MEAT & LIVESTOCK AUSTRALIA

ANIMAL HEALTH AND WELFARE **MANUAL**

Indonesia Biosecurity Support Project

AUSVET

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Abbreviations and acronyms

Abbreviation	Definition
BCS	body condition score
BRD	bovine respiratory disease
DIVA	differentiating infected from vaccinated animals
EPP	expectancy of protection percentage
ERP	emergency response plan
ESCAS	exporter supply chain assurance system
FMD	foot and mouth disease
FMDV	foot and mouth disease virus
ID	identification
IM	intramuscular
IPM	integrated pest management
LA	live attenuated
LSD	lumpy skin disease
LSDV	lumpy skin disease virus
MLA	Meat & Livestock Australia
NSAID	non-steroidal anti-inflammatory drug
SC	subcutaneous
SOP	standard operating procedure
VI	viral isolation
VNT	virus neutralisation titre
WHP	withholding period
WOAH	World Organisation for Animal Health (formerly OIE)

Summary

Foot and mouth disease (FMD) and lumpy skin disease (LSD) appeared in Indonesia in 2022, causing widespread outbreaks amongst susceptible animals, particularly cattle. Meat & Livestock Australia (MLA) engaged the services of Ausvet to assist the Indonesian beef supply chain in preventing and managing these outbreaks through provision of technical services.

These technical services include the *Animal Health and Welfare* (AH&W) *Manual*, which provides stakeholders with the information needed to empower them in decision making related to the management of disease and animal welfare, particularly in relation to FMD and LSD. Best practice approaches to animal health and welfare ensure intensive animal facilities are productive and profitable.

The management of FMD and LSD cases should be defined by the severity of their clinical signs. Vaccination and biosecurity practices are crucial to the prevention of FMD, and the selection of the correct vaccine for the circulating strain is crucial to success. The prevention of LSD can be achieved through controlling insect vectors, good biosecurity and vaccination.

The content of this manual is separated into (1) General animal health and welfare guidelines, (2) Foot and mouth disease and (3) Lumpy skin disease.

The manual is designed to be used alongside the *Biosecurity Manual* during 'business as usual' periods, and with the *Emergency Response Plan* (ERP) *Manual* during outbreak situations.

Introduction

Good animal health and welfare are critical to ensuring the production of safe meat for human consumption in a way that provides confidence in consumers and other interested parties. The provision of best practice animal health and welfare comes at a cost, but when managed appropriately contributes positively to the business.

How to use this manual

This manual outlines best practice animal health and welfare that can be implemented in feedlots and associated facilities in the context of ongoing outbreaks of foot and mouth disease (FMD) and lumpy skin disease (LSD)[1]. While some facilities and diseases may require tailored management practices, the practices outlined in this manual can be applied to various facilities, including those housing other livestock species. In addition, the measures described here are suitable for the management of FMD and LSD but could also be useful for managing other diseases.

This manual is designed to be used in conjunction with the *Biosecurity Manual* to cover the 'business as usual' day-to-day activities of a facility. The *Emergency Response Plan* (ERP) *Manual* should be referred to in the event of a local disease outbreak. It outlines the enhanced biosecurity and animal health and welfare measures required during an outbreak.

The technical contents of this manual are intended for people at management level or highly trained animal health staff such as veterinarians. The worksheets (provided separately) can be adapted for the specific site and aimed at team members with diverse training backgrounds and literacy levels.

[1] 'Associated facilities' is used throughout this manual to refer to quarantine facilities, breeding farms or abattoirs.

1 General animal health and welfare guidelines

1.1 Welfare requirements

Key messages

- Cattle welfare is defined by the five domains of nutrition, environment, health, behaviour and mental state.
- Infection with FMD, LSD and other diseases can severely impact cattle welfare.
- All cattle should be managed according to the exporter supply chain assurance system (ESCAS) standards.

Best practice animal welfare is based on the five domains of nutrition, environment, health, behaviour and mental state. Mental state refers to the overall impacts of the other domains on the animal's wellbeing and freedom from distress (2). Routine livestock husbandry aims to maintain these domains positively. The Terrestrial Animal Health Code outlines potential signs of negative animal welfare including abnormal behaviours, disease morbidity and mortality, poor physical condition, abnormal handling responses and complications from routine management events (1).

Both FMD and LSD can negatively impact these domains, for example by reducing an animal's capacity to seek food or water (3) or by causing animals to become agitated (4).

In addition, all cattle originating from Australia, must be kept according to the ESCAS framework which is based on the World Organisation for Animal Health (WOAH) animal health and welfare standards found in the Terrestrial Code (1).

1.2 General principles of animal healthcare

Key messages

- Different sites in the supply chain have different roles in maintaining animal health and welfare.
- Animals should be handled and loaded in a way that maintains their welfare.
- Health inspections should occur daily, and animals should be monitored for signs of FMD, LSD and other diseases.
- Downer cattle and animals needing emergency slaughter or humane euthanasia must be assessed safely and appropriately.

1.2.1 Sites for provision of animal healthcare

For the purposes of this manual, stages of the Indonesian beef cattle supply chain have been divided into three groups: *Pre-feedlot*, *Feedlot* and *Abattoir*. Different areas have different levels of logistical capacity to manage animal health effectively.

Table 1 Indonesian fattened beef supply chain areas and the management of health and welfare

Area	Disease management capacity	Standards of welfare
Pre-feedlot Shipping Port lairage Transport to feedlot	Limited	All animals must be assessed for loading prior to transport (see 1.2.3) Humane euthanasia decisions for animals that are not fit to load should be available (see 1.2.6) Facilities should be safe for cattle to be transported (see 1.2.3)
Feedlot Arrival (0–3 dof[2]) Onsite quarantine and induction (3–28 dof) Fattening (28–~90–120 dof) Finishing (final week on feed)	Comprehensive	Group management for welfare: bedding, adjusting handling practices to accommodate sore feet, adjusting feeding and watering (see 2.4 and 0) Treatment plan should be followed (see 2.4 and 0) Healthcare facilities must meet welfare standards (see 1.2.8) Increased frequency of health inspection with treatment/euthanasia decisions being made promptly to prevent excess suffering (see 1.2.4, 1.2.5 and 1.2.6)
Abattoir Transport to abattoir Abattoir lairage Slaughter	Limited	All animals must be assessed for loading prior to transport (see 1.2.3) Humane euthanasia decisions for animals that are not fit to load should be available (see 1.2.6) Facilities should be safe for cattle to be transported (see 1.2.3)

1.2.2 Handling

The handling of beef cattle should be done quietly and calmly, at the pace of the slowest animal in the group (1). For extensively raised cattle moving into the intensive feedlot environment, the transition can be highly stressful and, as such, handling events should be grouped together to reduce the number of events and their impact on the animals' welfare state. As handling becomes less stressful for the animals over time, management procedures should then be staged to prevent the additive effects of management from impairing the animals' mental state (1).

Animal handlers should always act in a way to avoid harm, distress or injury to the animal and themselves. Cattle handled calmly and consistently are less likely to display dangerous and aggressive behaviours towards handlers (5). In general, an animal can be moved by entering its flight zone; this is the distance at which a handler can stand and prompt movement in the animal. Usually, this is bigger in cattle that are

[2] dof refers to 'days on feed'

not used to being handled (such as new arrivals) and smaller in animals that are familiar with their handlers and used to being handled calmly (see Figure 1 and Figure 2).

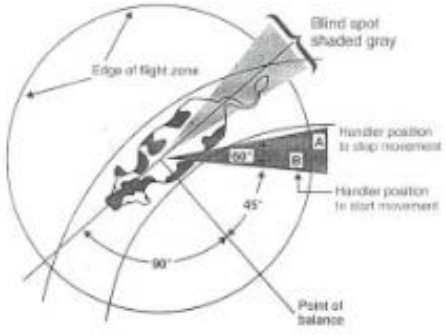
As a general principle, cattle will move to a location that they would prefer to be; often this is where there are more attractive items (forage, feed, open space) and away from places they would rather not be (around perceived threats, like unfamiliar humans). Differing levels of pressure (from light to firm) for handling include stepping into the animal's flight zone, walking forwards in the flight zone, calmly moving arms out as you walk, quiet and gentle vocalisation (such as whistling, clicking, or talking), physical goads (such as panels, flags, paddles, or a length of polypipe) and, finally, electronic goads if all other methods have failed. The appropriate use of an electric goad is outlined in the ESCAS Animal Welfare Standards; they cannot be used more than twice in a handling event on an individual animal (6).

Refusals to move, such as stopping, turning back and baulking, occur when the animal faces an obstacle in their path that is either distracting, distressing or deemed unsafe by the animal (5). At no point should handlers resort to excessive noise, excessive force or violent/injurious acts to move an animal (6).

The following list of common distractions should be removed or mitigated in all stressful handling situations to reduce refusals (1):

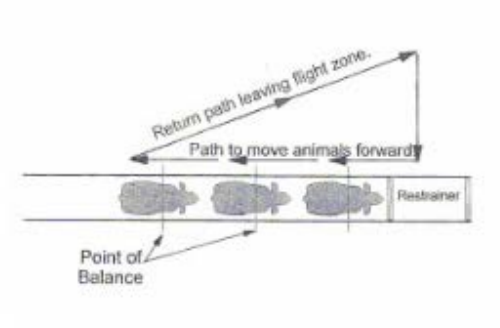
- reflections on shiny metal or wet floors
- dark entrances to chutes, races, stun boxer etc.
- people or unfamiliar equipment in front of the animal's point of balance
- dead ends
- loose objects hanging into chutes
- uneven flooring and sudden drops
- hissing sounds from pneumatic equipment
- clanging metal objects
- air currents blowing in the cattle's faces.

The ESCAS standards state that compliant handling will result in behaviours like slips, baulking and falls being kept below threshold percentages (see Appendix A).



Extracted from OIE (2022)

Figure 1 Flight zones of an individual animal



Extracted from OIE (2022)

Figure 2 Handler movement patterns to move cattle forward in a race

1.2.3 Loading cattle for transportation

An animal must be deemed fit to travel prior to transportation (6). The WOAH definition of an animal that is unfit to travel includes, but is not limited to, animals that are (1):

- sick, injured, weak, disabled or fatigued
- unable to stand unaided and bear weight on each leg
- blind in both eyes
- unable to be moved without causing them additional suffering
- newborn with an unhealed navel
- pregnant in the final 10% of their gestation period at the planned time of unloading
- female and travelling without young born within the previous 48 hours
- in a body condition that would lead to them suffering in the expected climatic conditions.

If an animal is not fit for routine travel, arrangements must be made by the feedlot or exporter to humanely manage the animal onsite (1,6).

ESCAS and the WOAH also outline the following criteria for safe loading of cattle (1,6):

- ramp sides on a loading vehicle should be high enough to prevent escape
- safe facilities with no sharp or protruding objects, good lighting, and ventilation
- competent supervision of loading and unloading.

1.2.4 Health inspections

Lot-fed cattle should receive a health inspection at least once per day, with increased inspections for high-risk groups such as animals affected by an FMD outbreak (1).

Health inspections should be carried out by experienced personnel who are competent in recognising challenged states of health and welfare in cattle (1). Regular health examinations performed by feedlot staff should include assessment of the following to aid the early detection of FMD and LSD:

- general demeanour (e.g. mentation; signs of discomfort, such as stamping or changes in expression; bullying behaviours)
- body condition score (BCS)
- feed intake
- urine and faecal appearance and consistency
- lameness (see Table 2)
- overall physical appearance, including the presence or absence of unusual nasal or oral discharge, skin lesions on lumps, unusual swellings, ectoparasites or faecal contamination of coat.

Table 2 outlines how to determine the mobility score of an animal, which can then be used for the triage of active cases of FMD and LSD.

Table 2 Mobility scoring in cattle

Score	Clinical appearance	Action
1	Normal gait	NA
2	Abnormal gait, weight bearing, able to keep up with the group when moving	Monitor
3	Abnormal gait, weight bearing, falls behind when moving with the group	Monitor and/or separate for treatment
4	Abnormal gait, toe touching or non-weightbearing lameness, unwilling to move but able to walk	Separate for treatment
5	Animal is unable to move or recumbent and unwilling to stand	Downer cow assessment Separate for treatment

Adapted from Garvey (2022)

Animals identified as sick or injured should be treated at the first available opportunity by trained animal handlers, or a veterinarian if the handlers are unable to successfully treat the animal (1). Safely removing a lame or sick animal will require gentle handling to maintain their welfare and avoid unnecessary pain or distress (see 1.2.2).

1.2.5 Preventing and managing downer cattle

ESCAS defines a downer cow as 'Those that cannot stand or walk' (6). If an animal has been recumbent in place between two health checks, or if it is indicated in your treatment plan for FMD/LSD, downer cow assessment should be initiated to determine if emergency slaughter or humane euthanasia are indicated. Downer cattle and buffalo should not be moved and must be emergency slaughtered or humanely euthanised where they lie (see 1.2.6) (6).

Cattle with severe FMD or LSD experience pain from the disease lesions, leading to excessive recumbency and the accompanying secondary complications that may cause them to become downer cattle (8). Secondary conditions from recumbency that worsen the prognosis for these animals include pressure sores, peripheral neuropathies, coxofemoral luxation and muscular damage (9).

Downer cow assessment can be performed using the flowchart shown in Figure 3. This flowchart will assist health teams in identifying if a recumbent animal is truly a downer cow, requiring emergency slaughter or humane euthanasia. This involves safely handling the animal to initiate standing, and problem-solving reasons why it refuses to stand. ESCAS prohibits the use of an electric goad to raise a downer cow (6). A larger version of Figure 3 is available in Worksheet 1 for reproduction and use on your feedlot.

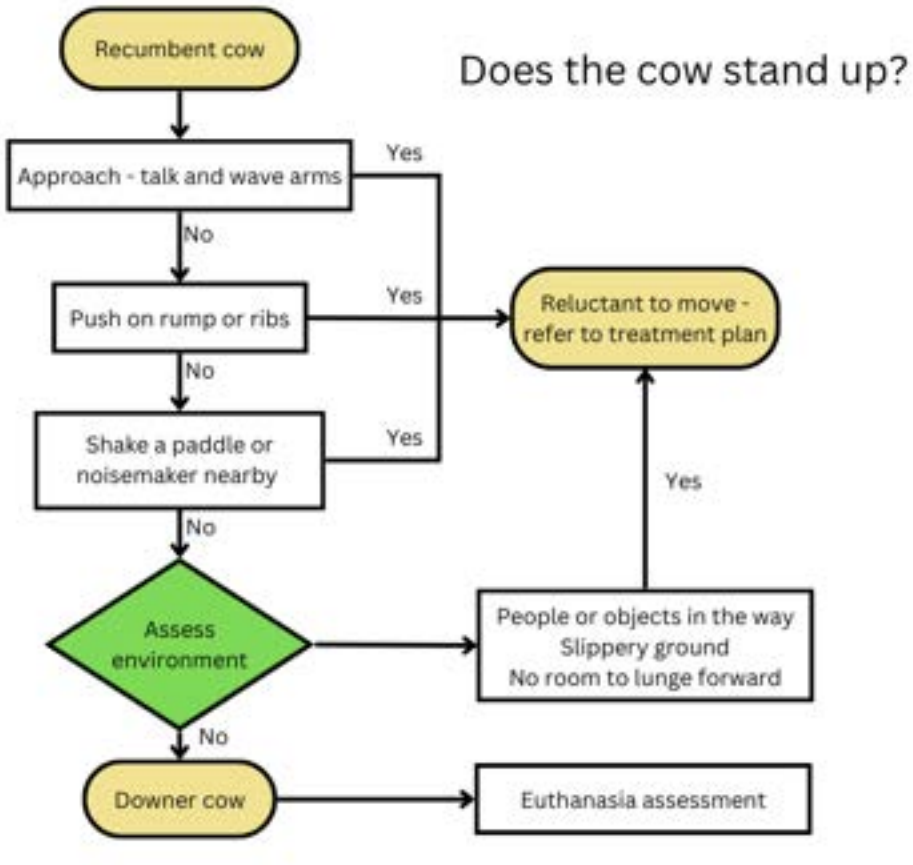


Figure 3 Downer cow assessment flowchart

1.2.6 Humane euthanasia and emergency slaughter

Animals experiencing a health condition with a poor prognosis for regaining welfare will need to be slaughtered, including animals that have been deemed downer cows in a downer cow assessment. An example would be an animal that is severely affected by LSD and has been unable to return to its original BCS. The euthanasia assessment flowchart in Figure 4 provides guidance on appropriate management of these animals.

Not all animals are safe to enter the food chain, and as such a choice should be made between emergency slaughter (where the carcass is destined for a customer) and humane euthanasia (where the carcass should be safely disposed so that it does not enter the food chain) (Figure 4). Emergency slaughter should only occur in animals that are fit for human consumption or pet meat. Animals with clinical signs indicating a

zoonotic disease risk such as rabies, rodenticide ingestion, anthrax or brucellosis **should not** be sent for emergency slaughter.

Humane euthanasia should occur when the animal's prognosis has been deemed poor and they are not a candidate for emergency slaughter. The euthanasia methods must comply with ESCAS with acceptable methods outlined in

Table 3 (6). Carcasses of humanely euthanised animals must be disposed of safely to prevent accidental transmission of the disease to other sites or build-up of rotting wastes that could attract flies and pest species. Guidelines are available in the ERP manual. A larger version of Figure 4 is available in Worksheet 2 for use on your facility.

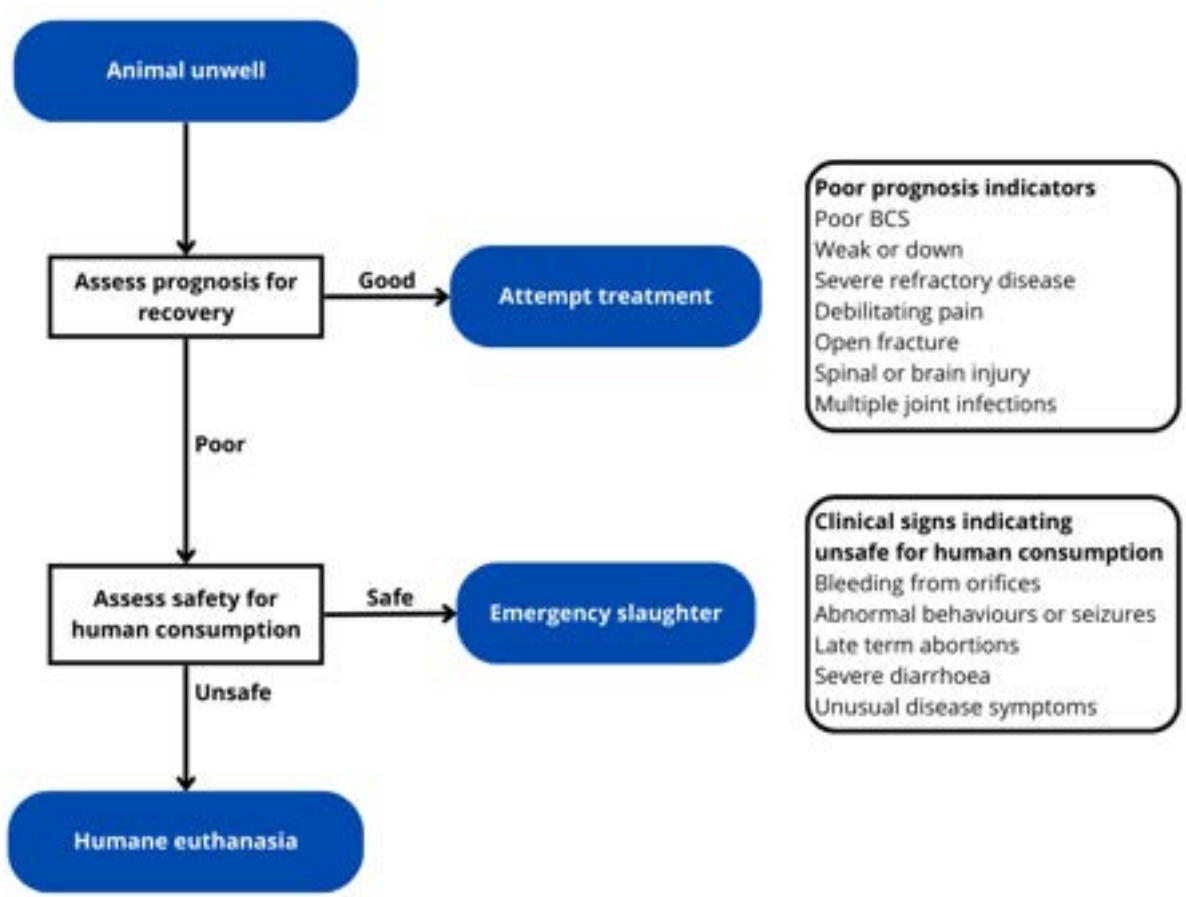


Figure 4 Euthanasia assessment flowchart

Table 3 Acceptable forms of euthanasia for cattle

Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application
All	Free bullet	No	Non-lethal wounding
All except neonates	Penetrating captive bolt followed by pithing or bleeding	Yes	Ineffective stunning, non-lethal wounding, regaining of consciousness before death
Adults only	Non-penetrating captive bolt, followed by bleeding	Yes	Ineffective stunning, regaining of consciousness before death
Calves only	Electrical, two-stage application	Yes	Pain associated with cardiac arrest after ineffective stunning
Calves only	Electrical, single application (method 1)	Yes	Ineffective stunning
All[a]	Injection with barbiturates and other drugs	Yes	Non-lethal dose, pain associated with injection site

a. Carcass must not be used for consumption by humans or animals

1.2.7 Quarantine facilities and arrivals

Animals newly arriving (new arrivals) to a facility should undergo 14 days of quarantine as per the Government of Indonesia (GoI) regulations.

Quarantine facilities should include bunker space, water access, and a comfortably ventilated and lit environment. Quarantine facilities should be isolated from other animals to avoid exchange of pathogens between newly arrived animals and those already in the facility. Management of run-off, staff and equipment movement should also take this into consideration.

If disease develops in a new arrival, special care should be taken when moving them to treatment facilities to reduce the risk of accidentally infecting other animals. New arrivals will be flightier than the rest of the animals in the feedlot, so handling should be done quietly and calmly. In addition, treatment facilities should be thoroughly cleaned and decontaminated after treatment to prevent infection of other animals in the feedlot.

Management of quarantined animals for optimal biosecurity is discussed in the *Biosecurity Manual.*

1.2.8 Treatment facilities/hospital pens

Facilities in the feedlot area of the supply chain (see 1.2.1), should have a dedicated hospital area for the treatment of sick animals. The hospital yards and crush should be safe for cattle to move into and free from protrusions, sharp edges and slippery ground surfaces (6).

Regular maintenance should occur on all yards, races, and cattle crushes to prevent injury to operator or livestock.

Since hospital facilities will often have sick animals passing through them, they should not be used for induction of new livestock unless they are thoroughly cleaned and disinfected prior to use.

All treatments (including vaccinations) need to be traceable to the animal in question. A record for each treatment should be created on paper or electronically that includes the animal ID, date, diagnosis, treatment type (pain relief, antibiotics, vaccination), dose, withholding period (WHP), batch ID and expiry. This should be linked to the animal's induction record.

Hospital facilities should not be used to hold animals that should be slaughtered immediately (see Figure 4) (6).

Relevant additional materials

- Worksheet 1: downer cow assessment
- Worksheet 2: euthanasia assessment

1.3 Vaccine management

Key messages

- Vaccines must always be kept refrigerated.
- Out-of-date vaccines are ineffective and should be disposed of appropriately.
- Vaccines can cause serious injury to humans if accidental needlestick injury occurs.
- Vaccine protocols ensure effective protection of your herd.

1.3.1 Vaccine storage

Vaccines have different shelf lives unopened. Vaccine shelf lives should be recorded so operators know when to throw away unused vaccines (see Worksheet 3). After a vaccination program, all unused doses should be safely disposed of as per the regulations of the GoI.

All FMD and LSD vaccines registered for use must be kept refrigerated (2–8 degrees) at all times and never frozen, including while herd vaccination is taking place (10,11). Refrigerators with stored vaccines

should have a temperature monitor that is regularly checked, and temperatures recorded (see Worksheet 4). While herd vaccination is taking place, vaccines can be stored in a cool box.

1.3.2 Operator safety during vaccinations

An appropriate standard operating procedure (SOP) should be in place to avoid needlestick injuries (see Worksheet 5). The FMD and LSD vaccines can cause mechanical damage, secondary bacterial infections and reactions to the adjuvant when inadvertently injected into people.

Oil-based vaccines can cause significant damage to the operator if accidentally self-administered, causing severe pain, swelling and even potential loss of digits. In severe injuries surgical attention is required. Training and protective equipment should be supplied to the user, and the animal must be adequately restrained to perform vaccination safely if using a mineral oil-based vaccine (12).

Aqueous and aluminium adjuvant vaccines are not as likely to cause severe damage to the operator, but secondary infections and tissue damage are still reported as side effects (12).

From National Centre for Farmer Health (2022)

Figure 5 Outcomes of accidental needlestick injury during vaccination

1.3.3 Developing effective vaccine protocols

A well-designed vaccination protocol will be easy to follow, safe for the administrators, easily traceable, provide the best protective immunity to cattle and minimise the impacts of vaccination on ongoing production. Important components for considerations are:

- simple instructions for dosage, including volume, site, equipment needed, cold chain and disposal instructions
- safety information with instructions for what to do if needlestick injury occurs
- an easy way to record the animal ID, vaccine dose, vaccine date, vaccine batch number and ID for traceability.

A tool to create a vaccine protocol for your feedlot is provided in Worksheet 6.

Relevant additional materials

- Worksheet 3: Vaccine storage and inventory sheet
- Worksheet 4: Fridge temperature monitoring worksheet
- Worksheet 5: Vaccine safety SOP
- Worksheet 6: Vaccine protocol SOP guide

2 Foot and mouth disease

2.1 Epidemiology of foot and mouth disease in Indonesia

Key messages

- Indonesia's first cases of FMD occurred in May 2022.
- The clinical signs of FMD can severely reduce animal health and welfare, but they are short term and can be managed with supportive care.
- FMD is a highly contagious virus that can arrive at a site on cattle, personnel, vehicles, food, water and the air.
- Outbreaks of FMD can have morbidity of up to 100% and mortality of 1–3%; however, 10–20% of cattle may need to be emergency slaughtered for welfare reasons.

Foot and mouth disease (FMD) is characterised by painful vesicular disease (blisters) in all species of even-toed hoofed mammals. This includes domestic and feral cattle, buffalo, sheep, goats and pigs. In addition, many vulnerable or endangered Indonesian wildlife species such as the lowland anoa (*Bubalus depressicornis)*, mountain anoa (*Bubalus quarlesi*) and the Javan rusa deer (*Rusa timorensis*) are likely to be susceptible to the disease.

When FMD first enters a feedlot that has never had any cases, up to 100% of unvaccinated animals may develop the disease with approximately 10–20% requiring euthanasia due to severe foot lesions. Transmission is summarised in Table 4 but can occur through direct contact between infected animals and susceptible animals that are either unvaccinated or inadequately covered by vaccination[3]. Transmission can also occur through indirect contact with infectious air, infrastructure, feed, water, personnel or equipment. Passers-by and visiting vehicles are known to be able to carry the disease between sites (Table 4). The control of transmission is detailed in the *Biosecurity Manual.*

[3] This may be due to inadequate time between vaccination and contact with FMD-positive animals or because the vaccine chosen is not protective against the strain of FMD virus introduced.

Table 4 Modes of FMD transmission

Mode of transmission	Example
Direct contact	Infected cattle entering the feedlot without a quarantine period (14)
Airborne	Outbreak in a nearby feedlot, smallholder herd, abattoir or dairy
Contaminated environment	Dirty trucks picking up cattle from port Faecal run-off from affected animals
Feed	Infected cattle grazing on forage for the feedlot
Water	Infected animals shedding into shared water sources
Fomites (personnel/equipment)	Vesicular fluid or contaminated faeces on the person/equipment
Fomites (vehicles)	Faecal contamination on the tyres and undercarriage

Environmental contamination has been shown to cause almost half of all infections in a group of cattle (15). Environmental contamination can occur through contact with faeces and urine of infected cattle in locations like trucks, pens and lairage. FMD virus (FMDV) can survive in infectious faecal slurry for up to three weeks at room temperature (16).

Aerosolised transmission can occur between groups of animals over large distances. Cattle are more susceptible to contracting FMD from the air, and the likelihood of airborne transmission depends on the distance, population size, species and environmental characteristics of the sites. To determine a facility's risk of aerosolised transmission, please refer to the Risk Assessment Matrix.

2.2 FMD prevention

Key messages

- Ensure best practice vaccine management procedures are in place using the processes outlined in 1.3.
- Select the right vaccine for the strain of FMD using Worksheet 7.
- Vaccinate as soon as possible after arrival in Indonesia.
- Some vaccines require a booster 25–28 days later.
- Vaccine side effects are minimal, but can include site reactions and mild lethargy.

2.2.1 Vaccination

Vaccination programs can fail because of inappropriate storage and handling practices. Manufacturer specifications must be followed. The processes outlined in section 1.3 will ensure successful handling and administration of vaccines.

The FMD vaccines currently registered for use in Indonesia are all inactivated viral antigen vaccines. When selecting a vaccine for a facility, the strains covered by the vaccine should match the strains circulating in the region. Vaccination can fail to protect animals when the vaccine selected does not protect against the strains circulating (17). FMD comes in different serotypes (O, A, C, Asia 1, SAT 1/2/3), each of which has numerous different lineages that produce the different strains. The strain

currently circulating in Indonesia (O/ME-SA/Ind2001e) is of the O serotype, from the ME-SA lineage and the Ind2001e isolate.

Vaccines are then compared to the circulating strains of FMD using a viral neutralisation titre (VNT) to calculate the r1 or a one-dimensional neutralisation test which is then used to calculate the expectancy of protection percentage (EPP) (18). A candidate vaccine should have an r1 >0.3 and/or an EPP of 75% or greater for adequate protection against a strain of FMD (18). At the time of publication, all vaccines *except* for the CAVac FMD vaccine have passed both these tests, making them suitable for use in the current FMD outbreak.

FMD vaccines are also made using different adjuvants, which are products added to the vaccine to help stimulate the immune response. Adjuvants also create a longer-lasting stimulation of the immune system, which can continue for up to 60 days with some vaccines. The primary considerations for which adjuvant type to select include species to be vaccinated, site of vaccination and management groupings of animals onsite. For more information on each vaccine and their dosing schedule, refer to Appendix B. The list of approved vaccines may change from time to time, so recent advice is recommended.

To determine which vaccine is best for the facility, refer to Worksheet 7.

Vaccination should occur as early as possible when (or even before) a consignment enters a facility. As many of the new animals as possible should be vaccinated in one event to avoid multiple rounds of yarding animals and reduce stress. Vaccination will reduce the number and severity of animals showing clinical signs if they are challenged with FMD early, potentially reducing the ongoing losses caused by an outbreak. The first vaccination will not prevent outbreaks for the first few weeks, as full protective immunity is not achieved until after the animal's immune system has had time to respond and produce antibodies. This may not be until after a second dose at around 28 days if required by the manufacturer (17).

Vaccination of a buffer zone around a facility helps reduce the risk of aerosolised transmission of the disease. Vaccination of susceptible animals owned by facility staff can also reduce the risk of accidental fomite contamination.

For this reason, it is advisable to vaccinate animals on arrival to the feedlot, rather than waiting 2–3 days to allow the cattle to settle in. The adjuvant means the vaccine will continue to stimulate immunity for a number of weeks after injection.

Vaccination in breeding animals is more complex. All vaccines used in Indonesia are safe for use in dams. Some vaccines are not recommended for animals under six months of age while others can be used at any age in the calves (see Appendix B).

Post-vaccination depression, lethargy or reduced food intake can occur with any vaccine delivered to cattle and is a normal reaction to the administration of a new vaccine. It is difficult to determine if this occurs directly because of vaccination or if it's related to the stress involved in accompanying events such as yarding or transport. Anaphylaxis may occur in very small numbers of cattle (≈ 0.23%) with timely treatment using corticosteroids indicated (19). Site reactions can occur in vaccinations using oil-based adjuvants; these are usually granulomatous lumps at the site of injection and will resolve with time (19).

2.2.2 Biosecurity

Biosecurity practices are paramount to preventing FMD; please refer to the principles outlined in the *Biosecurity Manual.*

Relevant additional materials

- Appendix B: FMD vaccine details
- Worksheets 3–6: Vaccine management worksheets

2.3 FMD clinical signs

Key messages

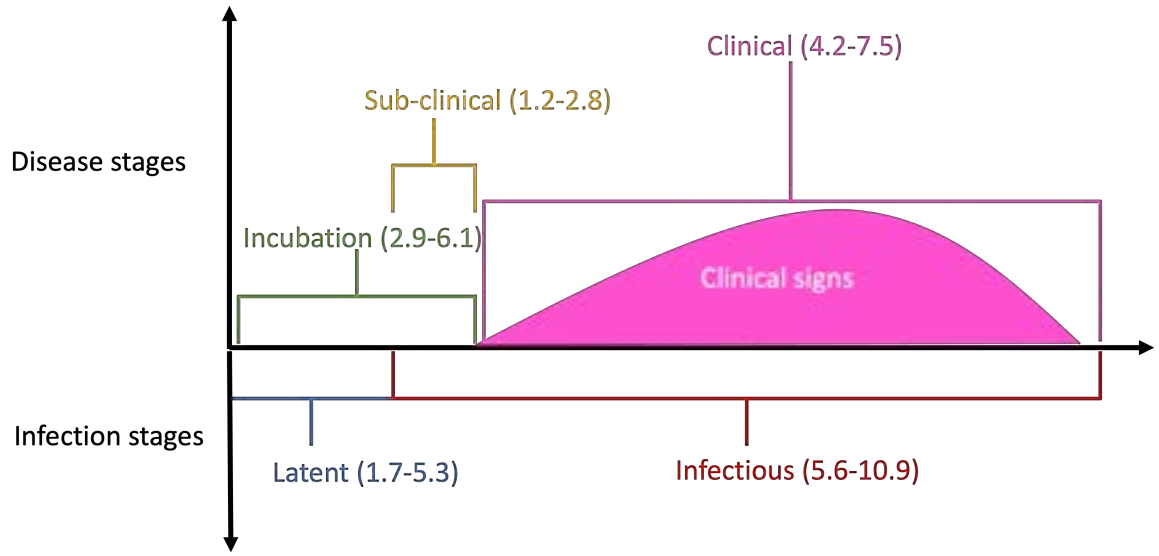
- Infected animals can take up to 6 days to show clinical signs, but they can still silently spread the disease for 1–4 days before the first clinical signs appear.
- Early clinical signs are depression, fever and excessive salivation/nasal discharge.
- Definitive clinical signs are vesicles of the mouth, feet and udder.
- Ongoing effects include reduced weight gains, secondary infections and severe hoof lesions.

2.3.1 Pathogenesis of FMDV infection in beef feedlot cattle

The pathogenesis of FMDV infection can be divided into three stages, *pre-viraemic*, *viraemic* and *post-viraemic* (20). These phases are defined by the detection of FMDV in the blood using viral isolation (VI) or viral RNA detection (20).

Pre-viraemic cattle are animals that have been infected by FMDV but in whom the virus is not yet detectable by VI and RNA methods; once the virus can be detected in the blood, the animal is considered viraemic.

The *viraemic* phase occurs from when the virus first becomes detectable in the blood until the time it is no longer detectable. While this period closely matches the clinical phase of infection, there may be a 1 – 2 day lag in the development of clinical signs after the transition to viraemia. Despite this, the virus will be present in a wide array of tissues (such as the epithelium and viscera) and shed through all excretions and secretions of the viraemic animal, allowing for subsequent spread of the disease (21).



Adapted from Cabezas *et al.* (2018)
The number of days since infection is shown in brackets after each stage

Figure 6 FMD infection dynamics in cattle

The *post-viraemic* or convalescent stage occurs after the virus is no longer detectable in the blood compartment; however, FMDV can still be present at very high levels in tissue predilection sites. The convalescent animal may have complete clinical resolution or enter the carrier state, and in some cases long-term complications may occur. The carrier state can occur in roughly 50% of both vaccinated and unvaccinated cattle affected by FMDV (20–23).

In a study of carrier animals in Vietnam, the mean duration of the carrier state was 27.7 months (24). The transmission dynamics of carrier cattle are poorly understood, with scant reports in the literature suggesting that it is highly unlikely for the virus to be transmitted naturally between carrier and naïve cattle (24,25).

2.3.2 Acute clinical signs

Acute clinical signs include:

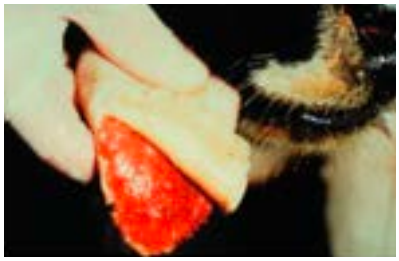
- depression
- anorexia
- ~40-degree pyrexia (1–2 days)
- vesicles on the tongue, hard palate, dental pad, lips, gum, muzzle, coronary band and interdigital space +/- teats (see Figure 7 and Figure 8)..

Subclinical infection can occur in animals that are vaccinated or naturally resistant to clinical disease (26). Incoming local animals should be closely monitored for clinical signs during a regional FMD outbreak, or when there is known disease circulating in the area (see *Biosecurity Manual*).

- profuse salivation, protruding tongue in severe cases
- nasal discharge (mucoid to mucopurulent)
- lameness
- foot stamping or weight shifting
- recumbency and resistance to movement.

Subclinical infection can occur in animals that are vaccinated or naturally resistant to clinical disease (26). Incoming local animals should be closely monitored for clinical signs during a regional FMD outbreak, or when there is known disease circulating in the area (see *Biosecurity Manual*).

a.



b.

c.

From Kitching (2002)
a. Vesicular lesion of the tongue
b. Hypersalivation
c. Vesicular lesion of the interdigital space

Figure 7 Images of FMD clinical lesions

2.3.3 Chronic clinical signs

Oral lesions rupture 1–2 days after appearance and leave a shallow erosion with shreds of skin around the edges, before filling with fibrin and appearing like normal tongue tissue (without papillae) at around 11 days. Hoof lesions rupture after 2–3 days depending on terrain and can be much slower to heal, leading to secondary infections or chronic lameness. Field reports from Indonesian facilities suggest that the heaviest cattle (600 kg +) are the worst affected by foot lesions, with some experiencing sloughing of hoof walls, requiring emergency slaughter. Thyroid damage can lead to ongoing hirsutism and heat intolerance in yearling cattle; these are sometimes termed 'hairy panters' (22).

Photo provided by Tri Umardhani (2022)

Figure 8 Foot lesion of Indonesian feedlot cow affected by FMD

2.3.4 Differential diagnoses for FMD

Differential diagnoses for FMD include:

- infectious bovine rhinotracheitis
- bovine viral diarrhoea
- malignant catarrhal fever
- stomatitis papulose
- vesicular stomatitis
- calf diphtheria
- pseudocowpox (*parapoxvirus*)
- bovine herpes mammilitis (bovine herpes virus 2)
- foot rot
- lumpy skin disease (LSD)
- orf virus (contagious pustular dermatitis) (27).

The *Emergency Response Plan Manual* provides information on diagnosing FMD in a facility including testing information and a discussion of case definitions.

2.4 FMD treatment and management

Key messages

- FMD treatment aims to keep animals comfortable and eating and prevent severe cases from requiring emergency slaughter.
- FMD cases should be triaged for severity.
- All FMD-affected animals require increased supportive care.
- Treatment plans should be applied based on severity.

The aim of FMD management is to keep animals comfortable and eating and to manage severe cases to prevent them from becoming 'downer cattle' (see 1.2.5). A treatment plan should be developed in advance of an outbreak using the information provided in this section, and Worksheet 8 provides a template for the development of your treatment plan. Severity of disease should guide treatment plans (see Worksheet 8 and Appendix E for examples), and a summary of disease severity can be found in Table 5. This table can be personalised to your site using Worksheet 8.

In intensive settings, FMD outbreaks can impact hundreds or even thousands of animals simultaneously. By the time clinical signs appear in an intensive facility such as a feedlot, it is likely that most animals that are not protected through vaccination have been exposed and will develop clinical signs. All animals should receive supportive care, increased health inspection (particularly monitoring the development of secondary infections in foot lesions) and a prognostic assessment approximately 14 days after contracting the disease. Repeated yarding and treatment should be minimised, as stress reduces immune response and walking over hard concrete can worsen foot lesions.

Animals can move between levels of severity quickly and downer animals must be slaughtered to comply with ESCAS (6). Salvage or emergency slaughter is unlikely to change the course of an outbreak as by the time clinical signs appear, unprotected animals will already have been exposed. If lameness continues more than 14 days after infection, prognosis is poor without direct hoof management as chronic lesions such as underrun soles are likely (0). The FMD triage tool (Table 5) has been developed in consultation with veterinarians specialising in intensive cattle medicine to assist animal health teams in understanding how to treat and manage cases.

Relevant additional materials

- Appendix D: Medication guidelines
- Appendix E: Example FMD treatment plan
- Worksheet 8: FMD treatment plan

Table 5 Diagnostic triage of FMD cases for treatment

Clinical sign	Mild	Moderate	Severe
Mobility score	>= 3	4	4 or 5
Appetite	Normal	Reduced	None
Behaviour/mentation	Normal	Slight dullness	Depressed
Vesicular lesions	Mild	Moderate >1 foot lesion	Severe All feet affected Heel and coronary band
Treatment plan	Supportive care ONLY	Supportive care and increased monitoring for development of severe disease	Supportive care, medical management, increased monitoring for down cow and euthanasia assessment

Supportive care for FMD includes (but is not limited to):

- provision of soft bedding to prevent pressure sores and secondary complications
- provision of additional watering and feeding points to assist animals that are reluctant to walk in accessing their nutritional needs
- provision of attractive foods if inappetence develops to assist animals that are experiencing painful oral lesions in maintaining their condition
- more frequent health checks (twice daily) to assess animals for severe disease and prevent cattle from becoming downers.

Photos provided by Tri Umardhani (2022)

Figure 9 Pressure sores in Indonesian feedlot cattle affected by FMD

The ideal depth of bedding for downer cattle is 40–50 cm of hay/straw or 20–30 cm of sand/sawdust/rice hulls (28). Rubber matting does not appear to be sufficient to prevent pressure sores in cattle that are recumbent for extended periods (P. Younis, pers comm 2022; Umardhani pers comm 2022). For animals that are lying down and standing up regularly, this depth can be reduced but there is no data available for recommended depths.

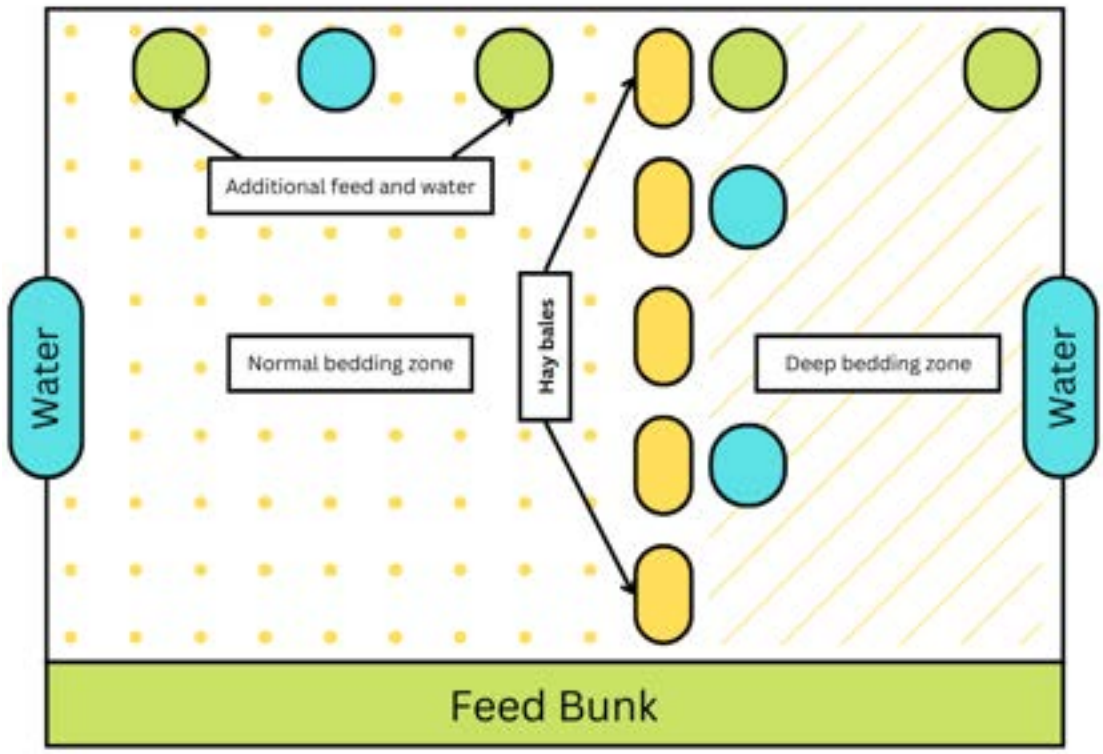


Figure 10 Example layout for pen with differing bedding depths

If there is a shortage of bedding in a facility, it may be advisable to make zones of different depths for animals with differing levels of severity within the pen (T. Batterham, pers comm 2022). This can be achieved using haybales or sandbags (Figure 10). Normal stocking density rules should be applied when there are zones within the pen, as the feed bunk must have enough room for all animals to eat comfortably shoulder to shoulder and there must be easily accessible water for all animals.

Animals infected with FMD can be treated with systemic non-steroidal anti-inflammatory drugs (NSAIDs) or topical analgesic agents like Tri-Solfen but their efficacy is unknown, and their use is unlikely to impact the clinical course of infection. Increasing the levels of supportive care and monitoring of the animals is likely to be more cost-effective and practical in an intensive environment.

Herbal remedies and nutraceuticals lack the evidence-based medicine to be included in the list of necessary treatments for severe cases. These are at the discretion of the feedlot to apply.

Disinfectant foot baths can be used to prevent secondary infections in moderate to severe cases, but care should be taken to not worsen the lesions with caustic agents. Copper sulphate (5%) is the preferred foot dip over formalin (2–6%) as it is less irritant and non-carcinogenic. Avoid disposing of copper sulphate foot dips into slurry that is intended for crops, as it can irreversibly damage soil quality and inhibit plant growth (29).

In cases where secondary infections have developed, particularly in foot lesions, antibiotic therapy may be appropriate, provided WHPs are observed.

Details on dosage, application and WHP for medical therapeutic options are provided in Appendix D.

An example of a treatment plan can be found in Appendix E.

3 Lumpy skin disease

3.1 Epidemiology of lumpy skin disease

Key messages

- LSD has been present in Indonesia since March 2022.
- Morbidities of 9.11–13.8% and mortalities of 0.51–4% have been observed in LSD outbreaks; however, the disease can cause severe ongoing welfare implications.
- Biting insects spread LSD from infected to susceptible animals.

Lumpy skin disease (LSD) was first detected in Indonesia in March 2022. Lumpy skin disease virus (LSDV) is less contagious than FMDV but still causes significant impacts on the health and welfare of affected animals. In retrospective analyses of LSD outbreaks, overall morbidity rates range from 9.11–12.3% and mortality rates range from 0.51–6.4% in affected farms (30,31). These figures were reported over a wide range of herd sizes, with a general trend toward lower morbidity and mortality rates in larger facilities (>50 cattle) (31).

The transmission of LSD occurs mainly through biting arthropods feeding on an infected animal and then feeding on a healthy one. Any local arthropod that feeds on cattle and frequently changes host could be implicated, noting that successful mechanical transmission is assumed to require tens or hundreds of bites. Potential vectors include hard ticks (*Rhipicephalus appendiculatus* and *Amblyomma hebraeum*), mosquitoes (*Aedes egypti)* and stable flies (*Stomoxys calcitrans*) (32).

Indirect transmission may occur with shared feed and water if infected animals contaminate these with nasal discharge and saliva (33). Transmission via infected semen has been recorded and is of concern in breeding operations (34). Direct transmission is a relatively ineffective route of transmission (33). The transmission of virus with contaminated needles may be over-emphasised at present. In cases where iatrogenic spread is implicated, the occurrence of disease is more likely due to the vaccination of already infected but not yet clinical animals (33).

Table 6 Modes of LSD transmission in intensive facilities

Mode of transmission	Example(s)
Mechanical vector-borne	Stable flies Mosquitoes Hard ticks
Feed	Infected cattle grazing on forage shared by other animals
Water	Infected animals shedding into shared water sources shared by other animals
Direct contact	Uncommon
Sexual	Semen from an affected animal used in artificial insemination

3.2 LSD prevention

Key messages

- Ensure good vaccine management procedures are in place.
- Select the right LSD vaccine for each facility.
- Vaccinate on arrival and monitor for side effects such as lethargy, lymph node swelling or 'Neethling disease'.
- Implement an integrated pest management (IPM) program for insect vectors.

3.2.1 Vaccination

Vaccination programs can fail because of inappropriate storage and handling practices. Manufacturer specifications must be followed. The processes outlined in Section 1.3 will ensure successful handling and administration of vaccines.

In relation to the LSD vaccination, the following conditions apply (11):

- Vaccines must be used within 4–6 hours of reconstituting the bottle.
- All spare doses must be disposed of after opening.
- Vaccines should be kept out of the light when stored and exposure time should be minimised when performing a vaccination campaign.
- All equipment to be used must be sterilised with boiling water, not methylated spirits or disinfectants, as these will kill the vaccine and make it ineffective. Allow the equipment to cool before using.
- Good needle hygiene must be practiced as iatrogenic spread may occur from actively infected animals (see Worksheet 5).

The LSD vaccines available in Indonesia are the Lumpyvax and MEVAC vaccines (see Appendix C). These are both live attenuated (LA) vaccines. LA vaccines are developed using a live strain of the virus (in this case the 'Neethling-type') that has been weakened to produce a lasting and strong protection by harnessing the animal's natural immune system (11).

The choice of vaccine should be based on cost and the number of doses in each bottle (compared to number of animals to be vaccinated), as the bottle must be used within 4–6 hours of opening.

Vaccination for LSD should occur at the same time as vaccination for FMD, and as early as possible after arrival in a facility since both vaccines take 7–10 days for immunity to develop and cattle will not reach full immunity until approximately 30 days after vaccination (11).

The LA LSD vaccines only require one primary dose, with booster doses every 12 months after the first dose. For further details on the protocols of the Lumpyvax and MEVAC vaccines, please refer to Appendix C.

In challenge studies of animals vaccinated with 'Neethling-type' LA vaccines, all vaccinated animals were protected from developing clinical LSD after vaccination (11). This demonstrates the high level of effectiveness of the LA vaccines against this damaging disease. In vaccination programs during outbreaks,

animals that have developed clinical disease within 14 days of vaccination were generally considered to already have been infected with a wild-type LSD, as no cases occurred more than 14 days post vaccination. In Turkish outbreaks where emergency vaccination was applied after the initial outbreak, there were no statistically significant improvements in morbidity or mortality outcomes for sites already affected (31).

LA vaccines can be less effective in high-stress situations like shipping or arrival. Numerous studies have demonstrated improved performance of delayed vaccination with live bovine respiratory disease (BRD) vaccines as compared to vaccination immediately after arrival, and as such the LSD vaccines may be less effective when administered in an intensive facility setting, such as a feedlot (35,36).

Side effects are frequently noted in LSD LA vaccine trials; however, the impacts of these side effects should be weighed against the losses caused by an outbreak. All vaccine trials noted that the animals appear normal in terms of their behaviour and condition. Common side effects from LA vaccines include (11,37):

- mild to moderate fevers 2–3 days post vaccination
- nodular swelling at vaccination site up to 10 cm in diameter that can last for at least 28 days
- pre-scapular lymph node enlargement
- Neethling disease.

Neethling disease is a less common side effect of vaccination where numerous small nodules appear on the animal for many weeks. The nodules can be easily differentiated from true LSD skin lesions.

Both vaccines can be delivered to pregnant cows, which will confer immunity to calves that feed on their colostrum. Maternally derived immunity will last for 4–6 months. Vaccination of these calves prior to 6 months may be less effective due to maternal antibody interference (see Appendix C). Conversely, calves of vaccinated dams fed colostrum from *unvaccinated* dams will need to be vaccinated to be protected from LSD.

3.2.2 Biosecurity

Biosecurity practices are paramount to preventing LSD; please refer to the principles outlined in the *Biosecurity Manual*.

3.2.3 Integrated pest management

Integrated pest management is paramount to preventing and controlling LSD; please refer to the principles outlined in the *Biosecurity Manual*.

Relevant additional materials

- Appendix C: LSD vaccine details
- Worksheets 3–6: Vaccine management worksheets
- Worksheet 9: LSD vaccine selection tool
- IPM factsheet (in *Biosecurity Manual*)

3.3 LSD clinical signs

Key messages

- Early clinical signs include fever, discharge from the eyes, nose and mouth, swollen lymph nodes and reluctance to move.
- Full skin thickness nodules (5–50 mm) will appear anywhere on the body, particularly the head and neck. These can develop into necrotic sitfast lesions.
- Ongoing complications include secondary skin infections, refractory pneumonia and chronic emaciation.

3.3.1 Acute clinical signs

Initial viraemia will occur after inoculation, followed by cutaneous localisation and the development of the nodular lesions that create the characteristic lesions and numerous subsequent complications of the disease:

- initial fever of 40–41.5 degrees that can last from 1–10 days
- increased ocular, nasal and pharyngeal secretions including lachrymation, nasal discharges (serous to mucopurulent over time)
- lymphadenopathy
- inappetence
- depression
- unwillingness to move.

Eruption of cutaneous nodules will occur within 1–2 days of initial presentation (Figure 11) (3,30,31,38). Nodules will be:

- 5–50+ mm
- anywhere on the body with a preference for the head, neck, perineum, genitals and limbs
- circumscribed, raised and with erect hair
- hyperaemic
- have drops of serum on surface
- be full thickness from epidermis to subcutis – will feel like they are attached to the skin rather than being moveable under the skin like a lymph node.

Affected animals may also have enlarged and oedematous regional lymph nodes after development of skin lesions.

Extracted from Tuppurainen et al. (2018)

Figure 11 Photographs of cutaneous LSD lesions

3.3.2 Chronic clinical signs

Mucosal and cutaneous lesions will become ulcerative and necrotic over time, forming an inverted cone shape, often termed a 'sitfast' lesion (Figure 12) (3,30,31,38). These lesions may appear on the muzzle, nares or oropharynx, upper respiratory tract or in the alimentary tract.

Additional clinical signs include ocular lesions and inflammatory or oedematous swellings of the limbs, brisket, pulmonary interlobular spaces, and genitals (3,30,31).

After the initial presentation of skin nodules, the lesions can remain as they are or slough away, leaving behind a full-thickness hole in the hide and potentiating numerous complications (3,30). Chronic complications include:

- aspiration pneumonia
- dysentery
- secondary bacterial infections
- increased susceptibility to New World screwworm fly (*Cochliomyia hominivorax*)
- mastitis and sloughing of mammary tissues
- abortion and infertility for several months after infection
- further nodular lesions throughout the connective and muscular tissues
- prolonged anorexia and immobility leading to poor body condition for up to 4–6 months in cases with extensive lesions.

Extracted from Abutarbush et al. (2015)

Figure 12 Inverted conical necrosis or 'sitfast' lesion of a cutaneous lesion

3.3.3 Differential diagnoses for LSD

Differential diagnosis of LSD include:

- pseudo lumpy skin disease/bovine herpes mammilitis (bovine herpes virus 2)
- pseudocowpox (*Parapoxvirus*)
- bovine papular stomatitis (*Parapoxvirus*)
- dermatophilosis
- demodicosis (can be ruled out with skin scrapings)
- insect bites
- urticaria
- photosensitisation
- besnoitiosis and onchocerciasis (44).

The *Emergency Response Plan Manual* provides information on diagnosing LSD in a facility, including testing information and a discussion of case definitions.

3.4 LSD treatment and management

Key messages

- LSD treatment aims to maintain animal welfare, manage secondary complications and reduce the spread of the disease.
- LSD cases should be triaged for severity.
- All LSD-affected animals require increased supportive care.
- Treatment plans should be applied based on severity.

In an intensive setting, emergency or salvage slaughter of severely affected animals may reduce the potential for ongoing transmission of the disease, while minimising the financial impacts of an outbreak. Unlike FMD, the entire feedlot is unlikely to be infected by the time the first clinical signs appear in affected animal(s).

LSD cases can be assessed for their severity using the following clinical signs outlined in Table 7. This table can be personalised to your site using Worksheet 10. Appendix F provides an example of a treatment plan for LSD.

Table 7 Diagnostic triage of LSD cases for treatment

Clinical sign	Mild	Moderate	Severe
Mobility score	>= 3	4	4 or 5
Appetite	Normal	Reduced	None
BCS	Good	Good	Poor
Behaviour/mentation	Normal	Slight dullness	Depressed
Nodular lesions	<25% of the body and NO sitfasts	25–75% of the body +/- sitfasts	>75% of the body +/- sitfasts
Secondary complications	None	Skin ONLY	Systemic secondary infections
Treatment plan	Supportive care ONLY	Supportive care, antibiotic therapy and increased monitoring for development of severe disease	Supportive care, medical management, down cow and euthanasia assessment

Treatment options for clinically affected animals include analgesia for painful lesions, antimicrobials in cases of secondary infections, prevention of myasis through good wound care, and supportive care such as increased feed/water availability for immobile animals. LSD lesions also increase the risk of an animal's infestation with New World screwworm fly, and they should be closely monitored for any signs (32).

Relevant additional materials

- Worksheet 10: LSD treatment plan
- Appendix D: Medication guidelines
- Appendix F: Example LSD treatment plan

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Appendix A ESCAS standards relevant to FMD/LSD

- Handling and movement of livestock must be carried out calmly and effectively, avoiding harm, distress or injury.
- Livestock must not be subjected to procedures that cause pain and suffering.
- Livestock must not be isolated unless necessary.
- Sick or injured animals must be humanely disposed of or segregated and treated appropriately.
- Livestock must never be forced to walk over the top of other animals.
- Livestock must not be left individually restrained during break times or delays.
- Ramp sides must be sufficiently high to prevent escape.
- Facilities and equipment must be free from any protrusions, sharp edges or other faults/flaws that could cause injury to the animals.
- Holding pens must provide enough space for the animals to stand up, lie down and turn around.
- Lighting must be conducive to animal movement and sufficient to perform inspection, when necessary.
- Clean water must be available and accessible to all animals.
- Feed of sufficient quantity and quality must be provided to all animals held over 12 hours.
- Animals must be protected from exposure to adverse weather conditions or alternative arrangements must be made to alleviate heat/cold stress.
- Animals must be inspected on arrival at the facility and daily thereafter (inspected twice daily in lairage if held longer than 12 hours). Animals must be held in suitable groups. Records of inspection must be maintained.
- Standards 15–28 are all relevant to slaughtering procedure and FMD/LSD are not relevant in these scenarios.

Appendix B FMD vaccine details as of date of manual printing

Name	Type	Primary dosing (days)	Boosters	Covers Ind2001	DIVA	Delivery	Comments
Aftopor (Boehringer Ingelheim)	Inactivated FMD viral antigen (O-3039, O1 Manisa, A22 Iraq) Double oil emulsion	0, 28 (40,41)	4–7mo (40,41)	Y	Y	IM in neck	Ages: Any Species: Pigs and ruminants Maternal antibody reaction: Calves of vaccinated mothers must be vaccinated at 2.5 months old with 2 doses 4–5 weeks apart. Shelf life: 6 months
Aftogen Oleo (Elanco)	Inactivated FMD viral antigen (O1 Campos) Single oil emulsion	0 , 21–28 (42)	6 mo (42)	Y	Y	IM in neck	Ages: >6 months old Species: Buffalo, cow, pig, sheep, and goats Maternal antibody reaction: No maternal antibody issues Shelf life: 2 years
Aftomune (CEVA)/ Aftrosa (Ourofino)	Inactivated FMD viral antigen (O1 Campos, A24 Cuzeiro) Non-saponified	0, 90* (43,44)	6 mo (43,44)	Y	Not labelled	SC/IM in neck	Ages: All ages Species: Cattle and buffalo Maternal antibodies: Not available Shelf life: Not available
CAVac FMD (China Agricultural Vet.Bio.science and Technology Co Ltd)	Inactivated FMD viral antigen (O/Mya98/XJ/2010, O/GX/09-7)	Not available	Not available	Not available	Not available	Not available	Not available

*Product label says to 'Follow official health guidelines'.

Appendix C LSD vaccine details

Name	Type	Primary dosing (days)	Boosters	Time to immunity (days)	Delivery	Comments
Lumpyvax (MSD) (45)	Live attenuated (Neethling-type)	0	12 mo	21	SC in neck	Ages: Calves of unvaccinated cows – Any; calves of vaccinated cows – 6mo Species: Cattle Maternal antibody reaction: Yes Shelf life: Throw out all remaining product after use WHP: Meat – 21 days (South Africa)
MEVAC LSD (Mevac) (46)	Live attenuated (Neethling-type)	0	12 mo	Not reported	SC in neck	Ages: Calves of unvaccinated cows – Any; calves of vaccinated cows – 6mo Species: Cattle Maternal antibody reaction: Yes Shelf life: Not reported WHP: Not reported

Appendix D Medication guidelines

Footbaths

The following should be implemented for successful foot bathing (29):

- Ensure correct mixing of foot dip solution, as excessively high concentrations will harm both the animals and staff involved.
- Wash feet in water or hosing prior.
- Bath should be 3.0 to 3.7 m long, 0.6 m wide at the base with a 0.25 m-high step-in height, with sloped sidewalls to 0.9 m wide at a height of 0.9 m above the floor of the bath.
- Refresh solution every 100–300 cow passes.

Table 8 Foot bath agents approved for use in Indonesia

Trade name	Agent (concentration/L)	Application	Notes
Tembaga II Sulfate Pentahidrat (Merck or PUDAK)	Copper sulphate (5 g/litre)	4 times consecutively to avoid interdigital dermatitis (29) Change solution every 100–300 cow passes Ensure appropriate depth and length Wash feet prior to application	Avoid spreading onto crops/pastures
Formalin	Formalin (2–6 g/litre)		Carcinogenic to humans, highly irritant to lesions – avoid using

A footbath that is 0.25 metres deep, 0.6 metres wide and 3.34 metres long contains ≈ 500 litres of water.

Antimicrobials

The following antimicrobial classes are registered for veterinary use in Indonesia: Aminoglycosides, Beta Lactam, Macrolides, Peptide group, Quinolones, Sulphonamides, Tetracycline, Flavophospholipol and Lincosamides.

Antimicrobials applied to prevent secondary infections for FMD or LSD should be broad-spectrum, with drugs of lesser human importance prioritised for primary use.

Table 9 Antibiotics approved for veterinary use in Indonesia

Trade name	Agent (concentration/mL)	Dose rate	Route	Frequency	WHP
Vet-Oxy SB	Oxytetracycline 50 mg Lidocaine 2%	4–8 mL/50–100 kg body weight, each increase of 50 kg dose plus 4 mL from the previous dose 3 doses, 24 hrs apart	IM	12–24 hrs	5 days [a]
Vet-Oxy LA	Oxytetracycline 200 mg	1 mL/10 kg No more than 20 mL per site 1–2 doses	IM	72 hrs or single dose	28 days [b]

Dosing advice and WHPs

a. Oxytetracycline 50 mg: https://shopee.co.id/VET-OXY-SB-100-ml-i.315426706.6255276866
b. Oxytetracycline 200 mg: https://agriculture.vic.gov.au/__data/assets/pdf_file/0010/577504/AGVIC_AVPG_A5_Flipbook_PRINT_WD.pdf

NSAIDs and other pain relief agents

All NSAIDs shown below, apart from Tri-Solfen, are approved for use in Indonesia at the date of publication of this manual. Tri-Solfen can be accessed via special use permit

Table 10 NSAID pain relief approved for use in Indonesia

Trade name	Agent (concentration/mL)	Dose rate	Route	Frequency	WHP
Metacam (Boehringer Ingelheim), Melovem (Dopharma), Apex Meloxicam (Dechra), Ilium Meloxicam (Ilium)	Meloxicam 20 mg	2.5 mL/100 kg Single dose	SC	Single dose	10 days [a]
Dupaprofen (Dutch farm), Neoprofen (Zoetis)	Ketoprofen 100 mg	3 mL/100 kg 1–3 doses	IM	24 hrs	4 days [b]
Tolfedine SC Injection (Vetoquinol)	Tolfenamic acid 40 mg	1 mL/20 kg 1–5 doses	IM high on neck	48 hrs	10 days [c]
Flunixin Injection (Globe Vet), Flumav Injection (Mavlab Pty Ltd), Flunixvet Inj. (Mebedco-vet), Fortis (Dongbang)	Flunixin 50 mg	1–2 mL/45 kg 3–5 doses	IM	24 hrs	7 days [d]
Analdon[4]	Dipyrone (Metamizole) 250 mg Lignocaine 20 mg	10–20 mL/ 200–400 kg Up to 6 doses	IM	8–12 hrs	1 day [e]
Tri-Solfen	Lignocaine 40.6 g/L Bupivacaine 4.2 g/L Adrenaline 24.8 mg/L Cetrimide 5.0 g/L	1 coating of spray per foot lesion (10–30 mL per animal) (4)	Spray	4 hrs	90 days [f]

Dosing advice and WHPs

a. Meloxicam: https://www.boehringer-ingelheim.com.au/sites/au/files/animal_health_new_zealand/metacam_20_nz.pdf
b. Ketoprofen: https://websvr.infopest.com.au/LabelRouter?LabelType=L&Mode=1&ProductCode=90601
c. Tolfenamic acid: https://websvr.infopest.com.au/LabelRouter?LabelType=L&Mode=1&ProductCode=52850
d. Flunixin: https://websvr.infopest.com.au/LabelRouter?LabelType=L&Mode=1&ProductCode=64930
e. Analdon: https://shopee.co.id/ANALDON-100-ml-(analgesik-antipiretik-anti-nyeri-dan-demam)-i.9228356.5510433855 ; https://www.dadvet.com/View_Article.aspx?type=2&inner=0&ID=884
f. Tri-Solfen: https://www.dechra.co.nz/wp-content/uploads/2021/11/trisolfen-gel-nz-20200819.pdf; https://websvr.infopest.com.au/LabelRouter?LabelType=L&Mode=1&ProductCode=60099

[4] Dipyrone dosing advice given based on formulations at 500mg/mL

Appendix E Example FMD treatment plan

FMD triage guide for Pt. Ausvet Feedlot

Clinical sign	Mild	Moderate	Severe
Mobility score	>= 3	4	4 or 5
Appetite	Normal	Reduced	None
Behaviour/mentation	Normal	Slight dullness	Depressed
Vesicular lesions	Mild <2 cm lesions in mouth 0–1 foot lesions	Moderate 2–5 cm lesions in mouth 2–3 foot lesions	Severe >5 cm lesions in mouth All feet affected Heel and coronary band

FMD treatment plans for Pt. Ausvet Feedlot

	Mild	Moderate	Severe
Supportive care	Y	Y	Y
Increased checks	Y	Y	Y
Foot dips	N	Y	Y
Pain relief	N	+/-	Y
Antibiotics	N	N	+/-
Downer cow assessment	N	N	Y

FMD treatments for Pt. Ausvet Feedlot

Treatment	Indication(s)	Instructions
Soft bedding	Supportive care	Apply 10 cm sawdust to all affected pens. Remove and replace daily.
Increased water points	Supportive care	Provide additional water sources to all severely affected animals. Refill twice daily and clean daily.
Increased feed availability	Supportive care	Provide additional feed sources to all severely affected animals. Refill twice daily and clean daily.
Triage and downer cow assessments	Increased health checks	Perform health checks twice daily. Assess all animals in affected group for severity of FMD signs, identify if any animals require medical intervention or downer cow assessment.
$CuSO_4$ 5% foot bath	Foot dips	Clean stock's feet using running water then walk stock through foot bath 1–2 times weekly for 2 weeks after initial infection. Replace foot dip solution after every 100–300 cows.
Flunixin meglumine	Pain relief	1 mL/45 kg IM, once daily for 3 days. WHP: 7 days
Vet-Oxy SB	Antibiotics	4 mL/100 kg IM, once daily for 3 days. WHP: 5 days

Appendix F Example LSD treatment plan

LSD triage guide for Pt. Ausvet Feedlot

Clinical sign	Mild	Moderate	Severe
Mobility score	>= 3	4	4 or 5
Appetite	Normal	Reduced	None
BCS	Good	Good	Poor
Behaviour/mentation	Normal	Slight dullness	Depressed
Nodular lesions	<25% of the body and NO sitfasts	25–75% of the body +/- sitfasts	>75% of the body +/- sitfasts
Secondary complications	None	Skin ONLY	Systemic secondary infections

LSD treatment plans for Pt. Ausvet Feedlot

	Mild	Moderate	Severe
Supportive care	Y	Y	Y
Increased checks	Y	Y	Y
Pain relief	N	Y	Y
Antibiotics	N	+/-	Y
Downer cow assessment	N	N	+/-
Euthanasia assessment	N	N	Y

LSD treatments for Pt. Ausvet Feedlot

Treatment	Indication(s)	Instructions
Soft bedding	Supportive care	Apply 10 cm sawdust to all affected pens. Remove and replace daily.
Increased water points	Supportive care	Provide additional water sources to all severely affected animals. Refill twice daily and clean daily.
Increased feed availability	Supportive care	Provide additional feed sources to all severely affected animals. Refill twice daily and clean daily.
Triage and downer cow assessments	Increased health checks	Perform health checks twice daily. Assess all animals in affected group for severity of LSD signs, identify if any animals require medical intervention or downer cow assessment.
Flunixin meglumine	Pain relief	1 mL/45 kg IM, once daily for 3 days. WHP: 7 days
Vet-Oxy SB	Antibiotics	4 mL/100 kg IM, once daily for 3 days. WHP: 5 days