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Sheep Health Handbook

by Thomas R. Thedford

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Sheep Health Handbook

A Field Guide for Producers
with Limited Veterinary Services

by

Thomas R. Thedford, DVM

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About the Author

Dr. Thomas R. Thedford is Extension Veterinarian and Professor of Veterinary Medicine and Surgery at the College of Veterinary Medicine, Oklahoma State University. During his 24-year career in research, teaching, and extension, Dr. Thedford has published a wealth of scientific and applied information on veterinary medicine and animal diseases and health. Long- and short-term professional assignments in Africa and the Caribbean have contributed to his knowledge and experience in diagnosis and treatment of tropical animal diseases. In 1982, Dr. Thedford accepted a one-year leave from Oklahoma State University to assume leadership in the preparation of various training materials and aids at Winrock International, including:

Manuals

Goat Health Handbook: A Field Guide for Producers with Limited Veterinary Services

Slide Presentations

Parasites of Small Ruminants
Bluetongue in Sheep
Epididymitis in Rams
Sore Mouth in Goats and Sheep
Abscesses in Goats and Sheep

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Preface

The world's sheep population reached an estimated 1,132 million in 1982. Approximately 634 million head, 56% of the total population, are found in developing countries primarily in small, crop/livestock farms and in livestock herds kept by pastoralists. Sheep products contribute substantially to the well-being of millions of families living in developing countries as annual production of sheep meat, milk, wool and skins in these countries amounts to 2.7, 4.3, 0.54 and 0.55 million metric tons, respectively. Production of these commodities varies in importance from one developing region to another, so does the contribution of sheep to the total regional supply of meat and milk. In North Africa and the Middle East, for example, sheep provide nearly one-third of the total meat supply. Other developing regions where sheep contribute substantially to the meat supply include the Indian subcontinent and Central and Southern Africa.

Although sheep are an important economic resource in many developing countries, major gaps in definition of policy issues regarding sheep production improvement/development programs still exist at local, regional and international levels. Also, evidence of neglect in applied research and dissemination of information is reflected in gaps in knowledge and adapted technologies necessary to improve productivity of sheep at the small farmer/producer level. Production constraints related to sheep nutrition, health, breeding, management and product marketing have been identified, but have yet to be addressed and coordinated action taken to remove them. Disease is a major factor responsible for low productivity of sheep in the humid and sub-humid tropics. High mortality, poor growth, loss of weight, reproductive failure and other conditions caused by disease can change an otherwise profitable sheep production activity into a marginal or unprofitable situation for the producer.

Winrock International, in its efforts to improve productivity of small ruminant (sheep and goats) production systems in developing countries, has committed substantial institutional resources to the dissemination of information and to the provision of technical and training services in this specialized area of livestock production. This handbook is one of a series of informational and training materials prepared in the area of sheep diseases and health. The handbook is intended for use in countries or localities where there is limited or no access to veterinarians. It is specifically designed to assist agricultural development workers and extension personnel in the execution of sheep production improvement programs and producer training activities.

Andres Martinez, Ph.D.
Winrock International

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Lastly, none of this could have been possible without the assistance, understanding, patience, and love of my family. My greatest thanks and love go to my wife, Nancy, and my daughters, Becky and Miriam.

My final comment goes to you, the reader and user. I hope this handbook will assist you in developing a more productive world animal agriculture with healthier animals. This is my goal.

Thomas R. Thedford, DVM.

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Using This Handbook

You are urged to seek the assistance of a veterinarian and the use of a diagnostic laboratory whenever possible. This guide has been designed to assist with sheep health care problems in areas that have limited veterinary services. The basic aim is simple: you should be able to recognize a sick sheep in the early stages of the disease process. If a sick sheep does not die within the first 3 to 5 days, it will usually recover without treatment. While it is sick, however, it does not gain weight or produce milk, and the disease can spread to many other animals. Thus, even if death losses are low, the producer's economic losses may be high. These losses can be decreased considerably through early diagnosis and treatment. A rapid recovery reduces the chance of the disease spreading to other animals, as do isolation, vaccination, and other preventive measures. It is hoped that you will use this guide as part of a systematic diagnosis and health care process, rather than for reference only.

Remember that diagnosis and treatment are extremely complex tasks. Diseases vary greatly in severity, both from disease to disease and within various forms of the same disease. An observed condition may have more than one cause. This makes it difficult to determine a diagnosis solely from the symptoms. The information in this guide will not allow you to make a specific diagnosis in most cases. However, it can help you to identify symptoms and narrow the range of diseases for treatment.

The handbook is divided into five major sections:

1. The **Diagnostic Guides** will help you to easily identify a small number of diseases that are the most probable causes of the symptoms that you have observed.
2. The detailed **Disease Descriptions** will allow you to reduce the number of potential diseases even further, provide appropriate treatment, and take preventive measures to avoid further spread of the disease.

3. The section on **Therapy** describes many of the antibiotics and other drugs that are used in the treatment of sheep diseases. It provides information on dosage and administration. In addition, this section includes some formulas that are useful in treating sick sheep.
4. **Techniques** of treatment are described and illustrated. This section covers such techniques as the sterilization of instruments and oral administration of medicine, and techniques of normal health care such as castration and foot trimming.
5. The section on **Birth and the Newborn** describes the procedures for both normal and difficult deliveries, with illustrations. It also covers pre- and post-delivery care.

In addition to the main text, the Appendices include a map showing regions of the world where no incidents of specific diseases have been reported. This will assist you in determining a reasonable diagnosis. Also, the Appendices contain a list of other sources of information on diseases of sheep, a glossary and an index.

Normal Sheep Physiological Data

Temperature: $39.5C \pm .5C$ (103F)
 Heart rate: 70 to 80 per minute, faster for lambs.
 Respiration rate: 15 to 19 per minute, faster for lambs.
 Rumen movements: 1 to 1.5 per minute.
 Onset of heat (estrus): 7 to 12 months, depending on nutritional condition.
 Length of heat (estrus): 30 to 36 hours
 Heat cycle (estrous cycle): 14 to 19 days--average 16.5 days.
 Most wool breeds show estrus only in fall.
 Tropical breeds will breed all year.
 Length of gestation: 144 to 151 days--average 146 days.

Temperature Conversions

	F	C
Subnormal	$\frac{100.4}{101.3}$	$\frac{38.0}{38.5}$

	<u>F</u>	<u>C</u>
Normal*	102.2	39.0
	103.1	39.5
	104.0	40.0
Slight Fever	104.9	40.5
	105.8	41.0
High Fever	106.7	41.5
	107.6	42.0
	or higher	

$$F = (C \times 9/5) + 32$$

$$C = (F - 32) \times 5/9$$

- * The body temperature is related to stress, exercise, and the environmental temperature. If sheep are excited, severely exercised, or the day is very hot or humid, let the animal calm down and retake the temperature.

Examining the Sheep for Disease Symptoms

You should observe all animals at least daily. Look for sheep that show such symptoms as lagging behind the flock, poor appetite, diarrhea, limping, breathing hard or fast, grunting, grinding of teeth, or other unusual behavior. If you spot any of these signs, you will want to make a more detailed examination.

Examination Checklist. (Take written notes)

1. Look at the undisturbed animal from a distance. Note the general condition and age of the sheep. Can it stand? Does it walk normally? Can it see? Is it bumping into objects? Does it exhibit signs of pain? Is it bloated? Are there swollen areas? Count respirations per minute (one count equals a complete in-and-out movement of air).
2. Approach the sheep. It should be held by an assistant by the neck and body and rolled into a sitting position. Do not chase the sheep or

- handle it roughly as this will cause false temperature, pulse, and respiration readings.
3. To take the sheep's temperature, shake the thermometer down, insert it into the sheep's rectum, and leave it for 3 minutes. Compare the sick sheep's temperature to normal sheep physiological data (above).
 4. Place your fist, palm, or fingertips on the left flank and feel for rumen movements. Also note if the sheep reacts as if in pain. If the rumen feels slushy or water-filled, this should be noted.
 5. Place fingertips on both sides of lower rib cage and feel for the heart rate. Count heartbeats for 1 minute. The pulse may also be taken by feeling the big artery on the inside of the rear leg and above the hock.
 6. Roll back the eyelids and lips of the mouth to observe color of mucous membranes. Pink is normal, except when dark skin colors extend into the mouth. The color of the inside of the lips of the vulva also may serve as an indicator of paleness.
 7. Feel over the sheep's body to locate swellings and/or signs of pain.
 8. Check for blindness. Move a hand toward the eye, but do not fan the air because a blind sheep will blink if it feels air movement. If the hand is moved straight toward the eye, blinking will occur only when the sheep can see.
 9. Note any unusual sounds. Wheezing or coughing could indicate a respiratory problem. Grinding teeth or grunting indicate general body pain, either in the chest or abdomen.
 10. Check all body openings to see if the sheep has diarrhea, excessive salivation, a runny nose (note whether the discharge is clear or cloudy), and crusty or runny eyes.
 11. When examining a lactating ewe, always check the udder. Look for clots or bloody milk. Feel for hard knots, heat, or signs of a painful udder.
 12. To detect abnormal sounds of the abdomen and chest areas of a sheep, a stethoscope should

be used. If one is unavailable, place your ear against the sheep's chest or abdomen and listen.

Having made notes of the abnormal signs that you have observed, you can turn to the Diagnostic Guides that follow this section. Check your notes against these Guides. The symptoms that you have noted will probably fit closely with some of the general symptoms described by the Guides. You should now have reduced the number of possible diseases. To narrow the number even further, read the detailed description of each disease that you have identified as a possible cause.

Diagnostic Guides to Diseases and Symptoms

An Example for Using the Guides

The sheep is a 2-year-old ewe. The body temperature is 41C (106F). The ewe is limping on the right foreleg, lagging behind the flock, and not eating well. She is drinking water. No joints are obviously swollen. The heart rate is 80 per minute and the respiration rate is 18 times per minute. The lame foot is found to be badly overgrown on the sidewall and very smelly. Therefore, the major symptoms include a lame right foreleg, poor appetite but drinking water, fever, but respiration and heart beat are in high normal range, and sidewall of hoof is overgrown and smelly.

Now turn to the Diagnostic Guides. Guide 6 deals with lameness and poor appetite. Reading down the Guide, we can pick out specific diseases that seem to fit the observed symptoms. For this example, we can use: brucellosis, foot and mouth disease, and foot rot.

In the Diseases section, we find more specific descriptions of the symptoms and diseases. We can begin to eliminate some of the possible causes.

Brucellosis: Sheep with this disease have an abortion as the primary symptom and usually have good appetite. Can be eliminated.

Foot and Mouth Disease: If small blisters or erosions are not detected on the dental pad or between the toes, then this too could be eliminated as possible cause.

Foot Rot: Fits most symptoms. Rotten smelling sidewall of hoof indicates that this disease is the most likely cause of the illness.

The next step is to turn to the table on drugs (Therapy) to select one for the treatment of foot rot.

Final Note: Always seek professional veterinary help if available; symptoms of many diseases are very much alike and require laboratory tests, postmortem examinations, and more training than we can provide in this handbook. Also read the complete description of the disease. It could be important to human health.

Diagnostic Guide 1: Nervous System

Disease	Causative agent	Page	Symptoms				
			Convulsions	Blindness	Head pressing	Circling	Other signs
Enterotoxemia	B	31	Yes	Usually not	Sometimes	Sometimes	Usually affects animals less than 1 year old. Very depressed. Head pulled back. Grinds teeth. Usually fatal.
Heartwater	P	72	Yes, after 1 or 2 days	No	Yes	Yes	Fever. Twitching eyelids. Tongue out. Very depressed. Affects all ages. Few die if treated.
Listeriosis	B	35	Yes	Yes	Yes	Yes	Fever. Drooping ear. Tongue out. May abort if nervous symptoms develop. Usually fatal.
Melioidosis	B	39	No	No	No	No	Jerking, trembling movements. All ages affected. Few die.
Polyarthritis	B	41	Yes	No	Sometimes	Sometimes	Fever. Enlarged navel stump (if very young). May be depressed with a poor appetite. 50% to 60% die.

R = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 1: Nervous System (continued)

Disease	Causative agent	Page	Symptoms				Other signs
			Convulsions	Blindness	Head pressing	Circling	
Polioencephalomalacia	M	68	Yes	Yes	Yes	Yes	No fever. Young animals show muscle tremors, grind teeth, roll eyes, no appetite. Respond well if treated.
Rabies	V	54	Yes	No	Maybe	Maybe	Fever. May be very excited or very depressed. Strange bleat. Chews on objects. May be very aggressive or dumb acting. All ages are affected. Always fatal.
Scrapie	V	56	No	No	No	No	Excited in early stages. Severe itching. Eats well. Incubation period will run from 1.5 to 5 years.
Tetanus	B	45	Yes	No	Maybe	Usually not	Sawhorse appearance. Excited and stiff when touched. Fever. No appetite. Usually associated with a wound about 2 weeks old.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 2: Diarrhea and Loss of Appetite, Young Animals (Under 4 Months)

Disease	Causative agent	Page	Symptoms			
			Dehydration	Pulse rate	Respiratory rate	Other signs
Coccidiosis	P	75	None	Normal	Normal	Diarrhea may be bloody. Sudden death may occur with or without diarrhea.
Colibacillosis	B	29	Severe	Normal	Normal	Dry mouth. Stomach full of gas. Usually fever. High death loss unless treated.
Colostrum deprivation (Hypogammaglobinemia)	M	64	Some	Normal	Normal	Dry mouth. Fever. May have swollen joints, enlarged navel stump, weakness. Most die.
Enterotoxemia	B	31	None	Normal	Normal	Full stomach and fever, usually.
Internal parasites	P	75-82	None	Increase	Increase	May have swelling under chin, paleness, severe weakness. Sudden death may occur before diarrhea develops.
Salmonellosis	B	43	Some	Normal	Slight increase	Diarrhea may be bloody or have mucous casts on it.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 3: Diarrhea and Loss of Appetite, Older Animals (Over 4 Months)

Disease	Causative agent	Page	Symptoms			
			Dehydration	Pulse rate	Respiratory rate	Other signs
Acidosis	M	60	Severe	Weak	Increased	Full stomach, watery contents. Diarrhea (watery, bad smell). Very weak. May not be able to stand. No rumen movement.
Bloat	M	62	None	May increase	Labored	Full stomach with gas or froth. Diarrhea develops after 24 hours.
Coccidiosis	P	75	None	Normal	Normal	Acute diarrhea usually with signs of blood. Severe straining.
Enterotoxemia	B	31	None	Normal	Normal	Full stomach and fever, usually. Sudden death common.
Internal parasites	P	75-82	None	Increased	Increased	May have swelling under chin, paleness, severe weakness. Sudden death may occur before diarrhea develops.
Nairobi sheep disease	V	52	None	Normal	Increased	Fever. Runny nose. Bright green diarrhea with some blood. Abortion.
Peste des petits ruminants (PPR)	V	52	None	Increased	Increased	Fever. Raw, red areas around mouth.
Rift Valley fever	V	55	None	Rapid, weak	Increased	Fever. Sores on cheeks and tongue. Abortion. High death loss in young lambs.
Salmonellosis	B	43	Yes	Rapid	Increased	High fever. Bloody diarrhea or yellow or green diarrhea.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 4: Blood Loss and Paleness of Mucous Membranes

Disease	Causative agent	Page	Symptoms			
			Red urine	Yellow membranes	Pulse	Other signs
Anaplasmosis	P	71	No	Yes	Rapid and weak	Slight fever. Poor appetite. Constipation.
Anthrax	B	24	Yes	No	Rapid and weak	Milk may be bloody. Bleeding from body openings. Death in 24 to 48 hours.
Babesiosis	P	72	Yes	No	Rapid and weak	Slight fever. Poor appetite. Bloody diarrhea, dark red urine.
Coccidiosis	P	75	No	No	Usually not affected	Acute, bloody diarrhea. Weak. Severe straining.
Internal parasites	P	75-82	No	No	May be rapid and weak	Good appetite (usually) until symptoms are very severe. Diarrhea (usually).
Trypanosomiasis	P	73	No	No	May be rapid and weak	Depressed appetite. Chronic weight loss, poor condition.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 5: Hard Breathing, Fever, and Poor Appetite

Disease	Causative agent	Page	Symptoms			
			Pulse rate	Nasal discharge	Cough	Other signs
Anthrax	B	24	Fast, weak	Bloody	No	Bleeding from body openings. Death within 24 to 48 hours.
Bluetongue	V	48	Increased	Nostril plugged	Sometimes	Lame. Erosions in mouth and on tongue. Red band at hoof line. Abortion, dummy, or deformed lambs.
Internal parasites (primarily lungworms)	P	75-82	Normal	Slight	Severe	Usually no fever in uncomplicated cases. Poor condition.
Melioidosis	B	39	Fast	Thick, crusty pus	No	Skin abscesses.
Peste des petits ruminants (PPR)	V	52	Fast	Dry-clear	Sometimes	Raw areas in mouth. Develops pneumonia.
Pneumonia (all types)	B, V, P	40	Fast	Runny, clear to pus	Yes	Tongue out. Rapid exaggerated movements of ribs, raspy sounds from lungs. Grunting, groaning, and grinding teeth from pain.
Sheep/goat pox	V	57	Normal	Runny, clear to pus	Usually not	Scabs over body that leave scar (pit). Develops pneumonia.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 6: Lameness and Poor Appetite

Disease	Causative agent	Page	Symptoms			
			Joints swollen	Age	Recovery	Other signs
Bluetongue	V	48	No	6 months or older	Most	High fever. Erosion in mouth and on tongue. Nasal discharge. Red band at hoof. Abortions, dummy, or deformed lambs.
Brucellosis	B	25	Sometimes	Adult, any age	Sometimes	Appetite good. May see repeat breeding in ewes and swollen testicles in males. Abortion.
Colostrum deprivation (Hypogammaglobinemia)	M	64	Yes	Up to 2 months	Not common, 80% die	Diarrhea. Large navel stump. Fever.
Contagious agalactia	B	30	Yes	Adult and lamb	With treatment	Severe mastitis in adults. Eye infection, fever, and sore joints in lambs.
Foot and mouth disease	V	51	Usually not	Any age	Very slowly	Small blisters and erosions between toes, teats, and mouth. Raw areas. Fever. Degree of sickness varies with type of virus.
Foot rot	B	33	Usually not	Any age	With treatment	Foot swollen. Sole and sidewall appear rotten. Bad odor.
Mastitis	B	37	No	Adult female	With treatment	Swollen, hot, painful udder. Fever.
Melioidosis	B	39	Yes	Any age	Usually	Skin abscesses.
Polyarthrititis	B	41	Sometimes	Young	Yes, in 2-4 weeks	May see eye problems. Pregnant ewes may abort.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 7: Inability to Stand

Disease	Causative agent	Page	Age of animal and time of occurrence	Symptoms	
				Attitude	Other signs
Colostrum deprivation (Hypogammaglobinemia)	M	64	First 3 weeks after birth	Convulsion or flat on side, may jump when touched	Fever. May press head or circle. Enlarged joints. Large navel stump.
Grass tetany	M	65	6 months and older (grazing new growth, lush grass)	May be aggressive	Trembling, some bleating. May appear after fertilization of pasture with potash in cool, wet weather. No fever.
Milk fever	M	65	Adult (1 week before and after lambing)	Very passive, head on side, no control over muscles	Subnormal temperatures. May appear as general muscular weakness and trembling before going down.
Pregnancy toxemia (Ketosis)	M	68	Adult (3 weeks before lambing)	Legs may be stretched behind them	May lose muscle control. Poor appetite. Most die unless they lamb. No fever.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 8: Scabs or Scales on Skin

Disease	Causative agent	Page	Description and location of lesion	Symptoms
				Other signs
Contagious ecthyma	V	50	Thickened areas on gums, around mouth, or on teats	Depression, fever, poor appetite. Usually affects lambs. Lambs may show symptoms on rear leg. Affected ewes commonly develop mastitis.
External parasites	P	83-86	Various symptoms due to specific type of parasite involved. See text on all types to help determine which is involved.	
Ringworm	P	84	Rough circular areas all over the body	Sometimes occurs on udder. No fever. Normal appetite. Diffuse lesions may occur over the body.
Sheep/goat pox	V	57	Scabs over body that leave a scar (pit)	Scabs are more visible in areas having short (or no) hair. No appetite, depression. Very sick.
Streptotricosis (Dermatophilosis)	B	44	Thick crusty scabs matted in the hair over body	Yellow pus under scab--leaves raw, granular pit that may bleed.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 9: Abscesses or Infected Spots on the Skin and Body

Disease	Causative agent	Page	Description and location of lesion	Symptoms
				Other signs
Caseous lymphadenitis	B	27	Large knots and abscesses located on body at lymph nodes, (see figure 13)	Fever (sometimes), usually in adults. May show chronic debilitating form (wasting).
Malignant edema	B	36	Spots of severe infection at a wound. Swollen and sore. Red streaks outward from spot.	Fever. No appetite. Very ill. Fatal if not treated.
Mastitis	B	37	Hot, hard, painful udder; may be black with dead tissue. Consistency of milk changed.	Fever. May show lameness. May have poor appetite.
Melioidosis	B	39	Abscesses on body and swollen joints	May appear as pneumonia. Fever. Coughing. Staggering. Poor appetite.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 10: Itching and Hair Loss

Disease	Causative agent	Page	Age	Symptoms	
				Death	Other signs
Allergies/insect stings	M	61	All ages	If animal dies, it is usually within first 15 minutes.	Bumps over whole body. Shock. Weakness. Trembling. Thickened skin. May not show hair loss.
Scrapie	V	56	Affects 2 to 6 year old sheep	100% death loss	Normal appetite. No fever. Very poor condition. Slow death (6 months).
Ticks, flies, and other pests	P	85	All ages	Screwworms and severe infestations can cause death.	Bloody areas. Anemia. Infections where bitten.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide II: Spontaneous Abortion

Disease	Causative agent	Page	When abortion occurs	Death in ewe	Symptoms	
					Other areas of body involved	Other signs
Bluetongue	V	48	Early. First 50-100 days	Not common	Erosions on tongue and mouth. Lameness with red ring at top of hoof.	Deformed or dummy lambs at term.
Border disease	V	49	Final 50 days of gestation	No	None	Lambs born with excessive straight hair. Shaking. Swollen joints.
Brucellosis	B	25	Final 50 days of gestation	Rare	Joints sometimes swollen	Slightly reduced appetite.
Chlamydial abortion (EAE)	B	28	Final 50 days of gestation	Rare	None	May not keep up with flock. Slightly reduced appetite. High percentage of flock will abort.
Foot and mouth disease	V	51	Early in disease	Very low percentage	Mouth, feet, teats	Fever. Increased pulse rate. No appetite.
Listeriosis	B	35	At any time (may be only symptom)	Rare (when abortion occurs)	Ears drooped, tongue out, head press	No appetite. Circling. Death common when central nervous system involved.
Nairobi sheep disease	V	52	During sickness	Rare	None	Fever. No appetite.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide II: Spontaneous Abortion (cont.)

Disease	Causative agent	Page	When abortion occurs	Death in ewe	Symptoms	
					Other areas of body involved	Other signs
Rift Valley fever	V	55	During sickness	About 20%	Sores on tongue and cheeks	Fever. No appetite. Rapid and weak pulse. Mortality--90-100% in lambs under 1 week old, 20% over 1 week old.
Salmonellosis	B	43	Final 50 days of gestation	About 30%	Diarrhea, intestinal lesions	Fever. No appetite.
61 Toxoplasmosis	P	81	Final 50 days of gestation	Rare	None	None.
Trypanosomiasis	P	73	After symptoms develop	Common	Weight loss. Fast pulse. Swelling of lower part of body.	Blindness and nervous symptoms sometimes develop.
Vibriosis <i>Campylobacter fetus</i>	B	46	Final 50 days of gestation	Rare	None	Recovered ewes are immune.
Wesselbron disease	V	58	1-2 weeks after infection	15-20%	Fever. Swollen yellow liver.	Lambs turn yellow and have fever and swollen lymph nodes.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 12: Failure to Lamb or Malformed Lambs

Disease	Causative agent	Page	Symptoms			
			Abortion occurs	Lamb appearance	Other areas of body involved	Other signs
Bluetongue	V	48	Early. First 50-100 days	Normal	Previous illness in ewe showing lameness and erosions in the mouth and on the tongue.	Most recover.
Border disease	V	49	Common. Final 50 days of gestation	Hair instead of wool	If alive, lamb has large joints and shakes uncontrollably.	Lambs are unthrifty but become normal if they live.
Ram epididymitis <i>Brucella ovis</i>	B	42	Occasionally	Normal	Testicles and epididymis of ram swollen.	Extended lambing time. Poor semen quality in rams.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 13: Chronic Wasting Diseases

Disease	Causative agent	Page	Symptoms				
			Appetite	Diarrhea	Fever	Other areas of body involved	Other signs
Caseous lymphadenitis	B	27	Good	No	No	May see abscessed lymph nodes.	Older sheep involved. Usually only 1 or 2 in flock.
Chronic internal parasites	P	75-82	Depressed	Usually	No	Paleness of gums and other tissues.	May see blood or dark color to feces.
Foot and mouth disease	V	51	Very depressed	Maybe	Yes	Many. See text.	Animals will recover slowly.
Johne's disease	B	34	Good	Intermittent	No	None	Only a few older sheep involved.
Melioidosis	B	39	Poor	No	Slight	Abscesses on and under the skin and at lymph nodes. Sometimes swollen joints or testicles.	Coughing and runny nose.
Progressive pneumonia	V	53	Good	No	No	Muscular weakness. Flared nostrils and rapid breathing.	Affects sheep at least 2 years old. Slow to move. Cannot follow flock. Eventually dies.
Scrapie	V	56	Good	No	No	Wobbly gait early. Unable to stand late in disease.	Intense itching. Wool or hair breakage. Always fatal.
Trypanosomiasis	P	73	Poor	No	Yes	Anemia. Nervous symptoms.	Abortion in pregnant females.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 14: Conditions of the Eye

Disease	Causative agent	Page	Symptoms				
			Cornea blue	Fever	Light sensitive	Other areas of body involved	Other signs
Contagious agalactia	B	30	Yes	Yes	Yes	Lameness	Mastitis. Rapid recovery. Watery eyes.
22 Follicular conjunctivitis	B	32	Usually	Yes	Yes	May see lameness and swollen joints.	Ewes may abort or have weak lambs. Recovery in 2 weeks. Watery eyes.
Peste des petits ruminants	V	52	No	Yes	Yes	Raw areas in mouth	Very depressed. Diarrhea and collapse. High percentage die.
Sheep/goat pox	V	57	No	Yes	Slight	Lumps or nodules over body	Death rate high. Arched back. Poor appetite. Watery eyes.

B = bacterial; V = viral; M = metabolic; P = parasitic.

Diagnostic Guide 15: Carcass of Diseased Animal (No More Than 6 to 8 Hours After Death)

Disease	Causative agent	Page	Bloat	Symptoms					
				Stiffness of limbs	Gas under skin	Blood from body openings	Membranes pale	Membranes yellow	Sudden death
Anaplasmosis	P	71	Usually not	Yes	No	No	Yes	Maybe	No
Anthrax	B	24	Yes	No	Maybe	Yes	No	No	Yes
Bloat	M	62	Yes	Yes	Yes	Maybe	No	No	Yes
Enterotoxemia	B	31	Yes	Yes	No	No	No	No	Yes
Internal parasites	P	75-82	Usually not	Yes	No	No	Yes	Maybe	No
Malignant edema	B	36	Usually	Yes	Yes	Maybe	No	No	Maybe
Polioencephalomalacia	M	68	Maybe	Yes	No	No	No	No	Maybe

B = bacterial; V = viral; M = metabolic; P = parasitic.

Bacterial Diseases

Causes, Treatment and Prevention

Any disease caused by the invasion of the body by bacteria is a bacterial disease. Bacteria may enter alone or following insult to tissue either by viral infection, trauma, or stress. Most will respond to proper antibiotic therapy.

Anthrax

(Splenic Fever, Charbon, Milzbrand)

Symptoms

Anthrax is marked by high fever, 41.5C (107F), severe depression, dark red to purple lining of the mouth and eyes, and sometimes bloody diarrhea. Breathing is rapid and shallow; heartbeat is rapid and weak. The sheep has no appetite and its milk or urine is red or blood-tinged. The tongue, throat, flanks, and area around the anus and vulva show swelling (edema).

In the dead animal, it is common to observe blood seeping from the body openings and a lack of stiffness in the carcass. If you suspect death by anthrax, **do not open the carcass.** Rather, you should remove one of the animal's ears, place it in a plastic bag (cooled if possible), and take it quickly to a veterinarian or a diagnostic facility for a diagnosis. Microscopic examination of blood from the ear can confirm the diagnosis. If the carcass is opened, the blood does not clot and usually the spleen is greatly enlarged.

Cause/Transmission

The bacterium *Bacillus anthracis* changes from an actively growing vegetative form in the body to spores or inactive forms when the organism comes in contact with air. When spores are swallowed by the animal, the organism changes back to the vegetative form and starts to grow.

The spores are spread animal-to-animal and by animals eating feeds contaminated by spores, i.e., by grazing on contaminated ground, drinking contaminated water, or eating unsterilized animal by-products such as bone meal or poorly cooked meat scraps. The disease in sheep is usually peracute

(kills the animal in 2 to 6 hours) or the acute form, which kills the animal in up to 48 hours.

Treatment and Prevention

After symptoms fully develop, treatment is usually not effective. If an outbreak is underway, all other animals in the area should be treated and vaccinated. Vaccination with spore vaccine is usually under the direction of agriculture department personnel. Treatment is with tetracyclines or penicillin in large doses for at least 5 days (see Therapy).

Spread is prevented by burning or deeply burying the unopened carcass. Only very strong disinfectants will kill spores. They are not killed by hot or cold weather or by drying and can live in the soil for many years. However, if the carcass of an animal killed by anthrax is buried unopened, rotting and lack of oxygen will prevent spore formation and kill the organism. Totally burning the carcass will also destroy the organism. Vaccination is recommended for animals in areas where anthrax reoccurs regularly.

Human Health Concerns

Anthrax is a very serious disease of both animals and man. A skin form known as malignant carbuncle or malignant pustule can be very serious. You may contract the disease when handling infected animals or fluids or parts of dead animals. An intestinal form contracted by eating infected meat is nearly always fatal to humans, as is a pneumonic form contracted by breathing spores from handling wool and hides of infected dead animals.

Brucellosis

(Bang's Disease, Malta Fever, Contagious Abortion)

Symptoms

The primary sign of brucellosis infection in sheep is abortion in the final 40-50 days of gestation. Close association with goats tends to extend this disease to the sheep population. A blood test is the best method of diagnosing brucellosis in sheep, and is usually done by a veterinarian or in

a diagnostic laboratory. Often brucellosis is traced to sheep or goats when symptoms are found in humans.

Cause/Transmission

Although there are other species of *Brucella*, *Brucella melitensis* is normally the most severe one that affects sheep. The disease spreads when sheep eat contaminated feed or lick infected material from the reproductive tract, newborn lambs, or around the external reproductive organs of the infected ewe. The organism also is transmitted to humans who handle these infected materials, drink infected raw milk, eat infected uncooked milk products, or assist with the birth process of infected ewes.

Treatment and Prevention

No treatments are effective. Usual recommendations are that infected ewes and their lambs be slaughtered for meat. The best prevention is buying uninfected animals. In some countries where infection is common, a vaccine is used to control spread of the disease.

Human Health Concerns

Brucellosis is a high risk disease. You should not drink uncooked or unprocessed milk or milk products. See the section on Mastitis for milk processing procedures. Do not handle or assist in the birth process of infected female animals without protecting your hands and arms with rubber or plastic gloves. Wash with soap and water after assisting. Slaughtering or eating meat from infected animals is not dangerous if minimum sanitary measures are followed and the meat is cooked.

Brucellosis in humans should be suspected when a recurrent flu-like syndrome is observed, along with high fevers and sweats that recur on a daily basis, especially if the person has been drinking milk that has not been boiled or pasteurized. These symptoms are accompanied by weakness and vague body aches and pains. Improvement is noticed in about 2 weeks, but symptoms recur a few days to 2 weeks later for extended periods of time.

Caseous Lymphadenitis (Pseudotuberculosis, Abscesses)

Symptoms

Swollen, abscessed lymph nodes occur most commonly under the jaw and ear, in front of the shoulder, high in the flank, or above the udder, scrotum, or hock. The nodes may feel warm, and may swell to 3 to 5 cm (1.5 to 2 in.) or larger. The disease is seldom fatal, unless it involves a major artery or nerve around the head, or the lymph nodes inside the body. The abscesses contain a characteristic cheesy, greenish pus. Diagnosis is based on the locations of the abscesses, the character of the pus, and microscopic culture examination, if available. This is a very common disease in agriculturally developed countries.

Cause/Transmission

Although normally contracted when sheep eat contaminated feeds, it might also be contracted via breaks in the skin. There is even some evidence that bacteria can enter unbroken skin.

Treatment and Prevention

Abscesses are treated by surgical lancing (see Techniques) or total removal by a veterinarian. Additional treatment by administration of antibiotics, usually penicillin or a tetracycline, should be continued for 3 to 5 days.

Caseous lymphadenitis is difficult to prevent due to the fact that *Corynebacterium pseudotuberculosis (ovis)* is a very common soil contaminant. Spread can be slowed by carefully lancing abscesses and washing the wound with 7% iodine. All material from the abscess should be deeply buried or burned. All new animals, especially those imported from agriculturally developed countries, should be held in isolation, away from local sheep, for at least 30 days and preferably 90 days. This gives them a chance to develop symptoms of this and other longer incubating diseases before being mixed with local sheep. A killed vaccine made from the organism of an infected flock has been reported to be a successful preventive.

Human Health Concerns

Humans should protect their hands from the pus as the organism could cause skin infection. Wash hands well after handling infected animals.

Chlamydial Abortion (Enzootic Abortion of Ewes)

Symptoms

Abortions occur late in pregnancy (usually one of the first three pregnancies). Later deliveries are normal. Lambs may be carried full term but delivered stillborn (sometimes as a mummified fetus) or in a weakened condition. Retained afterbirth is common after abortions. The ewe seldom suffers any aftereffect unless she gets a uterine infection from a retained fetus or afterbirth. Large numbers of ewes in newly infected flocks abort. Chlamydial abortion can be positively diagnosed only by culture of the aborted fetus or membranes or by a blood test done in a laboratory.

Cause/Transmission

The *Chlamydia psittaci* organism is common in sheep. It is thought that females or offspring may become infected by swallowing the organism during the lambing season, with the organism delaying growth in the ewe until late in the following pregnancy.

Treatment and Prevention

The use of tetracycline drugs given intramuscularly for 5 to 7 days has been reported to help decrease the number of abortions by reducing the spread of the organism to uninfected sheep. Feeding the oral tetracyclines at 110 to 165 g/metric ton or 110 to 165 mg/kg of feed has also helped control this disease. Those fetuses already infected, however, will abort regardless of treatment. The best way to keep the disease from spreading is to burn or bury the dead lamb and tissues from the birth process and to isolate aborting ewes from the rest of the flock. In some countries, a vaccine has been developed that seems to work quite well when given 1 month before breeding the ewes.

Human Health Concerns

None

Colibacillosis

(Scours, Diarrhea, White Scours, Yellow Scours)

Symptoms

Severe depression, weakness, and watery diarrhea are symptoms of colibacillosis. Rapid dehydration is evidenced by skin that stays up when pinched and by eyes that sink into the head. Skin is cold and clammy. Many causes of scours in lambs can have the same or similar symptoms. Lambs will die quickly unless lost fluids and electrolytes (body salts) are replaced. Diagnosis is based on the symptoms and can be confirmed by laboratory culture procedures.

Cause/Transmission

The bacterium *Escherichia coli* causes the disease in very young lambs (newborn to 2 weeks) and is usually related to dirty surroundings. *E. coli* is very commonly found and some types of the organism are more likely to cause disease than others. Outbreaks rapidly worsen unless strict sanitation procedures are begun. The organism is taken in by mouth, usually very soon after birth. Lack of adequate colostrum usually contributes to colibacillosis. See the section on care of the newborn.

Treatment and Prevention

You should 1) replace fluid loss, 2) correct electrolyte balance, and 3) kill the organism with antibiotics. Replace the milk given to the lamb with any of the formulas listed in the Therapy Section under Treatment for Scours. The appropriate amount is 10% of body weight, needed for daily usage or maintenance, plus the percentage lost due to dehydration. Start the lamb on an oral antibiotic, such as neomycin, spectinomycin, chloramphenicol, tetracycline, or a sulfa drug at about 5-10 mg/kg of body weight, twice daily. Always follow label directions on drugs.

Lambs are born with no immunity and must receive colostrum from their mothers to become resistant to disease. Feeding the lambs well with colostrum before they are 2 hours old will protect them until they are old enough to build their own disease defense mechanism. After the first 12 hours of life, the lambs' ability to absorb these antibodies decreases rapidly and is gone by the time they are 24 hours old. Clean surroundings also are important to prevent this disease. Lambs should be born in clean or unused areas and kept warm and dry, but not necessarily in a closed building.

Human Health Concerns

None

Contagious Agalactia

Symptoms

Fever and loss of appetite are seen in all three types of contagious agalactia. Other symptoms may include: (Type 1) acute mastitis exhibited as a hot, painful udder producing a greenish, cheesy, pus-like material (chunks) and a watery fluid, with the udder drying up in long-term cases; (Type 2) a cloudy cornea of the eye that may proceed to an ulcer and blindness, although complete recovery usually occurs quickly; and (Type 3) an arthritic form with hot, painful, swollen joints that sometimes rupture as abscesses, where the animal may not be able to stand if more than one joint is involved. Diagnosis is confirmed by laboratory procedures and blood tests.

Cause/Transmission

Contagious agalactia is a disease of sheep and goats caused by *Mycoplasma agalactia*. The organism is found in milk, urine, feces, and eye and nasal fluids for several months after infection. Spreading may occur when an uninfected sheep contacts these secretions.

Treatment and Prevention

Helpful antibiotics are tetracycline or tylosin given intramuscularly (see Therapy and Techni-

ques). The death rate can reach 20% of the infected animals. A vaccine is available in some countries.

Human Health Concerns

None

Enterotoxemia

(Type C: Struck, Lamb Dysentery)

(Type D: Pulpy Kidney Disease, Overeating Disease)

Symptoms

Symptoms include star gazing (upward lift of the head), convulsions, tooth grinding, twitching, and death within a few hours. Sometimes the sheep will have diarrhea, which may or may not be blood stained. The rumen motility will stop. Lambs are often found dead. Postmortem symptoms include fluid in the heart sac, which usually contains a clot that looks like chicken fat. Blood free in the intestine is also sometimes seen. A urine test for sugar will usually be positive. Urine test strips used by diabetics can serve for this test, but complete diagnosis should be made in a diagnostic laboratory.

Cause/Transmission

Types C (struck and lamb dysentery), and D (pulpy kidney disease and overeating disease) of the bacterium *Clostridium perfringens* are usually involved. Type C seems to affect the very young and older adult animals, with Type D affecting those from 3 to 4 weeks old to about 1 year. The organism lives in the soil and normally is found in the stomach and intestines of sheep and goats. The disease is triggered by changes in the normal rate of passage of feed through the gut. For example, a change in the type of feed or overfilling the stomach (such as a lamb drinking an excessive amount of milk) may allow the organism to grow. A toxin is produced by the fast growing bacteria, and the absorption of this toxin causes the symptoms of the disease.

Treatment and Prevention

Treatment of affected animals is not successful unless the specific antitoxin is available. Intravenous or subcutaneous administration of the antitoxin will usually reverse the seizures. Antibiotics (penicillin) will usually stop the growth of the bacteria but do not affect the toxin that has already been produced and absorbed. If antitoxin is not available, 115 to 170 g (4 to 6 oz) of powdered charcoal and 15 to 30 g of baking soda given by mouth may be helpful (see Techniques).

Only well-fed animals are affected by enterotoxemia, which can be prevented easily. Two doses of the vaccine (a toxoid) should be given to the ewe: one dose at 4 weeks before she lambs and another dose 2 weeks before she lambs. Lambs should be vaccinated after weaning with two doses, 2 weeks apart. One booster shot each year thereafter will protect the ewe and her subsequent lambs until they are weaned (see Therapy).

Human Health Concerns

None

Follicular Conjunctivitis

(Pinkeye, Infectious Keratoconjunctivitis)

Symptoms

Follicular conjunctivitis is seen in young sheep as a watering eye that is sensitive to light. The tissues around the eye are red and appear granular. The lamb may be blind and the cornea of the eye may turn blue or have an ulcer on it. Sometimes lambs show a lameness with this disease. Usually a high percentage of lambs will become infected but very few die. Recovery occurs in 10 to 14 days.

The cause of follicular conjunctivitis is *Chlamydia psittaci*, the same organism that causes polyarthrititis and chlamydial abortion. This disease is spread by direct contact among lambs and by insects feeding on the secretions (tears) from the eye.

Treatment and Prevention

Most sheep will recover without treatment in about 2 weeks. Tetracyclines or tylosin given intramuscularly will hasten recovery and reduce spreading. Isolation of infected animals also reduces chances that the infection will spread.

Human Health Concerns

Reported as rare in humans.

Foot Rot

Symptoms

Lameness is the first foot rot symptom. The sole and the sidewall of the diseased foot appear ragged and rotten and have an extremely bad odor.

Cause/Transmission

Caused by the invasion of two bacteria, *Fusobacterium necrophorus* and *Fusiformis nodosus*, the disease is usually spread from infected carrier animals into the soil and then to the uninfected feet. Sheep develop the condition more readily than goats. Wet soils and filth increase the possibility of disease outbreaks.

Treatment and Prevention

Remove the dead, rotten foot tissue with shears or a sharp knife (see Techniques). Trim down until healthy tissue is found. Some bleeding will occur. This is necessary to remove the diseased tissue. Spraying the area with a solution of chloramphenicol or 10% formalin, or forcing the animals to walk through a 10% formalin, copper sulfate or zinc sulfate foot bath can be beneficial (see Therapy). The foot bath should be placed so that the sheep must pass through it as they go to graze. Do not place the bath where sheep are likely to drink from it.

The best method of prevention is to remove animals from dirty and wet areas for about 4 weeks so the organisms in the soil will die out or decrease in number. Regular trimming of the feet will also help prevent this and other foot problems. Do not buy animals from infected flocks.

Human Health Concerns

None

Johne's Disease (Paratuberculosis, Wasting Disease)

Symptoms

Johne's disease is usually seen in animals 3 to 5 years old. Symptoms include progressive loss of weight, rough hair coat, decreased milk production, decreased appetite, and progressive depression. Diarrhea will develop within the last few days before death. Stress seems to trigger the disease or make it progress faster. The organism affects the area where the small and large intestines join together and interferes with the ability of the sheep to absorb nutrients from the intestine. Usually only a few sheep in the flock are involved.

Cause/Transmission

The disease caused by the bacterium *Mycobacterium johnei* is thought to spread through feed contaminated with the organism and should occur before the sheep is 6 months old. There is some evidence that lambs can be born with the disease or pick it up from the ewe's milk or fecal contamination on the udder.

Treatment and Prevention

There is no effective treatment. Diagnosis can be made in a laboratory by finding and growing the organism. The IV Johnin test can be run in the field but requires some knowledge of the procedure and of how to make white blood cell counts.

As preventive measures, you should buy healthy animals and remove infected sheep from the flock. Spread can be reduced by avoiding stress on the animals. An experimental vaccine has been used in Iceland with good results. This disease is not common in sheep.

Human Health Concerns

None

Listeriosis (Listerellosis, Circling Disease)

Symptoms

The abortion form usually shows no other symptoms. It can only be diagnosed by growing the organism from the aborted fetus in a laboratory. The nervous or encephalatic form has a rapid course and causes death in 4 to 48 hours after symptoms appear. Symptoms include circling in one direction, high fever, lack of appetite, red tissues around the eyes (maybe with blindness), and depression. Affected animals may have a paralysis of one side of the face, represented by a drooping ear, drooping eyelid, and saliva running from limp lips. Up to 20% of the sheep in a flock may be involved. When near death, the animal will lie down and may have fits. Confirming diagnosis can only be made in a diagnostic laboratory.

Cause/Transmission

Listeriosis is caused by the bacterium *Listeria monocytogenes* and is commonly seen in cooler climates. The bacteria are very hardy and are found in soil, silage, manure, milk, urine, and drainage of the eyes and nose of infected animals. Listeriosis is spread when sheep swallow, inhale, or get the bacteria in their eyes. The route by which it is spread can influence the symptoms. For example, swallowing the organism usually causes abortion, whereas infection through the eye or nose usually results in the nervous form.

Treatment and Prevention

There are no effective treatments for small ruminants, and they usually die after infection. Large doses of penicillin may help in some cases. When an outbreak occurs, you should isolate infected animals. If silage is being fed, discontinue its use.

Human Health Concerns

Listeriosis can cause serious diseases in humans. Be extremely careful when handling sick or dead animals. Do not eat any part or product of

the sick or dead animal. Wash hands and disinfect clothes and shoes. Use all sanitary measures possible. Pregnant women should avoid infected animals. Symptoms may range from a mild irritation on the hands and arms from assisting in the delivery of a lamb to a severe blood poisoning disease. Encephalitis and abortion of pregnant women may also be produced by listeriosis.

Malignant Edema (Gas Gangrene)

Symptoms

A swollen and infected spot on the animal is accompanied by high fever, depression, and a lack of appetite. If the infection is a castration wound, the animal may walk stiffly. The swollen and infected area will spread rapidly. The best diagnosis is obtained by growing bacteria in the laboratory.

Cause/Transmission

Although usually caused by the bacterium *Clostridium septicum*, other forms of *Clostridium* spp. could possibly cause the same kind of wound infection in sheep. The disease starts when a cut or some other type of wound is contaminated with the bacteria. The bacteria grow and produce a poison that kills the muscles and tissues around the infection site. Death of the animal can occur very rapidly or over 2 to 3 days depending on how much tissue is killed and where the infection is located.

Treatment and Prevention

Treatment with penicillin, tetracycline, or most any antibiotic or sulfa drug will kill the bacteria if started very early in the disease (see Therapy and Techniques). However, many animals infected with malignant edema die because of delay in treatment.

The best prevention is care and cleanliness when castrating or docking lambs. Any other injury should be carefully cleaned and antibiotic or sulfa powder applied to the wound.

Human Health Concerns

Human wounds can become infected with *Clostridium septicum*. Wash your hands very well after handling infected wounds and apply a small amount of antibiotic or sulfa powder to any cuts or scratches on your hands.

Mastitis

(Bluebag, Gargot)

Symptoms

Regardless of cause, the symptoms of all types of mastitis are heat, pain, and swelling of the udder. Usually you will note some discoloration of the tissue and abnormal milk. The infected udder will change in color from slightly more pink to a bright red, or to a black and cold udder, indicating gangrenous mastitis. Gangrenous mastitis usually kills the ewe and the udder is always destroyed even if she recovers. The milk from an infected udder will vary in color, texture, and thickness depending on the type of organism involved. Milk may be almost normal in all respects, or may be watery and pale, dark yellow and thick, chunky and greenish, or bloody. Almost any combination can occur. Lameness of a rear leg is a common symptom of pasturella mastitis or bluebag. This is a gangrenous mastitis.

The California Mastitis Test (CMT) is commercially available in most countries and has been recommended as a good test for subclinical mastitis. You should be cautious in using the CMT because many normal, healthy sheep may show a milk reaction to this test. Very marked reactions do indicate mastitis problems, however.

Laboratory culture or growth of the bacteria causing the mastitis is the best way to determine the exact diagnosis. Antibiotic sensitivity tests also can be run to determine the correct antibiotics to use.

Cause/Transmission

Mastitis is an inflammation of the mammary gland (udder or milk-giving gland) of animals,

usually caused by bacteria. *Staphylococcus spp.*, *Corynebacterium spp.*, *Streptococcus spp.*, or coliforms cause over 95% of all cases. Mastitis is usually characterized as clinical when symptoms are present or subclinical when symptoms appear periodically. In the latter case, the gland is still infected during periods when no symptoms are present. The subclinical type will usually reduce total milk production by at least 25%. Transmission occurs from animal to animal or from soil or filth on the teat ends. Ewes that give large quantities of milk and have only one lamb will often develop mastitis due to incomplete removal of the milk and bacterial growth in the remaining milk.

Treatment and Prevention

Several products are almost universally available for intramammary infusion (to be put into the teat). These products are antibiotics or a combination of antibiotics in a 10 to 15 cc dose and are packaged in a plastic throwaway tube to inject into the teat. When using one of these products, always wash the teat end with soap and water and wipe with alcohol before sticking the applicator into the teat. You should not reuse applicators or divide a dose between two teats (see Techniques).

Intravenous and intramuscular antibiotic injections should also be used in very serious cases. The udder should be milked out at least three times per day. Bathing the udder two or three times per day in warm water also will help to reduce some of the pain and swelling.

Human Health Concerns

Although sheep milk is not commonly used by humans, in some areas it is an important source of food. Some of the bacteria that cause mastitis can cause sickness in humans. Never use infected milk for human consumption, especially for babies. Do not use milk for human consumption for at least 3 days after animals are treated with drugs.

All milk should be pasteurized or boiled before being fed to babies or sick people. To pasteurize, place milk in a glass or stainless steel

container. Rapidly heat the milk to 74C (165F) and hold at that temperature for 20 seconds while stirring.

Rapidly cool the milk to 15.5C (60F) and store it at 4C to 7C (40F to 45F). If refrigeration is not available, boiled milk (just to a boil) will keep for about 1 day in a clean airtight container. Heating to 83.8C (183F) very quickly and letting it cool will also keep milk fresh for about a day.

Melioidosis

(Whitmore's Disease, Human Glanders)

Symptoms

Symptoms of melioidosis are slight fever, loss of appetite, depression, labored breathing, coughing, runny nose. Joints, lymph nodes, and testicles are sometimes swollen. Occasionally abscesses will form and drain. Nervous symptoms sometimes occur, including staggering, jerky movements, or paralysis. Young animals are more commonly infected, but older animals also develop the disease. Diagnosis is made by observing symptoms and growing the bacteria in the laboratory. Some blood and skin tests have proved useful in diagnosing this disease.

Cause/Transmission

Caused by the bacterium *Pseudomonas pseudomallei*, melioidosis is most commonly seen in Southeast Asia, but also occurs in most other areas of the world. Infection is due to the contamination of wounds with soil containing the organism. Spread from animal to animal or animal to man is unlikely.

Treatment and Prevention

Treatment is usually unsuccessful. Older animals sometimes recover but may get sick again when under stress. If you do decide to treat, use tetracycline, chloramphenicol, or sulfa drugs (see Therapy and Techniques). No vaccine is available. As a precaution, healthy animals should be kept away from areas where the disease has occurred.

Human Health Concerns

Although unlikely, human infection may occur as a result of swallowing the organism. Parts or products from infected animals should not be used for human food unless the animal recovers completely.

Pneumonia (Lung Sickness)

Symptoms

Symptoms are fever, runny nose, dry or wet cough, and changes in the rate and type of breathing (which may be shallow or labored). In severe cases, the sheep will breathe through an open mouth. If the lungs are painful, the sheep will not want to move and may grunt when breathing.

Cause/Transmission

Pneumonia may be caused by many bacteria and viruses, as well as parasites (primarily lungworms) and allergic reactions. The broad term "pneumonia" is used to describe infectious or noninfectious causes of inflammation of the lungs. The disease may be very acute (causing sickness and death in a few hours) or chronic (continuing for years).

Pneumonia is usually caused by organisms in the sheep's surroundings and begins with some type of stress. Probably the most common stress for sheep is that caused by poor or no ventilation in their housing. Air flow to keep humidity low is very important in preventing pneumonia. If you see moisture condensing in the shelter (small beads of water on the roof or pen) or smell ammonia, the ventilation is poor. By opening an area near the highest part of the roof or along the side of the barn, you can remove much of the moisture by letting the wet, hot air escape from the building. Gases, however, may be heavier than air, and may have to be ventilated out through the bottom of the shelter. In most climates, sheep require only a shelter from the rain, a windbreak, and adequate access to sunshine if they are to be stabled.

Treatment and Prevention

Treatment consists primarily of good care, warm, well-ventilated (but not drafty) quarters in an area where the animal can be handled gently for treatment. Intravenous or intramuscular administration of antibiotics or sulfa drugs is necessary (see Therapy and Techniques). Fresh feed and water should be easily available to avoid unnecessary movement.

Available bacterial vaccines have not been very successful. Proper ventilation and moisture and gas control are the most important aspects in preventing pneumonia in sheep.

Human Health Concerns

Rarely, if ever, transmitted from animals.

Polyarthriti s (Stiff Lamb Disease)

Symptoms

Polyarthriti s is seen in young lambs up to 6 or 8 months old. The symptoms are fever 41C (107F), poor appetite, soreness, pain, and lameness in one or more legs with little swelling of the affected joint. Most lambs will also show signs of follicular conjunctiviti s. Lambs may not be able to stand, will not eat, and lose weight. Most will recover after several weeks.

Cause/Transmission

Polyarthriti s is caused by *Chlamydia psittaci*, the same organism that causes chlamydial abortion and follicular conjunctiviti s. The organism is spread by direct contact, droplets in the air, or by flies. This disease appears to be an extension of follicular conjunctiviti s.

Treatment and Prevention

Treatment for 5 to 7 days with tetracyclines or tylosin speeds recovery. Isolate all affected lambs to reduce chance of spread.

Human Health Concerns

Rare in humans.

Ram Epididymitis (Brucellosis of Rams)

Symptoms

In rams, epididymitis appears as enlarged and hard testicles. The epididymis will be lumpy, hard, and in some cases swollen and hot. Many times the first indication of infection is a decreased or missed lamb crop or an extended period of time in which lambs are born (an indication of multiple breedings before conception occurred). Most rams do not become completely sterile but develop a reduced fertility and spread the disease to other rams.

Cause/Transmission

Brucella ovis is the most common cause of ram epididymitis. Other organisms, however, may infect the testicles of rams and show similar signs (approximately 10% of the cases). Sheep seem to be the only animals commonly affected by this organism. The organism is spread from ram to ram by swallowing feed that has been contaminated by urine or semen. Transmission also may occur from rams smelling or licking the reproductive organs of infected rams or ewes recently bred by infected rams. It is thought that ewes do not carry the infection from one heat period to another.

Treatment and Prevention

After the disease has developed, any effort at treatment is unsuccessful. All infected rams should be slaughtered. Rams not showing symptoms but that have been in contact with infected rams should be isolated from clean replacement rams. A vaccine used at 6 to 8 weeks of age and repeated 4 to 8 weeks later has been effective in large flocks. In small flocks, the best way to avoid the disease is by feeling the ram's testicles before purchase and rechecking once or twice a year. A blood test and/or semen evaluation are also very valuable tests if veterinary service is available.

Always try to make sure that replacement rams are being bought from flocks that do not have this disease.

Human Health Concerns

None

Salmonellosis (Bloody Scours or Black Scours)

Symptoms

A symptom of salmonellosis is blood-streaked or black tar-like diarrhea in young lambs. Sudden death may occur before diarrhea develops. The lambs will have a high fever and may pass a material with the diarrhea that looks like the stringy lining of the gut. Abortion in sheep due to salmonellae is fairly common in the last 50 days of gestation.

Diagnosis is best made from growing the bacteria in the laboratory. However, fairly reliable diagnosis can be made in a field situation. A postmortem examination done by a veterinarian is very helpful and highly recommended.

Cause/Transmission

Various types of the *Salmonella* bacteria cause salmonellosis in several species of animals. These bacteria are very common in the environment and are spread by carrier animals that usually show no symptoms of the disease. They can be passed from animal to animal by contact when the sheep eats feed contaminated by the bacteria.

Treatment and Prevention

Treatment with neomycin, tetracyclines, chloramphenicol or sulfas by mouth will be useful most of the time (see Therapy and Techniques). Encourage the sheep to eat and drink by offering fresh, clean water and good fresh feed. Keep the sick sheep as comfortable as possible and avoid chilling. To prevent salmonellosis, isolate infected animals, clean up the area carefully, including changing soil in small enclosures, and be careful not to buy animals from flocks with a history of

bloody scours. Keep the sick sheep away from healthy lambs after their recovery and clean the premises well.

There are vaccines available for specific types of salmonellae. They are helpful if the type is known.

Human Health Concerns

Salmonella spp. also may infect humans. Careful personal sanitation (washing hands after handling infected animals) is necessary to prevent contracting this disease.

Streptotricosis

(Dermatophilosis, Strawberry Foot Rot, Lumpywool)

Symptoms

Scabs that mat the hairs together form over the body. Extensive face and mouth lesions are common in some tropical areas. Acute generalized infection can occur in as short a time as 2 weeks or may take years. Additional symptoms are decreased milk production, weight loss, and in severe cases, death. When scabs are removed, the typical form is a cone-shaped scab with a concave bottom and with a yellow exudate under it. The tissue under the scab is red, granular looking and may bleed. During the healing stage the scab will separate from the skin but mat in the hair. Diagnosis is made from symptoms and laboratory procedures.

Cause/Transmission

The organism is transmitted by insects, tick bites, or from contaminated surroundings. Heavy rain or injury to the skin can enable the organism to penetrate the skin.

Treatment and Prevention

A large dose of penicillin (70,000 IU/kg) and streptomycin (70 mg/kg) will halt invasion of the organism as will long-acting tetracyclines. Treatment with chloramphenicol or shorter acting tetracyclines may help if the organism is resistant to

penicillin or streptomycin (see Therapy and Techniques). Advanced cases do not respond well and reinfection is common. Prevention is difficult.

Human Health Concerns

None

Tetanus (Lockjaw)

Symptoms

Symptoms of tetanus usually appear 7 to 14 days after the organism enters the body by way of a wound and include general stiffness or hardness of localized muscle groups, such as those in the head and neck. The stiffness and soreness progress to other parts of the body, and after 24 to 48 hours, the complete body is stiff or hard. If the animal can stand, the legs are straddled out, the neck and head are extended, and the tail is erect. The animal will go into violent stiff spasms of the muscles as a reaction to any quick movement, blow to the body, or sudden loud noise. The nostrils will flare, eyes open wide, and the third eyelid or membrane from the middle of the eye will drop about halfway across the eye. Body temperature will rise drastically when the muscle spasms start.

Cause/Transmission

Tetanus is caused by poisons produced by the bacterium *Clostridium tetani*. This organism is very common in soil and in the manure of all animals and man. The disease is spread when bacteria enter living tissue, which may occur in a puncture wound or any type wound that may close up and seal off. The bacteria grow and produce the toxin (poison) that causes the symptoms.

Treatment and Prevention

Treatment is usually unsuccessful; over 80% of the infected sheep will die. Large doses of penicillin injected into the muscles, plus sedatives or tranquilizers and 100,000 to 200,000 IU of tetanus antitoxin are required for treatment. Treatment usually is not practical for sheep.

Fortunately, a permanent form of prevention is rather simple. Two doses of tetanus toxoid can be given 30 days apart, with a yearly booster shot. This will adequately protect adults for at least 1 year. If a severe wound occurs, give a booster at that time. Tetanus antitoxin (1500 IU) can be given to protect animals when a wound occurs but this only protects for about 30 days. Very young lambs, up to 3 weeks of age, can be protected with as little as 150 to 300 IU of antitoxin each. This procedure should be followed when castration is done.

Human Health Concerns

The disease is not transmitted from animals to man, but humans can be infected. If the premises are contaminated, immunization of humans is usually recommended. Consult a physician.

Vibriosis (Campylobacteriosis)

Symptoms

Vibriosis is the most common cause of abortion in sheep, which occurs the last 50 days of gestation. Those ewes exposed that do not abort will usually be immune the following year as will the ewes that do abort. Vibriosis also causes weak or stillborn lambs, and occasionally a ewe will die from the infection.

Cause/Transmission

Vibriosis is caused by *Campylobacter fetus* subspecies *intestinalis* of a sheep variety. It is spread by carrier sheep that do not usually abort but carry the organism in their feces. After infection has entered a flock, the aborting ewes spread the disease from the fluids and fetuses that are aborted. The susceptible ewe picks up the infection by swallowing the organism in contaminated feed or water and by licking aborted fetuses and membranes. Abortion occurs 1 to 3 weeks later. Immunity from the disease lasts at least 2 years.

Treatment and Prevention

Tetracyclines IM for 3 to 5 days help control this disease. After first signs of an outbreak, all ewes should be vaccinated. Isolate all ewes that have aborted and bury or burn all aborted tissues to reduce possibility of spread. Revaccination before each breeding season thereafter is recommended.

Human Health Concerns

None

Viral Diseases

Causes, Treatments and Prevention

A viral disease is any disease caused by a virus. The incubation period is quite variable. Some viral conditions kill animals outright while others may serve as an insult to tissue thus allowing secondary bacterial growth. Antibiotics **do not** control viral diseases. At this time there are no commercially available antiviral products for use in animals.

Bluetongue (Sore Muzzle)

Symptoms

Symptoms of bluetongue are high fever, swelling of the mouth and head, red mucous membranes of the mouth that turn to shallow erosions on the dental pad and tongue, salivation, and nasal discharge that changes to a pus-like plug in the nostril. Other symptoms are increased shallow respirations, lameness accompanied by a red ring around the top of the hoof (not visible on black skin), lack of appetite, and generalized weakness. If infection occurs early in pregnancy, the ewe will likely abort or deliver a lamb with deformed and twisted legs and back, or the lamb may appear normal but cannot stand and refuses to nurse. These lambs lack proper brain development.

Cause/Transmission

Bluetongue is caused by a virus that has 21 different types. The disease is transmitted by the bite of the gnat *Culicoides spp.* The disease, in some cases, is thought to be passed to the fetus in the breeding process.

Treatment and Prevention

Bluetongue virus infection doesn't have a specific treatment. Antibiotics are used on acute cases to try to prevent establishment of bacterial pneumonias that may cause death.

Prevention by vaccination is used in many countries. The vaccine must be for the specific type that is infecting the animals since there is

no cross protection among virus types. Protection of the animals late in the evening until after sunrise will keep the gnats from feeding on the sheep and reduce chances of transmission. If possible, avoid grazing sheep on wet lowlands where the gnats abound. Vaccination is recommended before breeding to eliminate the possibility of damage to the fetus.

Human Health Concerns

None

Border Disease (Hairy Shaker Disease)

Symptoms

If a ewe has border disease, decomposed or mummified lambs are aborted. If the lamb is born alive, it may have excessive hair or long straight wool. Lambs have shaky movements (are unable to nurse), abnormal joints, and unthriftiness. If the lambs live long enough, the signs and symptoms disappear.

Cause/Transmission

Border disease is caused by the bovine viral diarrhea virus. It can be spread by animal contact with cattle and between sheep and from contact with the fluids and tissues from the birth process. The ewe picks up the virus from 1) contaminated feed and water, 2) virus particles in the air, and 3) direct contact with infected animals. Definite diagnosis requires laboratory isolation.

Treatment and Prevention

There is no treatment for this viral disease. Good nursing and individual care may save some lambs. Border disease can be prevented by keeping breeding sheep away from cattle and by isolating aborting ewes. Aborted fetuses and by-products of the birth process must be destroyed by burying or burning.

Human Health Concerns

None

Contagious Ecthyma (Sore Mouth, Orf)

Symptoms

Symptoms are thick, scabby sores that occur on the lips and gums and may be seen on udders or other areas that have little hair or wool. When the lesions appear on udders, they are painful and the ewe will not allow the lambs to nurse. As a result, mastitis often develops.

Cause/Transmission

Contagious ecthyma is a viral disease of sheep and goats. The virus is very hardy and can live for extended periods away from the host. Lambs pick up the disease from surroundings and may spread it to their mother's udder by nursing. Recovery from the disease gives an immunity for at least 1 year. There is little transfer of immunity from the ewe to the lamb by the colostrum.

Treatment and Prevention

Treatment is of little value. Softening ointments may help. Always make sure affected sheep are eating and drinking. Soft, tasty feeds are helpful. A vaccine is available and is very effective. Lambs should be vaccinated within 1 month of birth because of poor protection from the colostrum.

Adults need not be vaccinated again after the disease is in the flock and all young have been vaccinated. Continual exposure to the disease will keep the adults immune or resistant to sore mouth.

Human Health Concerns

This disease is contagious to man. People who work with sheep and goats that have sore mouth, or use the vaccine to protect sheep and goats, should wear gloves when handling these animals or the vaccine.

Foot and Mouth Disease (FMD)
(Aftosa, Aphthous Fever, Epizootic Aphthae)

Symptoms

Symptoms of foot and mouth disease in sheep are usually less severe than those seen in cattle. Sheep symptoms include dullness, fever, and small blisters in the mouth and on the tongue that break and leave small erosions. The most common site for blisters and erosions in sheep is on the dental pad. Small blisters also appear between the toes and on the feet. These areas turn pale and then peel off, leaving erosions and sores between the toes. The affected animals are very lame. The same type of blisters and erosions appear on the teats. Affected animals will not eat, and if the feet are very sore, will not stand. Sometimes the first symptoms are sudden death in lambs and death loss may run to 50%. Death of adults is very low, usually 1% to 2%. **Ministries and Departments of Agriculture require that FMD be reported, if suspected.** Diagnosis is based on symptoms and laboratory confirmations. The disease should be differentiated from sheep pox, PPR, contagious ecthyma, lip and leg ulceration, foot rot, and bluetongue. Only laboratory diagnosis can differentiate FMD from vesicular stomatitis.

Cause/Transmission

Foot and mouth disease is caused by a virus that has seven types and over 60 subtypes. It is widespread over much of the world. The disease is spread by swallowing the virus on feed or by inhaling or getting virus particles in the eyes from virus-laden air. Spread by recovered carrier cattle, sheep, goats, and hogs, foot and mouth disease can occur for a year or longer after the symptoms are gone. There is some evidence the virus can be spread through the air by winds. The incubation period is usually 3 to 5 days.

Treatment and Prevention

There is no effective treatment. Vaccination can be made as a preventive measure against the type that occurs locally. Some countries use the

eradication method--all exposed and sick animals are destroyed, then burned, or buried.

Human Health Concerns

None

Nairobi Sheep Disease

Symptoms

This disease is marked by high fever, runny nose, and bright green, watery diarrhea that may contain blood and mucous flecks when the animal is near death. The animals have poor appetites, weaken, and cannot rise. Pregnant ewes frequently abort. Mortality is very high in native sheep; however, in imported breeds and crosses, mortality rarely exceeds 40%.

Cause/Transmission

Nairobi sheep disease is an infectious, non-contagious viral disease transmitted by the brown tick *Rhipicephalus appendiculatus*. This disease has been reported only in eastern and central Africa. It is transmitted from sheep to sheep by the bite of the brown tick.

Treatment and Prevention

Treatment is of little value and many native and native-cross sheep recover. Those that do recover have a strong immunity. Sheep should be dipped or sprayed at weekly intervals to control ticks. A vaccine is being developed.

Human Health Concerns

None

Peste Des Petits Ruminants

(Pseudorinderpest of Small Ruminants,
Peste of Sheep and Goats, Kata, PPR,
Stomatitis-Pneumoenteritis Syndrome)

Symptoms

A sudden rise in temperature, up to 41C (106F), is seen in sheep that appear dull and restless. They have a dull coat, a dry muzzle with a

clear discharge, very little appetite, and reddening around the eyes. There may be some red or raw areas in the mouth. Diarrhea, dehydration, emaciation, and collapse sometimes occur. Pneumonia may develop as a complication. Few sheep die from this disease though most infected goats die within 8 to 10 days.

Several other diseases have similar symptoms, thus, laboratory diagnosis should be made using blood and culture tests. Sheep are less likely to develop the disease than goats.

Cause/Transmission

The disease is caused by a virus and has been reported only in West Africa. It is transmitted by direct contact with sick animals or with areas where sick animals have been recently kept. All tissues and fluids from sick animals contain the virus and are considered infectious. Cattle exposed to the virus do not become sick but do become immune to rinderpest. (Note: Rinderpest disease of cattle has been reported to cause a similar set of symptoms in sheep and goats; however, the symptoms are much less severe.)

Treatment and Prevention

There is no effective treatment. A vaccine that will protect sheep and goats for about 1 year is available in some areas.

Human Health Concerns

None

Progressive Pneumonia

(Ovine Progressive Pneumonia, Maedi-Visna,
Lunger Disease)

Symptoms

Symptoms of progressive pneumonia are severe loss of weight while still having a good appetite, rapid respiration with flared nostrils even when resting, normal body temperature, muscle weakness, and decreased ability to exercise. Seen in 2-year-old or older sheep.

Cause/Transmission

Progressive pneumonia, which is caused by a "slow virus," is nearly always fatal. It takes over 2 years from contact for the disease to develop. Transmission probably occurs when viral particles are inhaled.

Treatment and Prevention

There is no treatment. Prevention is by removal of sick sheep from healthy flocks.

Human Health Concerns

None

Rabies

(Hydrophobia, Lyssa, Mad Dog, Le Rage, Tollwut)

Symptoms

You should be extra cautious in diagnosing rabies. Symptoms include confusion, depression, loss of milk production, and loss of appetite. Many infected animals may chew on foreign objects such as wood or rocks. They may not be able to swallow, and saliva or water will drool from their mouth. **Hydrophobia or "fear of water" is not a symptom of rabies in animals.** Infected sheep may or may not bleat, but, if they do, it will be unusually low and off-key. Also, the eyes will "stare" from dilated pupils.

Cause/Transmission

A virus-caused disease of all warm-blooded animals and man, rabies is distributed over most of the world, except for those countries where it has been eradicated. The virus is in the saliva of the rabid animal and is most commonly transmitted by its bite. Rabies also can be contracted when saliva from an infected animal enters an open wound (for example, when licked). The virus has been transmitted to humans from bats in caves, probably by breathing small virus-laden droplets. The bite of the vampire bat is a common method of transmission. The incubation period for rabies can be very long, up to 10 months or so. It is usually about 2 weeks.

Rabies is always fatal. It is not commonly seen in domesticated animals raised for food, and in most cases they do not readily transmit it since they do not normally bite for self-protection. However, it is very common for people to think the sheep is choking and stick their hands into its mouth. Choking is **very unlikely** in a sheep. Diagnosis on symptoms alone is impossible due to the many similar diseases of the central nervous system. Laboratory diagnosis is necessary.

Treatment and Prevention

There is no effective treatment after symptoms develop. Preventive treatment for humans is practiced immediately after exposure. This is not practical in animals, which are usually destroyed.

There are several vaccines available for animals. These are especially useful in South America where vampire bats are common and are primary spreaders of rabies. **Never** use a vaccine on an animal for which it is not specifically intended. **Read the label.** Low egg passage vaccines, for example, are fine for dogs but **will cause rabies** in cats, cattle, horses, sheep, and goats.

Human Health Concerns

You can contract rabies from animals and it is **100% fatal**, once symptoms develop. When an animal shows severe nervous signs or unusual changes in behavior, either aggressive or passive, always consider rabies a possibility until it can be ruled out. Do not make any assumptions or take any chances with this disease. Remember, it is 100% fatal to humans. If humans have been exposed, **always** consult a physician.

Rift Valley Fever

Symptoms

High abortion rate occurs in adults and high death losses among very young animals. Sick animals show a rapid rise in temperature and a rapid, weak pulse. Gait is unsteady. Sores sometimes appear on the tongue and cheeks. Milk production rapidly decreases. Death losses are extremely high

for young lambs, kids, calves, and puppies. Adult sheep, cattle, and goats suffer a 10% to 20% death loss.

Cause/Transmission

Sheep, goats, cattle, very young puppies, and humans are affected by this virus-caused disease, transmitted primarily by mosquitoes. Ticks have also been identified as carriers. The disease is seen primarily on the African continent, usually during the wet season.

Treatment and Prevention

There is no effective treatment. Prevention consists of housing animals in insect-proof buildings or moving them to highlands away from insects. A vaccine is available; however, it is a live-virus vaccine and will cause abortions in pregnant animals and deformities in the fetuses.

Human Health Concerns

Humans are infected both by insects and by handling animals and tissues affected with this virus. Meat from infected animals should not be eaten. In humans, the disease is not usually fatal but does cause a long, 7 to 10 day flu-like disease that is very debilitating and painful. A vaccine is available for use in humans.

Scrapie

Symptoms

Early symptoms of scrapie are nervousness, slight muscle tremors, dull hair coat, and a slightly wobbly gait (especially if the animal is excited). As the disease slowly progresses, itching begins, usually at the top of the tail and progresses forward over the body. The animal will rub, scratch, bite, or do anything to scratch these areas. A high degree of pleasure is derived from this scratching and the animal will lift its head and nibble with its lips and lick its tongue, as if enjoying the scratching. All the hair over these itching areas is often rubbed from the body. The animal will progressively lose weight, yet will eat

until a day or so before dying. About 1 week before death, the animal will lie down and be unable to rise. You can usually expect no more than 1 to 2 animals in a flock to be infected at any one time, but up to 50% will eventually become infected. Diagnosis can be made from symptoms, but confirmation in a laboratory is necessary.

Cause/Transmission

Scrapie, a disease primarily of sheep and occasionally of goats, is caused by a slow virus or viroid (very small virus-like particle). The incubation period, according to most research, is from 18 months to over 4 years. As a result, it is usually seen in animals from 2 to 6 years old. Death losses are 100% once signs develop. From initial signs to death, 2 to 6 months will pass. The disease is thought to be spread by contact with infected animals and from mother to offspring.

Treatment and Prevention

There is no effective treatment. Several countries have eradication programs for scrapie. If this disease is suspected, the **Agriculture Department authorities should be contacted.** To prevent scrapie, buy from healthy herds and avoid all contacts with infected sheep and goats.

Human Health Concerns

There is no known connection at this time to two similar human diseases. However, most countries recommend that meat and products from infected animals not be used for human consumption, because of this similarity. Scrapie can be transmitted to some monkeys.

Sheep/Goat Pox

Symptoms

Sheep/goat pox infects all ages but is more severe in young animals. Early symptoms include runny nose, red eyes, fever, poor hair coat, standing with an arched back, and lack of appetite. One or 2 days later, numerous nodules (lumps) develop all over the body but are most visible in areas

with little or no hair. Most of these lumps develop a scab that remains for 3 to 4 weeks. Removal of these scabs leaves a pit or pock mark. The same type of eruption will develop inside the mouth and throughout the body. Sheep and goat pox should be differentiated from contagious ecthyma.

In all countries, when this disease is suspected, it should be reported to the Agriculture Department authorities. The death rate can reach 80%, usually from pneumonia.

Cause/Transmission

Common in the Middle East, the Indian subcontinent, and Africa, this virus-caused disease is spread by small droplets in the air and by contact with sick animals.

Treatment and Prevention

There is no effective treatment. Antibiotics may help prevent pneumonia. A vaccine is available for use in problem areas. Isolate sick individuals to help reduce spread of the disease.

Human Health Concerns

None

Wesselbron Disease

Symptoms

Young lambs exhibit fever, enlarged lymph nodes, may have yellow mucous membranes, and usually die in 1 to 2 days. Pregnant ewes abort after having a fever for 1 to 2 weeks. Dead animals have a friable, yellow liver.

Cause/Transmission

Wesselbron disease is caused by a virus and transmitted from sheep to sheep by the bite of mosquitoes. Definite diagnosis requires laboratory isolation of the virus.

Treatment and Prevention

There is no treatment for this or other viral diseases. Prevention is accomplished by reducing mosquito populations and vaccinating susceptible

sheep before breeding. Vaccination of pregnant ewes may cause abortion.

Human Health Concerns

A flu-like condition occurs in humans from this virus.

Metabolic Diseases Causes, Treatments and Prevention

Metabolic diseases are those that involve the lack of or unusual breakdown of physical and chemical processes in the body.

Acidosis/Indigestion/Impaction/Choke

Each of these conditions is related to feeding.

Acidosis occurs when sheep overeat easily digested feed with high levels of starch or sugar, including grains, grain by-products (brewer's waste or germ), and vegetable parts. The pH of the rumen will change to an acid state, usually below 5. The animal may bloat, refuse to eat, develop severe diarrhea, and become dehydrated (eyes sink into head and skin loses elasticity). Pain is exhibited by grinding of the teeth. Rumen motility will stop and the rumen will feel watery. The animal will weaken, stagger, and be unable to stand. If not treated, the sheep usually dies in 1 to 2 days. Treatment consists of using a stomach tube to administer oil and a mixture of charcoal and sodium bicarbonate (see Techniques and Therapy). Surgical clean-out of the rumen is required in many cases, only with aid of a veterinarian.

Indigestion is usually a mild form of acidosis. Symptoms include lack of rumen motility, loss of appetite, and decreased milk production. Some charcoal-bicarbonate mixture and a mild laxative, such as milk of magnesia (45 to 60 ml) or magnesium sulfate (epsom salts, 15 to 30 g mixed in 100 to 200 cc of water), will usually correct the problem when given by mouth or with a stomach tube (see Techniques and Therapy).

Impaction, which is uncommon in sheep, occurs when poor quality roughage is consumed faster than it is broken down by the digestive process in the rumen and passed on through the digestive tract. Sudden changes in the type of feed will slow passage of the material through the rumen and can also cause impaction or indigestion. Correcting rumen impaction almost always requires a surgical proce-

dures (rumenotomy) and the services of a veterinarian.

Choke is not common in sheep, unless they are feeding on vegetable or fruit waste. If a stomach tube is gently passed down the throat, the obstruction can usually be pushed into the rumen. If the tube procedure fails, contact a veterinarian for surgery.

Human Health Concerns

None

Allergies/Insect Stings

Symptoms

Severe generalized symptoms such as sudden collapse, coma, and death may appear from allergies/insect stings. Less severe and more common symptoms may include respiratory distress (difficulty breathing), heart irregularities, excessive saliva flow from the mouth or tears from the eyes, mild to severe itching, lumps (hives) that appear on the skin suddenly, hair standing erect, swelling of tissues with fluid retention (edema), and red areas on the skin. Common causes of allergies are feeds, injections, applications to the skin, and insect bites.

Cause/Transmission

An allergy is the animal's reaction to a substance (usually a protein) with which it has had previous contact and to which the body has developed an immune sensitivity. Many substances can cause allergic reactions, with varying degrees of severity. Some examples are pollens or other plant proteins, insect stings, many drugs and biological substances such as antisera, vaccines, or antibiotics. Many times the allergic reaction is dose related: small doses cause small reactions and large doses cause severe shock or even death. These reactions can occur almost immediately after contact or up to 3 weeks later.

Treatment and Prevention

Immediately remove the animal from its surroundings because the allergen usually is nearby. If the suspected allergen was applied to the skin, wash the animal with soap and water. (Protect yourself from the suspected allergen.)

Do not wash the sheep in a river; the allergen could kill fish or contaminate a water supply. If the sheep is dying, epinephrine should immediately be given intravenously or subcutaneously (see Therapy and Technique). Doses of antihistamines and corticosteroids injected or taken orally usually produce a dramatic response, completely reversing or greatly reducing the severity of the symptoms. To prevent further recurrence, do not place the animal in the same environment or use the same products.

Human Health Concerns

None

Bloat

(Ruminal Tympany, Tympanities, Hoven, Meteorism)

Symptoms

In addition to pain, discomfort, and difficulty in breathing, the sheep has a full left flank, jutting up and out, that sounds like a drum when thumped. Sometimes the right side also will be enlarged, and will protrude outward. Rumen movement usually continues until the inside of the mouth and the area around the eye turn blue instead of pink. This change indicates a lack of oxygen and approaching death.

Cause/Transmission

Basically, bloat stems from the sheep's inability to get rid of gas produced in the first compartment of the stomach--the rumen. This condition is nearly always an emergency. The gas can be free or mixed with the feed in the rumen (frothy bloat). If not relieved, it will cause extreme discomfort and death from reduced ability to exchange oxygen in the blood.

Bloat, especially frothy bloat, can be caused by feeding on legumes (especially alfalfa [lucerne] or clovers) and small grain pastures (wheat, barley, oats, and rye). Almost any feed can cause bloat if the animal cannot belch gas away, as can blockage of the esophagus (tube from mouth to stomach) by feed, froth, or a foreign object.

Treatment and Prevention

Swift treatment is necessary. Force the sheep to stand and walk. Tie a stick or rope in the mouth for the sheep to chew on. This stimulates saliva and helps reduce bloat.

If the animal is in critical condition, pass a rubber tube down the throat (see Techniques) into the rumen. Use a tube no larger than 1 to 2 cm (1/2 to 3/4 in.) in diameter. To see if the tube has reached the stomach, place your ear to the stomach area on the left side of the sheep and blow into the tube. You should hear a bubbling sound. If the accumulation is a gas bloat, relief is immediate. If it is frothy bloat, relief is limited. Pour or pump 100 to 200 cc (1 to 1.5 cups) of mineral or vegetable oil into the stomach by way of the tube. Sometimes 100 mg/kg of Poloxalone orally will help reduce frothy bloat. If no mineral or vegetable oil is available, unused motor oil will serve. **Do not use the motor oil unless necessary. Never use used motor oil.**

As a last resort, a large gauge needle, trocar and cannula, or piece of hollow stick (bamboo) can be punched into the left side of the sheep. This treatment is considered only as a last resort because **60% to 80% of the animals so treated die of infection** several days later. Best prevention is careful attention when flock is grazing legumes.

Human Health Concerns

None

Colostrum Deprivation (Hypogammaglobinemia)

Symptoms

If a lamb does not obtain enough colostrum, it will not have adequate disease protection. Such lambs will probably be sick most of their lives. If they live through the first month or 6 weeks, they will probably survive because they can then build their own immunities. Many hypogammaglobinemic lambs are stunted, however, and do not mature properly.

Cause/Transmission

Newborn lambs have little or no immunity to disease. Antibodies (disease protective particles) do not pass from the ewe to the lamb before birth. As a result, the ewe builds a very high level of antibodies in the udder, primarily gamma globulin. The lamb is capable of absorbing these protective bodies through the stomach and intestinal wall for a short time after birth, with peak absorption during its first 6 to 12 hours. This ability decreases rapidly over the next 12 hours; when 24 hours old, the lamb can no longer absorb the antibodies. Because the ewe's first milk, called colostrum, is high in antibody level, it is very important for the lamb to nurse soon after birth. It should receive about 10% of its body weight in colostrum the first day of life. This would amount to nearly 236 ml (1/2 pint) for the average-sized lamb.

Treatment and Prevention

There is no effective treatment after the condition occurs. Blood transfusions sometimes help, but these should be done by a veterinarian. Prevention is simple: be sure the lamb has adequate colostrum before it is 6 hours old. If the lamb is weak and cold, warm it gently by applying warm water or warm towels to its body. Tubing techniques using a small rubber catheter can and should be used to place warm colostrum into the stomach (see Techniques).

Human Health Concerns

None

Grass Tetany
(Grass Staggers, Hypomagnesemia Tetany)

Symptoms

A sheep suffering from grass tetany is first nervous and trembling, becomes progressively weaker, and then lies down and cannot stand. Symptoms can resemble those of milk fever.

Cause/Transmission

Grass tetany occurs when feed is low in magnesium content. The symptoms appear when the level of magnesium in the blood drops below a critical level. This usually occurs when lush green grass is the only feed or when pastures are fertilized with potash during the wet, fast-growing season. Lush green grass may be low in magnesium. Fast passage of feed and other factors may also limit the uptake of magnesium by the animal.

Treatment and Prevention

Treatment consists of IV administration of drugs containing magnesium. Usually milk fever remedies contain enough magnesium to treat this condition (see Therapy and Techniques). It is best prevented by feeding some legume hay and grain and by not allowing high milk producers to feed solely on lush grasses. Some dry straw-like forage might help reduce intake of grass or slow the passage of the grass through the digestive tract.

Human Health Concerns

None

Milk Fever

(Parturient Paresis, Hypocalcemia,
Lambing Sickness, Transport Tetany)

Symptoms

With milk fever, the ewe walks with wobbly gait or with foot dragging. She may be constipated or too weak to deliver her lambs. Occasionally, the ewe will not be able to stand and will be depressed. Keep the ewe's head slightly elevated and to one side so that if she vomits, fluid will not enter her lungs.

Laboratory confirmation of diagnosis is shown by a decreased serum calcium level, usually below 6 mg/100 ml.

Cause/Transmission

The last few weeks of pregnancy and after the birth of the lambs, ewes require more calcium. Stress or fasting can also upset this balance. Any factor that causes an upset of this balance may start hypocalcemia. Severe decrease of dietary calcium or any process that decreases utilization of that available in the blood is involved in the cause.

Treatment and Prevention

Treatment consists of a slow and cautious IV dose of 25% calcium borogluconate solution; usually 50 to 100 ml. If the product label indicates, half of this dose may be given intravenously (IV) and the other half subcutaneously (SQ) to reduce likelihood of heart stoppage from the intravenous calcium (see Therapy and Techniques). The response will be slower but almost as effective. Extreme caution should be used if intravenous calcium is being given. Feel the heart or listen for an increased or severely decreased rate while the solution is going into the ewe.

As a preventive measure, avoid feeds very low in calcium. Severe stresses, such as being transported long distances, and any situation where the ewe is without feed for an extended period of time, will also cause symptoms to develop. Excessive calcium just prior to lambing may initiate milk fever.

Human Health Concerns

None

Physical Injury/Wounds/Burns/Fractures

Sheep are often injured in fights with dogs, predators, and other sheep. Usually, with a little help, the animal will heal itself. First, bleeding should be stopped. This can normally be done by applying mild pressure. Second, clean wounds with

mild soap and water. Remove all dirt, hair, and trash. Be gentle so as not to cause renewed bleeding. Next, apply an antibiotic ointment, cream, or powder to the area. Finally, apply a bandage if the damaged area is large. Most wounds do not require bandaging.

Also clean and protect burned areas with an ointment. Use a saline or salt solution for cleaning and do not damage the burned area. If no antibiotic ointment is available, butter or cream will help.

If the wounds or burns are severe and large areas of skin are destroyed, the sheep probably should be slaughtered.

Fractures and dislocations sometimes are seen when sheep fight or get tangled in fences, feeders, or other equipment. Dislocations of joints are seen as an abnormal angle of the long bones from a joint. These are usually fixed or difficult to move. Sometimes the part farthest from the body can be pulled and it will pop back into place. If this cannot be done, the animal should probably be slaughtered. Fractures are usually of the long bones. Abnormal angle, loose movement, gritting of the fractured ends or protrusion of the bone ends into soft tissue or penetrating the skin will enable you to diagnose this condition. If the bone ends are in apposition (together), there is no penetration of the skin, and if the animal is valuable enough, the fracture may be cast and may heal in 6 to 8 weeks. Usually, however, it is best to slaughter as soon as possible after the break occurs.

In any of the above conditions, always assess the chance of survival and ability to return to useful service, compared to the immediate value for meat. If the meat value equals or exceeds the chance for return to service, the best option is slaughter.

Human Health Concerns

None

Polioencephalomalacia

Symptoms

The sheep shows sudden loss of appetite, depression, no fever, and normal or slightly reduced rumen motility with polioencephalomalacia. Nervous system signs are head pressing, grinding of teeth, aimless wandering, blindness, abnormal eye movements, muscle tremors, and overreaction or jumping when touched. When the sheep is unable to stand, the head usually will pull back. Convulsions and death follow in a few hours.

Cause/Transmission

Polioencephalomalacia is a noninfectious disease of fast-growing lambs and young adult sheep. The actual cause of the disease is unknown but may be due to molds on the feed that break down vitamin B₁ (thiamine) in the animal. It is usually seen in animals on a high grain ration and sometimes after a change in management practices.

Treatment and Prevention

Treatment requires thiamine injections of a total of 5 to 10 mg/kg, one-half of the dosage given IV and one-half given IM (see Therapy and Techniques). Additional half-doses should be given IM every 12 hours until the animal has recovered. If the sheep shows little improvement after 2 or 3 days, slaughter should be considered. No preventive measures have been reported.

Human Health Concerns

None

Pregnancy Toxemia (Ketosis)

Symptoms

Ewes with pregnancy toxemia are depressed, weak, and have poor muscle control and balance late in pregnancy. Later they lie down and are unable to rise. Death follows within a few days. After lying down, their symptoms often resemble those of milk fever. If treated for milk fever, they will

respond for a few hours in most cases and then relapse. This is because the products sold for milk fever contain 20% or more simple sugars, which will give temporary improvement. Early in the disease, many ewes will show a positive test for ketone bodies in the urine. Such test kits are often available and easy to use.

Cause/Transmission

Pregnancy toxemia occurs only within the last few weeks or days of pregnancy. It is usually seen when the ewe is carrying two or more lambs, or when the ewe is very fat. This disease is caused by the sudden extra demand for energy by the fast-growing lambs in the pregnant sheep. Because the uterus containing the lambs, fluids, and membranes requires increasing amounts of space inside the ewe, she has a decreasing amount of space available in the rumen to hold roughage. Also, if the ewe is fat, she has less room to hold feed than if she were slimmer. In either case, the end result is less available space for feed intake. To keep the lambs alive, the ewe will metabolize or break down fat from her body stores or break down her own body resources to maintain the pregnancy. This rapid breakdown of body stores produces ketones (a toxic by-product) and the symptoms of the disease. Do not allow fat ewes to lose weight in late pregnancy. Try to keep them from becoming overly fat earlier in the pregnancy.

Treatment and Prevention

If the ewe lies down and cannot stand, treatment is usually not successful unless she delivers at that time. Treatment with propylene glycol at 60 to 90 ml (2 to 3 oz) twice a day will help, as will treatment with corticosteroids and adding grain to the ration (see Therapy and Techniques). Cesarean section to deliver the lambs early will sometimes save the ewe and the lambs if they are near term.

As a preventive measure, do not let the ewe get fat early in pregnancy. **Do not** add a great quantity of molasses to the feed. Grain (primarily corn or sorghum) or grain by-products are a much

better source of energy and cause less indigestion. Oats are high in fiber and are not as good as corn or sorghum (milo). The last 4 to 6 weeks of pregnancy the ewe will require .47 to .90 kg (1 to 2 lb) of good quality grain or grain by-products and grass or good quality hay. If she is very large, or has a history of having three to five lambs, this diet will not be sufficient and should be increased 50% to 100%. Protein requirements should also be balanced, but protein level is not related to pregnancy toxemia.

Human Health Concerns

None

Parasitic Diseases
Causes, Treatments and Prevention
Blood Parasites

A parasitic disease is any disease condition caused initially or totally by the presence and activities of either internal or external parasites. This can occur in or on most parts of the body.

Anaplasmosis

Symptoms

Anemia is the most common symptom. Anemic animals have poor appearance and do not milk or reproduce well.

Cause/Transmission

This blood parasitic disease of sheep and goats is caused by the rickettsia *Anaplasma ovis*. The disease is usually passed from animal to animal by infected ticks, bloodsucking flies, and blood-contaminated needles and surgical instruments. Infected animals that show no symptoms of the disease are carriers of the organism. The disease is fairly common in areas where anaplasmosis occurs in cattle.

Diagnosis requires a laboratory examination for the organism inside the red blood cells.

Treatment and Prevention

Tetracycline drugs are recommended for prevention and treatment. Suggested treatment is based on cattle-dosage control at 4 mg/kg IM every 30 days using the 200 mg/cc oxytetracycline, or administered orally in feed at 20 to 30 mg per head per day on a continuing basis. Control of flies and ticks will help, as will sanitation of instruments used for castration, etc. (see Therapy and Techniques). Severe stress also tends to increase the risk of an anaplasmosis outbreak.

Human Health Concerns

None

Babesiosis (Red Water)

Symptoms

Sheep and goats usually show no outward clinical signs of *Babesia* infection. There may be a slight anemia and slight decreases in milk production, fertility, or growth rate. When such symptoms occur, you should look for fever, anemia, depression, and sometimes dark red urine. Most infected sheep recover completely in a short while.

Diagnosis requires a diagnostic laboratory examination for the *Babesia* organism inside red blood cells.

Cause/Transmission

Two blood parasites, *Babesia motasi* and *Babesia ovis*, are thought to cause babesiosis in both goats and sheep. Transmission is most likely by ticks belonging to the genus *Rhipicephalus*. This disease is most commonly seen in tropical areas.

Treatment and Prevention

Administer Acaprin or diminazene aceturate (Berenil). Control and prevention are based on controlling ticks with dips or sprays (see Techniques).

Human Health Concerns

None

Heartwater

Symptoms

Symptoms of heartwater vary from a sudden onset of high fever, convulsions, and death in 24 to 48 hours to an acute stage showing fever, reduced feed intake, depression, and rapid breathing. After 24 to 48 hours, the sheep will show nervous signs such as twitching of the eyelids, protruding tongue, walking in circles, or high stepping. The sheep may stand with its legs widespread and the head lowered as if to brace itself. As nervous symptoms increase, the animal will lie down and

start galloping movements. Death follows within 1 week of the first symptoms. A subacute form sometimes occurs with mild fever, slight incoordination, and recovery or death in about 2 weeks. Another form is seen primarily in wild ruminants and consists only of a high fever for a short time.

When diagnosing in the field, look for the presence of the "bont" tick (*Amblyomma hebraeum*). Postmortem signs of fluid around the heart and lungs also are helpful in diagnosis.

Cause/Transmission

Heartwater is seen in Africa and possibly in some Caribbean countries. It is caused by the rickettsia *Cowdria ruminantium*. The disease is not contagious from animal to animal; it must pass through the three-host tick *Amblyomma hebraeum*. Once infected, the tick remains infected for life but does not pass the infection to its offspring.

Laboratory tests are necessary to confirm the diagnosis. Heartwater has symptoms similar to other diseases of the nervous system, including tetanus (lockjaw), rabies, trypanosomiasis, piroplasmiasis, or poisoning by some plants, insecticides, and lead. Diagnosis is difficult.

Treatment and Prevention

Tetracyclines administered early provide good recovery and do not affect the immunity produced by having the disease. Prevention is difficult. In most places, young animals are infected artificially and then treated to provide immunity. Sheep in areas where the disease is prevalent remain immunized by continued exposure (see Techniques).

Human Health Concerns

None

Trypanosomiasis (Nagana, Sannare)

Symptoms

Symptoms of trypanosomiasis are primarily anemia, chronic weakness, and weight loss. Some 10% to 15% of untreated animals eventually die.

Blindness and nervous symptoms sometimes develop. Abortion occurs in females. Accelerated pulse and respiration are seen with swelling of lower parts of the body and legs (edema).

Cause/Transmission

Trypanosomiasis is caused by a blood parasite of sheep and goats transmitted by the bite of a tsetse fly and caused by *Trypanosoma brucei*, *T. congolense*, and *T. vivax*. Sheep and goats are not severely affected by these diseases, probably because the tsetse fly seldom feeds on them. Several African breeds appear to be trypanosome tolerant. This disease is seen only where the tsetse fly is found in Africa.

Treatment and Prevention

Treatment and prevention consist of injections of diminazene aceturate (Berenil) and homidium compounds (Novidium and Ethidium) and controlling the tsetse fly. When crossbreeding trypanosome-tolerant native sheep with exotic breeds to improve production, the lambs will usually be more susceptible to trypanosomes than their native parent; but they will be more tolerant than their exotic parent.

Human Health Concerns

Although it can occur in man, trypanosomiasis is not contagious nor passed from infected goats or sheep.

Parasitic Diseases

Causes, Treatments and Prevention

Internal Parasites

Coccidiosis

Symptoms

The symptoms of coccidiosis can vary from some loss of appetite and slight, short-lived diarrhea to severe cases involving great amounts of dark and bloody diarrhea, straining, loss of weight and appetite, dull appearance, with up to 15% mortality. Acute deaths are seen in young lambs. The feces of sick lambs contain many infective stages of the coccidia. When an outbreak begins, only good sanitation and isolation of sick animals will prevent its spread through the flock. Sheep that survive through a disease outbreak are usually immune to future problems.

Diagnosis is based on history, symptoms, and microscopic examination. Presence of coccidia in the feces of normal lambs does not indicate a disease situation. Do not treat unless symptoms are present.

Cause/Transmission

Coccidiosis is caused by a tiny parasite, *Eimeria* spp., that lives in the cells of the sheep's intestines. The tiny oocysts containing the infective stages are passed in the feces and contracted by other sheep through contaminated feed and water. The number of parasites that invade the intestine determines the severity of the symptoms. If the sheep is under severe stress, the disease becomes more severe, and other diseases such as pneumonia may be triggered. The combination of coccidiosis with another disease is usually fatal. The disease is most often seen when sheep are crowded into very unclean quarters. Coccidia are species specific and do not pass directly to or from other animals.

Treatment and Prevention

Several products are used in treatment, including two feed additives and a water additive.

However, the best treatment for the individual sheep is a first dose of sulfa drug at 200 mg/kg body weight followed by a half-dose (100 mg/kg) for 4 days (see Therapy and Techniques). Without good sanitation, however, treatments are ineffective. Keep lambs out of feed troughs, and arrange water troughs so that manure will not enter the water. Reduce crowding and stress, and separate the lambs from the adult sheep. Sheep that have been exposed to low levels of coccidia or have been treated and recovered develop a strong immunity.

Human Health Concerns

None

Flukes or Flatworms

Symptoms

Sheep with flukes or flatworms may show poor production and growth, bottle jaw, swollen and painful abdomen, anemia, and sometimes sudden death. Diagnosis is based on symptoms, identification of eggs under the microscope, and postmortem examination of dead animals.

Cause/Transmission

Flatworms are fairly large and live in several areas of the body. The most common is the liver fluke. Figure 1 describes the life cycle of these parasites. See Therapy section and table 1 (page 93) for control.

Human Health Concerns

None

Stomach and Intestine Roundworms

Symptoms

Anemia (paleness around the eyes, inside the mouth, or inside the edge of the rectum or vagina) is a prime symptom of stomach and intestine roundworms, along with blood loss and gut damage. You may also detect swelling under the jaw (bottle jaw) or low on the abdomen. Diarrhea may occur but sometimes the sheep dies before diarrhea can develop. Other symptoms include loss of weight,

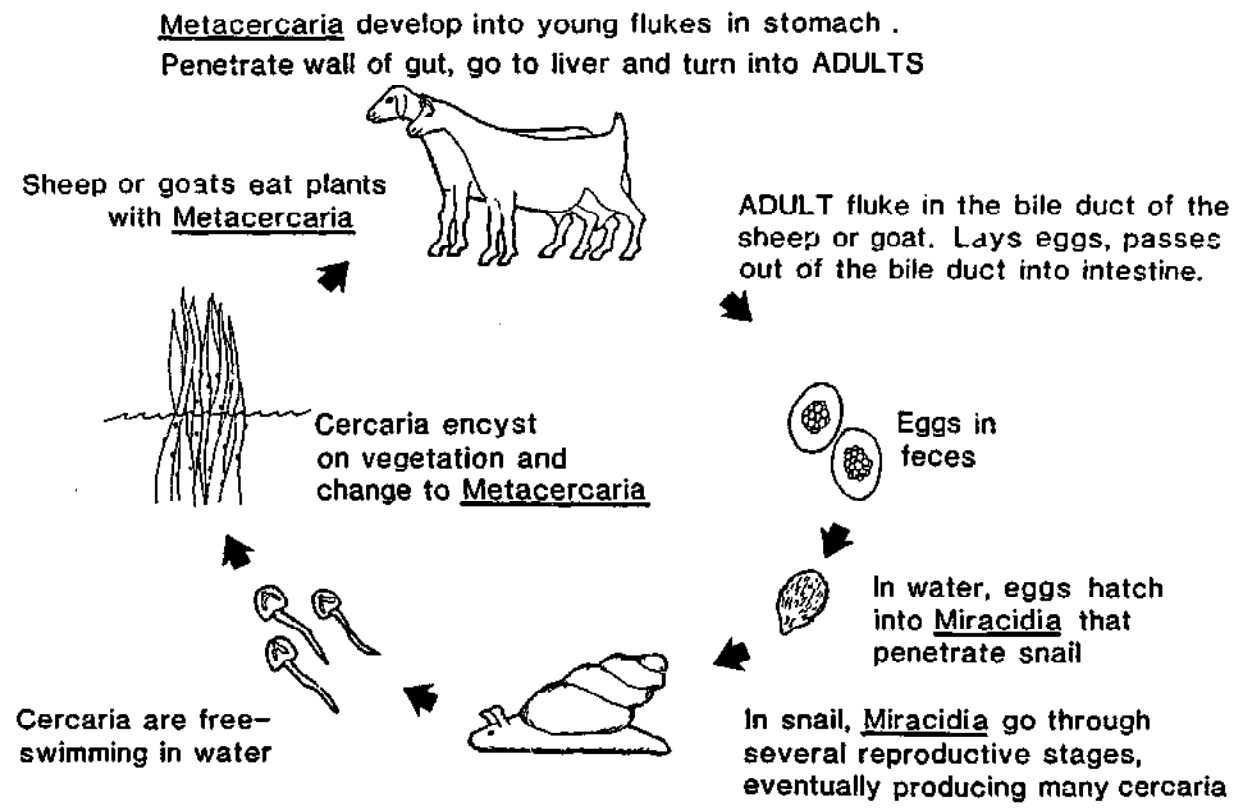


Figure 1. Typical Life Cycle of the Liver Fluke

poor growth, and a marked decrease in milk production. Normally the parasites require about 3 weeks to complete their life cycle. However, if large numbers of larvae are inactive and lying in the lining of the stomach and intestines, severe parasitism can occur within 7 to 10 days after deworming. Diagnosis is made on symptoms and identification of worm eggs under a microscope. Postmortem examinations of dead sheep also will help establish a diagnosis. Most of the adult worms are very small and difficult to observe in the stomach with an untrained eye.

Cause/Transmission

Young sheep are severely affected by these bloodsucking parasites. Figure 2 shows the life cycle of this type worm. All of the many species of these worms cause disease in a similar way.

Treatment and Prevention

Sheep should be treated regularly with drugs. Always treat before the sheep are placed onto new pasture, after lambing, and before and after spring growth or rainy seasons. See the section on Therapy for a description of useful drugs. The best preventives are a routine worming program and minimal fecal contamination of feed and water sources.

Human Health Concerns

None

Tapeworms

These long, flat, white worms live in the intestine as adult parasites and pass very visible segments out with the feces. They seldom cause any problem, except when great numbers infect very young lambs. They are easily controlled (see Therapy, page 93). Adult sheep usually build an immunity and no longer harbor many of the parasites. The life cycle is shown in figure 3.

Human Health Concerns

None

3rd-stage larvae in sheep or goats develop into 4th stage larvae.
Some develop into adults and lay eggs.
Others enter tissue as inactive larvae.

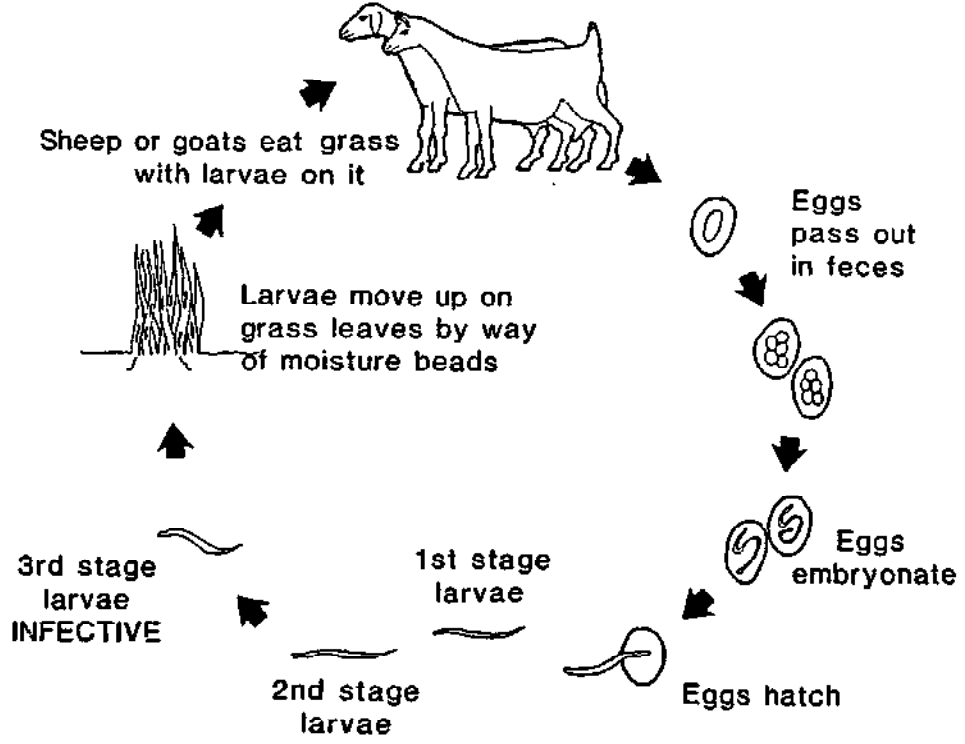


Figure 2. Typical Life Cycle of Bloodsucking Stomach and Intestine Roundworms

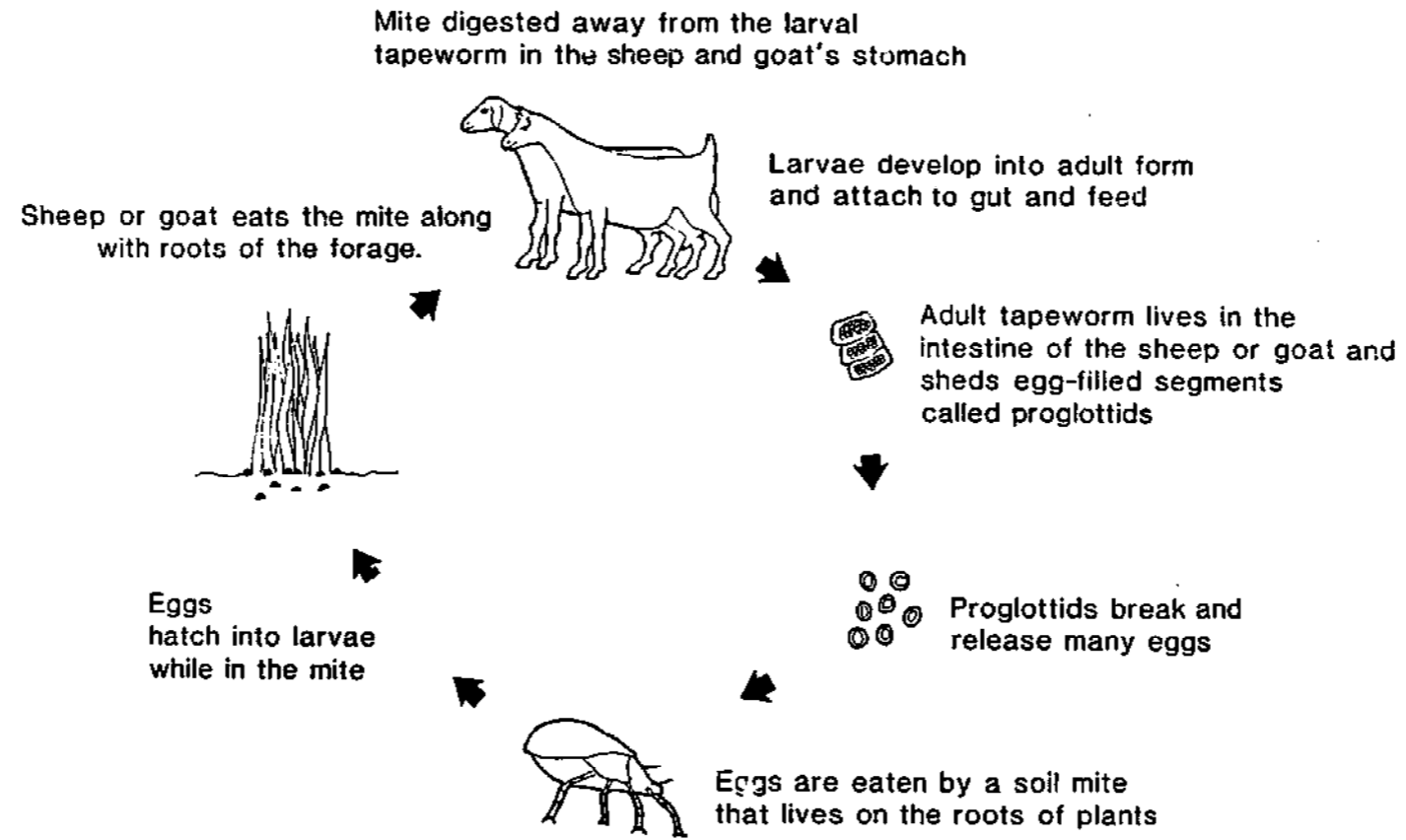


Figure 3. Typical Life Cycle of the Tapeworm

Whipworms

Whipworms may be associated with severe diarrhea. They usually do not cause a problem except in very severe infections and may then cause prolapse of the rectum. These worms feed on the content of the cecum and have a life cycle similar to the bloodsucking roundworms. They are slow to develop in the host, and eggs and larvae are very resistant to environmental conditions. Symptoms of unthriftiness and diarrhea are most common. Oxfendazole and fenbendazole are the best drugs for these parasites (see table 1, page 93).

Human Health Concerns

None

Lungworms

Lungworms have a life cycle similar to the intestinal roundworms. These parasites feed on mucus in the lungs and cause irritation and tissue damage which can predispose to pneumonia. The symptoms are poor condition, severe cough, rapid shallow breathing and no fever unless pneumonia has developed. Drugs that will control lungworms include cambendazole and levamisole (table 1, page 93).

Human Health Concerns

None

Toxoplasmosis

Symptoms

Very rarely does toxoplasmosis cause any sickness in goats and sheep, except an occasional abortion. Grey spots on the placenta of an aborted or stillborn lamb are seen. A few cases have been reported of children becoming infected after drinking unpasteurized or unboiled milk from goats or sheep that carry an internal infection. Diagnosis is by laboratory methods only.

Cause/Transmission

The coccidia-like organism first infects cats and can be passed to sheep if their feed becomes contaminated by cat feces. Other animals and humans may contract the disease through raw infected meat or by contact with infected urine, feces, or other excretions and fluids of the body, including milk. The disease probably occurs worldwide.

Treatment and Prevention

Some sulfa drugs are used in humans, but animals are seldom treated. Best prevention is by safeguarding feed supplies from cat feces.

Human Health Concerns

The risk is not great for humans but can be passed in unprocessed milk.

Parasitic Diseases
Causes, Treatments and Prevention
External Parasites

Lice
(Pediculosis)

Symptoms

With rare exception, lice are external parasites that live only on sheep, with the exception of one or two that also live on goats. They are very small; only one species can be seen by the naked eye. The symptoms are paleness and itching, with losses in growth rate due to irritation and blood loss. Diagnosis is made from the symptoms or from seeing some of the lice.

Treatment and Prevention

Treatment is easy. Many good insecticides are available to kill lice on sheep. A dip is best. Soak the sheep well. Treat at least twice, about 2 weeks apart, so that newly hatched young lice also will be killed. Use insecticides on lambs with extreme caution, as lambs are very sensitive. Do not spray the premises; lice that infect sheep live only on sheep. Contact with an infected sheep will reintroduce the parasite.

Human Health Concerns

None

Mange
(Scabies, Scab, Follicle Mites)

Symptoms

The two most common mites infecting sheep are the scab mite (*Sarcoptes*) and the follicle mite (*Demodex*). The scab mite causes severe itching, loss of hair, and scab formation. The follicle mite causes small lumps, usually on the forequarters but possibly over the entire body.

Cause/Transmission

Mange is transmitted by contact with infected sheep.

Treatment and Prevention

Both types of mange are difficult to control, especially the follicle mite. Use insecticides thoroughly and repeat at 2 week intervals for 2 to 3 months. Insecticides should be used with caution on lambs because of their extreme sensitivity.

Human Health Concerns

Humans may develop scab and follicle mites. However, they may be different from those found on animals. Transmission from animal to man is considered rare.

Ringworm

Symptoms

When ringworms infect an animal, they tend to extend outward from the infected area in a circular pattern. The symptoms are rough, scaly, circular areas where the hair or wool is missing or broken. The areas most commonly infected are the head, ears, neck, and sometimes the body and udder. The condition occurs only on the skin; there is no sickness or death loss. Diagnosis is made from the symptoms. Laboratory confirmation of the fungus can be done but is extremely slow.

Cause/Transmission

Ringworm infection is a skin fungus. Many such organisms can live for long periods in the soil.

Treatment and Prevention

Treatment for ringworm is best done by scrubbing the scales on the skin with a stiff brush or a piece of dull metal or wood. Apply 2% to 7% iodine on the lesion, 2 to 3 times per week. Be careful when applying iodine around the sheep's eyes. Rubbing the spots with a paste of the dewormer thia-bendazole, made with the powder and a small amount of water, will usually get rid of the fungus and will not injure the eyes. A suspension of wettable captan powder also works well. The building should be cleaned well after treatment to prevent reinfestation.

Human Health Concerns

Wash your hands after treating the animal because many ringworms that affect animals can also infect man.

Ticks, Flies, and Other Pests

Sheep are affected by ticks, flies, and other external parasites, including blowfly larvae and screwworms, in many parts of the world. If screwworms exist in the area, avoid surgical procedures (docking and castration) during the primary season for the pest. If lambs are born during this time, always treat any area where blood is found (navel or reproductive tract of the ewe) with an insecticide or a repellent. Many effective products are readily available worldwide.

It is also very important to control ticks because they transmit other diseases. Several good dip and spray insecticides are on the market worldwide. Follow the directions carefully for livestock usage or the recommendation of local livestock extension personnel. Lambs are very sensitive to insecticides, so use with care.

Treatment and Prevention

A list of insecticides and mixing instructions is not included in this guide because of the extreme worldwide variability of products available and recommended. However, the following comments and cautions should be adequate.

1. Any product recommended for a cow should be all right for a sheep. Remember, a sheep's weight is approximately one-tenth of a cow's. Use the same dilutions, but reduce the total dose according to weight if dose is based on body weight. Remember--wool sheep should be treated soon after shearing as a full fleece is very difficult to penetrate with insecticide.
2. **Always read and follow the manufacturer's recommendations and dilutions as printed on the container.** If they are not on the container or available, refuse to purchase the product.

3. Keep all insecticides away from children and from containers or utensils that will hold milk.
4. Keep insecticides away from drinking water sources and fish. Do not rinse cans in the river.
5. Do not keep empty insecticide containers--puncture, bury, or burn them.
6. Wash your hands well and any other part of your body that was exposed to the insecticide.

Little can be done to prevent reinfestation of these pests other than to confine the sheep; however, that is usually not a recommended procedure.

Human Health Concerns

These parasites affect man.

Therapy

Drug Usage

All drugs should be treated as potential poisons. Antibiotics can cause severe reactions if not used properly. The following recommendations apply to all drugs, regardless of type.

1. **Always read the label and follow the directions carefully.** Administer drugs only as stated on the label. For example, if the label states "for intramuscular (IM) use only," never give the drug intravenously (IV).
2. Out-of-date drugs should be used only when no others are available.
3. Do not mix drugs or give multiple drugs unless on the advice of a veterinarian.
4. Administer drugs for the time recommended on the label or by the veterinarian; the organism may develop resistance to that drug.
5. Antibiotics and sulfa drugs should always be given for at least 3 days or for 2 days after symptoms disappear.
6. Keep all drugs stored in a cool place, 1.5C to 12.5C (35F to 55F), and out of sunlight.
7. Always use sterile equipment when injecting drugs.

The chemical names are used for drugs in this guide because these are the names most likely to be found on the container in most countries. Trade names vary greatly, depending on the country and the company marketing the drug. Any source of a product used in the prescribed route of administration (injection, oral, etc.) and at the correct dosage for that route of administration will usually give satisfactory results. The recommended drugs are suggestions only and are assumed to be the most likely available and the most generally effective. However, many other products and treatment systems will perform equally well. Your veterinarian can usually give you the best advice possible based on knowledge of the local situation.

Remember, you are dealing with a food animal. It may be more beneficial and economical to salvage the animal through slaughter than to treat it with expensive drugs. Make this decision before any drugs are given so as not to contaminate the meat. Make sure no human health concerns apply.

How to Figure Dosage of Drugs

Liquid dosage in ml =

$$\frac{\text{Dose in mg/kg} \times \text{animal's weight in kg}^*}{\text{Concentration of drug in mg/ml}}$$

OR

Powder dosage in g =

$$\frac{\text{Dosage in mg/kg} \times \text{animal's weight in kg}^*}{\text{Concentration of drug in mg/g}}$$

*kg = pounds \div 2.2

For example, your sick sheep weighs about 40 kg. You want to give it an intramuscular dose of oxytetracycline hydrochloride. Your chart shows the dose as 6 to 10 mg/kg. Look on the bottle. It says the concentration is 50 mg/ml. The dose, 10 mg/kg, would be calculated as:

$$\frac{10 \text{ mg/kg} \times 40 \text{ kg}}{50 \text{ mg/ml}} \quad \text{or} \quad \frac{400 \text{ mg}}{50 \text{ mg/ml}} = 8 \text{ ml}$$

The dose for a 40 kg sheep at 10 mg/kg of a solution containing 50 mg/ml is 8 ml, given intramuscularly.

Always check the concentration of the solution because it may come in different strengths. For example, the tetracyclines also come in a 100 and a 200 mg/ml concentration. Use the same formula regardless of concentration or whether a liquid or powder.

Approximate Weights and Measures

1 teaspoon	= 5 milliliters = 60 grains = 60 drops = 5 grams
1 tablespoon	= 3 teaspoons = 15 milliliters = 0.5 ounce = 15 grams
1 ounce	= 30 milliliters
1 cup	= 16 tablespoons = 0.5 pint = 8 fluid ounces = 250 milliliters
1 pint	= 2 cups = 16 ounces = 500 milliliters
1 pound	= 2 cups = 16 ounces = 454 grams
1 ml	= 1 cubic centimeter (cc) = 15 to 16 drops = 1 gram
1 liter	= 1,000 milliliters
1 kg	= 2.2 pounds = 1000 grams

To make 750 ml of a 5% solution, dissolve 5 g in each 100 ml of volume. For a 750-ml liquor bottle, use 37.5 g of the powder. Double the powder to make a 10% solution.

Treatment for Scours or Diarrhea

Check the following signs to estimate percentage of dehydration in lambs based on body weight:

<u>% Fluid Loss</u>	<u>Signs</u>
0 to 5%	None
6%	Mouth dry--skin remains erect when pinched
10%	Body cold--unable to stand
12%	Flat on side--shock--near death
Above 12%	Death

The appropriate amount of replacement fluid per day required for a dehydrated lamb is the per-

centage of estimated loss due to dehydration plus 10% of the body weight, which is the amount of fluid needed for daily maintenance. For example, a 4.5-kg (10-lb) lamb approaching a 10% dehydration factor would need at least 500 ml of replacement fluid just to replace the amount lost. In addition, the lamb normally requires about 10% of its weight in fluids each day; therefore the lamb in our example would require a total of 1 liter per day.

Fluid Replacement Solutions—for Oral Use

For mixing with these formulas, it is best to boil the water for at least 10 minutes, although regular water sources can be used when necessary.

Formula #1

1 package MCP canning pectin
10 g low sodium table salt
10 g baking soda
1 beef bouillon cube dissolved in 200 milliliters of water

Add water until you have mixed 2.5 liters of solution. Use tube or bottle to administer by mouth at a rate of 10% of lamb's body weight plus the additional percentage for fluid loss (as estimated using chart above). Divide the total dosage into 2 to 4 parts to be given as the only source of food for 1 or 2 days. Use 1/2 formula and 1/2 milk on the next day and on the following day give 3/4 milk and 1/4 formula. Then give full milk if the lamb has improved.

Formula #2

10 g table salt
5 g baking soda
120 ml white corn syrup or honey

Add water to make 4.5 liters. Give by mouth, with a tube or bottle, at a rate of 10% of body weight plus percentage estimated for dehydration. Divide into 2 to 4 doses per day as the only source of food for 2 days. On third day mix 1/2 milk and 1/2 formula. On fourth day mix 3/4 milk and 1/4 formula. On fifth day give milk only if recovered.

If you cannot find some of the above ingredients, this next solution will help.

Formula #3

10 g salt
10 g baking soda

Add to 2.5 liters of water. Then, after removing lamb from milk, figure 10% of body weight, plus percentage estimated dehydration, and administer orally as one dose. Then divide the total amount into 2 to 4 doses for the next 2 days and gradually return lamb to full milk as outlined in formulas above. If the lamb does not improve, change the antibiotic used and start the fluid program again in the same way.

Formula #4

Where coconuts grow, the water from green coconuts can be used as a sterile fluid for replacement purposes.

Saline Solution

Put 1 g salt in 100 ml of water that has been boiled for 10 minutes. Can be administered intravenously or to clean wounds.

Grain Overload Mixture (for Rumen Acidosis)

125 g sodium bicarbonate
210 ml 12% formaldehyde solution
5 g magnesium oxide
10 g activated charcoal

Add water to bring contents up to 500 ml. This mixture will keep for 30 days. Shake well before using. To use, take 10 ml per 45 kg (100 lb) of body weight and mix with 1 liter of water. Give as a drench or, preferably, by stomach tube twice a day. Also give 2 ml dipyrone per 45 kg body weight IM.

Foot Bath Mixtures (Solutions to Soak Infected Feet)

Copper sulfate: 0.5 kg (500 g) of copper sulfate (bluestone) dissolved in 25 liters of water.

Zinc sulfate: 1 part zinc sulfate to 9 parts water.

Concentrated zinc sulfate foot bath: 1 kg of 99% zinc sulfate in 5 liters of water.

To make a foot bath, soak old rags or wool in the solution and place them in a walk-through trough 5 to 10 cm deep, 30 to 45 cm wide, and long enough that the sheep cannot jump over it.

Table 1. Drugs for Controlling Internal Parasites (Anthelmintics and Coccidiostats) ^a

Drug	Roundworms	Larvae	Whipworms	Tapeworms	Lungworms	Flukes	Coccidia	Precautions (always check label for withdrawal information.)
*Albendazole	5-10 mg/kg			5-10 mg/kg		10-20 mg/kg		Do not use 1st third of pregnancy-- 75 mg/kg fatal.
*Oxfendazole	5 mg/kg	5 mg/kg	5 mg/kg	5 mg/kg	5 mg/kg			Do not use in pregnant animals-- safe to triple dose otherwise.
*Cambendazole	10-15 mg/kg	25 mg/kg		20-25 mg/kg	40 mg/kg			Do not use in 1st third of pregnancy. Do not overdose.
*Fenbendazole	5 mg/kg	5 mg/kg	5-10 mg/kg	5-10 mg/kg	5 mg/kg	10 mg/kg or more		Safe in pregnant animals and breeding males.
Thiabendazole	44-66 mg/kg							Resistance common. Safe in pregnant animals.
*Oxibendazole	5-10 mg/kg	5-10 mg/kg						Safe in pregnant animals.
Mebendazole	13.5 mg/kg			13.5 mg/kg				Safe in pregnant animals.
Levamisole	8 mg/kg				8 mg/kg			Do not overdose or use on milking sheep. Safe in pregnant animals.
*Haloxon	50 mg/kg							May cause posterior paralysis.
Phenothiazine	12.5 g/11 to 27 kg 25 g over 27 kg							Do not use last third of pregnancy-- only fairly effective. Do not use on lactating ewes. Do not overdose or use on debilitated animals.
*Moxidectin	10 mg/kg							Safe in pregnant animals.

^aDrugs not approved for sheep and goats in the U.S.

^aNote that all dosages are based on active ingredients. Dosages are per kilogram of bodyweight unless otherwise indicated.

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Table 1. Drugs for Controlling Internal Parasites (Anthelmintics and Coccidiostats) continued ^a

Drug	Roundworms	Larvae	Whipworms	Tapeworms	Lungworms	Flukes	Coccidia	Precautions (always check label for withdrawal information.)
*Amprolium							10-14 mg/kg 50 mg/kg	Give for 5 days to 21 days. Long term use may cause thiamine (B ₁) deficiency. One time drench.
*Pyrantel	25 mg/kg							Safe in pregnant animals.
*Monensin							.75 g/44 kg (15 g/ton)	Fairly toxic. Feed throughout feeding period.
Sulfa drugs (dimidine, guanidine, methazine, quinoxaline)							200 mg/kg	Reduce dosage by 1/2 on subsequent days. Treat for 3-5 days. Make sure drinking water intake is normal.
*Lasalocid							1 g/44 kg (20 g/ton) 4.5 g/44 kg (90 g/ton)	In feed. In salt.
*Decoquinate							.5 mg/kg	In feed for 28 days.
*Avermectins	200 µg/kg	200 µg/kg						Also effective against external parasites. Dosage in micrograms.
Nitrofurazone							7-10 mg/kg	Prescription drug.

^aDrugs not approved for sheep and goats in the U.S.

^aNote that all dosages are based on active ingredients. Dosages are per kilogram of body weight unless otherwise indicated.

Table 2. Antibiotics and How to Use Them

Antibiotic	Route to be given:	Dose	Repeat dose:
Ampicillin	IM or IV	4-10 mg/kg	every 12 hr
Amoxicillin	orally	6-10 mg/kg	every 12 hr
Chloramphenicol	orally	20-50 mg/kg	every 8 hr
Erythromycin	IM or IV	10 mg/kg	every 12 hr
	IM	10-12 mg/kg (young) 2-5 mg/kg (adult)	daily
Penicillin			
G-Procaïne	IM	30,000-40,000 units/kg	daily
G & benzathine	IM	30,000-40,000 units/kg	only once
G & streptomycin	IM	30,000-40,000 units/kg	every 12 hr
Neomycin	orally	5-10 mg/kg	every 12 hr
Spectinomycin	orally	10 mg/kg	every 12 hr
Sulfabromomethazine	orally	130-200 mg/kg	daily
Sulfachloropyridazine	orally	65-95 mg/kg	daily
Sulfadimethoxine	orally	55 mg/kg	1st day
	orally	Reduce dose by 1/2 on second day	
Sulfaethoxypyridazine	orally	200-400 mg/kg	daily
Sulfamethazine	orally	200 mg/kg	1st day
(Sulfadimidine)		Reduce dose by 1/2 on second day	
Other Sulfa drugs	orally or IV	200 mg/kg	every 12 hr
		Reduce dose by 1/2 on second day	
Tetracycline group (all use same dose)			
Chlortetracycline	IV or IM	6-10 mg/kg	daily
Oxytetracycline	orally	10-20 mg/kg	daily
Tetracycline HCl			
Tylosin	IM	2-4 mg/kg	daily

Antibiotics should always be prescribed by a veterinarian. All antibiotics should be given 3 to 5 days at above dosages and times. If no improvement is seen after two days treatment, another antibiotic should be used, if possible.

Table 3. Other Common Drugs

Other drugs	Route to be given:	Dose	Repeat dose:
Aspirin	orally	10-20 mg/kg	every 6-8 hr
Calcium borogluconate (23Z)	IV, SQ	1 ml/kg in the first day	once or twice
Charcoal (activated)	orally	2-9 g/kg	as needed
Epinephrine 1:1000	IV or SQ	2-4 ml	as needed (2-4 hr)
Milk of Magnesia	orally	45-60 ml	every 6-8 hr
Mineral oil	orally	100-500 ml	as needed
Oxytocin	IM or IV	20-40 units	as needed (2-4 hr)
Poloxalone (bloat)	orally	100 mg/kg	as needed
Sodium bicarbonate	orally	15-45 g in water	as needed
Vitamin E - Selenium [®]	IM	0.1 mg/kg Selenium 1.36 IU/kg Vitamin E	once per mo once per mo daily
Magnesium sulfate (Epsom salts)	orally	1-2 g/kg	
Propylene glycol	orally	200 ml	every 12 hr
Methylene blue liquid or powder for minor wounds			
Iodine 2% liquid for minor wounds			
Iodine 5% liquid for minor wounds			
Iodine 7% liquid for dipping navels			

Techniques

Sterilizing Instruments, Syringes, and Needles

Sterilize all instruments before using. Clean instruments with soap and water after using and before sterilization. Scrub away all grease, blood, and tissue, then rinse with clean water. To sterilize, boil in clean water for 15 to 20 minutes. Dry heat and steam can also be used. Remove the instruments from the boiling water and wrap in a clean cloth to keep them clean until used. Wet sterilization in chlorohexadine or one of the quaternary ammonium disinfectants at the proper dilution can be used for surgical instruments just prior to use. Read label carefully. Soak instruments at least 20 minutes before using.

Do not use wet sterilization for syringes and needles. Residue in the syringe and needle from the disinfectant can cause irritation to the animal and can deactivate some vaccines. Boil syringes and needles instead.

Injection Sites

The following abbreviations are for the corresponding type of injection and the site on the sheep as shown in the illustration (figure 4).

Intramuscular (IM) - injected deep within a major muscle mass, such as that in the hind leg or on the shoulder. It should be given with an 18 gauge, 2.5 to 4 cm needle, pointed straight into the muscle. Before injecting the drug, always withdraw on the syringe plunger to make sure you have not hit a blood vessel. If this happens, blood will flow into the syringe. To correct, simply replace the needle in the muscle.

Subcutaneous (SQ) - injected under the skin, usually in the neck or behind the shoulder. Usually a 1 to 2.5 cm needle is inserted at an angle through the skin. So that you do not stick yourself, pick up the skin with your fingers and insert the needle through the skin while it is pointed away from your fingers.

Intravenous (IV) - injected into a vein, usually the jugular or neck vein as in the illustration (figure 4). This procedure takes some skill and practice. Become thoroughly familiar with the method before attempting to use it. The vein must be blocked with one hand near the shoulder to enlarge it and make it visible. Usually a 4 cm, 18 gauge needle is used for IV injections. All IV injections should be given slowly, using only products specifically approved for this method. The heart should be closely monitored as heart stoppage may occur.

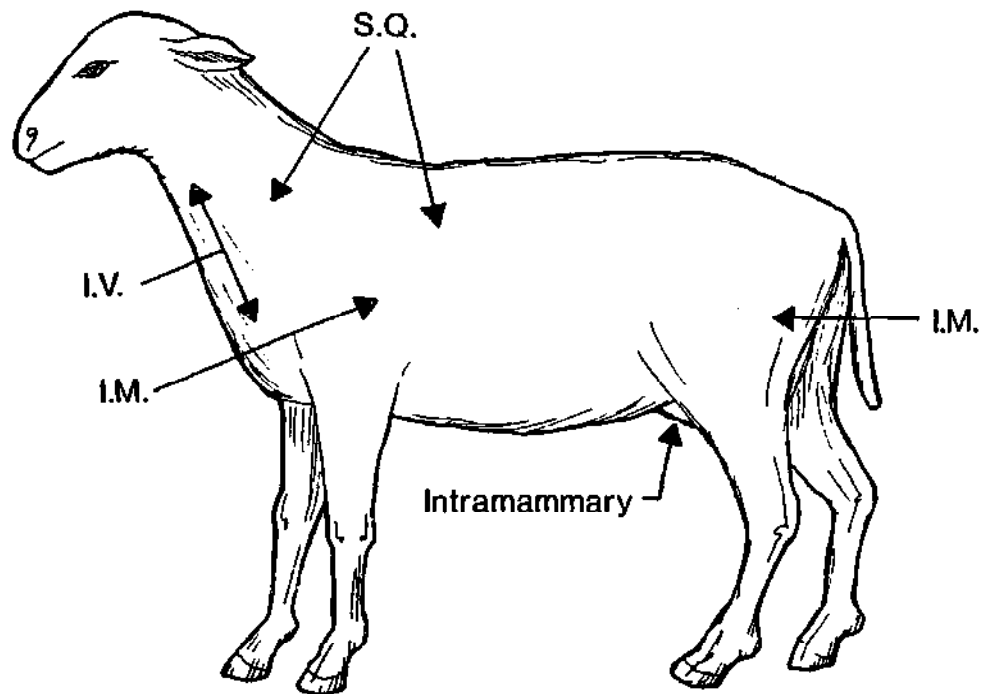


Figure 4. Injection Sites

Intramammary - injected within the milk gland, into the end of the teat through the natural opening. Always wash the teat end with soap and water and wipe it with alcohol before injection. Use only sterile, blunt, teat infusion needles or "throw-away" mastitis medicine applicators. Unclean material entering the teat will cause mastitis. Figure 5 shows the structure of the teat.

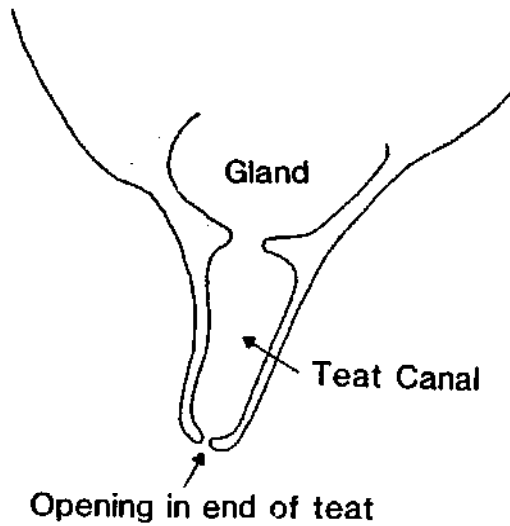


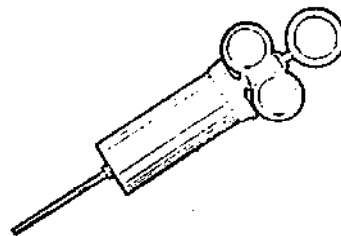
Figure 5. Intramammary Injection

Equipment and Procedures for Giving Medicine by Mouth

Drenching - Most sheep will swallow liquids placed into the mouth if their heads are held slightly upward. A dose syringe or a bottle with a rubber hose attached (figure 6) will work well. Place the end of the tube over the top of the tongue. Be careful not to injure the inside of the mouth. Tasteless liquids such as mineral oil should be given by stomach tube or flavored so that the sheep will swallow them.



Slide hose over bottleneck to use as a drench bottle



Dose Syringe - for giving liquid to sheep

Figure 6. Bottle with Rubber Hose and Dose Syringe

Stomach Tube - This is used to carry liquids (large volumes) into the stomach or to release gas. A 1 to 2 cm rubber or plastic tube can be used. First pass the tube through a metal pipe to clear the sheep's jaw teeth and prevent chewing (figure 7). A similar piece of equipment is a small rubber tube, (#18 French catheter) and 60 cc syringe (figure 8), which can be used to place colostrum into the stomach of a newborn lamb. A metal pipe to protect the tube is not necessary for newborns.

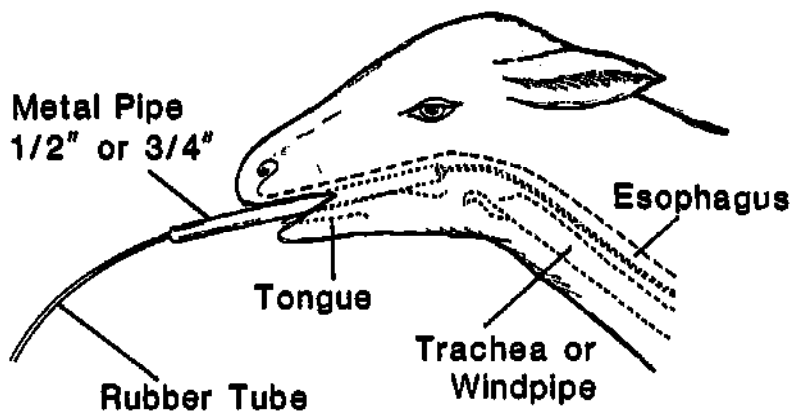
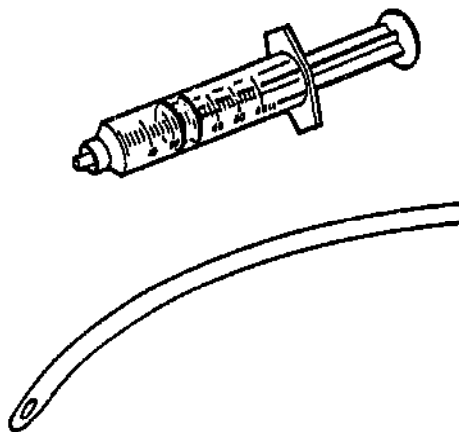


Figure 7. Stomach Tube Technique



**60cc Plastic Syringe
and
15" Human Catheter
Size #18 French**

Figure 8. Syringe and Catheter

Bolus or Pill Administration - A small balling gun (figure 9) is used to give pills or boluses to sheep. The small guns are passed into the mouth over the hump on the tongue, and the plunger is gently pushed down taking care not to injure the mouth. Sheep will often reject boluses, and they must be given again. Be patient. Pills may also be pushed over the back of the tongue with the fingers, but keep your fingers from between the jaw teeth. Do not overextend the head or the bolus may go down the windpipe.



Figure 9. Balling Gun for Giving Pills to Sheep

Rumen Inoculation - When a sheep has been sick and has not eaten, the rumen or large stomach becomes sour and lacks the proper bacteria to get started in the digestion process again. Many times the liquid from the stomach of a normal sheep, or one that has been recently slaughtered, can be pumped or poured through a tube or drenched into the rumen of the sick sheep. This procedure will help many sheep that do not want to eat but are otherwise recovering from sickness. Following the stomach tube or drenching technique, use a quart or more of liquid from the rumen of a healthy sheep.

Castration

Male lambs not wanted for breeding, or that will not be slaughtered for meat at an early age (4 to 6 months), should be castrated before they are 1 month old. The lower 1/3 of the scrotum (sack) is cut off. Place pressure on the testicles above the cut area and force the testicles out of the cut end of the sack. Each testicle should then be grasped, pulled out as far as possible, and cut off. A sharp knife or scissors can be used for this pro-

cess. Do not handle any tissue that remains in the sheep as infection is very likely to occur.

Young lambs can be castrated without anesthesia. However, if anesthesia is desired, consult with a veterinarian. Each lamb should receive 150 to 200 International Units (IU) of tetanus antitoxin (T.A.T.) at time of castration. If castration and docking are done at the same time, only one dose of T.A.T. is necessary. An antibiotic powder may be applied to the wound. If screwworms are a problem, always apply an insecticide or a fly repellent to the wound.

Docking

The procedure of cutting off lambs' tails is called docking. This is practiced on most wool-producing breeds to reduce fecal contamination of the fleece and to help reduce the likelihood of fly strike or wool maggots.

The lamb is held where the bottom of the tail can be seen and the tail is cut off where the 2 folds of skin join onto the tail (figure 10). Any sharp, clean instrument can be used to dock lambs under 1 week of age, but it is better if the instrument crushes the tissue some while cutting. This controls bleeding. Any of the instruments illustrated in figure 11 work well for docking.

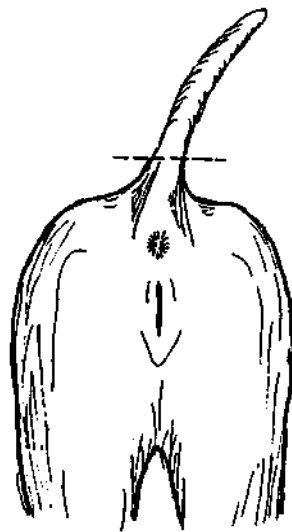
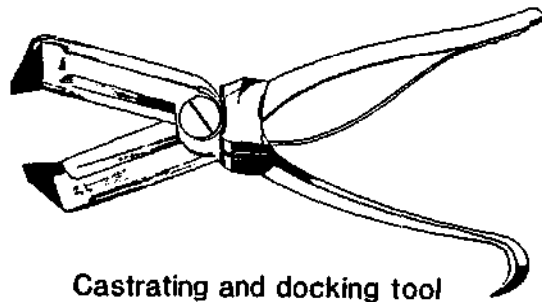
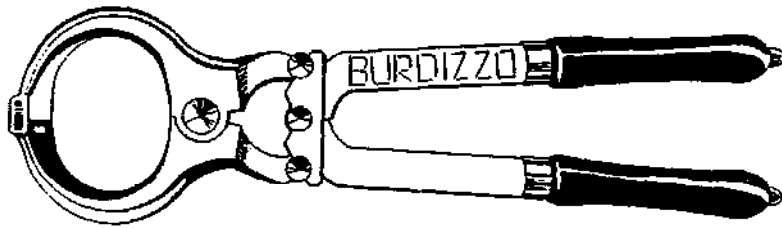


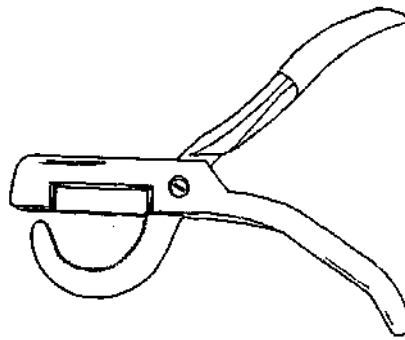
Figure 10. Correct Location to Dock Tail



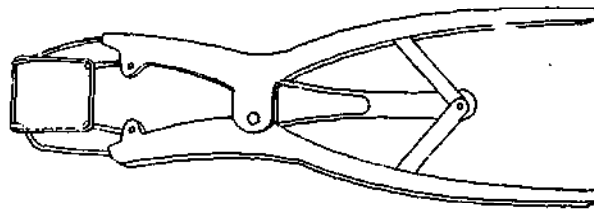
Castrating and docking tool



The Burdizzo castrator may be used for tail docking as well as castration



Emasculator - may be used for docking as well as castration



Elastrator - for docking or castration

Figure 11. Castration and Docking Instruments

Rubber bands called Elastrators may also be used, but to get the best results 150 IU T.A.T. should be given to each lamb. After 3 to 5 days, cut the dead end of the tail off below the band.

Foot Trimming

The sidewall and toes of sheep's feet sometimes become overgrown, especially if the animal is housed or not allowed to graze freely. These overgrown sidewalls should be trimmed as often as needed to keep the foot flat on the sole and toes pointed as shown. The feet can be trimmed with sheep foot shears, heavy scissors, or a sharp pocket knife. When trimming diseased foot tissue, some bleeding may occur.

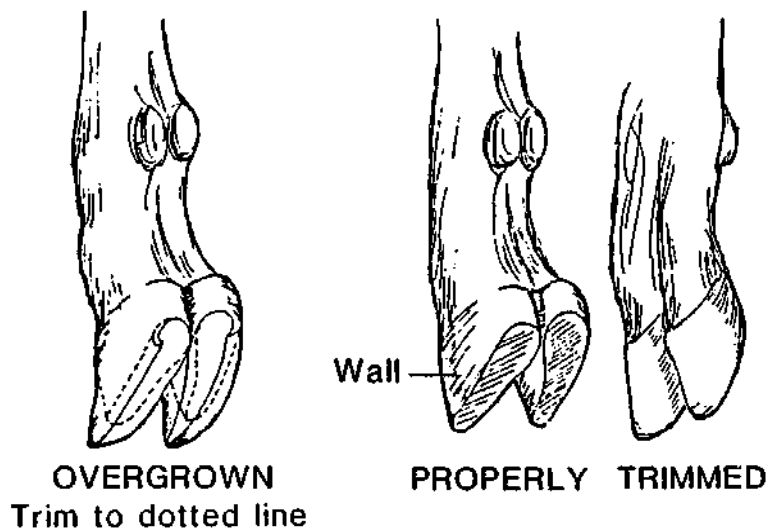


Figure 12. Proper Method of Trimming Foot

Lancing (Opening) Abscesses

Abscesses, usually caseous lymphadenitis, should be opened when they become ripe or pointed (when the abscess develops a soft center or is slightly raised in the center). First, clean the area to be opened with soap, water, and alcohol. Then stick a needle into the enlarged area. If blood comes through the needle, **stop**, you may have gone through a blood vessel. Remove the needle and

try another place. If pus is released, proceed on to the next step. Make a small puncture with a very sharp knife over the softest point, cutting downward toward the ground so that the abscess will drain. Gather all the pus on a piece of paper or cloth and burn or deeply bury the residue. Wash the abscess with water or alcohol, then wash with 7% iodine. Figure 13 indicates the areas most likely to have abscesses.

Be very careful when opening abscesses around the head or above the udder; you can easily cut into a large blood vessel or sever a major nerve.

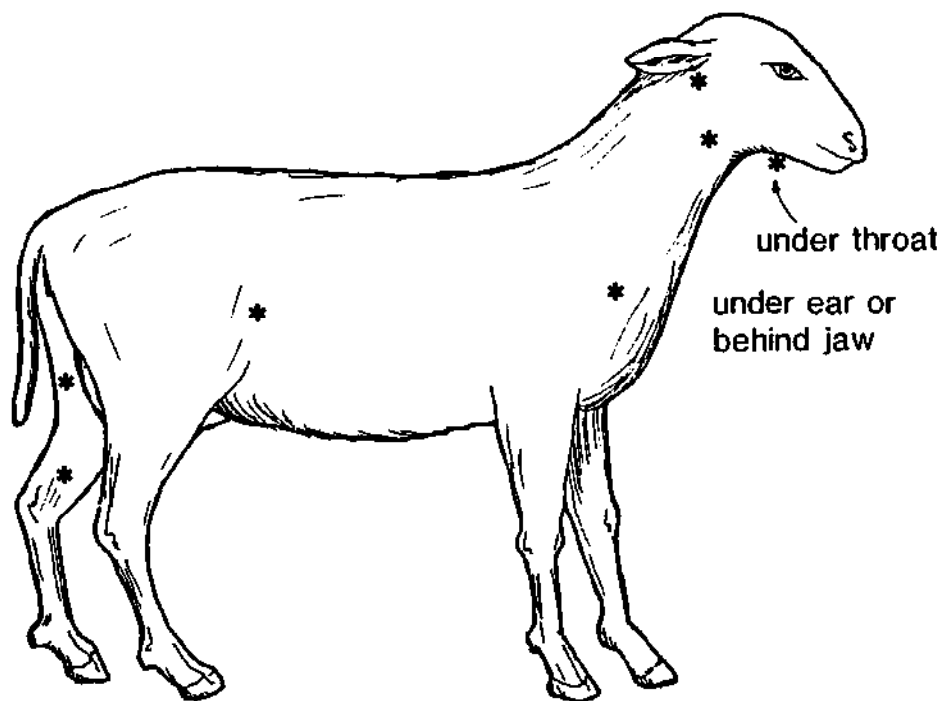


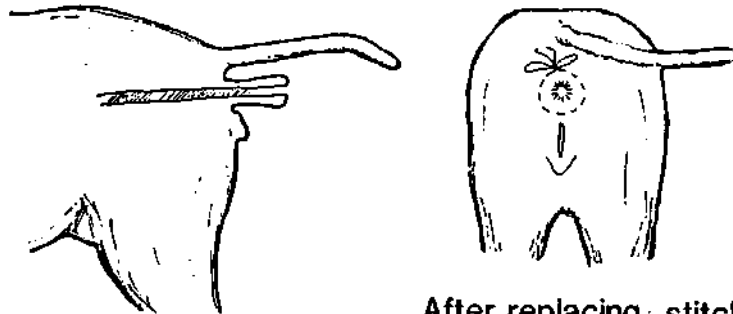
Figure 13. Lymph Node Locations Where Abscesses Occur

Collection of a Urine Sample

Have a small, clean container ready for catching the urine. Hold the sheep and pinch the nostrils closed until urination occurs. Most sheep will urinate in 30 seconds or less. Do not hold nostrils closed for more than one minute. Procedure may be repeated as often as necessary until sample is collected.

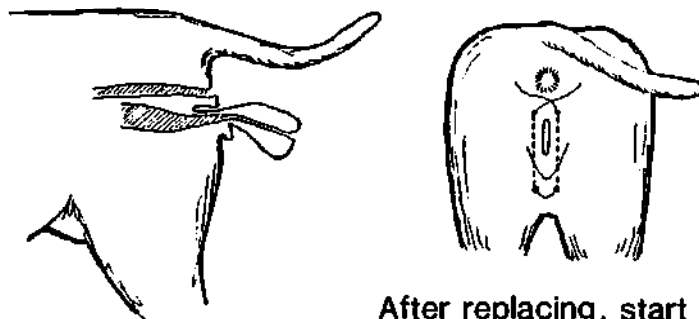
Rectal and (or) Vaginal Prolapse

The rectum and/or vagina may sometimes be ejected from the body by coughing, constipation, or difficulty in delivering lambs. Very short tail docking may contribute to prolapsing. The condition also may be inherited. If the tissue is fresh and undamaged, it may be washed, carefully pushed back into place, and stitched. Any type of heavy string (soaked in alcohol or disinfectant) can be used for stitching (figures 14 and 15). Most ewes injured in this way should probably be slaughtered after the lambs are weaned. If the tissue is torn, damaged, or has been outside the body for some time, slaughter is recommended.



After replacing; stitch around and tie bowknot at top leaving room for bowel movements.

Figure 14. Prolapse of Rectum



After replacing, start stitch at top, go 1/4" deep under the skin to bottom, out, across and back up.

Figure 15. Prolapse of Vagina

Birth and the Newborn

Birth Stages, Procedures, and Complications

Most ewes deliver their lambs without assistance after about 146 days of pregnancy. You should know the normal delivery time and procedure so as not to interfere with or injure the reproductive tract of the ewe (figure 16). Many ewes that do not rebreed may have been damaged at a previous lambing, which is the result of poor human management.

The ewe should be in good physical condition, but not fat, at lambing time. She should be full bodied, muscles filled out, and smooth over her ribs and top line. Proper feeding is necessary during the last 4 to 6 weeks before lambing to prevent pregnancy toxemia or ketosis. Daily exercise is also very important.

When delivery time is due, a very clean place should be available. The ewe may be placed in this area about 1 day before she is due, if due date is known. Do not keep her there much longer because of the build up of filth. Provide dry bedding to absorb the fluids that are produced during the birth process. If lambing occurs in the field or pasture, it is advisable to enclose the ewe and her lambs in a 1.3 m x 1.6 m pen for 2 or 3 days to ensure acceptance by the ewe and to keep the lambs safe. Besides the predator problem, other ewes may steal lambs.

Phase I of the birth process involves relaxation of the pelvis, initial contractions of the uterus, and dilation of the cervix, which enlarges the birth canal and eases delivery. During this time, the udder will become greatly enlarged and the teats will fill. This can occur several days before time to deliver. The vulva will become slightly red, everted or slightly rolled outward, and moist. Usually the ewe will have a depressed appetite. She may appear restless and paw the ground and bleat. This phase may require more than 1 day. Usually the "water bag" ruptures near the end of this phase.

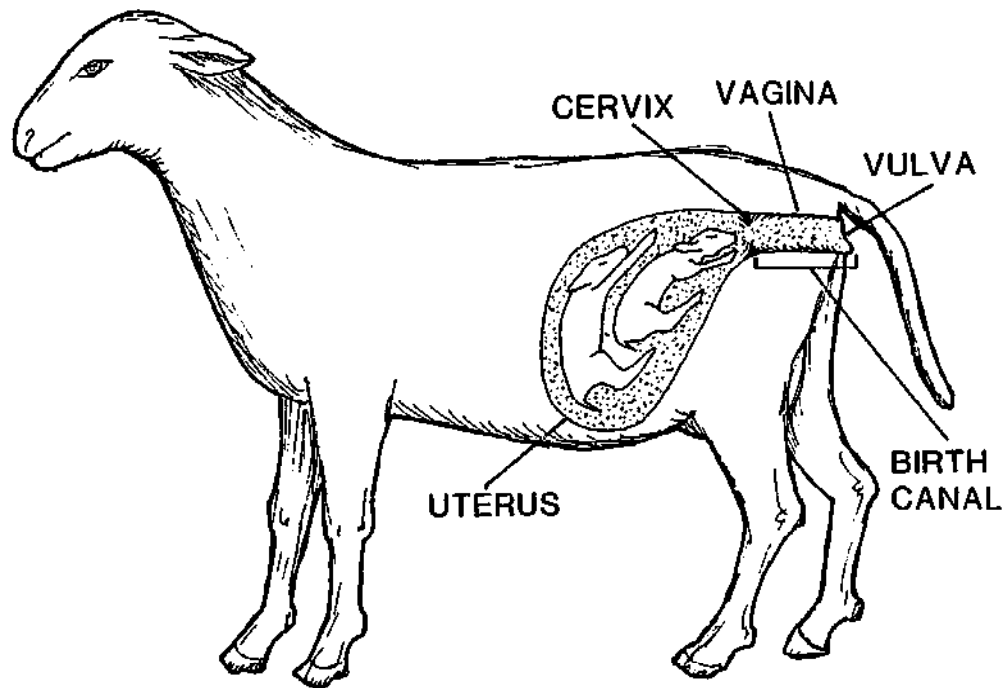


Figure 16. Normal Positions and Locations of the Reproductive Tract of the Sheep

Phase II is the actual delivery of the lamb. It starts with the entry of the lamb into the birth canal. With this entry pressure, the ewe begins to strain, pushing with the abdominal muscles. This phase should never last more than 3 hours. The lamb is usually delivered within 1 to 1.5 hours. Multiple births follow 30 minutes to 1 hour apart. As a good rule of thumb, if the lamb has not been delivered within 1.5 hours, you should examine the ewe. If delivery cannot be made with assistance within 2 hours from the start of true labor, you should seek veterinary assistance. You should watch the ewe continuously during this phase.

Lambs are delivered in many different postures or positions, two of which are absolutely normal: 1) the anterior position, with the head lying on the forefeet, the chin resting on or about the knees, and the lamb's back up (figure 17); and 2) the posterior entry with both rear legs into the birth canal and the lamb's back toward the ewe's back (figure 18). Usually the posterior position takes a little longer for delivery. Abnormal positions are discussed later.

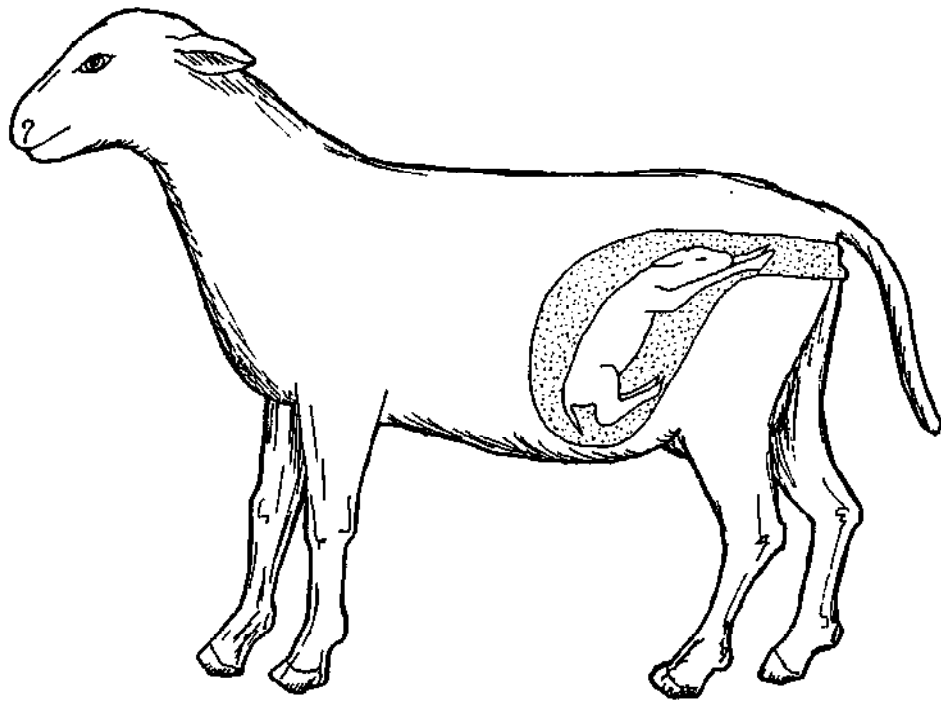


Figure 17. Normal Anterior Presentation

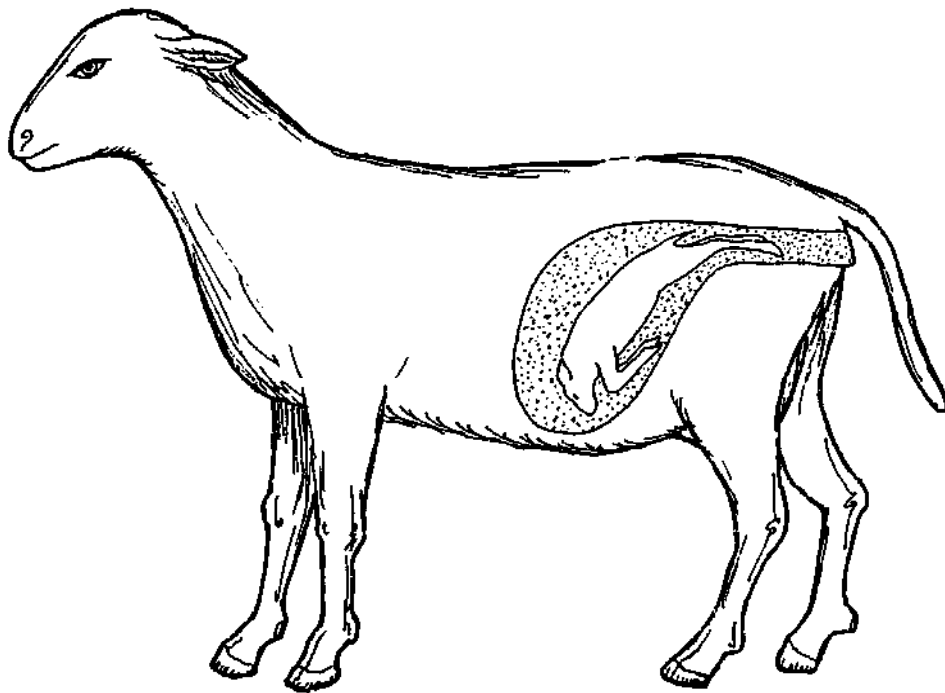


Figure 18. Normal Posterior Presentation

Phase III is a clean-up phase which, after a normal delivery, requires up to 2 weeks. It consists of 1) delivery of the afterbirth (which usually requires a maximum of about 12 hours), 2) reduction of the uterus to normal size (which may take up to 2 weeks), and 3) emptying of extra fluids from the uterus. Most fluids are gone by the time the afterbirth or placenta falls out. However, it is normal to have a slightly bloody to clear discharge for up to 2 weeks after lambing. Problems that might occur in phase III are 1) retention of the afterbirth for longer than 24 hours, 2) a pus-like discharge occurring within 2 to 3 days after lambing, or 3) a reddish discharge increasing in volume, having a foul smell, or containing pus. If you see these symptoms, consult a veterinarian or, if not available, begin use of antibiotics such as penicillin or tetracycline.

Problems With Delivery

Difficult delivery (dystocia) can occur when the lamb is not in one of the previously described normal positions (figures 17 and 18), when the ewe has a small or injured pelvis, or when a lamb is very large. Problems also occur if a lamb dies before birth; usually the lamb's head is out of position (down or to one side). A small, light nylon cord is very helpful in correcting head position. When you encounter a problem delivery, follow these steps:

1. Wash the ewe's vulva and area around it with mild soap and warm water.
2. Wash your hands and arms similarly.
3. Lather your hands well, using the mild soap as a lubricant. Very gently enter the vagina with your hand.
4. Feel and identify the parts of the lamb that are in the birth canal. Make sure legs, head, and body parts all belong to the same lamb. Remember multiple births are common in sheep. To deliver a lamb in the forward position, you must have at least one front leg and the head in the canal. Ideally, you should have both

front legs and the head. If you do not feel both front legs, reach further into the canal to find the other leg and gently pull it into place. A gentle but firm pull should bring the lamb out. If the delivery is posterior, both hind legs must be in the canal. Check to be sure that these are rear legs and not the forelegs with the lamb's head to one side. If the toes point **upward** and the lamb's back is **upward**, those are front legs. If the back is **upward** and the toes point **downward**, then they are rear legs. Also feel the hocks. If they point upward, you have the rear legs.

5. If some part of the lamb's body is not in proper position, you can very gently feel to determine where it is located, then carefully position it where it belongs. A small cord is helpful to pull the legs or the head into position. To be safe, it is a good idea to pull only with your hands. The strength a person has in his hands and arms is all the pressure that can safely be applied to the sheep.
6. After the lamb's body parts are in position, pull firmly and gently to deliver the lamb.
7. Make sure all membranes are cleared from the nostrils so that the lamb can breathe. Sometimes tickling the inside of the nose with a small straw will stimulate the breathing reflex. If a lot of mucus is in the lamb's nose, hold the lamb by the rear legs and swing it carefully. Do **not** attempt mouth-to-mouth or mouth-to-nose resuscitation because of the possibility of disease transmission, especially if brucellosis is a problem in the area.
8. After the lamb is breathing properly, hold it up and dip the navel stump in 5% or 7% iodine to stop the entrance of bacteria. In areas where screwworms are a problem, it is advisable to also apply an insecticide or insect repellent.
9. Let the ewe lick the lamb and dry it off. Watch to see if it stands up and make sure it nurses within 3 to 6 hours. See the disease section on hypogammaglobinemia.

10. If the lamb is to be raised separately from the ewe, do not separate them until the next day to ensure adequate colostrum intake. Keep the lamb in a dry and draft-free area with sufficient ventilation to remove moisture and gases.

The Breech Presentation

Special problems are caused by the breech position (figure 19). The rump of the lamb is pushed into the birth canal and its rear legs are pointed forward. In this case, all you will feel is the hindquarters and tail of the lamb. Push the body of the lamb forward until your hand is able to grasp its hock. Raise the hock upward and outward and with one or two fingers try to rotate the foot of the lamb toward the opposite side. For example, with the right leg, rotate the hock to the right and push the foot to the left and bring it backward until it is straight and out. Repeat the same procedure, but raise the left hock up and to the left while pushing the foot to the right and then back. Then, with both of the lamb's feet in the proper posterior position, gently pull the lamb from the ewe.

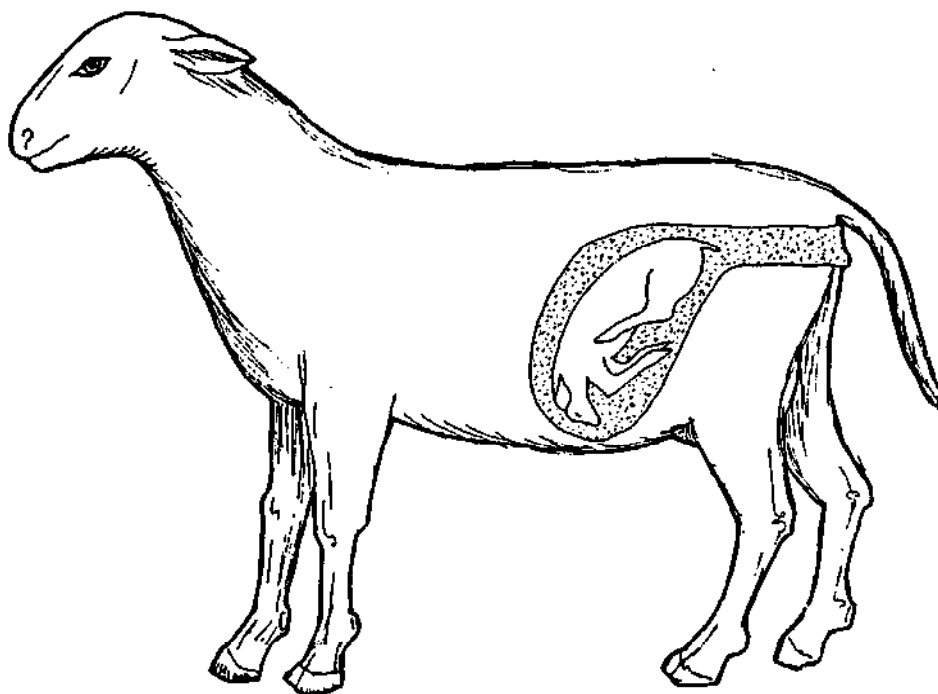


Figure 19. Breech Position

Elbow Lock

An additional problem of delivery in sheep is the elbow lock (figure 20). This is a fairly common occurrence. The elbows of the lamb are slightly bent and hang up on the pelvis. Elbow lock is indicated when the lamb's nose and tips of the toes are protruding the same amount from the vulva. Normally the nose should be about the level of the knees. It is easily corrected by pulling gently on one foreleg while pushing the lamb's head and other foreleg slightly back into the ewe. This should straighten out the elbow and extend the leg out where it belongs. Repeat the procedure while pulling on the other foreleg. Then pull both legs at the same time to deliver the lamb.

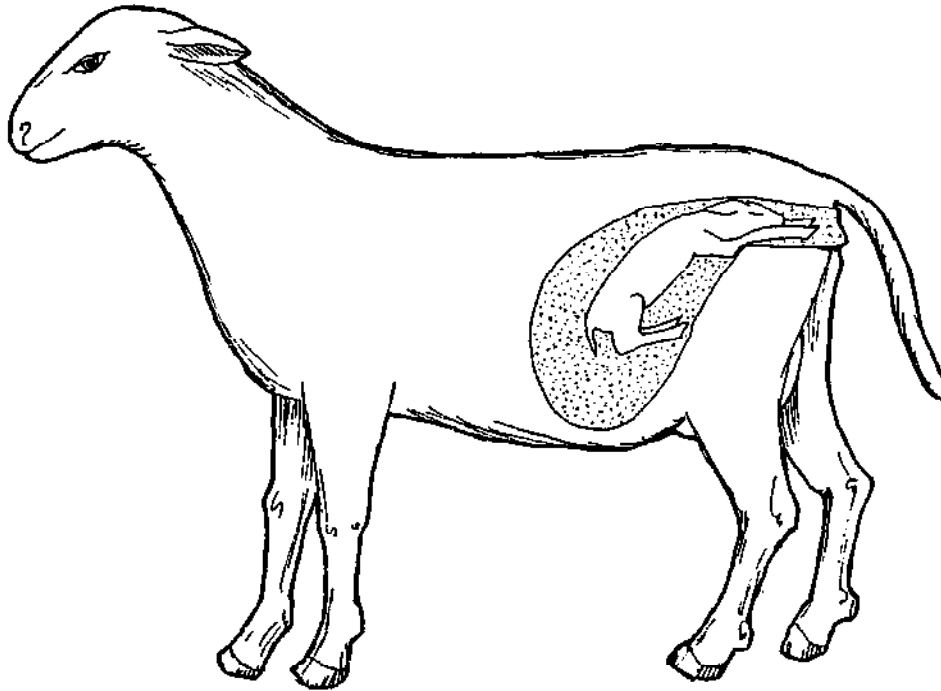


Figure 20. Elbows Hooked on Pelvis Brim

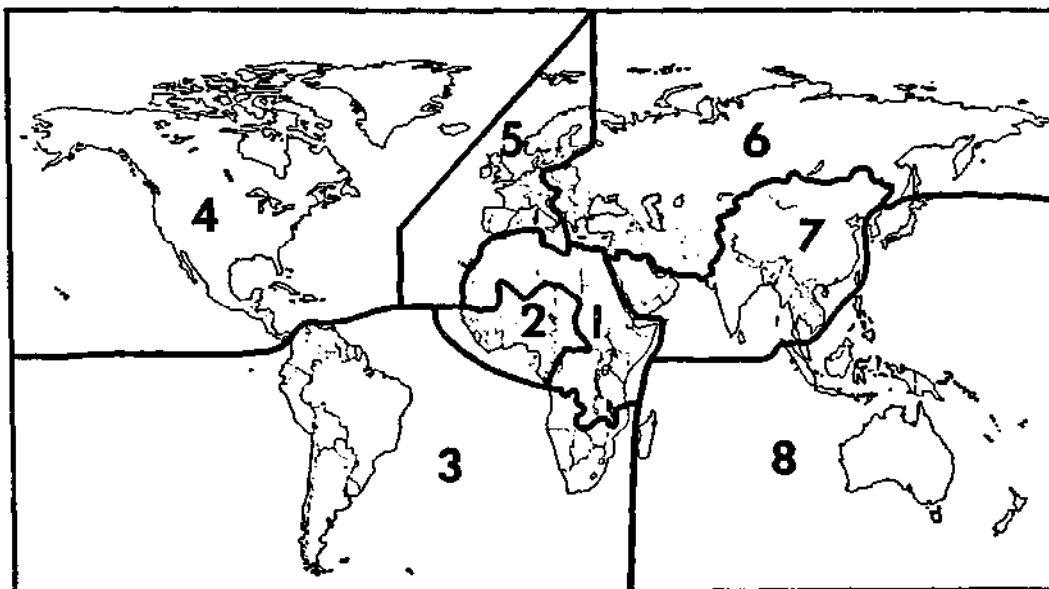
Removal of Afterbirth

If the ewe has not shed her afterbirth within 24 hours after the lambing, grasp the tissue hanging from the vulva and pull gently. If the tissue

does not pull loose, give the ewe an IM dose of an antibiotic (penicillin or tetracycline). Then wait and try to remove the membranes the next day. Do **not** put your hand into the reproductive tract and **do not** pull hard enough to tear the tissue. With medication and time, the membranes can be withdrawn. Wear rubber or disposable gloves, if possible.

Appendix I

MAP OF WORLD REGIONS WHERE NO INCIDENCE OF SPECIFIC DISEASES HAS BEEN REPORTED



According to the Animal Health Yearbook, 1978-FAO-WHO-OIE, the following regions do not report any incidence of the listed diseases.

Region 1

Listeriosis
Melioidosis
Scrapie
Vibriosis

Region 2

Contagious Agalactia
Nairobi Sheep Disease
Rift Valley Fever
Scrapie
Vibriosis

Region 3

Contagious Agalactia
Melioidosis
Nairobi Sheep Disease
PPR
Rift Valley Fever in South America
Salmonellosis
Scrapie

Region 4

Babesia - United States and Canada
Brucella melitensis - United States and Canada
Contagious Agalactia
Foot and Mouth Disease
Heartwater
Melioidosis
Nairobi Sheep Disease
PPR
Rift Valley Fever
Sheep/Goat Pox
Trypanosomiasis

Region 5

Anaplasmosis
Bluetongue
Brucella ovis
Contagious Agalactia
Foot and Mouth Disease - United Kingdom, Ireland, Scandinavia, Netherlands, Belgium, Luxembourg, Switzerland, Austria, Spain, and Portugal
Heartwater
Melioidosis

Region 5 (cont.)

Nairobi Sheep Disease
PPR
Rabies - United Kingdom
Rift Valley Fever
Sheep/Goat Pox
Trypanosomiasis

Region 6

Contagious Agalactia
Dermatophilus congolensis
Heartwater
Melioidosis
Nairobi Sheep Disease
Rift Valley Fever
Trypanosomiasis

Region 7

Bluetongue - complete area except India
Brucella ovis - complete area except Nepal
Dermatophilus congolensis
Enzootic Abortion - complete area except Nepal
Heartwater
Nairobi Sheep Disease
Rift Valley Fever
Scrapie - complete area except Yemen

Region 8

Anaplasmosis - New Zealand
Melioidosis - New Zealand
Bluetongue
Brucella melitensis
Contagious Agalactia
Enzootic Abortion
Foot and Mouth Disease - Australia and New Zealand
Heartwater
Nairobi Sheep Disease
PPR
Rabies - Australia and New Zealand
Rift Valley Fever
Salmonellosis
Scrapie
Sheep/Goat Pox
Trypanosomiasis - Australia and New Zealand

Appendix II

Other Sources of Information on Diseases of Sheep

Books and Reports

- Current Veterinary Therapy. Food Animal Practice. W. B. Saunders. 1981. Edited by Jimmy L. Howard, DVM. Philadelphia, London, Toronto.
- Diseases and Parasites of Livestock in the Tropics, 1977. M. T. B. Hall, Longman, New York, NY 10036, USA.
- Diseases of Sheep, 2nd edition. 1982. R. Jensen and B. L. Swift. Lea and Febiger, 600 S. Washington Square, Philadelphia, PA 19107, USA.
- The Merck Veterinary Manual, 5th edition. 1979. Merck and Company, Inc. Rahway, NJ 07065, USA.
- Proceedings 1976, 1979, American Association of Sheep and Goat Practitioners. c/o Dr. Don E. Bailey, Secretary-Treasurer, 248 N.W. Garden Valley Road, Roseburg, OR 97470, USA.
- The Sheepman's Production Handbook. Sheep Industry Development, 200 Clayton Street, Denver, CO 80206, USA.

Institutions

- Agriculture Department or Ministry Officials in the country you are working in.
- Winrock International, Informational and Technical Services, Route 3, Morrilton, AR 72110 USA

Local or District Veterinarian

Appendix III

Glossary

Abscess - an enlargement or pocket filled with pus either within the body or under the skin.

Acute - rapid onset of illness, usually measured in hours, to a day or two.

Anemia - A decrease of red blood cells caused by blood loss or inability to produce red blood cells.

Anterior - toward the head.

Antibiotics - a drug derived from a living organism, used to suppress growth of or kill an organism (bacteria, chlamydia, or rickettesia).

Antibodies - particles of material that aid in protection from disease.

Antiserum - an immunizing agent made from blood serum. It provides a short-lived immunity, usually no more than 30 days.

Arthritis - an inflammation or disease of the joints. Arthritic refers to arthritis.

Bacterin - a vaccine prepared from dead bacteria or their products.

Bicarbonate ion - salts containing the HCO_3 anion as obtained from sodium bicarbonate or baking soda. Used to keep the blood from becoming too acid.

Casts - clear to cloudy mucous plug shaped in the form of the intestine.

Chronic - a long period of illness measured in days to months or years.

Colostrum - the first milk of animals after the birth of their young. It is high in antibodies and protects the young from disease until they are old enough to produce their own antibodies.

Contagious - a disease capable of being transferred from one animal or person to another.

Cornea - the clear part on the front of the eyeball.

Dehydration - loss of water from the body. This is a very critical situation: over 12% dehydration results in death.

Dummy lamb - newborn lamb with incomplete development of nervous system. Has problems walking, standing, nursing, and(or) seeing.

Electrolyte - normal chemical particles in the blood capable of conducting electricity and needed to maintain natural cell balance. The electrolyte ions are sodium, potassium, chloride, and bicarbonate.

Emaciation - a wasted, excessively lean condition of the body.

Encephalitis - inflammation or infection of the brain by an organism.

Fecal - See feces.

Feces - manure (waste from the gut).

Fetus - unborn young.

Friable - easily crumbled, torn.

Gangrenous (mastitis) - dead, dry, rotten tissue that has no blood supply and shows no reaction to pain.

Genital - referring to the reproductive organs.

Gestation - period of time for fetus development from conception to birth; about 146 days in sheep.

Heat (estrus) - period of time that the female is fertile and will accept the male for breeding.

Host - an animal on which a parasitic organism depends for its life. The parasite may live on or within the host.

Immunity - security against the development of a particular disease. High resistance to a disease.

Infectious - the ability of an organism such as a virus or bacterium to multiply in an animal and cause disease.

Intramuscular (IM) - refers to placing or injecting a substance into a muscle or muscle tissue.

Intravenous (IV) - refers to placing or injecting a substance into a vein.

IU - International Units

Ketone Bodies - by-products of fat breakdown found in the blood and urine.

Lancing - to cut or incise, as to lance an abscess or boil.

Lesions - an abnormal change in structure of an organ or part due to injury or disease.

Lymph Node - normally a small mass of tissue associated with the lymph system; drainage system primarily containing white blood cells that help fight diseases.

Mastitis - an inflammation or infection of the mammary gland.

Metabolic Disease - those diseases that involve the lack of or unusual breakdown of physical and chemical processes in the body.

Mucous Membrane - tissue lining the inside surface of the mouth, throat, eye, reproductive tract, and anus.

Mummified Fetus - a dead, dried fetus, usually carried to term or later.

Noninfectious disease - one not caused by a biological organism.

Oocyst - a developmental stage of coccidia, passed in the feces, that contains many infective particles.

Organism - any living matter such as bacteria, virus, parasite, etc.

Parasite - an organism that lives on or within another animal (host), benefitting at the host's expense.

Peracute - extremely rapid onset and period of illness, usually measured in minutes or hours.

Pneumonic - refers to the lungs or pneumonia.

Posterior - toward the rear.

Postmortem Exam (Necropsy) - an examination done to a dead animal.

Respiration Rate - movements of air from the lungs measured in rate per minute; one in-and-out movement counts as one respiration.

Rickettsia - an organism that lives on or in red blood cells; a blood parasite.

Rumen - the first stomach in the ruminant animal, a large compartment that stores roughage or forage while the contents are being digested or broken down by bacterial action.

Rumen Movement - in the digestive process, the rumen moves to shift and mix the material eaten by the animal. Each of these movements can be seen or felt on the left side of the animal. They can be counted to evaluate the health and function of that organ.

Ruminant - an animal that has a four-compartment stomach, including cattle, sheep, goats, buffalo, deer, antelope, camels, etc.

Secretions - normal or abnormal fluids coming from a body organ. Tears are secretions of the eyes.

Seizures - fits, convulsions, or other central nervous system dysfunctions.

Silage - moist, fermented plant material that has been stored in an airtight environment and is used as feed for ruminants.

Spleen - an organ within the body that serves as a blood reservoir and aids in the breakdown of red blood cells.

Spore - a very hardy, dormant, or inactive form of bacterial or fungal life.

Stillbirth - a fetus born dead.

Subclinical mastitis - infected udder that does not always show symptoms.

Subcutaneous (SQ, Sub. Q.) - refers to placing or injecting a substance under the skin.

Three-Host Tick - a tick that spends each of three separate parts of its life cycle on a different host.

Toxoid - an immunizing agent against toxins produced by bacteria.

Ulcer - a raw, red, eroded area occurring on a mucous membrane or on the skin.

Vaccine - a biological product that is injected into an animal to stimulate an immunity to a particular disease. It can contain live, modified live, or killed organisms.

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