the nose when the animal is suckling.

Goitre (Enlarged Thyroid Gland)

Cause

Iodine is naturally found in soils near the sea. In inland areas (for example, the prairies) there may be an iodine deficiency. Iodine is used by the thyroid gland to produce thyroid hormone. If the diet is iodine deficient, the thyroid gland starts to enlarge, forming a swelling (known as a goitre) over the trachea (windpipe) just below the chin. This is most commonly seen in newborn lambs/kids. In severe cases the lambs/kids may be born weak or the ewe/doe may abort. There are also certain *Brassica* plants such as kale and white clover that prevent iodine absorption. Excess iodine in the diet may also cause the thyroid gland to be enlarged.

Clinical Signs

Lambs or kids with a mobile swelling in the neck over the windpipe/trachea.

Diagnosis

A diagnosis is normally made based on the clinical signs.

Treatment

Affected lambs/kids should be treated with three to five drops of Lugol's iodine orally in milk, or 20 mg of oral potassium iodide daily, until the gland assumes a normal size.

Prevention

Ensure that you are using a mineral mix containing an appropriate concentration of iodine. Most salt used for livestock in the prairies contains iodine.

Acquired Health Disorders of Newborns

Navel Ill

Cause

When the umbilical cord breaks after birth, the tissues of the cord are exposed to bacteria in the environment. Because the immune system of the lamb/kid is immature, it is easily overwhelmed. A serious infection can develop, entering through the navel. A navel infection can spread directly to the liver or bladder. Infection can also enter the bloodstream and spread throughout the body (septicemia).

Clinical Signs

The lamb/kid shows signs of pain around the umbilical area, which may or may not be swollen. The navel may drain pus. In the first 48 hours of life the newborn is not active; while it may nurse it does not nurse with enthusiasm.

Diagnosis

A presumptive diagnosis of navel ill can be made based on clinical signs and age of the animal when affected.

Treatment

The best treatment for this condition is use of an antibiotic. Navel ill is assumed to be caused by *E. coli* until it is proved otherwise, so antibiotic therapy must be directed at that class of bacteria. It is also unlikely that this is a "pure" infection, and other types of bacteria are probably involved. Seek veterinary advice on what an appropriate treatment plan would be for your operation.

Prevention

1. Ensure lambs/kids get sufficient colostrum in the first 12 hours of life.
2. Ensure the birthing area is clean and dry.
3. Treat navels with a tincture of iodine solution at birth.
4. In event of an outbreak, seek veterinary advice.

Consideration for Management Team

Navel ill is a management disease and usually means there is a hygiene problem in the birthing facility. This can expose lambs/kids to bacteria that can infect the neonate through the navel. Consultation with your veterinarian may be necessary at this point to develop a treatment plan.

Watery Mouth (Slavers, Rattle Belly)

Cause

There may be a build up of bacteria in the birthing area during a lambing/kidding season. This is most common in those operations that confine and house the ewes or does during the parturient period. While it is less common in flocks that lamb/kid on pasture, it can still occur there too. Newborn lambs/kids that have not received sufficient colostrum may swallow these bacteria; the bacteria can then colonize in the intestinal tract. The bacteria can then enter the bloodstream, causing infection throughout the body (septicemia).

Clinical Signs

The overgrowth of bacteria in the intestinal tract creates gas; the abdomen appears full. The lamb/kid does not look thin like most sick animals. The disease typically occurs in animals under three days of age. The abdomen becomes so enlarged that the neonate is unable to swallow; it salivates profusely and develops a wet chin and mouth. If the lamb/kid is shaken, a characteristic “tinkling” noise can be heard from the gas filled intestinal tract. It is important to recognize that the wet mouth and chin are non-specific symptoms caused by the neonate’s not swallowing the saliva that it normally produces. Although the wetness is common with this condition, sick lambs or kids could have a wet mouth and chin for a variety of other reasons.

Diagnosis

Sometimes the first cases of “watery mouth” will be newborns that are found dead. It is important not to explain these deaths away as laid on, starved out, or newborns “that just died.” It is best to submit the bodies of these sentinel cases for laboratory diagnostics. Valuable information can be determined about the bacteria involved and the antibiotics to be used for treatment.

Treatment

Most animals with advanced watery mouth will die of a combination of septicemia, endotoxemia and dehydration/starvation. If the disease is caught early, animals can be saved with appropriate antibiotic therapy, together with fluid and thermal support. As with any treatment plan, early consultation with your veterinarian will be critical to successful treatment of this condition.

Endotoxemia

- toxins produced by bacteria enter the bloodstream and poison the body.

Septicemia

- bacteria enter and grow in the bloodstream causing infection throughout the body.

Consideration for Management Team

This is a management disease. The key to prevention is ensuring that each lamb/kid receives adequate colostrum during the first 12 hours of life and maintaining a clean birthing area. In the event of a herd outbreak you should consult with your veterinarian about the use of prophylactic (preventative) oral antibiotics to be given to each newborn at birth. In some cases it may be necessary to develop a custom vaccination program as a key component to the disease management plan.

Orf

Cause

Orf is caused by a pox virus that affects both sheep and goats. The virus is shed from skin lesions into the environment, where it can survive for many months. The virus cannot penetrate intact skin; lesions usually begin to develop at the boundary between the skin and mucous membranes. Infection also occurs through small breaks in the skin.

Zoonosis Alert: This virus can be easily passed to humans (it is a zoonosis).

Clinical Signs

The disease is most commonly identified in lambs and kids, especially bottle raised lambs/kids (because they share nipples). However, small ruminants of all ages are susceptible. In most cases scabby lesions are seen around the mouth and nose. During the early stages the lesions look like pustules or small red bumps. In severe cases the lesion may either spread across the mouth, nose and face or spread backwards into the mouth. Lesions may also be found on the teats and udder of the ewes and does.

Treatment

There is no treatment for this **viral** disease. There are many “old wives tales” about treatment, but there is no treatment that really works. The body’s immune system will develop immunity over time and the lesions will resolve in four to six weeks. Treatment is supportive in nature and affected individuals should be isolated.

Zoonosis

– a disease of animals that may secondarily be transmitted to man.



Lamb exhibiting orf.

Prevention

Avoid buying animals with obvious lesions. Keep bottle raised lambs/kids separate from the rest of the flock. If you have an outbreak, thoroughly disinfect the birthing area before the next season with a product that will control the pox virus. Although vaccines are available elsewhere, they are not licensed in Canada. Vaccines for orf are not highly effective and can cause more problems than they solve. The vaccine is essentially a live virus that is administered by scratching the skin in the armpit of the animal being vaccinated. This gives the vaccinated animal orf in a site that does not affect the animal's well-being. Consequently, the animal's immune response is induced, which allows it to shed its virus load.

Considerations for Management Team

Look for cases of orf in young stock that fails to thrive and in dams that do not allow lambs or kids to nurse because they may have lesions on their teats. Be careful when handling affected individuals because humans may become infected with orf.

Constipation

Cause

The first feces present in the rectum (meconium, which are black/tarry) may become very hard and difficult for the newborn to pass.

Clinical Signs

Listlessness, failure to nurse, colic, no evidence of feces around anus.

Diagnosis

This is based on clinical signs and observation. Most lambs/kids will be observed to have defecated while nursing.

Treatment

Carefully pass a well lubricated catheter tipped syringe approximately five centimetres (two inches) into the anus. Inject a small volume (approximately 20 mL) of warm water, soapy water (you can use dish soap) as an enema. Feces should be passed within 10 minutes.

Considerations for Management Team

This should be an individual problem that occurs very occasionally. Newborns are stimulated to defecate by nursing and by their mothers licking their backsides. Newborns that have experienced poor maternal behaviour maybe at greater risk for meconium impaction.

Fecal Soiling (Poopy Bum)

Cause

Consuming a rich milk diet, resulting in soft sticky feces. The feces stick to the tail and area around the rectum, forming a solid ball-like mass that completely occludes the anus.

Clinical Signs

Obvious fecal mass beneath the tail. Also, the lamb or kid is not thriving.

Diagnosis

Ensure that the newborn lamb does not have an infected tail docking site that is affecting its ability to pick up the tail while defecating.

Treatment

In the early stages simply pull the fecal mass off the animal. In severe cases, when the feces have completely dried, you may have to soak the back end of the lamb or kid in warm water first before removing the feces.

Considerations for Management Team

Ensure there are no feces soiling the application site when docking tails of newborn lambs with elastrator rings. If there is soiling, take the time to clean and dry the area completely before applying the rubber ring. Application of an elastrator ring to a dirty site promotes this situation.

Scours (Diarrhea, Enteritis)

There are many possible causes of diarrhea in young lambs and kids. All must be considered serious until the specific one affecting the animal is identified. All may result in death if not appropriately addressed. Causes of scours can be divided into two main groups.

Non-infectious	Infectious
Nutritional	<i>E coli</i>
	Rotavirus
	<i>Salmonella</i>
	Cryptosporidium
	Clostridium
	Coccidia

Nutritional Scours (Non-infectious)

Cause

This is caused by excessive nutrients in the gut (for example, a single lamb on a good ewe) or a change in diet (for example, from milk to milk replacer). A single, healthy lamb or kid on a heavy milking dam is little cause for concern but scours associated with feeding milk replacer can be deadly.

Clinical Signs

Diarrhea.

Treatment

Successful feeding of milk replacer is dependent on attention to detail. Accurate measurement of the water and powder, temperature of the water when mixing, temperature of the milk replacer when fed, the volume fed, and the cleanliness of all equipment used in milk replacer preparation and feeding are all critical.

Prevention

A successful milk replacer supplementation program is all about the details; **there are never corners that are safe to cut.**

Infectious Scours

Cause

Infectious agents enter the gut via the mouth and damage the lining of the intestines. This results in poor absorption of nutrients and a potentially massive loss of water and electrolytes. Because young lambs and kids have little water and electrolyte reserve, this may be life threatening.

Zoonosis Alert: Some of these types of scours can also affect humans.

Clinical Signs

The clinical signs of scours are obvious —wet fleece and tail. It is important to be able to recognize the lambs/kids that are severely affected. Signs include:

- Lethargy (very sleepy babies)
- Drunken behaviour (unable to walk without staggering)
- Inability to stand or extreme slowness getting up
- Sunken eyes

Note: Scours can predispose animals to hypothermia (as outlined below) and to hypoglycemia (low blood sugar).

Diagnosis

In almost all cases it will require laboratory testing to identify the exact cause of the scours.

Treatment

Only bacterial scours will respond to antibiotics. It is rare that scours itself kills lambs or kids; **it is the dehydration that kills them.** Therefore, all scouring lambs and kids must be treated with oral electrolytes. Lambs/kids require treatment of approximately 100 mL four times daily. This is best done by stomach tube. Maintain a separate stomach tube to treat sick lambs/kids and make sure that you clean it with a disinfectant between animals treated. Any calf scours electrolyte will do (for example, Calf Lyte, Revibe).

It is not necessary to use the HE (high energy) formulas. Mix the entire two litre batch, use what you need and store the rest in the fridge. Simply re-warm the saved batch before use. Another option is to use sterile balanced intravenous (iv) electrolyte solutions as an oral electrolyte (for example, Normosol R). The advantages are that no mixing of the oral electrolyte is required and it is easy to dispense only the volume needed for an individual case.

Zoonosis
– a disease of animals that may secondarily be transmitted to man.

Specific Infectious Scours

E. coli scours with profuse watery diarrhea is typically seen in the first few days of life. It is mainly seen in intensively housed flocks. Young lambs/kids affected by *E. coli* can easily die of dehydration. Antibiotics may be of use in this situation because the cause is bacterial. If you face an outbreak situation, have the diagnosis confirmed by a veterinary laboratory to allow an appropriate treatment plan to be developed.

Oral electrolytes are absolutely vital in treating affected lambs and kids.

Rotavirus, coronavirus and cryptosporidium all cause scours in older lambs or kids (typically one to two weeks of age) and do not respond to treatment with antibiotics. For these diseases, the immune system will eventually develop immunity and the animal should recover. However, the risk of death from fluid and electrolyte losses is still very real so fluid therapy is still very important.

Salmonella is, fortunately, rare in sheep and goat flocks. It can cause severe diarrhea and death in young animals and diarrhea and abortion in adults. Also, *Salmonella* can easily be spread to humans. You will require a veterinarian's assistance should you ever be faced with this disease.

Coccidiosis generally affects slightly older animals. (Refer to *Chapter 11, Coccidiosis.*)

Dealing with a Scours Outbreak

Regardless of the cause of the disease, certain principles apply to all outbreaks.

1. Isolate affected animals from the main group. This serves two purposes: firstly, it is easier to treat the affected animals, and secondly, it reduces contamination of healthy animals with the feces from the sick neonates.
2. Ensure that all newborns get sufficient colostrum during the first 12 hours of life. While it will not entirely prevent disease, adequate colostrum is vital to ensure that all newborns have the chance to develop their immune systems.
3. If the remainder of the flock is confined, consider spreading them out to reduce disease transmission; move them to a different area or aggressively re-bed the area to reduce contamination.

4. Ensure that mothers have plenty of clean areas in which to lie down without getting contamination of the udder.
5. Shear the fleece around the udder to keep this area clean.
6. Contact your veterinarian; he or she can make a diagnosis and explain the specific treatment options that may be available.

Although scours vaccines are available for use in cattle, there has been no work done to assess their use in sheep or goats and they are not labelled for use in these species.

Hypothermia (Reduced Body Temperature Due to Exposure, Starvation)

Cause

Hypothermia is the number one cause of death in young lambs and kids. A young animal has few energy reserves and insulating protection from its limited fat reserves and thin coat. In addition, it has a relatively large surface area and loses heat rapidly.

To survive, the newborn must be licked dry by its mother, fed sufficient colostrum and then protected from the elements by its mother.

Anything that interferes with the maternal bond or suckling colostrum and milk during the first few days of life can easily result in hypothermia.

The situation is made worse by inclement weather. When an animal is chilled, it uses energy to keep warm. When it runs out of energy, the body temperature starts to drop and the body's organs shut down. The animal becomes depressed, sinks into a coma and dies.

Common causes of hypothermia include:

- Rejection of the neonate by its mother
- Mother has mastitis
- Mother's failure to produce sufficient milk
- A lamb/kid defect that prevents sucking
- Bad weather

Clinical Signs

Lamb or kid appears weak. It often appears hunch backed and depressed. In the early stages it may bleat but will soon slip into unconsciousness.

Diagnosis

The diagnosis is simple - use a rectal thermometer to measure body temperature. Target body temperature for a lamb/kid should be 38.6 to 39.7°C (101.3 to 103.3°F). If the body temperature is below this range, the animal has hypothermia. A presumptive diagnosis can be made if the baby's mouth is cold.

Treatment

If the animal is less than 12 hours of age, it must receive colostrum. If it is older, real milk is best, but warm milk replacer is acceptable.

Refer to *Chapter 23, Hypothermic Lambs*. If the animal's body temperature is within a 2°C range of normal the animal should simply be fed. If the body temperature is 2°C or more **below normal**, assess the age of the lamb/kid:

1. If less than six hours old—this animal has typically been chilled by the weather and still has body energy reserves. It should be dried, warmed and then fed colostrum by a stomach tube (see illustration).
2. If more than six hours old—it has probably run out of energy reserves and requires a source of energy. If the lamb/kid can hold its head up, it should be fed by stomach tube with colostrum or milk (as appropriate), dried and warmed. If the animal cannot lift its head, it will require a glucose injection (see illustration). The lamb/kid should then be warmed; when it can lift its head it should be fed by stomach tube.

As long as the dam appears to accept the young animal the two of them should be left together in a sheltered environment and monitored.

Considerations for Management Team

Hypothermia is a management disease. It needs to be handled accordingly.



Stomach tubing a lamb



Injection technique for intra-peritoneal (ip) dextrose injection

Floppy Kid Syndrome

Cause

The term floppy kid syndrome is a catch all term for weak sick kids. It has no specific cause, although possibilities include hypothermia, sepsis, dehydration, and white muscle disease.

Clinical Signs

A weak, non-reactive kid.

Diagnosis

Rule out other possible problems; always check body temperature.

Treatment

This will vary according to case. Most will require supplemental nutrition and warming.

Considerations for Management Team

Once the cause has been determined the treatment and prevention plan can also be determined.

Rib Fractures

Cause

Rib fractures tend to occur in lambs/kids that have been rejected by their mothers. The dam repeatedly butts the neonate away from the udder and may pin it against something, causing severe trauma to the ribs.

Clinical Signs

The main clinical sign is difficult breathing. Close examination will reveal that the chest is moving in an abnormal manner. Careful palpation of the ribs will reveal fractures. Some lambs or kids are merely found dead and the cause of death is only determined by a post-mortem examination.

Treatment

If only one or two ribs are affected, a neonate will often recover with appropriate nursing care. In severe cases, where multiple ribs are involved, the animal should be euthanized.

Considerations for Management Team

Watch for cases of mis-mothering. Also, look for signs of aggression between dams or lambs/kids or where lambs/kids have been trampled during fighting.

Problems with Walking

Joint Ill

Cause

Bacteria may enter the bloodstream of a newborn via the navel or the gut. If this newborn does not receive sufficient colostrum, the bacteria may settle in the ends of the long bones or joints, causing an infectious (septic) arthritis.

Clinical Signs

An animal will be lame. If more than one leg is involved, the animal may be reluctant to get up at all. Closer examination will reveal swollen joints.

Diagnosis

Fractures also cause swelling near joints. In the case of any lame animal, be sure to rule out any fractures.

Note: Never stick a needle into an infected joint.

Treatment

In most cases, by the time joint ill is identified there is already serious damage to the surface inside the joint. Additionally, most antibiotics do not penetrate joints and bone very well. If joint ill is identified early, and you want to pursue treatment, consult with a veterinarian earlier rather than later. This is critical to successful treatment. Otherwise most of these animals should be humanely euthanized.

Considerations for Management Team

The management team should consider the following:

- Ensure all newborns get sufficient colostrum during the first 12 hours of life.

- Ensure the birthing area is clean and dry.

- Consider treating navels with tincture of iodine.

- In event of an outbreak of joint ill, seek veterinary advice.

White Muscle Disease (Stiff Lamb Disease, Nutritional Muscular Dystrophy and Deficiency of Vitamin E and Selenium)

Cause

This disease can be caused by lack of either vitamin E or selenium in the dam's diet which can lead to a deficiency in newborns. Without vitamin E or selenium the normal metabolism of muscles is altered, leading to tissue injury. Either vitamin E or selenium may be deficient in the diet.

Clinical Signs

These may show up at any time from birth to one month of age. Most cases occur at approximately one week of age as the newborns become more active. Animals will typically appear weak in the back end, with stiff legs and a "bunny hopping" gait.

Diagnosis

The diagnosis can be confirmed with appropriate blood and tissue samples.

Treatment

Affected animals should be treated with an injectable vitamin E/selenium supplement (for example, E-Se, Dystosel). When giving newborns selenium injections, be very careful not to overdose with this product because this could be fatal. Affected newborns also require careful nursing because they may not be able to suck effectively or keep up with their mothers.

Considerations for Management Team

This is a management disease. If a region is known to be deficient in selenium or a farm has had previous problems, the mothers should be treated with an injectable supplement late in pregnancy. Alternatively, a supplemental mineral mix should be added to the diet at least 60 days before lambing/kidding is to begin. As well, newborns should be treated at birth.

Tetanus (Lockjaw)

Cause

This is caused by bacteria (*Clostridium tetani*) which are present in the soil. The bacteria typically enter the animal through a wound with devitalized tissue, especially at castration and tail docking sites. The bacteria produce a toxin which causes rigid paralysis of the muscles.

Clinical Signs

Signs occur typically at one to two weeks of age. The lambs become very stiff and eventually are unable to stand. The jaw becomes locked and the animals assume a classical “rocking horse” position. They eventually die from paralysis of the respiratory muscles, hypothermia or starvation.

Treatment

An animal affected by tetanus requires aggressive therapy if it is to survive. If this cannot be provided the affected animal should be humanely euthanized.

Considerations for Management Team

All pregnant ewes and does should be vaccinated during late pregnancy with a clostridial vaccine that includes tetanus. The antibodies provided will enter the colostrum and be absorbed by the lambs/kids, preventing the disease. Obviously, it is vital that all neonates receive sufficient colostrum.

Swayback

Cause

Swayback is caused by copper deficiency in the ewe/doe, leading to deficiency in the offspring. Copper is needed for the normal development of the brain and spinal cord of the fetus. If copper is lacking the nerves do not form properly, leading to problems walking.

Clinical Signs

Sway back may present in two slightly different ways:

Congenital Swayback—the lamb/kid is affected at birth; in most cases it will be unable to stand. In some cases, it may be able to stand but unsteady in the hind legs.

Delayed Swayback—the lamb/kid is born healthy but typically develops signs between two to six weeks of age.

Diagnosis

Based on clinical signs and laboratory analysis of tissues. Diseases which can be confused with swayback are joint ill, stiff lamb disease and spinal abscesses.

Treatment

There is no treatment for swayback in an affected lamb/kid.

Considerations for Management Team

Ensure the diet contains sufficient copper. However, do not be excessive with this nutrient because excess copper in the diet is highly toxic.

Spinal Abscess

Cause

The cause of spinal abscesses is essentially the same as joint ill. The bacteria enter the bloodstream and settle in the bones and joints of the spine, forming an abscess. The abscess then presses on the spinal cord, causing nerve dysfunction.

Clinical Signs

The function of the hind legs is affected; the legs become weak and eventually useless.

Diagnosis

Based on clinical signs. This is confirmed at post-mortem examination.

Treatment

If the disease is caught early, aggressive antibiotic therapy may be of use. In many cases, by the time the symptoms appear it is too late for treatment. Humane euthanasia is the only option at this point.

Considerations for Management Team

The following should be considered:

- Ensure that all newborns get sufficient colostrum in the first 12 hours of life.

- Ensure the birthing area is clean and dry.

- Consider treating navels with an iodine solution.

- In event of an outbreak, seek veterinary advice.

Limb Fractures

Cause

Trauma to the limbs either during birthing or as a result of being stepped on or trapped.

Clinical Signs

Obvious lameness.

Diagnosis

Careful palpation of the limb will reveal instability in a long bone.

Treatment

Ideally these animals should be assessed by a veterinarian. However, in simple cases it is possible to fashion a well padded splint to allow the fracture to heal. Splints should fully stabilize the fractured area and extend to one joint above and below the fracture. Most fractures involve the cannon bone, so start the splint at the foot and come up above the front knee or the hock. The leg must be checked daily to ensure the splint is well positioned and that no sores are developing. Splints should be changed regularly as the lamb/kid is growing fast. Ensure that an animal with a splint is able to nurse.



6. Diseases of Pregnancy

Abortion Storms

The situation is considered to be an abortion storm if:

- more than **five percent** of exposed females have aborted following one breeding season, or
- if abortions occur as a cluster in time during the lambing/kidding period, or
- if there are an increased number of stillbirths and/or weak lambs or kids.

Zoonosis Alert: Pregnant women should avoid handling pregnant ewes or does during the birthing and peri-parturient period (the time immediately following birthing) because many of the abortion diseases can infect humans and unborn babies.

To be able to accurately assess if this is happening you will need to know:

1. How many females were bred in any one breeding group.
2. From the exposure dates, when you can expect the first babies to arrive.
3. When each female gives birth, to how many, and if they live or not.
4. If the newborns die, when did they die and why.
5. The result of any laboratory submissions (if you do not look for disease you will never find it).
6. The performance of the flock last year and how this year compares.

Zoonosis
– a disease of animals that may secondarily be transmitted to man.

7. Were any new animals were introduced to the flock, and if so, the health status of the flocks they came from. To be able to decide if new introductions are a risk to your flock you first need to know the health status of your own flock. Sub-clinical levels of disease may be active in your flock but if its effect on flock health is not measured then you are unaware of its impact until the “storm” hits. It is not enough to say “I have not had a problem in the past” unless you have the records to back that statement up.

Vibriosis (*Campylobacter* Abortion)

Cause

Vibriosis is caused by the bacterium *Campylobacter fetus* and *Campylobacter jejuni*. These bacteria are normal inhabitants of the intestine in a wide variety of species, including sheep and goats.

The problem occurs when a group of animals that have never been exposed to the bacteria are suddenly infected. If sheep or goats are first infected in late pregnancy, it is likely that they will abort two to three weeks later.

Infection at any other time will simply result in development of a protective immunity in the dam.

Infected sheep or goats may continue to shed the bacteria in their feces for the rest of their lives.

Clinical Signs

Abortion usually occurs in late pregnancy. Abortion storms may be very severe, with up to 50 per cent of dams affected. There is often a history of new replacements being brought into the flock two to three weeks earlier, or a feed change in the same period. Once the disease is endemic in a flock, sheep/goats will become infected before they become pregnant and will develop immunity. However, replacement animals mixed with the flock in late pregnancy may abort.

Diagnosis

This requires laboratory analysis of aborted material. It is critical to any laboratory investigation of abortions to include the placenta from the affected dam. Do not freeze any of the aborted material, fetus or placenta, and always handle the infected products of conception with gloves.

Treatment

There is little one can do when faced with a campylobacter abortion storm; the infection has occurred several weeks previously. Herd treatment with oxytetracycline (either injectable or in feed) may be of some benefit.

Control

Controlling *Campylobacter* abortion in flocks is fraught with difficulty.

If the disease is completely excluded from the flock, the effects of introducing it can be disastrous. If the disease is endemic (already widespread in your flock) it is of no real significance. Sources of infection are replacement animals and wildlife. (Refer to *Chapter 22, Biosecurity*.) The disease is transmitted fecal-orally so that attention to keeping feed and water sources free of fecal contamination may be important in the control program for this disease.

Vaccination

A vaccine is available for sheep in Canada. You should discuss the potential for its use with your flock veterinarian. The vaccine is a killed product; subsequently, vaccination protocols must be designed to ensure maximum immune response to the product. If the vaccine is not going to be used according to the directions then there is no point in using it at all.

Zoonosis Alert: Infection in sheep and goats may be associated with diarrhea and the bacteria may also cause diarrhea in humans.

Toxoplasmosis

Cause

This disease is caused by the protozoal parasite *Toxoplasma gondii*. The parasite has a complex life cycle. The eggs are passed in cat feces and can be ingested by sheep or goats. The parasite then forms microscopic cysts in various tissues in the animal. There is no effect of infection unless a pregnant female is infected for the first time while pregnant; she may subsequently abort the fetus.

The fetal membranes of the aborted fetus will contain toxoplasma cysts which are also infectious to other animals. This can result in an abortion storm. Depending on the immune status of the flock and the level of infection, up to one-quarter of ewes/does may be affected.

Clinical Signs

The clinical signs associated with the infection will depend on the stage of pregnancy at which infection occurs.

In the **first two months** the fetus will be killed with no outward signs; the dam will re-cycle and may or may not conceive. This will simply look as if the dam was infertile, and the lambing/kidding interval will be extended.

In **mid-pregnancy** the fetus will die and likely become mummified, or the fetus may survive to be born prematurely and weak, unlikely to survive.

Infection in **late** pregnancy has little effect.

Diagnosis

In some cases, there may be small white spots on the cotyledons (buttons) of the placenta. Otherwise, diagnosis requires laboratory confirmation.

Treatment

Fortunately, toxoplasmosis appears to be a rare cause of abortion in western Canada, either because it truly is not there or it has not been looked for during laboratory diagnostics.

There is some evidence that when you are faced with a toxoplasmosis abortion outbreak, medicating feed with monensin (Rumensin) may be beneficial. Because this product is not licensed for use in sheep/goats, you will require a veterinarian to write the prescription.

Considerations for Management Team

Complete control of cats on farms is not really practical. However, attempts should be made to control the number of young cats as they excrete the most *Toxoplasma* oocysts (eggs).

Every attempt should also be made to keep the cats out of all forms of feed; do not let the cats use the chop house as a cat box.

If breeding females are continually exposed to cats it is likely that they will be infected when not pregnant and be able to develop a protective immunity before pregnancy.

Zoonosis Alert: *Toxoplasma* can infect humans. Immuno-compromised individuals and pregnant women are especially susceptible to toxoplasmosis infection, with serious consequences. Such individuals should avoid contact with cat feces and never have contact with aborting sheep.

Chlamydial Abortion (Enzootic Abortion of Ewes, EAE)

Cause

The cause of this disease is *Chlamydomphila abortus* (previously known as *Chlamydia psittaci*). This is the most commonly diagnosed form of abortion in sheep and goats; it is also the most difficult to control because of the organism's complex life cycle.

If a ewe/doe is infected with EAE in late pregnancy there will be no effect during that pregnancy. However, she will likely abort at the end of the following pregnancy. This can cause significant problems when you come to purchase new stock. A ewe/doe may be bought with no history of abortion, yet she may be carrying chlamydia. She will abort her next pregnancy and contaminate the rest of flock, leading to a serious abortion storm the following year.

Abortion commonly occurs in the last two weeks of pregnancy. The fetus looks normal or lambs/kids may be born prematurely and be very weak.

In some cases the region of the placenta between the cotyledons (buttons) can appear yellowed and thickened.

Abortion rates may reach from one-third to one-half of the flock.

A ewe/doe aborting from chlamydia will shed the organisms in the fetus, placenta and all vaginal discharges for up to one month. Other animals that lick contaminated areas will develop an infection. An-

other way to spread this disease is to pile old bedding from the lambing barn in a place where other females will be exposed to it and come in contact with the microorganism.

After an abortion the animal develops a strong immunity that should last at least three years.

Diagnosis

This requires laboratory analysis of the aborted placenta and fetus.

Treatment

Chlamydophila abortus is susceptible to oxytetracycline antibiotics. It may be possible to treat the herd with a long acting product or use a medicated feed before the birthing period begins. Consult with your veterinarian.

Considerations for Management Team

Real care must be taken when purchasing replacement ewes/does. If the abortion history of the seller's flock is not known, purchase with extreme care.

Consider housing such animals separately from the rest of the flock.

Vaccines are available to help manage this disease. The first dose is given two months prior to breeding and the second dose one month prior to breeding. Annual vaccination at one month prior to breeding is also required. If you consider your flock to be at risk you should discuss vaccination with your veterinarian.

Zoonosis Alert: *Chlamydophila abortus* can be transmitted to humans and can cause abortion in pregnant women.

Other Causes of Abortions

There are many potential causes of abortion. The following diseases are uncommon but are identified occasionally:

- Salmonellosis
- Border disease
- Q fever
- Listeriosis
- Brucellosis

Salmonellosis

Cause

Various strains of *Salmonella* have been linked to abortion outbreaks in sheep and goats. *Salmonella* is usually thought of as a cause of serious diarrhea. However, in late pregnancy if the dam is sick enough she will abort. One particular strain of *Salmonella*, *S. abortus ovis*, can cause very serious problems, although other strains are also capable of causing clinical disease.

The source of the infection is rarely known. It may be from contaminated feed, water, wildlife, new introductions, or exposure to sewage material. Once in the flock, feces and abortive products from affected animals will spread the disease.

Diagnosis

This requires laboratory analysis.

Treatment

Once the bacteria have been identified in an outbreak situation, and the susceptibility to antibiotics determined, it may be possible to use an antibiotic to minimize the effects of the disease.

Control

The control of this disease is similar to *Campylobacter* infection:

- Attempt to keep wildlife away from sheep/goat feed.
- Control rodents.
- Ensure water sources are unpolluted.
- Take care when purchasing replacement animals.

Considerations for Management Team

Salmonellosis is a management disease. Attention to hygiene is critical to controlling *Salmonella* associated disease in all species. In the long term, treatment plans that do not include an assessment of the environmental risks and a way to manage them will fail to control the disease.

Border Disease

Cause

This disease is caused by border disease virus. This virus can circulate in sheep (goats appear to be resistant) and cause almost no problems. However, if dams are infected while pregnant, there may be different outcomes depending on the stage of pregnancy.

Clinical Signs

Infection during the first half of pregnancy usually causes fetal death. This may cause immediate abortion. In other cases, ewes may abort some time later, even close to term.

If the fetus survives infection, it is usually born with birth defects. The most common type of defect is termed a “hairy shaker.” These lambs tremble continuously due to nerve damage from the virus; they also typically have an unusual “hairy” fleece because the virus has damaged the fibre follicles

Some newborns may have eye abnormalities or other defects.

Diagnosis

Laboratory analysis is required.

Treatment

There is no treatment for this viral disease. Affected lambs should be humanely euthanized because they continuously shed virus and are a source of infection for the rest of the herd.

Refer to *Chapter 5, Hairy Shakers*.

Considerations for Management Team

Develop effective biosecurity measures to prevent bringing the disease onto the farm. When cattle and sheep are co-mingled the risk of a border disease outbreak is increased.

Q-Fever

Cause

Coxiella burnetii can cause abortion in a wide variety of species. The organism is very hardy and can survive in the environment for a long time. It is shed in the abortion fluids and lives in dust. Transmission is by ingestion or inhalation of infective dust. Remember, if you do not look for this organism, you will never be sure if it is causing abortion or stillbirths. *Coxiella* should always be part of the "abortion work-up" which includes *Campylobacter*, *Chlamydia*, and *Coxiella*.

Clinical Signs

Abortion and stillbirth in late pregnancy. The dams may occasionally show signs of mild illness such as reduced appetite.

Diagnosis

Laboratory examination of the fetus and placenta is required.

Treatment

Use tetracycline medications as injections or feed additives, as described previously.

Prevention

No vaccine is available.

Zoonosis Alert: *Coxiella* can cause very serious heart disease in humans. Extreme care must be exercised by the management team if *Coxiella sp.* is identified circulating in the flock.

Listeriosis

Cause

This disease is caused by the bacterium *Listeria monocytogenes*. Although it is most commonly associated with "circling disease" it can cause abortion during pregnancy. Listeriosis has been closely associated with feeding silage to small ruminants. (Refer to *Chapter 10, Listeriosis*.)

Clinical Signs

Abortion, possibly with neurological signs typical of nervous listeriosis.

Diagnosis

Laboratory examination is required.

Treatment

Individually affected animals can be treated with oxytetracycline.

Considerations for Management Team

The source of the bacteria must be identified to control flock exposure. Ensure that any silage fed to small ruminants is high quality.

Brucellosis

Cause

In sheep *Brucella ovis* mainly causes an infection of the ram's testicles (orchitis) and occasional cause abortion in females. In goats *Brucella melitensis* causes abortion. In sheep the disease is passed from the ram to the ewe. In goats, the does that abort shed the organism in milk, urine, feces and from the vagina.

Clinical Signs

Most abortions from this infection occur early during pregnancy. Affected rams have abnormal testicular conformation and reduced fertility.

Diagnosis

Analysis of the aborted fetus and placenta is required.

Prevention

You should examine the testicles of all rams pre-breeding. Do not buy breeding animals from an unknown source. There is no vaccine available for use in any small ruminants. Affected rams can be identified during the pre-breeding soundness evaluation.

Zoonosis Alert: *Brucella melitensis* is considered an important human pathogen. As previously advised take care when handling abortions. Brucellosis is a reportable disease.

When you are faced with any abortion, try to save all of the products of abortion, fetus and placenta, for further laboratory examination. Any material that is not saved for laboratory submission should be burned or buried and kept away from dogs, cats, birds, and other sheep or goats. Remove all bedding contaminated by the birthing process and burn it. **Do not** fork it out into the corral to expose the remaining females. Isolate the dam who has aborted until a diagnosis is reached and/or the uterine discharges have stopped. Be **very** careful to protect the management team that is caring for the affected individuals from becoming infected.

Zoonosis
– a disease of animals that may secondarily be transmitted to man.

Metabolic Diseases Associated with Pregnancy

Pregnancy Toxemia (Twin Lamb Disease)

Cause

This condition typically occurs during the last third of pregnancy. It is most common in dams carrying more than one lamb/kid and is especially common in dams that are in either very fat or very thin body condition. The disease occurs due to the metabolic demands of the offspring outstripping the mother's energy supplies. As well, as the lambs/kids grow in the uterus they compress the stomach, reducing the mother's capacity to consume greater volumes of feed. In the case of a thin ewe/doe there are no body reserves to make up the energy deficit and she becomes sick. In a fat animal, the fat reserves mobilize rapidly and can swamp the liver's ability to deal with them. The end result for the fat female is the same as that for the thin animal.

Note: Pregnancy toxemia may be complicated by hypocalcemia and polioencephalomalacia. Refer to *Hypocalcemia* in this chapter. Refer to *Chapter 10, Polioencephalomalacia*.

Clinical Signs

An affected animal become depressed, goes off feed, eventually lies down and is unable to stand. As the disease progresses she starts to tremble and grind her teeth, and may gaze up at the sky.

Diagnosis

The best way to confirm the diagnosis is to test the urine for ketones. You can get dip sticks from your veterinarian which will change color if ketones are present in the urine. To get a urine sample from a ewe/doe, simply cover her mouth and nostrils so she cannot breathe. After about 30 seconds she will urinate in response to the slight stress.

Treatment

It is vital to treat pregnancy toxemia quickly and aggressively. The longer you wait the less chance there will be for treatment to be successful. The challenge is that until the pregnancy ends it is very difficult to treat the dam. You should discuss a treatment plan for pregnancy toxemia with your veterinarian **before** you even start breeding.

Treatment options include:

1. Emergency C-section to remove the lambs/kids. The goal here is to save the dam as the prognosis for the lambs'/kids' survival is poor.
2. Terminate pregnancy with a dexamethasone injection. This is an economical option and supports the dam as well. Dexamethasone helps prepare the lambs/kids for birth, but the majority of offspring will go on to die.
3. Treat the mother conservatively. Give dextrose solution intravenously (100 to 250 mL of 50% dextrose). Be very careful not to inject the dextrose perivascular as this may cause the skin overlying the injection site to slough off. Give oral drenches with sugar and propylene glycol. Offer the mother highly palatable feed and encourage her to eat.

Prevention

Ensure ewes/does are in appropriate body condition during pregnancy. Ensure a good quality diet in late pregnancy is available. Slowly increase concentrates (grain) in the ration to provide additional energy and to compensate for a reduced capacity for feedstuffs.

Feed bunk management becomes critical in the late pregnancy stage. Ensure that all pregnant females have adequate access to feed. Ensure that the stocking density in the pens takes into account dominance issues within the group that could affect feed consumption. Avoid sudden changes in diet or management that may make animals go off feed. Going off feed can cause pregnancy toxemia. In short, anything that adversely affects energy intake in late pregnancy will predispose the female to pregnancy toxemia.

Hypocalcemia (Milk Fever)

Cause

Milk fever is usually seen in the last few weeks of pregnancy or immediately before birth. The demand for calcium increases as the late-pregnant female readies for the onset of milk production. Lactating females are at risk of developing hypocalcemia until they reach peak lactation at 30 to 45 days postpartum. Hypocalcemia can be caused by a number of management related scenarios:

1. Having an absolute deficiency of calcium in the diet. The ration fed to the late-pregnant female simply did not provide enough calcium for her own metabolism.
2. An imbalance between calcium and phosphorus that affects how the female utilizes the calcium.
3. A dietary protein deficiency that causes a low blood albumin level and adversely affects how the animal utilizes the calcium.
4. Feeding high calcium forages late in pregnancy will adversely affect the female's ability to activate the metabolic processes she needs to cope with lactation calcium demands.

Clinical Signs

Clinical signs may resemble polioencephalomalacia or pregnancy toxemia. It would be wise to consider all three diseases when presented with an affected individual. (Refer to *Chapter 6, Pregnancy Toxemia*.)

Diagnosis

Analyzing a blood sample (serum) for calcium, phosphorus, and albumin is the only way to achieve a definitive diagnosis.

Treatment

Confirming the diagnosis is crucial. Fatal levels of calcium may be reached in the animal if calcium is injected based on an incorrect guess about the initial blood level.

Affected animals should be treated with 23 percent calcium borogluconate solution (50 to 100 mL, either intravenously or subcutaneously). Great care should be taken with intravenous dosing. Have your veterinarian train you to do this safely. Poor technique associated with intravenous administration of calcium products is responsible for treatment failures, death of the patient, and complications associated with the injection site.

Calcium is needed for a number of vital functions including those in the nervous and cardiovascular systems and for general muscle function.

Prevention

The strategy to prevent milk fever varies according to your production systems. Prevention is the key to managing hypocalcemia.

- **Sheep and meat goats**—ensure that the diet in late pregnancy contains adequate available calcium. This is where having a good relationship with a nutritional consultant is invaluable.
- **Milking goats**—ensure the diet during the dry period is calcium restricted to allow the female's calcium mobilization pathways to be enabled. Dietary management of the dairy sheep or goat is critical to maximizing the individual's milking capacity. Retaining the services of a nutritional consultant helps promote successful lactation management.



7. Mastitis

Bacterial Mastitis

Cause

Mastitis is defined as an inflammation of the mammary gland, most commonly caused by bacteria, especially *Staphylococcus sp.* and *Pasturella sp.* In most cases the infection enters the mammary gland through the teat during lactation. Often the early disease is not identified as the ewe or doe may not be generally sick. However, an experienced stockperson may recognize that the offspring are suffering either from starvation or a failure to thrive because the dam's milk supply is inadequate. The disease progresses within the udder, destroying the milk producing tissues and resulting in a non-productive half, or the infection might become so severe that the dam dies.

Clinical Signs

The clinical signs of mastitis are variable, depending on the exact strain of bacteria involved. In mild cases the only signs may be a slight change in the milk. In severe cases the udder may become hardened, red and hot. In more extreme cases the ewe/doe may become systemically sick due to the absorption of toxins into the bloodstream from the udder. In the most severe cases the udder becomes swollen and blue in color. The udder is cool to the touch and will actually slough off (blue bag).

Chronic Mastitis—Some cases of mastitis are identified at the pre-breeding examination. Typically one half of the udder is larger than the other and feels hard and irregular. It is likely that this is the final stage of an infection that occurred during the previous lactation.

Such animals are unlikely to produce milk from that half during subsequent lactations and should be culled. In some cases the infection within the mammary gland is confined to a single mammary unit, causing a lump to be formed after the infection has resolved. Individuals affected in this manner need to be closely monitored early in the lactation phase for an acute episode of mastitis.

Treatment

If the disease is identified early the antibiotics penicillin and oxytetracycline (at labelled dose) are both good choices. Newborns should be examined regularly to ensure they are receiving sufficient milk.

Note: Animals with blue bag should be humanely euthanized.

Diagnosis

Collect a clean milk sample before any antibiotic treatment is initiated; this is essential to help identify the specific bacteria causing the disease. Send the sample to a laboratory for culture and sensitivity testing.

The California Mastitis Kit may be used to help determine if there is inflammation present in the mammary gland; however, it will not tell you what is causing the disease. (This kit can be ordered through your veterinarian.)

Prevention

Most mastitis enters the udder through the teat end. The bacteria come either from the environment or the lamb/kid. Birthing areas should be kept as clean and dry as possible. You do not want a dam to lie in an area covered in large numbers of potentially infectious bacteria. Use plenty of clean bedding. Remove this bedding after birth and consider using a drying agent such as slaked lime before laying down new bedding. The area should be well drained; avoid overstocking. In areas prone to soiling, for example, individual mothering pens, the complete removal of bedding between animals is essential to mastitis and navel ill prevention.

Orf on the teat end may predispose to mastitis.

Orphans in the flock learn to move from dam to dam, grabbing the odd mouthful of milk. These lambs/kids can quickly spread orf or mastitis bacteria. They should be removed from the flock and reared by hand.

Considerations for the Management Team

Most shepherds will check the udder of a newly lambed/kidded dam to ensure that she has sufficient colostrum. Unfortunately, most do not think about the risks associated with such a procedure. A shepherd's hands are rarely clean and he or she may have just examined a dam with mastitis. Before stripping the udder of a ewe/doe, either wash and dry your hands or wear disposable latex gloves.

Hard Bag

Occasionally animals may be found at lambing/kidding time with a large udder that appears normal but is hard when palpated and produces little or no milk. It is not hot, red, or painful. This is an unusual form of maedi-visna in sheep or CAE in goats. (Refer to *Chapter 12, Maedi-Visna*.) These animals should be culled.

Mastitis in Milking Goats

Mastitis in milking goats is obviously a very important disease, both economically and with respect to human health. It is a complex disease, made complicated because of the spread of the disease occurs during milking. Any discussion of mastitis control in the milking herd is beyond the scope of this manual. There is limited information regarding mastitis in dairy goats; most of what is known has been extrapolated from cattle information. An excellent resource is *Mastitis Control in Dairy Herds* by R. Blowey and P. Edmondson – Old Pond Publishing. Producers are encouraged to contact their own veterinarian for further advice.

Note: Milking goats may be treated with intra-mammary preparations. This is an extra-label use and you should always consult your veterinarian regarding appropriate withdrawal times and technique.

Abnormal Lactation in Goats

Abnormal Lactation in Male Goats

Cause

An udder may develop in males, and produce milk, in certain lines of high producing dairy goats (gynocomastia). In some cases, these animals may develop mastitis. Fertility of affected males is otherwise normal.

Clinical Signs

The obvious sign is mammary development. If mastitis develops the gland will become swollen, red and painful.

ELDU

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Treatment

Never milk these animals. Reduce protein and energy in the diet to dry them up. If mastitis does develop, treat it according to established protocols.

Prevention

Bucks prone to the problem should be fed a restricted diet during high risk times of the year (spring and summer). In severe cases the udder can be removed surgically.

Abnormal Lactation in Female Goats

Cause

It is not uncommon in some lines of high producing dairy goats to see the udder develop at inappropriate times, even to the point of lactation.

Two common times are:

- 1.** Immediately after birth in newborn females; this is referred to as "*witch's milk*."
- 2.** At puberty, when it is referred to as "*maiden's milk*."

In some cases mastitis may develop.

Clinical Signs

Udder enlargement; some animals may also have dripping milk.

Treatment

Attempt to dry the animal off by restricting feed, and treat mastitis as appropriate. Do not milk these animals.



8. Skin Diseases

Most text books subdivide skin problems by cause (for example, viral, fungal and parasitic). However, this is not very helpful in making a diagnosis. Instead we shall approach them by major presenting sign:

- Itchiness
- Crusting
- Oozing
- Hair loss

Itchiness

Spotting an itchy sheep or goat is not difficult. They will rub on anything, which often causes severe damage to their fleece and underlying skin. In severe cases they are so itchy they stop eating; they can also lose a lot of weight. Severe itchiness (often called **pruritis**) is an animal welfare issue. It must be addressed as soon as possible.

Scrapie

Scrapie is a degenerative neurological disease that can cause some animals to experience extreme itchiness. Scrapie is both a federal and provincial reportable disease in Alberta. Federal jurisdiction comes under the Canadian Food Inspection Agency (CFIA). The disease is described in detail in the neurological diseases section. (Refer to *Chapter 10, Scrapie*.)

***Pruritis** is the medical term for itching. **Pruritus** is an uncomfortable skin sensation that results in itching or rubbing.*

Psoroptic Mange (Scab)

Cause

The cause of scab is the skin mite—*Psoroptes ovis* in sheep and *Psoroptes caprae* in goats. This microscopic mite burrows into the surface of the skin and feeds on skin material and secretions. The mite is highly contagious and can quickly spread between animals. Mites may persist in the environment for up to two weeks. This disease is a serious problem in most parts of the world. In Canada, it is a reportable disease although it has largely been eradicated.

Clinical Signs

The presence of the mite causes extreme irritation. Sheep and goats will rub themselves on anything and nibble at their fleece. The fleece initially looks unkempt and dirty before significant wool is lost. Careful examination of sheep and goats may reveal wool caught in the teeth. Close examination of the affected areas (typically along the back) will show yellow crusting at the base of the wool caused by serum oozing out through damaged skin. If the affected areas are rubbed, sheep/goats often raise their head or make nibbling motions and appear to enjoy it. This is known as the *nibble reflex*. As the disease progresses, animals lose weight and may develop secondary skin infections.

Diagnosis

Veterinarians can scrape the skin at the edge of the lesion with a scalpel blade and examine the material under a microscope to find the mites.

Treatment

The *Psoroptes* mite is very sensitive to ivermectin injection. Sheep/goats should be treated twice, at two-week intervals; they should also be monitored. **Note:** Ivermectin is not licensed in goats.

Prevention and Control

All new animals introduced to the flock/herd should be quarantined for at least 30 days. Any affected individuals should receive prompt treatment and be isolated until the parasite is removed.

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Foot Scab

Cause

This is caused by the mite *Chorioptes ovis* (sheep) and *Chorioptes caprae* (goats). The mite mainly affects the lower limbs, scrotum, the brisket, and the area around the eyes. It can be differentiated from *Psoroptes* mites by examination under a microscope.

Clinical Signs

Itchiness and crusting in the typical areas described above.

Diagnosis and Treatment

As for scab.

Prevention and Control

Introduction into flock/herd can be controlled with biosecurity measures.

Lice

Cause

This is caused by infestations of the sheep louse *Damalinia ovis* and the goat louse *Damalinia caprae*. These biting lice live within the wool/hair and eat skin debris. Their presence causes severe itchiness. There are also sucking lice that affect both sheep and goats but they are less common. Lice cannot live for long off the animals; the disease is spread mainly by direct transmission.

Diagnosis

Identification of lice in the fleece/hair under the microscope.

Treatment

Common biting lice do not suck body fluids like mites; therefore, treatment with systemic parasiticides like ivermectin is ineffective. Sheep must be treated with a parasiticide applied to the skin. If sucking lice are identified, ivermectin products can be used.

Prevention and Control

Lice do not survive very long away from sheep and goats. They are normally introduced by carrier animals. The disease can be avoided by being cautious when sourcing replacements and limiting contact with other sheep and goats at shows or community pastures.

Sheep Keds

Cause

This is caused by the parasite *Melophagus ovinus*. These are small oval parasites that look very much like ticks, but they are actually classified as wingless flies. They walk around in the fleece, taking intermittent blood meals. Close examination will also show that unlike ticks they have three pairs of legs, not four.

Clinical Signs

Although keds do cause some irritation and hide damage, they are most commonly seen simply crawling through the fleece. As mentioned, they are often mistaken for ticks. Affected individuals may be itchy.

Diagnosis

Seeing keds crawling through the fleece.

Treatment

Systemic treatment with ivermectin should be effective as keds are blood suckers. Treatment must be strategic to be effective. Treatment with the effective product **must be** done at shearing time because the keds will be forced to take a blood meal soon after shearing; they will not be able to hide in the fleece. Ectiban is approved for use in sheep for this parasite.

Prevention and Control

Keds do not live off the host; infection occurs after close contact between individuals. When purchasing replacements and herd sires, ask the sellers if they have keds in their flock. If so, treat the individual before putting it into your flock.

Crusting and Oozing Skin Conditions

Orf

Refer to *Chapter 5, Acquired Health Disorders in Newborns*.

Mycotic Dermatitis (Lumpy Wool Disease, Fleece Rot)

Cause

This disease is caused by *Dermatophilus congolensis* bacteria. These bacteria are able to become established in the skin when the fleece is continuously saturated with water.

Clinical Signs

The disease is typically seen where the sheep's fleece is the wettest, usually along its back, neck and head. There is a thick crusting at the base of the fleece; often lumps of wool can be pulled out, revealing a red, raw area.

Diagnosis

Laboratory culture of the organism.

The disease is rare on the prairies, due to our relatively dry climate. Persistent wet weather is required to promote this problem.

Treatment

In mild cases the disease is self limiting. In severe cases the fleece must be clipped; the clipped area should be cleaned with a disinfectant, such as Hibitane soap. Animals should also be treated with penicillin for three to five days.

Prevention and Control

There are no preventative measures as mycotic dermatitis is a consequence of environmental conditions.

Ringworm

Cause

This is caused by the fungus *Trichophyton verrucosum*, derived from cattle. The fungus is left on inanimate objects, such as fence posts, when an affected cow rubs on the area. A sheep or goat may develop the disease by rubbing on the infected post. The fungus can survive in the environment for many months. The disease in sheep is typically much less severe than in cattle; sheep will recover without treatment. Goats may be affected more seriously.

Clinical Signs

You will see scabby, crusty white lesions, typically around the face or any area of the body covered by hair. Ringworm lesions rarely occur under the area covered by wool. The disease can look similar to orf but is not so severe.

Diagnosis

The fungus can be grown in the laboratory from a hair sample.

Treatment

The disease is usually self limiting; treatment is often not necessary. However, topical iodine on the lesions is sometimes used; antifungal drugs are also available if you wish to treat the condition.

Prevention and Control

Avoid contact between your flock and any other affected livestock. Do not share halters, brushes, or cards between flocks.

Zoonosis Alert: Ringworm can also affect humans.

Zoonosis

– a disease of animals that may secondarily be transmitted to man.

Blowfly Strike

Cause

Blowflies lay eggs on animals anywhere they are wet. Maggots hatch from the eggs to invade the tissues close to the affected areas. Blowflies are attracted to areas where there is damaged tissue. Such areas include:

- The areas around the anus in sheep/goats with severe diarrhea.
- Wounds in the skin, common causes include shearing wounds and dog bites.
- The prepuces of rams/bucks, if it becomes saturated with urine.
- Head wounds in rams/bucks, due to fighting.
- Around the feet in animals with foot injuries, especially foot rot.
- The backs of sheep with full, wet fleeces that are developing mycotic dermatitis.

The maggots secrete enzymes that enable the maggot to feed on the surrounding tissues. As more tissues become affected, more blow flies are attracted to the area; they lay more eggs and the situation worsens.

Clinical Signs

An important skill is identification of a "struck" sheep/goat. The animals are typically irritated at the lesion; they will rub the area, nibble at the area, lip smack and wag their tails. An affected animal will separate from the flock/herd and stop feeding. The fleece over the affected area may become discoloured. As the condition progresses, bacteria grow in the rotting tissue releasing toxins which are absorbed into the blood, leading to septicemia and toxemia (blood poisoning).

Diagnosis

Simply part the animal's fleece/hair. The smell of the rotting tissue and the presence of maggots are unmistakable.

Treatment

The fleece over the affected area must be fully clipped. The area should then be washed with a mild veterinary disinfectant such as Hibitane or Betadine. Use a pair of tweezers to remove all obvious maggots. You then need to assess the severity of the problem. In mild cases where the infestation is superficial and the sheep/goat is in good health, this may be all that is required. In more severe cases, when the maggots have migrated into the deeper tissues, contact a veterinarian. In very severe cases it is often best to euthanize af-

affected animals. However, do not be quick to euthanize the affected animal until the area has been completely cleaned and the severity assessed; it often looks worse than it actually is.

Specific Treatments

For problematic infestation animals can be treated with a dose of injectable ivermectin; this will help to kill maggots in the tissues. Severely affected animals should be treated with a broad spectrum antibiotic and given supportive care. This support can include providing fluids with a stomach tube or injecting anti-inflammatory drugs, in accordance with your veterinarian's recommendations. Once the area is dry and clean the flies will no longer be attracted to it; this is critical to case management.

Prevention and Control

It is important to follow the following steps to prevent fly strike on the prairies:

- 1.** Reduce the number of flies. Carcasses, afterbirths, and other waste tissues act as breeding grounds for flies. Remove and burn these to reduce the attraction of flies. Keep corrals as clean as possible and keep manure piles to a minimum.
- 2.** Ensure that flies are not attracted to sheep or goats by:
 - Docking tails appropriately (sheep only)
 - Preventing diarrhea or treating it quickly if cases do occur
 - Cleaning and treating wounds quickly
 - Shearing animals before fly season

Realize that animals that are down for any reason are at increased risk to fly exposure.

Bacterial Dermatitis

Cause

Any injury to the skin can allow bacteria to penetrate, setting up an infection. This may commonly occur after an animal has been scratching itself, or after an injury.

Clinical Signs

The skin is inflamed and reddened. There may be oozing and thickening of the skin.

Diagnosis

You may want to collect and submit a sample to the laboratory for culturing.

Treatment

Mild cases may only require cleaning of the area. It is usually necessary to clip the hair/fleece around the affected area and clean with a mild disinfectant. More severe cases may require treatment with antibiotics.

Prevention and Control

Identify affected animals and treat promptly.

Hair Loss

Most hair loss in sheep and goats is due to itchy animals scratching themselves. Occasionally, animals in close confinement will lose hair from areas that are continually rubbed, for example, the neck area on feeders.

Wool Slip

Cause

It is suspected that when some sheep become very sick wool growth is adversely affected. Wool grows continuously. When an animal is sick, a weak point develops in each fibre of the fleece at the same level deep in the skin. Several weeks later the wool starts to break off. As the fleece grows out the "weak area" reaches the surface and the break-off section develops. As this occurs across the whole body the fleece starts to fall off.

Clinical Signs

Fibre loss with no other signs. There may be a history of illness in the last month.

Diagnosis

This is based on history and examination.

Treatment and Prevention

Recognize that this can happen anytime that an individual is severely ill. Remember to include it on your differential list when presented with a case. Wool Slip is an individual animal problem and should never be considered as the possible disorder when a number of animals in a flock are experiencing fibre loss.

Skin Lumps

Caseous Lymphadenitis

Cause

Corynebacterium pseudotuberculosis bacteria cause this condition. In sheep/goats the bacteria are spread by externally discharging abscesses or by sheep/goats with lung lesions. Shearing is considered a high risk event only because the chance of lancing an abscess open with the shears is high. The shears become contaminated when an abscess is inadvertently cut and the bacteria are then spread to other sheep via nicks in the skin. Confinement under cover is a significant risk factor because those individuals with lung lesions can more easily transmit the disease. Research has shown that confining animals under cover together for greater than one hour after shearing increases the risk of infection by three times, compared with non-confined animals. In goats, the abscesses tend to burst as animals rub them on fence posts and buildings. Other animals rubbing in the same area then become infected. In some cases, the bacteria may enter the bloodstream and spread to internal organs (Refer to *Chapter 13, Caseous Lymphadenitis*.)

Clinical Signs

Lumps will appear on the body. Anywhere there is a lymph node a "caseous" lump may form.

Diagnosis

Not all abscesses are caused by *C. pseudotuberculosis*. To make sure of the cause, your veterinarian can do cultures.

Treatment

Abscesses should never be opened as this simply contaminates the environment and encourages spread of disease. Antibiotics do not work to treat these abscesses. The abscesses on individual animals can be surgically removed by your veterinarian. Affected animals should be culled as soon as possible, especially if they have multiple abscesses. Injection of formalin into such abscesses has been reported. This should **never** be done; formalin is known to cause cancer. Sheep and goats are classified as food producing animals; formalin contaminated animals should **not** be entering the human food system.

ELDU

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Prevention

Do not buy animals with lumps. Cull affected animals. Ensure affected animals are sheared last. Vaccination is an effective way to reduce the number of abscesses in the flock. (Use either Case-Bac or Caseous D-T). This is a very common disease in sheep and goat flocks. Initial vaccination protocols will be more effective if individuals are at least 14 weeks of age when the vaccination series is started. Use of the above vaccines in a goat flock constitutes an ELDU which requires a veterinary prescription.

Abscesses

Cause

The most common cause of abscesses is caseous lymphadenitis. (Refer to *Chapter 8, Caseous Lymphadenitis*.) However, abscesses can be formed for other reasons. There are a number of types of bacteria that may cause an abscess to form following a penetrating wound.

Clinical Signs

Swelling, often slightly soft and also warm.

Diagnosis

As for caseous lymphadenitis; a needle can be used to collect a sample of the pus.

Treatment

Treatment is complicated by the fact that caseous lymphadenitis is a common cause of abscesses. Because these CL abscesses should never be opened, a diagnosis should always be made before treatment is attempted. The softest portion of the abscess should be identified and the area clipped and cleaned with disinfectant. A cut should be made with a scalpel and the pus drained and collected for disposal. The abscess should then be flushed clean daily with mild disinfectant until it is healed. This may take several weeks.



9. Lameness

Lameness in sheep and goats is a very important condition in small ruminant flocks, for a number of reasons:

- Some diseases such as foot-rot are highly contagious and can quickly spread throughout the flock/herd.
- Lameness is a welfare issue, as lame animals are suffering.
- Lameness affects an animal's ability to move around to find food and water, so they quickly lose condition and become more susceptible to predation.
- During the breeding season, lameness can severely affect fertility in both the males and females.

Foot Rot

Cause

Classical foot rot is caused by *Dichelobacter nodosus* bacteria in conjunction with *Fusobacterium necrophorum* bacteria. *Fusobacterium necrophorum* is found in the soil and feces wherever livestock are found. It cannot be eliminated. *Dichelobacter nodosus* is a bacterium specific for the sheep/goat foot and is an absolute requirement for true foot rot. The bacterium cannot survive away from sheep/goat for more than 10 days. It can therefore (and should) be eradicated.

Clinical Signs

Severe lameness. An animal may obviously favour one leg, or it may tend to crouch on its knees, unable to stand. The animals often separate from the flock/herd and may lose much weight.

Diagnosis

Diagnosis depends on examination. The feet should be cleaned with a stiff brush or water to aid visualization. In the **earliest stages** of the disease the skin between the claws becomes inflamed and reddened. This is known as "scald". (Refer to *Chapter 9, Scald*.) A **secondary infection** with *Dichelobacter nodosus* will allow the bacteria to penetrate and eat away the soft horn under the bulb of the heel causing the horn to separate. In **severe cases** there is extensive under-running of the hoof wall and toe. The area under the under-run horn is full of foul smelling, grey, cheesy material. If the disease is untreated the horn will eventually start to grow back, but this process is disorganized, resulting in deformities of the hoof.

If confirmation is required, your veterinarian can take samples from the affected feet and submit them to the laboratory for bacterial culture.

Treatment

Foot rot is such an important and problematic disease in sheep that individual treatment is a complete waste of time. The disease must be eradicated in the flock to avoid the costs of treatment (time and money) and the welfare implications.

Eradication

Bring the whole flock (including rams) into a holding area. The feet of all animals should be examined and the flock divided into three groups:

Group 1—apparently unaffected animals

Group 2—lame animals

Group 3—animals with severe infection and/or misshapen feet

Animals in Group 1 should have their feet trimmed (disinfect trimmers between animals) and be foot bathed in 20 percent zinc sulphate solution.

Animals in Group 2 should be treated as above but when the feet are trimmed, all digits or cracks must be fully trimmed out. These animals can also be treated with a long acting oxytetracycline antibiotic (extra label use or "ELDU").

Animals in Group 3 should be culled.

It is vital that sheep are managed in a complete "one way system." After the foot bath animals must be moved to a pasture that

ELDU

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has been free of sheep for at least two weeks. They must also be moved by a route that has been free of sheep for two weeks.

Foot Bath Preparation

Ideally, the foot bath should be of a size to hold as many animals as can have their feet trimmed in one hour. The depth of solution should be eight centimetres (three inches) to ensure that the entire foot is covered. The foot bath solution is prepared from two kilograms of zinc sulphate monohydrate powder dissolved in 10 litres or two pounds in one Imperial gallon of water. You must add a wetting agent to ensure the solution penetrates the foot (175 mL laundry detergent per 100 litres of water or one cup per 30 gallons). Zinc sulphate is usually available from agricultural merchants or your veterinarian.

Math Made Easy

Once it is determined how big the footbath needs to be to hold the desired number of sheep, measure the inside of your footbath in centimetres or inches.

Metric Measure
Litres of zinc sulphate required
1. Width (cm) X Length (cm) X Depth of 8 cm
2. Divide the answer by 1000 = number of litres
Kilograms of zinc sulphate required
3. Number of litres (from 2) X 0.2 = number of kg of zinc sulphate required
Millilitres of laundry detergent required
4. Number of litres (from 2) x 1.75 = number of mL of laundry detergent
Imperial Measure
Gallons of zinc sulphate solution required
1. Width (inches) X Length (inches) X Depth of 3 inches
2. Divide the answer by 280 = number of gallons
Pounds of zinc sulphate required
3. Number of gallons (from 2) X 2 = number of pounds of zinc sulphate required
Cups of laundry detergent required
4. Number of gallons (from 2) ÷30 = number of cups of laundry detergent

Herd animals into the foot bath and keep them standing in it for one hour. **Do not** let the animals drink the solution; it is toxic.

The solution becomes less effective with use. The quality of the solution can be measured with a battery tester (not an anti-freeze tester). If the zinc sulphate concentration falls below 15 percent it will not be effective at all.

Because zinc is toxic, disposal of the solution must be done carefully so that it does not become an environmental hazard.

Prevention

This disease can be considered animal dependent because *D. nodosus* can only survive a short time in the environment away from animals.

If the disease gets into your flock, it is because it was either brought in by a replacement animal or your animals have been in contact with infected animals. Remember that the organism can live in the environment for 10 days, making any area where animals are either mixed or share walkways high risk for spreading this disease.

Preventing foot rot involves buying replacement animals only from flocks with a known history. Even then, all replacements should be quarantined. During the quarantine process the animals' feet should be trimmed and they should have the foot bath treatment.

If your animals are to mix with others in a community pasture, or at a livestock show or other event, ensure that there are protocols in place to aid in the control of foot rot.

Vaccines have been developed in other parts of the world and appear to be effective. A vaccine is available in Canada, but first an EDR must be completed, through your veterinarian.

Scald

Cause

This disease is caused by the bacterium *Fusobacterium necrophorum*. These bacteria are naturally present in the soil and feces wherever livestock are kept. In situations where the ground is very wet the surface of the skin between the two claws becomes soft and is easily invaded by the bacteria, causing inflammation.

Clinical Signs

Mild lameness. Examination of the hoof will reveal reddening of the skin between the claws.

Diagnosis

Clinical signs only.

Treatment

Most cases will resolve without treatment if the animals are moved to a dry area.

EDR

Emergency Drug Release permits the manufacturer of a new drug to sell a limited quantity of the new drug to a veterinary practitioner. The new drug is one which is not marketed in Canada and is requested by the practitioner for the purpose of diagnosing or treating a medical emergency.

Foot Abscesses

Cause

The junction of the hoof wall and sole of the foot, often referred to as the white line, is the weakest part of the foot. It is possible for debris to erode this part of the hoof, allowing bacteria to enter the deeper tissues. Should the bacteria reach the deeper tissues of the foot an abscess may form. Abscesses occur most commonly in the toe region and are also more common after episodes of laminitis. (Refer to *Laminitis* - next topic in this chapter.)

Clinical Signs

It is common to see severe lameness in one limb. The affected claw will be hot and painful if squeezed. Typically, black debris is embedded in the white line.

Treatment

Trim down the discoloured white line with hoof shears and a knife until you reach the abscess. Allow the area to drain and remove all under run horn; do not leave pockets to be filled with dirt. In most cases no further treatment is necessary.

Laminitis (Founder)

Cause

When animals are fed concentrated diets high in carbohydrates (sugars) the increased lactic acid produced by the rumen causes inflammation of the deep tissues of the hoof. This causes inflammation and pain. Laminitis may also occur after severe systemic illness as a response to stress.

Clinical Signs

Lameness in more than one foot. Feet are often warm and painful if pressed with pliers.

Treatment

Reduce the amount of carbohydrate that the animal is consuming and offer supportive care, because affected individuals often have difficulty moving around. Consult with your veterinarian about using an anti-inflammatory drug to make the animal more comfortable.

Prevention

This is a management disease. Careful review with a nutritional consultant of how your rations are formulated will go a long way towards

preventing this disease. Avoid high concentrated diets with too much grain and restricted amounts of roughage.

Ovine Digital Dermatitis (ODD, Hairy Heel Wart)

Cause

ODD has recently been discovered in sheep in the UK. The disease appears to be related to hairy heel wart in cattle. It is caused by a *Spirochete* bacterium.

Clinical Signs

The animal has severe lameness affecting one limb. There is typically an ulcerated lesion on the skin on the bottom of the hoof, with severe under running of the hoof wall.

Treatment

In cases which have been caught early enough, using a foot bath with oxytetracycline antibiotics applied to the lesions works well. In severe cases it may be necessary to amputate the affected digit.

Prevention

To date there has been no diagnosis of this disease in North American sheep.

Foot Trimming

Foot trimming is an important skill that anyone working with sheep or goats should be and can be proficient at. Anyone trimming a foot should have a plan in mind; it is unacceptable to simply hack at the foot until it bleeds.

Tools

Feet can be trimmed using a hoof knife, hoof trimmer pliers or a combination of both, depending on the operator's preference. A hoof rasp is also useful for finishing the hoof.

Restraint

Sheep are typically set up on their butts and held between the knees for foot trimming. Goats typically stand. Several types of cradles and devices are also available to hold animals while their feet are trimmed.

Trimming Principles

The hoof of a sheep or goat grows continually (like a finger nail). The sole and the wall grow at the same rate. However, the wall is much

tougher than that of the sole so the sole tends to wear away more rapidly. The amount of wear of the walls depends on the environment, the type of ground, the amount of walking and the breed. The two goals of foot trimming are:

1. To restore the natural balance of the foot
2. To deal with any problems

Make the first cut straight across the toe. If you are unsure about how much horn to trim, start by trimming small pieces; you can always take off more later. In most cases, the outer wall of the hoof grows around and under, covering the sole.

This whole area should be removed until it is level with the sole and all the packed debris is cleaned out. The wall on the inner surface of the hoof rarely overgrows excessively, but should be trimmed level with the outer wall. Trim the heel area only if it is very overgrown. Finally, any areas of under run horn or pockets of embedded debris should be explored and cleaned. You can use a rasp to smooth any sharp edges after trimming.

Upper Limb Lameness

Arthritis

Cause

As the sheep ages, arthritis develops, mainly by the natural degeneration of the joints. This is termed "osteoarthritis."

In goats, most arthritis is due to infection with CAE. (Refer to *CAE* - next topic in this chapter.)

Clinical Signs

Animals are lame. There will be no signs in the foot to explain the lameness. Close examination of the legs may reveal swollen joints and/or joints that are apparently painful when manipulated. The animal may exhibit an abnormal gait.

Treatment

Most of these animals should be culled because there is no treatment. Individual animals may be made comfortable using anti-inflammatory drugs, with veterinary advice.

Prevention

Osteoarthritis cannot be prevented; it is part of the aging process. For information on CAE prevention, refer to *CAE* below.

Caprine Arthritis Encephalitis (CAE)

Cause

Caprine arthritis encephalitis (CAE) is caused in goats by the CAE virus, a virus very closely related to maedi-visna in sheep. (Refer to *Chapter 12, Maedi-Visna*.) The two diseases are very similar; while maedi-visna in sheep tends to affect the lungs and brain, CAE most commonly affects the joints and brain.

Clinical Signs

Arthritis is seen in goats more than six months old. The animals are lame and the joints are typically swollen. The disease may wax and wane initially, but is slowly progressive, with animals becoming progressively lamer.

Diagnosis

A diagnosis is based on the clinical signs. A blood test can be used to determine if an animal is infected with CAE. Samples of fluid may also be aspirated from a joint to confirm the diagnosis. It is important to recognize that an individual may test positively for the CAE virus and have no clinical signs.

Treatment

None. Anti-inflammatory drugs may help in the short term to keep an animal comfortable.

Prevention

Control of CAE in goats is essentially the same as control of maedi-visna in sheep. (Refer to *Chapter 12, Maedi-Visna*.)



10. Neurological Diseases

A wide variety of diseases can affect the nervous system of small ruminants. Most present as any one or a combination of:

- Depression
- Inability to get up
- Difficulty in walking

Making a diagnosis is challenging. This section covers the most common diseases, and the goal is to enable you to narrow down the possible causes of the clinical signs you are presented with, by taking into account both the clinical signs and factors such as the age and production stage of the animal. It is important to recognize that no single disease is ever described by only one clinical sign. For example, not all staggering sheep have scrapie, but scrapie is on the list.

Diseases typified by circling:

- Listeriosis
- Tapeworm Cysts (GID)

Diseases typified by staggering gait:

- Scrapie
- Tetanus
- Brain Worm (Cerebrospinal Nematodiasis)
- Caprine Arthritis and Encephalitis (CAE)
- Maedi-Visna (MVV)

Diseases typified by blindness:

- Polioencephalomalacia

Diseases typified by abnormal behaviour:

- Rabies

Listeriosis

Cause

The bacterium, *Listeria monocytogene*, is naturally found in the soil. If silage is made with contaminated soil and the pH does not fall low enough *Listeria* can easily grow in the silage. Animals that eat this silage are at risk of disease. *Listeria* can cause abortion (refer to *Chapter 6, Listeriosis*) or the bacteria may penetrate down the side of a tooth where they can enter nerves and ascend to the brain where they cause disease.

Clinical Signs

As listeriosis is a bacterial infection most affected animals run a mild fever. Since the bacterium initially affects only one side of the brain, the signs are asymmetrical. Often one side of the face is paralyzed and the animal is unable to eat; the ear on the same side is often dropped, and close examination of the eyes may reveal that they flick from side to side. Many affected animals will also walk in a circle.

Diagnosis

It is possible to collect a sample of fluid from the spine to confirm this diagnosis, but most often affected animals are treated on the basis of clinical signs.

Treatment

Listeria bacteria can be treated with antibiotics. Common strategies include penicillin at the label dose, but twice daily, or oxytetracycline at the label dose, but twice daily. (These are both ELDU protocols and require a veterinary prescription.) Treatment should be continued for approximately 10 days. Since many affected animals cannot drink they will often require fluid therapy through a stomach tube.

Prevention

Use only good quality feed. Never feed spoiled silage. Old silage left in the feed yard that is not cleaned up can be a risk. Very occasionally cases of listeriosis occur in animals with no access to silage.

ELDU

Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

Tapeworm Cysts (GID, Sturdy, *Taenia multiceps*, Coenurosis)

Cause

The tapeworm, *Taenia multiceps*, has a similar life cycle to *Taenia ovis*. (Refer to *Chapter 20, The Sheep or Goat as an Intermediate Host*.) The egg is passed by a dog in its feces and is eaten by the sheep/goat. The eggs hatch and the larvae move through the blood to the brain where they form cysts (*Coenurus cerebralis*). The cysts take approximately eight months to develop.

Clinical Signs

The presence of a large cyst in the brain can cause a wide variety of signs, mainly circling, abnormal walking and blindness.

Diagnosis

There may be softening of the bones of the skull over the cyst.

Treatment

It is possible to remove the cysts surgically, but this is not usually pursued. Most animals are humanely euthanized.

Prevention

Same as *Taenia ovis*, refer to *Chapter 20, The Sheep or Goat as an Intermediate Host*.

Scrapie

Cause

Scrapie is a degenerative condition of the nervous system affecting sheep and goats. The cause is an abnormal prion protein. A prion is not a living organism. It is not bacterial, viral, or protozoal, yet in small ruminants it is infectious. A normal brain contains normal prion protein. If abnormal protein enters the brain it may cause the normal protein to convert to the abnormal form. The abnormal proteins build up in brain cells and cause the cells to die. This brain damage leads to the observed clinical signs.

We know that sheep infected with scrapie excrete abnormal prion protein in the placenta and birth fluids. Infection of newborns and other females in the flock at this time is common and an important control point when you are dealing with the disease. The abnormal prion protein is ingested or crosses the placenta, and makes its way

to the brain. The time between infection and presentation of clinical signs is variable and can range from two to eight years.

Clinical Signs

The earliest signs of scrapie are mild changes in behaviour such as mild apprehension, fixed gaze, failure to herd and aggression. As the disease progresses the animal's condition will deteriorate; the gait becomes unsteady and clumsy, with animals often described as drunk looking. Some animals will develop itchiness. (Refer to *Chapter 8, Scrapie*.) Eventually, there may be tremors and a very strange goose stepping gait. In this debilitated state the animal may fall victim to another disease such as pregnancy toxemia, which is not related to scrapie, so if you do not look for scrapie in dead or euthanized adult female small ruminants you will not know if it is there.

Diagnosis

For many years the only diagnostic test for scrapie was to examine the brain after death. This is still the main test for the disease. It is possible for veterinarians to take a sample of tissue from the third eyelid which can be used to identify animals carrying the scrapie prion.

Treatment

There is no treatment. Scrapie is a fatal disease.

Prevention

Scrapie is a federally reportable disease. All **suspect** cases **must** be reported to the Canadian Food Inspection Agency (CFIA). Suspect animals are slaughtered and if they are found positive a protocol is in place to determine the susceptibility of other flock/herd members. Compensation is paid for animals culled due to scrapie. For more information on scrapie control programs refer to the Scrapie Canada (www.scrapiecanada.ca) and the CFIA websites (search CFIA scrapie and select *The Manual of Procedures*).

Scrapie Genetics

Scrapie is an infectious disease in which the animal's susceptibility is determined genetically. Scrapie belongs to a small group of diseases called transmissible encephalopathies (TSEs or prion diseases). All TSEs are characterized by a long incubation period, a relatively short clinical course, lack of host immune response yet no immune system suppression. There is considerable genetic variation in susceptibility

Current scrapie information:
<http://www.scrapiecanada.ca/genotyping.html>
and
<http://www.scrapiecanada.ca/certification.html>

to infection. For a complete description of scrapie genetics refer to Scrapie Canada (www.scrapiecanada.ca).

Tetanus

Refer to *Chapter 5, Tetanus*.

Brainworm (Cerebrospinal Nematodiasis)

Cause

The larvae of the worm *Parelaphostrongylus tenuis* (*P. tenuis*) cause this disease. This worm is normally carried by white tailed deer, where it rarely causes disease. Sheep and goats eat small slugs and snails which are carrying the larval form of the worm. The larvae are released in the intestines and make their way to the brain where they can cause serious inflammation, resulting in disease.

Clinical Signs

The most common sign is paralysis, which usually occurs in lambs/kids with bright attitudes and good appetite. Occasionally animals may appear blind or have a head tilt with severe depression.

Diagnosis

Your veterinarian may be able to collect a sample of spinal fluid for laboratory analysis to help with the diagnosis by looking for a cell called an eosinophil.

Treatment

Treatment with a large dose of ivermectin (an initial dose of 500 mg/kg subcutaneously – ELDU-requiring a prescription), followed by five daily doses of 200 mg/kg subcutaneously. Most animals should also be treated with anti-inflammatory drugs to suppress the inflammation caused by the death of the parasite.

Prevention

ELDU

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Minimize contact with white tail deer. Regular deworming will also help to prevent this disease in problem areas. If the small slug or snail that is the intermediate host for this parasite is in your area, then consider this disease as a possibility.

Caprine Arthritis and Encephalitis (CAE)

Cause

CAE virus is closely related to the maedi-visna virus of sheep. (Refer to *Chapter 12, Maedi-Visna.*)

Clinical Signs:

Kids are usually affected at one to four months of age. Kids appear drunk, and gradually become paralyzed in all limbs. Some animals may go blind. Most animals will die within two weeks.

Diagnosis

Blood test for CAE antibodies can help make the diagnosis.

Treatment

There is no treatment for this disease.

Prevention

Refer to *Chapter 12, Maedi-Visna.*

Maedi-Visna (MVV)

Cause

In some cases infection with the maedi-visna virus in sheep can result in neurological disease (the “visna” form). MVV is related to the caprine arthritis encephalitis virus of goats, with cross infection possible between the two species.

Clinical Signs

The earliest signs are a stumbling or drunken-like gait. The disease slowly progresses over weeks or months with the hind legs becoming completely paralyzed.

Diagnosis/Control

Refer to *Chapter 12, Maedi-Visna*.

Polioencephalomalacia (Polio, Thiamine Deficiency, Cerebro Cortical Necrosis, CCN)

Cause

The cause of this condition is a deficiency of thiamine (vitamin B1). Without thiamine the brain cannot process glucose (sugar) and the brain cells die of starvation. All ruminants have the capacity to produce their own thiamine requirements within the rumen; hence the disease can only occur when thiamine production in the animal is compromised.

This loss of production can occur in the following situations:

- Excessive carbohydrate in the diet causes rumen acidosis.
- Certain toxins such as bracken fern can cause polio.
- Some drugs, for example, Amprolium for coccidiosis can cause polio.
- Excessive sulphates, either in the water or feed, can interfere with thiamine production in the rumen.

Clinical Signs

The first signs of the disease are depression followed by apparent blindness. The animals may head press and become recumbent. Most often, early in the disease an animal just “looks off.” They often become rigid and extend the head back toward the shoulder. Animals then begin to convulse and will die. Polio becomes a very serious disease in the late-pregnant female when the likelihood of her developing concurrent pregnancy toxemia is greatest.

Diagnosis

The best diagnostic test for this is to assess eye function. In polio the animal goes blind and will not respond to sudden movement (it will not blink when an object moves towards it). Examine the animal in a dark area; if you shine a flashlight into the eye the pupil will get smaller. Animals that die of polio can be diagnosed through a post-mortem examination.

Treatment

These animals require thiamine. Injectable thiamine is available and animals should be treated at a dose of 10 mg/kg. The first dose should be intravenous (iv); subsequent doses of 10mg/kg every six hours for two days may be given intramuscularly (im). The sooner animals are treated the better chances for a positive outcome. Any treatment protocol for a small ruminant that is off feed for any reason should include thiamine. The use of thiamine does not constitute a food safety risk and withdrawal time is not an issue.

Prevention

Avoid sudden diet changes to diets rich in carbohydrates, and beware of sheep/goats eating bracken fern. Special care is needed when using Amprolium.

Note: Sulphate poisoning causes a similar condition to this. Refer to *Chapter 18, Sulphates*.

Zoonosis

– a disease of animals that may secondarily be transmitted to man.

Rabies

Zoonosis Alert: Humans are extremely susceptible to the rabies virus. Extreme care must be taken when handling rabies suspects.

Cause

The rabies virus may be carried by any warm-blooded animal and is considered endemic in the wildlife population; it is carried by skunks, rats, squirrels and other warm-blooded vermin. When any warm-blooded animal is infected, the rabies virus moves to the brain and affects the animal's behaviour. Rabies may be presented as either the "dumb" or "furious" form. The virus also spreads to the salivary glands and cerebrospinal fluid and is therefore present in the saliva and in the fluid surrounding the central nervous system.

Clinical Signs

Sheep and goats are essentially dead-end hosts for the rabies virus because they do not usually bite other animals. However, people who either handle infected animals or infected animal tissues during post-mortem examination can be at risk.

It may take weeks or months for the virus to reach the brain. However, once it reaches the brain and the animal becomes affected the animal typically dies within seven to 10 days. Signs of rabies are non-specific and include depression or excitation and aggression. Rams

are often noted to have sexual excitement. The disease progresses rapidly, with the animal often being paralyzed and salivating excessively.

Note: Do not examine the oral cavity of an animal salivating excessively without taking appropriate precautions. People die from rabies.

Diagnosis

The only way to diagnose rabies is by examination of the brain immediately after death. Since the brain tissues are required, care should be taken during performance of euthanasia, so that the brain is not damaged. Animals suffering from rabies look very much like those affected by scrapie and must be differentiated from them.

Treatment

Rabies is a fatal disease. There is no treatment for any species.

Prevention

Vaccines are available for use in sheep and goats. Rabies is a reportable disease and all suspect cases must be reported to the Canadian Food Inspection Agency (CFIA). Rabies is transmissible to humans. If you suspect rabies, never handle the animal without gloves. If you are exposed to body fluids from a suspect animal, notify your veterinarian who will notify the CFIA and the public health agency in your area to arrange for post exposure vaccination.



11. Diseases of Growing Animals

After the first few weeks of life, young animals are stronger and more resistant to disease but there are still several important diseases to consider, especially:

- Coccidiosis
- Pneumonia
- Enterotoxemia (Pulpy Kidney)
- Rectal Prolapse
- Urolithiasis

Coccidiosis

Cause

Coccidiosis is an infection of the intestines caused by the microscopic protozoal parasite *Eimeria* found in sheep and goats. Most types are harmless. However, several specific species can cause severe disease conditions. *E. crandallis*, *E. ovinoidalis* and *E. ahsata* can cause severe problems in lambs; *E. arloingi* and *E. ninakohlyakimovae* can cause severe disease in kids. The oocysts (eggs) are shed in the feces of adult animals or affected young lambs or kids. The oocysts require warmth and moisture to mature to the infective forms which are eaten by other young animals without immunity.

The parasite invades the cells lining the gut and completes its complex life cycle, destroying the cells. This can result in severe diarrhea, with the stool occasionally containing blood and/or mucus.

Clinical Signs

Animals between one and four months of age are most susceptible to infection. The disease most commonly presents as diarrhea, causing reduced growth rates and stunting. Sudden death from coccidiosis can occur with overwhelming disease, or death can result when a debilitated lamb or kid goes undiagnosed and succumbs to another disease.

Diagnosis

Diagnosing coccidiosis can be surprisingly difficult. It is possible to examine a fecal sample for oocysts; unfortunately, sheep and goats typically secrete many oocysts from species of *Eimeria* that do not cause disease. However, when you have clinical disease and evidence of *Eimeria*, assume that there is a correlation.

It is also important to recognize that in small ruminants, as in other species affected by coccidiosis, animals that are in the early or late stage of an *Eimeria* infection do not shed oocysts, but are still suffering from the disease.

Often the diagnosis is based on the clinical signs and knowledge of the management system. In severe cases, a post-mortem examination may demonstrate direct evidence of coccidiosis.

Treatment

There are many drugs that can help prevent coccidiosis (see below); however, most of these drugs do not help animals already showing clinical signs. The only drugs that can help at this stage are known as potentiated sulfonamides - for example, Borgal or Trivetin. These drugs are not licensed in these species and require a veterinary prescription.

Prevention

There are some simple management changes that can help to reduce the risk of coccidiosis in a goat/sheep herd. Increasing sanitation, avoiding overcrowding and using appropriate drugs are critical. Minimizing stress ensures that an animal's immune system is in the best shape to develop immunity and avoid disease.

Despite the best management practices, many producers must use medication to control the disease. These drugs are known as coccidiostats (see the following table).

There are no products in Canada licensed for use in sheep and goats. However, products are available for use in cattle and poultry.

These drugs are used in sheep and goats in Canada and other parts of the world; they are very safe to use. You will require a veterinary prescription to use them for your sheep or goats.

Coccidiostat options include:

Medication	Dosage Level	Regulated Use in Canada
Lasalocid	20 to 30 g/tonne of feed 0.5 to 1 mg/kg daily intake	Bovatec for cattle ELDU
Decoquinatate	100 g/tonne of feed 0.5 mg/kg daily intake for 28 days	Decox ELDU
Amprolium	50 mg/kg for 19 days (Note- this is five times the cattle dose)	Amprol solution for in water medication or feed mix ELDU
Monensin	10 to 30 g/tonne of feed	Coban - licensed in calves ELDU

Depending on the medication used, treatment options include mixing it with:

- Milk replacer
- Creep feed
- Ration
- Water
- Mineral mix

Care must be taken with dosage as overdoses can cause serious problems, especially with Amprolium, where excessive doses result in polio. Monensin toxicity results in death; some drugs are toxic to dogs and horses that may have opportunity to consume the medicated feeds.

Note: Monensin and Lasalocid also increase feed efficiency and increased growth rate.

Pneumonia

Refer to *Chapter 12, Respiratory Diseases*.

Enterotoxemia (Pulpy Kidney)

Refer to *Chapter 16, Clostridial Diseases, Enterotoxemia (Pulpy Kidney)*.

ELDU
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Rectal Prolapse

Cause

Rectal prolapses are most commonly associated with lambs having their tails docked too short.

Clinical Signs

Red inflamed bulging mucosa from the anus below the tail will be obvious. Lambs may be straining to pass feces.

Diagnosis

Observe the clinical signs.

Treatment

It is possible to carefully replace the rectum and stitch it in place but the problem has a tendency to reoccur. Most animals are humanely euthanized.

Control

Ensure tails are docked correctly. Do not purchase animals with short tails. See recommendations for tail docking in *Chapter 4, Lamb/Kid Processing*.

Urinary Calculi (Urolithiasis, Bladder Stones)

Refer to *Chapter 15, Urinary Calculi*.



12. Respiratory Diseases

Respiratory disorders (especially pneumonia) are common causes of disease in sheep and goats. Not all of them respond to antibiotics, so it is important to try and narrow down the potential causes of disease.

First, it is important to determine if the disease is affecting the upper airways or the lungs. Disease in the upper airway tends to be associated with noisy breathing (especially breathing in); there may also be sneezing and nasal discharge. Diseases affecting the lower airways tend to cause faster breathing and coughing, and may be associated with a fever.

Diseases of the Upper Airways

Laryngeal Chondritis

Cause

Damage to the vocal cords allows a bacterial infection to develop. Possible causes of damage include feeding dry grain, drenching injuries and genetic predisposition, especially in Texels and South Dorset breeds.

Clinical Signs

The disease comes on quickly, causing severe respiratory distress and collapse. Affected animals make very loud breathing sounds, especially when they breathe in.

Diagnosis

The signs are very characteristic.

Treatment

Some individuals can be saved with surgery but most are culled.

Control

Take care when administering oral medications.

Enzootic Nasal Tumour

Cause

The disease is caused by a retrovirus similar to that which causes pulmonary adenomatosis (*Jaagsiekte*). The virus is shed and spread through nasal secretions. The virus infects the cells in the nasal passage to create a tumour.

Clinical Signs

The disease is typically seen in middle aged sheep; there have been no reports of this disease in goats. There is nasal discharge and noise when breathing. In severe cases sheep may have difficulty breathing and may breathe through their mouths.

Diagnosis

A final diagnosis is often made at post-mortem. Careful examination of affected sheep may reveal an abnormal shape to the bones of the face.

Treatment

None. Affected animals should be humanely destroyed.

Control

Early culling of affected animals.

Nasal Miasis (Nose Bots)

Cause

Fly - *Oestrus ovis*. The adult female fly lays her eggs most commonly in the nasal openings of sheep. Goats are also infected, although less commonly than sheep. The eggs hatch and larvae crawl up the nose and develop high up in the nasal passages. They then emerge several weeks later and are sneezed out.

Clinical Signs

The presence of the fly agitates the animals, causing them to cluster together, stamp their feet and try to push their noses down to the soil in an attempt to avoid the flies. Once the animal is infected there is typically a large amount of nasal discharge. In severe cases

the larvae in the top of the nasal passage may form cysts, leading to pressure on the brain and severe neurological disease.

Diagnosis

Clinical signs.

Treatment

Regular treatment with ivermectin will eradicate the larvae in the nasal passages.

Control

It is not really possible to avoid the fly. In areas with a problem, routine treatment with ivermectin in late summer will help.

Diseases of the Lung and Deeper Airways

Sudden Onset (Acute) Pneumonia

Cause

Acute pneumonia is rarely caused by a single organism. Typically the disease starts with a virus such as ovine herpes virus (OHV) or parainfluenza virus 3 (PI3). These can cause mild damage to the innate defence mechanisms of the respiratory tract. In turn, secondary invaders, such as mycoplasma (*M. ovipneumoniae*) or bacteria (*Pasteurella multocida* or *Mannheimia haemolytica*) can be established in the lung tissue to cause the disease.

Clinical Signs

As mycoplasma or bacteria start to grow in the lung tissue, they release toxins into the bloodstream. Animals appear generally sick; they separate from the flock, appear depressed and may back off their feed. Close examination will probably reveal that an infected animal is running a fever. As the lung tissue is damaged and the disease progresses, an animal will start to show laboured breathing, cough and have nasal discharge.

Diagnosis

Most causes of pneumonia are never truly diagnosed. Animals are simply treated. However, in situations where there is an outbreak and animals are dying of disease, a full post-mortem examination should be performed. Lung tissue taken from affected animals can be processed by the laboratory to find the agent causing the disease. Tissue cultures are most valuable in animals that died before any treatment was given. This will allow therapy to be tailored to the specific problem seen on your farm. To get the most value from a

post-mortem examination, pick an animal that is typical of the disease you are seeing. Do not pick the worst affected or the most unusual. Also ensure the post-mortem is performed promptly after death or euthanasia. After death, the carcass will start to decompose rapidly and decomposition will severely affect the quality of the laboratory results.

Treatment

Most cases of pneumonia are treated with antibiotics. Because many pneumonias are viral in origin, antibiotics will not be of value in treating the primary pathogen but may help to control secondary bacterial invaders. Antibiotics used to treat pneumonia should be effective against the bacteria commonly associated with pneumonia cases on your farm.

Medication	Dosage Level	Regulated Use in Canada
Oxytetracycline LP (low pain)	Daily dose required as indicated on the bottle.	This is a sheep labelled product.
Oxytetracycline LA (long acting)	A single treatment is often effective.	This is a prescription drug for sheep and goats. ELDU
Tilmicosin	A single treatment is often effective. It is critical to follow the recommended injection technique. Do not use in goats; it is toxic.	This is a sheep labelled product. Tilmicosin is toxic to sheep if used incorrectly, follow the label! Tilmicosin is also potentially toxic to humans, use safely.

Refer to Appendix 1 for appropriate brand name medication

Prevention

Many cases of pneumonia require some sort of predisposing factors which allow the infectious agent to overcome the animal natural defences. Follow good husbandry management practices.

Common Risk Factors

Housing

Whenever animals are housed, the air quality in the building will always be lower than when they are outside. The air becomes more humid and carries more particles from feed and bedding. In addition, bacteria and viruses that are breathed in and coughed up by animals are not simply blown away; they continue to circulate within the enclosed space. The number of particles in the air can simply overwhelm the lung's natural defences, which leads to disease.

Stress

Stress causes the animal to secrete the stress hormone, cortisol, into its circulation. Cortisol has many functions; one is to suppress

the effects of the animal's immune system. Stress can, therefore, make the animal more prone to disease, especially pneumonia.

Mixing

When animals from different sources are brought together each animal brings its own population of viruses and bacteria with it. Each animal is immune to its own population. When the animals are mixed they suffer stress, which decreases immunity. They can then become overwhelmed by the mix of bacteria and viruses from the other animals. This is especially true when animals from multiple sources are mixed, so this situation should be avoided if possible.

Weather

Sudden changes in weather, especially temperature, can affect the lung's ability to deal with infection, which can predispose animals to infection.

Prevention Strategies

If animals are housed, ensure the barn is well ventilated. If necessary, contact an extension specialist to assist in developing an effective ventilation strategy. As a rule of thumb, if a barn seems stuffy or smelly, ventilation is inadequate. If the air in your barn makes you cough, it is not healthy for your flock either.

Common stresses affecting sheep and goats include weaning, transport, mixing, handling and vaccinations. While it is not possible to avoid all stresses, care should be taken to avoid compounding them. For example, weaning animals, moving them to the feedlot and mixing with other animals at the same time are all recipes for disaster.

Vaccination

In other parts of the world vaccines have been developed to control common causes of pneumonia. Vaccines developed for other species but which may be effective in your flock may be used, with a prescription.

Prophylaxis

This can be considered for high risk management styles where the occurrence of pneumonia can be anticipated, for example, animals arriving in a feedlot. Vaccination and management protocols to reduce the risk of animals' succumbing to pneumonia can be developed, once the risks predisposing the animals have been identified.

Atypical (Chronic Non-progressive) Pneumonia

Cause

This is principally caused by mycoplasma (especially *M. ovipneumonia*), often in association with other viruses and bacteria. The disease causes a low level pneumonia in young animals, especially when they are housed at high stocking densities. The disease is spread by coughing.

Clinical Signs

The disease is mild, with the main clinical sign being occasional coughing. There may be some nasal discharge. Typically animals do not run a fever. Severely affected animals will not grow as fast as others; animals rarely die. Affected feeder lambs eventually do become finished but the cost to get them there far exceeds the production cost of finishing unaffected animals.

Diagnosis

This diagnosis is usually made either at post mortem (for some other condition), or the disease is found when animals are slaughtered for meat.

Treatment

Although this disease causes reduced growth rate and coughing, almost all affected animals will recover and the lungs will heal. The quality of replacements retained in flocks where the disease is endemic may be affected; the animal's ability to thrive is compromised by the mycoplasma organism. Severe cases should be treated with antibiotics effective against the mycoplasma organism; consult with your veterinarian.

Control

The disease is normally controlled through good management practices, such as reducing stocking density and ensuring adequate ventilation of barns. If young animals are purchased, avoid mixing groups, to minimize the spread of disease.

Parasitic Pneumonia

Cause

Three lungworm species affect sheep and goats:

Dictyocaulus filaria

Muellerius capillaris

Protostrongylus rufescens

In all cases the larvae are ingested by the sheep. They then migrate to the lungs where they may cause disease. Fortunately these diseases are uncommon in western Canada.

Clinical Signs

Only *Dictyocaulus filaria* infection is truly associated with severe disease such as coughing, rapid respiration, nasal discharge and weight loss. The other worms cause very little damage to the lungs.

Diagnosis

Dictyocaulus filaria infection can be diagnosed using a special analysis of the feces from affected animals. (The test is different from a standard worm egg count).

Treatment

Fortunately all lungworms of sheep and goats respond well to commonly used dewormers such as ivermectin and others.

Control

Most lung worm problems can be controlled through an appropriate biosecurity program (Refer to *Chapter 22, Biosecurity*) and strategic management considerations.

Chronic (Slowly Progressive) Pneumonias

There are a number of causes of pneumonia in adult animals that are slow in onset and progressive, eventually leading to death.

Maedi-Visna (Ovine Progressive Pneumonia, OPP)

Cause

This is caused by the maedi-visna virus, a member of the retrovirus family. The virus infects white blood cells and the virus's genetic code is inserted into the cells. Over many years the cells' function becomes impaired and the affected cells start to build up in specific tissues, leading to disease. The most common tissue affected is the lung. The virus can be spread in a number of different ways:

1. The virus is present in colostrum and can spread from mother to offspring.
2. There is a small risk that a mother can pass it to her offspring while she is pregnant.
3. The virus is easily spread through blood, especially when needles are reused for injections.
4. The virus can spread through coughing.

Clinical Signs

The pneumonia (*Maedi*) form of the disease typically presents as exercise intolerance and increased respiratory effort. You will notice the sides of the animal moving with every breath, and animals may stand with their necks extended and breathe through their mouths. Animals do not run a fever.

The disease may also present in a number of different syndromes, including mastitis (refer to *Chapter 7, Hard Bag*) and neurological disease (refer to *Chapter 10, Maedi-Visna*).

Diagnosis

It is only possible to make a final diagnosis at post-mortem. However, animals carrying the virus can be identified by a simple blood test before they develop clinical signs, as this virus has a long incubation period.

Treatment

There is no treatment.

Prevention

The only way to prevent this disease is to eradicate it from the flock.

Always work with your veterinarian to determine if control or eradication of maedi-visna is right for you. The critical point for control is to test all sheep every year and cull any that are positive. In addition, you need to minimize the spread of disease by using new needles for all injections. The other component of control is preventing the spread from one generation to the next. Consequently, no offspring from affected dams should be kept for breeding. It is technically possible to remove newborn lambs from the mother before they consume colostrum. These animals should be fed colostrum from another virus-free source and be hand reared. They should then be free from infection. This technique, however, is very time and labour intensive; hence it is rarely implemented by producers.

Caprine Arthritis and Encephalitis (CAE)

Cause

CAE is caused by a virus which is very closely related to maedi-visna in sheep. However, it affects goats instead and although it more commonly causes arthritis and brain disease, it does occasionally cause a pneumonia similar to maedi-visna. (Refer to the previous section, *Maedi-Visna*.)

Caseous Lymphadenitis (CL)

In some cases the bacteria carrying CL can get into the bloodstream and spread to the internal organs, especially the lungs, where large abscesses can form. Affected individuals may exhibit signs of pneumonia and suffer significant weight loss. Most animals will also have signs of a CL abscess under the skin. There is no absolute way of making a diagnosis other than by post-mortem and culture. There is no treatment; animals should be euthanized.

Refer to *Chapter 8, Caseous Lymphadenitis*.

Lung Abscesses

An episode of severe pneumonia often leaves the affected animal with areas of damage in the lung. Over years these areas can become colonized by bacteria. The damaged lung forms an abscess. While there are often not signs of respiratory disease associated with this abscess formation, the animals do poorly and lose weight. Lung abscesses are an important cause of carcass condemnation at slaughter. (Refer to *Chapter 13, Poor Body Condition*.)

Jaagsiekte (Pulmonary Adenomatosis, Pulmonary Carcinoma)

Cause

This is caused by *Jaagsiekte* retrovirus, a virus is similar to the one causing maedi-visna. The virus inserts itself into the DNA of a sub-population of cells in the lungs. The virus may then cause these cells to become neoplastic, leading to the development of a specific lung tumour. The virus is spread by coughing and takes many years to develop.

Clinical Signs

The disease typically affects sheep aged two to four years of age. This disease also occasionally affects goats. These animals have difficulty breathing if you attempt to drive them; they collapse from exertion (Jaagsiekte - means *moving disease* in African). Animals do not have a fever.

Diagnosis

If you lift an animal up by the hind legs (wheel barrow test), large amounts of fluid will pour from the nose, fluid which has been accumulating in the lungs because of the cancer.

Treatment

There is none. These animals should be humanely euthanized.

Control

Control consists largely of culling affected animals early to prevent spread of the disease. If the disease has high levels in your herd, you may consider culling the offspring of affected animals.



13. Poor Body Condition (Old Thin Ewe/Doe)

There are a number of possible causes for poor body condition in old ewes/does. The most common include:

- Malnutrition
- Broken mouth
- Parasitism
- Johne's Disease
- Maedi-Visna/Caprine Arthritis and Encephalitis (MV/CAE)
- Caseous Lymphadenitis

Due to their fleece, sheep in poor body condition are often hard to spot. Since goats carry much of their body fat in their abdomen it is also hard to spot animals in poor body condition. Producers must become experts at body condition scoring. Refer to *Body Condition Scoring* in the *Nutrition* module. An approach to diagnosing causes of weight loss is described in *Chapter 23, Treatment Protocols for Disease*.

Malnutrition

Cause

Failure to consume sufficient nutrients to maintain the animal's physiologic needs. A number of factors can come together, resulting in malnutrition, including:

- Feed, water and mineral availability.
- Feed quality.
- Stocking density.
- Animal hierarchy within a group.

Feed bunk capacity.

Feed bunk management.

The animal's physiologic state and the metabolic demands of that state, for example, pregnant with triplets versus carrying a single.

These factors may affect either individual animals or the entire flock.

Clinical Signs

Poor body condition.

Diagnosis

Requires a careful examination of the diet and eating habits. Older ewes and does with or without other health problems may not be able to compete effectively with the rest of the flock/herd; they may not have as much access to the feed as you assume. Observation of the flock/herd at feeding time may give you some indication of how individuals within the group access their feed. The presence of feed does not rule out malnutrition.

Feed quality can only be determined accurately by analysis. Someone with a nutrition background can best formulate a cost-efficient diet that optimizes the animal's requirements and owner's feed costs. A veterinarian or animal nutritionist can assess the ration to ensure it provides sufficient energy, protein, vitamins and minerals for each different type of animal at different stages of its production cycle.

Treatment

If the ration is deficient, it should be reformulated and new feed acquired. If a small number of animals are affected they should be separated from the flock and thoroughly examined, to rule out other potential diseases; they should then be fed a high quality ration for several weeks to see if their condition improves. Often you will observe an improvement in general demeanour before you see an increase in body condition; the animals will be brighter and more active. Weight gain takes time, so be patient.

Prevention

Always have feed ingredients analyzed, to ensure you are feeding a balanced ration. It is not possible to assess the nutrient quality of any feed by sight or smell alone. This is a management disease but one that affects both small and large flocks. To be able to control this

syndrome you should be aware of your animals' general body condition and nutritional demands.

Broken Mouth

Cause

The cause of this problem is bacterial infection at the base of the front teeth at the gum junction (gingivitis). The infection weakens the tooth attachment to the jaw and the teeth are eventually lost. The disease is an important cause of culling in all parts of the world. The incidence of the disease varies by region and by flock and the risk factors for development are not well understood. Sheep on marginal land seem more prone to the condition than those grazing higher quality pastures.

Clinical Signs

Often the first sign of disease noticed (unless animals are regularly checked) is poor body condition. Examination of the incisors is all that is required to make a diagnosis. The gum line may be swollen, bleeding or both, and there may be pus present. As the disease progresses the gums regress, exposing more of the tooth root. Eventually the tooth is lost.

Treatment

There is no treatment for a broken mouth. Many of these animals are culled. It is possible to keep these animals but they require individual care and access to high quality feeds.

Prevention

There is no way of preventing broken mouth at the present time.

Parasitism

Cause

Infection with a wide variety of parasites may lead to poor body condition. Refer to *Chapter 20, Parasite Control*.

Clinical Signs

Parasitism typically results in soft feces or diarrhea. There will likely be a history of inadequate parasite control or atypically hot weather.

Diagnosis

Fecal analysis for worm eggs.

Treatment

Treat with a dewormer.

Prevention

Develop a deworming schedule with your veterinarian. Refer to *Chapter 20, Parasite Control*.

Johne's Disease

Cause

The cause of Johne's disease is a bacterial infection of the intestines by the *Mycobacterium avium* subspecies paratuberculosis. The bacteria are shed in the feces and ingested, infecting young animals. Typical routes of ingestion would be via fecal contamination of the mother's teats or contaminated feed. Once in the intestines the bacteria cause disease very slowly. Most animals show clinical signs between two and seven years of age. The bacteria cause thickening of the gut, resulting in a failure of normal digestion that leads to malnutrition.

Clinical Signs

The main clinical sign of Johne's disease is weight loss despite a good appetite. Diarrhea (the main clinical sign in cattle) is rare in sheep and goats.

Diagnosis

Diagnosing Johne's disease is difficult. Fecal culture is the best test, but it might be four months before laboratory results are known. There are a number of blood tests available. However, false negative results are possible early in the disease because of its long incubation period.

Treatment

There is no treatment. Infected animals should be humanely euthanized.

Prevention

The mainstay of Johne's disease prevention is eradication. Never buy animals from an unknown source where there is no information regarding the Johne's status of the flock/herd. All clinically ill animals suspected of having Johne's disease should be culled. Lambing/kidding areas should be maintained in a sanitary manner; animals (especially young animals) should not be fed off the floor. There are other strategies that can be used to help control Johne's disease. Discuss these with your veterinarian.

Maedi-Visna/Caprine Arthritis and Encephalitis (MV/CAE)

Cause

CAE is caused by a retrovirus. Refer to *Chapter 12, Maedi-Visna*.

Clinical Signs

This disease is most commonly associated with chronic pneumonia (lungs) and arthritis (joints); it can also affect other organs. It presents itself as slow weight loss.

Diagnosis

The diagnosis is mainly based on a blood test for the virus.

Treatment

None is available.

Prevention

Refer to *Chapter 12, Maedi-Visna*.

Caseous Lymphadenitis

Cause

The cause of this disease is by a bacterial infection by *Corynebacterium pseudotuberculosis*. (Refer to *Chapter 8, Caseous Lymphadenitis*.) Most animals infected by caseous lymphadenitis develop abscesses in the skin lymph nodes. The bacteria occasionally enter the bloodstream, leading to the development of abscesses in internal organs.

Clinical Signs

Weight loss despite good teeth and nutrition. There may be evidence of superficial abscesses or a history of the disease in the flock.

Diagnosis

Not really possible.

Treatment

None.

Prevention

Consider an eradication program, including vaccinations.



14. Eyes

Most diseases of the eye present the same way:

There is discharge and tear staining of the face.

The eye is held closed.

Most animals will avoid direct light.

In all cases it is necessary to perform a basic examination of the eye to determine the cause of the problem. This is best done in a dark area using a flashlight.

Entropion

Cause

The cause of this disease seems to be genetic; however, the heritability pattern is unclear.

Clinical Signs

Watery or red eyes in newborn lambs. Close examination will show that the lower eyelid has rolled in so that the eyelashes, and possibly hair on the eyelid, are rubbing against the surface of the eye. The cornea may be cloudy.

Treatment

In **early, simple cases**, you can simply roll the eyelid out with your finger and monitor to make sure the problem does not reoccur.

In **more complex cases**, a small amount of saline can be injected into the lower eyelid to create a bubble; this stretches the eyelid and prevents the problem from reoccurring. This technique requires some skill. Ask your veterinarian to teach you how to do this.

In **severe cases** it is necessary to put a stitch in the lower eyelid. Again, ask your veterinarian to teach you how to do this safely. The stitch must be removed after approximately seven days.

Note: Eye infections in newborn animals are extremely rare. In almost all cases entropion is the cause of newborn eye problems.

Pink Eye (Conjunctivitis)

Cause

Pink eye refers to inflammation of the soft tissues surrounding the eyeball, known as the conjunctiva. This condition may occur for a number of possible reasons. Pink eye in sheep differs from cattle because it is typically caused by *Mycoplasma* or *Chlamydophila ovis* (the cause of contagious abortion). The agents can be spread by fleece-to-fleece contact when animals are crowded, especially at feed troughs or feed fences. It can also be spread by flies.

Clinical Signs

The eye is closed or the animal blinks repeatedly. There may be a pus-like discharge. Close examination will reveal that the membranes of the eye are reddened.

Diagnosis

In a severe outbreak of disease it may be helpful to collect swab samples from affected eyes and have the laboratory identify the cause; the treatment can then be targeted more precisely. However, most cases are simply treated with antibiotics.

Treatment

Many **mild cases** will simply clear up on their own.

More **serious cases** are troublesome. Seriously affected animals should be separated from the flock. Treatment typically involves a combination of systemic (injectable) antibiotics and topical (eye ointment) antibiotics. Long acting oxytetracycline is effective against most cases of pink eye. A single treatment is often sufficient.

Antibiotic eye ointments containing oxytetracycline are even more effective but need to be administered three times a day, which is very time consuming. If a case of pink eye fails to respond to three days of treatment you should contact your veterinarian.

It is also possible to inject antibiotic into the lower eyelid. Ask your veterinarian to teach you how to do this before attempting the procedure.

Conjunctiva is the alternative spelling for conjunctiva.

Note: Long acting oxytetracycline and antibiotic eye ointments containing oxytetracycline are off-label – talk to your veterinarian.

Prevention

It is not possible to eradicate pink eye completely because animals may carry the disease without any obvious signs. However, never buy animals with obvious eye disease and mix them with your flock. All additions to the flock should be quarantined for thirty days.)

Foreign Body

Cause

Something stuck in the conjunctival sac (typically a piece of dust, hay or a seed) often causes irritation. Foreign bodies in the eye are among the most common causes of eye disease.

Clinical Signs

As described above. When you open the eye, all the eye tissues will be bright red and very inflamed.

Diagnosis

Foreign bodies tend to fall under gravity and sit under the lower eyelid. Gently pull the lower eyelid down and look for a foreign body. If you find one, roll it out using the eyelid. The other place that foreign bodies can accumulate is under the third eyelid in the inner corner of the eye. Put on a latex glove, wet the little finger and carefully feel under the eyelid for a foreign body. If you find one, hook it out with your finger.

Treatment

In most cases, no further treatment is necessary. If the eye is severely inflamed a course of antibiotic ointment may be beneficial. No drugs are licensed for use in any small ruminant eyes, so talk to your veterinarian.

ELDU

Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

Serious Eye Injuries

Cause

Many causes are possible, including severe infection, traumatic injury and severe foreign body implantation.

Clinical Signs

May look like pink eye but fail to respond to treatment. The eye may also have obvious severe damage.

Treatment

In these severe cases the eye should be removed by your veterinarian, if the animal's value warrants it; otherwise, the animal should be euthanized.



15. Urinary System

Relatively few conditions affecting the urinary system occur with any frequency. The most common problems are seen in young males being finished for slaughter. Disease typically presents as straining to urinate.

Urinary Calculi (Urolithiasis, Bladder Stones)

Cause

High levels of dissolved salts in the urine may start to settle out and form small crystals in the urine in the bladder. These crystals start to grow, forming small stones. If small enough, these stones may simply be passed with a normal urine stream. The danger arises when a stone is small enough to enter the urethra (pipe connecting the bladder to the outside world). Because the urethra is longer and narrower in males, these stones may become lodged, blocking the flow of urine. Stones most commonly lodge in the urethral process on the end of the penis. They may also create blocks in the sigmoid flexure and the opening of the bladder, as well as in the kidney and the ureter (structure connecting kidney and bladder).

There are several different types of stones found in sheep and goats. The most common are phosphatic calculi. This type of stone occurs in animals on a high-carbohydrate, low-forage diet rich in phosphorus. It is especially common in castrated males, and the Texel breed appears to be at an increased risk. The disease is especially common in male feeders of either species.

Clinical Signs

Affected animals have difficulty urinating. They may be seen to be straining and dribbling urine, and may vocalize. The abdominal muscles can be seen contracting and the tail may “flag.” Blood is sometimes present in the urine.

Any suspect animal should be caught and the penis examined to see if a stone can be identified in the urethral process.

Treatment

As many as two-thirds of cases can be treated simply by amputating the urethral process with a clean, sharp pair of scissors. Discuss this with your veterinarian, who can teach you how to identify and correct the problem.

Other treatments exist for dealing with stones farther up the urethra or in the bladder. All of these techniques require a veterinarian and are surgical in nature.

Prevention

Animals at risk must always have free access to plenty of clean water to ensure ample production of dilute urine. Adding regular salt (sodium chloride) to the diet at three to five percent may also work to increase the amount of water that the animals drink.

Balancing salts in the diet, especially phosphorus, calcium and magnesium, is the real key to controlling this disease.

Ideally the diet should contain a two to one ratio of calcium to phosphorus. Cereal grains are all high in phosphorus and low in calcium; pelleted rations can make matters worse as these diets result in reduced saliva production.

The situation can also be made worse by feeding very high protein diets.

In general, to avoid the condition, feed some forage, ideally alfalfa which is high in calcium. Thirty percent forage diets also provide sufficient beta-carotene, which has been shown to reduce stone formation.

Other techniques to reduce stones focus on acidifying the urine using vitamin C or ammonium chloride. Consult a nutritionist on supplementation.

Types of Stones

Whenever urolithiasis is suspected, stones must be submitted to the laboratory for analysis. Other types of stones such as silicates and oxalates require a different prevention strategy. Consult your veterinarian for further advice.

Pizzle Rot

Cause

Male animals kept on a very high protein ration may be prone to an infection of the prepuce and enlargement of the penis caused by *Corynebacterium renale*.

Clinical Signs

There may be signs of straining to urinate and swelling of the prepuce. Close examination will show matted stained hair around the prepuce, a foul odour and thick discharge.

Treatment

The following should be done:

1. Reduce the protein content of the diet.
2. Thoroughly clean the prepuce area.
3. Shear hair from around the prepuce.
4. A short treatment with antibiotics (for example, penicillin) may be helpful.

Prevention

Avoid feeding diets which contain excessive protein.



16. Sudden Death

The diseases that progress so rapidly that they kill animals with few signs of illness preceding death are relatively few in number. These diseases are important, however, because in many cases they are either infections or result from a deficiency that may also affect the rest of the herd.

These diseases almost all have the potential to be flock problems. They include:

- Anthrax
- Clostridial diseases
- Lightning
- Grass Staggers

Anthrax

Cause

This is caused by the bacterium *Bacillus anthracis*. These bacteria are able to form spores. (Spores are like bacterial eggs; they are inactive and can survive for many years in the correct environment.)

Anthrax spores survive best deep in alkaline, organic soils. They can be brought to the surface following flooding or disturbance of the soil, for example, trenching. If eaten by an animal the spores reactivate and start to grow. Anthrax bacteria secrete three very potent toxins that can very quickly cause death.

Clinical Signs

The major sign of anthrax is simply death. In some cases there may be evidence of blood draining from the nose, anus or vagina of dead

animals. Carcasses may also appear bloated and appear to decompose quickly.

Diagnosis

Anthrax is a reportable disease in Canada. If you suspect an animal has died of anthrax you must contact your veterinarian or the Canadian Food Inspection Agency (CFIA). They will take a blood sample from the dead animal and send it off to the lab. Results should be available in about 48 hours. In the meantime, you will be asked to protect the carcass from predators, pending the results of the test.

Treatment

Although anthrax is a frightening disease, it does actually respond to most antibiotics. Penicillin and oxytetracycline are both very effective. The difficulty is in identifying sick animals before they die. Animals with anthrax appear very sick and separate themselves from the flock. They will also have a very elevated body temperature.

Prevention

Preventing anthrax requires two strategies:

- 1.** Vaccination. There is a very effective anthrax vaccine available.
- 2.** Preventing environmental contamination. When an animal dies of anthrax the body tissues are riddled with anthrax bacteria. If the carcass remains closed, the tissues will rapidly putrify. During the rotting process, the natural rotting bacteria will destroy the anthrax bacteria.

If, however, the carcass is opened and the anthrax bacteria are exposed to oxygen, they will form spores. The spores will then be washed or dropped onto the soil where they can survive for years.

The goal is to prevent this environmental landmark by ensuring that the carcass is disposed of correctly.

- Ensure that carcass predation does not occur. Cover the carcass with a tarpaulin and spray with formalin.
- CFIA will direct you on how to dispose of the carcass by either deep burial or incineration. Both techniques are very effective and the choice is based on the environmental conditions.

Because anthrax is a reportable disease there is an indemnity paid by the federal government to cover the expenses associated with carcass disposal.

Vaccination

If anthrax is identified on your farm, the CFIA will arrange to have your animals vaccinated.

Vaccination Verses Prophylaxis

The decision to vaccinate your flock against anthrax on a routine basis is complex. The disease is rare but can be devastating. It is best to discuss your farm's particular risk factors with your veterinarian.

Note: Anthrax can affect a wide variety of species. Sheep and goats are not particularly susceptible, while cattle and bison are much more likely to develop the disease. Anthrax can also affect humans; however, the risk is extremely small. Anthrax bacteria from the tissues of a dead animal getting into cuts on your hands constitutes the greatest risk. You can avoid this risk completely if you do not handle suspect anthrax carcasses.

Clostridial Diseases

Enterotoxemia (Pulpy Kidney)

Cause

This is caused by the bacterium *Clostridium perfringens* type D. These are also a spore-forming bacteria widely present in soil and feces. In certain circumstances, such as animals being fed a high grain diet, the environment in the intestines may allow the bacteria to start to grow. The bacteria release toxins which are absorbed into the bloodstream and result in rapid death.

Clinical Signs

Sudden death, typically of very well grown healthy animals on a rich diet (high in concentrates).

Diagnosis

A prompt post-mortem examination of an animal that has died of clostridial disease will reveal that the carcass appears to rot very quickly. The intestines will be reddened and the tissues often appear slightly "cooked." The kidneys will appear very soft and will dissolve if held under running water.

None of these signs is specific as all carcasses will look like this as they rot. The key is that animals that have died of pulpy kidney look like this **immediately**.

The urine of animals that have died of pulpy kidney normally contains glucose; this can be easily tested by the lab.

Treatment

Pulpy kidney occurs so fast that treatment is nearly always impossible. If an animal is identified in the early stages, penicillin should be effective.

Prevention

Vaccination for pulpy kidney is highly effective.

Animals should be vaccinated twice, approximately three weeks apart, and then vaccinated yearly. Ewes and does should be vaccinated in late pregnancy. This will ensure that high levels of antibodies are transferred to the lambs and kids in the colostrum.

The ewe's/doe's antibodies will last approximately two to three months. Lambs/kids should then receive their first dose, followed by the booster three weeks later.

Lambs/kids being fattened on high grain diets are at the most risk of pulpy kidney; this can be a serious disease in a feedlot situation.

Blackleg

Cause

This is caused by the bacterium *Clostridium chauveoi*. Like other clostridia, these bacteria are present in the soil. Bacteria are consumed and can migrate from the intestines to the muscle tissue, where they lie dormant.

It is thought that if the muscle becomes injured or bruised the local environment changes, and the bacteria start to grow. They release toxins into the bloodstream that result in rapid death.

Clinical Signs

Simply sudden death. Sometimes an animal may appear lame shortly before death.

Diagnosis

On post-mortem examination a small, very dark lesion may be found in the affected muscle. Samples sent to the lab can finalize the diagnosis.

Treatment

None.

Control

This disease seems to be much more uncommon in sheep and goats than in cattle.

All 8-way vaccines available contain blackleg. Vaccination should be used as outlined for other clostridial diseases.

Tetanus

Cause

Clostridium tetani bacteria. These bacteria are commonly found in soil and feces where they exist as spores. If spores get into a wound where there is damaged tissue and low levels of oxygen, they hatch and start to grow. Castration and tail docking sites are prime locations for infection.

The bacterium produces a toxin that causes the extensor muscles to constrict and become rigid.

Clinical Signs

Animals may initially appear lame with stiff legs. As the disease progresses, the animals will be unable to stand. They have straight legs and arched backs and their faces may have a leering expression. The disease eventually paralyzes the muscles required for breathing, resulting in death.

Diagnosis

Samples collected at post mortem can be submitted to the lab for a final diagnosis.

Treatment

If the disease is identified early, anti-toxin may be administered. Other at-risk animals in the flock may be given high doses of penicillin before clinical signs develop.

Prevention

There is a highly effective vaccine for tetanus. All sheep and goats should be vaccinated.

Lambs and kids are at especially high risk as the wounds left by tail docking and castration are very prone to tetanus infection. Therefore, it is vital that ewes and does are vaccinated in late pregnancy with a clostridial vaccine that contains tetanus antigen. Also, all lambs/kids should receive sufficient colostrum.

Other Clostridial Diseases

There are a number of other clostridial diseases that occasionally cause clinical disease in unvaccinated flocks. All these diseases kill very quickly, so the most common clinical sign is death.

Lamb Dysentery – *Cl. perfringens* Type B – causes intense abdominal pain and bloody diarrhea in young lambs. Very rare in Canada.

Braxy – *Cl. septicum* – occasionally eating rich frosted forage can result in bacterial overgrowth in the abomasum (true stomach), resulting in bloating and death. Rare.

Struck – *Cl. perfringens* Type C – similar to pulpy kidney but very rare.

Black Disease – *Cl. oedematiens* – similar to blackleg, but the bacterial spores settle in the liver and can be activated following a liver fluke infection. Particularly important in areas where liver flukes are prevalent.

Bacillary Haemoglobinuria – *Cl. haemolyticum* – bacterial spores settle in the liver but when activated produce toxins that destroy red blood cells. This results in red/black urine and death. Occasionally seen in western Canada.

Malignant Edema (Gangrene) – caused by a variety of clostridial organisms. Following a severe injury, tissues may be infected with clostridial organisms, resulting in rapid rotting of the tissues; may be seen following birthing, in bad mastitis, or in head injuries in fighting rams or bucks.

Lightning Strike

Cause

Lightning.

Clinical Signs

None. Animals are found dead after a thunderstorm.

Diagnosis

A full post-mortem undertaken for insurance purposes may find signs consistent with lightning strike.

Prevention

None.

Hypomagnesemia (Grass Staggers)

Cause

The cause is a deficiency of magnesium in the consumed forages. This is typically seen in adult animals turned out to lush green pasture in the spring. The animals are typically low in magnesium after the winter; lush spring grass is low in magnesium but rich in potassium and nitrogen, which makes the situation worse.

Clinical Signs

Animals are typically found dead. If alive, animals are often convulsing.

Diagnosis

Samples can be submitted to the laboratory after a full post-mortem.

Treatment

If an animal is found convulsing, treatment with magnesium solutions administered intravenously is possible. However, finding an animal in this stage of disease is unusual.

Prevention

Ensure animals have access to a mineral supplement containing magnesium.

Other Less Common Causes of Sudden Death

Acute Pneumonia

Occasionally, animals may become infected with a large dose of a virulent respiratory pathogen causing very severe pneumonia that kills before clinical signs are observed. Refer to *Chapter 12, Sudden Onset (Acute) Pneumonia*.

Bloat

Occasionally animals that develop bloat will be found dead. A full post-mortem can determine if bloat was the cause of death, rather than a result of death, since all animals will bloat after death. Refer to *Chapter 19, Bloat*.

Coccidiosis

Especially in young goats, exposed to a high dose of coccidia—the first sign of disease may be sudden death. Refer to *Chapter 11, Coccidiosis*.

Predation

Animals dying at pasture are prone to predation by scavengers. It is important to be mindful that scavenged carcasses may represent natural deaths rather than healthy animals taken by predators. The wound patterns on the carcass will help distinguish between the two.

Casting

Heavily pregnant ewes occasionally roll onto their backs and are unable to right themselves. They may bloat while cast, and casting also makes them easy prey for scavengers, especially carrion birds.



17. Important Diseases of Sheep and Goats

A number of diseases of sheep and goats can be considered especially important because they are either highly infectious to other sheep and goats, transmissible to humans, or important economically. Some of these diseases are controlled by governments while others are not. The details of many of these diseases can be found in other chapters of this manual.

Highly Transmissible	Zoonotic	Economic
Foot and Mouth Disease (FMD) <i>(this chapter)</i>	Anthrax <i>(Chapter 16)</i> Toxoplasmosis <i>(Chapter 6)</i> Chlamydial Abortion <i>(Chapter 6)</i>	Scrapie <i>(Chapter 10)</i> Foot Rot <i>(Chapter 9)</i> Cysticercus <i>(Chapter 20)</i> Maedi-Visna(MV) <i>(Chapter 12)</i> CAE <i>(Chapter 9)</i> Johne's Disease <i>(Chapter 13)</i> Infectious Abortion <i>(Chapter 6)</i>

Zoonosis
 – a disease of animals that may secondarily be transmitted to man.

Foot and Mouth Disease

Cause

Foot and mouth is perhaps the most important animal disease in the world. The virus affects all cloven footed animals and pigs. The disease causes small blisters to form on the mouth, lips and feet. The blisters cause pain and animals often lose a lot of weight. If pregnant, the animals may abort. The virus will also affect the hearts of newborn lambs and kids, killing them. The virus is very tough and highly contagious. It has been eradicated from North America. Because foot and mouth disease has been eradicated from most developed nations, there are very strict import restrictions to keep it out. If foot and mouth were to be diagnosed in Canada, we would immediately lose all export of agricultural products.

Clinical Signs

The small vesicles (blisters) on the mouth and feet are very distinctive, but are small and easily missed. Animals appear sick, off feed and are commonly lame. You have to look very closely to see the blisters.

Diagnosis

If you ever suspect foot and mouth disease **you must** contact your veterinarian or the local Canadian Food Inspection Agency (CFIA) office. It is important that you stay where you are and prevent all animal movement to limit the spread of disease. The CFIA will take samples for the laboratory to rule out FMD as the cause of disease.

Treatment

There is no treatment for this viral disease. Due to the highly infectious nature of the disease and the need to eradicate it, the CFIA's policy has been to slaughter all affected and in contact animals. Producers are paid compensation to cover the losses associated with the disease.

Control

The key to controlling foot and mouth disease in Canada is to keep the disease out of the country. Ensure that if you travel abroad, you never bring any animal products back with you. If you have such products or if have been in contact with livestock you should speak to the custom officials at the airport or port authorities.



18. Deficiency and Toxicity Syndromes

Deficiency

Much of the discussion on nutrient deficiencies has been done in other parts of this document. These can be found as follows:

Iodine – *Chapter 5, Goitre*

Vitamin E and Selenium – *Chapter 5, White Muscle Disease*

Copper – *Chapter 5, Swayback*

Thiamine – *Chapter 10, Polioencephalomalacia*

Magnesium – *Chapter 16, Grass Staggers*

Calcium – *Chapter 6, Hypocalcemia*

Refer to the *Nutrition Module* for additional information on nutrient deficiencies.

Toxicity

There are several situations in which materials might be consumed by sheep or goats which present a toxicity problem for the animal. These are discussed on the following pages.

Copper Toxicity

Cause

Sheep and goats differ in their tolerance to copper. In fact, different sheep and goat breeds have different susceptibilities to copper toxicity. Sheep generally are very susceptible to copper poisoning. Rations developed for cattle, goats, or horses should **never** be fed to sheep as they could cause disease. Other sources of copper include land fertilized with hog manure (which contains high levels of copper). Changes in the molybdenum content of the diet can also change copper absorption. Since copper is stored in the liver, at times of stress there may be a massive release of copper, which causes the acute disease.

Clinical Signs

Affected animals are depressed, off feed, weak and may have diarrhea. Many animals are simply found dead. Others may have red urine or may show yellowing of the mouth and eyes (jaundice).

Diagnosis

You need to have blood samples from affected animals or a post-mortem examination to confirm a diagnosis

Treatment

Treating affected animals is usually unrewarding; affected animals should probably be euthanized. If the animal is valuable, contact your veterinarian about treatment options.

Prevention

Never feed a ration or mineral mix to sheep that is not designed specifically for that species. When in doubt, have your feed analyzed and contact your veterinarian or a nutritionist.

Lead

Cause

Lead is mainly found in old batteries or old lead paint. An inquisitive animal may eat these products; young sheep and goats are particularly at risk.

Clinical Signs

In sheep the disease looks almost exactly like polio (refer to *Chapter 10, Polioencephalomalacia*). In goats it generally causes anorexia, weight loss, diarrhea and death.

Diagnosis

A diagnosis can be made using blood tests or a post-mortem examination.

Treatment

Although treatment is possible, it is rarely attempted.

Prevention

Ensure old car batteries are disposed of appropriately and that grazing animals do not have access to areas where lead based products are stored.

Bracken Fern

If there is little else available, sheep and goats will graze on bracken fern. This plant contains a number of different toxic elements which can cause polio (refer to *Chapter 10, Polioencephalomalacia*), retinal degeneration leading to blindness and suppression of bone marrow. It is best avoided.

Yew

The needles from yew trees are highly toxic. Animals should be kept away from yew trees and any clippings. Animals found dead from yew poisoning typically have the needles still in their mouths.

Sulphates

Cause

Sulphates are naturally present in soil. In low amounts they can interfere with copper absorption. In high concentrations they have a direct effect on the brain, causing a syndrome which is identical to polio (refer to *Chapter 10, Polioencephalomalacia*). The most common sources of sulphates are water and certain plants (for example, kochia weed and thistles). Surface water is problematic as the sulphate concentration may change, not only throughout the year but from year to year depending on the precipitation level. Well water should be analyzed to determine if the sulphate level is safe for livestock. The worst problems occur when there are very high concentrations of sulphate in the water and the forage is also high in sulphates.

Clinical Signs

Identical to polio. (Refer to *Chapter 10, Polioencephalomalacia*.)

Diagnosis

The only difference between sulphate poisoning and polio is that classical polio responds to thiamine treatment while sulphate poisoning does not. To finalize the diagnosis you must determine the sulphate content of the water and feed.

Treatment

None.

Prevention

Consider testing water sources annually. Water with more than 4,000 ppm sulphates should not be used for livestock. Water with sulphate levels of 200 to 4,000 ppm can be used with caution. If your water is not suitable for your livestock you may have to haul water from another source.

Sweet Clover

Cause

If hay made from sweet clover becomes mouldy, natural plant chemicals may be converted to dicoumerol which acts as an anti-coagulant, preventing the blood from clotting.

Clinical Signs

Animals may develop swellings associated with bleeding under the skin. Most affected animals die.

Diagnosis

Diets may be analyzed for dicoumerol content.

Treatment

Stop feeding contaminated feed and treat animals with vitamin K at a level of 1.3 mg/kg body weight, intramuscularly (im).

Prevention

Avoid sweet clover hay if there is evidence of mould.

Nitrate Poisoning

Cause

Nitrate exposure may come from fertilizer, contaminated water or plants (depending on the stage of their growth). Nitrates irritate the gastrointestinal tract, which may result in diarrhea. More importantly, nitrates are converted to nitrites by the rumen; nitrites react with hemoglobin in the red blood cells, preventing it from carrying oxygen.

Clinical Signs

Animals appear to be in respiratory distress, weak and stumbling. The mucous membranes of the mouth and eyes may be blue and blood may be brown in colour. Many affected animals will die; if animals are to be saved treatment must be initiated early and aggressively.

Treatment

If animals are to live, aggressive and immediate treatment must be initiated by your veterinarian. Contact your veterinarian at the first suspicion of nitrate exposure.

Prevention

Prevent animals from accessing fertilizer, contaminated feedstuffs or contaminated water sources. By timing the harvesting of high risk feeds, plant exposure can be controlled.

Alga Blooms (Cyanobacteria)

Cause

Stagnant sloughs occasionally develop “blooms” of blue-algae. Certain species of algae produce potent toxins, which are ingested when animals drink the water.

Clinical Signs

Animals are simply found dead.

Diagnosis

Immediately collect water samples for analysis.

Prevention

Prevent animals from drinking potentially contaminated water. Provide alternative water sources.



19. Intestinal Diseases

Intestinal diseases generally present in three ways:

1. Diarrhea
2. Bloat
3. Weight loss

Diarrhea

There are many possible causes of diarrhea. Which is the most likely cause depends on the animal's age:

Neonatal scours – refer to *Chapter 5, Acquired Health Disorders in Newborns*.

Coccidiosis – refer to *Chapter 11, Coccidiosis*.

Intestinal worms – refer to *Chapter 20, Parasite Control*.

Diarrhea in flocks of small ruminants may present in outbreak form if caused by *Salmonella* or *Campylobacter*. Contact your veterinarian for assistance in dealing with these situations.

Bloat

Cause

Bloat can occur in two distinct circumstances:

1. If the rumen fails to contract normally, the gases produced during fermentation of forage accumulate and the rumen distends. This form can also occur if an animal becomes cast.
2. Under certain circumstances, the feed in the rumen can form foam which traps the gas, so the animal is unable to belch off

the gas. This is most commonly seen when animals are moved to a pasture which has a high content of alfalfa or clover.

Bloat is dangerous because as the rumen expands, it puts pressure on the chest, seriously inhibiting breathing. The rumen also puts pressure on major blood vessels, blocking blood circulation.

Clinical Signs

The abdomen of affected animals appears massively distended. Careful examination may reveal that the most obvious distension is on the left side behind the last rib. The animal may appear to have difficulty breathing. If the area of the bloat is flicked with a finger, it often appears very resonant - "like a bass drum."

Treatment

In all cases of bloat the first approach is to pass a stomach tube into the rumen. Ideally, you should have a stomach tube on hand, but in an emergency, a length of hose will suffice. A mouth gag is needed to prevent the animal chewing the tube/hose; a six inch length of plastic pipe is very effective. Place the gag (pipe) in the mouth between the dental pad and the front teeth. Gently push the tube/hose into the back of the mouth and allow the animal to swallow it. Then advance the tube/hose into the rumen. This is often easier if you blow down the tube/hose to distend the esophagus.

If it is a free-gas bloat, once the tube is in the rumen the gas will be released and the problem resolved. If it is a foamy bloat, there will be little or no gas released. In these cases, animals should be treated by pouring a bloat treatment such as **Tympanex** down the tube. The treatment causes the froth to collapse, releasing the gas.

Remove the stomach tube and wait 10 minutes. If the bloat has still not resolved, the stomach tube should be passed again to relieve the gas.

Prevention

Avoid sudden changes in diet, especially sudden moves to rich alfalfa pastures. Products such as **Alfasure** may also be used to control problems.

Weight Loss

Many intestinal problems present as weight loss. Refer to *Chapter 13, Poor Body Condition*.

Miscellaneous Intestinal Diseases

Rumen Acidosis

Cause

Rumen acidosis occurs when animals are fed a diet that contains too little forage and/or too much concentrated carbohydrates (grain). The carbohydrates (sugars) are rapidly fermented to produce large amounts of acids. The acids in large quantities are very damaging to the rumen, killing the normal bacteria and damaging the rumen wall. In addition, the large amount of acid in the rumen draws water from the circulation and animals may go into shock. The damage to the rumen wall allows toxic compounds and bacteria to enter the bloodstream and that can result in problems such as laminitis (refer to *Chapter 9, Laminitis*) or liver abscesses.

Clinical Signs

The signs will be dependent on the amount and type of feed ingested. They will also depend on the normal diet of the animal, since over time animals can adapt to high concentrate diets, such as those used in feedlots. Signs typically occur from 12 to 36 hours after eating a high concentrate ration. Animals are typically depressed and off feed. They tend to lie down and may have a staggering gait and look drunk. They often appear bloated and have diarrhea.

Diagnosis

The best way to make a diagnosis is to collect a sample of fluid from the rumen using a stomach tube and measure the pH (acid content). This level should be five (pH 5).

Treatment

Traditionally, very extreme treatments such as surgical rumenotomies to empty the rumen were recommended. This is a surgical procedure requiring the help of a veterinarian.

Supportive treatments include:

- **Oral antacids to neutralize the rumen** – magnesium hydroxide or magnesium oxide at 1 g/kg body weight.

pH is a measure of the acidity or basicity of a solution. Pure water is said to be neutral. The pH for pure water at 25°C is close to 7.0. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are said to be basic or alkaline.

ELDU

Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

- **Systemic anti-inflammatory drugs** – these are extra label use (ELDU); consult your veterinarian.
- **Thiamine supplementation** – rumen acidosis can predispose to polio. Thiamine given three times daily at 5 mg/kg body weight until the animal recovers will help prevent the disease.
- **Transfaunation** – due to the disruption of the normal flora in the rumen, it may be necessary to collect a sample of rumen fluid from a healthy animal and administer it to the affected animal in an attempt to repopulate the rumen with healthy bacteria.

If you suspect that animals have consumed too much grain, the first thing to do is remove them from water, since access to water will accelerate the fermentation process and make the disease more severe.

Note: Due to the wide variation in the severity of the disease you should contact your veterinarian for advice.

Prevention

Ensure that animals are kept away from feed storage areas. If you have any concerns about your animals' diet, contact a nutritionist or your veterinarian.



20. Parasite Control

Parasites can be broadly split into three categories:

1. Worms
2. Insects
3. Protozoa

These categories can be further subdivided. Different parasite categories require different control strategies.

Worms can be divided into three main types:

1. Roundworms
2. Tapeworms
3. Flukes

Roundworms

Most roundworms that affect sheep and goats have a direct life cycle. This means that the adult worms live in the intestines of the sheep/goats. The adult female lays eggs that are passed onto pasture through the feces. The eggs typically hatch on pasture and the larval form of the worm migrates from the feces onto the grass where it is eaten by another sheep/goat. The larva undergoes further development to the adult worm within the intestines.

Important Roundworms of Sheep and Goats

The larval form of this worm develops in the wall of the abomasum (or true stomach). The development causes inflammation that prevents normal digestion, resulting in severe diarrhea. *Ostertagia sp.* can also undergo a form of hibernation (called hypobiosis) in which the larvae

stop their development and simply “wait” in the wall of the stomach before emerging many months later. This is typically done to survive the winter months.

Haemonchus

The adult form of this worm also inhabits the true stomach of sheep and goats. The adult actually bites into the wall of the stomach and sucks blood. Although an individual worm sucks only a very small amount of blood, a large infestation will result in significant blood loss which can be seen as very severe anemia .

In addition to these worms there are others such as ***Nematodirus*** and ***Trichostrongylus*** that inhabit the abomasum and small intestine causing inflammation and interfering with digestion. This results in diarrhea and poor body condition despite adequate nutrition being supplied.

Anemia
– reduction in the normal level of red blood cells in circulation.

Diagnosing Roundworms

All roundworms shed eggs into the feces. In the laboratory it is possible to analyze feces and count the number of eggs per gram of feces (a fecal egg count) in order to determine the magnitude of an infection.

Note: For some worms such as ***Ostertagia***, the developing immature larvae cause significant disease. The larvae do not produce eggs, so a fecal egg count would be negative even though the worms are causing clinical disease.

Controlling Roundworms

Roundworm infections have been a scourge for small ruminant production around the world and the focus of much research. This research has led to some major advances in how roundworms are controlled using effective management strategies and new highly effective drugs.

However, the situation on the Canadian prairies differs from most other sheep/goat producing areas of the world. The summers here are generally very dry. Roundworms need moisture for survival and do not do well on dry pastures. Our long cold winters typically kill off residual eggs left on the pasture from the previous summer.

Practical strategies for controlling roundworms in western Canada:

- Work with your veterinarian to develop a control strategy tailored to your farm location and management style.
- Consider deworming ewes/does at lambing/kidding time. Ewes/does are typically immuno-suppressed at this time and excrete

many more eggs (Periparturient Rise) which contaminate the environment and infect the lambs/kids.

- Quarantine all brought in animals, deworm them, and wait before mixing them with your flock/herd.
- Consider deworming in the fall when the animals come off pasture. Sheep/goats tend not to become infected during the winter months.
- **Most important**—rather than deworming on a fixed schedule, consider moving to a system in which you randomly collect some sheep/goat feces and submit them to the lab for analysis. Deworm only when animals have a high worm burden. While the analysis has some cost, this will result in significant savings as you will spend much less on deworming product. You will also avoid over treating, which can lead to worms developing resistance to dewormers.
- When you use dewormers, ensure all animals get a full dose. If necessary weigh animals and dose on a body weight basis. Fasting animals for 12 hours before administering a deworming product will increase its effectiveness.

Note: Roundworms only cause problems through animal disease and reduced productivity. They do not spread to man or other domestic species.

Tapeworms

The Sheep or Goat as a Primary Host

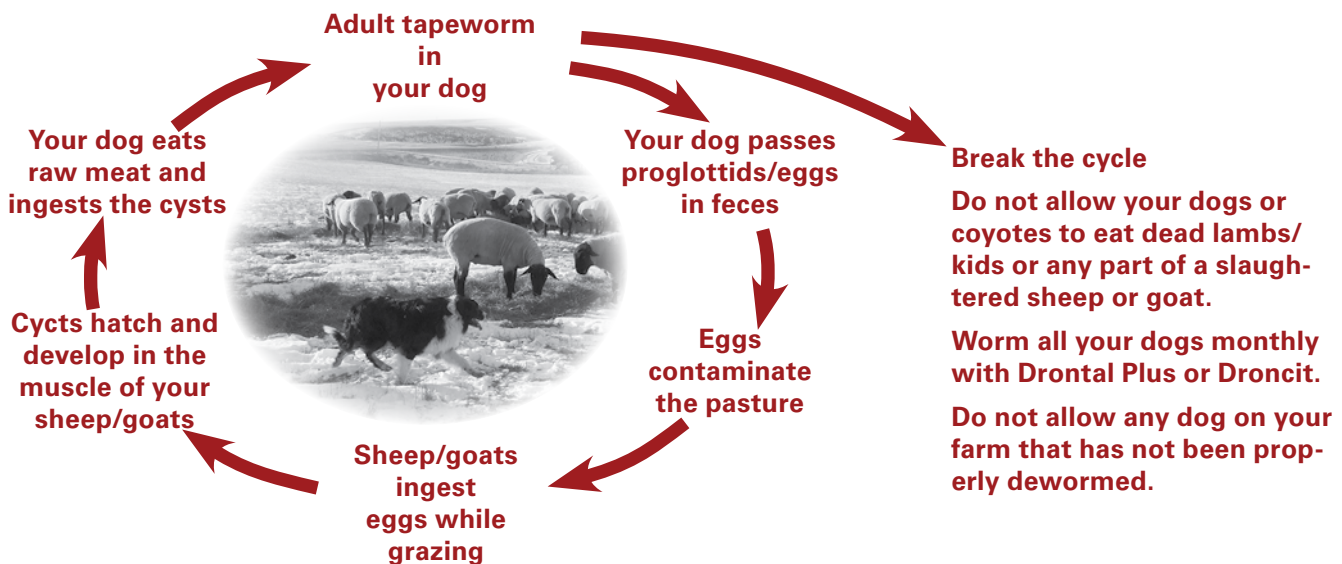
There are actually very few tapeworm species which use the sheep or goat as a primary host. *Monezia*, the main species, uses forage mites as an intermediate host, and while the parasite rarely causes death, it can be responsible for poor rates of gain and in extreme situations contribute to “thin ewe/doe syndrome.” Occasionally the tapeworm segments may be seen in feces. Infection can be easily treated with Valbazen administered as an oral drench.

The Sheep or Goat as an Intermediate Host

Sheep/goats can act as an intermediate host to a wide variety of tapeworms. The most important are:

Worm in Sheep/Goats	Primary Host	Cyst Site
<i>Taenia ovis</i>	Dog	Muscle
<i>Taenia hydatigena</i>	Dog	Liver
<i>Taenia mulliceps</i>	Dog	Brain
<i>Echinococcus</i>	Dog	Liver, lungs

Taenia sp. are not a human health risk but *Echinococcus* is. If the cysts are found in the carcass at slaughter, the carcass—all or part of it—may be condemned. *Taenia ovis* has been the cause of very significant economic loss to the Canadian sheep industry in the last few years.



Tapeworms have a more complex life cycle than roundworms. A tapeworm life cycle involves a primary host in which the adult tapeworms lie in the intestines and produce eggs. The eggs are shed in the feces and are eaten by the intermediate host (a different species). The eggs hatch in the intestines, penetrate the gut wall and migrate through the bloodstream before establishing themselves in specific tissues to form a cyst. When the animal dies the cysts are eaten with the carcass by the primary host. The cysts reactivate in the primary host's intestines and grow into adult tapeworms, and the cycle continues.

Controlling Tapeworm Cysts (C.Ovis)

There is no wormer that will effectively control the dog tapeworm in your sheep. **The key to controlling tapeworm cysts is prevention.** The goal is to break the cycle of infection between the dog and the sheep or goats.

C. ovis (also referred to as sheep measles) is the intermediate stage of a tapeworm that infects any member of the dog family, wild or domestic. It is important to understand that this is **not** a sheep/goat tapeworm; it is a **dog** tapeworm that **must** infect sheep or goats to complete its life cycle.

The dog is the final host where the adult tapeworm lives—all two metres of it. While inhabiting the intestine, the adult sheds eggs in the dog's stool, up to 250,000 per day. Eggs have the ability to survive on pastures for up to **six** months, depending on the conditions. The sheep and goats then become infected by eating the eggs. The eggs contaminate anything that the dog can defecate in or on: the pasture, feed bunk, chop house, silage pit, or round bale feeder.

The tapeworm eggs then hatch—inside the sheep or goats, not on the ground—and develop either into cysts in the muscle or into cysts that hang off the liver, lungs, or diaphragm.

Dogs become reinfected by eating infected sheep/goat carcasses.

Four to five weeks after consuming the eggs, the sheep/goats develop the infective cysts. Each cyst contains a tapeworm head which, if eaten by a dog, grows into an adult dog tapeworm, *Taenia ovis*. Assuming that lambs/kids really start to eat forage at about 21 days of age, they can have cystic lesions as early as 56 days of age.

At about three to six months after ingestion (116 to 176 days of age) most of the cysts die and they become hard and gritty; the typical

white spot is known as sheep measles and is detected at meat inspection. This stage is known as *Cysticercus ovis* or *C. ovis* and this is the lesion that causes condemnations. **This is not a human health hazard, but it is unacceptable and carcass condemnations are common.**

Therefore:

- **Do not** feed dead lambs or kids **of any age** to your dogs or allow coyotes to eat them.
- **Do not** feed **any part** of a slaughtered goat or sheep to your dogs. Bury it or burn it. If you compost, make sure that no animals dig up what you buried. Make the compost pile dog proof.
- Worm your dogs, **all** dogs (including pets), at least every two months with a **praziquantal** based wormer. Either use **Drontal Plus** or **Droncit** tablets. Guardian dogs can be very difficult to get pills into; you can grind the pills up and mix them into canned dog food. Make sure that you see the dog swallow the wormer and that he does not spit the pill out. Guardian dogs in particular can be very suspicious and difficult to worm.
- It takes seven weeks for this tapeworm to develop in the dog, so worming the guard dog **monthly** is necessary.
- **Do not** let any dog onto your farm that has not been properly dewormed. Make sure that you know what product was used and when it was last given.

The Role of Coyotes

Many producers continue to blame *C. ovis* losses on coyotes. However, there is no evidence to support that coyotes, while they can be the primary host for the tapeworm, are in close enough proximity to the flock for a long enough time to be significantly responsible for *Taenia* infestation in small ruminants. Evidence from Australia, where the disease has been nearly eradicated by the diligent deworming of dogs and feed control, supports this conclusion despite the presence of wild canines that also prey on flocks.

Controlling *Echinococcus*

The *Echinococcus granulosus* cysts are found in the liver and lungs of affected sheep. This parasite is important because the eggs can be ingested by humans, leading to serious disease when the cysts form. The cycle of infection can be controlled as described above for *Taenia* tapeworms.

Flukes

Flukes are flat, leaf shaped worms which are typically found in the liver. Flukes have a very complex life cycle that involves intermediate hosts. There are three main flukes found in western Canada.

Fasciola hepatica

Although this form of liver fluke has been occasionally reported in southern Manitoba and the Waterton Lakes area, it is uncommon elsewhere in Canada. It does have a tendency to be over-diagnosed because the eggs of *Nematodirus* look very similar. In sheep and goats fluke infestations are very serious and commonly result in death or severe disease without eggs ever being produced. The diagnosis is commonly made on post-mortem examination.

Should a problem with this fluke arise, there are effective drugs available in other parts of the world that can be imported into Canada on a case by case basis.

Fascioloides magna

This is a natural fluke of deer and moose. It is occasionally found in small ruminants, where infection with even one fluke can prove fatal. It is usually diagnosed at post-mortem and is considered sporadic.

Dicrocoelium dendriticum

This is the natural fluke of small ruminants. The fluke is very small and does not usually cause any serious problems.

Protozoan Parasites

There are three main protozoan parasites of sheep/goats. Two coccidia species and cryptosporidium cause diarrhea in young lambs/kids. These are covered in detail under lamb/kid diseases. Refer to:

Chapter 11, Coccidiosis.

Chapter 5, Acquired Health Disorders of Newborns respectively.

The other, *Toxoplasma*, can cause abortion in sheep/goats and is covered in detail in *Chapter 6, Diseases of Pregnancy, Toxoplasmosis.*

Insects

Flies

Flies can cause problems to sheep and goats in a number of ways. Probably the most important is fly strike (refer to *Chapter 8, Fly Strike*). Biting flies can be a nuisance but they rarely cause serious problems. Other potential fly problems include keds, which are really wingless flies, (refer to *Chapter 8, Sheep Keds*) and nasal bots (refer to *Chapter 12, Nasal Miasis*).

Lice

Refer to *Chapter 8, Lice*.

Mites

Refer to *Chapter 8, Psoroptic Mange (Scab) and Foot Scab*.

Ticks

Ticks are occasionally found on sheep and goats. Many times keds are mistakenly called ticks, but they are different insects. Ticks have eight legs and a round body shape, and in most cases when found on an animal they will be attached and feeding. In contrast, keds have six legs and a segmented body, and are normally walking around in the fleece.

The occasional tick is not a serious problem, but a heavy infestation of ticks can cause serious blood loss. Ticks can also carry disease.

There are several insecticidal sprays available that can be used to treat the flock/herd if it becomes necessary.



21. Developing a Vaccination Plan

For a vaccination plan to be effective the following points should be considered:

1. Is the disease likely to occur in your area?
2. If the disease occurs, is it significant?
3. Is the vaccine effective?
4. Is the vaccine readily available?
5. Is the vaccine safe?
6. Is use of the vaccine cost effective?

It is, therefore, worthwhile discussing the needs of your flock/herd with your local veterinarian. There are very few vaccines available for use in Canada that are approved for either sheep and/or goats.

Clostridial Vaccines

Most clostridial vaccines come in combination, commonly referred to as multi-valent. No matter which one you choose it should contain *Cl. tetani* (tetanus) and *Cl. perfringens* type D (pulpy kidney). These two diseases are common killers of lambs/kids. The vaccine is cost effective to use and is effective in controlling the disease. Remember that if the vaccine is given to the ewe/doe then passive immunity is given to the lamb/kid in the colostrum. Passive immunity should protect the lamb or kid until 60 days of age, at which time the lamb/kid will need to undergo a vaccination series of a primary vaccination followed by a booster three to four weeks later. Annual vaccination is required to maintain adequate protection.

Important Note:
*Some of the 7-way and 8-way vaccines have recently been reformulated with *Cl. sordellii* instead of tetanus (*Cl. tetani*); ensure that the vaccine that you use contains tetanus.*

Caseous Lymphadenitis

This disease is common in many sheep and goat flocks. The vaccine is cost effective and safe. The real role of the vaccine is to reduce the number of abscesses seen in the herd. The vaccine is available alone or in combination with tetanus and pulpy kidney. Research has shown that lamb/kid vaccination series that are delayed until the lamb/kid is at least 11 weeks of age are more effective in protecting the vaccinated animals than those given at a younger age.

Rabies

There are several rabies vaccines licensed for use in sheep in Canada; none are approved for use in goats. Clinical cases of rabies in small ruminants are uncommon. If a sheep/goat did get rabies the risk of transmission to humans would be extremely low, but nonetheless a risk.

Anthrax

Sheep and goats are at a relative low risk of acquiring anthrax compared to other species. Generally speaking, unless you are in a higher risk area, the vaccine would not be routinely administered.

Note: There have been reports of adverse reactions to the vaccine in Pygmy goats.

Enzootic Abortion Vaccine (*Chlamydia psittaci* Bacterin)

Given how common this form of abortion is in small ruminant flocks in western Canada, any protection afforded by this vaccine is worthwhile. If your flock has had previous problems, consider vaccination for any replacements. Producers who purchase animals from unproven sources should also consider vaccination. The vaccine is not 100 percent effective but can help reduce abortion rates in the flock/herd. For goats use of this vaccine is an ELDU. The vaccine is made by the Colorado Serum Company and distributed in Canada by the Canadian Cooperative Wool Growers (CCWG) and CDMV Inc.

ELDU

Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

Vibriosis Vaccine (*Campylobacter fetus*, Bacterin-ovine)

This form of abortion is also very common in western Canada and once again any protection afforded by this vaccine would be worthwhile. This is especially true since even with the very best management it is not possible to completely exclude this disease from your flock. The vaccine actually contains the two most common strains of the bacteria responsible for abortions. The first dose is given just before breeding and the second dose two to three months later. Annual boosters are required. The vaccine is made by the Colorado Serum Company and distributed in Canada by the Canadian Cooperative Wool Growers (CCWG) and CDMV Inc.

Other Vaccines

In other parts of the world where there is a larger industry there are other vaccines available, notably a foot rot vaccine, an orf vaccine, and a foot and mouth vaccine.

Foot rot is less prevalent in western Canada as there is less moisture and the disease is best controlled by good biosecurity measures. The vaccine is available in Canada with an EDR completed by your veterinarian.

The orf vaccine, although widely discussed, is not very helpful as the vaccine is simply orf virus which is administered by scratching the skin in the armpit of the ewe/doe. The immunity is not long-lived and the ewes/does shed virus into the environment. It is only of value in flocks/herds which have a severe problem with clinical disease.

Because foot and mouth disease has been eradicated from Canada, vaccination is not available. In a worse-case scenario in which the disease were to appear the government may use vaccination as a disease control measure.

EDR
Emergency Drug Release permits the manufacturer of a new drug to sell a limited quantity of the new drug to a veterinary practitioner. The new drug is one which is not marketed in Canada and is requested by the practitioner for the purpose of diagnosing or treating a medical emergency.



22. Biosecurity

Biosecurity is the term used to describe procedures put in place to prevent new diseases being brought onto your farm. Many of the important diseases of sheep and goats are best controlled by avoidance or eradication. If a herd is free of a disease it is vitally important that the disease be kept out. Once the disease has been eradicated, none of the remaining animals will have immunity; if the disease were to return it would commonly have dire consequences since in the absence of immunity it would spread unchecked.

Disease may enter a farm in a number of ways:

- Purchased animals

- People

- Rodents

- Feed

- Equipment (objects, such as feed trucks, water buckets, etc.)

Preventative Procedures

Purchased Animals

Many important diseases of sheep and goats (Johne's disease, maedi-visna, CAE, abortion) are carried by animals that appear completely normal. There is no way to determine if they are carrying disease by examining them. A blood test can be used to detect some diseases, such as maedi-visna or CAE; however, some diseases do not have a diagnostic test available.

The only way to know if the disease may be present is by asking the vendor and trusting the answer. The purchase of any animal will always

involve some measure of risk, but if you know the vendor or know their reputation the risk can be minimized. Avoid purchasing animals at auctions and never buy newborn animals. Newborns that are sold are either orphans or “extras” and may not have not received sufficient colostrum. As a result, they may be incubating a wide variety of diseases.

Regardless of where purchased animals come from, it is important that all new animals are placed in some form of quarantine. The quarantine area should be separate from the rest of the herd. The animals should be dewormed and monitored for any signs of illness for two to six weeks. The animals can then be introduced to the herd after the quarantine period is over.

People

Any visitors to your farm can carry disease on their clothing or footwear. The highest risk visitors are those who routinely come in contact with other small ruminants. It is important that routine procedures be put in place to ensure that visitors do not bring disease with them.

All visitors should be provided with footwear and coveralls to avoid any risk of carrying disease. At the very least, these visitors should not wear clothing that has been in contact with other animals and they should thoroughly clean their footwear before entering the pastures or corrals, or wear disposable plastic boots over their own shoes. Clean footwear by scrubbing with a detergent solution until clean and then soaking with an appropriate disinfectant for five minutes. Other visitors should clean their footwear before visiting the animals.

Note: Simple foot baths are ineffective.

Rodents

All wild animals can carry disease that may be transmitted to your herd. It is important to protect your herd from contact with wildlife as much as possible. Suitable fencing provides some protection. Introducing a rodent control program is important. Minimizing the number of cats on the farm is also beneficial.

Feed

Feed may be contaminated with infectious material in any number of ways. The only protection that you have is to buy good quality feed from a reputable source. Once you have the feed it should be stored in such a way as to minimize further contamination, for example, it should be well-protected from vermin and birds.

Equipment

Any equipment that has been in contact with sheep and goats can harbour disease. This is especially true of veterinary equipment and shearing equipment. All equipment that has been in contact with sheep and goats on other premises should be thoroughly cleaned with soap and then disinfected with an appropriate disinfectant at the labelled concentration for at least five minutes.

If any visitor to your farm refuses to abide by the biosecurity arrangements, ask them why they have a problem with it. The choice is yours; assume the risk of whatever the visitor may bring with them or ask them to leave. It is your farm and your finances that are at risk. You do not want visitors who do not care about the well-being of your farm.

Biosecurity in Alberta^{1, 2}

The Office of the Provincial Veterinarian (OCPV) has commenced a biosecurity initiative, which is designed to increase the awareness and the use of biosecurity practices among Alberta's livestock producers and livestock service industries.

The implementation of the Alberta's Biosecurity Initiative is designed to:

- Protect livestock from disease.
- Decrease production losses arising from preventable disease.
- Improve the health status of livestock.
- Maintain market access by preventing the occurrence of any Foreign Animal Disease (FAD) in Alberta and demonstrating that Alberta's livestock producers and livestock service industries do in fact follow best practices in biosecurity.

What is Biosecurity?

The term "biosecurity" refers to the protection of the health of livestock by preventing the transmission of disease. Whatever the situation, biosecurity precautions should be a part of the management practices followed by all agricultural operations.

Examples of biosecurity practices include:

- Quarantining new stock
- Maintaining a vaccination program
- Controlling rodents
- Cleaning footwear
- Changing coveralls
- Controlling access of visitors and service people

FAD
Foreign Animal Disease - any disease of animals which is not normally present in Canada.

Limiting exposure to wild birds and other wildlife

A complete farm biosecurity program will minimize risks from:

- Incoming stock
- Feed and water
- Pets
- Pests
- Farm visitors

Why is Biosecurity Important?

Biosecurity can:

- Help prevent the introduction of diseases from other countries, for example foot and mouth disease. FMD can spread quickly, devastate export markets and cause severe economic consequences for the entire livestock industry.
- Help prevent the spread of certain diseases already found in Alberta, such as Johne's disease and infectious foot rot in sheep. These diseases can have a significant financial impact on a farm operation.
- Protect the operator and his/her family from disease causing organisms that are transmissible from animals to humans, such as *Salmonella*, *E. coli* 0157:H7 and *Campylobacter*.
- How well a farming operation implements biosecurity will attest to their commitment to the health of the livestock industry.

How are Livestock Diseases Spread?

Some diseases require direct contact between infected and healthy animals, while others can be easily carried on boots or clothing contaminated by infected manure or other bodily discharges. People can carry and transmit some diseases to livestock, for example salmonellosis, while some other diseases cannot be transmitted by humans at all.

By understanding how diseases are spread, you will be better able to design an effective biosecurity control program for your farm or service industry.

Who Should Practise Biosecurity?

Biosecurity should be practised by anyone who:

- Owns livestock
- Works with livestock

- Visits farms, abattoirs or premises where livestock, poultry or their products are handled, including stockyards, auction markets and livestock shows.

Knowing the Risk

Everyone should know, manage and keep accurate records on the disease status of their own animals. There is little point in being totally focused on others when your own flock/herd is sick.

The Introduction of New Livestock

In order to lessen the chance of introducing disease, new livestock should be bought from sources that also practise good health management, as infected stock carries the highest risk of introducing a disease into an operation.

- New stock should be isolated in a clean area.
- Care of the resident animals should precede the care of quarantined animals.
- Those working with the isolated animals should change their outer clothing and wash their hands when they leave the isolated area.
- Farm equipment used in the quarantine area should be disinfected before being used in other areas of the farm.

Sick Animals

Isolation of all new animals is critical. Follow the same quarantine procedure you would use for the introduction of new livestock.

For Feed and Water

- Ensure that feed and water sources are not accessible to visitors.
- Ensure that feed and water are not contaminated with manure, either directly or through runoff.
- Do not use the feed hauling equipment to transport manure.

Farm Visitors

Farm visitors generally represent a lower risk. However, visitors have been known to introduce disease-causing organisms on soiled footwear, clothing or equipment. Farm visitors can be classified by the risk they represent:

1. Low risk visitors come from urban areas, from within the same country of origin, and for the most part do not have contact with livestock or poultry. They present almost no risk of introducing disease, even if few precautions are taken. Ag tourism guests usually fall into this category, as they are primarily from urban

Quarantine – isolate animals from all other animals for a period of thirty days. The distance between the quarantined animals and other stock must be at least 30 metres (100 feet.)

locations. However, it is common courtesy to greet each guest and to:

Make them aware of the operation's biosecurity program.
Enquire about their proximity to livestock and poultry in the past two weeks.

2. Moderate risk visitors are those who travel from farm to farm, but have no direct contact with livestock or manure. This would include such visitors as oil and gas workers visiting wells on your property, for example.
3. High risk visitors are those who travel from farm to farm and have direct contact with livestock or manure. Therefore, when you visit other farms yourself, be sure to practise good biosecurity measures and ask that others also extend the same courtesy to you and your farm.

The following are suggested procedures for agricultural operations concerned with practising biosecurity.

For Visitors

- Establish a visitor protocol to prevent random access to an operation.
- Greet every visitor in a predetermined location away from the livestock; for example, ensure that all visitors come to the house first to be greeted and do not allow them wander about the farm at will.
- Find out where they have been in the past two weeks. Ensure that foreign visitors, especially those from countries with foot and mouth disease, have taken the appropriate precautions against the risk of their carrying disease agents. Keep accurate and current records of these visits.
- Provide alternative footwear or plastic disposable booties as a cover for visitors' footwear.
- Provide a clean-up area, including hand washing facilities, for all visitors.
- Do not allow animals access to any human food or packaging material that visitors may have brought onto the premises. Disease outbreaks have occurred via this route.
- Educate all visitors about the biosecurity plan and its universal benefit.
- Enforce the biosecurity plan.

For Vehicles

- Establish a traffic pattern to prevent random access to the operation and to avoid contact with manure.
- If applicable, provide facilities for washing and disinfecting tires, mud flaps, etc.

Will All Premises Have the Same Biosecurity Requirements?

There can be no single biosecurity plan to meet the needs of all farms or agricultural businesses. The diseases and potential risks vary between livestock species, and also depend on the activities occurring on the premises.

Each business must assess all potential risks and develop a flexible and practical biosecurity plan tailored to its circumstances. For more information on developing a biosecurity plan, contact the Office of the Chief Provincial Veterinarian -

Website: [www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/all/cpv4264](http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/cpv4264)

Phone: 780-427-3448

References

1. *Biosecurity in Alberta, Apr 09.* [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/cpv10708#order](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/cpv10708#order)
2. *Biosecurity Considerations for Ag Tourism Ventures, Apr 09.* [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex10345](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10345)



23. Treatment Protocols for Disease

The following protocols are not meant to take the place of good advice from your own veterinarian, but are here to help you work with your veterinarian to develop treatment plans which will work for your flock.

Abortion

If a ewe/doe aborts during late pregnancy immediately:

1. Separate the animal from the remainder of the flock.
2. Remove the fetus and afterbirth – wearing disposable gloves, place it in a strong garbage bag and tie the top. Refrigerate, do not freeze.
3. If you are pregnant, may be pregnant or are in ill health avoid all contact with the flock.
4. Keep the aborted material somewhere cool and out of reach of animals.
5. Monitor the rest of the flock closely for signs of other abortions.
6. If there are other abortions manage as above.
7. You should already have worked with your veterinarian to develop an intervention level (for example, three abortions or two percent of the flock). If the intervention level has been reached, submit the aborted material to the laboratory for analysis.
8. Work with your veterinarian to determine if it is appropriate to treat the flock with oxytetracycline by injection or in the feed.

Pneumonia in Growing Lambs/Kids

1. Growing lambs/kids that separate from the group or go off feed may be showing early signs of pneumonia.
2. Signs of overt pneumonia include coughing, nasal discharge, depression and death.
3. If you suspect pneumonia, take the animal's rectal temperature using a regular medical thermometer. If the temperature is greater than 40.5°C (104.5°F), the animal likely has infectious pneumonia.
4. Treatment options for pneumonia in lambs include an oxytetracycline LP injection daily for three to five days. Another medication licensed for use in lambs but requiring a prescription is Micotil; a veterinarian may also prescribe long acting oxytetracycline, which is an extra-label use.
5. There are not any injectable antibiotics licensed for use in goats; you will require a prescription for all treatments.
6. **Note:** Most treatments used in lambs will work in goats but **never** use Micotil in goats, as it can be toxic.
7. If animals start to die from pneumonia, ensure that a post-mortem is performed to determine the cause in order to ensure that the correct treatment is being used.

Sick Ewes/Does in Late Pregnancy

1. If an animal goes off its feed and goes down in the last few weeks of pregnancy the two most common disorders are ketosis (twin lamb disease) or hypocalcaemia (milk fever).
2. First assess the animal's body condition score. Animals in very good or poor body condition are more prone to ketosis.
3. Collect a urine sample and test it for ketones (to collect a urine sample cover the animal's nose and mouth so that it starts to suffocate; within approximately 30 seconds it will start to struggle and will then urinate).
4. If there are ketones in the urine, the animal has ketosis (twin lamb disease).
5. If there are no ketones, check the response of the eyes to light (normally the pupils will shrink when a flashlight is shone into them); also see if the rumen is moving. If the rumen is not moving and the eye response to light is poor, the animal likely has hypocalcaemia (milk fever).
6. Animals with ketosis should be treated with a ketosis drench and receive approximately 100 mL of 50% dextrose iv. Make

every effort to get the animal eating. In severe cases, talk to your veterinarian about terminating the pregnancy with steroids or performing a C-section. Remember that other animals in the flock will be at risk of developing the same condition.

7. Animals with hypocalcaemia should be treated with 100 mL of 23 percent calcium borogluconate under the skin. Remember that other animals in the flock will be at risk of developing the same condition.

Scours in Young Lambs/Kids

1. Scours is common in young animals and is caused by a variety of organisms.
2. Is the animal a single and also bright and happy?
 - This animal probably has nutritional scours; monitor, no further treatment required.
3. Is the animal scouring but active and looking to nurse?
 - Treat the animal twice daily with oral electrolytes.
4. Is the animal scouring and depressed?
 - Check body temperature; if the animal is hypothermic, treat appropriately (Refer to *Hypothermic Lambs/Kids* in this chapter).
 - Administer oral electrolytes four times daily.
5. If you are experiencing a major outbreak, contact your veterinarian. If animals are dying, get a post-mortem exam to determine the cause.

Scours in Older Lambs/Kids

1. Scours in animals over one month of age is more commonly due to worms or coccidiosis.
2. Fecal samples may be used to determine the cause.
Note: Due to the life cycle of the parasites worms may not always be excreted.
3. If the diagnosis is worms, deworm all sheep/goats.
Note: Dewormers are not labelled for use in goats.
4. If it is coccidiosis, treat severely affected animals with an injectable sulfa drug for example, Borgal or Trivettrin (ELDU). Consider treating the whole group with a coccidiostat in the feed.

ELDU
Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

Old Thin Ewes/Does

There are many possible reasons why an older animal may be in poor body condition. When dealing with such an animal always consider the following:

1. What is the condition of the teeth? Poor teeth are a common cause of weight loss; such animal should be culled.
2. Is the animal competing for feed and failing to get enough to eat? This is also a very common cause of weight loss. Try putting the animal in a smaller group with good quality feed.
3. Is there any evidence of abscesses due to caseous lymphadenitis (CL), or is there a herd history of CL? Affected animals should be culled.
4. Do the feces look normal? If they are softer than normal consider either parasites or Johne's disease; either deworm or cull.
5. Is there a history of maedi-visna or CAE in the flock? Consider blood testing the animal or cull if there are clinical signs of disease.

Hypothermic Lambs/Kids

Any lamb or kid in the first few days of life that is failing to thrive should be considered hypothermic.

1. Take the rectal temperature. If the temperature is between 37 and 39°C, go to step 2. If the temperature is less than 37°C go to step 3.
2. Dry the lamb/kid and give it a feed of warm milk by stomach tube. If the lamb/kid is active and temperature is close to normal, return it to its mother. Otherwise keep it in the nursery area.
3. First assess the age. If the animal is less than six hours old go to step 4. If the animal is older go to step 5.
4. Young animals should be dried and warmed. When they become active they should immediately be fed good quality warm colostrum by stomach tube. Attempt to return the animal to its mother as soon as the temperature is normal, and monitor for signs of rejection.
5. If the animal can lift its head go to step 6. If the animal cannot lift its head go to step 7.
6. Feed the animal by stomach tube with warm milk. Ensure that it is dry and place it in the warmer. When it is dry and the body temperature is normal return it to its mother and monitor.

7. Severely affected animals should first be treated with an intra-peritoneal injection of dextrose. Then dry and warm the animal. When it can lift its head it should be fed milk via stomach tube. When the temperature has returned to normal and the animal is active, return it to its mother and monitor.

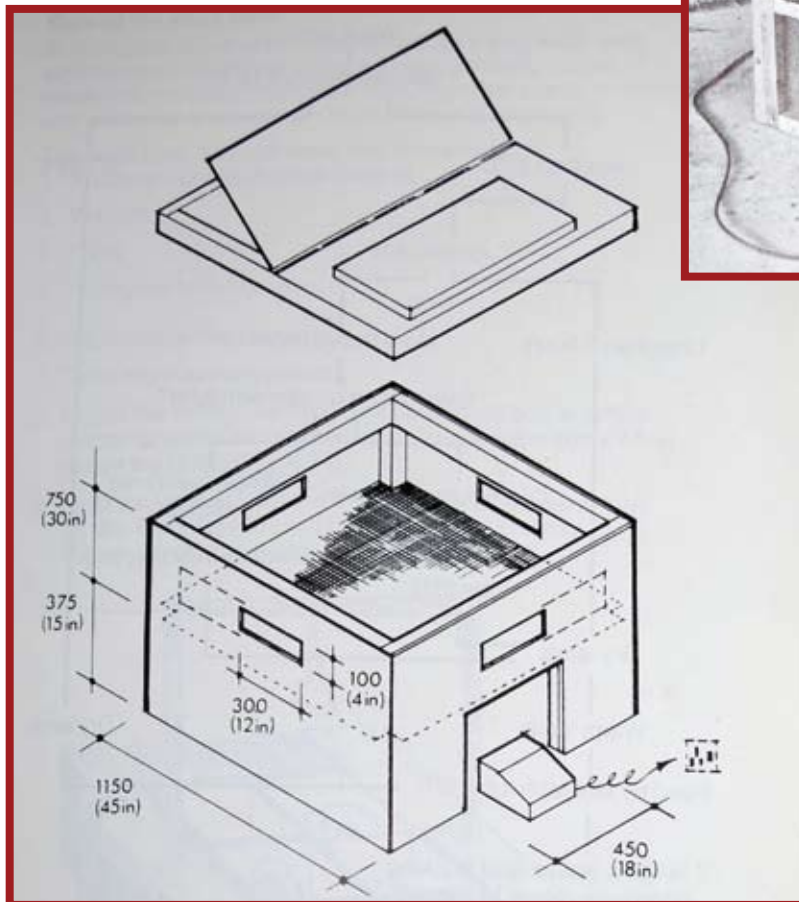


Figure 1 and 2 - Lamb/kid warming box

Appendix 1: Products for Use in Sheep and Goats

from *Compendium of Veterinary Products, 11th ed.*
North American Compendium Ltd., 2009

Products for Goats

Generalized Conditions

Infectious Diseases

Infectious diseases - bacterial

Anthrax (*Bacillus anthracis*), immunization

- Anthrax Spore Vaccine (Colorado Serum)

Nutritional Deficiencies

Energy supplementation

- Lamb and Kid Kare (Champion Alstoe)

Multiple supplementation (oral)

- Lamb and Kid Kare (Champion Alstoe)

Nervous System

Anesthesia and Clinical Procedures

Sedation (with analgesia), induction

- Acevet Injection (Vétoquinol)

Behavioural Disorders

Fractions animals, management

- Acevet Injection (Vétoquinol)

Other Uses

Feeding

Milk replacement

- KidGro On Hand Milk Replacer (Grober)

Products for Sheep

Circulatory System

Blood and Lymphatic System

Anemia (iron deficiency), prevention/treatment (injectable)

- Hemostam (Rafter 8)
- Newcells (Wyeth Animal Health)

Vitamin B12 deficiency, prevention/treatment

Never use Micotil on goats. It is toxic to them.

ELDU

Extra-label drug use, also referred to as "off-label use" refers to the actual use or intended use of any drug, whether it is a prescription drug or over-the-counter (OTC) drug, in an animal in a manner that is not in accordance with the approved label or the package insert of the drug licensed by Health Canada.

- Cyanocobalamin Injection U.S.P. (Dominion)
- Hemostam (Rafter 8)
- Newcells (Wyeth Animal Health)

Digestive System

Gastrointestinal

Gastrointestinal - bacterial

Enteritis (bacterial), prevention

- Sulvit (Vétoquinol)
- Calf Scour Bolus (P.V.L.)
- Co-op® Scour Solution (IPCO)
- Neomix® Soluble Powder (Pfizer)
- Oxysol-220 (Vétoquinol)
- Oxysol-440 (Vétoquinol)
- Oxytetracycline 50 Granular Premix (Bio Agri Mix) r
- Oxytetracycline 100 Granular Premix (Bio Agri Mix)
- Oxytetracycline 200 Granular Premix (Bio Agri Mix)
- Scour Solution (Vétoquinol)
- Sulmed Plus (Medprodex)
- Super Scour Calf Bolus (Dominion)
- Terramycin®-50 Premix (Phibro)
- Terramycin®-100 Premix (Phibro)
- Terramycin®-200 Premix (Phibro)

Enteritis (bacterial), treatment

- 3-Sulvit (Vétoquinol)
- Calf Scour Bolus (P.V.L.)
- Cocci Bol-O-Tab® Jr. (Intervet Canada Ltd.)
- Cocci Bol-O-Tab® Sr. (Intervet Canada Ltd.)
- Co-op® Scour Solution (IPCO)
- Germe-Zone (Dominion)
- NeoMed 325 (Medprodex)
- Neomix® Soluble Powder (Pfizer)
- Neomycin 325 (Vétoquinol)
- Neorease (Bimeda-MTC)
- Onycin 250 (Vétoquinol)
- Onycin 1000 (Vétoquinol)
- Oxy 250 (Medprodex)
- Oxysol 62.5 (Vétoquinol)
- Scour Solution (Vétoquinol)
- Scour Suspension (Dominion)
- Scour Suspension (P. V.L.)

- Scour Treat (Citadel)
- Sodium Sulfamethazine Solution 12.5% (Dominion)
- Sodium Sulfamethazine Solution 25% (Dominion)
- Sulectim* 100 (Equivet)
- Sulfa 25 (Jaapharm)
- Sulfa "25" (P. V.L.)
- Sulfa 25% Solution (Bimeda-MTC)
- Sulfavite (Dominion)
- Sulmed Plus (Medprodex)
- Super Scour Calf Bolus (Dominion)
- Tetra 250 (Jaapharm)
- Tetracycline 250 (Vétoquinol)
- Tetracycline 1000 (Vétoquinol)
- Tetracycline Hydrochloride (Dominion)
- Tetracycline Hydrochloride (P.V.L.)
- Tetramed 250 (Medprodex)
- Tetramed 1000 (Medprodex)
- Triple Sulfa Bolus (P.V.L.)

Enteritis (non-specific), treatment

- Astringent Powder (Bimeda-MTC)

Salmonellosis (intestinal), control and/or prevention

- 3-Sulvit (Vétoquinol)
- Sulmed Plus (Medprodex)

Salmonellosis (intestinal), treatment

- 3-Sulvit (Vétoquinol)
- Sulmed Plus (Medprodex)

Gastrointestinal - other conditions

Constipation, prevention/treatment

- Anti-Bloat (P.V.L.)
- Anti Gaz Emulsion (Vétoquinol)
- Bloat-Eze (Dominion)
- Mineral Oil (Dominion)
- Mineral Oil (Vétoquinol)
- Toxilax (Jaapharm)

Gastrointestinal - parasites

Coccidiosis, control/prevention

- Cocci Bol-O-Tab@ Jr. (Intervet Canada Ltd.)
- Cocci Bol-O-Tab@ Sr. (Intervet Canada Ltd.)

Coccidiosis, treatment

- Cocci Bol-O-Tab@ Jr. (Intervet Canada Ltd.)

- Cocci Bol-O-Tab® Sr. (Intervet Canada Ltd.)
- Sulfa 25% Solution (Bimeda-MTC)

Gastrointestinal parasites, systemic treatment/control

- Ivomec® Drench for Sheep (Merial)
- Ivomec® Injection for Cattle, Sheep and Swine (Merial)
- Noromectin® Drench for Sheep (Kane)
- Noromectin® Drench for Sheep (Walco)

Rumen Disorders

Bloat, treatment

- Anti-Bloat (P.V.L.)
- Anti Gaz Emulsion (Vétoquinol)
- Bloat-Eze (Dominion)

Ruminal function, aid to

- Peptonic (Vétoquinol)
- Rumex Bolus (Bimeda-MTC)

Generalized Conditions

Dehydration/Electrolyte Imbalances

Dehydration, prevention/treatment (oral route)

- Co-op® Electrolytes Plus (IPCO)
- Electra Caps (P.V.L.)
- Electras (Dominion)
- Electras (P.V.L.)
- Electrolytes-A/F (Vétoquinol)
- Electrolytes Plus (Vétoquinol)
- Electrolyte Tabs (Dominion)
- Elvit (Medprodex)
- Super Electrolyte (Medprodex)

Dehydration/hypovolemia, treatment

- Electrolyte Infusion (Bimeda-MTC)
- Lactated Ringers Injectable (Central Sales)
- Lact-R (Bimeda-MTC)
- Physiological Saline (Bimeda-MTC)
- Physiological Saline (Central Sales)
- Uni-Lyte (Univet)

General and Supportive Treatments

Bacterial infections, systemic treatment

- Duplocillin® LA (Intervet Canada Ltd.)
- Longisil (Vétoquinol)
- Penmed (Medprodex)
- Procillin LA (Eagle)

- Sulfamethazine Bolus (Dominion)
- Sulfamethazine Bolus (P.V.L.)
- Triple Sulfa Bolus (P.V.L.)

Infectious Diseases

Infectious diseases - bacterial

Anthrax (*Bacillus anthracis*), immunization

- Anthrax Spore Vaccine (Colorado Serum)

Bacillary hemoglobinuria (*Clostridium haemolyticum*), immunization

- Covexin® 8 (Schering-Plough Canada Inc.)

Big head (*Clostridium novyi*/*C sordellii*/*C chauvoei*), immunization GI

- Covexin® 8 (Schering-Plough Canada Inc.)
- UltraChoice® 7 (Pfizer)
- UltraChoice® 8 (Pfizer)
- Vision® 7 with Spur® (Intervet Canada Ltd.)
- Vision® 8 with Spur® (Intervet Canada Ltd.)

Black Disease (*Clostridium novyi*), immunization

- Clostri Shield® 7 (Novartis)

Blackleg (*Clostridium chauvoei*), immunization

- Clostri Shield® 7 (Novartis)
- Covexin® 8 (Schering-Plough Canada Inc.)
- Tasvax® 8 (Schering-Plough Canada Inc.)
- UltraChoice® 7 (Pfizer) El UltraChoice® 8 (Pfizer)
- Vision® 7 with Spur@ (Intervet Canada Ltd.)
- Vision® 8 with Spur® (Intervet Canada Ltd.)

Blackleg (*Clostridium chauvoei*), treatment

- Duplocillin® LA (Intervet Canada Ltd.)
- Longisil (Vétoquinol)
- Penmed (Medprodex)
- Procillin LA (Eagle)

Caseous lymphadenitis (*Corynebacterium pseudotuberculosis*), immunization

- Case-Bac (Colorado Serum)
- Caseous D-T (Colorado Serum)

Enterotoxemia (*Clostridium perfringens*), immunization

- Caseous D-T (Colorado Serum)
- Clostri Shield® 7 (Novartis)
- Covexin® 8 (Schering-Plough Canada Inc.)
- Tasvax® 8 (Schering-Plough Canada Inc.)
- UltraChoice® 7 (Pfizer)

- UltraChoice® 8 (Pfizer)
- Vision® 7 with SpurO (Intervet Canada Ltd.)
- Vision® 8 with Spur® (Intervet Canada Ltd.)
- Vision® CD-T with Spur® (Intervet Canada Ltd.)

Enterotoxemia (*Clostridium perfringens*), reduction of losses

- Aureomycin® 1101220 G Drug Premix (Diluted) (Alpharma)
- Aureomycin® 110 G (Alpharma)
- Aureomycin® 220 G (Alpharma)
- Co-op® Aureomycin™ Vitamin Premix Crumbles (IPCO)
- Oxysol-220 (Vetoquino!)
- Oxysol-440 (Vétoquinol)
- Oxytetracycline 50 Granular Premix (Bio Agri Mix)
- Oxytetracycline 100 Granular Premix (Bio Agri Mix)
- Oxytetracycline 200 Granular Premix (Bio Agri Mix)
- Terramycin®-50 Premix (Phibro)
- Terramycin®-100 Premix (Phibro)
- Terramycin®-200 Premix (Phibro)

Enterotoxemia (*Clostridium perfringens*), temporary immunization/treatment

- Clostridium Perfringens Types C & D Antitoxin, Equine Origin (Colorado Serum)

Infectious necrotic hepatitis (*Clostridium novyi*), immunization

- Covexin® 8 (Schering-Plough Canada Inc.)
- Tasvax® 8 (Schering-Plough Canada Inc.)
- UltraChoice® 7 (Pfizer)
- UltraChoice® 8 (Pfizer)
- Vision® 7 with Spur® (Intervet Canada Ltd.)
- Vision® 8 with Spur® (Intervet Canada Ltd.)

Malignant edema (*Clostridium septicum*), immunization

- Clostri Shield® 7 (Novartis)
- Covexin® 8 (Schering-Plough Canada Inc.)
- Tasvax® 8 (Schering-Plough Canada Inc.)
- UltraChoice® 7 (Pfizer)
- UltraChoice® 8 (Pfizer)
- Vision® 7 with Spur® (Intervet Canada Ltd.)
- Vision® 8 with Spur® (Intervet Canada Ltd.)

Tetanus (*Clostridium tetani*), immunization

- Caseous D-T (Colorado Serum)
- Super-Tet® with Havlogen® (Intervet Canada Ltd.)

- Tasvax® 8 (Schering-Plough Canada Inc.)
- Tetanus Toxoid (Colorado Serum)
- Vision® CD-T with Spur® (Intervet Canada Ltd.)

Tetanus, emergency treatment/temporary immunization

- Tetanus Antitoxin (Colorado Serum)
- Tetanus Antitoxin (Wyeth Animal Health)

Pasteurellosis, treatment

- Sulfa 25 (Jaapharm)

Intoxications

Hypoprothrombinemia, acute (anticoagulant poisoning), treatment

- Veta-K1 (P.V.L.)
- Vitamin K1 Injection (Vétoquinol)

Hypoprothrombinemia, non-acute (Vitamin K deficiency), treatment

- Veta-K1 (P.V.L.)
- Vitamin K1 Injection (Vétoquinol)

Poisoning (per os), emergency treatment

- Toxilax (Jaapharm)

Management and production

Production enhancement

Feed efficiency improvement

- Aureomycin® 110 G (Alpharma)
- Aureomycin® 220 G (Alpharma)

Weight gain increase (growth promotion)

- Aureomycin® 110 G (Alpharma)
- Aureomycin® 220 G (A/pharma)

Reduction of losses

Navel infections/Navel ill, treatment

- Penmed (Medprodex)

Metabolic Conditions

Acetonemia (ketosis), treatment/prevention

- Domcol Solution (Dominion)
- Glycol-P (Vétoquinol)
- Ketamalt® (Bimeda-MTC)
- PCE-Glycol (Vétoquinol)
- Phosphonortonic* (Pfizer)

Anabolism, stimulation of

- Amino Boluses Improved (P.V.L.)
- Phosphonortonic* (Pfizer)

Ca/Mg/P/K deficiencies, prevention/treatment

- Cal Mag-K® (Bimeda-MTC)
- Cal Mag Phos (Citadel)
- Cal-Plus® (Bimeda-MTC)

Hypocalcemia, treatment

- Calcium Borogluconate 23% (Bimeda-MTC)
- Calcium Borogluconate 23% (Citadel)
- Calcium Gluconate 23% (Univet)
- Calcium Gluconate 23% Injection (Rafter 8)
- Cal-Nate 23% Injection (Wyeth Animal Health)
- Mag-Cal™ (Bimeda-MTC)
- Norcalciphos* (Pfizer)
- Supercal (Dominion)

Hypoglycemia, treatment

- Dex 50 (Rafter 8)
- Dextrose 50% (Bimeda-MTC)
- Dextrose 50% (Citadel)

Parturient paresis (milk fever), treatment

- Phosphonortonic* (Pfizer)

Nutritional Deficiencies

Amino acid supplementation

- Amino Boluses Improved (P.V.L.)

Cobalt supplementation

- Copro®25 (Zinpro)

Energy supplementation

- Lamb and Kid Kare (Champion Alstoe)

Iron supplementation (oral)

- Availa®Fe 120 (Zinpro)
- Irol Liquid (Jaapharm)

Manganese supplementation

- Availa®Mn 80 (Zinpro)
- Manpro®80 (Zinpro)

Microorganism supplementation

- Zoologic® Mammal Bene-Bac™ (PetAg)

Mineral supplementation

- Rumex Bolus (Bimeda-MTC)

Multiple supplementation (oral)

- Plex® (Zinpro)
- Amino Boluses Improved (P.V.L.)
- Availa®4 (Zinpro)
- Elvit (Medprodex)

- EquiSol (Jaapharm)
- Irol Liquid (Jaapharm)
- Lamb and Kid Kare (Champion Alstoe)
- Min Plus Powder (Jaapharm)
- Red Sol (Jaapharm)
- Vita Min Plus (Jaapharm)

Multiple supplementation (parenteral)

- Amino Solution (Dominion)
- Amino Solution (P.V.L.)
- HB Injection (Bexco)
- Promo-155 (Dominion)

Phosphorus supplementation

- Phosphonortonic* (Pfizer)

Vitamin A & D supplementation

- Co-op® A+D Injectable (IPCO)
- Master (Vétoquinol)
- Vitamin A & D (Dominion)
- Vitamin A 8 D (P.V.L.)
- Vitamin AD3 Forte (Rafter 8)
- Vitamin AD-500 Injection (Citadel)
- Vitamins AD-500 Injection (Bimeda-MTC)

Vitamin B complex deficiency, prevention/treatment

- Race-Vite (Dominion)

Vitamin B supplementation

- Mega B (Jaapharm)

Vitamin C supplementation (parenteral)

- Mega B (Jaapharm)

Vitamin E deficiency, prevention/treatment (parenteral)

- E-Master (Vétoquinol)

Vitamin supplementation (oral)

- ADE Solution (Jaapharm)
- Booster Plus (Medprodex)
- Co-op® ADE Liquid (IPCO)
- Co-op® Electrolytes Plus (IPCO)
- Electrolytes Plus (Vétoquinol)
- Rumex Bolus (Bimeda-MTC)
- Super Electrolyte (Medprodex)

Zinc supplementation

- Availa®Zn 100 (Zinpro)
- Zinpro®40 (Zinpro)

- Zinpro®100 (Zinpro)
- Zinpro®180 (Zinpro)

Immune System

Allergic Reactions, Symptomatic Treatment

- Antihistamine (Vétoquinol)

Anaphylactic Shock, Emergency Treatment

- Epinephrine 1:1000 (Neogen)

Integumentary System

Antisepsis

- Antiseptic Iodine Spray (Dominion)
- Co-op® Iodine Wound Dressing (IPCO)
- El Gentle Iodine Spray (Citadel)
- Iospray (P.V.L.)
- Strong Iodine 16% (Vétoquinol)

Fungal Skin Diseases

Dermatophytosis (Ringworm), localized treatment

- Coppercure (Equivet)
- Copperox (Univet)
- Coppersept (Citadel)
- Cristisol (Dominion)
- 1 Kopertox® (Wyeth Animal Health)
- Koppersol (P.V.L.)
- Pododerm (Dominion)

Localized Conditions

Bacterial soft tissue infections, systemic treatment

- Depocillin® (Intervet Canada Ltd.)
- Hi-Pencin 300 (Equivet)
- Pen Aqueous (Wyeth Animal Health)
- Pen G Injection (Citadel)
- Penmed (Medprodex)
- Penpro (Vétoquinol)
- Pen Vet 300 (Rafter 8)
- Procillin™ (Bimeda-MTC)

Wound cleansing

- Chlorhexidine Solution (Partner Animal Health)

Wound infections, local treatment (with antimicrobial drugs)

- Sulfa Urea Cream (Dominion)
- Sulfa Urea Cream (P.V.L.)

Wound protection

- AluShield™ (Neogen)

- Aluspray (Vétoquinol)
- Intracell™ Wound Dressing (Macleod)

Wounds/abrasions, local treatment

- Antisep 2% (Vétoquinol)
- Antiseptic Iodine Spray (Dominion)
- Co-op® Iodine Wound Dressing (IPCO)
- Co-op® Pinkeye Spray (IPCO)
- Cristisol (Dominion)
- Gentle Iodine Spray (Citadel)
- Germe-Zone (Dominion)
- Iospray (P.V.L.)
- Jentex Cream (Steven Jenter)
- Keraplex (Dominion)
- Kopertox® (Wyeth Animal Health)
- Petrolatum Amber N.F. (Dominion)
- Pink Eye Guard (Dominion)
- Pinkeye Spray (Citadel)
- Pododerm (Dominion)
- Wound and Pinkeye Spray (Bimeda-MTC)

Parasitic Infestations

Ectoparasite and/or flea build-up (premises), prevention

- Di-Thoate 4E (Vétoquinol)
- Doktor Doom® Extra Strength Farm & Livestock Insect Eliminator (UltraSol)
- Doktor Doom® Maximum Strength Livestock & Business Insect Eliminator (UltraSol)
- Doktor Doom® Metered Release Flying Insect Spray (Ultra Sol)
- Doktor Doom® Ornamental Concentrate Knockdown (Ultra Sol)
- Doktor Doom® Residual Surface Insecticide Spray (UltraSol)
- Sevin® (Dominion)
- Tempo® 20 WP Insecticide (Bayer)

Ectoparasite and/or flea build-up (premises), treatment

- Doktor Doom® Extra Strength Farm & Livestock Insect Eliminator (UltraSol)
- Doktor Doom® Maximum Strength Livestock & Business Insect Eliminator (UltraSol)
- Doktor Doom® Metered Release Flying Insect Spray (Ultra Sol)

- Doktor Doom® Ornamental Concentrate Knockdown (Ultra Sol)
- Doktor Doom® Residual Surface Insecticide Spray (UltraSol)
- Ectiban® 25 Fly-Killer (Engage)

Ectoparasite infestation, treatment/control

- Co-op® Louse Powder (IPCO)
- Dri-Kil® Dust (Engage)
- Dusting Powder (Dominion)
- Ectiban® 25 Fly-Killer (Engage)
- Malathion 500 EC Insecticide (IPCO)
- Sevin® (Dominion)

Fly and/or Mosquito treatment and/or control

- Dispar-Mist II (Vétoquinol)
- Disvap® MEC (Vétoquinol)
- Disvap® PYR (Vétoquinol)
- Di-Thoate 4E (Vétoquinol)
- Doktor Doom® Metered Release Flying Insect Spray (Ultra Sol)
- Ectiban® 25 Fly-Killer (Engage)
- IPCO® Cygon™ 480 EC (IPCO)
- Starbar® Premium Fly Bait (Wellmark)

Fly and/or Mosquitoes, control/prevention (premises)

- Agita® Fly Bait (Novartis)
- Doktor Doom® Extra Strength Farm & Livestock Insect Eliminator (UltraSol)
- Doktor Doom® Maximum Strength Livestock & Business Insect Eliminator (UltraSol)
- Doktor Doom® Ornamental Concentrate Knockdown (Ultra Sol)
- Doktor Doom® Residual Surface Insecticide Spray (UltraSol)

Keds, treatment/control

- Doktor Doom® Residual Surface Insecticide Spray (UltraSol)

Lice infestation, treatment/control

- Co-op® Louse Powder (IPCO)
- Dusting Powder (Dominion)
- Malathion 500 EC Insecticide (IPCO)
- Sevin® (Dominion)

Skin Appendages

Dehorning

- Dehorning Paste (Dr. Naylor)

Dehorning wounds, hemostasis

- Co-op® Kopper Kare (IPCO)
- Coppercure (Equivet)
- Copperox (Univet)
- Kopertox® (Wyeth Animal Health)
- Kopper Kare (Dominion)
- Koppersol (P.V.L.)

Musculoskeletal System

Foot Disorders

Footrot [Fusobacterium necrophorum and/or Porphyromonas levii (Bacteroides spp)], control and/or treatment

- Co-op® Kopper Kare (/PCO)
- Coppercure (Equivet)
- Copperox (Univet)
- Coppersept (Citadel)
- Duplocillin® LA (Intervet Canada Ltd.)
- Kopertox® (Wyeth Animal Health)
- EKopper Kare (Dominion)
- Koppersol (P.V.L.)
- Sulfa 25% Solution (Bimeda-MTC)

Footrot [Fusobacterium necrophorum, Porphyromonas levii (Bacteroides spp)] prevention

- MycAseptic™ E (Neogen)
- Pododerm (Dominion)

Hoof punctures/cracks, treatment

- Kopertox® (Wyeth Animal Health)

Joints and Related Structures

Arthritis (septic), systemic treatment

- Noromycin LP (Kane)
- Noromycin LP (Walco)
- Oxymyline LP (Wyeth Animal Health)
- Oxytetracycline 100 LP (Vétoquinol)
- Oxytetramycin 100 (Dominion)
- Oxyvet® 100 LP (Vétoquinol)
- Penmed (Medprodex)

Nutritional Myopathies

Selenium/Vitamin E supplementation

- Dystosel* (Pfizer)
- E Plus Powder (Dominion)
- Selenium-E (Vétoquinol)

- Selon-E Injection (Vétoquinol)
- Ultra-Sel (Univet)

Nervous System

Anesthesia and Clinical Procedures

Anesthesia (general), induction

- Thiotal 1 g (Vétoquinol)
- Thiotal 5 g (Vétoquinol)

Anesthesia (local), induction

- Lidocaine HCl 2% and Epinephrine Injection USP (Bimeda-MTC)

Epidural blocking

- Lidocaine HCl 2% (Wyeth Animal Health)
- Lidocaine HCl 2% and Epinephrine Injection USP (Bimeda-MTC)
- Lidocaine Hydrochloride 2% with Epinephrine 1:100,000 (P.V.L.)
- Lidocaine Neat (Wyeth Animal Health)

Euthanasia, induction

- Dorminal (Rafter 8)

Sedation (with analgesia), induction

- Acevet Injection (Vétoquinol)
- Atravet® 10 mg Injectable (Wyeth Animal Health)

Behavioural Disorders

Fractious animals, management

- Acevet Injection (Vétoquinol)
- Atravet® 10 mg Injectable (Wyeth Animal Health)

CNS Nutritional Deficiencies

Thiamine (vitamin B1) deficiency, prevention/treatment (parenteral)

- Thiamine Injection (Rafter 8)

Viral Nervous Diseases

Rabies immunization

- [Defensor® 3 (Pfizer)
- Imrab® 3 (Merial)
- Imrab® Large Animal (Merial)

Reproductive System

Abortion and Infertility

Campylobacteriosis (Campylobacter fetus) immunization

- Campylobacter Fetus Bacterin-Ovine (Colorado Serum)

Ovine enzootic abortion (*Chlamydia psittaci*), immunization

- Chlamydia Psittaci Bacterin (Colorado Serum)

Breeding

Embryo transfer

- MAP-5 (Bioniche Animal Health)
- MAP-5 (50 mg) (Bioniche Animal Health)

Estrus Control

EI Estrus control/synchronization

- Progesterone 5% (Vétoquinol)

Estrus, induction

- Estradiol Cypionate in Oil (P. V.L.)

Ovulation, induction

- Folligon® (Intervet Canada Ltd.)
- Lutropin®-V (Bioniche Animal Health)
- Novormon™ 5000 (Partner Animal Health)
- Pregnecol™ 6000 (Bioniche Animal Health)

Mammary Gland/Udder Conditions

Mammary tissues (during mastitis), evacuation/debridement/drainage

- Oxytocin Injection (Bimeda-MTC)
- Oxytocin Injection (Wyeth Animal Health)

Mastitis, systemic treatment

- Noromycin LP (Kane)
- Noromycin LP (Walco)
- Oxymycine LP (Wyeth Animal Health)
- Oxytetracycline 100 LP (Vétoquinol)
- Oxytetramycin 100 (Dominion)
- Oxyvet® 100 LP (Vétoquinol)
- Penmed (Medprodex)
- Sodium Sulfamethazine Solution 12.5% (Dominion)
- Sodium Sulfamethazine Solution 25% (Dominion)
- Sulfa 25 (Jaapharm)
- Sulfa "25" (P. V.L.)
- Sulfa 25% Solution (Bimeda-MTC)

Teat chap, treatment/prevention

- B.B. Jell-Udder Balm (Dominion)
- Red Udder Ointment (Dominion)

Puerperal Conditions

Dystocia due to uterine inertia

- Oxy-20 (Rafter 8)
- Oxy-20 NW (Rafter 8)

- Oxytocin (Vétoquinol)
- Oxytocin Injection (Bimeda-MTC)
- Oxytocin Injection (P.V.L.)
- Oxytocin Injection (Wyeth Animal Health)
- Oxyto-Sure™ (Vétoquinol)

Lactation, induction

- Oxy-20 NW (Rafter 8)
- Oxytocin (Vétoquinol)
- Oxyto-Sure™ (Vétoquinol)

Metritis, local treatment

- Aureomycin® Uterine Oblets® (Wyeth Animal Health)

Metritis, systemic treatment

- Depocillin® (Intervet Canada Ltd.)
- Hi-Pencin 300 (Equivet)
- Noromycin LP (Kane)
- Noromycin LP (Walco)
- Oxymycine LP (Wyeth Animal Health)
- Oxytetracycline 100 LP (Vétoquinol)
- Oxytetramycin 100 (Dominion)
- Oxyvet® 100 LP (Vétoquinol)
- Pen Aqueous (Wyeth Animal Health)
- Pen G Injection (Citadel)
- Penmed (Medprodex)
- Penpro (Moquinol)
- Pen Vet 300 (Rafter 8)
- Procillin™ (Bimeda-MTC)
- Sodium Sulfamethazine Solution 12.5% (Dominion)
- Sodium Sulfamethazine Solution 25% (Dominion)
- Sulfa "25" (P. V.L.)
- Sulfa 25% Solution (Bimeda-MTC)
- Sulfamethazine Bolus (Dominion)
- Sulfamethazine Bolus (P.V.L.)
- Triple Sulfa Bolus (P.V.L.)

Prolapsed uterus correction, aid in

- Oxy-20 NW (Rafter 8)
- Oxytocin (Moquinol)
- Oxytocin Injection (Bimeda-MTC)
- Oxytocin Injection (Wyeth Animal Health)
- Oxyto-Sure™ (Moquinol)

Pyometra/endometritis, evacuate tissue and debris

- Oxy-20 (Rafter 8)

- Oxy-20 NW (Rafter 8)
- Oxytocin (Moquinol)
- Oxytocin Injection (Bimeda-MTC)
- Oxytocin Injection (Wyeth Animal Health)
- Oxyto-Sure™ (Moquinol)

Uterine contractions, induction

- Oxy-20 (Rafter 8)
- Oxy-20 NW (Rafter 8)
- Oxytocin (Moquinol)
- Oxytocin Injection (Bimeda-MTC)
- Oxytocin Injection (P.V.L.)
- Oxyto-Sure™ (Moquinol)

Uterine hemorrhage (post-partum), control and/or prevention

- Oxy-20 (Rafter 8)
- Oxy-20 NW (Rafter 8)
- Oxytocin (Moquinol)
- Oxytocin Injection (Bimeda-MTC)
- Oxytocin Injection (Wyeth Animal Health)
- Oxyto-Sure™ (Vétoquinol)

Uterus contraction following caesarian section, aid in the treatment of

- Oxy-20 (Rafter 8)
- Oxy-20 NW (Rafter 8)
- Oxytocin (Vétoquinol)
- Oxyto-Sure™ (Vétoquinol)

Reproductive Disorders

Reproductive disorders in males/females, treatment

- Lutropin®-V (Bioniche Animal Health)

Respiratory System

Allergic Reactions

Allergic respiratory conditions, treatment

- Antihistamine (Vétoquinol)

Bacterial Respiratory Diseases

Pneumonia (bacterial), control/prevention

- Sulvit (Vétoquinol)
- Sulmed Plus (Medprodex)

Pneumonia (bacterial), treatment

- 3-Sulvit (Vétoquinol)
- Depocillin® (Intervet Canada Ltd.)
- Hi-Pencin 300 (Equivet)

- Neorease (Bimeda-MTC)
- Noromycin LP (Kane)
- Noromycin LP (Walco)
- Oxymyline LP (Wyeth Animal Health)
- Oxytetracycline 100 LP (Vétoquinol)
- Oxytetramycin 100 (Dominion)
- Oxyvet® 100 LP (Vétoquinol)
- Pen Aqueous (Wyeth Animal Health)
- Pen G Injection (Citadel)
- Penmed (Medprodex)
- Penpro (Vétoquinol)
- Pen Vet 300 (Rafter 8)
- Procillin™ (Bimeda-MTC)
- Scour Treat (Citadel)
- Sulfamethazine Bolus (Dominion)
- Sulfamethazine Bolus (P.V.L.)
- Sulmed Plus (Medprodex)
- Triple Sulfa Bolus (P.V.L.)

Respiratory disease (bacterial), control/treatment

- Excenel® Sterile Powder (Pfizer)
- Onycin 250 (Vétoquinol)
- Onycin 1000 (Vétoquinol)
- Oxy 250 (Medprodex)
- Oxysol 62.5 (Vétoquinol)
- Sulfa 25% Solution (Bimeda-MTC)
- Tetracycline 250 (Vétoquinol)
- Tetracycline 1000 (Vétoquinol)
- Tetramed 250 (Medprodex)
- Tetramed 1000 (Medprodex)

Respiratory disease, ovine (*Mannheimia haemolytica*), treatment

- Micotil® (Elanco)

Respiratory tract infections (bacterial), prevention/treatment

- Procaine Penicillin G (Dominion)
- Sodium Sulfamethazine Solution 12.5% (Dominion)
- Sodium Sulfamethazine Solution 25% (Dominion)
- Sulectim* 100 (Equivet)
- Sulfa "25" (P.V.L.)
- Sulfavite (Dominion)

Lungworm Infection, Control/Treatment

- Ivomec® Drench for Sheep (Merial)
- Ivomec® Injection for Cattle, Sheep and Swine (Merial)
- Noromectin® Drench for Sheep (Kane)
- Noromectin® Drench for Sheep (Walco)

Nasal Cavity

Nose bots (*Oestrus ovis*), treatment

- Ivomec® Drench for Sheep (Merial)
- Ivomec® Injection for Cattle, Sheep and Swine (Merial)
- Noromectin® Drench for Sheep (Kane)
- Noromectin® Drench for Sheep (Walco)

Respiratory Disease

Cough, relief of

- Sodide (Rafter 8)
- Sodium Iodide (Bimeda-MTC)
- Sodium Iodide 20% Injection (Univet)
- Sodium Iodide Solution 20% (P.V.L.)

Diagnostic Uses

Clinical Diagnosis

Inflammatory processes, detection

- Gelmate (V.D.I.)

Clinical Pathology and Laboratory Analysis

Dermatophyte diagnosis

Dermatophyte culture

- Fungassay® (Synbiotics)

Dermatophyte screening

- Fungassay® (Synbiotics)

Fecal analysis

- El Fecal Diagnostic Kit (Vétoquinol-Vet Solutions)
- Ovassay® Plus (Synbiotics)
- Zinc Sulfate (Vétoquinol-Vet Solutions)

Reproductive Tests

Estrus detection

- Ovucheck® Plasma (Biovet)

Pregnancy determination

- Ovucheck® Plasma (Biovet)

Hospital/Farm Uses

General Procedures

Dosing vehicle/irrigation

- Sterile Water, USP (Bimeda-MTC)

Lubrication

- Centaur Light Lube™ (Centaur)

Odour Control

Premise/household deodorizing

- Multi-Phenolic Disinfectant (Bio Agri Mix)
- Proquat™ (Engage)

Disinfection, Sanitation and/or Cleaning

Boot Wash/Foot Dip

- DuPont™ 904 (Vétoquinol)
- Hyperox (Vétoquinol)
- Premise Disinfectant (West Penetone)

Cleaning of Animal Facilities

- Agro-Clean® (SEC Repro)
- Biofoam (Vétoquinol)
- Biosolve (Vétoquinol)
- DuPont™ Biosolve® Plus (Vétoquinol)
- DuPont™ Neutrafoam™ (Vétoquinol)
- Gluquat (West Penetone)
- Multi-Phenolic Disinfectant (Bio Agri Mix)
- Vir-Kil* (Engage)

Cleaning of Animal-Derived Food Processing Equipment

- Agro-Clean® (SEC Repro)
- DuPont™ Biosolve® Plus (Vétoquinol)
- Multi-Phenolic Disinfectant (Bio Agri Mix)

Cleaning of Animal-Derived Food Processing Facilities

- DuPont™ Neutrafoam™ (Vétoquinol)
- Multi-Phenolic Disinfectant (Bio Agri Mix)
- Vir-Kil* (Engage)

Cleaning of Waterlines

- Citric Acid (Medprodex)

Disinfection and/or Sanitation of Animal Facilities

- Aseptol 2000® (SEC Repro)
- DuPont™ 904 (Vétoquinol)
- Fumalyse 11 (Bio Agri Mix)
- Gluquat (West Penetone)
- Hyperox (Vétoquinol)
- Multi-Phenolic Disinfectant (Bio Agri Mix)
- PF 300 (DuBois)
- Premise Disinfectant (West Penetone)
- Profilm® (Engage)

- Proquat™ (Engage)
- Vir-Kil* (Engage)
- Virkon® Disinfectant/Cleaner P.W.S. (Vétoquinol)
- Virkon® Tablets (Vétoquinol) 0- Virocid® (Merial)

Disinfection of Animal-Derived Food Establishments/Processing Plants

- Beaucoup (Ecolab Healthcare)
- Hyperox (Vétoquinol)
- Multi-Phenolic Disinfectant (Bio Agri Mix)
- Premise Disinfectant (West Penetone)
- Vir-Kil* (Engage)
- Virkon® Disinfectant/Cleaner P.W.S. (Vétoquinol)
- Virocid® (Merial)

Fumigation (Reagent)

- DuPont™ 904 (Vétoquinol)
- Fumalyse II (Bio Agri Mix)
- Hyperox (Vétoquinol)
- Profilm® (Engage)

Sanitation of Hoofmat(s)

- Hyperox (Vétoquinol)

Other Uses

Feeding

Milk replacement

- CL Ewe Replacer (Champion Alstoe)
- CL Nanny Replacer (Champion Alstoe)
- Dairy Lamb-Gro Lamb Milk Replacer (Grober)
- KidGro On Hand Milk Replacer (Grober)
- LambGro On Hand Milk Replacer (Grober)

Appendix 2: Euthanasia for Sheep and Goats

from *Euthanasia Resources and Training Program*

Jennifer Woods

J. Woods Livestock Services

Blackie, Alberta

Understanding Euthanasia and Your Moral Obligation

Euthanizing an animal is never a welcome task, but it is one that must be accomplished with compassion. (UC Davis School of Veterinary Medicine)

If you have livestock you will need to deal with the euthanasia issue sooner or later. This appendix is meant as a reference to help you understand the issues surrounding euthanasia, and assist in your decision making process.

By Definition

Compassion

Compassion is a sense of shared suffering, most often combined with a desire to alleviate or reduce such suffering; to show special kindness to those who suffer. (Wikipedia)

Humane

Pertaining to the avoidance of infliction of pain, discomfort and harassment; used especially with regard to animals.

(<http://medical-dictionary.thefreedictionary.com/humane>)

Euthanasia

Euthanasia is the act of inducing *humane* death in an animal with a minimum of *pain, fear* and *distress*.

Moral Obligations

All livestock owners and handlers have a moral obligation to ensure the welfare of their animals, and that includes ensuring that their lives are as stress and pain free as possible. The moral obligations pertaining to health care and euthanasia of the animals include:

- Protecting the animal from unnecessary suffering and distress.
- Providing an environment that promotes good health.
- Providing the necessary health care, both preventative and treatment.

- Shipping animals for meat processing only when the animal is fit for transport and human consumption.
- Having euthanasia as a treatment option. Therefore you should:
 1. Have an active euthanasia program outlined in your standard operating procedures.
 2. Have the means and skills readily available to perform euthanasia in a timely and effective manner.
 3. Perform euthanasia in the most painless and stress free manner available.
 4. Euthanize the animals in a timely manner to ensure the least amount of pain, suffering and distress to the animal.
 5. Put the animal's quality of life over the emotions of the caretaker.
 6. Not allow an animal to suffer or be in distress for economic reasons.

Societal Obligation

Canada has both federal and provincial laws in place that reflect society's expectations that animals will be protected. These laws are neither restrictive nor economically detrimental to producers. Canadian society allows livestock producers to operate freely with minimal regulations or restrictive legislation, with the understanding and trust that producers care for and raise their animals consistent with the values of the community. This means that society is trusting producers to provide animals with the best care possible.

The Veterinarian's Role

Canadian society places the highest level of trust in the veterinary profession, allowing a great deal of discretion to be utilized in care and treatment of animals based on experience and professional judgment. It is the responsibility of every veterinarian, as outlined in the Oath (CVMA 2004), to promote animal welfare and relieve animal suffering. Often, there is no greater benefit to the welfare of the animal than to relieve animal suffering through the act of inducing a humane death with a minimum of pain, fear and distress.

The Human Factor

Employee Attitudes and Considerations

The human factor is an often overlooked part of the euthanasia process, yet it greatly influences the timeliness, effectiveness and humaneness of the procedure. There are many factors that influence the handler's attitude towards euthanasia. They include socio-demographic, environmental and educational influences. By obtaining a clearer understanding of how each of these factors influences the act of, and attitude towards euthanasia, we can better manage and train livestock handlers for the process of euthanasia.

When handlers are provided with comprehensive training that covers all aspects of euthanasia, they will often become more comfortable with the procedures and have a better attitude towards euthanasia. Training not only gives them the skill to perform the act, but also the confidence to make timely decisions on when to euthanize an animal.

Psychological Effects

Many studies have documented that euthanasia can have negative psychological effects on animal handlers. Livestock handlers who are constantly exposed to euthanasia may demonstrate careless/aggressive handling of livestock and application of euthanasia, and experience job dissatisfaction, increased missed work days, depression, grief, frustration, sleeplessness, nightmares, isolation, high blood pressure, ulcers and substance abuse.

Reaction to euthanasia procedures will vary among individuals, with some experiencing no adverse affects, while others are deeply affected. Experience has shown, however, that the more handlers are educated and made aware of the procedures and reasons for euthanasia, the more comfortable they become with the job. The greater the level of comfort, the less likely they are to experience stress related symptoms.

Management Considerations

Owners and managers must be acutely aware of all the factors listed in this section, no matter the size of their operation. Whether an operation has a staff of 50 or is managed just by the owner and his family, it is the manager's responsibility to do all they can to alleviate the challenges those involved in the operation may face. They must ensure they

appropriately assign tasks to those who are skilled and comfortable with euthanasia, and they must monitor their performance.

Training

Not only should training be required for new staff entering the production site, but continual training and assessment for existing staff should be provided. The training should be comprehensive and include all aspects of euthanasia, with both literature review and hands-on training. Livestock handlers should not be allowed to euthanize animals on their own until they have been tested proficient on skill, efficiency and effectiveness.

Attitude

The attitude of the livestock handler is key to ensuring proper handling and euthanasia procedures in the barn. Research has revealed sequential relationships between the attitudes of the stockperson towards the animals, the behaviour of the stockperson with the animals, the behavioural response of animals to humans (e.g. fear) and the overall performance and welfare of the animal.

Management will often set the tone for the attitude of the barn staff. Managers must have a proactive approach to all aspects of animal welfare and demand the same attitude from the staff. Company policy must be clearly posted.

Employee Selection

When hiring or selecting employees for positions that include euthanasia, the manager must ensure that the handler is comfortable performing the expected task. It is detrimental to employee morale, safety and animal welfare to force handlers who are not comfortable with euthanasia to perform it. Keep in mind that some handlers may be comfortable performing euthanasia, but they may not be comfortable with the modes of euthanasia used within your operation. This must be discussed before they are expected to euthanize animals.

Management of Employees

Management can alleviate some of the strain on employees by rotating the euthanasia task throughout the staff, especially in operations where euthanasia is a regular part of the routine. Managers must keep the lines of communication open with employees and note any changes in behaviour, attitude, frequency of sick days, etc. Support should be provided for employees who request it or appear to need it. This support network should include open lines of communication, task rotation when requested and counselling if required.

Assessment

It is the responsibility of management to verify that all staff are performing euthanasia properly and in a timely manner. Each employee should be evaluated on a regular basis and barns assessed for active euthanasia practices utilizing a standard audit program or third party verification process.

Recognizing Pain and Distress in Livestock

One of the biggest challenges with livestock is recognizing when they are in pain or distress. As prey animals, they are genetically predisposed not to express pain, as it makes them vulnerable to predators. This makes them very different from predators, including humans. When we are hurt or injured we express the pain verbally and physically; livestock will normally only show very subtle signs of pain and distress, if any at all. Handlers must understand that this lack of expression does not mean the animal is not experiencing pain.

The lack of emotional expression often delays euthanasia and prolongs an animal's suffering. A majority of respondents to a survey on swine euthanasia agreed or strongly agreed that sick pigs that appear to be in pain are easier to euthanize than pigs that show no signs of pain. The survey also revealed that an overwhelming percentage agree that it is more humane to euthanize a sick/injured pig that appears to be in pain than let it suffer. While this study focussed on the swine industry, the principles remain the same across all species. Learning to recognize the subtle signs of pain and distress in livestock will make us more responsible livestock handlers and improve the welfare of our animals.

Defining and Understanding Pain, Suffering and Distress

Pain

An awareness of acute or chronic discomfort, occurring in varying degrees of severity, and resulting from injury, disease or emotional distress as evidenced by biological and/or behavioural changes. (University of Arizona Institutional Animal Care and Use Committee Handbook)

Suffering

Suffering is to endure pain or distress. (Webster's Ninth New Collegiate Dictionary. Merriam-Webster Inc., 1990)

Distress

An animal experiences distress when the biological cost of coping with the stressor(s) diverts resources away from other primary

biological functions (growth, reproduction, etc.) (Moberg, 1985) The Alberta Animal Protection Act states an animal is in distress if it is

1. deprived of adequate shelter, ventilation, space, food, water or veterinary care, or lacks reasonable protection from injurious heat or cold;
2. injured, sick, in pain or suffering, or
3. abused or subjected to undue hardship, privation or neglect.

Signs of Pain and Distress

Below is a list of possible signs that an animal may express if it is experiencing distress. Any of these signs may appear alone or in conjunction with other signs, including ones that may not even be listed. It must also be noted that each one of these listed behaviours/reactions may not necessarily be related to distress. Experience and education will allow a handler to assess the animal's behaviour to determine if in fact the animal is in distress or just expressing normal behavioural reaction to its current environment. If you are unsure, consult an experienced handler or professional to assist in assessing the situation. Signs of distress include (but are not limited to):

- Stress vocalization
- Attempts to flee
- Aggression
- Rapid or irregular breathing, mouth breathing
- Salivation
- Struggling
- Urination
- Defecation
- Rapid heart beat
- Sweating
- Dilation of the pupils
- Tremors/shaking
- Freezing/standing completely still
- Grinding teeth
- Reduced suckling

Pain - *If it would cause us pain, it will most likely cause them pain.*

Below is a list of possible signs that an animal may be in pain. Any of these signs may appear alone or in conjunction with other signs and may overlap with signs of distress. If you are unsure if the animal may be experiencing pain or why the animal is in pain, consult an experienced handler or professional to assist in assessing the situation.

- Inability or unwillingness to rise
- Inability or unwillingness to walk
- Reluctance to put weight on a limb
- Protecting the painful area
- Vocalization, especially when animal moves or painful area is touched
- Open mouth breathing
- Arched or hunched back
- Abdomen tucked up
- Drooping head
- Droopy ears
- Lack of interest in food or water
- Lack of interest in surroundings
- Staying away from other animals, no response to other animals
- No response when touched or prodded
- Standing in a rigid position
- Shivering, trembling or profuse sweating
- Attraction to area of pain, scratching or shaking affected area
- Kicking or biting at abdomen
- Getting up and lying down frequently
- Walking in circles
- Grunting
- Hiding in bedding
- Licking, biting, scratching or shaking of a specific area
- Change in personality
- Change in eye brightness, glassy eyes, dilated pupils
- Reduced suckling
- Tail flicking
- Inability to get comfortable, acting unsettled
- Head turned back when lying down, lying on belly
- Increased blood pressure and heart rate

Indications for Euthanasia

Euthanasia should be viewed as a management tool in livestock production. It offers a means to alleviate the suffering of individual animals and protect the health of all animals under the producer's care. It is also a financial management tool to ensure the operation stays economically feasible.

Providing handlers with the training and knowledge to make informed decisions will make the euthanasia process easier for all. Surveys of swine barns in the US found that having a euthanasia policy and providing employees with training makes employees more comfortable and confident with their decisions on which animals to euthanize. It will also help ensure there is consistency within the operation in the euthanasia process.

As livestock owners we are financially responsible for the welfare of the animals in our care; however, we also are responsible for the financial stability of our operation and family. Since an animal's welfare must never be compromised for financial reasons, the financial cost of treating an animal must be part of the decision process. However if the treatment is going to be financially detrimental to the operation and family, euthanasia is not only the financially responsible choice, but also a humane choice for the animal.

Assessing Each Situation

Indications for euthanasia of livestock include poor health, disease, injury, loss of productivity, economics and safety. There are three possible treatment options for livestock producers faced with any of these situations:

1. Ship the animal for meat processing **if** the animal is fit for transport and human consumption.
2. Treat the animal
3. Euthanasia

Note: Not all animals are fit for transportation.

Refer to the Guide to the *Humane Care, Handling and Transportation of Sheep* which can be viewed at www.ablamb.ca and the Recommended *Code of Practice for the Care and Handling of Farm Animals - Goats*, which can be viewed at www.albertagoatbreeders.ca.

Some cases are very black and white, where the only treatment option is euthanasia. Other cases may offer the possibility of shipping or

treatment. The latter is the more challenging situation for handlers. Just because there is a chance for recovery, it does not mean treatment is always the optimal choice for the producer or the animal. When deciding which option is best, a handler has to ask several questions in order to make a responsible decision.

What is the level of pain and distress? **If the animal is experiencing a high level of pain or distress or if the animal requires continual medication to alleviate the pain, euthanasia must be seriously considered.**

What will the animal's quality of life be during recovery/treatment? **How much pain and suffering will it need to endure during recovery? If the recovery and treatment will cause greater pain and suffering, euthanasia must be seriously considered.**

Is the animal going to be able to access water and food during treatment/recovery? **If the animal is going to have limited access to food or water, or if feeding and watering is going to be labour intensive, euthanasia must be seriously considered.**

How long will it take the animal to recover? **An extensive recovery period can adversely affect the welfare of the animal by prolonging the suffering. There will also be increased expenses including medication, labour and cost of return to productivity with an extended recovery.**

Will there be a full recovery and if not, what will the animal's quality of life be and will there be added management and financial responsibilities? **Will the animal achieve a full recovery? If it does not fully recover, what will its quality of life be—will it experience constant pain or struggle to get to food and water? Will winter weather increase its pain and suffering? Will it need continual medication and increased veterinary care and what will be the cost to the owner? If it will experience chronic pain, unnecessary suffering or be a financial burden to the owner, euthanasia must be seriously considered.**

Is the animal going to infect or adversely affect the health or welfare of other animals in the barn? **If the animal is contagious and can spread the disease or illness to other animals, adversely affecting their welfare and the economics of the facility, euthanasia must be seriously considered.**

Will the weather create inhumane conditions for the ill animal? **The weather can increase the level of suffering and greatly compromise its welfare. In cases such as arthritis, will cold weather worsen the condition so the animal has to suffer through the winters? If the animal will be exposed to extreme cold, heat or wet conditions during the illness or treatment euthanasia must be seriously considered.**

What is the economic cost (labour, veterinary care and medication) of the treatment? **If the cost of treatment is going to exceed future productivity income or if it will put a financial burden on the owner or the household, euthanasia would be the best option.**

Will the animal be condemned if processed for meat? **If the animal will be condemned or even has the risk of being condemned, on farm euthanasia must be seriously considered.**

Will there be a withdrawal period from the medication before the animal can be processed for meat? **If you chose to treat the animal with a medication that has a withdrawal time and the animal does not respond, you will not be able to ship the animal for slaughter until the withdrawal time passes. If the chances of recovery are not high, you may choose to ship the animal without treatment if the animal is fit for transport and if the animal will not be condemned at the meat processing facility. If you choose to treat the animal and it does not show signs of improvement in 24 to 36 hours, the animal must be euthanized on farm.**

Timeliness of Euthanasia

Another challenge handlers face is the timeliness of the decision—*how long should an animal be given to recover?* Current industry literature and guidelines range from 24 to 48 hours from the time treatment begins to when the animal should be showing signs of recovery. Most animals will begin responding to treatment within 24 hours. Rarely do they recover if they do not show progress within the first 36 hours.

Injuries are more challenging and the expected timeline for recovery will need to be established with your veterinarian. Leaving an animal to die or “letting nature takes its course” is **not acceptable**. It is not acceptable to extend the animal's suffering to wait for the next sale day, for

access to professional services such as a veterinarian or for the next shift of barn staff to arrive. Euthanasia **must occur in a timely manner**.

Poor Health/Disease

This is a list of the more common conditions, illnesses and diseases that livestock producers may face while raising animals. This reference list is neither all inclusive nor exclusive, but provides some common examples of poor health and disease to assist the producer in the euthanasia decision making process.

- Disease is transmittable (zoonotic) to other animals or people (e.g. rabies, foot and mouth). Any suspected zoonotic diseases must be reported immediately.
- Animal is too weak to ship due to emaciation and poor body condition.
- Extreme weakness.
- Animal shows a lack of desire to eat or drink, persisting for 24 hours or more.
- Animal is unresponsive to treatment within 24 to 36 hours of onset.
- Disease in which no effective treatment is known.
- Disease in which expected recovery is unusually prolonged.
- Drastic weight loss – greater than 20 percent of total body weight.
- Contagious disease.
- Unresolved prolapses.
- Respiratory disease/illness (Sheep - Ovine Progressive Pneumonia (OPP)). **Note:** An animal with early stage respiratory illness can only be transported short distances.
- Advanced urinary tract infection.
- Peritonitis (infection of the body cavity).
- Fever 3°C or higher than normal body temperature for greater than three days and/or unresponsive to treatment.
- Advanced or infectious arthritis affecting more than two joints.
- Septicemia.

Injury

- Severe, debilitating pain. (Refer to *Signs of Pain and Distress* in this chapter.)
- A wound significantly impacting a critical biological function (e.g. major organ, muscle or skeletal system, brain injury, etc.).

- Profuse bleeding.
- Animal cannot rise, walk or remain standing without assistance.

Note: Please refer to the *Guide to the Humane Care, Handling and Transportation of Sheep* provided by Alberta Lamb Producers to assist producers in the care and handling of unfit animals. This document can be viewed at www.ablamb.ca. Guidelines may also be found in the *Recommended Code of Practice for the Care and Handling of Farm Animals - Goats*, which can be viewed at www.albertagoatbreeders.ca.

Loss of Productivity

Most livestock are raised for production purposes—whether that purpose is raising offspring or providing meat, eggs or dairy products. When the cost of feed, veterinary care, housing and labour exceeds the productivity income of an individual animal, it is the responsibility of the producer to remove the animal from the production cycle. Producers should cull the animal in a timely manner while the animal is still fit for transport and processing—this will allow the owner to recover some of the cost.

In cases where animals are unfit for transport or not acceptable to be processed for meat, it is the responsibility of the producer to euthanize the animals. An example of this would be lightweight piglets which are more likely to have a very poor rate of gain and are more susceptible to illness and disease. Producers who adopt a policy of euthanizing more compromised nursery pigs on arrival have the advantage of immediately improving the welfare status of the farm without incurring capital costs. Removing these animals from the production cycle at an early age will increase the profitability of the farm and improve the overall welfare and health status of the herd.

Economics

Animal welfare must never be compromised in the name of economics.

Economics must be factored into the decision to euthanize; however it is very difficult for producers to decide when an animal becomes uneconomical. The economic implications include the cost of treating the animal, the loss in productivity during the illness or injury, infection of other animals, the cost to return the animal to profitable productivity and the economic considerations of the mode of euthanasia chosen.

The cost of treating a sick animal includes the cost of medication, the expense of increased labour during treatment and veterinary care. Treating an animal can be very expensive and exceed the future profitability of the animal, making treatment an economically detrimental decision for a producer. The cost of treatment must not put a financial burden on the production unit or the household. It is not cruel or irresponsible to make the decision to euthanize an animal because keeping it would put a financial strain on you or your household.

The animal may need to be removed from the production cycle, resulting in a loss of income from that animal during the treatment and recovery period. If this loss, especially when combined with the cost of treatment, exceeds the future income potential of the animal or if it is more economical to replace the animal with new stock, euthanasia would be the responsible decision.

It is not uncommon for animals to lose weight during illness or because of injury. Along with the cost of treatment and loss of production, the added feed input and time to bring the animal back to condition add to the overall economic picture of an sick animal. Each one of these costs must be factored into the decision to euthanize or invest in recovery.

One other area where economics must be considered for euthanasia is which mode of application you will choose. Each mode of euthanasia comes with its own economic implications. For large facilities where euthanasia is a regular part of production, it would not be economically feasible to euthanize animals using barbiturates. Gunshot is one of the least expensive means, but must be performed by a skilled individual.

Dangerous Animal

When an animal has become dangerous to you, your family, your staff or other animals you must ship the animal for meat processing or euthanize it. No matter how productive the animal is, you are responsible for the safety of all those on your farm or within your facility. It is irresponsible, and you may be held liable if you ship a dangerous animal to an auction for sale to another producer, knowing the animal can hurt someone.

Health Emergency

The Canadian Food Inspection Agency (CFIA) is responsible, under the Health of Animals Act, for eradication of foreign animal disease (FAD) in Canada. Alberta Agriculture and Rural Development (ARD) is responsible under various authorities to ensure the health and viability of the agri-food supply in Alberta. An outbreak of a foreign animal disease or a reportable disease as identified by the Office of the Chief Provincial Veterinarian (OCPV) will require immediate action to contain, control and eradicate the disease. These actions may include: animal movement controls, euthanasia, disposal, cleaning and disinfecting of infected premises and transport. There may be instances though where the producer will be required to assist in cases of health emergencies.

Selecting the Appropriate Mode of Euthanasia

There are three different mechanisms under which death will occur:

1. Direct depression of neurons
2. Hypoxia
3. Physical disruption of brain activity

Direct depression of the central nervous system is achieved through overdose of injectable barbiturates. Though not commonly used in the livestock production setting, inhalant anaesthetics such as ether or halothane will also induce death through depression of neurons, but they have significant human safety concerns.

Hypoxia means lack of oxygen and is achieved by exposing animals to high concentrations of gases such as CO₂ or argon or through rapid blood loss (exsanguination).

Gunshot, blunt force trauma or captive bolt guns all induce death by **physical disruption of brain activity**. Death occurs when the mid-brain centres controlling respiration and cardiac arrest fail.

Properly euthanized animals do not feel pain because the necessary sensory processing within the cerebral cortex is blocked or disrupted. No matter which mode of death you choose, the method should result in rapid loss of consciousness, followed by cardiac or respiratory arrest and subsequent loss of brain function.

Considerations

There are several considerations when you come to choose the most appropriate mode of euthanasia. Ideally, your method of choice will be as painless as possible, non-reversible and appropriate for the age and size of the animal, produce a rapid death, cause minimal stress to the animal, be safe for the handler and cause minimal emotional distress to humans.

Human Safety

The method chosen must be one that is safe for the individuals performing the task. There is potential for injury from both the tool being used and by the animal being euthanized. Each one of the modes listed in this manual has individual safety precautions. Proximity to the animal, restraint method required, accessibility to restraint and the animal's involuntary muscular spasms all pose a hazard to the handler. Safety of other personnel or animals present must be considered.

Animal Welfare

Handlers must do all they can to minimize pain, fear, distress and anxiety for the animal.

Animals cannot be dragged, prodded or forced to walk on broken limbs or made to move when pain and suffering will occur except in cases of obvious human safety issues. They should not be carried or swung in a way that will cause pain or distress. They must be restrained as gently as possible and the welfare and safety of other animals in the immediate proximity must also be considered (e.g. chance of missed gunshot hitting other animals, or startling other animals).

Reliable

The method chosen must be reliable, repeatable and robust to minimize the impact of operator selection and maintenance requirements. Reliability is affected by skill, maintenance and consistency. If the mode requires high skill, the number of employees able to utilize certain tools will be limited. Tools must be maintained to ensure reliability. As an example, captive bolt guns have high maintenance requirements in order for them to remain reliable. When not maintained properly, the gun can become ineffective. Consistency of delivery is a challenge with the reliability of manual blunt force trauma.

Economics

Some methods of euthanasia are more costly than others. Tools such as captive bolt guns have a high initial cost, but are relatively inexpensive to use. Anaesthetic overdose has a relatively high cost as a veterinarian must perform the procedure, and means of disposal can be costly due to limitations. The number of animals euthanized within the operation is also a consideration. If you only euthanize an occasional animal, cost is not as much a factor as it would be in a larger operation in which animals are euthanized more frequently, or in the case of mass destruction of livestock.

Skill Level

Each method of euthanasia requires a certain level of skill and training. This is an extremely important consideration as the skill and efficiency of the person performing the task is vital for the proficiency of the task. Improper use of the tool will not only jeopardize the safety of the handler, but also the welfare of the animal. The vast majority of failed euthanasia cases come about as the direct result of human error.

Skill levels will be categorized as:

Level 1 - Minimal skill required. Proficiency tested.

Level 2 - Minimal skill. Training required. Proficiency tested.

Level 3 - Moderate skill. Training required. Proficiency tested.

Level 4 - High skill. Training required. Proficiency tested.

Level 5 - High skill and extensive training required. Both literature review and field training required. Personnel must shadow trainer before being allowed to perform euthanasia alone. Proficiency tested.

No matter the skill level required, euthanasia procedures should be routinely assessed to ensure the welfare of the animal and safety of the handler.

Aesthetics

Each method of euthanasia has its own degree of aesthetic displeasure. Some means can have a more peaceful appearance (e.g. anaesthetic overdose), than other means (e.g. blunt force trauma). Aesthetics are affected by blood loss, physical trauma to the animal and involuntary movement of the animal following application. In the case of manual blunt force trauma, the act itself is violent in appearance. Consideration must be given to the aesthetic comfort level of the person performing the task and that of bystanders (e.g. general

public or media). Humaneness and aesthetics do not always go hand in hand; just because one method is less aesthetically appealing than another, does not mean it is less humane. Therefore aesthetics should never override humaneness.

Handler Comfort

Individual preference for method of euthanasia must be considered. People are often more comfortable with one means of euthanasia than another. The more comfortable a person is with the chosen acceptable method, the more proficiently they will perform the act. Factors that can determine the level of comfort include religion, background, gender, education/training, previous experience and aesthetics.

Legal Restrictions

There are legal restrictions with some of the acceptable methods. Anaesthetic overdose can only be delivered by a registered veterinarian. In the case of firearms, the gun must be registered and the operator must hold a valid firearms license.

Biosecurity

Bio-security considerations include the spread of further disease and euthanasia site clean up. Euthanasia techniques that must be followed by exsanguination lead to possible contamination of the facilities with the blood. Expelling of brain matter is a possible risk with gunshot, captive bolt gun and blunt force trauma. Other body fluids may also be released during the euthanasia process, which can contaminate facilities.

Size, Age and Animal Type

Even though each of the methods listed below is an acceptable means of euthanasia, all are not necessarily acceptable on all animal types, sizes or ages. In Canada, manual blunt force trauma is only recommended on poultry, piglets under three weeks of age and infant lambs and kids. The skulls of boars, sows, bison and mature bulls are much thicker and more difficult to penetrate with firearms and captive bolt guns, thus limiting the selection of effective tools.

Disposal of Carcass

The mode of disposal of the carcass must be considered. Animals that are going to be put out for scavenging cannot be euthanized with drugs. Animals that are going to require screening or testing after death must be euthanized in a way that will not damage or

destroy the required tissue samples. Different regions have different laws regulating the disposal of dead livestock.

Acceptable Methods of Euthanasia of Livestock

Lethal Injection

Mode of Action—Depresses the central nervous system.

Human Safety Considerations—Low risk. Risk due to restraining animal if necessary.

Animal Welfare—Good. Poor handling and restraint may impact the welfare of the animal.

Cost—High. Drugs must be administered by a veterinarian and the restrictions on disposal options elevate the cost of lethal injection.

Skill Level—Only a registered veterinarian can administer. Skill required in delivering intravenous injections.

Aesthetics—Good.

Limitations/Special Considerations—Can only be administered by veterinarians and the animals must be safely restrained for administration. Carcasses cannot be scavenged and must be disposed of properly as they are toxic to other animals. There will be circumstances where the drugs will be difficult to administer or their effectiveness may be variable.

Even though many people feel that lethal injection is the most humane euthanasia option for animals, there are many situations where it is not applicable for a variety of reasons. Each of the following options is considered humane and meets the definition of euthanasia when applied correctly.

Penetrating Captive Bolt Gun

Mode of Action—Physical disruption of the brain.

Human Safety Considerations—Moderate to high risk. Some circumstances may require the animal to be restrained as a human safety precaution. The make and style of the gun will determine the effectiveness and safety level.

Animal Welfare—Good when applied correctly.

Cost—Moderate. There is an initial equipment cost and cartridges must be supplied. After the initial investment, cost would be low.

Skill Level—Level 3 to 4. Moderate to high skill. Training required. Proficiency tested.

Aesthetics—Moderate. May be some blood loss and animals may have involuntary movement after death. If exsanguination or pithing is required, the aesthetics would be more displeasing.

Limitations/Special Considerations—It is highly recommended that a **captive bolt gun designed for on-farm euthanasia is used**. The design, bolt length, calibre and cartridge power must be appropriate to the size and type of animal. Other devices may only stun the animal and therefore require a secondary kill step such as exsanguination or pithing.

Penetrating captive bolt guns may not be appropriate for smaller animals as animals may need to be restrained when applied. Effectiveness of the captive bolt gun can be greatly influenced by proper cleaning and maintenance procedures.

Controlled Blunt Force Trauma

Mode of Action—Physical disruption of the brain.

Human Safety Considerations—Low risk.

Animal Welfare—Good. Acceptable tools for controlled blunt force trauma include cartridge and pneumatic non-penetrating captive bolt guns.

Economics—After initial purchase of the equipment, the only cost is ammunition.

Skill Level—Controlled blunt force would require a skill level of 3. Moderate skill. Training required. Proficiency tested.

Aesthetics—Moderate. Animal may have involuntary movement after death.

Limitations/Special Considerations—Controlled blunt force can be used on lambs and kids up to 15 kg (33 lb.). It is not recommended as a stand-alone euthanasia tool on larger animals and must be followed immediately with exsanguination. Its effectiveness is also affected by animal size, skull structure and mass, and the skill of the person using the gun.

Gunshot

Mode of Action—Physical disruption of the brain.

Human Safety Considerations—High risk, must be performed by a skilled person. Safety can be greatly enhanced with proper training. Danger of ricochet.

Animal Welfare—Good. When gunshots are administered correctly, death is very rapid.

Cost—After initial purchase of the firearms, the only cost is ammunition.

Skill Level—Level 3 to 5. Skill level varies depending on type of gun used and distance from animal. Proficiency tested.

Aesthetics—Moderate. May have some blood loss and the animal may have involuntary movement after death.

Limitations/Special Considerations—Handler must have knowledge of anatomical location of the shot and in-depth knowledge of ballistics, including what size of firearm is required for different classes of livestock.

Controlled System Electrocutation

Mode of Action—Physical disruption of the brain activity and/or hypoxia. Electrocutation induces death by rendering the brain insensible (incapable of physical sensation, e.g. pain), followed by cardiac fibrillation. Cardiac fibrillation normally leads to immediate cardiac arrest; however even in the absence of immediate arrest, fibrillation reduces blood circulation in the body, leading to a state of hypoxia.

Human Safety Considerations—Moderate to high depending on the level of training received and equipment used.

Animal Welfare—Good, when administered properly.

Economics—There is a high initial equipment cost but after initial investment, relatively no cost related.

Skill Level—Level 4 to 5. High skill. Training required. Proficiency tested. Skill level can vary depending on equipment used.

Aesthetics—Moderate. There may be involuntary movement after application.

Limitations/Special Considerations—Proper equipment is a must for both human safety and animal welfare. Requires a controlled (amp/voltage) system.

Manual Blunt Force Trauma

Mode of Action—Physical disruption of the brain.

Human Safety Considerations—Low risk.

Animal Welfare—Good, when performed properly with enough force to cause immediate insensibility and timely death. The object must strike the animal's head, not the other way around with the animal's head striking the object. The object used to strike the animal must be solid, sturdy and large enough to cause enough brain destruction to induce death. Striking the animal to the object significantly decreases the animal welfare standard. If animals are swung during the application of blunt force trauma, they will experience higher stress and a much greater chance of injury such as dislocated joints, broken legs, etc. An acceptable tool for manual blunt force trauma can include a ball peen hammer, a heavy pipe and re-bar.

Cost—Low.

Skill Level—Manual blunt force requires a high level of skill - Level 5. High skill and extensive training are required. Both literature review and field training are required. Personnel must shadow a trainer before being allowed to perform euthanasia alone. Proficiency should be tested and routinely monitored to ensure proper euthanasia procedures are followed.

Aesthetics—Very poor. The act itself may be offensive. Can result in skull damage and open wounds.

Limitations/Special Considerations—Manual blunt force trauma is only acceptable on neo-natal lambs under nine kg (20 lb.) and neo-natal kids under seven kg (15 lb.).

Unacceptable Means of Euthanasia

These include: injection of non-anaesthetic pharmaceutical agents (e.g. paralyzing agents, household chemicals), air embolism (injection of large amount of air into blood vessels), exsanguination of an animal that is not stunned, anaesthetized or unconscious, electrocution with a 120 volt electrical cord, starvation/dehydration, drowning, use of car exhaust (CO), or manual blunt force trauma to any animal other than a neo-natal lamb or kid (as defined above).

Acceptable Methods of Euthanasia of Sheep and Goats

Acceptable Means	Limitations/Special Considerations
Lethal Injection	Acceptable on all age and weight groups.
Penetrating Captive Bolt Gun	Acceptable on all age and weight groups. To ensure death it may be necessary to provide a secondary procedure such as exsanguination or pithing.
Controlled Blunt Force Trauma	Controlled blunt force trauma is acceptable as a stand-alone means on lambs and kids under 15 kg (33 lb.). Only stuns larger animals so is only acceptable when followed immediately by exsanguination
Gunshot	Not recommended on small lambs or kids. Large calibre may be required for rams/bucks with horns.
Controlled System Electrocution	Acceptable when proper voltage/amperage is used.
Manual Blunt Force Trauma	Manual blunt force trauma only acceptable on neo-natal lambs under nine kg (20 lb.) and neo-natal kids under seven kg (15 lb.).

Proper Application of Euthanasia Tools

Responsibility of Handler

1. Choose the appropriate tool for the species, age and weight of the animal and the skill of the handler.
2. Have proper training and possess the necessary skills and knowledge, including knowing the anatomical locations of the vital organs.
3. Minimize stress to the animal prior to euthanasia.
4. Be aware of human safety concerns.
5. Ensure the most humane death possible.

Preparation for Euthanasia

- Animals should **not** be moved for euthanasia except in cases of human safety or unless other animals are in danger. If non ambulatory or injured animals must be moved, a humane method of movement must be utilized, such as a sled.
- Animals should be handled as little as possible.
- Ideally, animals will not have to be restrained, but if restraint is necessary:
 1. It must occur for the shortest time possible.
 2. The least stressful means available must be used.
 3. If small animals are being restrained by hand for penetrating captive bolt gun, extreme caution must be exhibited to avoid shooting the hands or legs of the person performing the restraint.
 4. Minimize stress to the animal pre-euthanasia. Stressors can include, but not be limited to:
 - Noise
 - Novel, unfamiliar physical environments
 - People in close proximity
 - Isolation from other animals
 - Rough or aggressive handling

Restraint

When choosing a method of restraint ensure:

1. It is safe for handlers and as stress free as possible for animals. The safety of the person doing the restraint is of utmost importance.
2. The animal cannot strike out at you.

3. The animal cannot escape if something goes wrong.
4. You will be able to remove the carcass from the area following euthanasia.

Sheep

Use restraint chutes designed for sheep, or halters. If you must use a halter, make sure it has enough lead to enable you to untie it following euthanasia so the animal will not be hanging.

Goats

Use restraint chutes designed for goats, or halters. If you must use a halter, make sure it has enough lead to enable you to untie it following euthanasia so the animal will not be hanging.

Lethal Injection

Effective on all species. By law, this can only be performed by a veterinarian.

Captive Bolt Guns

It is highly recommended that **captive bolt guns designed for on-farm euthanasia should be used**. These devices are designed to cause sufficient destruction of the brain (cerebral cortex) to cause loss of consciousness and destruction of the brainstem (specifically the medulla oblongata), leading to the loss of life functions with no chance of recovery. The ability to kill versus stun is based on the bolt length, calibre and cartridge power appropriate to the size and type of animal. Other devices may only stun the animal and therefore require a secondary kill step such as exsanguination or pithing.

Guidelines

- Only to be performed by trained handlers.
- Familiarize yourself with the gun before use. There are many different designs on the market which have different features and directions for use.
- The shooter should wear both protective ear and eye gear.
- Never cock the gun until you are ready to fire. Make sure the safety is set until you are ready to discharge it.
- Keep the discharge end of the captive bolt pointed towards the ground at all times.
- In the case of a misfire, do not open the stunner breech for 30 seconds in case the problem is a "hang fire" due to a slow primer ignition.

- Animals may need to be restrained to effectively apply the captive bolt gun. Animals that are upright and mobile may be impossible to safely captive bolt without restraint.
- Wait until the animal stops moving its head, before firing the shot. Do not chase the animal's head.
- Ideally, one shot will dispatch the animal. If in doubt, apply a second shot or a secondary action such as pithing or exsanguination. If a second shot is required, it cannot be administered in the same place as the first shot. If the first shot was correctly placed, apply the second shot slightly above and to the side of the first hole. If the first shot was incorrectly placed, the second shot should be placed in the correct position.

Captive bolt guns are powered by gunpowder or compressed air which must provide sufficient energy to penetrate the skull of the species on which they are being used. Accurate placement, energy of gun (bolt velocity) and depth of penetration determines effectiveness of the gun. Bolt velocity is dependent on maintenance, repair, storage and grain strength.

Captive bolt guns come in 9 mm, .22 calibre and .25 calibre. Styles include in-line (cylindrical) and pistol grip (resembling a handgun). Pneumatic penetrating captive bolt guns (air powered) must be supplied with sufficient air pressure and air volume to operate, and for the most part are limited to slaughter plant environments.

Manufacturers have developed captive bolt euthanasia systems that utilize the body of a single device with interchangeable length bolts and non-penetrating heads that are paired with specific cartridges based on the species and size of the animal. This system significantly reduces the cost of the unit and the maintenance requirement for barns that house multiple age/weight of animals or farms with mixed species of livestock. These guns are also valuable for people that deal with a variety of species and weight classes of animals such as veterinarians, SPCA, auction marts, transporters and livestock rescue crews.

Cartridges vary in strength and are classified by the amount of propellant they contain. This is measured in grains. The higher the amount of grains, the larger the animal they are intended for. 1.25 grain cartridges are for small animals, such as lambs and small pigs. Large animals such as mature cows would require a 3.0 to 4.0 grain cartridge. The cartridges are also specific to use in a 9 mm, .22 or .25 calibre. Cartridges are color coded by each manufacturer who will provide you with guidelines for the appropriate size for each species and weight classes

for their guns. You must ensure you use the correct cartridges with the correct gun, as manufacturers have different colour coding systems and cartridges are specifically designed for use with specific guns. Ammunition is **not** interchangeable between manufacturers or even different guns produced by the same company.

Application

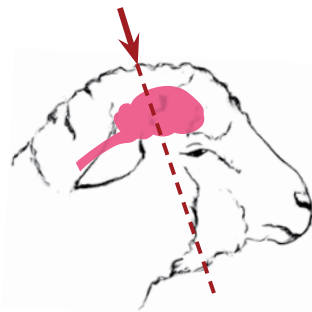
The captive bolt gun must be placed firmly against the animal's head. If it is not held flush to the animal's head, the bolt may not penetrate. It may also cause the bolt to ride up the head of the animal. The animal can be approached from head on or you can approach from behind and off to the side, and out of the line of sight of the animal. You then reach over the poll of the animal and place the gun on the front of the head. The gun can be fired by a trigger (most common) or by making contact with the animal's head.

The recoil in the guns varies depending on calibre, buffer configuration, manufacture and the cartridge used. If necessary, the handler should use two hands when firing the gun. The style of gun also can make a difference in how loud the gun is.

The most common cause of misfires and ineffective kills is poor maintenance. Captive bolt guns must be cleaned and maintained in order to operate effectively. Guns should be cleaned and inspected at the end of each day of use. Guns that are not used regularly still need to be cleaned and oiled at least once a month. Refer to the manufacturer's instruction manual for cleaning instructions. Make sure the gun is unloaded before cleaning.

Captive bolt guns and cartridges must be stored in a dry area. Exposure to humidity will affect both the gun and the effectiveness of the ammunition.

Species Specific



Sheep - Highest point/top of the head.



Goats - Behind the poll.

Penetrating Captive Bolt Guns

Penetrating captive bolt guns consist of a steel bolt, with a flange and piston at one end, which is housed in a barrel. On firing, the expansion of gases propels the piston forward and projects the bolt out of the barrel, without leaving the barrel. The bolt is then retracted back into the gun, either automatically or manually.

Non-penetrating Captive Bolt Guns (Controlled Blunt Force Trauma)

A blow to the head can be an effective stand-alone means of euthanasia for small animals with thin craniums. A single, sharp blow must be delivered to the central skull bones with sufficient force to produce immediate depression of the central nervous system and destruction of brain tissue, without breaking open the skull.

Non-penetrating captive bolt guns are classified as controlled blunt force trauma and can be used as a stand-alone means on lambs and kids under 15 kg (33 lb.). When used on animals larger than the ones listed above, their use must be accompanied by a secondary action such as exsanguination.

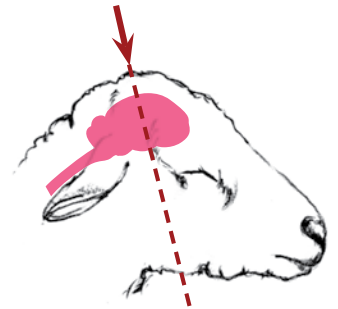
Lambs

When using a non-penetrating captive bolt gun you must restrain the animal's head. Place the gun on the top of the lamb's head.

Goats

When using a non-penetrating captive bolt gun you must restrain the animal's head. Place the gun on the back of the head behind the poll.

If you are unfamiliar with the use of a firearm - safety precautions, use or maintenance, it is advisable to enroll in a firearm's safety course.



Lambs - On the top of the head.



Goats - Behind the poll.

Gunshot

Guidelines

- To be performed only by trained, skilled and licensed handlers using a registered gun.
- The shooter must be trained in the safe use of firearms.
- The safety of the handlers, public and other animals is of the utmost importance.
- Accuracy of the shot is vital to the effectiveness of gunshot.
- The shooter must always ensure he has a clear background when shooting.
- If possible, have a backstop such as a manure pile that will stop the bullet if you miss or if it passes through the animal.
- The shooter should wear both protective ear and eye gear.
- If there are other people present, they must all be behind the shooter and out of the line of fire. Other animals must be away from the line of fire.
- Ricochet can occur off the skull, and with missed shots off the pavement or other solid objects.
- Wait until the animal stops moving its head before you fire the shot.
- Ideally, one shot will dispatch the animal. If in doubt, apply a second shot or perform a secondary action such as pithing or exsanguination.
- All firearms must be maintained and kept clean. Ammunition must be kept dry at all times; this includes protection from humidity.

Choice of Firearm and Ammunition:

Gunshot euthanizes by mass destruction of the brain. The degree of brain damage inflicted by the bullet is dependent on the characteristics of the firearm, the nature of the bullet and the accuracy of the shot. It is imperative that you use a sufficiently powerful firearm.

For euthanasia purposes, handguns are limited to close range shooting of less than five to 25 cm (two to 10 inches) and are restricted to law enforcement officers and those with special permits in Canada. Shotguns are appropriate for a distance one to two metres (one to two yards) and rifles for long distance shots. The correct selection of ammunition is vital to effectively euthanizing animals. It is recommended that a minimum of 300 ft. lb. of muzzle energy be available

for firearms used in the euthanasia of animals up to 180 kg (400 lb.), and at 1000 ft. lb. of muzzle energy for animals, greater than 180 kg (400 lb.).

Shotgun 28, 20, 16, 12 Gauge or .410

Shotguns are very effective for euthanasia of livestock. When utilized for euthanasia, they are best used at a distance of one to two metres (one to two yards). The 20, 16 and 12 gauge can be used on all weight and species classes. The 28 gauge and .410 should not be used on larger animals. Number 4, 5 or 6 birdshot is appropriate ammunition for close range, but slugs are best as they do not disperse as they leave the barrel. As birdshot leaves the barrel of the gun it begins to disperse or spread, lessening impact and destruction as the distance from the animal increases. In the cases of animals that are loose or where the handler is unable to get close to the animal a shotgun with solid slugs should be used.

Rifles

The most common rifles found on farms are .22 Calibre Long Rifles; however these do not meet the recommended minimum of 300 ft. lb. of muzzle energy. Therefore .22s are best used for young lighter weight animals from a distance of five to 25 cm (two to 10 inches). A long rifle, round nose, lead bullet should always be used with a .22. A .22 will not be powerful enough to penetrate the skulls of rams and are not reliable when shooting at a distance greater than 25 cm (10 inches).

For longer distances of up to 275 metres (300 yards) and animals under 180 kg (400 lb.) the recommended common rifle cartridges include:

Cartridge	Muzzle energy	Muzzle energy at 300 yards
.22 Calibre Long Rifle	100 ft. lb.	
.357 Magnum (rifle)	1175 ft. lb.	337 ft. lb.
.223 Remington*	1296 ft. lb.	574 ft. lb. *5.56mm NATO
30-30 Winchester	1902 ft. lb.	651 ft. lb.
.308	2648 ft. lb.	1193 ft. lb.
30-06 Springfield	2841 ft. lb.	1455 ft. lb.

National Animal Health Emergency Management System Guidelines, U.S. Department of Agriculture, January 2004

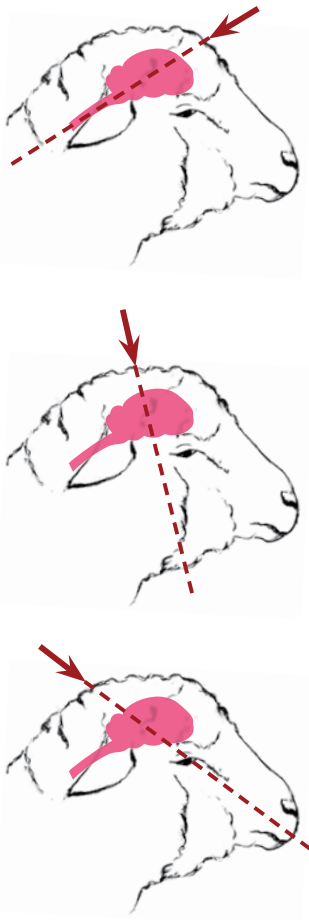
Larger calibre rifles such as .308 are not appropriate for close range shots.

Handguns

Handguns can be used for close range euthanasia five to 25 cm (two to 10 inches) with the appropriate round nose, lead bullet ammunition. Common handgun cartridges that exceed the recommended 300 ft. lb. of muzzle energy include:

Cartridge	Average Muzzle Energy
.40 S & W	408 ft. lb.
.45 Automatic	411 ft. lb.
.357 Magnum	557 ft. lb.
.41 Remington Magnum	607 ft. lb.
10 mm Automatic	649 ft. lb.
.44 Remington Magnum	729 ft. lb.

*National Animal Health Emergency
Management System Guidelines, U.S.
Department of Agriculture, January 2004*



Three acceptable points of entry on sheep

When higher muzzle energy is required it is recommended you use a rifle.

Application

Firearms must never be held flush to the animal's head or body. This may cause the gun to explode.

Ideally, the gun should be angled so the bullet follows the angle of the neck or the angle of the spine. With a free bullet or shotgun slug, the bullet will travel through the brain and ideally end up around the top of the spine or brain stem area. Ideally, the gun must be pointed so that the projectile travels into the mass of the body—you do not want the projectile to exit the skull of the animal.

Note: The AVMA Guidelines on Euthanasia 2007 do not recommend gunshot to the heart or neck as it does not immediately render the animal unconscious.

Sheep and Goats

Sheep and goats can be difficult to shoot. Their brains are located at the top of their heads and different breeds of sheep have different skull shapes. There are **three acceptable points** of entry on sheep:

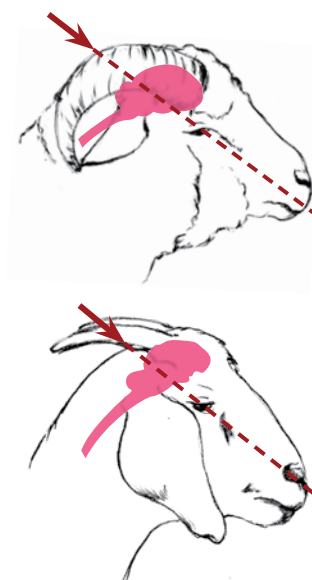
1. The front of the head
2. The top of the head
3. The back of the poll

When the front of the head is the point of entry, the shot must enter right **above** the eyes. Different skull shapes can make this shot chal-

lenging. You must be careful that the angle is correct so that the free bullet travels a path into the body mass.

When an animal has horn mass, the most effective shot is behind the poll. The projectile will not have to pass through the extra bone mass created by the horns that cover the area in front of the brain. It is best to make this shot with a shotgun, to eliminate the chance of free bullet pass through. The shot should be aimed towards the mouth.

The ideal shooting position for **sheep without horns** is a shot to the top of the head. The shot should be placed in the mid-line of the skull, pointing straight down at the throat. This shot will take the projectile through the brain. A shotgun is best to use for this shot to avoid pass through hazards.



Ideal shooting position for sheep and goats with horns

Electrocution

Electrocution is considered humane when adequate current passes through the brain to induce a grand mal seizure and fibrillation of the heart. Cardiac fibrillation leads to cardiac arrest and ultimately death.

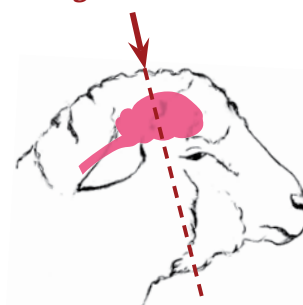
The animal is either euthanized by an initial passage of current through the brain, followed by the redirection of current through the heart of the unconscious animal to induce cardiac fibrillation, or through simultaneous induction of unconsciousness and cardiac ventricular fibrillation.

The amount of current delivered will depend upon the voltage and total impedance in the pathway, which is affected by the species, size of the electrodes, applied pressure, location placement, distance between electrodes and phase of respiration during application of shock.

There are a multitude of combinations of voltage, current, frequency and length of application that have been utilized successfully as a euthanasia technique. However, the selection of these factors should be based on scientific evidence and verified in commercial conditions. The absolute minimum of current applied to the heart required for killing are:

Minimum Currents Necessary for Killing	
Cattle	1.5 Amperes
Calves	1.0 Amperes
Sheep/Goats	1.0 Amperes
Lambs/Kids	0.6 Amperes
Pigs	1.3 Amperes

The frequency of current should be no greater than 100 Hz. HSA 2004



Ideal shooting position for sheep without horns

In order for electrocution to be considered humane, it must be performed with appropriate equipment, preferably a constant current system. For animal welfare and human safety reasons, only properly designed and tested devices should be used.

Care must be taken that the electrodes are applied correctly, **before** the electrical shock is applied. When the wand is electrified before placement on the animal it is called hot-wanding and is considered inhumane.

Sheep and Goats

The process may either be conducted by first applying the electrodes on the opposite sides of the head so that the current travels through the brain. The current is then redirected through the heart of the unconscious animal to induce the cardiac fibrillation.

The other option is to place the electrodes at the brain and behind the heart so that adequate current results in simultaneous induction of unconsciousness and cardiac ventricular fibrillation. For either method, the proper placement of the tongs, current (amperage) usage and application time are critical to ensuring a humane death. The presence of heavy wool and dry skin can lead to lower effectiveness of the electrocution procedure.

Manual Blunt Force Trauma

A blow to the head can be an effective means of euthanasia to small animals with thin craniums. For livestock, manual blunt force trauma is currently an acceptable means of euthanasia for infant lambs under nine kg (20 lb.) and infant kids seven kg (15 lb.). A single, sharp blow must be delivered to the central skull bones with sufficient force to produce immediate depression of the central nervous system and destruction of brain tissue, without breaking open the skull.

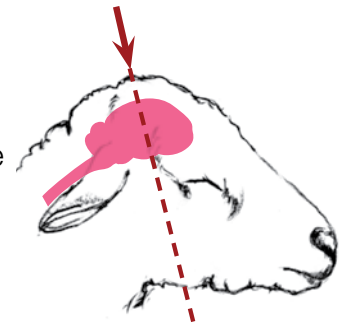
For manual blunt force trauma, the object must be brought to the animal's head and not the other way around with the animal's head striking the object. Striking the animal's head to the object significantly decreases the animal welfare standard. If animals are swung during the application of blunt force trauma, they will experience high stress and a much greater chance of injury such as dislocated joints, broken legs, etc. Common acceptable tools used for manual blunt force include ball peen hammers, rebar, wooden clubs and pipes.

Lambs

For blunt force trauma the blow must be of sufficient strength and placed properly on the top or back of the head to ensure death. It is essential that the blow be administered accurately and with absolute determination.

Kids

For blunt force trauma the blow must be of sufficient strength and placed properly on the top of the head to ensure instantaneous death.



Blunt force trauma to the top of the head

Secondary Actions

Pithing

Pithing is a procedure that is used to ensure the death of an animal by physically disrupting the brain and rostral part of the spinal cord. In the case of livestock, pithing is most commonly used following a gunshot or the use of the penetrating captive bolt gun. Though commonly used in the EU, pithing is a relatively new procedure in the North America.

A pithing rod can be made out of a variety of materials, or purchased. The rod itself must be somewhat rigid, yet still flexible. It must be long enough to reach through the brain to the spinal column. Following gunshot or application of the penetrating captive bolt gun, the pithing rod is inserted into the hole created by the bullet or the bolt and pushed through the brain to the spinal cord. The rod is then moved back and forth and around inside the head. In order for pithing to kill effectively, the original bullet or rod must have been accurately delivered into the brain.

Exsanguination

Exsanguination is the process of bleeding out an animal. This is achieved by the severing of the carotid artery or jugular vein. Exsanguination is not recognized as a stand-alone method of euthanasia and the animal must be stunned prior to bleeding. This procedure can be very disturbing due to the large volume of blood loss, as well as raise concerns with bio-security.

In sheep and goats the most common location for exsanguination is the neck. You must use a sharp knife that is at least 152 mm (six inches) in length. The knife is fully inserted into the upper one third of the neck behind the angle of the jaw and directed toward the spinal column through the trachea, until bone is contacted. Successful severing of the vessels can be recognized by free flowing, pulsing blood.

Great care must be practised while performing exsanguination on all animals as although they are unconscious, animals are still capable of making violent involuntary muscle contractions that can cause injury to the handler.

Determination of Death

The Process of Death

Understanding the process of death is important. Death is a process and does not occur immediately. Animals are first rendered insensible and then the body begins to die as the brain stops, the heart quits beating, the lungs stop breathing and the blood quits circulating. There is no such thing as immediate death. This process can take up to three minutes when euthanasia is delivered correctly. In the case of barbiturates it may take even longer.

When a person is not knowledgeable about what to expect, he or she may mistakenly interpret any movement as sensibility and a lack of movement as loss of consciousness. Reflex motor activity or muscle spasms may follow the loss of consciousness; this is a normal part of the death process and should not be perceived as the animal being in pain or distress. Certain species and modes of euthanasia will have greater involuntary muscle movement than others. The muscle spasms may take up to a minute to begin and in neo-natal lambs/kids can last for several minutes. The head and neck should be relaxed within 10 seconds, though the animal's limbs may make uncoordinated movements for several minutes.

There may also be bleeding depending on the mode of euthanasia (e.g. penetrating captive bolt gun, firearm). The animal may bleed profusely from the entry wound, the mouth or the eyes.

Means to Determine Death

Determining death is a vital step in the process of euthanasia. You must confirm that the procedure was reliable and induced a quick death. Confirmation of the onset of death (insensible or unconscious) should occur within the first 30 seconds following euthanasia application. The primary indicators for this stage include lack of corneal reflex, lack of rhythmic breathing and loss of deliberate movement.

Death must be then be confirmed at three minutes. Confirmation of death can be challenging outside of a veterinarian office or laboratory. The cessation of heartbeat and absence of respiration are the most reliable modes for determining death, but are extremely challenging to confirm in a field environment due to background noise. At least three of the following signs of death must be confirmed to verify an animal is dead. Never assume an animal is dead because it is not moving.

If there is any uncertainty over whether an animal is dead or not, the procedure should be repeated or a second method applied. This should occur within 30 seconds of the first attempt. Animals must be checked again after three minutes to ensure death.

The onset of rigor mortis and bloating will vary among the species. In sheep, it will normally set in within eight to 12 hours. Rigor mortis should not be used as a means to confirm death due to the extreme delay of onset.

Human safety must also be considered when confirming death. The handler must be aware of the involuntary movements that the animal may make in order to avoid being struck. It is best to approach the animal along the back/spine in order to avoid contact with the legs or head of the animal.

Absence of Rhythmic Breathing

Action

Visual observation of movement of a study movement of the chest. May also palpate for chest movement. Gasping and random breaths or exhaling would not be considered rhythmic.

Sign of Death

Chest movement will not be observed for more than three minutes.

Indication of Death

The animal is no longer breathing because its respiratory system has shut down.

Limitations/Special Considerations

Animals that are unconscious can have very sluggish and irregular breathing, making it difficult to determine existence of chest movement.

Along with the absence of rhythmic breathing, two of the following five other modes of confirmation must be met before an animal is confirmed technically dead. Animals must not be moved until death is confirmed. It is best to wait at least 20 minutes before moving the animal for disposal.

Cessation of Heartbeat

Action

Evaluated on-farm using a stethoscope. You may be able to palpate the heartbeat in some circumstances.

Sign of Death

Unable to detect the beating of the heart for more than three minutes.

Indication of Death

The animal's heart has stopped pumping, ceasing the flow of blood through the body and to the brain.

Limitations/Special Considerations

Very challenging in a field environment. For detection with a stethoscope, you must have a stethoscope and the heartbeat can be difficult to hear because of background noises. A pulse is not always palpable, so it cannot be solely relied upon for determining cessation of heartbeat.

Absence of Pulse

Action

Detected through palpation of an artery.

Sign of Death

No pulse present.

Indication of Death

The animal's heart is no longer beating.

Limitations/Special Considerations

Requires skill and practice. Very challenging in a field environment, best on larger species. A pulse is not always palpable, so it cannot be solely relied upon for determining cessation of heartbeat or confirming determining death.

Palpebral Reflex

Action

Run finger along the eyelashes.

Sign of Death

To be performed before corneal reflex to avoid pain of touching the eye of a sensible animal. There should be no eye movement or blinking when eyelashes are touched.

Indication of Death

The animal is brain dead.

Corneal Reflex**Action**

Touch the cornea (surface of the eye).

Sign of Death

There should be no eye movement or blinking when touched. Eye should remain open and the lid does not move.

Indication of Death

The animal is brain dead.

Dilation of Pupils**Action**

Visual observation of corneas.

Sign of Death

Pupils will be fully dilated.

Indication of Death

Blood is no longer being pumped through the body due to the cessation of heartbeat, stopping the supply of fluid to the eyes.

Loss of Colour in Mucous Membranes and Capillary Refill**Action**

Visually observe the mucous membranes in the mouth.

Sign of Death

Mucous membranes become pale and mottled. No return of colour or refill after pressure is applied. They will become dry and sticky.

Indication of Death

Blood is no longer being pumped through the body due to the cessation of heartbeat.

An animal is not dead if it:

- Lifts its head off the ground or attempts to right itself.
- Vocalizes after application.
- Has the presence of eye movement or blinking.
- Has a palpable pulse or fails at any of the above tests.
- Has an extended period of movement or 'flopping'—the initial involuntary movements should last no more than 20 to 30 seconds. There may continue to be the occasional involuntary spasm following this time period, but not to the degree as the initial onset.
- Pupils are constricted.
- Responds to painful stimuli (e.g. pinching the nose).

Disposal of Dead Livestock

Following euthanasia, it is the responsibility of the owner to dispose of the carcass in a timely and effective manner. In Alberta, the disposal of dead animals is regulated by the *Animal Health Act 2009 - Destruction and Disposal of Dead Animals Regulation*.

Note: The regulations governing the disposal of dead livestock will be changing, and producers should refer to the link on the next page for up to date regulations.

Currently, per this act, the owner must dispose of the deadstock within 48 hours, unless the outdoor ambient temperature is low enough to keep the dead animal completely frozen or the animal is in a freezer unit. It also can be stored for no more than one week in an enclosed structure with impervious walls and floors that have been constructed for the storage of dead animals.

There are several factors that the owner must consider when choosing the means of disposal. This includes the mode of euthanasia, bio-security, health condition of animal pre-death and provincial laws. For example, an animal that is confirmed or suspected to have died from an infectious or a reportable disease must be disposed of under the direction of an inspector appointed under the *Health of Animals Act (Canada)* or a veterinary inspector appointed under the *Livestock Diseases Act (Alberta)*.

Means of Carcass Disposal in Alberta

At the present, there are several acceptable methods for disposal of carcasses including:

- Natural Disposal
- Burial
- On-Farm Composting
- Incineration
- Rendering
- Landfill

Unacceptable Use of Dead Animals

No person shall feed a dead animal to other food-producing animals unless:

- The material from the dead animal has been properly rendered at a licensed rendering plant and the prohibition to feed prohibited material to ruminants under the *Health of Animals Regulation* (Canada) is complied with, or
- The feeding of the material is a recognized means of stimulating natural immunity for specific disease conditions and the prohibition to feed prohibited material to ruminants under the *Health of Animals Regulation* (Canada) is complied with.

Provincial and Federal Laws

For further information and current laws please refer to the complete *Livestock Diseases Act, Destruction and Disposal of Dead Animals Regulation*

http://www.qp.alberta.ca/574.cfm?page=2000_229.cfm&leg_type=Regs&isbncln=9780779726066 or contact the Ag-Info Centre at 310- FARM (3276).

Suggested Other Resources

1. Pugh D.G. *Sheep & Goat Medicine*. W.B. Saunders Co. 2001.
A very good veterinary textbook with lots of information on diseases and flock health
2. Smith Mary C and Sherman David M. *Goat Medicine*. Wiley, John & Sons, Incorporated. 1994.
Another very good veterinary text book
3. Henderson David C. *The Veterinary Book for Sheep Farmers*. Farming Press. 2002.
An excellent resource on all aspects of sheep farming. It is written for a British readership, but there is a lot of good information
4. Eales F A and Small J. *Practical Lambing*. Longman Group. 1985.
An excellent small book on all health aspects of lambing
5. Smart Meg. *Goat Production Guide*. Aspen Hills Enterprise. 1997
A very good reference, written for western Canada on all aspects of goat production. The nutrition section is very good.
6. Smart Meg. *A Practical Guide to Profitable Sheep Production*. Aspen Hills Enterprise. 1996
A very good source of information for western Canadian shepherds. Again, the nutrition section is excellent.

