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.

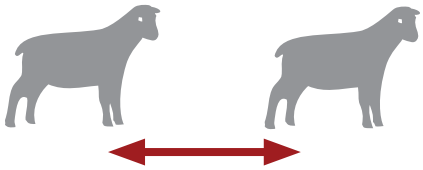
Causes of Disease

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.

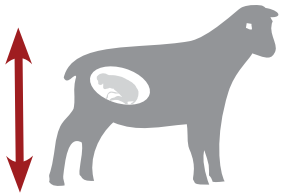
Disease can be split into two distinct types: **Infectious** and **Non-infectious**.

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.



Horizontal transmission occurs between two independent individuals



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

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.

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*).

Antibiotics have no effect against viral diseases.

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.

*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.*

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.

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.

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

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.

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.

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 frostbite 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 or 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.

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

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

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)

Veterinary pharmaceutical drugs can be further classified as:

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

Over the Counter Medications (OTC)

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.

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 Trivetrin in sheep or a short-acting oxytetracycline 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

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: 3

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.

DOSAGE: Shake well before using. 4

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.

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: 5

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.

WARNING: 6

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.

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 prier 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: Vétoquinol N.-A. Inc., 2000, ch. Georges, Lavaltrie, QC, CANADA J5T 385

	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

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.

A typical drug label

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-nitrofuran 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.

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.

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

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.

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.