

Making More From Sheep

A joint initiative of



Lambs Alive

A hands-on approach to optimising lamb survival

INTRODUCTION AND OVERVIEW	3	STEP 2: ANALYSING THE RESULTS	28
Purpose of this tool	3	Leading causes of death	28
When to use this tool	3	Birth trauma (primary dystocia)	30
How to use this tool	4	Birth trauma (secondary dystocia)	32
Seeking further advice	9	Starvation (mismothering)	34
Further training	9	Exposure	35
STEP 1: CARRYING OUT A POSTMORTEM	10	Primary predation	36
Record your observations	11	Late abortion	37
Equipment required	11	Infection post birth	38
Field history	12	Nutritional deficiencies	39
External observations	12	Congenital disorders	40
Preparing the lamb	14	STEP 3: MANAGEMENT IMPLICATIONS	42
Displaying the internal organs	16	Managing for maximum survival	42
Inspecting the organs	18	Ewe nutrition during pregnancy	43
Inspecting the spinal cord	25	Genetics — ram and ewe selection	47
Inspecting for oedema	27	Mob size and lambing management	48
		Paddock shelter and layout	49
		Predator control	51
		Disease-specific management	52
		Infection post birth	53
		Nutritional deficiencies	54
		GLOSSARY	56
		ADDITIONAL RESOURCES	58

Published by Meat & Livestock Australia Limited
 ABN 39 081 678 364
 Date of publication: November 2017
 ©Meat & Livestock Australia Limited (2017)

Disclaimer

This is a joint publication and initiative of Australian Wool Innovation Limited (ABN: 12 095 165 558) and Meat & Livestock Australia Limited (ABN: 39 081 678 364). © 2015.
 Care is taken to ensure the accuracy and currency of this publication. However Meat & Livestock Australia Limited (MLA) and Australian Wool Innovation Limited (AWI) do not guarantee accuracy or currency. This publication is not comprehensive and is only intended to provide general information to assist with the reduction of lamb losses. You should make your own enquiries before making decisions concerning your interests, including without limitation relevant safety precautions. MLA and AWI accept no liability for any losses incurred if you rely on the information and/or procedures contained in this publication. Reproduction in whole or part of this publication is prohibited without prior consent and acknowledgement of MLA.

Acknowledgement

Australian Wool Innovation Ltd and Meat & Livestock Australia Limited gratefully acknowledges the funds provided by the Australian government to support research, development and marketing of Australian wool and red meat.

Purpose of this tool

The Australian sheep industry is dedicated to best-practice management, animal welfare and husbandry. Sheep and lamb producers are passionate about improving lamb survival and ensuring they run highly-professional, sustainable and productive businesses. *Lambs Alive — A hands-on approach to optimising lamb survival* [postmortem](#) tool has been developed to help sheep producers identify and overcome key factors that are impacting lamb survival during late pregnancy and the first week of life.

The tool outlines the step-by-step process of carrying out an on-farm postmortem of lambs and highlights the important observations.

You can use the tool and accompanying resource sheets to analyse the results of the postmortem, draw likely conclusions about the cause of lamb death and assess the management changes that will optimise lamb survival rates.

Lamb survival — more than just profit

Increasing kilograms of lamb (or wool) per hectare drives profitability in most sheep enterprises. This requires a management approach that optimises reproduction and ensures attention to detail throughout the reproductive cycle. However, lamb survival is about more than just profit — it also is about animal welfare, and producer and employee well-being. Some losses occur as a matter of course and are unavoidable, but optimising lamb survival has positive impacts on animal welfare producer and employee morale and the industry's overall reputation.

When should I use the tool?

Understanding the limiting factors of any farm enterprise provides the information necessary to help optimise productivity and profitability.

More than 80% of lambs that die between birth and weaning die within the first 48 hours of life. Factors such as weather (which is largely out of producers' control) and predators often are blamed for lamb deaths during the first week of life. In reality the key factor driving lamb survival is often birth weight, which is a result of ewe nutrition, and can be influenced by management.

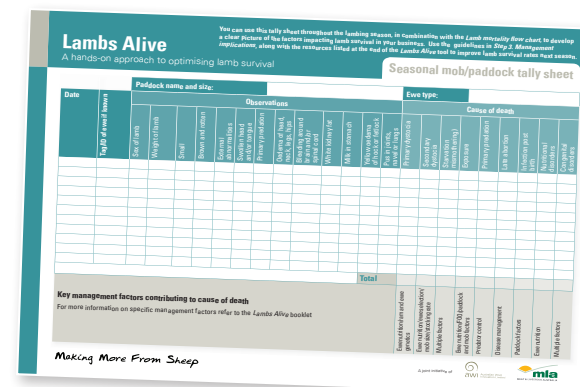
This tool will allow you to better understand the key factor impacting lamb survival in your flock, enabling you to take effective steps to minimise deaths and optimise survival.

To gain a true understanding of the leading factors behind the deaths of your lambs in any given season, every other day during lambing, inspect all the dead lambs from a specific paddock. Choose a different paddock each time. With practice, a single postmortem will only take about 5–10 minutes.

A postmortem can be done up to 36 hours after death in cold conditions and 12–24 hours in warm or hot conditions.

On first inspection the reasons for death can appear obvious (for example predation is not always the primary cause of death), however it is worth carrying out a full postmortem because the primary (actual) cause of death is often not visible externally, especially if lambs are within the normal weight range.

4



Step 1: Carrying out a postmortem — a hands-on guide

The first steps in determining the most likely cause of death are to: assess any field history and external indicators, weigh the lamb, and carry out a basic postmortem.

This section of the tool has been divided into 'external' and 'internal' investigations and provides a step-by-step guide to working through the postmortem process.

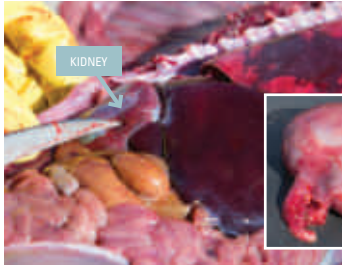
Use the *Recording sheet* to note key observations as you work your way through the postmortem.

The information you include will prove invaluable if you need to seek further advice from a vet, so be as accurate as possible in recording what you observe during the postmortem.

The kidneys

Inspect the colour of the fat surrounding the kidneys. Healthy fat, which has not been **metabolised** (used by the lamb as a source of energy), will be firm and whitish in colour.

Fat that appears gelatinous (jelly-like) and pink or reddish in colour indicates the lamb has used fat reserves (metabolised the fat) for survival in the absence of sufficient feed.



Unmetabolised fat: Fat surrounding the kidneys that appears firm and white (as shown above) has **NOT** been metabolised by the lamb as a source of energy.

Metabolised fat: Fat surrounding the kidneys that appears reddish in colour and jelly-like (e.g. shown at knife point in main image and inset) has been used as a source of energy.

Step 1: Carrying out a postmortem

19

WARNING: This section of the *Lambs Alive* tool contains graphic images of dead lambs at various stages of the postmortem process. No lambs were killed for the purposes of developing this tool.

Introduction

Lambs Alive

A hands-on approach to optimising lamb survival

Fill in this recording sheet as accurately as possible. If dead lambs are taken to a lab for further analysis, a completed recording sheet can assist in making an accurate diagnosis.

Recording sheet

Field history

Date: 6/08/2015 Assessor name: Shaun Lamb

Paddock name and size: Racecourse / 12ha

Mob identifier (e.g. yellow-tags): Orange tags

Mob type (if scanned): twins / single

Ewe type: maidens / adults

Paddock shelter: high / medium / low

Average mob CS: 3.5

Estimated feed on offer (kg DM/ha): 1400

Extreme weather conditions during past 24 hrs: yes / no

If yes: heavy rain / windy / extreme temperature (hot / cold)

External observations

Lamb weight: 5.7kg Estimated age of lamb: < 1 day old / > 1 day old

Assisted birth: yes / no Cleaned: yes / no Ewe condition (e.g. cast, blind teats, CS, predator attack): n/a

Signs of predation: yes / no Type: bird / fox / other: none

Coat condition: (mecorum stained) / brown or rotting

Walked: yes / no Signs of swelling (oedema): yes / no Degree of blood at site: nil / medium / significant

Condition of placenta (e.g. signs of white 'pimples' on the 'buttons'): n/a

Where: head / legs / abdomen

Signs of abnormalities on lamb (e.g. goitre, hairy birth coat, cleft palate, imperforate anus etc): nil

Internal observations

Preparing the lamb		Tick relevant column		Comments
Yes	No	Yes	No	
Sign of swelling, redness or discharge at navel or joint?				Swollen head
Displaying the internal organs				
Abdominal bleeding?				
Excess fluid in abdomen or chest cavity?				
Inspecting organs				
Liver – bleeding	Are there signs of bleeding or rupture?			
Liver – swelling	Are there signs of swelling, blotches or spots?			
Kidneys	Fat colour	white	reddish	
Lungs	Has the lamb breathed?			
Stomach	Has the lamb fed?			
Heart	Fat colour	white	reddish	
Thyroid glands	Is there white grit in the heart muscle?			
Brain	Are the glands enlarged?			
Spinal cord	Rank the bleeding around the brain	significant	nil or minor	
Oedema	Rank the bleeding around the spinal cord	significant	nil or minor	
	Is there clear or bloodstained fluid under the skin (legs/head/neck)?			
	Is there yellowish fluid under the skin above and behind the hooves?			

Summarise your observations on the Summary sheet and compare with the tables in Step 2: Analysing the results to estimate the most likely cause of death:

Birth trauma (primary dystocia)

Making More From Sheep

A joint initiative of

CSIRO Australian Wool Innovation Company mla

Devil is in the detail: Ensure you record as much detail as possible when completing the postmortem Recording sheet — it will prove invaluable when determining the likely cause of death or if you seek further help from your veterinarian or pathology laboratory.

Step 2: Analysing the results

After completing the postmortem and recording your observations, compare your results with the leading causes of death and the typical signs associated with them presented in the *Summary sheet* and the tables included in *Step 2* of the *Lambs Alive* booklet.

Explanations have been provided to help you draw conclusions about the most likely cause of death for each lamb postmortem undertaken.

Mob identifier (e.g. yellow-tags): Orange tags

Mob type (if scanned): twins / single

Mob size: 70

Ewe type: maidens / adults

Average mob CS: 3.5

Paddock shelter: high / medium / low

Estimated feed on offer (kg DM/ha): 1400

Extreme weather conditions during past 24 hrs: yes / no

If yes: heavy rain / windy / extreme temperature (hot / cold)

External observations

Lamb weight: 5.7kg

Estimated age of lamb: < 1 day old / > 1 day old

Ewe condition (e.g. cast, blind teats, CS needed):

Assisted birth: yes / no

Cleaned: yes / no

Signs of predation: yes / no

Type: bird / fox / other:

Walked: yes / no

Signs of swelling (oedema): yes / no

Condition of placenta (e.g. signs of white 'pimples' on the 'button'):

Signs of abnormalities on lamb (e.g. goitre, hairy birth coat, cleft):

Internal observations

Preparing the lamb

Sign of swelling, redness or discharge at navel or joints?

Displaying the internal organs

Abdominal bleeding?

Excess fluid in abdomen or chest cavity?

Inspecting organs

Liver – bleeding Are there signs of bleeding or rupture?

Liver – swelling Are there signs of swelling, blotches or spots?

Kidneys Fat colour

Lungs Has the lamb breathed?

Stomach Has the lamb fed?

Heart Fat colour

Is there white grit in the heart muscle?

Thyroid glands Are the glands enlarged?

Brain Rank the bleeding around the brain

Spinal cord Rank the bleeding around the spinal cord

Oedema Is there clear or bloodstained fluid under the skin (legs/head/neck)?

Lambs Alive

A hands-on approach to optimising lamb survival

Summary sheet

Summarise your observations from your Recording sheet below and compare with the tables in Step 2: Analysing the results.

Observation	Tick if applicable	Primary dystocia	Secondary dystocia	Survival of micromerger	Exposure	Primary predation	Late abortion	Nutritional deficiency	Infection post birth
Paddock, weather and ewe condition									
Limited paddock shelter					XX				
Insufficient feed on offer					XX				
Sub-optimal ewe condition score <2.5 (or >3.5)		XX			XX				
Inclement weather conditions during previous 24 hours					XXX				
Assisted birth (malpresentation)									
White spots on placenta (afterbirth)									
External observations									
Abnormal conformation/physical defect									
Cleaned			XX		XX	XX			XXX
Meconium-stained (yellow) coat		XX							
Bare skin or incomplete wool development									
Twin lamb				XX	XX				
Single lamb		XX							
Above optimal weight									
Below optimal weight				XX	XX	XX			
Within optimal weight range				XX					
Walked				XXX	XXX	XXX			XXX
Not walked									
Less than one day old		XX	XX						
Up to five days old				XX					XX
Signs of predation (significant blood loss at site)			XX			XXX			
Swelling (oedema) heads/legs			XX	XX					
Swollen joints									XX
Dead in utero (brown rotting skin, bloodstained fluid under the skin and in the abdominal and chest cavities)									XX
Goitre (swollen thyroid glands in neck)									XXX
Internal observations									
Signs of infection (pus, abscess, discharge) at navel or joints									XXX
Blood in abdominal cavity			XX						
Excess fluid in abdominal or chest cavity									
Liver rupture			XX						
Liver blotches or white spots									XX
Enlarged liver									XX
White fat around heart and kidneys			XX	XX	XX	XX			
Reddish fat around heart and kidneys			XX	XX	XX	XX			
White grit in heart muscle (WMD)									XXX

Step 2: Analysing the results

30

Birth trauma (primary dystocia)

Lambs that have died from primary dystocia have not survived birth either due to excessive size (or poor ewe energy levels) or malpresentation (e.g. breach birth or tangled legs).

These lambs may have swollen heads, typically with subcutaneous oedema (excess fluid) around the head and neck.

In most cases, these lambs will not have breathed, depending on the timing of assistance at birth and time of death.

Late premature lambs can be difficult to distinguish from lambs that have died from birth trauma or other causes. However premature lambs will not have subcutaneous oedema around their head. It is easy to distinguish lambs that have died from birth trauma from those that have died in utero — these lambs will have started to decompose and have blood-stained fluid in their chest, abdominal cavity and under their skin.



White fat: A lamb that has died from primary dystocia will not have metabolised (used) any fat reserves and the fat surrounding the heart (shown above) and kidneys will be white.

Observation	Likelihood
Not walked	XXX
White fat around heart and kidneys	XXX
Less than one day old	XXX
Empty stomach	XXX
Above normal weight range	XX
Not breathed	XX
Oedema (heads/legs)	XX
Meconium stained (yellow) coat	XX
Bleeding around brain	XX
Bleeding around spinal cord	XX
Ewe condition score <2.5 (or >3.5)*	XX
Cleaned	X
Assisted birth	X
Liver tear/rupture	X
Blood in abdominal cavity	X
Predation	X

* Both ewes in poor condition (with associated low energy levels) and overfat ewes can have difficulty during the birthing process leading to birth trauma.

Sign is typically seen: XXX
Sign is often seen but not essential: XX
Sign is seen occasionally: X

Analysing results: Tables and explanatory notes will help you determine the most likely cause of death from the results on your Recording sheet.

Glossary

A glossary of terms has been provided to establish a common language across regions and states. This terminology will help you when seeking further management advice from your local veterinarian or advisor. Glossary terms are highlighted as coloured text throughout the booklet.

Glossary

56

abomasum — fourth stomach in an adult sheep, leading into the small intestine.

bloodied oedema — excess red fluid beneath the skin of in the chest or abdominal cavity which contains blood.

campylobacter — bacterial infection leading to late abortions in non-immune ewes.

cleft palate — congenital deformity of the roof of the mouth that prevents lambs from suckling effectively.

colostrum — the first fluid secreted from the udder, rich in antibodies.

condition score — a manual method of determining (on a scale of 1 to 5) the soft tissue (fat and meat) covering the short ribs and backbone of sheep. For more information go to the *Making More from Sheep* website www.makingmorefromsheep.com.au/vean-more-lambs/tool_10.1.htm

congenital deformities — a physical deformity present from birth. May be due to genetics or toxin exposure.

cotyledons — raised area of the placenta that supply blood and nutrients to the developing lamb in the uterus.

dead in utero — where the lamb has died inside the ewe, before birthing process.

diaphragm — a wall of muscular tissue separating the abdominal chest cavities.

dystocia — difficult birth, typically caused by a large or awkwardly positioned foetus (primary), or weak ewe (secondary).

exposure — death from being subjected to severe weather conditions with inadequate shelter or bodyfat reserves for survival.

gestation length — period of time from conception to birth (typically about 150 days in sheep).

goitre — a swelling of the neck resulting from enlargement of the thyroid gland.

haemorrhaging — bleeding.

(causing birthing difficulties) or too small (reducing lamb viability).

After weighing the lamb, record any other visual signs that could build a picture of the cause of death.

- Lamb weight (kg)
- Estimated age of lamb
- Whether or not the birth was assisted
- Whether the lamb has been cleaned or not
- Yellow-brown staining of coat (presence of **magnesium**)
- Signs of predation (note the degree of blood loss at the site of attack)
- Whether or not the lamb has walked
- Signs of swelling (head, legs and abdomen)
- Condition of the **placenta**, noting any white 'pimples' on the 'buttons'
- Signs of abnormalities (e.g. **goitre**, hairy birth coat, **cleft palate**, **imperforate anus** etc).

Mark each lamb collected with an ID number using the spray marker. Record external observations for each lamb on the recording sheet with the same lamb number. You can also use

Additional resources

A list of additional resources and references has been included so you can find out more about the causes of death and relevant management approaches available to maximise lamb survival.

Additional resources

58

Ewe management during pregnancy

Bred Well Fed Well

Bred Well Fed Well is a practical, one-day workshop highlighting the key production benefits of superior genetics, plus feed management for improved reproductive performance and flock productivity.

More information: www.makingmorefromsheep.com.au

Lifetime Ewe Management

Lifetime Ewe Management (LTEM) is a 12-month course that educates producers on the best management practices for ewe management, with proven results to increase on-farm productivity and profitability. Past participants have seen an increase in stocking rate of 14% and an increase in marking rates of 12–15%. This equates to an average increase in the number of lambs weaned per hectare of more than 30% while almost halving ewe mortality.

More information: www.rist.com.au

LTEM smartphone application

The *Lifetime Ewe Management (LTEM) Application* is a digital extension of the LTEM course. The Application best suits producers who have completed LTEM and understand ewe requirements. Download the *Lifetime Ewe Management* app from the App Store.

More Lambs More profit

More lambs, More Profit, originally published as *Wean more lambs*, includes the latest research findings and breaks the breeding calendar into six discrete management periods in order to highlight the critical management techniques and production level targets that boost flock fertility.

More information: www.mla.com.au

EverGraze

The *EverGraze* website provides access to a wide range of feed budget and pasture management tools.

More information: www.evergraze.com.au

Feed on offer library

The *Feed On Offer (FOO)* library allows users to estimate FOO and nutritive value of grazed pastures.

More information: www.feedonofferlibrary.com

Making More from Sheep (Module 10 — Wean more lambs)

Making More From Sheep, is a best practice package of information, tools and learning opportunities for Australian sheep producers.

More information: www.makingmorefromsheep.com.au

Seeking further advice

Lambs Alive — A hands-on approach to optimising lamb survival has been developed as a basic hands-on guide to help producers gather valuable information about lamb deaths on farm. It is not intended to replace the role of veterinarians or pathology laboratories in providing a clinical diagnosis.

In most cases, a postmortem will provide sufficient evidence to determine the causes of lamb deaths. However, there are exceptions, for example, goitre (iodine deficiency), white muscle disease (selenium deficiency), campylobacter and toxoplasmosis all can be difficult to conclusively diagnose without a pathology test.

Where a cause of death is still unclear following the postmortem, contact your veterinary practitioner or state department of primary industries veterinary officer.

Further training

Workshops are carried out in some states and territories to increase producers' skills and knowledge around lamb survival. Contact your local department of primary industries, MLA or AWI grower network for more information.



Tips for storing and handling dead lambs and organ samples for further analysis

If the cause of death is unclear following the postmortem process, take any suspect lambs (or organs) to your vet or pathology laboratory for further analysis. Wherever possible whole dead lambs are preferred to avoid any risk of contamination to organs, which can make an accurate diagnosis difficult. To maintain the integrity of any samples (including whole lambs) and to prevent any further degradation:

- place the samples in a double layer of plastic bags
- store the samples in a refrigerator or an esky on ice)*
- deliver the lamb or organ within 12 hours of collection.

***NOTE:** Some infectious sheep diseases are transmissible to humans — ALWAYS wear protective clothing when handling dead lambs and their organs. NEVER place lambs or organs in a refrigerator or esky used for storing food for human consumption.

Producer workshops: Further training on the postmortem process and management strategies to optimise lamb survival is available in most areas.

Step 1: Carrying out a postmortem

10

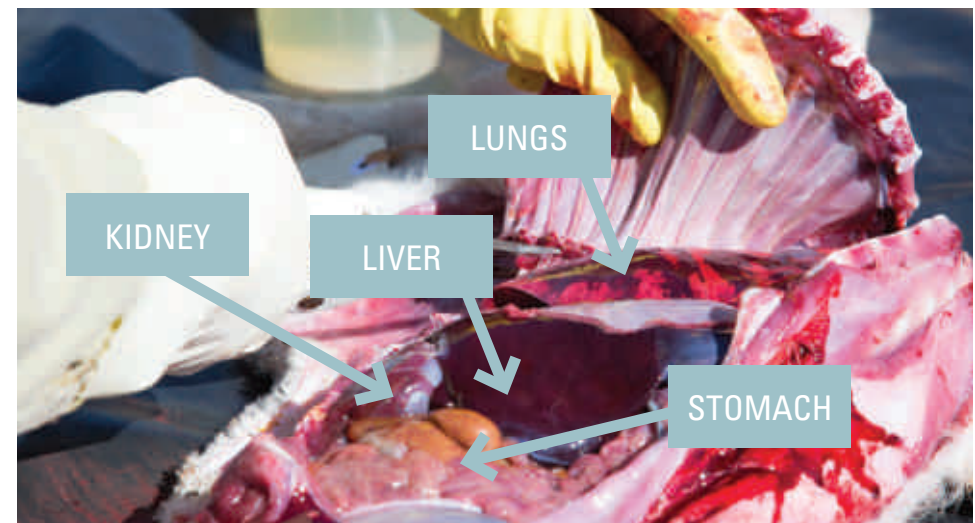
The following section outlines a step-by-step process to carrying out a **postmortem (autopsy)**. With practice you will be able to carry out a postmortem in about 10 minutes and will start to become familiar with the tell-tale signs that indicate potential causes of death.

Working with a fresh carcass is best — depending on conditions a postmortem can be done up to 36 hours after death in cold conditions and 12–24 hours in warm or hot conditions. Handle the carcass with care to maintain its condition.

By far most lambs die as a result of **dystocia** (birthing difficulties). While some lambs present clear signs of a difficult birth (e.g. large lamb with swollen head), not all deaths from a difficult birth are so readily identified.

Lambs subjected to a long and stressful labour are less vigorous, less able to generate their own bodyheat, have a poorer suckling ability and often the ewe is less interested in the lamb. As such, lamb deaths diagnosed as mismothering or starvation may be more accurately diagnosed as being the result of lambing difficulties with a full postmortem.

It is important to carry out the full postmortem to be able to draw accurate conclusions about the likely cause of death — even if you suspect you have identified it part way through the process.



Practice makes perfect: With the right tools and some practice, carrying out a lamb postmortem will become quick and efficient. Recognising signs and symptoms will become easier the more postmortems you carry out.

Record your observations

It is critical to record your observations as you work your way through the postmortem. Accurate and clear records will prove invaluable if you cannot easily determine the cause of death and need to seek further support from your vet or pathology lab.

Recording and Summary sheets have been provided with the *Lamb postmortem tool*. When you have completed the postmortem and filled in the *Recording sheet* and summarised your observations on the *Summary sheet*, work through *Step 2: Analysing the results*.

Workplace health and safety

In some cases, lamb deaths may be caused by infectious diseases that can be transmitted to humans (e.g. toxoplasmosis, listeria and campylobacter).

Avoid carrying out a postmortem if you are pregnant — pregnant women are particularly at risk as these infectious diseases can affect the baby.

Always wear gloves when carrying out a postmortem and disinfect hands immediately after the postmortem. Thoroughly clean and disinfect all equipment, and the surface on which the postmortem was carried out.

Equipment required:

- Spray marker (to identify lambs)
- Scales (note — spring scales are acceptable for weighing lambs, but check they can accurately weigh up to 15kg in 0.1kg increments)
- Electronic scales that weigh to 0.1gm (to weigh thyroid glands)
- Plastic sheeting on which to carry out postmortem
- Sharp knife (~15cm blade, 1/4 curve to straight)
- Sharpening steel
- Secateurs (footrot or similar)
- Sharp scissors
- Bucket or jug of clean water
- Disinfectant
- Rubber gloves and apron (cutproof gloves are a good idea)
- Resource sheets and pencil
- Clean, dry container or bag to store whole lambs or organ samples if required for submission to veterinary pathology laboratory.

NOTE: Before carrying out your first postmortem, read through the following steps to gain an overall understanding of the process. This will help to ensure you take the necessary care to preserve the carcass as you step through the postmortem, avoiding damage to tissues or organs as you proceed.

Step 1: Carrying out a postmortem

Step 1: Carrying out a postmortem

12

A pencil icon has been included throughout Step 1 to remind you to record any observations on the appropriate resource sheet.



Field history

Before starting the postmortem, fill in the *Recording sheet* details including:

- Date and name of postmortem assessor
- Paddock name
- Lamb ID number (see box section below)
- Mob identifier (e.g. yellow-tag twins)
- Mob size (number of ewes)
- Mob type if scanned (twins vs singles)
- Average ewe condition score (CS) in the mob
- Ewe type (maiden vs adult ewes)
- Feed on offer (kg DM/ha)
- Paddock shelter (high/moderate/low)
- Weather conditions during past 24 hours
- Other details (e.g. large or blind teats — if known).

External observations

The first step in the postmortem process is to weigh the lamb — up to 80% of lamb losses are a result of birth weight — either too big (causing birthing difficulties) or too small (reducing lamb viability).

After weighing the lamb, record any other visual signs that could build a picture of the cause of death:

- Lamb weight (kg)
- Estimated age of lamb
- Whether or not the birth was assisted
- Whether the lamb has been cleaned or not
- Yellow–brown staining of coat (presence of **meconium**)
- Signs of predation (note the degree of blood loss at the site of attack)
- Whether or not the lamb has walked
- Signs of swelling (head, legs and abdomen)
- Condition of the **placenta**, noting any white ‘pimples’ on the ‘buttons’
- Signs of abnormalities (e.g. **goitre**, hairy birth coat, **cleft palate**, **imperforate anus** etc).

Mark each lamb collected with an ID number using the spray marker. Record external observations for each lamb on the *Recording sheet* with the same lamb number. You can also use the spray marker to write the lamb’s weight on its side, which can provide a useful comparison for a group of dead lambs.





Quick comparison: Marking each lamb with their weight as you go (using spray marker) can help compare lambs quickly to determine whether birth weight is an issue.

Weighing the lamb — a birth-weight guide

The optimal birth-weight range varies between breeds:

- Merino — 4.0 – 5.5 kg (single average 4.9, twin average 3.7)
- Cross-bred — 4.5 – 6.5 kg.

NOTE: Ewe size (maiden vs adult), ewe condition, litter size (twin vs single), lamb gender and any predation (i.e. body loss) can impact on lamb weight.

Abnormalities

Occasionally lambs will die from a rare developmental abnormality. During the external examination, make notes on any physical defects apparent on the lamb such as:

- Cleft palate
- Coat condition (e.g. hairy coat)
- Spinal deviation
- Imperforated (missing) anus.



Imperforate anus: Some lambs lack an anal opening preventing them from defecating, leading to a swollen and distended abdomen.

Photos courtesy: David Rendell

Step 1: Carrying out a postmortem

Step 1: Carrying out a postmortem

14

Preparing the lamb

The tray of a farm ute is an ideal surface on which to carry out a postmortem. Cover the tray with plastic sheeting or several large garbage bags before lying the lamb flat, with legs facing towards you.



The first step is to open the carcass to inspect for bruising and bites from predators and inspect for signs of swelling and inflammation around the **umbilicus** (navel).

- 1 Start with hind leg — cut through hip joint and fold leg back. This will make it easier to lay the lamb flat and inspect the abdominal cavity.
- 2 Cut under the front leg and fold leg back to expose rib cage.

- 3 Run the knife from under the jaw, up to the chin and fold skin back to reveal the gullet.
- 4 Slice the skin from under the front back towards the hind leg.
- 5 Skin around the chest to expose ribcage and abdomen.
- 6 Examine navel for any signs of swelling or infection.



The next step is to open the abdominal and chest cavities to check for internal bleeding (see page 16), and to assess internal fat colour — particularly surrounding the kidneys and heart. Take care to not cut too deeply and damage organs as you open the abdominal and chest cavity.

As you proceed, look for signs of swelling, redness, pus or cloudy, smelly fluid — particularly in the abdomen and around the navel and umbilical cord. Record any observations.

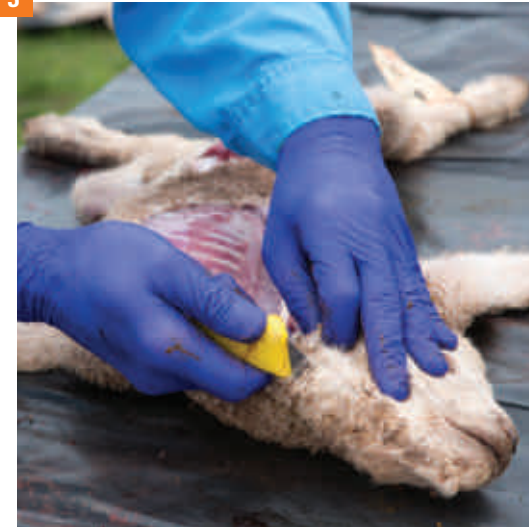
1



2



3



3



4



5



6



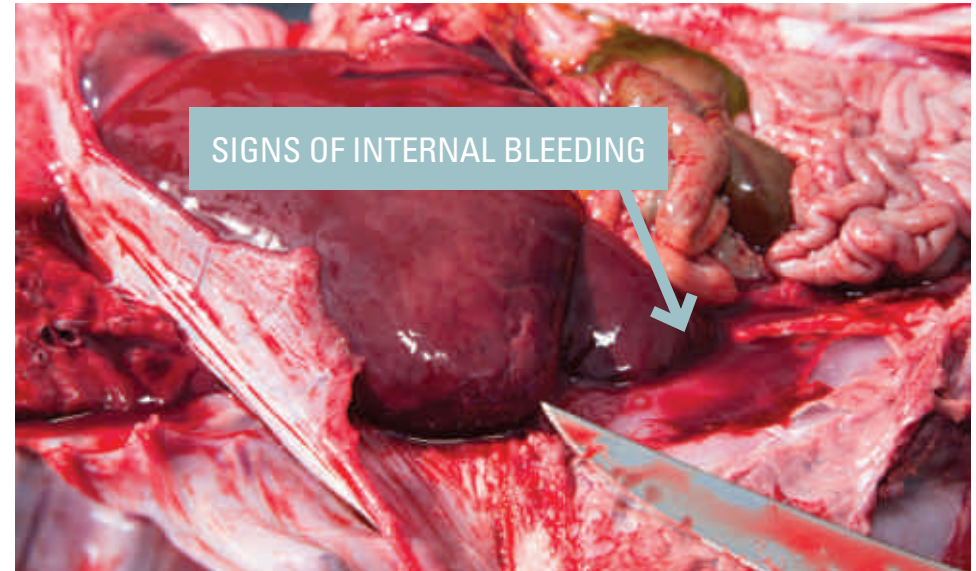
Step 1: Carrying out a postmortem

Step 1: Carrying out a postmortem

16

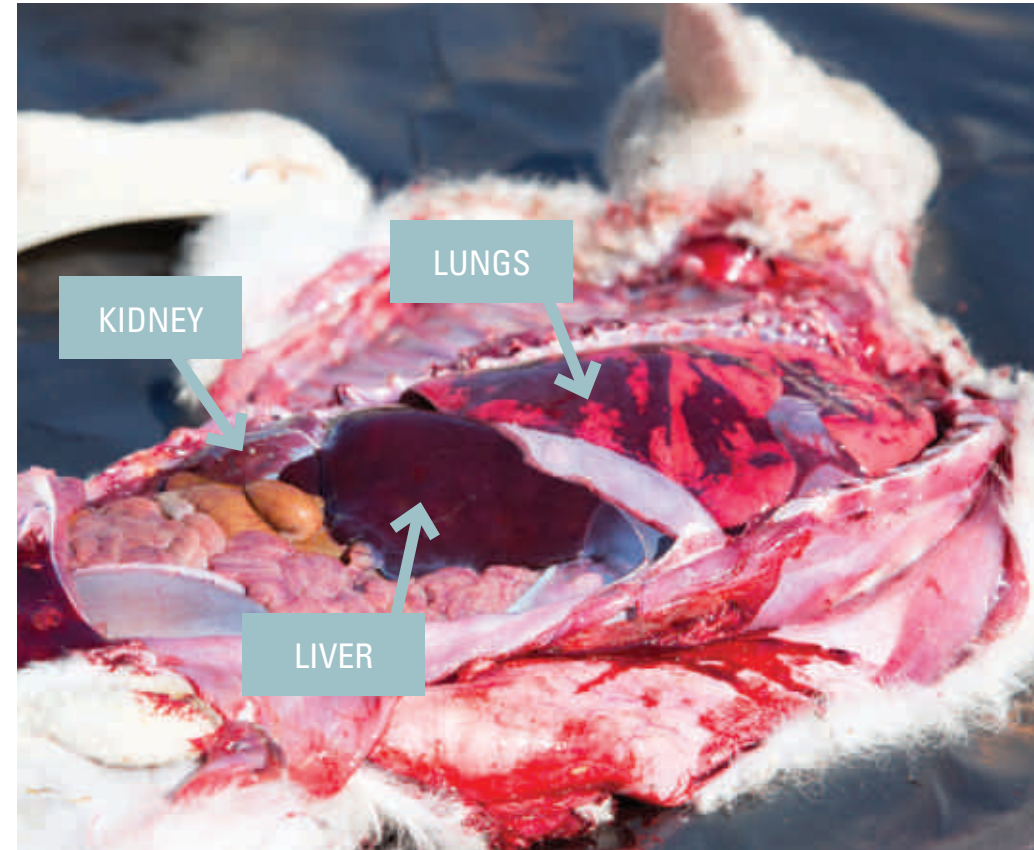
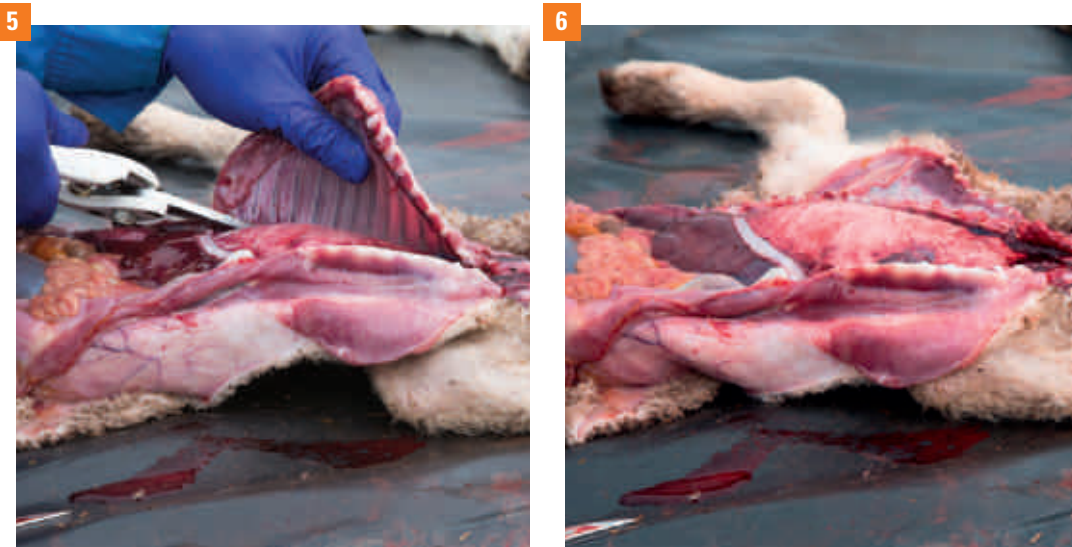
Displaying the internal organs

- 1 Lift the edge of the ribcage and cut through the abdominal wall, just behind the ribcage, taking care to not damage internal organs.
- 2 Look inside abdominal cavity for signs of internal bleeding or excess fluid.
- 3 Cut the rest of the abdominal wall away to expose the internal organs.
- 4 Now lift the ribcage again and slice into the **diaphragm** and through the cartilage on the ribcage near the brisket to allow you to see into the chest cavity (and lungs). Look for any signs of excess fluid in the chest cavity.
- 5 Take a pair of secateurs and cut away the ribcage to allow access to the lungs and heart.
- 6 You now should be able to see the contents of both the abdominal and chest cavities.



Internal bleeding: Check the abdominal cavity for signs of internal bleeding.





Important signs: Check the abdominal and chest cavities for internal bleeding, and assess internal fat colour — particularly surrounding the kidneys and heart. Check the liver for signs of damage (tears) or rupture — an indication of a difficult birth. Check the lungs to determine whether or not the lamb has breathed before dying. More details on how to check for these signs are on the following pages.

Step 1: Carrying out a postmortem

Step 1: Carrying out a postmortem

18

Inspecting the organs

Work your way through the abdominal and chest cavities, inspecting each organ for signs of stress and disease.

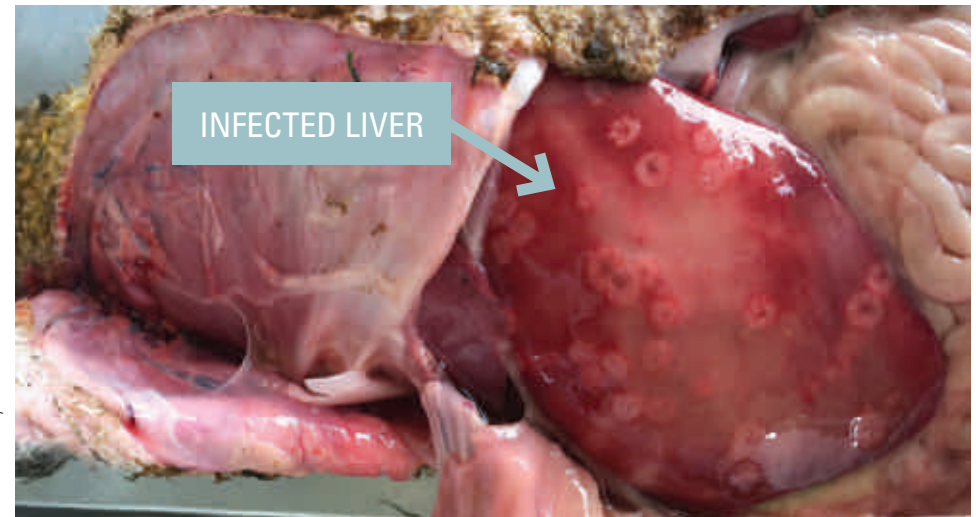
The liver

Inspect the liver for signs of **rupture** (bleeding), punctures or tears, which can indicate a difficult birth.

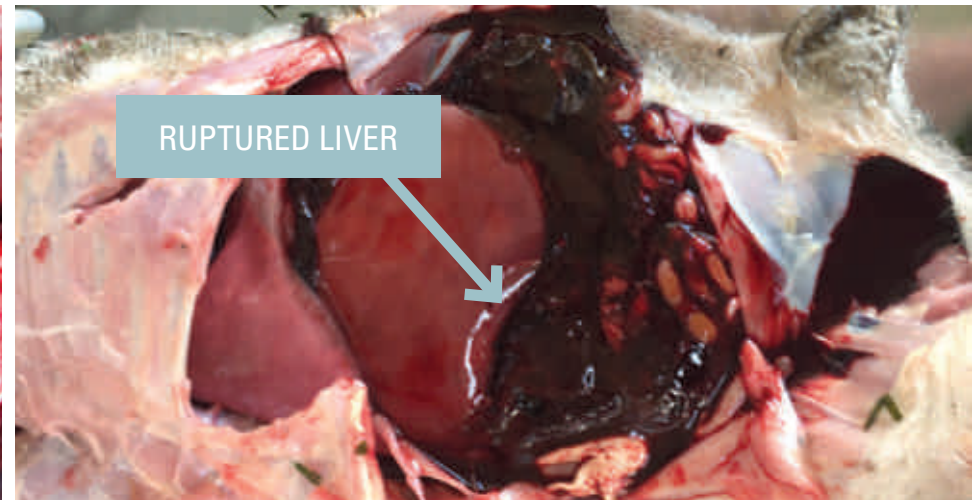
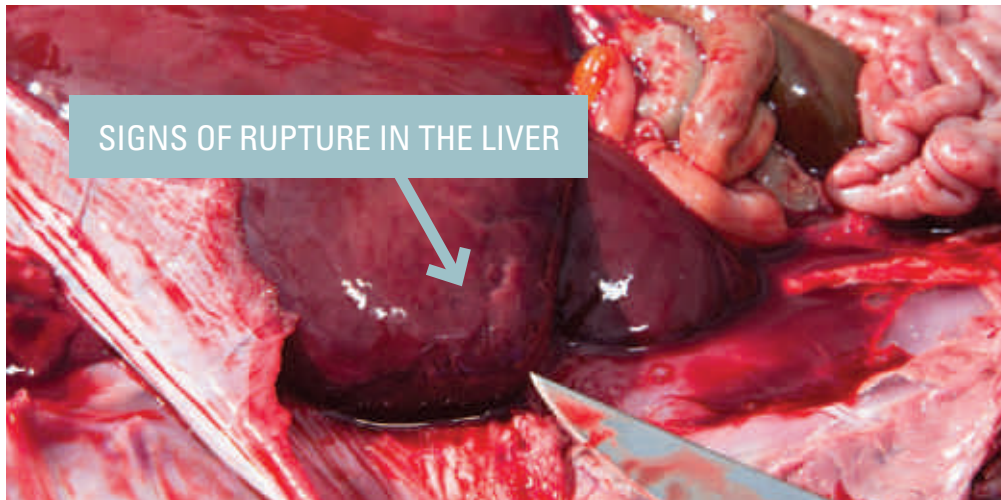


A swollen liver congested with blood, or a liver with white blotches or spots can indicate infection of some type — make a note of any signs of infection and submit any suspect infected whole livers to your vet.

Photo courtesy: David Rendell



Liver infection: White spots on the liver indicate infection — submit samples of any infected whole livers to a veterinary pathology laboratory for analysis.



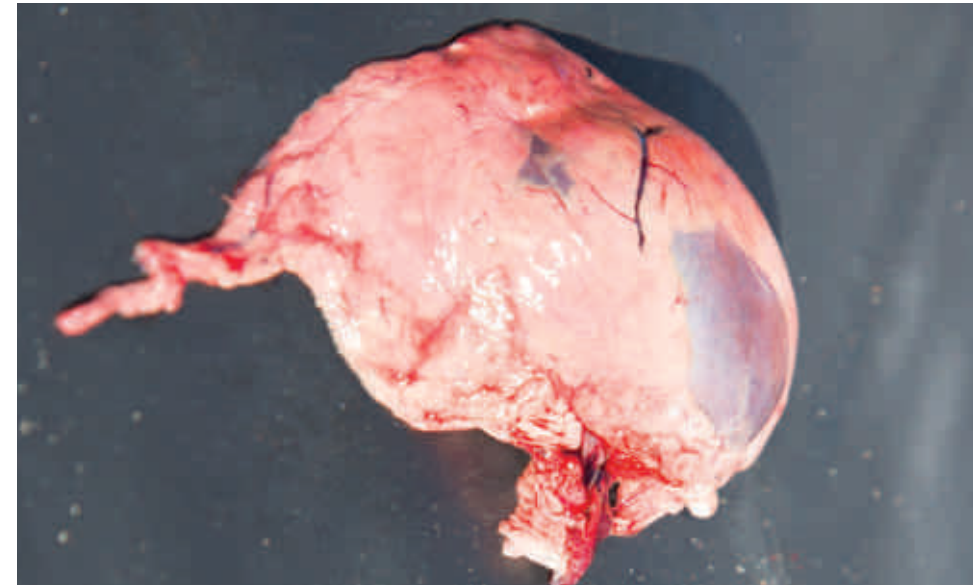
Ruptures or tears: Ruptures or tears in the liver can be signs of a difficult birth or infection of some type.



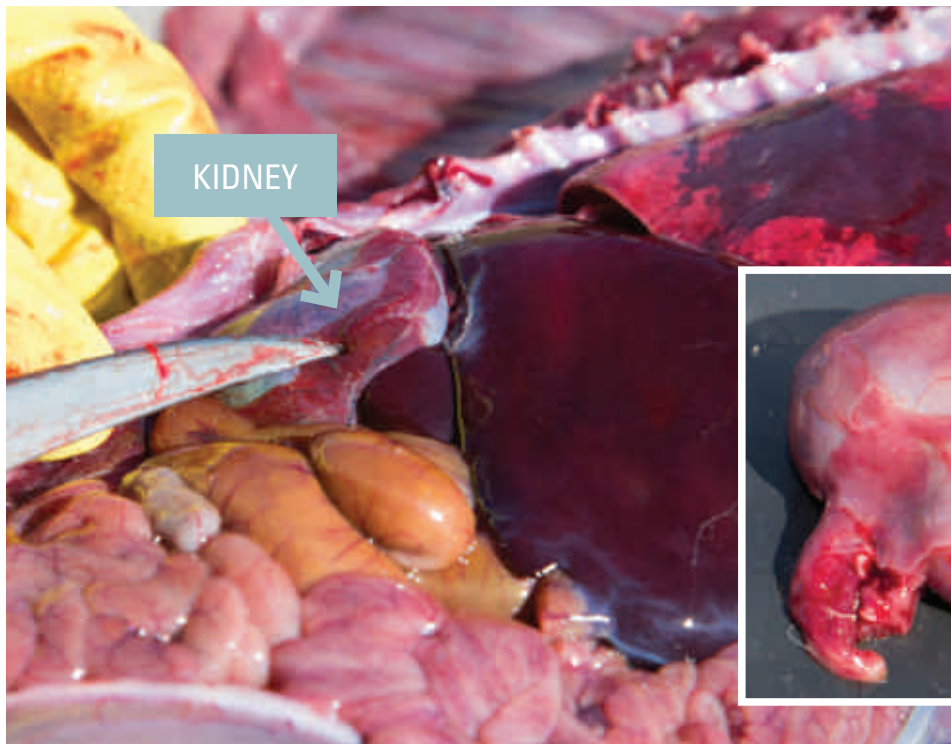
The kidneys

Inspect the colour of the fat surrounding the kidneys. Healthy fat, which has not been **metabolised** (used by the lamb as a source of energy), will be firm and whitish in colour.

Fat that appears gelatinous (jelly-like) and pink or reddish in colour indicates the lamb has used fat reserves (metabolised the fat) for survival in the absence of sufficient feed.



Unmetabolised fat: Fat surrounding the kidneys that appears firm and white (as shown above) has NOT been metabolised by the lamb as a source of energy.



Metabolised fat: Fat surrounding the kidneys that appears reddish in colour and jelly-like (e.g. shown at knife point in main image and inset) has been used as a source of energy.

Step 1: Carrying out a postmortem

Step 1: Carrying out a postmortem

20



The lungs

Inspecting the lungs can provide information about whether or not the lamb breathed before dying.

Healthy lungs are pink and spongy in texture. Lungs that are dark red or bluish in colour and firm in texture indicate the lamb has not breathed. Lambs that have only taken a few breaths may have both pink and dark (mottled) areas on their lungs (see below).

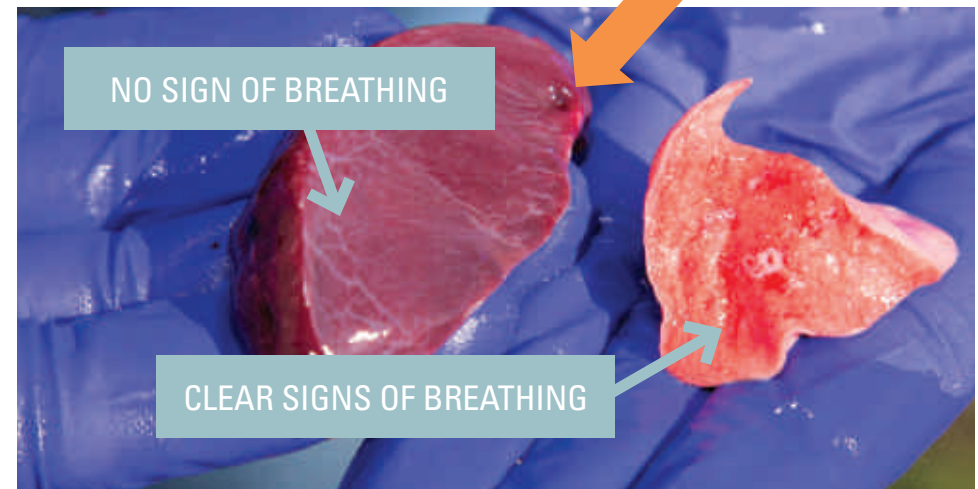
If you are unsure, you can cut off a small piece (5cm section) of lung and place it in a jug of water. A spongy pink lung that floats in water indicates the lamb breathed before dying. If the lung sinks the lamb has not breathed (see picture at top right).

Testing the lung:

The floating section of lung shown above indicates the lamb had breathed before dying. The section of lung at the bottom of the jug indicates the lamb had not breathed before dying.



Signs of life: A mottled lung (as shown above) suggests the lamb may have taken a breath or two, but essentially died soon after birth.



Colour and texture: Lungs dark in colour indicate the lamb has not breathed (left) while bright pink lungs are a sign the lamb breathed (right).

The stomach

The largest organ in the abdomen of a newborn lamb is the stomach (**abomasum**) (see photo on page 10 for location of stomach). The other three stomachs (rumen, reticulum and omasum) develop as the lamb gets older. Inspecting the stomach contents can indicate whether the lamb has fed.

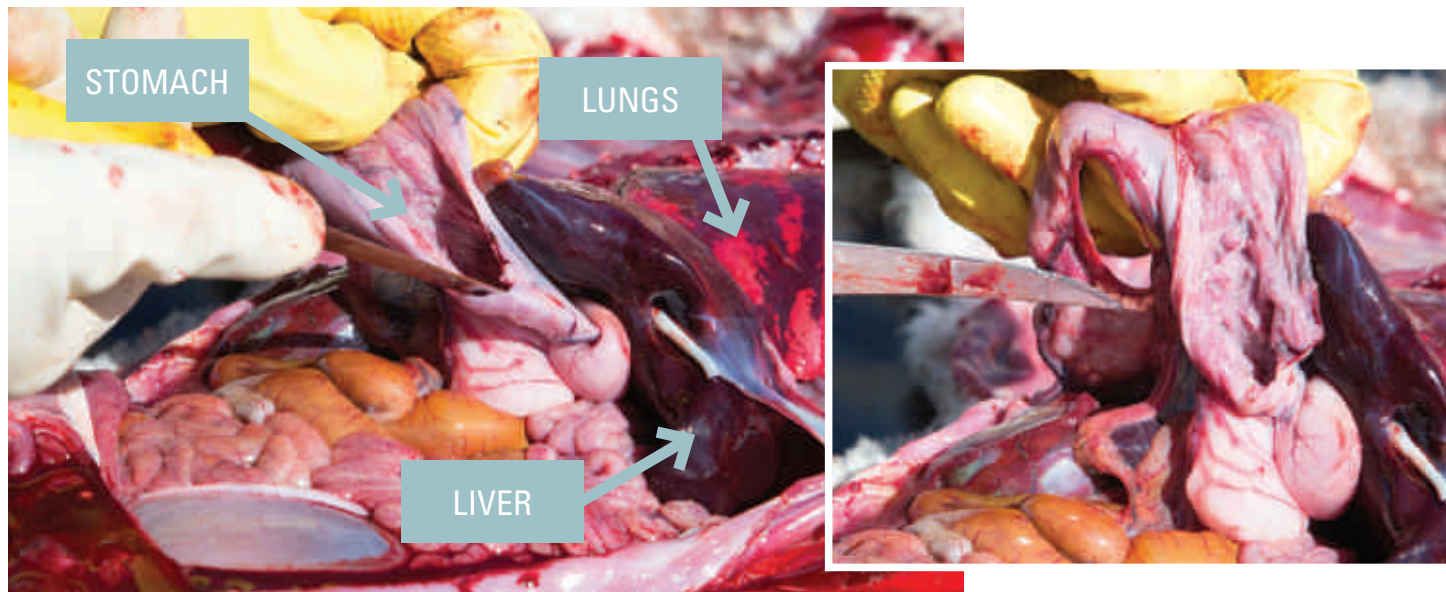


The presence of white curd-like lumps in the stomach indicates the lamb has suckled and ingested some **colostrum** and/or milk and has had at least one feed.

Clear or yellow mucus in the stomach, in the absence of any other contents, indicates the lamb has not successfully fed from the ewe.



Signs of milk: White curd-like lumps in the stomach indicate the lamb has had at least some colostrum or milk.



Empty: The stomach (main image and close-up at inset) shows no sign of the lamb having ingested any colostrum or milk.

Step 1: Carrying out a postmortem

Step 1: Carrying out a postmortem

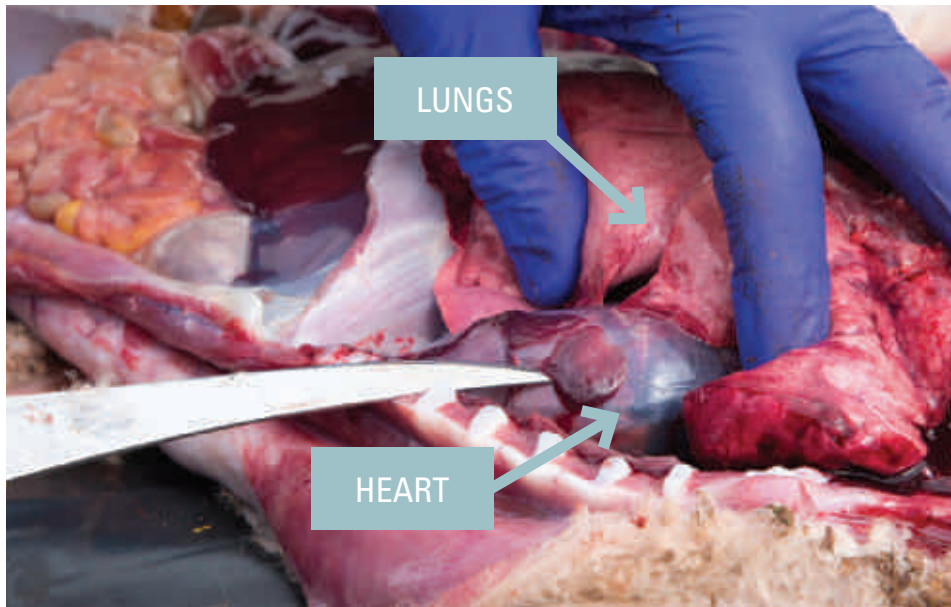
22

The heart

The heart of an otherwise healthy lamb will be surrounded with white fat. Fat that appears gelatinous (jelly-like) and pink or reddish in colour indicates the lamb has used fat reserves (metabolised fat) for survival in the absence of sufficient milk.



Cut open the heart and inspect the heart tissue. Lambs suffering from white muscle disease (selenium and / or vitamin E deficiency) will have gritty heart tissue, flecked with white.



Using reserves: A heart surrounded by jelly-like reddish fat (shown at knife point above) indicates the lamb has metabolised (used) its fat reserves.



Removing the heart: Remove the heart (note white fat surrounding the heart at knife point in image above) and cut open to inspect for any signs of abnormality.

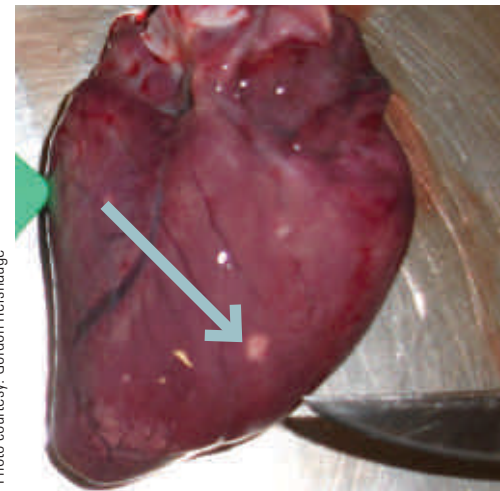


Photo courtesy: Gordon Reishauge

Signs of deficiency: White gritty flecks in the heart muscle (shown at arrow) indicate selenium and / or vitamin E deficiency).

The thyroid glands

The size and condition of the thyroid glands can indicate iodine deficiency. Remove the thyroid glands, which can be found either side of the trachea (windpipe), just below the voice box, and weigh both glands together.

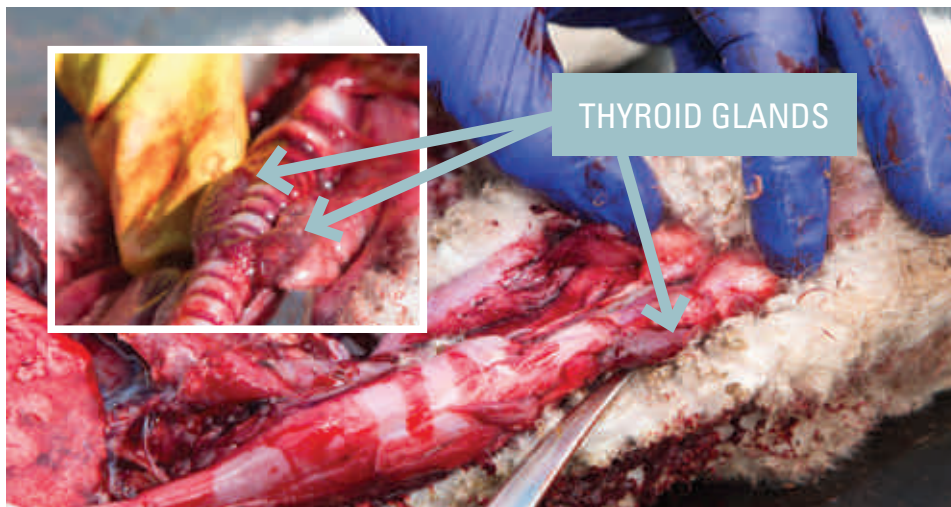
Divide the total weight of both thyroid glands (gm) by the total weight of the lamb (kg):

Weight of both thyroids (gm) / weight of lamb (kg)

If the result is 0.4 or higher it is worth sending to pathology.



Size matters: Weigh both thyroid glands (in grams) and divide this weight by the weight of the lamb (in kilograms)



Thyroid glands: The thyroid glands are located underneath the voice box and either side of the trachea (windpipe).

Photos courtesy, Robert Suter and David Rendell



Chronic deficiency: The lambs above shows signs of a grossly enlarged thyroid from chronic iodine deficiency. Lambs can die from more acute deficiency and have thyroids smaller than this (see inset) — some almost normal size.

Step 1: Carrying out a postmortem

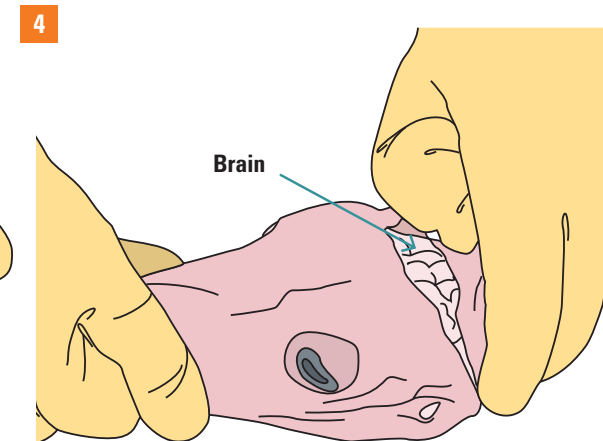
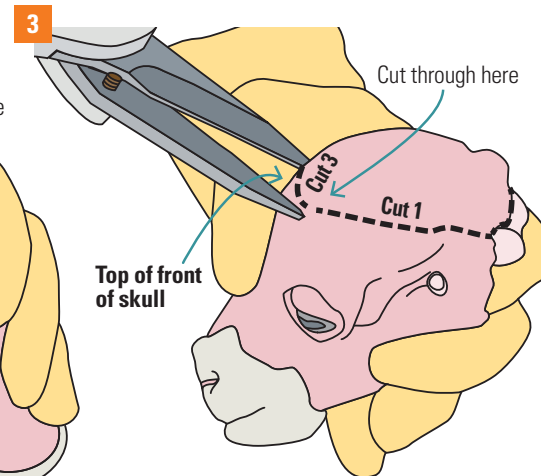
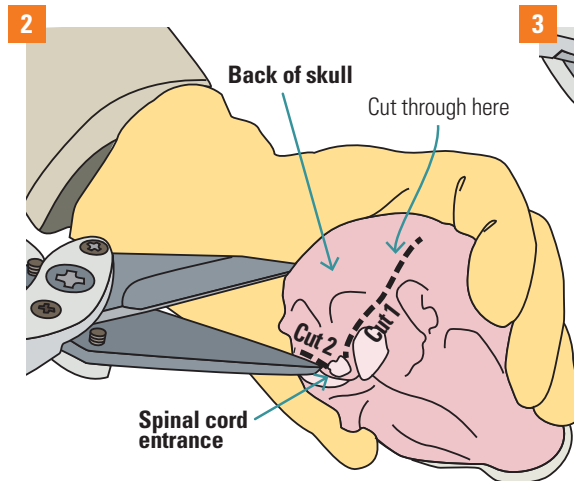
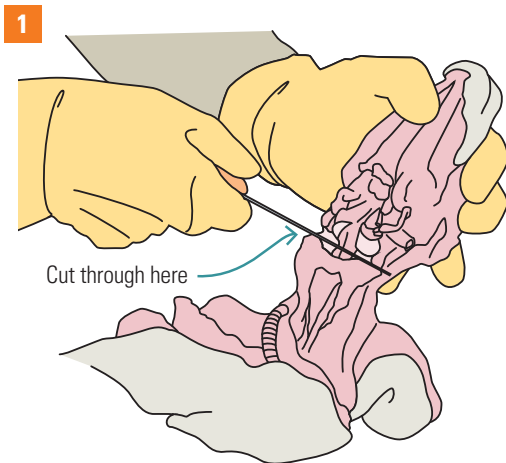
Step 1: Carrying out a postmortem

24

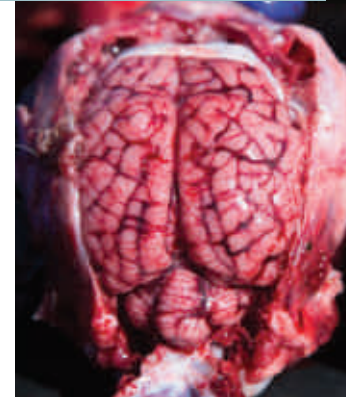
The brain

An inspection of the brain is one of the most revealing aspects of any postmortem: it is also one of the most difficult. **Haemorrhaging** (bleeding) under the membrane that surrounds the brain indicates a difficult or stressful birth — which is by far the leading cause of lamb death.

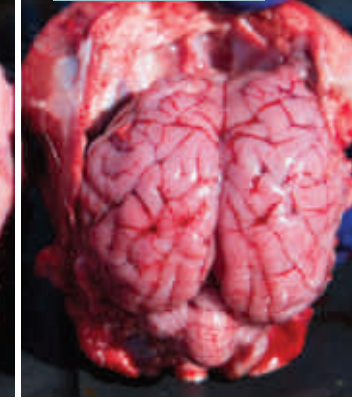
- 1 Skin the head and remove it from the body with a sharp knife (check for oedema under the skin see page 27).
- 2 Using the secateurs, starting at the back of the head where the spinal cord emerges, cut forward on both sides of the skull (see Cut 1 and Cut 2 on diagram below — it may take several cuts) to expose the brain (take care to avoid cutting the brain).
- 3 Turn the skull around and using the tips of the secateurs, taking care not to damage the enclosed brain tissue, join Cuts 1 and 2 (see Cut 3 below).
- 4 Remove the top of the skull and inspect for signs of bleeding, recording observations on the recording sheet.



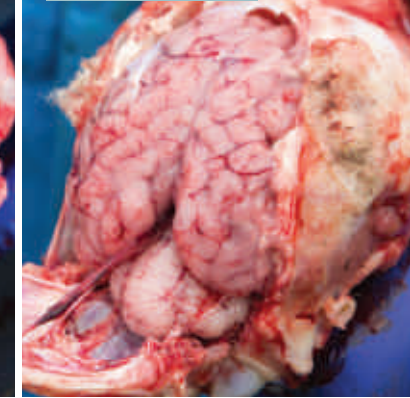
SIGNIFICANT CAUSE FOR CONCERN



MODERATE DAMAGE



NORMAL BRAIN



Brain bleeding: Although the degree of bleeding may vary (as shown above), any amount of bleeding under the brain membrane can indicate a difficult birth and possible brain damage leading to eventual death — even if born alive. Any bleeding in excess of that evident in the brain shown above right is significant and indicates birthing trauma.

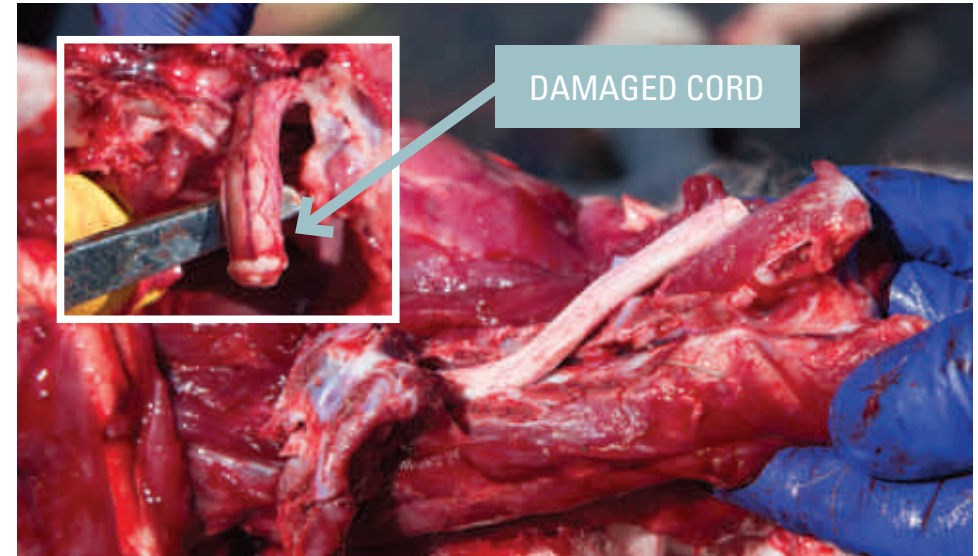
Inspecting the spinal cord

The final step in a complete postmortem is to investigate the spinal cord. This process takes practice, but will add another layer of information to form a more complete picture of the possible cause of death.

*NOTE: If you are not confident to carry out a **spinal dissection** and have lots of lambs that appear to have been mismothered (more than you would normally expect), collect some dead lambs and take them to your vet for an expert postmortem.*

The aim is to carefully take the top off the spinal canal to expose a length of the spinal cord.

- 1 Using a knife, remove the muscles from the top of the spine from the base of the skull down to the shoulder.



No damage: An undamaged spinal cord will appear white and free from signs of bleeding around the cord and in the spinal canal.



Step 1: Carrying out a postmortem

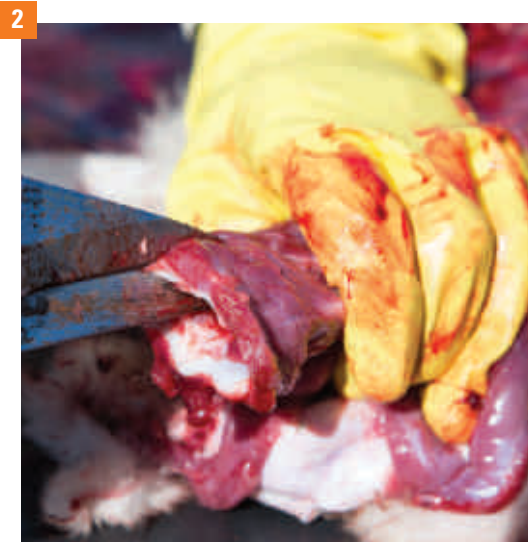
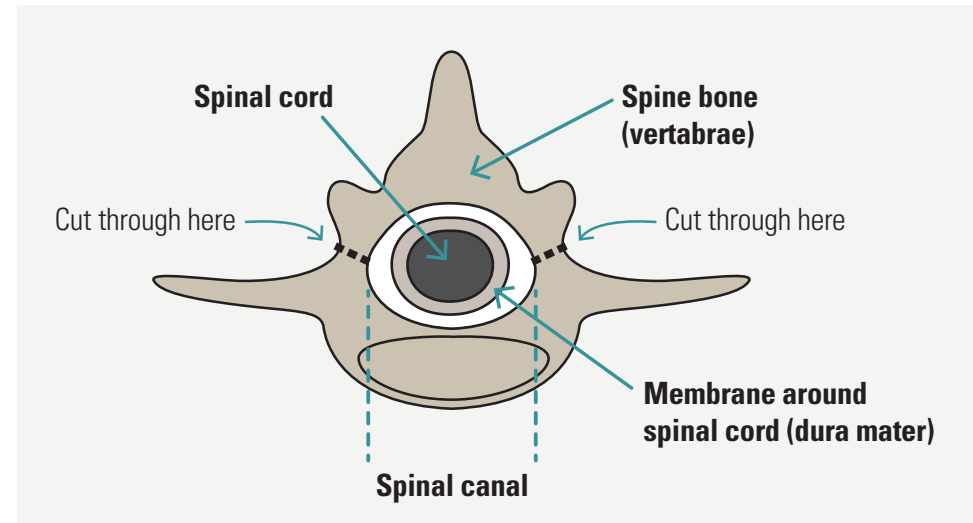
Step 1: Carrying out a postmortem

26

- 2 Using the secateurs, place the tip of the lower blade inside, and to one side, of the top of the spinal canal. Cut through the top of the **vertebrae** and then repeat on the opposite side.
- 3 Lift the severed section of the vertebrae to start to expose the spinal cord. Holding the flap of vertebrae, repeat with the next three or four vertebrae.
- 4 Inspect the spinal cord and spinal canal for signs of bleeding.



Cross-section of the spine



Inspecting for oedema

Signs of oedema (clear or blood-stained fluid) can be found in some dead lambs under the skin around the legs, head and neck where they have died from birth trauma. This fluid will have seeped into the tissue under the skin. External signs of oedema appear as a juicy swelling under the skin. When prodded the indentation will remain for 3–4 seconds, much like beans in a bean bag.

In some cases this fluid can be yellowish in colour (above the back of the hooves and the base of the tail), indicating the lamb may have died from exposure.



Subcutaneous fluid: Jelly-like fluid under the skin surrounding the head can indicate a difficult birth.

Bloodstained fluid can also pool in the abdomen, chest and under most of the skin, indicating death some time before birth.

Strip skin off all four legs, the tail and the head to inspect for subcutaneous oedema (excess fluid under the skin) or pus in the joints.

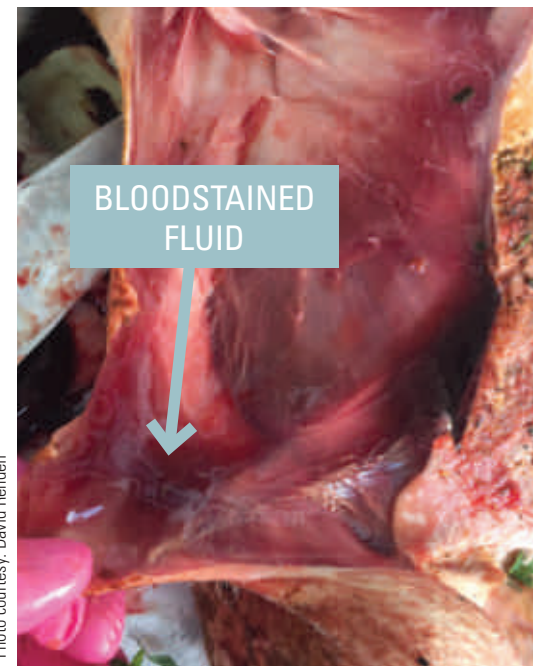


Photo courtesy: David Rendell



Subcutaneous fluid: Oedema can be bloodstained (as shown above left) as a result of birth trauma or late abortion, or yellowish at the back of the hooves or fetlock (above right) suggesting death from exposure. **INSET:** Normal at top right, yellowish oedema at bottom left.

Step 2: Analysing the results

28

Leading causes of death

The following section outlines the leading causes of lamb deaths and the symptoms associated with each cause of death.

Compare the observations you have recorded with the information outlined on the following pages to determine the most likely cause of death for each lamb [postmortem](#).

More than 80% of lambs that die between birth and weaning die within the first 48 hours of life.



Difficult diagnosis: Determining the cause of lamb death can often be difficult. A methodical postmortem will increase your chances of identifying any underlying causes of death you can fix through management.

The leading causes of death covered by this tool include:

- Birth trauma ([primary](#) and [secondary dystocia](#))
- Starvation (mismothering)
- [Exposure](#)
- [Primary predation](#)
- [Late abortion](#)
- Infection post birth
- Nutritional deficiencies
- Congenital deformities.

Analysing your observations

Using the observations on your *Recording* and *Summary sheets*, compare the information listed in the tables on the following pages. For each cause of death relevant symptoms have been rated according to the following system:

Sign is typically seen:	X X X
Sign can be seen but is not essential:	X X
Sign is seen occasionally:	X

If you are still unsure of the cause of death after analysing your results, seek the advice of your vet and provide the completed *Recording sheet* to assist discussion.



Birth trauma: The presence of yellow-stained meconium indicates stress during a difficult labour.



Starvation: Although lambs with empty stomachs (as shown above) have clearly not eaten before dying, the underlying cause of death can be difficult to identify.



Predation: Lambs that have died from predation as the primary cause of death are difficult to diagnose in isolation of other factors.



Late abortion: Lambs that have died in utero have usually started decomposing and may have brown rotting skin and brown body tissue.

Photo courtesy: Gordon Reifshaug

Step 2: Analysing the results

30

Birth trauma (primary dystocia)

Lambs that have died from primary dystocia have not survived birth either due to excessive size (or poor ewe energy levels) or **malpresentation** (e.g. breach birth or tangled legs).

These lambs may have swollen heads, typically with **subcutaneous oedema** (excess fluid) around the head and neck.

In most cases, these lambs will not have breathed, depending on the timing of assistance at birth and time of death.

Late premature lambs can be difficult to distinguish from lambs that have died from birth trauma or other causes. However premature lambs will not have subcutaneous oedema around their head. It is easy to distinguish lambs that have died from birth trauma from those that have died in utero — these lambs will have started to decompose and have blood-stained fluid in their chest, abdominal cavity and under their skin.



White fat: A lamb that has died from primary dystocia will not have metabolised (used) any fat reserves and the fat surrounding the heart (shown above) and kidneys will be white.

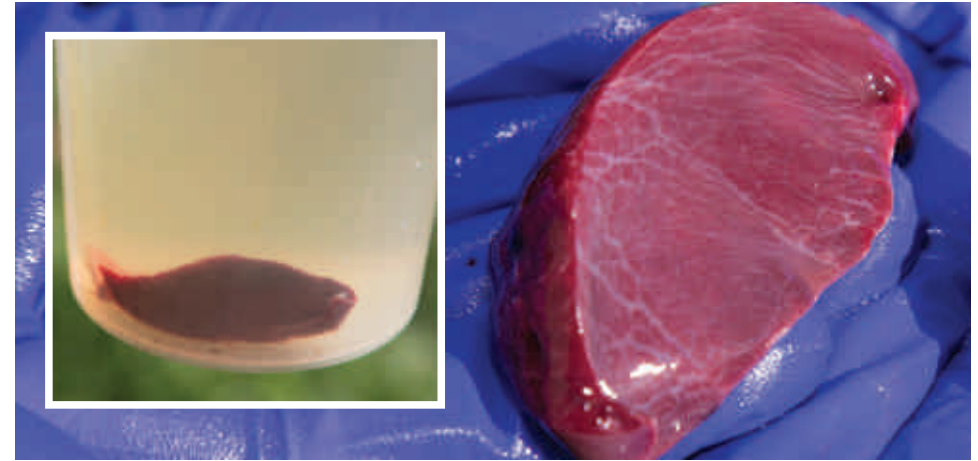
Observation	Likelihood
Not walked	XXX
White fat around heart and kidneys	XXX
Less than one day old	XXX
Empty stomach	XXX
Above normal weight range	XX
Not breathed	XX
Oedema (heads/legs)	XX
Meconium stained (yellow) coat	XX
Bleeding around brain	XX
Bleeding around spinal cord	XX
Ewe condition score <2.5 (or >3.5)*	XX
Cleaned	X
Assisted birth	X
Liver tear/rupture	X
Blood in abdominal cavity	X
Predation	X

* Both ewes in poor condition (with associated low energy levels) and overfat ewes can have difficulty during the birthing process leading to birth trauma.

Sign is typically seen: **XXX**
Sign is often seen but not essential: **XX**
Sign is seen occasionally: **X**



Obvious dystocia: The swollen head (oedema) and presence of meconium (faecal-stained coat) are clear indicators of primary dystocia.



Breathless: Lambs that have died from primary dystocia will typically not have breathed, indicated by a firm dark lung that sinks in water (INSET).



No food: A completely empty stomach is another typical sign of lambs that have died as a result of a prolonged and difficult birth.



Walked or not walked: Note the wearing of the pads on the bottom of the feet (left) indicates the lamb has walked. The lamb with pale, soft, unblemished pads (right) has not.

Step 2: Analysing the results

Step 2: Analysing the results

32

Birth trauma (secondary dystocia)

Lambs classified as dying from secondary dystocia will not necessarily be abnormally large in size or appearance, but will have clear signs of significant bleeding around the brain and/or spinal canal.

Birth trauma may be a result of poor ewe condition, a nutritional imbalance (e.g. [hypocalcaemia](#)), entangled lambs (malpresentation), or ewes that take too long to give birth.

Although some of these lambs may survive up to five days after birth, they will have suffered from reduced oxygen to their brain during a prolonged birth such that they are less vigorous, less able to suckle and keep warm and the ewe is more likely to abandon these lambs.

These lambs will have [metabolised fat](#) around their heart and kidneys. They will have breathed, walked but have often ingested little or no milk because their suckling reflex has been compromised by brain damage.

Lambs that endure a longer labour often are less vigorous, less able to generate their own body heat, have poorer suckling ability and their mothers show less interest in them.

The presence of significant bleeding around the brain and / or spinal cord differentiates this death category from lambs that may have died from starvation (mismothering) or exposure.

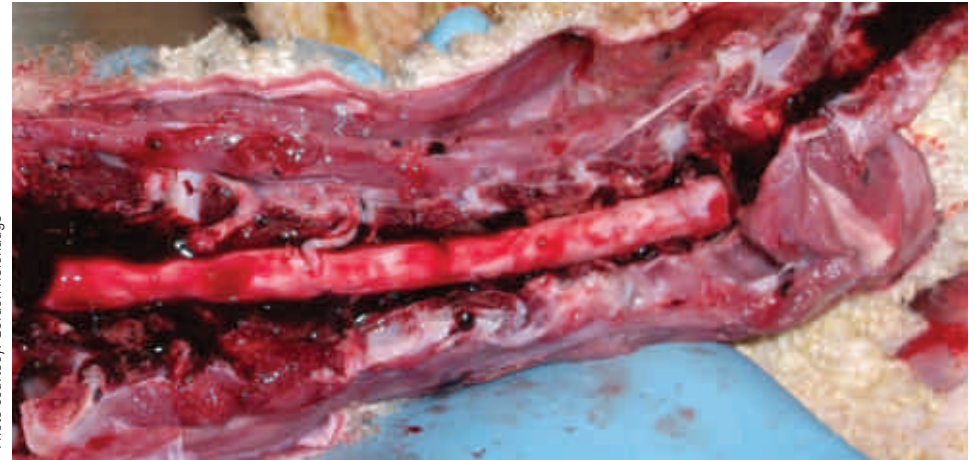
Observation	Likelihood
Significant brain bleeding	X X X
Significant spinal bleeding	X X X
Breathed	X X X
Reddish fat around heart and kidneys	X X X
Empty stomach	X X X
Walked	X X X
Average birth weight	X X
Cleaned	X X
Assisted birth	X
Swelling (oedema) head/legs	X
Meconium stained (yellow) coat	X
Predation	X

Sign is typically seen: **XXX**
Sign is often seen but not essential: **XX**
Sign is seen occasionally: **X**



Difficult diagnosis: Lambs dying from secondary dystocia can be difficult to diagnose as there are often no clear external signs.

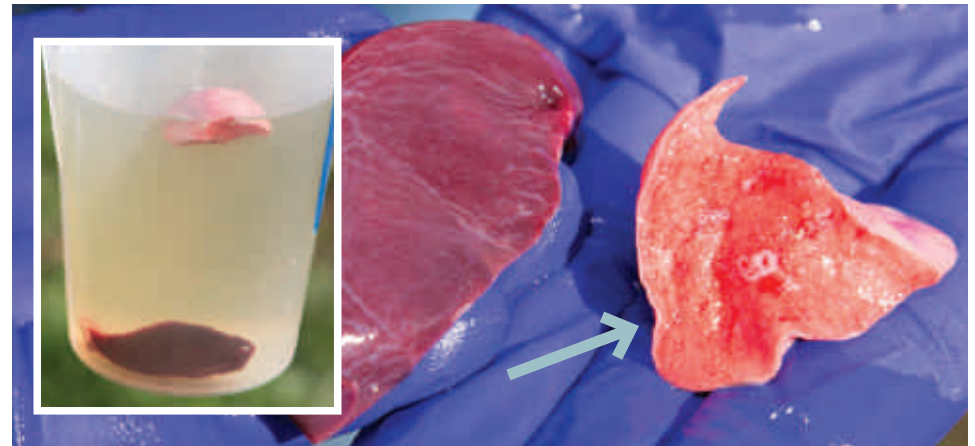
Photo courtesy: Gordon Reifshauge



Spinal bleeding: Signs of a significant amount of blood around the spinal cord indicate secondary dystocia as the primary cause of death.



Metabolised fat: Signs of reddish metabolised fat surrounding the kidney (shown at left) compared with white (unmetabolised) fat (shown at right).



Signs of breathing: Lambs dying from secondary dystocia are likely to have breathed before dying and will have bright pink lungs, which float in water (INSET).

Step 2: Analysing the results

Step 2: Analysing the results

34

Starvation (mismothering)

Lambs that have died from starvation (mismothering) as the primary cause of death will not have significant bleeding around their brain or spinal cord.

They are viable lambs that have walked and breathed but failed to suckle adequately and will have either no milk, or insufficient amounts of milk in their stomach for survival. In the absence of milk, they will have metabolised (used) their fat reserves, which often, but not always, are limited due to low birth weight and/or body reserves.

NOTE: It can be difficult to differentiate between lambs that have died from birth trauma (secondary dystocia) and starvation or mismothering. Lambs that have starved will not have significant bleeding around their brain or spinal cord.



No reserves: In addition to an empty stomach, lambs that have starved as the primary cause of death are likely to have metabolised the fat around their kidneys (shown above at knife point).

Observation	Likelihood
Reddish fat around heart and kidneys	X X X
Empty stomach	X X X
Walked	X X X
Breathed	X X X
Below-average weight	X X
Ewe condition score < 2.5	X X
Twin lamb	X X
Lamb age up to 5 days	X X
Cleaned	X
Insufficient feed on offer (F00)	X
Inclement weather during past 24 hours	X



Sign is typically seen: **XXX**
Sign is often seen but not essential: **XX**
Sign is seen occasionally: **X**

Worn down: Lambs that have died from starvation (mismothering) are likely to have walked, which will be indicated by worn hoof pads.

Exposure

Don't assume an extreme weather event is the primary cause of death. Lambs dying of exposure as the primary cause of death will have signs that indicate viability, such that they would have survived in the absence of an inclement weather event. The key difference between these lambs and lambs that have died from starvation or mismothering is the occurrence of a severe weather event.

These lambs will have breathed, metabolised the fat around their heart and kidneys, walked and are not likely to have signs of significant bleeding around the brain or spinal cord. However, in extreme weather conditions lambs can die so quickly they don't metabolise body fat or even walk before dying.

Fluid beneath the skin just above the back of the hoof and at base of the tail clearly indicates exposure as the cause of death, but in some cases lambs die before this oedema accumulates.



Fluid retention: Excess jelly-like fluid under the skin around extremities, such as the back of the fetlock, tail, head and neck is a clear sign of exposure.

Observation	Likelihood
Inclement weather event during past 24 hours	X X X
Reddish fat around heart and kidneys	X X X
Cleaned	X X X
Breathed	X X X
Walked	X X X
Yellow subcutaneous oedema (in extremities)	X X
Limited paddock shelter	X X
Below-average weight	X X
Twin lamb	X X
Insufficient feed on offer (FOO)	X X

Sign is typically seen: **XXX**
Sign is often seen but not essential: **XX**
Sign is seen occasionally: **X**

Iodine deficiency and exposure

Be aware that lambs with goitre (iodine deficiency) have a reduced ability to generate their own body heat. They are particularly susceptible to death from hypothermia (exposure) and you may not see obvious signs of swollen thyroid glands. For this reason it is important to inspect and weight the thyroid glands during a postmortem (see pages 23 and 39 for more details).

Step 2: Analysing the results

36

Primary predation

Lambs that have died from predation as the primary cause of death are difficult to diagnose in isolation of other factors. More often, lambs will have been weakened or died due to another factor and have then been finished off by a predator. There will be no (or minimal) blood at the site of attack (e.g. head or neck) if the lamb died before the predator attack (secondary predation).

Often the internal organs have been eaten so clues that would otherwise help determine whether there were other factors leading to the death are not available. However, if the skull is intact there may be evidence of bleeding around the brain (indicating secondary dystocia) that may have predisposed the lamb to attack. Even if the carcass is partly destroyed by predation, there may be value in inspecting the remains. Likewise, if the head is destroyed, but the body is intact, there may still be clues about whether the lamb was unlikely to be viable before attack.

Where predation is the primary cause of death the lamb is otherwise viable, often has lived for some time and is not likely to have metabolised their internal fat reserves. **These lambs will have bled heavily from their wounds, indicating viability at the time of attack.**

Lambs that have died from primary predation should exhibit clear signs that they would have survived in the absence of predator attack — breathed, walked, fed with little to no bleeding around the brain or spinal cord.

Observation	Likelihood
Signs of predation (and significant blood loss at the site of attack i.e. where the lamb has been bitten or pecked)	X X X
Breathed	X X X
Walked	X X X
Cleaned	X X
Signs of having fed	X X
White fat around heart and kidneys	X X

Sign is typically seen: **XXX**
Sign is often seen but not essential: **XX**
Sign is seen occasionally: **X**



Signs of attack: Signs of predator attack need to occur in isolation of other casual signs of death in order for predators to receive the full blame.

Late abortion

The most common causes of late abortion include: [campylobacter](#), [toxoplasmosis](#) and [listeria](#). Some of these lambs will die in utero and others can be born looking fairly normal, but die soon afterwards.

Late abortion lambs that have [died in utero](#) have usually started decomposing and may have brown rotting skin, brown body tissue and bloodstained [subcutaneous oedema](#) (fluid beneath the skin) across their entire body and excess bloodstained fluid in their chest and abdominal cavities.

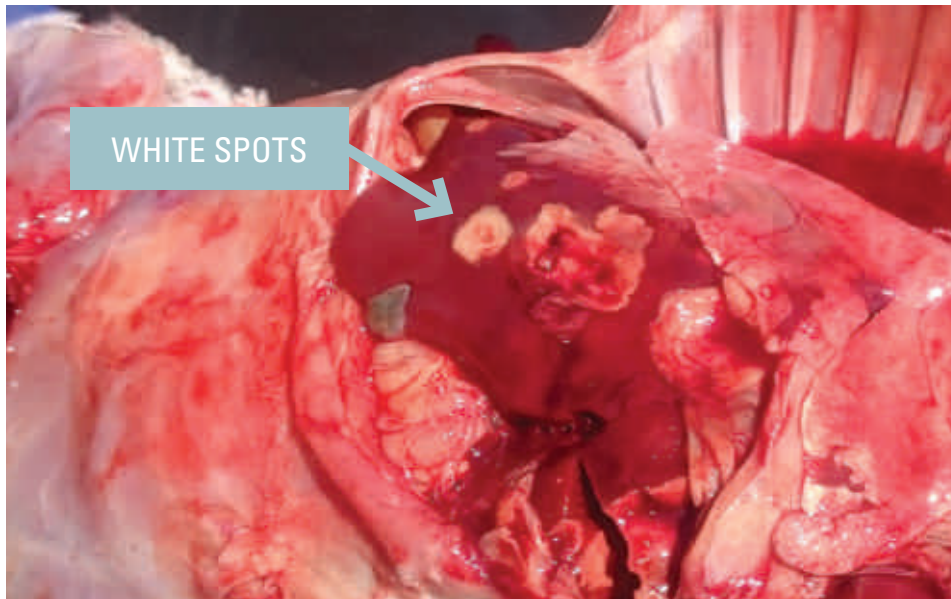


Photo courtesy: David Rendell

Infectious abortion: White spots on the liver of a dead lamb are a typical sign of infectious disease such as *campylobacter*.

Observation	Likelihood
Below-average weight	X X
Enlarged liver (with rounded edges)	X X
White spots on liver*	X X
Not breathed	X X
No milk in stomach (distended with slimy fluid)	X X
Dead in utero — brown rotting skin, bloodstained subcutaneous oedema (fluid under the skin), excessive blood-stained fluid in the abdominal and chest cavities	X
White spots on 'strawberries' or 'buttons' in placenta (afterbirth)*	X
No wool (bare skin) or incomplete wool development	X

* Is not always seen, but if seen is a strong indicator of late infectious abortion.

Sign is typically seen: **XXX**
 Sign is often seen but not essential: **XX**
 Sign is seen occasionally: **X**

For an accurate diagnosis of the cause of late abortion take 3–5 suspect lambs (that you have not dissected, with intact internal organs) or suspect livers (enlarged or with white spots) to your vet or nearest pathology laboratory for analysis.

If you have already carried out some postmortems on other lambs take the completed *Recording sheets* to your vet along with the undissected lambs.

Step 2: Analysing the results

Step 2: Analysing the results

38

Infection post birth

Lambs that have died from infection after birth (as opposed to dying of infection in utero or just after birth) vary in their postmortem signs depending on the source of infection.

A postmortem can reveal indicators such as abscesses in the lungs, on the liver or pus and signs of infection around the umbilical cord (navel) or in the joints. Spinal abscess (which enters through the navel) is sometimes seen in older lambs that lose the use of their hind legs. These lambs should be treated with antibiotics or euthanased.

Lambs that have died from infection have typically been cleaned, breathed, walked and ingested milk.

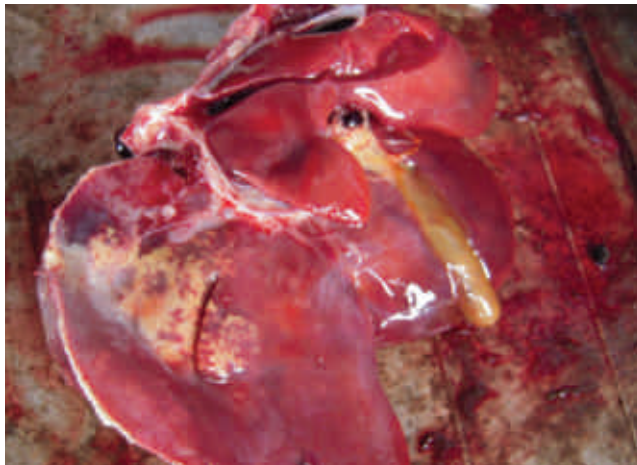
Observation	Likelihood
Cleaned	X X X
Breathed	X X X
Walked	X X X
Signs of infection (abscess, pus in or around joints or navel)	X X X
Ingested milk	X X
Several days old	X X
Swollen joint/s (signs of pus in joint fluid)	X X
Reddish fat around heart and kidneys	X

Sign is typically seen: **XXX**

Sign is often seen but not essential: **XX**

Sign is seen occasionally: **X**

Photo courtesy: Robert Suter



Lung infection: Lumps or abscesses in the lungs are clear signs of infection.

Photo courtesy: Gordon Refshauge



Signs of infection: Keep an eye out for signs of pus and infection around the navel as shown above.

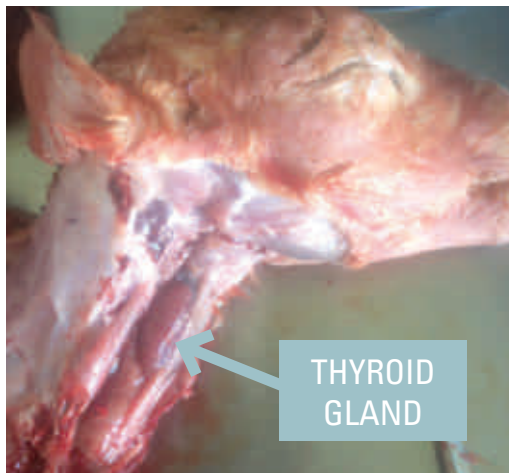
Nutritional deficiencies

Although relatively uncommon as a rule of thumb, the more common nutritional deficiencies include:

- **goitre** (iodine deficiency)
- white muscle disease (selenium deficiency)
- copper deficiency.

Goitre

Lambs may be stillborn or weak at birth because of iodine deficiency yet show no external signs of an enlarged thyroid gland. In severe chronic cases the enlargement can actually be seen as a swelling in the neck. An acute iodine deficiency, with minimal outward signs of goitre, can be a major contributor to young lamb deaths often attributed to starvation (mismothering) or exposure.

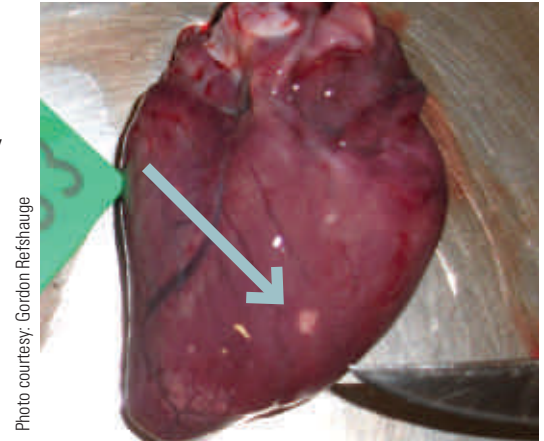


Enlarged thyroids: A thyroid to lamb weight ratio of more than 0.4 indicates iodine deficiency. Send glands to the laboratory to confirm diagnosis.

White muscle disease (selenium deficiency)

White muscle disease (WMD) is known as 'stiff lamb disease' in older lambs, typically up to three months of age. If selenium/vitamin E deficiency occurs in newborn lambs it affects the heart muscle.

Where newborn lambs suffer (and die) from the disease they typically show signs of white grit in their heart muscle.



White grit: Flecks of white in the muscle tissue in the heart (shown at arrow) indicate selenium deficiency.

Copper deficiency

While no particular signs will probably be seen at postmortem on newborn lambs, lambs suffering from copper deficiency are more likely to die from starvation (mismothering).

Lambs a few weeks of age that show signs of swayback, brittle bones or fractured ribs are symptomatic of copper deficiency.



Brittle bones: Fractured ribs in young lambs are a typical sign of copper deficiency.

Step 2: Analysing the results

Step 2: Analysing the results

40

Congenital deformities

Although relatively uncommon as a rule of thumb, the more common congenital deformities include:

- cleft palate
- imperforate (missing) anus
- bent legs
- spinal deviation
- coat condition (e.g. hairy coat — pestivirus).

If you only have the odd case of congenital deficiency there is little concern. However, if congenital deformities occur regularly seek advice from your vet. Some congenital defects can be caused by inbreeding or viruses and/or toxins ingested by the ewe during pregnancy.



Photos courtesy: David Rendall

Imperforate anus: Some lambs lack an anal opening preventing them from defecating, leading to a swollen and distended abdomen.



Photo courtesy: Gordon Refshauge

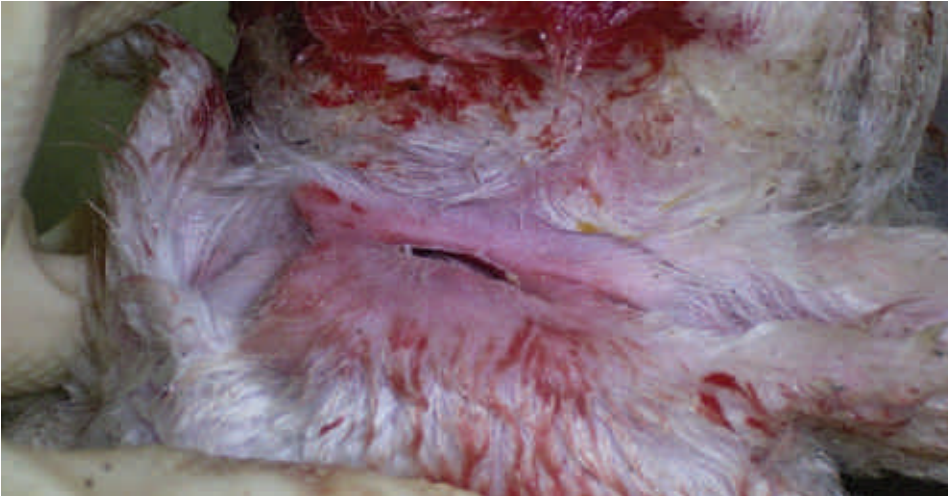
Spinal deviation, with spine twisting about half-way towards tail



Photo courtesy: Bruce Jackson

Hermaphrodite (genitalia of both genders) with imperforate (missing) anus

Photo courtesy: Bruce Jackson



Deformed head with ears at each side, but no other facial features (slit is approximately where mouth would be)

Photo courtesy: Bruce Jackson



Two-headed lamb

Photo courtesy: Bruce Jackson



Deformed head

Photo courtesy: Robert Suter



Undershot jaw

Step 2: Analysing the results

Step 3: Management implications

42

Managing for maximum survival

The factors that contribute to lamb deaths and the ultimate causes of death are summarised in the table below, along with suggested management practices to address them.

These management practices are covered in more detail in the following pages along with links to additional resources and information.

Cause of death	Factors contributing to death	Key management practices
Birth trauma (primary dystocia)	• Lamb size too large relative to ewe size/capacity (more common in singles)	• Ewe nutrition during pregnancy • Ram genetics and ewe selection
Birth trauma (secondary dystocia)	• Ewe lacks energy to complete birthing process • Nutritional imbalance in the ewe (e.g. hypocalcaemia) • Poor mothering characteristics (physical or behavioural)	• Ewe nutrition during pregnancy • Ewe selection • Mob size and stocking rate
Starvation / mismothering	• Low birth weight (more common in twins) • Poor ewe milk supply • Poor mothering characteristics (physical or behavioural) • Poor paddock layout • Excessive mob size • Disruptive lambing management	• Ewe nutrition during pregnancy • Feed on offer at point of lambing • Mob size and stocking rate • Ewe selection • Lambing management • Paddock factors
Exposure	• Low birth weight • Being a multiple lamb (e.g. a twin or triplet) • Insufficient paddock shelter and/or poor layout	• Ewe nutrition during pregnancy • Feed on offer during lambing • Paddock shelter and/or layout • Mob size relative to available shelter
Predation	• Predator pressure • Ewe nutrition (lamb vigour)	• Predator control program • Ewe nutrition during pregnancy • Feed on offer at lambing
Late abortion	• E.g. campylobacter, toxoplasmosis, listeria	• Disease-specific management programs
Infection post birth	• Bacterial infection through the navel (umbilicus)	• Paddock factors
Nutritional imbalances	• Nutrient deficiencies in soils/pastures	• Improved nutrient management
Congenital deformities	• Various factors	• Sire/dam selection, toxins/poisonous plant management

Ewe nutrition during pregnancy

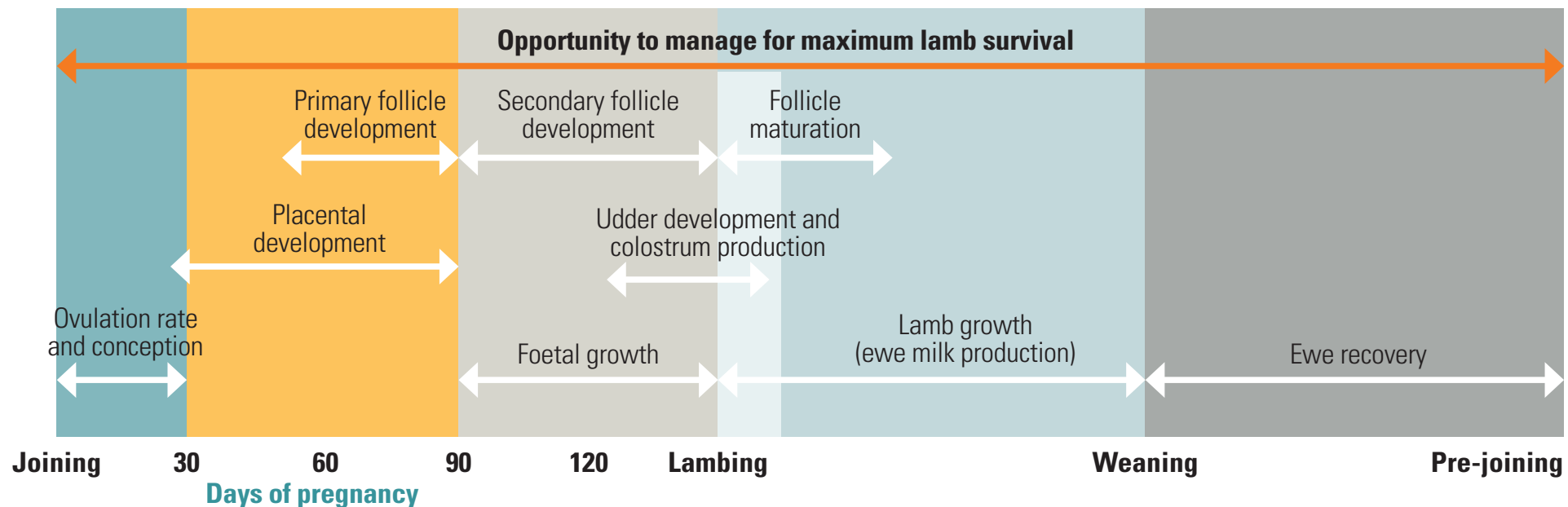
Ewe nutrition during pregnancy (and at the point of lambing) is the most important factor affecting lamb survival during the first week of life.

Managing ewe nutrition and condition score from joining influences birth trauma, starvation/mismatching, exposure and predation (via lamb birth weight, the ewe–lamb bonding process, ewe energy levels and milk production, lamb vigour and growth).

As outlined below, critical development of the foetus and supporting systems (e.g. placenta and udder development) start during early pregnancy and continue after lambing.

It is critical to ensure the ewe gets an adequate opportunity to recover body condition between weaning and the next reproductive cycle to preparing her sufficiently for her next joining and pregnancy.

The stages of pregnancy and lamb development in relation to the reproductive cycle of the ewe



Source: Adapted from www.lifetimewool.com.au

Step 3: Management implications

Step 3: Management implications

44

Lamb birth weight and ewe condition

The survival rate for single or twin lambs is mostly explained by difference in birth weight and ewe condition score (CS) at lambing. Lamb birth weight is primarily determined by ewe nutrition in early pregnancy, during placental development (up to day 90), and in the final 50 days of pregnancy (see previous page), although ewe nutrition during late pregnancy has a much greater impact on birth weight (± 0.5 kg), than early pregnancy nutrition (± 0.3 kg).

Lamb birth weight also is affected by gender, litter size, sire and dam genetics and gestation length.

Scanning ewes 70 – 90 days after the start of joining allows you to identify which ewes are carrying singles and which are carrying twins (or triplets).

This information allows you to more effectively manage ewe nutrition during late pregnancy to optimise lamb birth weight and ewe condition, and reduce the risk of birth trauma, starvation/mismothering and death from exposure.

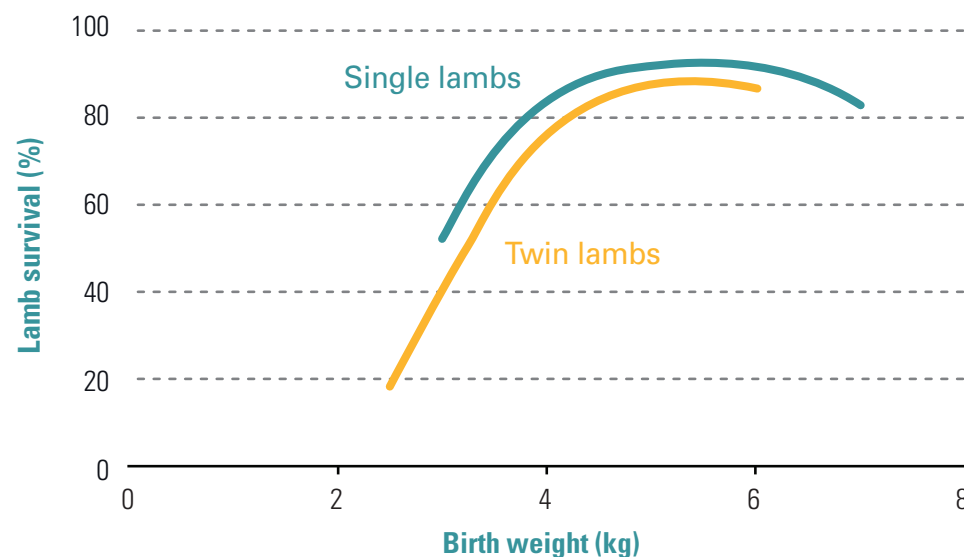
Risks associated with high birth weights

High birth weight lambs are more likely to be single lambs.

Ewes carrying excessively large lambs are often overfat (above CS3.5) at the point of lambing, making lambing more difficult and increasing the risk of birth trauma (primary dystocia).

Maintain feed on offer for single-bearing ewes at 1000kg DM/ha of green feed to prevent them from becoming overfat.

Impact of lamb birth weight on survival



Source: Adapted from www.lifetimewool.com.au

Impacts of ewe nutrition on lamb survival

Where ewe nutrition is in excess during pregnancy and through to lambing the impacts can lead to:

- birth trauma (primary dystocia).

Risks associated with low birth weights

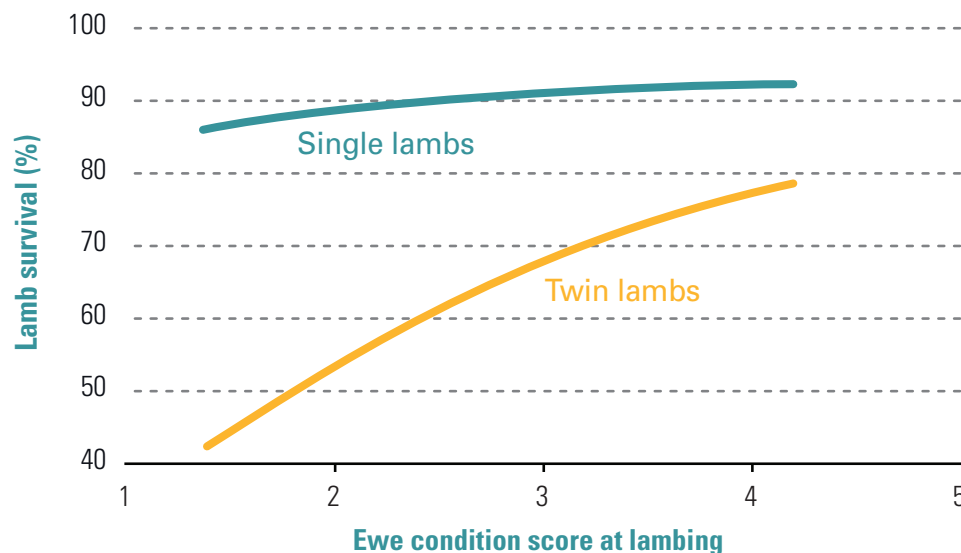
Low birth-weight lambs are more likely to die due to starvation/ mismothering and exposure because they:

- are generally weaker and less vigorous at birth than larger lambs
- have a larger surface area per unit of body weight, making them more susceptible to cold
- have lower reserves of body fat, which reduces their energy levels and resistance to cold climatic conditions
- often have reduced suckling reflex
- are typically born into situations where the ewe is hungry, decreasing maternal behaviour and compromising ewe-lamb bonding during the first 4–6 hours of the lamb's life.

Key messages — ewe condition

- Maintain condition at CS3 during early pregnancy to facilitate placental development.
- Scan ewes 90 days from the start of joining and manage according to litter size as pregnancy progresses.
- Maintain single-bearing ewes in CS2.8 to 3.0.
- Maintain twin-bearing ewes in CS3.0 to 3.3.
- Manage paddock allocation during late pregnancy and lambing to ensure twin-bearing ewes have access to >1500kg DM/ha of feed on offer.

Relationship between ewe condition and lamb survival



Source: Adapted from www.lifetimewool.com.au

Key messages — lamb birth weight

- Lamb birth weight is a key factor affecting lamb survival during the first week of life.
- Optimum lamb birth weight for survival is 4.5 – 6.0kg.
- Survival decreases sharply when birth weight drops below 4.0kg or rises above 6.5kg.
- Manage ewe nutrition during pregnancy to optimise lamb birth weight.

Step 3: Management implications

46

Feed on offer at point of lambing

Poor ewe nutrition and low ewe condition score at lambing not only results in low birth-weight lambs, but impacts on ewe maternal instinct, which contributes to numerous causes of lamb deaths — starvation, mismothering, hypothermia due to exposure and [secondary predation](#).

Poor ewe nutrition delays the onset of milk production, and colostrum, for up to four hours. This delay is most common in twin-bearing ewes and often results in one lamb dying.

The feed on offer during lambing (especially for twin-bearing ewes) is also critical. With sufficient feed the ewe doesn't need to leave the birth site, allowing longer for ewe–lamb bonding.

Condition score 3 at lambing, with adequate feed on offer (quantity and quality) will reduce the risk of starvation/mismothering and hypothermia and ensure a good start to lactation.

Pasture requirements at lambing

Litter size	FOO (kg DM/ha)	Feed quality (% digestibility)
Singles	900 – 1100	Moderate to high (70 – 75%)
Twins	1500 – 800	High to very high (75 – 80%)

The critical skills required to manage ewe nutrition are: feed on offer assessment, ewe condition scoring, feed budgeting, and proactive management.

Feed quality as important as quantity

Energy intake is determined by the quantity and quality of feed on offer — it is not only the quantity of feed available during pregnancy and at lambing that is important but also the quality and nutritional balance. Secondary dystocia can occur as a result of nutritional challenges, such as [hypocalcaemia](#) (low blood calcium levels) and [pregnancy toxaemia](#) (insufficient energy levels) during the last six weeks of pregnancy.

Impacts of ewe nutrition on lamb survival

Where ewe nutrition is inadequate during pregnancy and through to lambing the impacts can lead to:

- birth trauma (dystocia)
- starvation (mismothering)
- exposure
- secondary predation.

Genetics — ram and ewe selection

Ram selection

Ram selection, especially for maiden ewes, or meat breed rams joined to small-framed Merinos can impact on lamb survival.

To minimise the risk of ewes producing excessively large lambs select sires with moderate birth weight, lower gestation length and higher lambing ease ASBVs.

Select low-birth-weight breeds for maiden ewes (if problems persist).

Ewe selection

Cull ewes that consistently fail to successfully rear lambs. Ewes that fail to rear lambs could be a result of:

- udder and teat injury, defect or infection
- poor maternal behaviour
- poor ewe nutrition and management during pregnancy and/or during lambing
- non-viable lamb.

Small, but consistent, gains can be made towards weaning more lambs by culling ewes which lamb, but fail to rear their young. Failure to rear may not be the ewe's fault and it can be worth giving Merino ewes (particularly maiden ewes) a second chance. Consider wet-dry culling on rearing ability, tagging Merino ewes that have failed to rear, so she can be easily identified and culled if she fails to rear a second time. Cull any cross-bred ewes that fail to rear in any one season —

no second chance is warranted. Cull any ewe that has udder faults (blind teats, bell teats or mastitis).

The 'wet and dry' technique (stripping fluid from the udder at lamb marking) can identify ewes that are either rearing a lamb or have lambed and lost. Ewes not rearing a lamb have some udder development but tend to have clear fluid and teats that are dirty. Dry ewes have no birth stain on the breech and little udder development.

The progressive gains from culling maidens that fail to rear a lamb include:

- Ewes that reared lambs as maidens rear 10% more lambs at subsequent lambing.
- The ability to rear a lamb is passed on to subsequent generations, especially if ram selection includes maternal rearing ability.

Impacts of ram and ewe selection on lamb survival

Ram and ewe selection can adversely impact on lamb survival through:

- birth trauma (dystocia)
- starvation (mismothering).

Step 3: Management implications

48

Mob size and lambing management

To optimise lamb survival manage mob size and handling during lambing to prevent the risk of starvation (mismothering).

The smaller the mob size, the lower the risk of mismothering. Recommended targets are:

- multiple-bearing ewes < 200 ewes
- single-bearing ewes 400 – 500 ewes
- maiden ewes 250 – 400 ewes.

Larger mob sizes and stocking densities are likely to create more mismothering and lamb losses.

Aim to minimise mob size and stocking rates at lambing — particularly twins. This will reduce the number of fresh lambs born in any one area at any one time.

Splitting ewes into early and late-lambing mobs and pregnancy scanning can help manage mob size and feed allocation (it also helps manage lamb size through management of the ewe throughout pregnancy).

Handling of mob during lambing

Disturbing ewes excessively during lambing can increase the incidence of mismothering — drive through mobs before lambing to help them become used to this. Ensure any dog taken into the lambing paddock can be controlled easily.

Carry out paddock inspections between 1 – 3pm when it is warmer and ewes and lambs are more relaxed.



Photo courtesy: Catriona Nicholls

Do not disturb: Minimise the amount of disturbance to mobs of lambing ewes to reduce the risk of mismothering.

Key messages mob size and management

- Manage mob size for single, twin-bearing and maiden ewes accordingly.
- Avoid disturbing ewes unnecessarily during lambing.

Paddock shelter and layout

The best protection against death from exposure is adequate birth weight and lamb vigour, combined with paddock shelter and plentiful milk production in the ewe.

Ensure ewes with multiple lambs are given priority for shelter, supplements and quality forage, and are in their lambing paddock about one week before lambing.

Ideal lambing paddocks have effective shelter, which reduces wind speed to less than 8km/h (a gentle breeze) at lamb height. This is best achieved by:

- allocating paddocks with a northerly aspect, which protect stock from cold southerly or westerly winds
- planting strategic windbreaks of trees and tall perennial grasses

Impact of shelter on lamb survival

Location	Shelter	Singles (% survival)		Twins(% survival)	
		Unsheltered	Sheltered	Unsheltered	Sheltered
Hamilton, Victoria	Cypress	81	94	73	87
Hamilton, Victoria	Phalaris	88	91	67	81
Armidale, NSW	Phalaris	83	91	49	64
Armidale, NSW	Sarlon marsh	89	95	32	69
Hamilton, Victoria	Grass hedgerows	78	82	76	87

* EverGraze 2009 Source: Adapted from Bird *et al* 1984

- avoiding exposed topography.
- allocating twin-bearing ewe preferentially to sheltered paddocks as they will have lower-birth-weight lambs compared with single-bearing ewes.

Time of lambing

Time of lambing can impact on lamb deaths to exposure. To help determine the value of shelter and the best time to lamb it is important to understand the local 'chill risk' and how it varies between months. It is also important to match lambing with a time of year when their is maximum feed availability.



Photo courtesy: Leanne Sherriiff

Protection: Ideal lambing paddocks have plenty of shelter to reduce wind speed at lamb height

Step 3: Management implications

Step 3: Management implications

50

Paddock factors

Paddock factors that can impact on ewe and lamb behaviour, and subsequently lamb survival, include:

- It is the nursery area in the paddock that is important, not where the boundary fence is located. Observe mob behaviour — if the ewes congregate in a single area due to prevailing weather, warmth, feed, pasture palatability, water or feed supply then privacy will be limited at the lambing site, increasing the risk of mismothering.
- Avoid lambing ewes across two paddocks with open gateways — this will increase the risk of mismothering by separating ewes and their lambs.
- Keep accurate paddock records to identify the best lamb-survival paddocks over multiple seasons. Use this information to assign the best paddocks to twin-bearing ewes in following seasons.



Photo courtesy: Leanne Sherriff

Productive paddocks: Identifying paddocks that support lamb's survival over multiple seasons will help with planning for twin-bearing ewes.



Photo courtesy: Catriona Nicholls

Bonding opportunity: Manage lambing ewe mobs to support the development of strong lamb-ewe bonds during the first 48 hours of the lamb's life.

Impacts of paddock factors on lamb survival

Mob management and paddock factors impact on lamb survival through:

- starvation/mismothering
- exposure.

Predator control

Common predators include foxes, eagles, feral pigs, crows and dogs. In some areas predation can account for up to 5 – 10% of lamb losses, but is usually of secondary importance compared with other factors which may predispose the lamb to predation.

Primary predation can be important, but not necessarily in every flock or every year. The key to effective predator control is to identify the predator and the necessary steps required to limit their impact. Depending on the scale of problem, this may include cooperating with neighbours on a strategic control program targeting the predator's life cycle.

The most effective approach to manage fox predation is likely to be a twice annual widespread community baiting program.

Often losses are not obvious at the time of lambing and are observed as low marking percentages. If you believe predators are an issue, pre-emptive action before and during lambing is important (starting 15 – 30 days before the start of lambing). This can include:

- strategic selection of lambing paddocks
- fencing to exclude predators
- trapping, shooting and poisoning
- guard animals (maremmas and alpacas)
- a combination of these options.

Predators can also attack ewes during the lambing process. Ensuring ewes have adequate nutrition leading up to and during lambing will ensure they have the best fighting chance against predator attack.

Predator	Problem or risk	Action
Feral pigs	• Kill lambs • Disrupt lambing	• Baiting, fencing, shooting and trapping
Foxes	• Kill lambs • Disrupt lambing	• Baiting, fencing, shooting, guard dogs and alpacas
Crows	• Injure and kill lambs	• Trap and relocate — seek advice on this action • Ensure ewes are in adequate nutrition to support strong mothering bond
Wild dogs	• Kill lambs • Disrupt lambing	• Baiting, fencing, shooting, guard dogs and alpacas

Key approaches to manage predators

- Identify predators and determine scale of issue.
- Develop appropriate control program, which may be at the tactical (individual property) level or a more strategic (community-based) program.

Impacts of predators on lamb survival

An inadequate predator control program can lead to:

- high lamb losses.

Step 3: Management implications

52

Disease-specific management

Lamb losses due to infectious diseases in ewes are most often seen as lower-than-expected marking percentages — depending on the stage at which lambs are aborted.

Where late abortion occurs and lambs are found dead in the paddock, the most common causes include campylobacter, toxoplasmosis and listeriosis. Less common causes of abortion include leptospirosis and hairy shaker disease (pestivirus).

Late abortion storms occur sporadically and are often associated with waterlogged pastures, high stocking densities, and intensive rotational grazing systems.

Cause of death	Management
Campylobacter (vibrio)	- Expose maiden ewes to infected ewes prior to mating - Implement vaccination program for ewes - Dispose of livestock carcasses through burial or burning to reduce disease spread
Listeriosis	Avoid feeding poor-quality silage and grazing waterlogged pastures
Toxoplasmosis	- Control feral cat populations, particularly around sheds and feed storage areas - Protect feed stores from access by cats - Dispose of livestock carcasses through burial or burning to reduce disease spread

If infectious abortion is suspected, submit 3 – 5 fresh carcasses to your vet, preferably with internal organs and afterbirth intact (laboratory analysis is carried out on stomach contents). Store samples wrapped in two layers of plastic (double-bag) in a refrigerator. Transport samples in an esky with ice. Do not use a refrigerator or esky used for food for human consumption — some infectious sheep diseases can be transmitted to humans. Any delay in submission will reduce the chance of obtaining an accurate diagnosis.

Key approaches to managing infectious disease

- Effective paddock hygiene — timely and appropriate carcass removal and disposal (burn or bury each carcass to avoid scavenging by predators).
- Understanding the disease risk and transmission.
- Consult with your vet to develop an appropriate disease-management program.

Impacts of infectious diseases on lamb survival

Infectious diseases in pregnant ewes can lead to:

- early or late abortion.

Infection post birth

The usual cause of infection in young lambs is from bacteria entering the navel (umbilicus) during or shortly after birth.

The range of bacteria commonly responsible for infection are commonly found in the environment and usually respond to treatment with antibiotics.

It is important to diagnose the cause of the infection, particularly if there has been a poor response to treatment.

Take any suspect lambs to your vet or pathology laboratory for testing and diagnosis.

Prevention

The risk of infection increases when lambing occurs during exceedingly wet and muddy conditions. Poor paddock hygiene will increase the likelihood of infection. Remove all lamb and ewe carcasses as soon as possible.

Lambs that have received adequate colostrum and are well nourished tend to have stronger immune systems and are less likely to succumb to infection.

Strategies that support optimal lamb survival (including adequate ewe nutrition, paddock shelter and optimal paddock layout) will promote lamb health following birth.

Choose lambing paddocks with plenty of groundcover and minimal contamination from previous mobs of stock.

Key approaches to prevent infection

- Lamb into clean paddocks with plenty of groundcover.
- Manage ewe nutrition during pregnancy to optimise lamb birth weight and vigour post birth.
- Good paddock hygiene.

Impacts of infection post birth

Infection post birth can lead to:

- lamb deaths
- joint ill (arthritis).

Photo courtesy: Philip Barret-Lennard



Supporting survival: Conditions that support lamb survival, such as adequate ewe nutrition, ground cover and shelter, will promote optimal lamb health.

Step 3: Management implications

Step 3: Management implications

54

Nutritional deficiencies

It is not only the quantity of feed on offer that is important to optimise lamb survival, but also the nutrient balance offered to the ewe throughout pregnancy.

Iodine deficiency (goitre)

Goitre is most commonly seen in areas where soils are known to be deficient in iodine, particularly where stocking rates are low or stock have been grazed for a prolonged period on white clover or brassica crops, such as forage rape, turnips or broccoli. Goitre also has found to be more prevalent in iodine-deficient areas where there has been 100mm of rain during the previous three months.

Avoid grazing pregnant ewes in higher-risk areas, especially during late pregnancy.

Supplementing ewes with iodine during late pregnancy is an effective precaution in known goitre areas, especially during wetter seasons. Drenching can be more effective than ad lib mineral supplements.

Selenium deficiency

Selenium deficiency is most common in high-rainfall areas in actively-growing legume-dominant pastures, or paddocks that have received heavy or long-term sulphur-containing or superphosphate fertiliser applications.

In high-risk areas, consider treating ewes with selenium 4–6 weeks before lambing starts.



Photo courtesy: Ben White

Balanced diet: Prolonged grazing of actively-growing legume-dominant pastures during pregnancy can increase the risk of selenium deficiency.

Copper deficiency

Copper deficiency is more likely to occur during wet years on waterlogged paddocks in winter (and spring in colder regions). It may be worth taking some liver samples for copper analysis if unexpected losses occur in a copper-deficient area during a wet winter and a lot of sub-viable lambs are seen with no other cause obvious.

Excessive soil levels of molybdenum may induce secondary copper deficiency. Determine the cause of copper deficiency and treat as required.

Calcium

Calcium deficiency in ewes at lambing (hypocalcaemia) can prevent uterine muscles contracting, leading to lamb losses due to birth trauma (prolonged or slow birth).

Avoid moving ewes on the point of lambing (or lactating ewes) from a high-calcium diet (e.g. lucerne) to a low-calcium diet (e.g. cereal crops or lush grass pastures). If supplementing ewes during late pregnancy, continue supplements until after peak lactation is completed.

Supplementing grain rations can reduce the risk of hypocalcaemia (1–1.5% of limestone to the weight of grain). Providing access to roughage (e.g. hay) if grazing lush pasture can help ewes to mobilise their calcium reserves.

Minimise any time off feed within two weeks of lambing for single-bearing ewes, or within three weeks off lambing for twin-bearing ewes.

Key approaches to manage nutritional deficiencies

- Identify deficiency.
- Manage pasture nutrient applications and grazing regimes accordingly.
- Consider supplementing ewes (e.g. drench).



Photo courtesy: FFI CRC

Maintain calcium levels: Avoid moving ewes during late pregnancy from high-calcium pastures to low-calcium pastures to prevent hypocalcaemia.

Impacts of nutrient imbalances on lamb survival

Nutritional imbalances in pregnant ewes can lead to:

- slow birth (secondary dystocia, starvation and mismothering)
- starvation / mismothering and exposure (calcium, iodine and copper)
- congenital disorders (iodine deficiency — goitre, selenium deficiency — white muscle disease).

abomasum — fourth stomach in an adult sheep, leading into the small intestine.

bloodied oedema — excess red fluid beneath the skin of in the chest or abdominal cavity which contains blood.

campylobacter — bacterial infection leading to late abortions in non-immune ewes.

cleft palate — congenital deformity of the roof of the mouth that prevents lambs from suckling effectively.

colostrum — the first fluid secreted from the udder, rich in antibodies.

condition score — a manual method of determining (on a scale of 1 to 5) the soft tissue (fat and meat) covering the short ribs and backbone of sheep. For more information go to the *Making More from Sheep* website www.makingmorefromsheep.com.au/wean-more-lambs/tool_10.1.htm

congenital deformities — a physical deformity present from birth. May be due to genetics or toxin exposure.

cotyledons — raised area of the placenta that supply blood and nutrients to the developing lamb in the uterus.

dead in utero — where the lamb has died inside the ewe, before the birthing process.

diaphragm — a wall of muscular tissue separating the abdominal and chest cavities.

dystocia — difficult birth, typically caused by a large or awkwardly positioned foetus (primary), or weak ewe (secondary).

exposure — death from being subjected to severe weather conditions with inadequate shelter or bodyfat reserves for survival.

gestation length — period of time from conception to birth (typically about 150 days in sheep).

goitre — a swelling of the neck resulting from enlargement of the thyroid gland.

haemorrhaging — bleeding.

hypocalcaemia — deficiency of calcium in the bloodstream.

imperforate anus — missing or deformed anus.

late abortion — loss of the lamb during late pregnancy due to infection or undue stress.

listeria — a type of bacterial infection, which can cause late abortion in sheep.

malpresentation — an abnormally presented lamb (e.g. breach or with head presented first).

meconium — a light brown or orange-coloured substance forming the first faeces of a newborn lamb, which can stain the coat during birth.

metabolised fat — internal fat that has been used as a source of energy by the lamb for survival in the absence of sufficient food.

oedema — excess of watery fluid collecting in tissues of the body.

placenta — the membranes and blood vessels that join the uterus of the ewe to the umbilical cord of the lamb.

postmortem (autopsy) — the systematic examination of a dead body to determine the cause of death.

pregnancy toxemia — a metabolic disorder where the body's energy requirements are not being met during late pregnancy, resulting in breakdown of fat reserves and production of toxic byproducts.

premature lambs — lambs that have been born before the pregnancy has reached full term.

primary dystocia — where the leading cause of death is the result of a difficult birth due to excessive lamb size (in comparison to ewe pelvic size) or lamb malpresentation.

primary exposure — where the leading cause of death is the result of inclement weather conditions in an otherwise viable lamb.

primary predation — where the leading cause of death is attack of an otherwise viable lamb by a predator (e.g. fox, wild dog, crow etc).

secondary dystocia — where the leading cause of death is the result of a prolonged birth process.

secondary predation — where a dead or non-viable lamb is attacked by a predator (e.g. fox, wild dog, crow etc).

subcutaneous oedema — excess fluid infiltrating tissue.

rupture — break or burst.

spinal dissection — cutting open the spine to inspect the contents.

toxoplasmosis — an infectious disease caused by the parasite *Toxoplasma gondii* where cats are the primary host.

umbilicus — navel.

vertebrae — each of the small bones forming the backbone.

Ewe management during pregnancy

Bred Well Fed Well

Bred Well Fed Well is a practical, one-day workshop highlighting the key production benefits of superior genetics, plus feed management for improved reproductive performance and flock productivity.

More information: www.makingmorefromsheep.com.au

Lifetime Ewe Management

Lifetime Ewe Management (LTEM) is a 12-month course that educates producers on the best management practices for ewe management, with proven results to increase on-farm productivity and profitability.

Past participants have seen an increase in stocking rate of 14% and an increase in marking rates of 12–15%. This equates to an average increase in the number of lambs weaned per hectare of more than 30% while almost halving ewe mortality.

More information: www.rist.com.au

LTEM smartphone application

The *Lifetime Ewe Management (LTEM) Application* is a digital extension of the LTEM course. The Application best suits producers who have completed LTEM and understand ewe requirements.

Download the *Lifetime Ewe Management* app from the App Store.

More Lambs More profit

More lambs, More Profit, originally published as *Wean more lambs*, includes the latest research findings and breaks the breeding calendar into six discrete management periods in order to highlight the critical management techniques and production level targets that boost flock fertility.

More information: www.mla.com.au

EverGraze

The *EverGraze* website provides access to a wide range of feed budget and pasture management tools.

More information: www.evergraze.com.au

Feed on offer library

The *Feed On Offer (FOO)* library allows users to estimate *FOO* and nutritive value of grazed pastures.

More information: www.feedonofferlibrary.com

Making More from Sheep (Module 10 — Wean more lambs)

Making More From Sheep, is a best practice package of information, tools and learning opportunities for Australian sheep producers.

More information: www.makingmorefromsheep.com.au

Genetics (ram and ewe selection)

Making More from Sheep (Module 9 — Gain from genetics)

Making More From Sheep is a best practice package of information, tools and learning opportunities for Australian sheep producers.

More information: www.makingmorefromsheep.com.au

Australian Sheep Breeding Values — a guide for ram buyers

Australian Sheep Breeding Values — a guide for ram buyers is available for download at:

More information: www.sheepcrc.org.au

Wet and dry ewes

A YouTube video that shows producers how to assess udders and identify ewes that have lambed, those who have lost their lamb and ewes rearing lambs.

More information: www.youtube.com/watch?v=ceL3i5ldOxo&feature=youtu.be

Predator control

Feral.org.au

Contains the **PestSmart Toolkit**, which provides information and guidance on best-practice invasive animal management on several key vertebrate pest species including wild dogs, foxes, and feral cats.

More information: www.feral.org.au

Infectious diseases

NSW DPI

More information: www.dpi.nsw.gov.au/agriculture/livestock/sheep/health

DPIPWE Tasmania

More information: dPIPWE.tas.gov.au/biosecurity/animal-biosecurity/animal-health/sheep

DAWFA

More information: www.agric.wa.gov.au/pests-weeds-diseases/diseases/livestock-health-diseases

Infection post birth

Bacterial arthritis in lambs (NSW DPI)

More information: www.dpi.nsw.gov.au

Other postmortem resources:

Holst PJ (2004) Lamb autopsy: Notes on a procedure for determining cause of death NSW Agriculture (PDF 663.9KB)

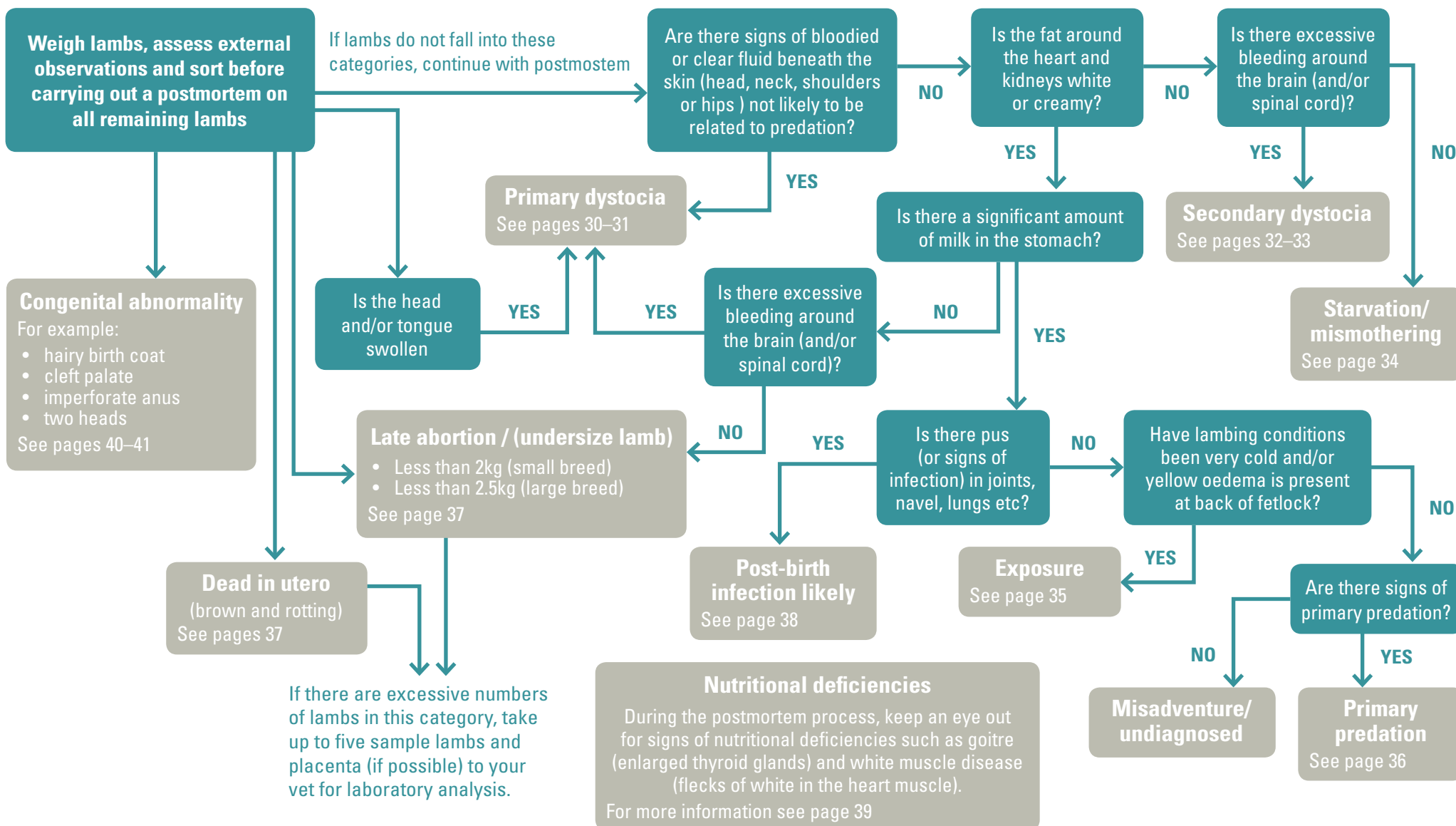
Everett-Hincks M and Duncan SJ (2008) Lamb Post-Mortem Protocol for Use on Farm: To Diagnose Primary Cause of Lamb Death from Birth to 3 Days of Age, *The Open Veterinary Science Journal*, 2, 55-62 (PDF 1.8MB)

Lambs Alive

A hands-on approach to optimising lamb survival

Use this flow chart to categorise lambs as to the likely cause of death and to decide if lambs should be submitted to a veterinarian.

Lamb mortality flow chart



Making More From Sheep

A joint initiative of



Lambs Alive

Fill in this recording sheet as accurately as possible. If dead lambs are taken to a lab for further analysis, a completed recording sheet can assist in making an accurate diagnosis.

A hands-on approach to optimising lamb survival

Recording sheet

Field history

Date: Assessor name:

Paddock name and size:

Lamb identification number:

Mob identifier (e.g. yellow-tags):

Mob size:

Mob type (if scanned): twins / single

Average mob CS:

Ewe type: maidens / adults

Estimated feed on offer (kg DM/ha):

Paddock shelter: high / medium / low

Extreme weather conditions during past 24 hrs: yes / no
If yes: heavy rain / windy / extreme temperature (hot / cold)

External observations

Lamb weight: Estimated age of lamb: < 1 day old / > 1 day old

Ewe condition (e.g. cast, blind teats, CS, predator attack):

Assisted birth: yes / no

Cleaned: yes / no

Coat condition: meconium stained / brown or rotting

Signs of predation: yes / no Type: bird / fox / other: Degree of blood at site: nil / medium / significant

Walked: yes / no Signs of swelling (oedema): yes / no Where: head / legs / abdomen

Condition of placenta (e.g. signs of white 'pimples' on the 'buttons'):

Signs of abnormalities on lamb (e.g. gottle, hairy birth coat, cleft palate, imperforate anus etc):

Internal observations

Tick relevant column
Yes No

Comments

Preparing the lamb

Sign of swelling, redness or discharge at naval or joints?

Displaying the internal organs

Abdominal bleeding?

Excess fluid in abdomen or chest cavity?

Inspecting organs

Liver – bleeding Are there signs of bleeding or rupture?

Liver – swelling Are there signs of swelling, blotches or spots?

Kidneys Fat colour

white

reddish

Lungs Has the lamb breathed?

Stomach Has the lamb fed?

Heart Fat colour

white

reddish

Is there white grit in the heart muscle?

Thyroid glands Are the glands enlarged?

Brain Rank the bleeding around the brain

significant

nil or minor

Spinal cord Rank the bleeding around the spinal cord

significant

nil or minor

Oedema Is there clear or bloodstained fluid under the skin (legs/head/neck)?

Is there yellowish fluid under the skin above and behind the hooves?

Summarise your observations on the *Summary sheet* and compare with the tables in *Step 2: Analysing the results* to estimate the most likely cause of death:

Making More From Sheep

A joint initiative of



Australian Wool
Innovation Limited



MEAT & LIVESTOCK AUSTRALIA

Lambs Alive

A hands-on approach to optimising lamb survival

You can use this tally sheet throughout the lambing season, in combination with the *Lamb mortality flow chart*, to develop a clear picture of the factors impacting lamb survival in your business. Use the guidelines in *Step 3. Management implications*, along with the resources listed at the end of the *Lambs Alive* tool to improve lamb survival rates next season.

Seasonal mob/paddock tally sheet

		Paddock name and size:												Ewe type:																						
Date	Tag/ID of ewe if known	Observations												Cause of death																						
		Sex of lamb	Weight of lamb	Small	Brown and rotten	External abnormalities	Swollen head and/or tongue	Primary predation	Oedema of head, neck, legs, hips	Bleeding around brain and/or spinal cord	White kidney fat	Milk in stomach	Yellow oedema of hock or fetlock	Pus in joints, navel or lungs	Primary dystocia	Secondary dystocia	Starvation (mis-mothering)	Exposure	Primary predation	Late abortion	Infection post birth	Nutritional disorders	Congenital disorders													
														Total																						
Key management factors contributing to cause of death For more information on specific management factors refer to the <i>Lambs Alive</i> booklet															Ewe nutrition/ram and ewe genetics		Ewe nutrition/ewe selection/mob size/stocking rate		Multiple factors		Ewe nutrition/FOO/paddock and mob factors		Predator control		Disease management		Paddock factors		Ewe nutrition		Multiple factors					

Lambs Alive

A hands-on approach to optimising lamb survival

Summary sheet

Observation	Tick if applicable	Primary dystocia	Secondary dystocia	Starvation/mismothering	Exposure	Primary predation	Late abortion	Nutritional deficiency	Infection post birth
Paddock, weather and ewe condition									
Limited paddock shelter					XX				
Insufficient feed on offer				X	XX				
Sub-optimal ewe condition score <2.5 (or >3.5)		XX		XX					
Inclement weather conditions during previous 24 hours				X	XXX				
Assisted birth (malpresentation)		X	X						
White spots on placenta (afterbirth)							X		
External observations									
Abnormal conformation/physical defect									
Cleaned		X	XX	X	XXX	XX			XXX
Meconium-stained (yellow) coat		XX	X						
Bare skin or incomplete wool development							X		
Twin lamb				XX	XX				
Single lamb		XX							
Above optimal weight		XX							
Below optimal weight				XX	XX			XX	
Within optimal weight range			XX		XX	XX			
Walked			XXX	XXX	XXX	XXX			XXX
Not walked		XXX							
Less than one day old		XXX							
Up to five days old				XX					XX
Signs of predation (significant blood loss at site)		X	X			XXX			
Swelling (oedema) heads/legs		XX	X						
Swollen joints									XX
Dead in utero (brown rotting skin, bloodstained fluid under the skin and in the abdominal and chest cavities)							X		
Goitre (swollen thyroid glands in neck)								XXX	
Internal observations									
Signs of infection (pus, abscess, discharge) at navel or joints									XXX
Blood in abdominal cavity		X							
Excess fluid in abdominal or chest cavity							X		
Liver tear/rupture		X							
Liver blotches or white spots							XX		
Enlarged liver (with rounded edges)							XX		
White fat around heart and kidneys		XXX				XX			
Reddish fat around heart and kidneys			XXX	XXX	XXX				X
White grit in heart muscle (WMD)								XXX	
Breathed			XXX	XXX	XXX	XXX			XXX
Not breathed		XX					XX		
Empty stomach		XXX	XXX	XXX			XX		
Signs of milk in stomach						XX			XX
Yellow subcutaneous oedema in extremities					XX				
Bleeding around brain		XX	XXX						
Bleeding around spinal cord		XX	XXX						

Making More From Sheep

A joint initiative of



Australian Wool
Innovation Limited



MEAT & LIVESTOCK AUSTRALIA

Lambs Alive

A hands-on approach to optimising lamb survival

Gaining a better understanding of the true causes of lamb deaths is a key step to implementing management changes to improve lamb survival rates and reduce mortality.

Increased lamb survival rates improve the profitability of individual sheep enterprises and whole-of-industry animal welfare outcomes.

Lambs Alive: A hands-on approach to optimising lamb survival, is a simple, but effective, decision support tool for sheep producers nationally. The tool provides a pictorial step-by-step guide that identifies the key signs to look for in conducting a lamb postmortem, enabling producers to assess the likely cause of death. Key management strategies to address each cause of death are outlined in the tool. This tool is designed to be used in conjunction with producer workshops.

This project is a collaborative effort between Macquarie Franklin, Making More from Sheep (MMfS) and Sheep Connect Tasmania, Dr Jason Trompf (JT Agrisource), Dr Bruce Jackson (Senior Veterinary Officer, DPIPW), Dr David Rendell (Livestock Logic), Catriona Nicholls (Hot Tin Roof Communications) and Megan Hele (Megan Hele Design). The project team would like to acknowledge the support of Dr Gordon Refshauge (Livestock Research Officer, NSW DPI) and project funders MLA and AWI.

For further information to provide or to request additional copies of the tool contact:

Leanne Sherriff, Macquarie Franklin

e: lsheff@macfrank.com.au

t: 0429 329 349

Making More From Sheep

