SHEEP IQ

Increasing Your Lamb Crop Series

Reducing lamb death loss

Introduction

Reducing lamb loss at birth should be a goal of sheep producers, regardless of production system. Establishing benchmarks for lamb mortality is challenging as mortality is affected by many factors including prolificacy, environmental conditions, and management practices. Establishing a single standard benchmark is not very helpful without considering the farm's production system and its specific patterns of loss. The best approach is to define patterns of loss and their magnitude and to record this information. These patterns may show some variation from year to year, but it is common that farm-specific patterns emerge. The major means of reducing loss comes from prevention strategies with treatment protocols also playing a role when feasible. Once patterns are identified, it is possible to target those that have the greatest potential for impact.

RECORDING AND ASSESSING PATTERNS OF LOSS

Recording both the age and presumed cause of death is a first step in reducing lamb mortality. Most lamb loss occurs during the first week of life and more specifically during the first 24 hours, making these key focus periods. It is also helpful to record loss after the first week of life until weaning. Loss categories are also important to define to be able to understand the pattern of loss. Recording this information helps to identify patterns of loss and record flock productivity over time for benchmarking purposes. An example of useful productivity benchmarks and mortality information is shown in Table 1. Once loss patterns are identified, a prevention plan can be developed.

Determining the cause of death may require a simple necropsy exam in some cases. Often times, after performing a few of these simple necropsies, the external signs become more apparent lessening the need for necropsy. A simple, efficient exposure of the thoracic and abdominal cavities can provide a lot of information (see Figure 1). The major categories of loss are stillborn lambs and those dying from the combined effects of starvation and exposure. Other significant categories include respiratory loss or pneumonia, enteric infection, preterm loss due to abortion disease, clostridial disease, and accidental death or trauma.

Table 1. Example of productivity and lambing records for a May lambing flock that describes flock productivity and lamb mortality patterns.

May lambing period		
	Number	% of total
Ewes exposed to rams	140	
Ewes lambing	128	
Conception rate		91
Ewe mortality[1]	2	1.4
Lamb born, dead or alive	238	
Lambing percentage[2]		186
Live lambs born per ewe exposed[3]		170
Lambs weaned per ewe exposed[4]		146
Period of lamb loss		
Preterm	2	0.8
<7 days of age	28	11.8
>7 days of age	4	1.7
Total	34	14.3
Presumed cause of lamb death		
Stillborn/dystocia	22	9.2
Exposure on day 1	0	0
Starvation/exposure	6	2.5
Pneumonia	1	0.4
Clostridial disease	1	0.4
Enteric infection	0	0
Accidents	2	0.8
Unknown	2	0.8

[1]Ewe mortality: number of ewes dying between from ram introduction to weaning/ number of ewes exposed x 100.

[2]Lambing percentage: number of lambs born dead or alive/ number of ewes lambing x 100.

[3]Live lambs born per ewe exposed: Number of lamb born alive (total lambs born -preterm + stillborn/dystocia losses)/ number of ewes exposed to rams x 100.

[4]Lambs weaned per ewe exposed: Number of lambs weaned/ number of ewes exposed to rams x 100.

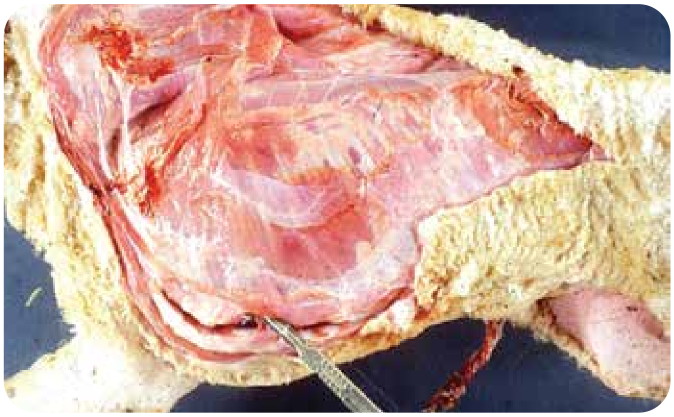

Figure 1. Removal of the front shoulder and accessing the thoracic cavity as part of a simple lamb necropsy examination (photo J. Rook).

ASSESSING PATTERNS OF LOSS

Pre-term loss. Lambs born before 140 days of pregnancy do not have sufficient lung surfactant to survive, so pre-term lambs less than 140 days typically are born dead or live only a few minutes following birth. These lambs will have sparse wool coats, primordial features, and small size.

A general benchmark is that pre-term loss <2% is "normal", whereas greater loss warrants investigation for abortion disease. In cases of an abortion disease outbreak, it may also be expected (depending on the abortion disease) to find a higher percentage of both full-term lambs born dead and weak lambs that succumb to starvation/exposure early in life (day 1-3). When preterm loss rises above 2% and especially when associated with a high incidence of full term stillborn and weak lambs. It is advised to contact a veterinarian to submit fetal and placental tissues (membranes and cotyledons) to a diagnostic laboratory to identify the cause of the increased preterm death loss. Preventing abortions is a high priority in sheep flocks. If diagnostic results identify infectious agents, then appropriate health interventions can be followed to reduce future occurrence. **All tissues collected from pre-term losses should be handled with caution with appropriate protective equipment as several abortive agents in sheep are zoonotic.**

There are also other causes of preterm loss that are not due to infectious disease including micronutrient deficiency and by improper use of medications. If no infectious agents are identified in the diagnostic report, it can be particularly useful to assess fetal liver tissue for mineral concentration.

Loss during the first 24 hours. It is important to differentiate between lambs that did not take a breath (stillborn lambs) and those that died from other causes during day 1. Stillborn lambs will have non-inflated lungs, copious fat reserves around their kidneys and heart (brown fat), and the soft tissue covering the hooves will be undisturbed (Figure 2). The cause of stillborn death can be hard pinpoint as it can be related to a difficult birth (dystocia), or failure of placental function (oxygen and nutrient delivery) sometimes called placental insufficiency. One differentiating factor can be damage to ribs and pooling of blood in the soft tissue of the ribs. This can occur in dystocia losses particularly with large lambs.

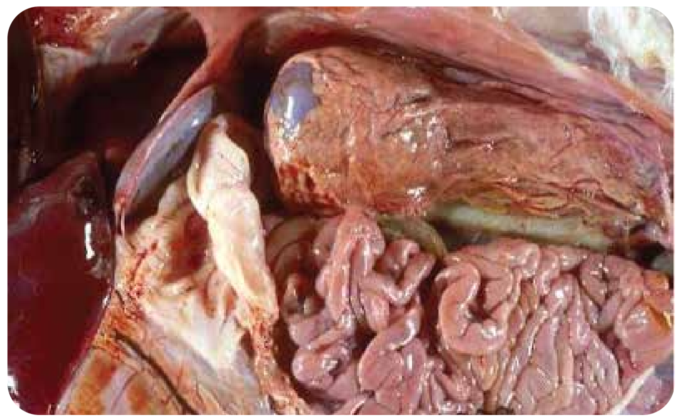

Figure 2. The large mass of brown fat surrounding the kidney, the noninflated lungs and empty stomach indicate that this is a stillborn lamb (photo J. Rook).

Lambs that die of hypothermia during the first day of life can be termed exposure losses due to uncomplicated hypothermia. Exposure and starvation interact to cause loss, and the combined effect is often called the starvation/exposure complex. Lambs that die of hypothermia under extreme cold in the first several hours of life retain a large mass of brown fat around their heart and kidneys, fully inflated lungs and often empty stomachs. Lambs that succumb to hypothermia in the latter part of the first day of life may have suckled but their colostrum intake was not adequate to maintain heat sufficient heat production. These lambs often have partially depleted brown fat reserves, fully inflated lungs and little to no colostrum in their stomachs.

Loss day 2-7. Lambs that die of the combined effects of starvation and exposure (starvation/exposure) after day 1 typically have depleted brown fat reserves around their kidneys and heart, and little to no colostrum/milk in their stomachs. The remaining tissue surrounding these organs and depleted of fat has a red color and is sparse (Figure 3). These lambs are usually also dehydrated which is characterized by sunken eyes.

Losses from pneumonia are observed after day 3 and are typically characterized by lesions in the region of the lung surrounding the heart (anterior/ventral) (see Figure 4). Pneumonia progresses quickly in young lambs, so death may be the first symptom.

Figure 3. The brown fat surrounding the kidneys is full metabolized in this 3-day old lamb that died of starvation/exposure. There is a small amount of red colored tissue containing vasculature with no fat that remains surrounding the kidney (photo J. Rook).

Figure 4. Internal organs from a lamb that died of pneumonia on day 6. Note the dark lesions in the region of the lung surrounding the heart (anterior and ventral aspects of the lung). Also note the full stomach and gastro intestinal tract (photo J. Rook).

Other important but typically less frequent causes of death are enterotoxemia and scours. Enterotoxemia during week 1 is characterized by sudden death, a milk-filled stomach, and hemorrhage of the small intestine and is most commonly caused by *Clostridium Perfringens* Type C. Scours caused by *E. coli* are characterized by watery diarrhea and/or excessive salivation and a cold mouth.

Predation losses are also a factor in some production systems and can occur anytime during the preweaning period. The indicators for predation loss in young lambs can be subtle. Carefully skinning lambs can often reveal puncture wounds on the neck or body with associated bruising in surrounding tissues.

Accidental death is another category to record and covers a multitude of accidents that can happen after birth. These include suffocation from getting laid on by ewes or by strangulation from rope/twine. Trauma injuries from equipment accidents and drowning deaths all fit in this category along with other accidents that can occur during the preweaning period.

PATTERN/MAGNITUDE OF LOSS: OPPORTUNITIES FOR IMPACT

Some patterns of loss are easy to address while others are more difficult to impact as summarized in Table 2. An example of loss that is difficult to impact would be non-disease related term stillborn loss in highly prolific lines of sheep. While the idea of "acceptable" levels of lamb mortality may seem like resignation, it is important to understand that a flock with a high lambing percentage (>200%) may find it difficult to reduce non-disease related, full-term stillborn loss below 10% as these are often due to dystocia due to entanglements or placental insufficiency, both of which are fairly inherent in prolific sheep. Improved late pregnancy nutrition and crossbreeding may offer promise but impacting this loss can be challenging due to the biology of prolific sheep. The good news, however, is that it is possible to impact other patterns of loss in these flocks (starvation/exposure, pneumonia, and abortion losses) with prevention strategies. The following is a list of prevention and treatment strategies that individually and collectively can make a significant impact on reducing loss during the first week of life.

Table 2. Impact potential of lamb loss according to age at death and category.

Category of lamb loss	Impact potential
Preterm	High
Day 1	
Exposure	High
Stillborn	Low
Day 2-7	
Starvation/exposure	Moderate
Pneumonia	High
Enterotoxemia	High
Enteric infection	High

PREVENTION STRATEGIES TO TARGET LOSS

Birth zone climate-Change birth time. In pasture lambing programs it is ideal to time lambing until after the soil temperature is above 50°F (10° C) to reduce loss due to cold temperature/wind/rain. This also conveniently times birth to commence after grass growth is well started, insuring that ewes receive quality forage during late pregnancy to optimize fetal growth and colostrum production. However, waiting until soil temperature is appreciably warmer to start the birth period is not optimal, as this creates a new set of problems due to warmth and humidity (increased incidence of "flystrike" and gastrointestinal parasite infection). Indoor lambing programs are also susceptible to losses due to starvation/exposure, and moving birth from January to March may similarly reduce loss.

Birth zone climate- Modify environment. In indoor lambing programs, maintaining ambient temperature above 32° F (0°C) will reduce starvation/exposure losses appreciably. But can this be done economically, safely and without detrimental increases in humidity? Supplemental heat in the drop and early weaning areas can provide a "dry" heat but will require substantial energy to heat large barn areas. Heat lamps are often used but these are only useful after birth, and they can cause fire safety issues. The cost: benefit and safety of such interventions need to be considered. Another approach is to design a facility with an insulated drop/early rearing area that relies on animal heat to maintain ambient temperature above freezing while allowing for sufficient air exchange to prevent harmful levels of humidity. Preliminary analyses of two such facilities indicate a 5-7 year payback period when accounting for the cost of insulation materials compared to lambs saved. These systems can also be modified to add supplemental heat if greater control over humidity is needed. There are also improvements in flock welfare that are harder to measure in economic terms. Another less tangible, albeit important benefit, is improved shepherd comfort.

Improve ventilation and air quality. Adequate air exchange is vital to reducing humidity levels that can lead to increased incidence of pneumonia, scours and other issues. This need, however, must be balanced against excessive drafts that will promote hypothermia in newborn lambs. Ridge vents and adjustable sidewall air intake control (curtains, louvers) are means of providing ventilation without producing excessive draft in passive ventilation systems. Positive pressure ventilation systems can also be used, and these can be adapted to nearly any building.

Air quality can also be improved with barn cleaning to reduce manure gas. Excessive manure gas can cause irritation of the respiratory tract, allowing pathogens to enter the lungs. Barn cleaning and maintaining adequate bedding are also important in minimizing issues related to enteric infection.

Nutrition. Optimizing nutritional management of the pregnant ewe is of primary consideration in improving lamb survival during the first week of life. This topic is covered in the "Optimal nutrition of the ewe" fact sheet. Meeting energy and protein as well as micronutrient (vitamins and minerals) requirements for pregnancy are of central importance in determining size at birth, colostrum production and even lamb vigor. These are key factors influencing survival during week 1. Therefore, providing the appropriate levels of ewe nutrition during late pregnancy and into early lactation should be a priority in preventing lamb loss.

Bonding management. Mismothering is one of the underlying causes of starvation/exposure, so consideration must be given to optimizing the maternal bonding process. The management of bonding is vastly different according to the production system. In pasture lambing, the concept is to minimize the disturbance of ewes and lambs from the birth site and in indoor or drop lot lambing systems, bonding is managed by placing ewes and lambs in a small lambing pen for a few days. In pasture lambing, disturbance from the birth site due to human or predator pressure or to seek food should be minimized. Overstocking of pastures can also force movement from the birth site. The two major methods of pasture lambing, set stocking and drift lambing, can both be managed effectively to minimize movement from the birth site.

In indoor and drop lot lambing systems, the time in lambing pens and the dynamics of mixing pens (residence time, group size, animal density) are keys in minimizing mismothering. If starvation/exposure is elevated during days 2-7, then this is a key area of focus.

Health program. Elimination of chronic disease (i.e. Maedi-visna/ ovine progressive pneumonia [OPP]) will reduce the incidence of starvation/exposure due to inadequate colostrum/milk production. OPP can cause indurative mastitis commonly referred to as "hard bag" in which the entire udder is turgid/firm and produces little milk. Flocks that have eliminated OPP report huge decreases in the number of lambs reared artificially, as older ewes have sufficient colostrum/milk to support their lambs. When abortion is a documented problem, vaccination programs may be an essential step in reducing losses. Finally, booster vaccination of ewes during late pregnancy against enterotoxemia types C and D and well as tetanus is a cost-effective measure of reducing lamb mortality. Lambs receive effective protective antibody titer via passive immunity through colostrum consumption when ewes are vaccinated in late pregnancy and are protected until at least 40 days of age.

Genetics - "Hybrid vigor" or heterosis is achieved by maximizing the use of cross breeding. This strategy can reduce mortality by close to 20%. There are also differences between breeds in survival traits including suckling drive and aspects of maternal behavior. In general, breeds selected for specific production traits (wool, carcass quality) are inferior to those more subject to natural selection (less shepherding and specific production characteristics not selected). A challenge exists in identifying sheep that are superior in both production and survival, as these traits tend to be opposed. Evaluation of the genetics of cold stress resistance in newborn lambs has demonstrated that cold resistance has modest heritability (h^2=0.40) manifest mainly through determinants of heat production and to a lesser degree through birth coat characteristics. More recently, specific polymorphisms for regulatory genes involved in newborn thermogenesis have been associated with incidence of newborn mortality. These findings suggest potential for use of these polymorphisms as markers for selection of cold resistance in newborn lambs.

Predation control: Wildlife, especially coyotes, prey on sheep flocks in any type of management system and geographical location in the United States. However, young suckling lambs in grazing systems with extensively managed operations are the most vulnerable. Many resources are employed to protect lambs and adult ewes from predation including state or federal animal damage control professionals, improved fencing, and the use of guard animals. Guard dogs, donkeys or llamas are often used to ward off predators.

Treatment strategies to Target loss

The major arm of control to reduce lamb loss should focus on preventative strategies. However, there are specific treatment strategies that may be necessary and employed as needed to reduce loss. The feasibility of these approaches will be dependent on the production system.

Colostrum management. Ensuring colostrum consumption is of critical importance in the first day of life. Monitoring lambs for feeding can be done by assessing gut fill. Lambs that have suckled successfully with the first 2 h of life seldom falter later. In high-risk conditions, however, it can be beneficial to do preemptive colostrum feeding using a stomach tube. These high-risk conditions include climatic conditions causing hypothermia (cold and /or wet and/or windy), lambs with weak suckling drive and/or competition from litter mates. Provision of colostrum obtained from the ewe or from stored sources via stomach feeding can often provide enough activation energy for the lamb to strengthen and maintain its suckling drive to suckle successfully on its own thereafter. The amount of colostrum a lamb requires for the first 24 h is about 10% of its body weight. Only 20-25% of daily needs should be fed at a single feeding. Preemptive colostrum feeding to better distribute colostrum among litter mates is a good strategy. In cases where colostrum supply and not distribution are the problem, then grafting or artificial rearing of at least some of the litter is needed.

Treating hypothermia. Warming lambs with a warming box or other heating system with forced air heating is an effective way to raise body temperature. It is imperative to warm a hypothermic lamb before feeding colostrum or it will likely not recover. Feeding a lamb can prevent chilling as described but cannot rescue a hypothermic lamb. Hypothermic lambs cannot digest colostrum or milk, and the digestive process can deepen hypothermia. When lambs are severely hypothermic, they can be administered an intraperitoneal injection of dextrose which will raise blood glucose without depressing body temperature. After they recover to normal body temperature, they can immediately be fed colostrum via stomach tube. Consult your veterinarian or extension sheep experts for training in these techniques.

SUMMARY

Developing prevention programs to reduce lamb mortality starts with assessing mortality patterns on an individual farm basis. Identifying if the lamb died before or after birth and whether it received colostrum are critical to defining existing problems and potential solutions. Prevention programs should be prioritized to target loss in areas with the greatest impact potential. Examples of high impact areas include optimizing maternal nutrition programs, improving the birth environment (heat and humidity), using cross breeding programs, and implementing disease prevention programs such as vaccinations.

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