DairyNZ

Good Practice Calf Rearing

Calf rearing

The reference guide for calf rearing in New Zealand

DairyNZ

For more information visit **dairynz.co.nz**

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Protect your calves and your farm

01

Clean, comfortable environment

Rear calves in clean and comfortable conditions

- Start with a clean calving environment
- Ensure you have the facilities for current and future needs.
- Provide calves with protection from wind, rain and heat.
- Disinfect rails, partitions, walls and gates in calf pens.
- Keep clothing and boots clean to minimise the spread of disease.
- Plan procedures to minimise the need to enter calf pens.

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Calving environments

Clean, observable and sheltered

The conditions calves are born into can have a lasting impact on health and growth. Clean, dry, sheltered environments lead to healthier calves, better growth, and fewer health problems later.

Plan your calving cow or 'springer' mobs

Prior to the start of calving, organise several different calving areas to ensure all cows have enough space to calve in clean conditions. This can be as simple as dividing paddocks with tapes to create calving areas that can be used for shorter periods. Protect the health of cows and their newborn calves by avoiding high stocking of the calving area. Calving areas should always have access to fresh, clean water.

Environment	Considerations
Clean	• Calves born in dry, clean conditions are less likely to be exposed to diseases such as Johne's and those causing calf scours. • Use well drained paddocks that are not in the treatment mob rotation or grazing rotation. • Lock up paddocks for an extended period before calving commences to minimise manure contamination. • Do not use the calving paddock for the introduction of new stock, as they could carry disease. • Identify a 'back-up' paddock if conditions are too wet.
Observable	• Choose a location where it is easy to monitor calving cows and newborn calves.
Well drained	• It has been said that disease bugs don't jump, they swim! Anything you can do to keep the area dry will help reduce disease risk and make it easier for newborn calves to stand quickly. • Make sure dairy yard effluent doesn't drain into calving areas.
Sheltered	• Exposure to harsh climatic conditions compromises calf welfare. • Provide shelter from radiant heat and cold winds.

On many New Zealand dairy farms, cows approaching calving are managed as follows:

- Calving mobs are decided well in advance based on calving date to ensure correct nutrition, trace element and transport requirements are met.
- Springer cows (usually those within two weeks of calving) are brought to paddocks closer to the dairy shed.
- Calving cows are on appropriate paddocks or off-paddock facilities – clean, observable and sheltered.
- Springer cows are observed regularly, and freshly calved cows transition to the colostrum mob. Newly born calves are moved to the calf sheds.

Calving pads

A well-designed calving pad is about cow comfort, hygiene, and effective effluent management.

It is important to consider the following:

- Surface and bedding
- Drainage
- Space
- Shelter
- Hygiene
- Effluent management
- Access and facilities (including troughs)
- Management

Be prepared to make changes and repairs to the calving area during the calving period. Adequate supplies of bedding should be kept on hand to allow regular top dressing of the pad, if necessary. For more information on off-paddock design refer to: Dairy cow housing (dairynz.co.nz/media/wszdiof1/dairy-cow-housing-2025.pdf)

Designing the calf rearing environment

When designing a calf rearing area or assessing your existing facilities, it is important to remember:

- Most calves are housed when their immune system has not developed so they are very vulnerable to disease.
- Calves that are housed in poorly designed, poorly maintained or dirty, overcrowded environments have an increased rate of disease and do not grow as well.

The following design elements all need to be considered to ensure calf health and comfort:

Space	Have you allowed enough room (minimum 1.5m^2 per calf, ideally 2.5m^2), for times of peak demand?
Shelter	Are all calves protected from wind, rain and hot sun?
Ease of access	Can you manage all necessary stock handling, feeding and cleaning activities?
Sick calves	Do you have a quarantine area or isolation pen?
Orientation	Is the shed open to sunlight and protected from the prevailing wind?
Ventilation	Is air circulation adequate to ensure fresh air and help dry bedding while managing draughts at calf level?
Drainage	Is the calf rearing area protected from dairy effluent?

Bedding	Does it provide good insulation and is comfortable?
Feeding space	Is there enough space for all calves to access the feeder?
Ease of cleaning	What cleaning regime will be used for hard surfaces in pens etc?
Maintenance of bedding	How will it be refreshed or replaced?
Water	Do all calves have access to fresh drinking water? Is there a good supply of water for cleaning the calf rearing area and equipment?
Enrichment	Have you considered including items for enrichment in the calf pen?

Clean, comfortable calf rearing environment

Calves should be reared in clean and comfortable conditions to ensure:

- less diseases like scours and pneumonia
- reduced death rates
- increased growth rates.

A calf rearing environment that provides clean and comfortable conditions limits the risk of disease.

Building a new calf housing facility?

It pays to do some research before designing your calf housing facility. Visiting other farms is a great way to get ideas.

Space requirements and layout

Space requirements

Whatever approach you adopt to housing your calves, make sure you can respond to changing circumstances on the farm. When considering pen size or numbers of calves to allocate per pen, keep in mind that newborn calves require at least 1.5m^2, preferably 2.5m^2 so they have space as they grow. Calves with greater space allocation exhibit more locomotor behaviour and social play which is associated with good welfare.

Establish groups of similar sized calves and avoid moving calves between groups. Plan for peak calving numbers and factor in the average time calves will be housed. Be prepared to alter plans if climatic conditions change.

As calves grow, it is recommended to increase the space available to greater than 2.5m² – particularly where access to paddocks or yards is limited. Adequate space allows calves to rest undisturbed in a clean, dry area. This significantly improves calf comfort and wellbeing and reduces the risk of disease.

Restricting the number of calves per pen will improve disease control and reduce competition. Try to keep the age range of calves within a group to less than two weeks. Group size is another critical management consideration as there is an association between the number of calves per pen and disease and death rates.

Smaller group sizes are especially important in early life stages, to allow close observation of health, and reduce competition between calves for milk. If larger group numbers are used e.g. 20, farms must ensure they can consistently manage all calf rearing aspects to a high standard.

Stable groups and an all-in, all-out approach, is recommended. It creates an opportunity for cleaning, disinfection and resting of pens between groups, enables more consistent feeding due to more uniform group characteristics e.g. size, and reduces feeding competition between older and younger calves.

Make sure your space estimates are realistic.

- Review the predicted calving pattern – when will you have the most calves?
- Factor in the average time calves are held in the calf rearing environment – will there be any bottlenecks?
- Identify alternative housing areas for potential periods of overcrowding – where else can you house calves in comfort?

Build in space for cleaning access and stock handling

Remember that young calves have poor herding instincts so moving calves takes time and patience. Design pens for easy access and stock movements.

If possible, keep the design of pens and laneways flexible so they can be easily modified. Moveable partitions can be useful.

Pens should be completely cleaned out and disinfected between calf rearing seasons so allow access points for the necessary equipment.

Design to minimise physical contact between calves

Limiting contact between sick and healthy calves is important to prevent the spread of infectious diseases. Solid partitions between pens are the best option for preventing contact between calves. However, you need to also ensure that ventilation is still adequate.

Consider quarantine areas

Separating sick calves from healthy calves can reduce the risk of transferring disease and help manage antibiotic residues in treated calves.

Areas should be set aside for the isolation and treatment of sick animals as well as for calves requiring special attention, however, there are some considerations:

- If separate sick pens are not available, sick calves may be left with their immediate group if they do not have direct contact with calves in neighbouring pens.
- Once a calf is moved to a sick pen it should not be returned to the group for at least three weeks to prevent reinfection or spread of disease.

A footbath and boot scrubbing facility should be provided at the entry into the quarantine area. Provide staff with easy access to handwashing facilities, disposable gloves and a separate store of clean aprons or overalls.

Comfort in the sick pen

Attention to the comfort and wellbeing of sick calves will improve survival rates. Sick calves will often have body temperatures outside of the normal range. They will also experience higher levels of stress.

Providing a controlled temperature and ample, clean bedding can significantly improve the welfare and chances of survival of a sick calf.

Separate areas for sale calves

The risk of antibiotic residues in calves destined for sale must be minimised.

Any calf treated with antibiotics or other chemicals with a meat withholding period on the label needs to be managed very carefully. Ideally, they should be physically separated from non-treated calves.

- Housing sale calves is a separate area can help avoid a mix up between treated and non-treated calves.
- Separate areas also ensure that no physical contact or sharing of feed or equipment, such as buckets and stomach tubes, between treated and non-treated calves can occur.

Remember, sale calves that become ill must receive appropriate treatment or be humanely euthanised.

Sale or bobby calves must be provided with a clean, comfortable and hygienic environment. New Zealand has regulations about holding and loading facilities and these can be found on the DairyNZ website.

Keep feeding and watering areas clean and dry

Feeding areas

Areas where calves are fed often become the wettest and most contaminated areas within the calf housing. Milk feeding sites (both manual and automatic) may become very wet under foot due to milk spillage. Often calves will pass manure or urinate shortly after feeding.

Position calf feeding stations on flooring which can be easily cleaned and is well drained, such as cement. If this is not possible then replenish bedding under feeders regularly to ensure it is fresh and not waterlogged. Consider providing some underground drainage in these sites.

Monitor feed troughs for urine and faecal contamination and clean as necessary.

Watering areas

Fresh, clean water must be available to all calves from day one of life.

Water can be supplied by troughs, either plumbed in or manually topped up every day. Monitor bedding under water sites for waterlogging and replenish regularly.

Trough space

Each calf should have an allowance of at least 35cm of trough space as this ensures that all calves can access solid feed.

Long feeding troughs are preferred over small round tubs as they permit greater access for all, especially shy feeders and smaller calves.

If smaller tubs are used, make sure multiple feeders are available.

Enrichment

Enrichment items should serve a specific behavioural purpose rather than simply providing novelty.

The aim is to allow calves to express natural behaviours that contribute to their physical development and wellbeing. Enrichment items can provide opportunities for play and decrease the likelihood of nibbling on other calves or suckling navels. Some options include brushes mounted at appropriate height, horse hay balls or treat dispensing balls, and hanging objects for licking and manipulation.

Location, orientation and ventilation

The calf shed must be located at least 20 metres away from the farm dairy. Sale calves can be held within 20 metres of the farm dairy temporarily, immediately prior to pick-up.

Orientate calf sheds to maximise sunlight while protecting from prevailing wind and rain.

Exposure to adverse weather conditions limits growth rates as the calf diverts its energy to keeping warm. The two main design issues to consider are:

- ensuring good air circulation
- avoiding ground level draughts.

Good ventilation reduces the risk of calf illness and keeps conditions comfortable in cold and hot weather.

Good air quality is critical to remove moisture, ammonia, dust and airborne pathogens (diseases).

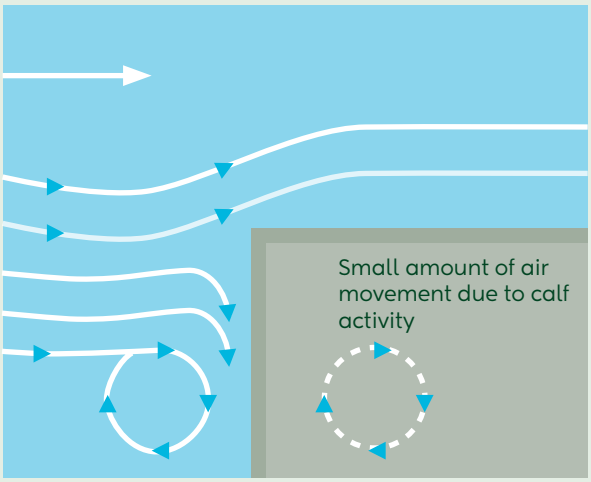
The challenge with ventilation is producing an environment that is draught free at the level of the calf but with enough air movement above the calf to remove pollutants. Sheds that are not purpose designed for calves can have some ventilation problems, but it may be possible to make changes to minimise the impact of the prevailing wind.

Open faced sheds can benefit from adding a roof skirt to minimise wind and rain impact.

Additional warmth and protection can be provided to vulnerable calves by using calf covers.

Ideally, the back of the shed should protect calves from prevailing winds and rain.

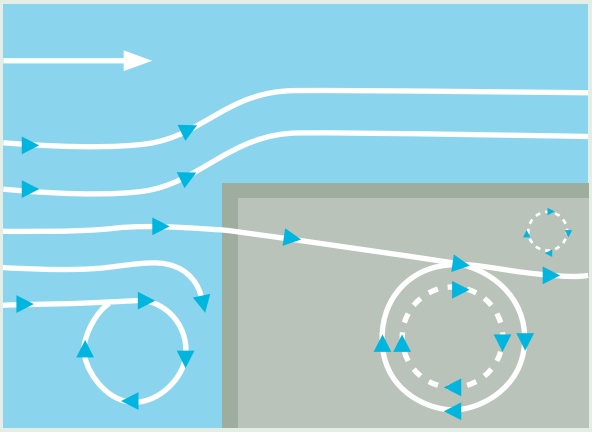
The basic shed design below may not have enough ventilation to maintain good air quality.



——— strong air movements
- - - - weak air movements

Research has shown that improved ventilation can be achieved in this type of shed by creating an opening of 600mm at the very top of the wall.

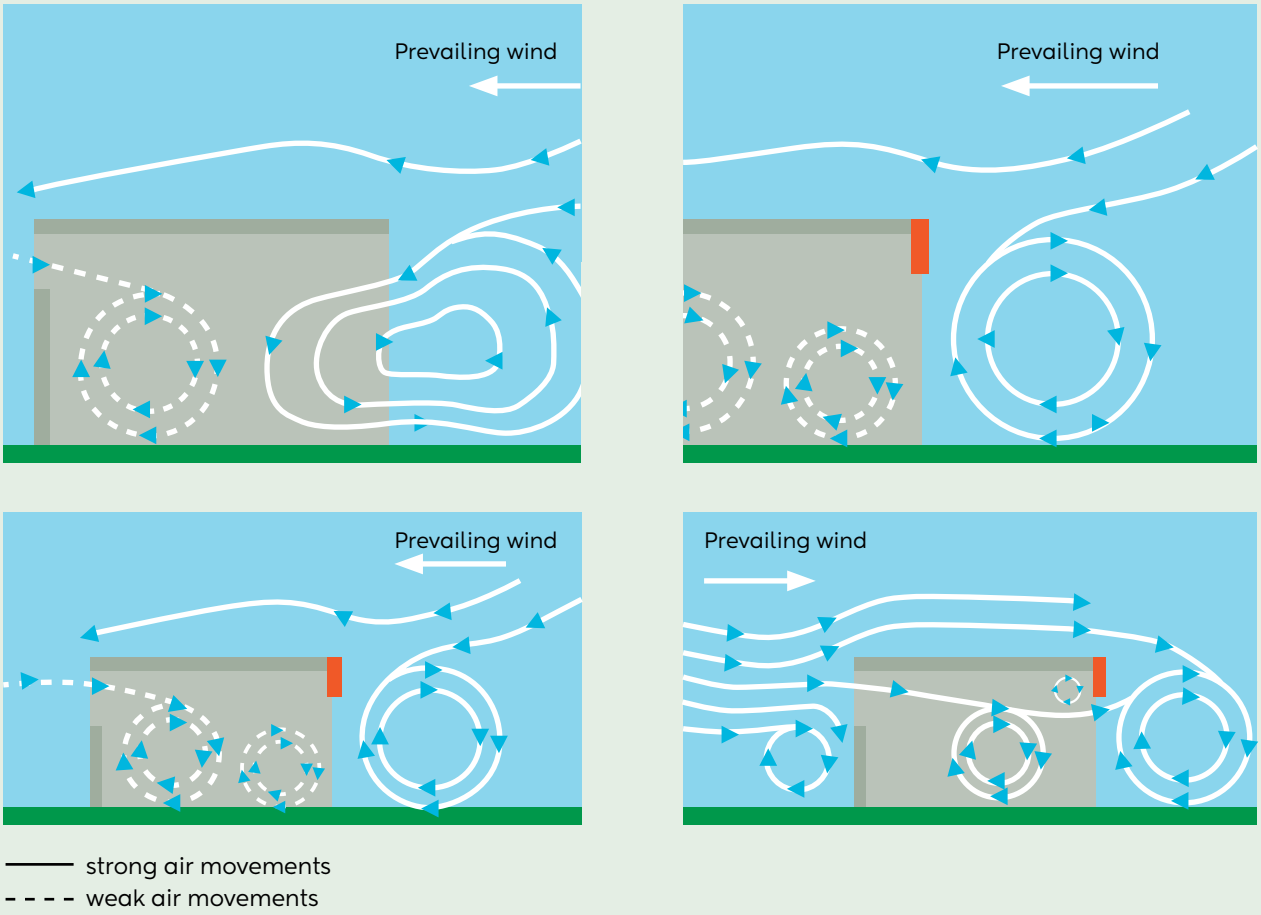
A gap high on the back wall permits good air circulation without exposing calves to direct draughts.



——— strong air movements
- - - - weak air movements

The gap was found to be particularly important in open faced sheds which were 9 metres or more deep. Sheds that were less than 4 metres in depth did not require this opening.

Open faced sheds can benefit from adding a roof skirt to minimise wind and rain impact.



Work with the prevailing wind

No matter which direction the wind is coming from, with some careful observation and planning, it is possible to create comfortable conditions for calves.

Avoid ground level draughts

- Adding a solid front to the pen may be beneficial if the open face is exposed to prevailing wind and rain.

- Slatted floors, such as those found in converted sheep shearing sheds, are draughty – modify them to prevent draughts by covering with shade cloth and bedding material. Restrict air movement beneath the floor with barriers.

Keep calves cool in hot weather

Calves do best in environments between 12–25° Celsius. Once it gets warmer than that, they tend to eat less and start using energy to keep cool, instead of for growth.

In hot weather, limit stressful activities such as moving and handling to cooler parts of the day. Ensure calves have access to shade, fresh air, and plenty of cool, clean water – heat-stressed calves can drink up to 20 litres per day. Provide fresh feed before or after peak heat and regularly clean water troughs to prevent algae and bacterial growth.

Drainage

Calf rearing areas must be well drained. Poor drainage causes wet bedding, ammonia build-up, pathogen build up, pathogen survival and discomfort. Pathogens are disease causing bugs and can come from effluent, so it is essential effluent runoff does not enter calf areas. The best time to get drainage right in the calf shed is in the design phase.

Concrete or firm base materials that are well compacted can be used to create a slope towards the front of the pen. Deep bedding (over 20cm) is then placed on top. Ensure the bedding is absorbent and drains well so calves have dry comfortable surfaces for lying.

Managing and adapting existing calf rearing facilities or buildings

Choose the area to rear your calves carefully. Buildings or paddocks that have been used by older stock pose a higher risk of disease for calves due to contamination from manure.

Multipurpose sheds used to store farm supplies or machinery are commonly used for calf rearing. Ensure the principles of ventilation, natural sunlight, drainage, minimising contact between batches of calves, stock density, and access to water are factored in. Paint on old timber can contain lead which when nibbled by calves causes lead poisoning so should be avoided.

Paddock rearing

Calf rearing systems in New Zealand usually require a transition from calf sheds to dedicated paddocks before weaning.

It is important for welfare and performance that calves can maintain their thermoneutral zone (normal body temperature). If a calf becomes too cold it uses extra energy to generate body heat, which can slow growth and increase disease susceptibility. Providing adequate shelter is very important when rearing outdoors. This can be provided by purpose-built structures (permanent or transportable) or tree lines and dense vegetation to enable shelter and dry lying surfaces.

In very cold environments, calf covers can be used to reduce cold stress in pre-weaned calves, by providing insulation and reducing heat loss. Research consistently shows that covers increase skin temperature, indicating improved thermal comfort. However, most studies report little effect on growth, feed intake, or overall health. Some evidence suggests a slight reduction in respiratory disease in colder conditions. Overall, calf covers may be most beneficial in very cold, wet, or draughty environments and should be viewed as a supportive tool rather than a substitute for good housing or shelter.

Management of the calf rearing environment

Comfortable bedding

Providing dry, clean bedding is critical as calves typically spend around 18 hours per day lying down. Calf rearing outcomes, behaviour, physiological responses and overall health and welfare are influenced by comfortable, dry bedding.

Good quality bedding helps maintain body temperature by preventing heat loss. Less energy is then used for keeping warm and more can be directed to growth. Adequate rest is closely linked to improved growth rates, making it a key factor when considering both welfare and performance.

- Bedding depth should always be at a minimum of 20cm.
- Calves should be able to nestle deeply in bedding with their legs obscured by the bedding material. A measure of bedding adequacy is the nesting score.
- If a calf lies in wet bedding, it will conduct heat away from its body.

Nesting Score

Score 1 The calf's legs are entirely visible when lying down. This indicates insufficient bedding for cold conditions.

Score 2 The calf is slightly nestled, with lower legs partially covered by bedding, but part of the upper leg remains visible.

Score 3 The calf's legs are not visible when lying down. The bedding is deep enough to allow the calf to nest, trapping warm air around its body.

Bedding options

There are different options for bedding. The most commonly used materials in New Zealand calf sheds are wood shavings and bark chips.

When selecting bedding materials, remember to consider ongoing availability, price, and the degree to which the material compacts over time.

Another important consideration is whether calves will attempt to eat bedding material – avoid this if possible. Also avoid using dusty bedding as it can cause respiratory problems.

Options	Note
Bark chips	Wood chips, tan bark and post peelings are absorbent bedding materials with good insulating properties and low palatability to calves.
Wood shavings Sawdust	Fine particle sawdust will compact more and is less suitable than larger wood shavings. Treated wood/pine shavings or sawdust should not be used as these could be toxic if consumed.
Straw	Straw offers superior thermoregulatory benefits. It is widely used internationally. Care needs to be taken if straw or hay is also used as a fibre source as calves may nibble the bedding.
Sand or river stones	Sand or river stones do not provide any insulating properties. They are **not recommended**.

Regularly replenish bedding

Bedding should be at least 20cm deep and should always remain dry. An accessible supply of bedding should be available for the whole calf rearing period.

Calf rearing areas should be designed to allow for easy access of cleaning machinery used to remove, replace or top up bedding.

'Topping up' bedding is an approach used by many farmers.

Digging up soiled bedding when calves are close by can expose them to pathogens contained in dust and particles in the air. Putting new bedding on top makes sense from a disease control perspective as it creates a physical barrier to the contaminated bedding below.

Topping up saves labour during this busy time.

Cleaning

Maintaining a clean environment throughout the calf rearing period can make a significant difference to the disease levels and comfort calves will experience.

- In seasonal or batch calving herds, calf sheds should be cleaned as soon as practical after the last calf leaves.
- Pathogens persist longer in the environment if organic materials such as manure, saliva and bedding are present, so all bedding and organic material should be removed.
- Pressure cleaning is recommended.
- Steam or hot water will improve disinfection.
- Calf rearing personnel should always wear clean clothes and boots.
- Make sure disinfection procedures are carried out carefully with an approved disinfectant at the correct concentration

Disinfecting

Rails, gates, partitions, walls and feeders should firstly be cleaned of any obvious manure or other organic material.

- Disinfection works best if the dirt and manure are removed.
- Hot water and soap may be necessary first steps when cleaning milk residues as they aid the removal of fat.
- Use an approved disinfectant at the correct concentration.
- A minimum of 10 minutes contact time is required – 30 minutes is preferred –for effective disinfection.
- If cleaning pens when calves are in them, avoid wetting calves or creating aerosols of moisture that contain particles and pathogens.
- Calf trailers should be kept clean and disinfected each day.

Products such as lime are thought to sterilise dirt but have minimal impact on pathogen numbers and can irritate humans and calves. There is little scientific justification for lime-based dirt sterilisers. Products that work through drying and absorption, rather than sterilisation have better evidence to support their use.

Summary of recommendations

Calf rearing environments should be clean and comfortable to reduce the risk of disease and help calves grow well.

1. Check that your calf rearing facilities are suitable for your current and future needs.
2. Design calf rearing sheds to provide adequate protection from wind, rain and heat. Consider adjusting sheds to ensure good air circulation, while minimising draughts.
3. Keep dairy effluent away from the calf rearing environment.
4. Choose an absorbent and comfortable bedding material that insulates the calf from the cold and enhances wellbeing.
5. Maintain a clean environment by topping up bedding material regularly and disinfecting rails, partitions, walls and gates in calf pens.
6. Make sure that calf rearers do not spread disease – clothes and boots should be cleaned and disinfected as appropriate.
7. Plan pen layouts and procedures that minimise the need to enter calf pens.

02

Colostrum management

Colostrum is essential for all calves

- All calves need colostrum to get off to a great start, regardless of whether they are being kept or sold.
- Failure to absorb enough antibodies from colostrum in the first 24 hours of a calf's life will make the calf more susceptible to disease and death. This is known as Failure of Passive Transfer (FPT).
- Good management practices (the 5 Qs) can limit the chance of FPT.
- Testing can confirm the level of FPT and quality of colostrum management.

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Colostrum: The first milk after calving

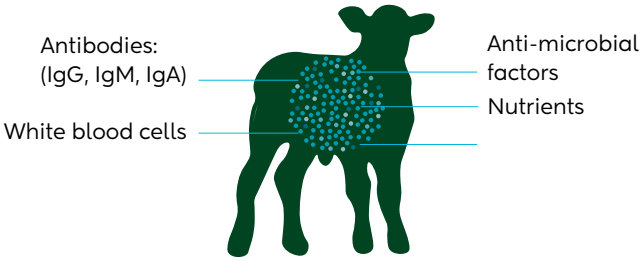
Colostrum, often referred to as 'gold colostrum', is the first milk a cow produces after calving. Unlike in humans, the placenta of the cow keeps the maternal blood supply separate from that of the developing foetus. This means that the calf is born without antibodies in its bloodstream so has no natural immunity. Colostrum provides maternal antibodies for the newborn calf that help it fight disease.

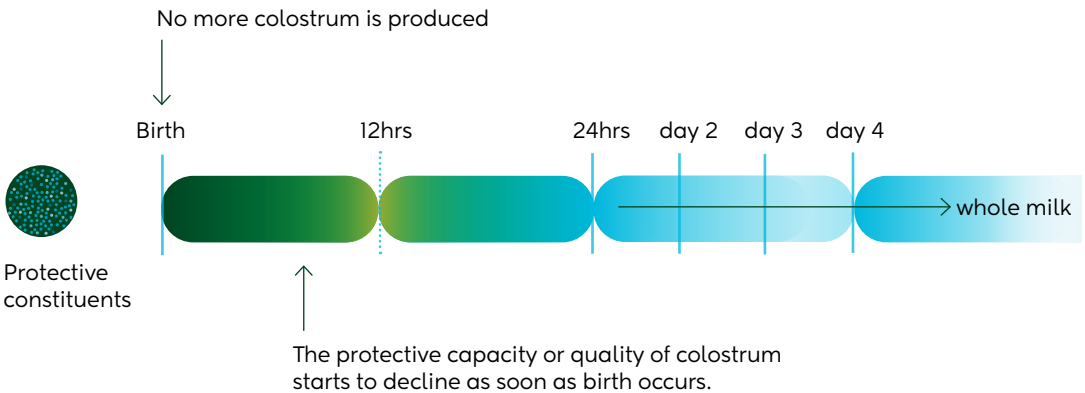
A calf begins to develop its own immune system from four weeks of age, but it takes months to fully develop. Without good quality colostrum, they are highly vulnerable to disease, which could result in illness and ongoing impacts.

All newborn calves need colostrum – including bobby calves.

Colostrum begins forming in the udder about 5 weeks before calving and stops as soon as the cow gives birth. It is most concentrated and of highest quality at the point of calving. Colostrum is a unique mix derived from the cow's udder and blood that work together to provide nutrition, growth factors and immunity for the newborn calf. Many calf rearers refer to it as liquid gold.

Key constituents





Why is colostrum so important?

Providing the correct amount of high-quality colostrum to newborn calves will help ensure:

- less scours and other diseases
- reduced death rates
- better growth rates
- improved lifetime milk production and fertility (in females)

Preventing Colostrum residues

Milk for supply must be free from contaminants including antibiotics, teat sealants, and elevated antibodies (IgG) levels, so the first eight milkings must be excluded from the milk vat. Some milk processors refer to all milk from the first eight milkings as "colostrum", however, only the very first milking after calving is "true colostrum". The remaining seven milkings are commonly referred to as "transition milk". Transition milk is still very nutritious and can be fed to older calves, however quality of colostrum declines significantly after the first milking.

Remember

- No additional colostrum is produced by the cow from the moment she gives birth.
- The protective quality of the cow's colostrum declines after calving, even if the cow is not milked or suckled.
- Colostrum collected straight after birth maintains its protective capacity if stored correctly in the fridge or freezer.

Only use 'first milking' colostrum tested at 22% brix or higher for newborn calves.

Failure of passive transfer of immunity

The only way a newborn calf can receive immunity from the cow is through consuming colostrum. This is referred to as passive transfer of immunity. Failure of Passive Transfer (FPT) means that calves do not have protective levels of antibodies in their blood stream 36–72 hours after birth. There may not be observable differences to calves with FPT , particularly where there is a low disease challenge, but they will have an increased risk of disease and death prior to weaning.

Longer term issues include:

- increased animal health veterinary costs and stress associated with sick calves/heifers
- increased losses in the pre- and post-weaning periods
- decreased rate of growth
- increased average age at first calving
- lower milk production during their early years in the milking herd

*FPT is common. It is estimated that approximately 31% of pre-weaning deaths in the first three weeks of life could be related to this issue. Research on New Zealand farms has shown that **33% of calves experience Failure of Passive Transfer,** but it ranges between 5% and 80% on different farms.*

*Current recommendations state that colostrum containing **less than 50 g/L of IgG antibodies** should only be fed to calves that are **more than 24 hours old**. When colostrum contains **more than 50 g/L IgG**, feeding **10–12% of the calf's bodyweight** as colostrum within **six hours of birth** is likely to provide sufficient passive immunity for most healthy calves.*

Why do calves experience FPT?

- Feeding colostrum with inadequate levels of IgG.
- Feeding insufficient volumes of colostrum.
- Feeding colostrum too late after birth.
- Bacteria contaminating colostrum at collection , during storage or at feeding.

Coliforms (bacteria from faecal material) have the worst effect on immunoglobulin absorption.

Testing for the prevalence of FPT can be done by blood sampling 12 healthy calves (not scouring or dehydrated), between 24 hours and seven days of age, for laboratory analysis of total protein. It is recommended that this is done both at the beginning and at the peak of calving when the prevalence of FPT is typically higher. A total protein value of 52 mg/ml (or above) indicates that successful passive transfer has occurred.

Five Qs of colostrum management

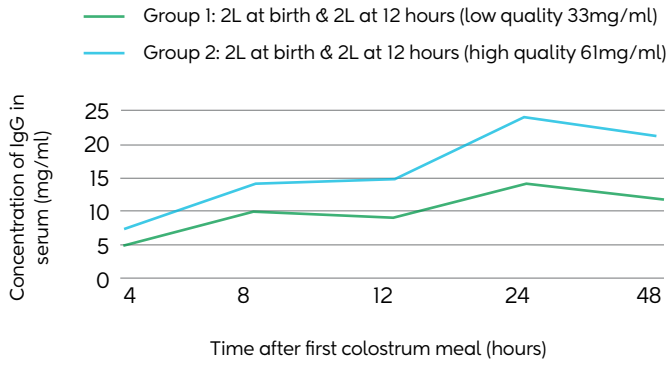
Successful transfer of immunity via colostrum requires close attention to the following factors:

- **Q**uality
- **Q**uickly
- **Q**uantity
- s**Q**ueaky clean
- **Q**uantify

1. Quality

High quality colostrum has a brix test result of 22% or higher or an IgG (antibody) concentration of > 50 mg/ml IgG.

Colostrum with a high IgG concentration is more reliable at transferring immunity to the calf.



These results show the benefits of using high quality colostrum. Calves were fed the same quantities within the same timeframes. Calves fed better quality colostrum had much higher concentration of serum IgG in their blood test results.

Key influences on colostrum quality

Influence	Why this matters
Time since calving (Delay in first milking)	Colostrum quality declines the longer it remains in the udder after calving. Milking the cow as soon as possible should be priority to prevent a significant reduction in antibody levels.

Influence	Why this matters
Vaccination of the dam and general health status	Cows in good health and body condition at calving who have been vaccinated 3–6 weeks before planned start of calving, will often produce good quality colostrum containing specific antibody levels.
Volume of colostrum at first milking	High volumes at first milking (more than 8.5 litres) may indicate poorer quality. Always test colostrum before allocating to newborn calves.
Length of the dry period	Dry periods of less than 5 weeks are likely to reduce colostrum quality.
Age of dam	Older cows generally produce better quality colostrum due to greater disease exposure, though some heifers can also produce high-quality colostrum. Always test before use.
Breed of dam	Jerseys tend to have higher IgG levels due to lower colostrum volume, but colostrum quality should still be tested.
Mastitis / high cell counts in dam	Do not use colostrum that is stringy, flaky, or bloody. Colostrum from cows with high cell counts may still be good quality–test IgG levels before deciding.
Early calvers	Cows that calve earlier than their expected due date generally produce colostrum with lower IgG levels.

Assessing the quality of colostrum

Use a Brix refractometer to check the quality of colostrum rather than by eye. Routinely assess the quality of each colostrum sample collected. Testing individual cows only takes five seconds using a Brix refractometer. You cannot accurately assess colostrum quality visually.

Using a Brix refractometer

Brix refractometers are robust, pocket-sized tools that are well suited for use in the dairy environment. Inexpensive Brix refractometers can be purchased from vet clinics or rural supply stores. Both optical and digital versions are available. The Brix refractometer uses a beam of light to determine the density of the colostrum. The greater the protein level in the sample, the more light is bent from the light path. Values are read as a percentage.

Mix the colostrum sample well before taking a single drop for testing. Results are accurate and repeatable. A digital Brix refractometer does not need a bright light source to read the scale and takes the guess work out of the reading by supplying an exact number.

Tip: If a reading on the scale of an optical Brix refractometer appears fuzzy, try wiping the face of the refractometer clean and then re-apply a smaller drop of colostrum. Alternatively, adjust the focus if possible or choose a point midway between the end and start of the blue fading.

Brix Score (%)	Colostrum Quality	Approx. IgG Concentration	What it Means
22% or higher	Good quality	**> 50 mg/ml IgG**	Suitable for feeding newborn calves
20–21%	Moderate quality	~30–50 mg/ml IgG	Still usable but not ideal for newborns
below 20%	Poor quality	**< 30 mg/ml IgG**	Low antibodies – not recommended for first feed

Do not feed poor quality colostrum to calves during the first 24 hours of life. Newborn calves should be given the highest quality colostrum. Older calves can be given older and lower quality colostrum.

Mixing colostrum from different cows

Mixing colostrum can greatly reduce the quality of colostrum – mixing high quality (high IgG/ml) with low quality colostrum creates a more dilute and lower quality colostrum. If high quality colostrum is harvested and fed to newborn calves, then the quantity required is much less. If mixing is unavoidable, only mix like with like i.e. Brix >22% with Brix >22%. This way the quality will not be affected.

Calves requiring special care

Research has found that calves born in weather extremes are more likely to have difficulty in standing and suckling and so are likely to have reduced IgG intake and absorption. Calves that experience a difficult birth or are born prematurely are also at risk. Identify high risk calves as soon as possible after calving and make sure that they get the highest quality colostrum.

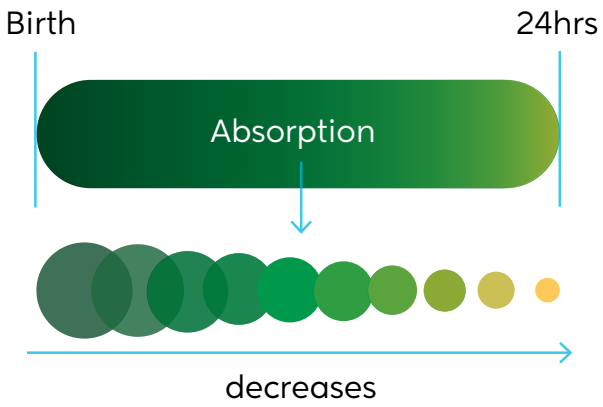
Commercial colostrum replacers

These replacers may be used where good quality maternal colostrum is unavailable, and for management, convenience or disease control. If you need to use a replacement colostrum product, do your research and choose a reputable, high-quality substitute.

2. Quickly

Time is of the essence in the transfer of immunity to the newborn calf. The clock starts ticking as soon as the calf is born because the calf's intestine can only absorb antibodies (IgG) for a short time.

- Straight after birth – the calf's intestine absorbs the large IgG molecules easily.
- 6 hours after birth – the intestine's ability to absorb IgG has decreased by 30–50%.
- Between 24 to 36 hours after birth no more IgG can be absorbed.



Calves should be picked up as soon as possible after birth and fed colostrum to reduce exposure to pathogens that cause diseases like calf scours and Johne's disease. Leaving the calf to suck colostrum from the dam is no guarantee of successful transfer of immunity.

Continuing to feed colostrum to calves beyond the initial 24 hours (after the calf gut 'closes') still has advantages, as the IgG can still bind to pathogens in the gut and help protect the calf from infections. Colostrum and transition milk is also a highly nutritious food for calves.

Poorer quality colostrum (Brix less than 22%) should be reserved for feeding calves over 24 hours of age

3. Quantity

Newborn calves need enough colostrum, as soon as possible, to absorb the antibodies that protect them from disease. As a guide, calves should receive at least 10% of their bodyweight in colostrum within the first 12 hours of life.

For example, calves born weighing between 25kg - 40 kg will need 2.5l – 4l in their first 12 hours, split across at least two feeds. Avoid feeding more than 2–3 litres in one feed and leave at least two hours between feeds.

Knowing the exact amount of colostrum each calf needs depends on a multitude of factors, including the quality of the colostrum (IgG level), how soon after birth it is fed, how clean the colostrum is and the overall health and strength of the calf. Testing colostrum with a Brix refractometer helps remove the guesswork.

Simple feeding guide for a 40kg calf:

If colostrum is good quality (≥ 22% Brix):

- Feed 2 litres as soon as possible after birth
- Feed another 2 litres within the first 12 hours

If colostrum is lower quality (< 22% Brix) or not tested:

- Feed 3 litres as soon as possible after birth
- Feed another 3 litres within the first 12 hours

Extra feed (recommended):

- Give another 2 litres of good quality fresh colostrum in the next 12 hours if available.

Remember: Feeding larger volumes will not overcome poor quality colostrum; the focus should primarily be on ensuring colostrum quality of at least 22% Brix is fed as soon as possible after birth. Although colostrum is essential for immunity, calves also need warm, dry shelter, good nutrition, and clean housing to thrive.

Keeping track of colostrum feeds

It is useful to have a recording system to ensure each calf receives the correct number of feeds of colostrum, such as a white board with ticks i.e. 2 ticks = 2 feeds, or paint marker on calves i.e. 1 stripe/dot = 1 feed

Check the volume

A farm plan should be in place to ensure calves consistently receive the correct volume of colostrum. Ensure the capacity of feeding bottle or tubers is sufficient.

If teat feeding, using a compartment feeder with known volume for each compartment is the most effective way to track the volume fed.

4. sQueaky clean

Excellent hygiene is necessary to maintain colostrum quality and minimise the growth of bacteria. Large numbers of bacteria in collected colostrum may bind to the antibodies and interfere with absorption by the calf. Bacteria present in colostrum and other pathogens may also cause disease in the newborn calf. These issues can be minimised by:

- avoiding direct contamination of colostrum during collection, storage and handling
- preventing any bacteria present from multiplying up to high levels.

Bacterial contamination of colostrum shouldn't exceed 100,000 bacteria per ml, and no more than 10,000 faecal bacteria per ml.

High numbers of bacteria may interfere with IgG absorption across the calf's intestine in the first 24 hours of life. Feeding contaminated colostrum can contribute to FPT from the cow to the calf, putting it at greater risk of disease. The newborn calf's intestine is also very 'leaky' for the first 14 days of life so bacteria can more easily enter the body and cause disease.

Laboratory Testing

A Total Plate Count (TPC) or Total Coliform Count (TCC) can be obtained for fresh or frozen colostrum by submitting samples to a laboratory via your vet practice. It is best to submit samples from a few different batches of colostrum over the calving period. As a guide, if more than 80% of samples come back with TPC exceeding 100,000 cfu/ml or TCC over 10,000 cfu/ml then review the cleanliness of your colostrum collection and storage practices.

How to clean milk feeding equipment:

1. Clean with water hot enough to remove the milk fat deposits where bacteria grow. Adding detergent can help.

2. Brush all surfaces to remove any milk residue. Disinfection can be added at this time. Virkon-S or similar can be used as per label directions. To achieve disinfection the solution needs to be in contact with equipment for at least 5–10 minutes.

3. Rinse container thoroughly using warm water. You can finish with an acid rinse and leave it on to dry.

4. Allow the bottles and buckets to drain and dry – preferably on drying racks. Do not stack buckets inside each other. Do not sit buckets upside down on a concrete/solid floor as residues build up around the rim.

5. Rubber teats should be thoroughly cleaned inside and out following the above protocol. A firm brush will help. Discard teats that are cracked and showing signs of aging. It is good practice to replace teats at least annually (or sooner if required).

Controlling contamination of colostrum

Cow side:

- Wash and dry dirty teats, check for mastitis, and keep everything as clean as possible before collecting colostrum. This helps protect both the cow and the calf from infection and ensures the best quality colostrum.
- Always use lids to prevent contamination
- **Do not use colostrum from cows that are sick** or suspected of being positive for diseases such as Johne's disease.
- Discard colostrum if there is evidence of faecal contamination.

Equipment:

- Collection, storage and feeding equipment must be spotlessly clean and disinfected before use. Use the above protocol as a guide on how to clean equipment.
- Stainless steel buckets are easier to clean. Where possible, look for alternatives to plastic that are easy to keep clean.

5. Quantify

Reviewing colostrum management on farm is important. A colostrum protocol should evaluate colostrum quality and calves' immune status.

- ***Measurement of colostrum quality:*** Colostrum quality is measured by testing its specific gravity using a Brix refractometer. Good quality colostrum has > 50 g/L of IgG antibodies or a Brix measurement of ≥ 22%.

- ***Evaluation of calf immunity through blood testing:*** Blood samples can be taken from calves aged 24 hours to seven days. Serum total protein (STP) is used as an indirect measure of passive transfer, providing an indication of a calf's immune status. This test evaluates the transfer of antibodies from cow to calf through colostrum. Doing this at the beginning and peak of calving will give the best insights into how effective colostrum management is on farm. Speak to your vet for advice around testing. They will provide further guidance if any concerns arise around colostrum management.

Storing colostrum: short term

- Store colostrum in a container with a lid to avoid further contamination.
- If colostrum is not fed immediately then preservatives should be used to reduce bacterial growth. Alternatively, it can be frozen or refrigerated. Refrigeration at 4°C will maintain bacterial quality for up to 48 hours.
- Stored colostrum should be warmed and fed to calves at 35–38°C – place container in a warm water bath (not hot water) or use milk warmers to gently warm colostrum, being careful not to overheat.

Preserving using Potassium Sorbate:

- Potassium sorbate (a preservative commonly used in the food and wine industry) can be added to colostrum immediately after collection to inhibit bacterial growth for at least four days. Refrigeration at 4°C is still essential – if potassium sorbate is added to colostrum which is then left at room temperature, bacteria will quickly multiply. Potassium sorbate is not helpful if colostrum is already heavily contaminated or starting to go off. Vets can provide advice on sourcing, handling and using this product at the correct concentration.

How to make a 50% solution of potassium sorbate

Potassium Sorbate	to	Water (stir thoroughly)
50 grams	to	100 mls
500 grams	to	1 litre
5,000 grams	to	10 litres
10 kg	to	20 litres

How to add a 1% potassium sorbate mix to colostrum

Potassium Sorbate (50% solution)	to	Colostrum
1 ml	to	100 mls
10 mls	to	1 litre
100 mls	to	10 litres
200 mls	to	20 litres
1 litre	to	100 litres

Storing colostrum: long term

- Always test colostrum quality before storing – it is unwise to store poor quality colostrum. Record the Brix reading on the container, along with date of collection.
- Deep freeze excess colostrum as soon as possible to prevent microbial growth.
- Using thin, flat storage bags (e.g. plastic bags laid on trays) rather than plastic containers can help to reduce both freezing and thawing times.
- It is good practice to freeze some good quality colostrum towards the end of calving, ideally from vaccinated cows. This will provide a 'colostrum bank' for calves born at the beginning of the next calving season. Be sure to focus on saving high quality >22% colostrum for newborn calves first.
- Frozen colostrum should be discarded within 12 months of collection. Ensure stored colostrum is labelled with its collection date for future reference.
- Colostrum should be thawed in a lukewarm water bath. Do not use a microwave as this will destroy the antibodies.

Heat treatment and pasteurisation

Heat treatment of colostrum using commercial pasteurisation units on farm is a relatively new approach to improving the cleanliness of colostrum. This practice involves heating colostrum to 60°C for 30 or 60 minutes in a special pasteurising unit. This process differs from traditional milk pasteurisation, which causes damage to the antibodies in colostrum

Although the initial setup can be expensive and it requires additional ongoing work, pasteurisation can deliver significant benefits for colostrum quality. Studies have shown significantly reduced bacterial counts without damage to colostrum IgG, and when fed, resulted in higher IgG levels in calves. It is a valuable method for reducing pathogens that cause calf health problems and disease. Pasteurisation of milk fed to older calves offers similar health benefits.

If using heat treatment or pasteurisation of colostrum, it is recommended to regularly test the bacterial levels of the treated colostrum (by culturing) to ensure the processing system is working correctly.

How to feed colostrum

The two most common ways to feed colostrum are via Oesophageal feeding tube (tubing) and teat feeding (bottle or multi-teat feeder).

Tube feeding

Colostrum can be given to a calf via an oesophageal tube (commonly referred to as 'tubing'). Oesophageal tube feeders ensure rapid ingestion of a known volume of colostrum. This is particularly valuable when the calf is born weak, has had a difficult birth or is unable to stand.

> Care needs to be taken as poor technique may damage the oesophagus and incorrect tube placement can result in colostrum being taken into the lungs causing pneumonia or even death of the calf. Once the correct technique of 'tubing' calves is learnt it can be quickly carried out.

The operator must be trained to ensure correct placement of the tube and to regulate the rate at which the colostrum is administered. Check the volume of the bottle – some only hold a maximum of 1.8 litres when full.

Teat feeding

Some studies suggest that feeding colostrum via a teat may enhance IgG absorption compared to oesophageal tube feeding, however other research indicates that the method of feeding does not significantly affect passive transfer. The importance lies with making sure that calves receive a sufficient volume of high-quality colostrum.

In a newborn ruminant, **tubed colostrum does not enter the true stomach (abomasum)** unless the **oesophageal groove reflex** is triggered. When tubing, that reflex is bypassed so the colostrum is deposited into the rumen/reticulum. This can delay the absorption of the colostrum. If fed good quality colostrum in the first 12 hours, this slightly slower absorption is of little consequence, but if colostrum intake has been delayed, it may be beneficial to feed colostrum via a teat.

If for some reason a calf has not received colostrum in the first 12 hours of life it may be better to teat feed it

Summary of recommendations

Remember the 5 Qs:

1. Quality – Colostrum should be harvested as soon as possible after a cow has calved. Test colostrum quality. Use a Brix refractometer to assess the antibody concentration in the colostrum before you feed, store, or discard it.

2. Quickly – Feed calves as soon as you can – remember the calf can only absorb antibodies for a short time after birth.

3. Quantity – feed calves at least 10% of their body weight in colostrum. Use the Brix reading to adjust the volume – if in doubt give more rather than less.

4. sQueaky clean – Make sure colostrum is collected hygienically into clean containers. If storing colostrum, preserve with potassium sorbate, refrigerate or freeze quickly.

5. Quantify - Review colostrum management on farm by establishing a colostrum protocol. Work with a veterinarian to carry out testing to evaluate colostrum quality and calf immune status.

Feed newborn calves with the highest quality colostrum available – as soon as possible after birth, ideally 22% or higher on the Brix refractometer.

03

Feeding fundamentals

A healthy start and a productive future

- Feed calves according to their body weight for optimal growth.
- Feed whole milk or high-quality milk replacers to support growth and digestion.
- Provide fresh clean water from birth.
- Introduce small quantities of grain-based feed from day one to support rumen development.
- Offer small amounts of good quality fibre from week one to support rumen development and function
- Monitor growth rates regularly – early growth affects age at first calving and first-lactation milk yield.

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Healthy now for a productive future

The aim of any calf rearing system is to ensure that all calves are healthy and that replacement calves are productive over the course of their lives in the herd.

The effect of good nutrition provided at the start of a calf's life has a big impact in terms of:

- growth rate and weaning age
- general health and wellbeing
- heifer liveweight targets and age at puberty
- fertility and mating
- production levels
- longevity in the herd.

Providing calves with good quality colostrum straight after birth gets them off to a great start. The next challenge is to help the animal make a smooth transition from being a 'drinker' to an 'eater'. Initially, milk provides the sole source of energy for the newborn calf. As the calf ages, it obtains more of its nutrients from solid feed. Fresh, clean water is essential throughout an animal's life and must be provided to all calves from day one.

Good Nutrition

Provide consistent and correct nutrition to all calves.

The benefits include:
Healthier calves
Steady rumen development
Better growth rates
Less setback at weaning
Earlier calving ages
Improved milk production in future lactations

Healthy calf development depends on correct nutrition.

Managing liquid feeding

Feeding systems should be based on what works for the individual farm system and the fundamentals of good calf nutrition. There is no single best way to rear calves, but recommendations have evolved based on farmer experience and as new research has become available.

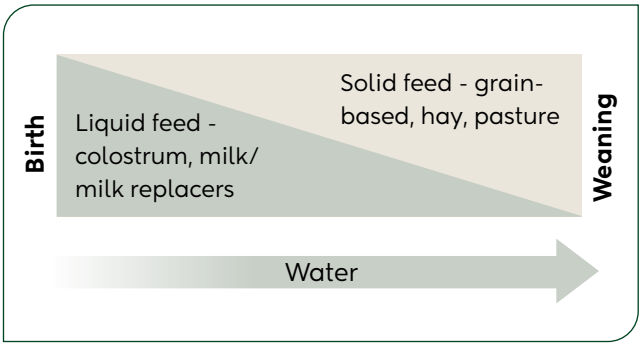
Milk and milk replacer

The abundance of surplus milk in New Zealand dairy systems means that on many farms the use of milk replacers may be uneconomical.

Feeding transition milk supports the calf's developing gastrointestinal tract by providing growth factors, and bioactive compounds that stimulate the development of the intestinal epithelium. These non-nutritive factors aren't found in milk replacers.

When surplus milk is not readily available, or milk prices are high, calves can be reared economically on high quality, reputable milk replacers.

Milk replacers may be useful to prevent the spread of infection from the herd and for the control of diseases such as Johne's disease.



Consistency is the key to success with milk replacers. Always read the label and mix according to the manufacturer's directions. The digestive system of the calf takes some time to adapt to a new diet, so avoid sudden changes in products or mixing rates. Automated calf feeding systems can achieve good results with milk replacers, as the preparation and mixing is consistent.

Milk Replacer

Advantages

- Consistency of product
- Can be stored and handled more easily than fresh milk
- A potential cost benefit over saleable whole milk
- Can be a source of milk for rearing additional calves
- Less risk of disease transfer from cow to calf
- Well suited to automated calf feeding systems

Disadvantages

- Cost compared to feeding surplus / transition milk
- Labour and infrastructure required to mix
- Space and facilities required for dry storage
- Risk of spoilage by rodents
- Potential supply issues due to high seasonal demand

How to Calculate the Relative Cost of Vat Milk and Milk Replacer

- The relative value changes each year
- Milk replacer quality does vary so this comparison is only good for high quality milk replacers that can achieve similar growth rates to whole milk.

Price, Composition and Mixing Rates			Calculation Steps	Value
A	Milk payout ($/kg MS)	**9.00**	**A x B**	**Value of milk (cents/litre)** **76.50**
B	Milk solids (%)	**8.50**		
C	CMR price ($/bag excl. GST)	**95.00**	**C ÷ D x E ÷ 10**	**Value of CMR (cents/litre)** **71.25**
D	Bag size (kg)	**20.00**		
E	Mixing rate (g/l)	**150**		

This simple formula doesn't include premiums for milk supplied on the shoulders of the season, or any incentives milk processors may offer.

Choosing a milk replacer

Calf milk replacers can be used as either a total replacement for fresh milk or as an additive to fresh milk, producing a liquid feed higher in nutritional value, often referred to as 'fortified milk'.

When comparing calf milk replacers, make sure that the product contains adequate protein and fat to meet your calf rearing objectives.

Protein

When milk replacer containing casein protein is digested in the calf's abomasum it forms a clot, much like whole milk, making these products suitable for young calves. Whey based products are also available. These do not form a clot and are not suitable for newborn calves. Some of the protein in the milk replacer may come from plant sources such as wheat and soy. Newborn calves find milk proteins much easier to digest than proteins from plants. Choose reputable products with proven results when feeding young calves as the protein percentage of milk replacers can vary significantly.

Newborn calves require 22-25% protein (on a dry matter basis) to support sufficient growth and development. Calves being reared on an ad-lib or high milk feeding regime require more protein to support more rapid growth, so will benefit from milk replacer with a protein percentage of at least 25% on a dry matter basis.

Fat

Fat content of milk replacer commonly ranges from 18–22% on a dry matter basis, providing less dietary fat compared to whole cows' milk. Higher fat products may be valuable for rapidly growing calves on ad-lib or high milk feeding regimes. Under very cold conditions, calves also benefit from the extra energy supplied by a higher fat diet.

No curd

Images supplied by NZAGBIZ

Good curd

Feeding Frequency and Volume

How much and how often calves are fed milk are closely linked - total daily volume only delivers its full benefit when spread across enough feeds for adequate digestion. Calves consuming at least 20% of their bodyweight in milk each day, split across a minimum of two feeds, are more likely to achieve higher average daily growth rates. Research shows that higher early growth is associated with improved milk production in the first lactation. This level of feeding during the first few weeks provides the energy calves need to grow, play, and thrive.

Milk Feeding Volume

Traditionally, two different approaches have been taken:

- Feeding milk at 20% of body weight, which more closely mimics the milk consumption of a calf on a cow and ensures good daily growth rates and wellbeing outcomes.
- Feeding milk at 10% of body weight, which aims to achieve rapid rumen development and early intake of solid feed but achieves lower average daily weight gains and calves may lack energy and experience hunger.

Feeding 20% of body weight

A growing body of evidence indicates that lifetime productivity gains can be made by feeding calves greater volumes of milk. Well grown heifers are generally more productive in their first and subsequent lactations. It has been estimated that 22% of the variation in first lactation milk yield can be traced back to the average daily gain of heifers. Birth to 12 weeks is an ideal time to increase average daily body weight gain and increase the chances of growing greater milk-producing tissue earlier in life.

Recommended feeding volume based on 20% birthweight (heifers)

Calf breed	Typical birthweight (kg)	Milk volume (L/calf/day)
Friesian	35	7 L
Crossbred	32	6.5 L
Jersey	28	6L

Calves fed 20% of their body weight from day one achieve significantly higher average daily weight gains. Growth rates above 1.0kg/day can be achieved due to the high efficiency of young calves in converting milk nutrients into body tissue. Higher volume milk feeding may also reduce calf disease in the early weeks of life. However, you won't see this benefit if milk hygiene is poor or the calf rearing environment is suboptimal.

Several methods can be used to increase milk intake in calves including:

- feeding more milk volume per feed
- increasing the number of feeds daily
- increasing solid concentration of whole milk by addition of milk powder (fortification).

Calves will eat less solid feed, so rumen development may be slower until solid feed intake increases. This is not an issue as solid feed intake increases from around 3 weeks (when calves are able to digest energy from solid feed) and as milk volume is reduced.

Restricted feeding - 10% of body weight

This approach was common in the 1990s with the objective of improving the profitability of rearing calves for beef; milk production later in life wasn't a factor. The newborn calf receives closer to 10% bodyweight in milk daily (approximately 4 litres per day) throughout the pre-weaning period. Research shows that young calves cannot compensate for low milk intake through solid feed consumption alone, which can result in energy deficits, reduced growth and increased vulnerability to disease. It takes between 3–4 weeks before substantial intake, digestion and absorption of solid feed energy can regularly occur. This means that calves may lack energy, grow more slowly and experience hunger. Apart from the animal welfare considerations, this early check in growth rate can delay maturity and fertility, and reduce the overall efficiency of the heifer rearing system.

Feeding systems

Feeding systems impact calf health, growth rates, and labour requirements.

Understanding the advantages and considerations of each system is important in selecting the approach that best suits the farm operation.

Twice daily

- Twice daily feeding allows calves to consume and digest adequate amounts of milk to ensures good daily growth rates and wellbeing outcomes are achieved.
- Feeding twice daily also allows calves to be closely observed. Reluctance to drink or other signs of illness can be detected quickly and action taken.

Ad-libitum (ad lib) feeding

- Ad-libitum (ad-lib) feeding provides calves with constant access to milk or milk replacer, typically using large drums fitted with multiple teats for groups of up to 20 calves.
- This method reduces labour, lowers manual feeding frequency, and growth rates can be significantly higher compared to other feeding systems.
- Calves are likely to consume higher volumes of milk compared to twice daily feeding.

Automated systems

- Automated systems provide adlib or set amounts of milk at intervals chosen by the calf. This mimics the natural feeding behaviour of a calf on a cow.
- These systems can significantly reduce labour and growth rates can be much higher when set up for ad-libitum feeding.
- Properly managed, automated systems have been found to reduce nutritional or non-infectious scours and the need for additional labour.

OAD

Once daily feeding should not be implemented until calves are at least 14 days of age.

Feeding OAD before 14 days does not fully meet the nutritional or behavioural needs of calves.

Calves are more vulnerable in their first two weeks of life. Feeding OAD during this time may increase the risk of scours and infection leading to illness.

Feed calves fresh, clean milk

Calves should be reared on fresh, clean milk. Avoid feeding milk from mastitis cows or antibiotic contaminated milk. Milk destined for calves should be collected as cleanly as possible, with collection and feeding equipment kept rigorously clean and well maintained. Any surplus/transition milk should be used quickly and kept chilled or preserved to minimise the growth of bacteria. Milk that is contaminated with organic material and faeces is a potential disease source for calves. Similarly, water used to mix with CMR should be from a clean, safe source.

Milk containing antibiotics should never be fed to sale or bobby calves.

Milk from sick cows may contain pathogens or antibiotic residues. Feeding milk containing antibiotics ("red milk") may also lead to increased risk of antimicrobial resistance. Avoid using mastitis milk, but if necessary, only feed it to older calves. Calves under 14 days of age are more vulnerable to infections due to their immature immune system. Never feed milk from cows treated with antibiotics or other veterinary medicines to sale or bobby calves. Rear any calves destined for sale in an area separate from heifer replacement calves, using clearly marked, separate feeding equipment that is never used for contaminated waste milk. Milk from cows with confirmed bacterial infections such as Salmonellosis or Johne's disease should not be fed to calves under any circumstances.

Milk pasteurisation

Small pasteurising units are commercially available, making it practical for some small herds to treat milk on farm before feeding it to calves. Pasteurisation significantly reduces the number of pathogens in milk and has been shown to reduce disease rates in milk fed calves.

Milk temperature

Feeding warm milk is recommended whenever practical. Calves must warm milk to around 38°C (body temperature) before it can clot and be digested. When calves are fed cold milk, they must use body energy to heat it, diverting energy away from growth and development. This energy cost increases with colder milk temperatures and newborn calves are highly sensitive to cold temperatures. This sensitivity decreases from three weeks of age.

Some farmers use cold milk in ad-lib feeding systems to limit bacterial growth or due to practical limitations. Calves typically compensate for the energy cost of cold milk by consuming more milk throughout the day.

Calves respond best to consistent milk temperature so it is important to avoid feeding warm milk one day and cold the next.

Calf digestion

Understanding the basics about how a calf digests milk, water, grain-based feed, fibre and pasture allows you to work with a calf's digestive system to achieve successful weaning and future production.

Milk

When a young calf sucks milk from a teat, it bypasses the rumen and enters the abomasum directly. Once the milk enters the abomasum, it forms a clot and nutrients are slowly released into the calf's blood stream. After a while this clot moves into the intestine where it is digested further.

Water

The pathway that water takes is different from milk. When a calf drinks water from a trough, it is mainly channelled towards the rumen. Fresh water, as well as the water present in milk or milk replacer, is essential for a calf's health. Diluting milk and milk replacer impacts the clotting process leading to digestive issues, so water needs to be provided separately. Water also plays a critical role in the healthy function and development of the rumen.

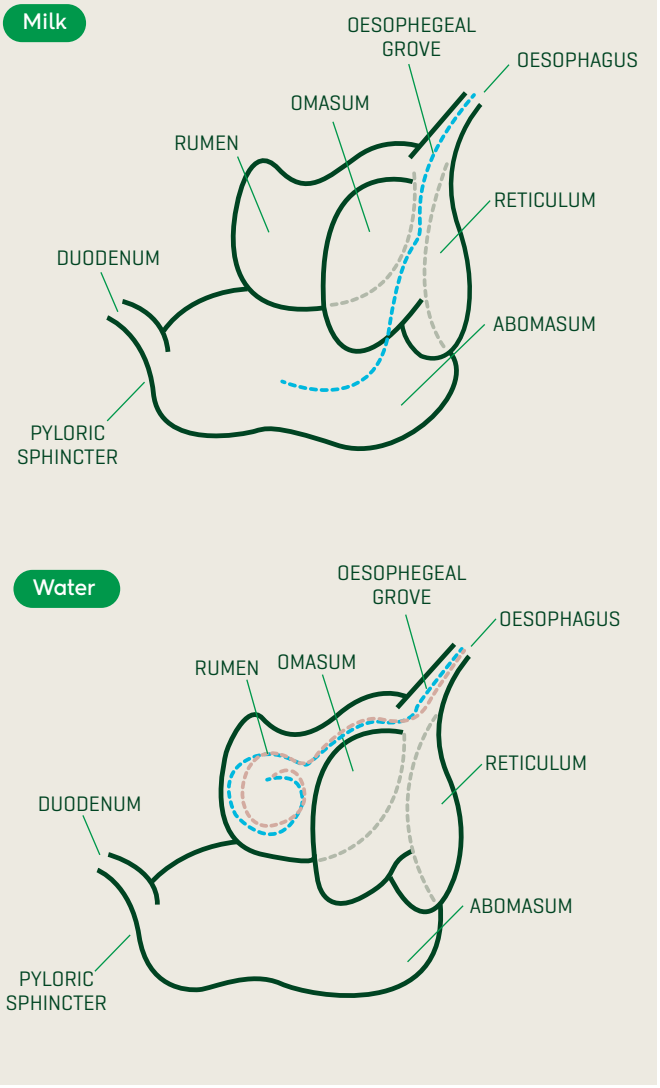
Fresh, clean water is essential

All calves, including bobby calves must be provided fresh, clean water from birth for normal body function, rumen development, and to prevent dehydration during scours. Never rely on milk or milk replacer alone to meet water requirements.

Water also encourages solid feed consumption. In one study calves without water ate 31% less solid feed and gained 38% less weight over a four week period.

Ensure water is provided separately in clean troughs, accessible at all times.

The absorption of milk and water



Rumen development and rumen function

It is important to distinguish between rumen development and rumen function. The ability to wean a calf is dependent on both rumen development and healthy rumen function working together.

Rumen development refers to the physical growth of rumen structures, particularly the papillae that absorb nutrients. This development is accelerated by grain and grain-based feeds, which ferment to produce the volatile fatty acids needed for papillae growth. These volatile fatty acids are also produced from digestion of fibre e.g. hay, but at a lower rate; therefore, rumen develop will still occur for calves reared without meal, but it will take longer.

Rumen function refers to maintaining a healthy rumen environment with proper pH balance and microbial activity. Fibre in the diet is essential for healthy rumen function - it promotes rumination and helps prevent digestive upsets like acidosis.

While earlier thinking emphasised fibre for rumen development, research shows that excessive fibre can reduce growth rates. The key is providing enough grain-based feed to drive structural development while including sufficient fibre to maintain healthy function. Calves need both for successful weaning and consistent growth.

The digestion of grain-based feed

The difference between a poorly developed rumen and one that is well developed is the size and numbers of papillae on the rumen wall. Papillae are small projections that grow on the wall of the rumen that absorb nutrients. The two key things to remember about papillae are:

- the more papillae there are, the greater the surface area available to absorb nutrients.
- the presence of certain chemicals in the rumen promotes the development of papillae.

The two principle chemicals that contribute to papillae development are propionate and butyrate – these are both volatile fatty acids (VFAs) and are the major breakdown products of grain-based feed. As these photographs show, early introduction of grain-based feed stimulates the growth and development of papillae. As calves get older, they can digest additional energy from grain-based feed. This supplements the total energy available to them, alongside adequate amounts of milk.

The digestion of grain-based feed

Diet: milk only - 6 weeks

Diet: milk and hay - 6 weeks

Diet: milk and grain - 6 weeks

The role of fibre

The role of roughage or fibre is to promote the growth of the muscular layer of the rumen and to maintain the health of the rumen lining.

- Papillae can become too long and clumped if exposed only to high levels of the volatile fatty acids contained in grain.
- Dietary fibre provides gentle abrasion in the rumen, helping keep papillae healthy and functioning well.

Choose a source of fibre that is different from the bedding. If straw is used as bedding it should not be used as a feed supplement. Calves may eat contaminated bedding and consume disease causing organisms.

From liquid to solid feed

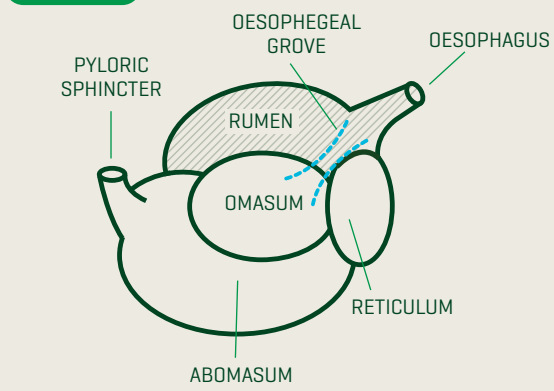
As a calf makes the transition from absorbing nutrients from milk to solid feed, its digestive system adapts and changes. These diagrams illustrate the changes that occur.

- The digestive system of a calf is designed to process milk, so the abomasum is large in comparison to other parts. At birth the abomasum makes up approximately two thirds of the total volume of the four stomachs of the calf.
- The rumen is designed to handle solid feed, grass and roughage.

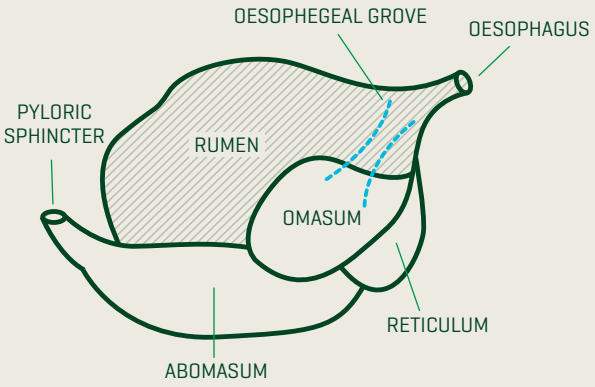
The rumen grows as the calf eats more solid feed. At weaning the rumen should ideally make up two thirds of the total volume of the stomachs.

The developing rumen

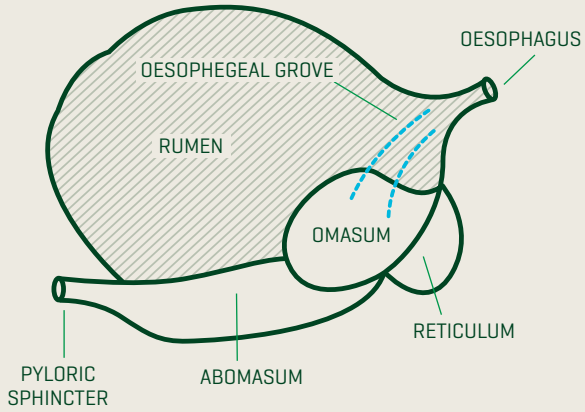
First week



Three to four months



Maturity



Introducing solid feed

To promote steady growth and maintain health calf feed needs to be formulated so it contains:

- energy to support maintenance and growth
- protein for all basic metabolic processes and growth
- fibre for rumen function and to ensure cud chewing
- vitamins for metabolic processes, bone formation and disease resistance
- minerals for carbohydrate metabolism, cartilage and muscle function.

Introduction of fibre

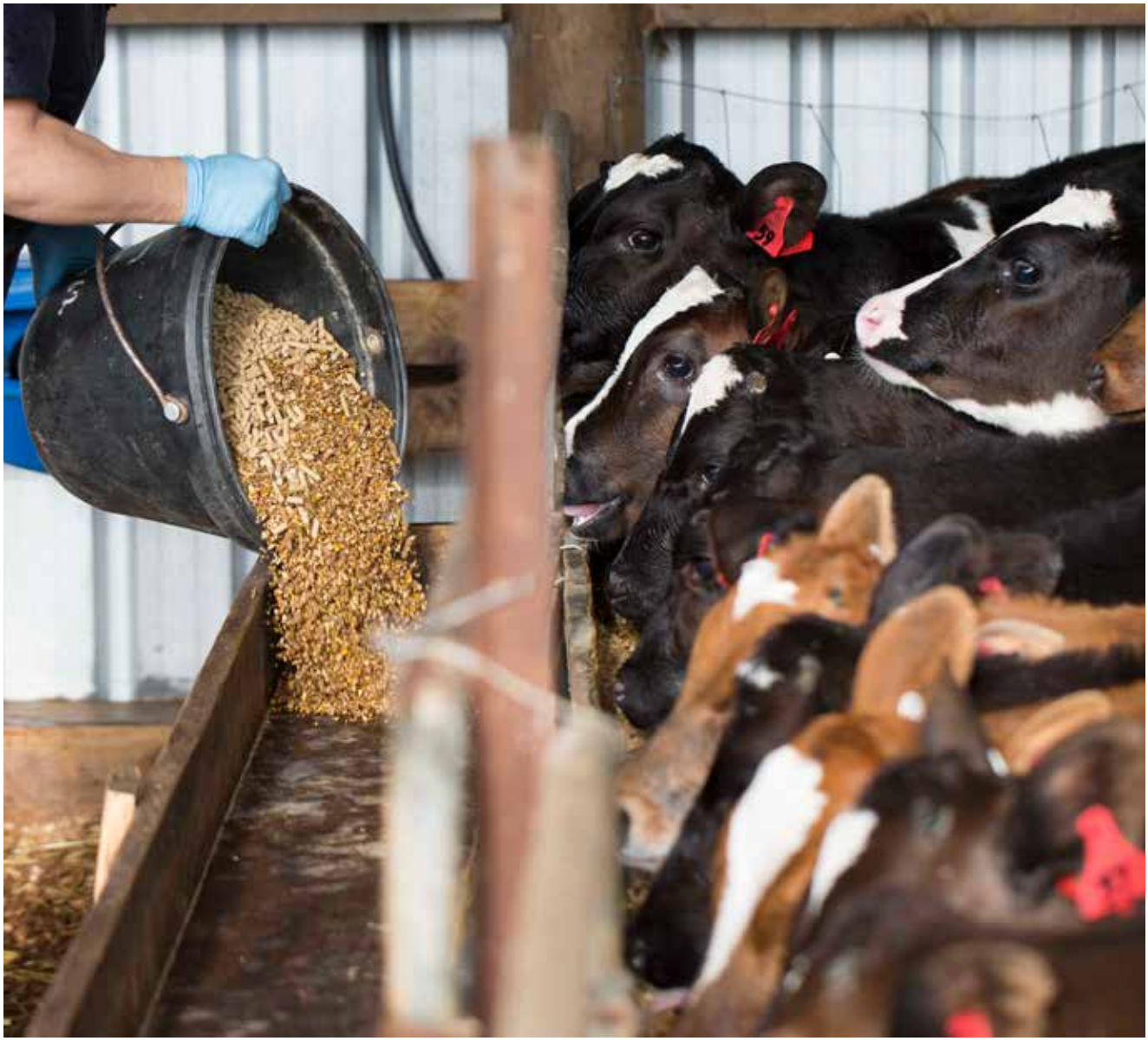
Small amounts of fibre, a handful per calf per day, can be introduced within the first week of a calf's life and provides environmental enrichment in the calf pen. The total amount of fibre supplied, such as hay or other forages, should not contribute more than 10% of the diet during the pre-weaning period.

Large amounts of fibre introduced too early in a calf's life can reduce average daily weight gain.

Feeds high in fibre create a fill effect, reducing overall daily energy intake. Lucerne is an example of a feed high in fibre, very palatable, and attractive to calves, but if fed ad lib may limit the consumption of milk and/grain-based feed.

Feeding pasture

If calves have access to grass, they will normally start to nibble on it from a young age. While this is not a problem, it is important to understand that young calves rely on milk as their main source of nutrients. They cannot digest adequate amounts of energy from pasture until their rumen has fully developed.



Energy, protein and additives

If you are purchasing high energy feeds such as grains, meal or pellets, an awareness of its composition is important to ensure that what you are paying for is 'fit for purpose'.

Consider the following when selecting a solid feed:

Energy	• Supplements for calves from birth to weaning should have adequate energy supplied from a grain base. • Where possible aim for values of 13–14 MJ ME/kg dry matter. • Grain based products produce propionate and butyrate – the breakdown chemicals that encourage the growth of rumen papillae.
Protein	• Grain-based feeds generally range from 16-20% crude protein (CP) on a dry matter basis. Select protein percentage based on the age and development of your calves and your overall feeding system. • Protein levels beyond 22% may be of little additional benefit for the extra cost.
Additives	• Some grain-based feeds contain additives such as monensin, which aid rumen function and feed conversion and may promote optimal growth rates however, they are not essential. • The addition of coccidiostats may be of value where coccidiosis is considered a risk.
Vitamin premixes	• Prior to the development of the rumen, calves cannot manufacture any of the B group of vitamins and so addition of these may be of some benefit.
Probiotics	• Farmers should confirm there is a scientific benefit prior to using any commercially supplied probiotic product. The specific strain of probiotic has a large impact on effectiveness and each product varies.

Recommendations for feeding fibre

Fibre content	• Early calf rations should aim for adequate fibre content but not at the cost of energy. • Aim for no more than 10% hay or roughage in the pre weaning ration. • Neutral detergent fibre (NDF) is the fibre part of feed that creates the feeling of being full. Its value reflects the physical fibre level of a feed – the goal is to have NDF levels in pre weaning calf rations of between 15–25%.
Fibre length	• Take care with pellets – finely ground particles can cause digestive upsets and promote excessive thickening of the lining of the rumen if fed alone. This type of pellet must be accompanied by a suitable source of fibre. • Calf meals and muesli usually contain fibre of a sufficient length to promote healthy rumen function. • Optimum fibre length is 1–2cm. • Chopped hay is a source of fibre that can be added to pellets and other calf feeds like meal and muesli as required.

Monitoring intake and growth

It is important to regularly monitor calves to make sure that they are consuming enough milk and supplements and are growing as expected.

Feed intake

Monitoring feed intake is a valuable tool for assessing the health of calves – decreased intake can indicate problems:

- Sick calves will often show evidence of decreased appetite early in the disease process.
- Early attention to calf illness can reduce its potential impact.

Solid feed intake in healthy calves can be influenced by the amount of milk/milk replacer being consumed, the nature of the feed (coarse meals are preferred), size of calf, and water availability/intake. It is important to build up to an intake of around 1kg of solid feed per day before removing milk entirely. Studies have shown that calf solid feed intake increases rapidly from weeks 3 to 6 and then increases more slowly.

Growth weights

Monitoring calf weight is essential for ensuring optimal growth rates during the pre-weaning period. Increasing evidence shows that early-life factors, particularly pre-weaning growth rate, are important in determining the future productivity of heifers when they enter the milking herd, including their milk production, fertility, and longevity. A representative sample of the mob can be measured to save labour.

Regular weighing helps to:

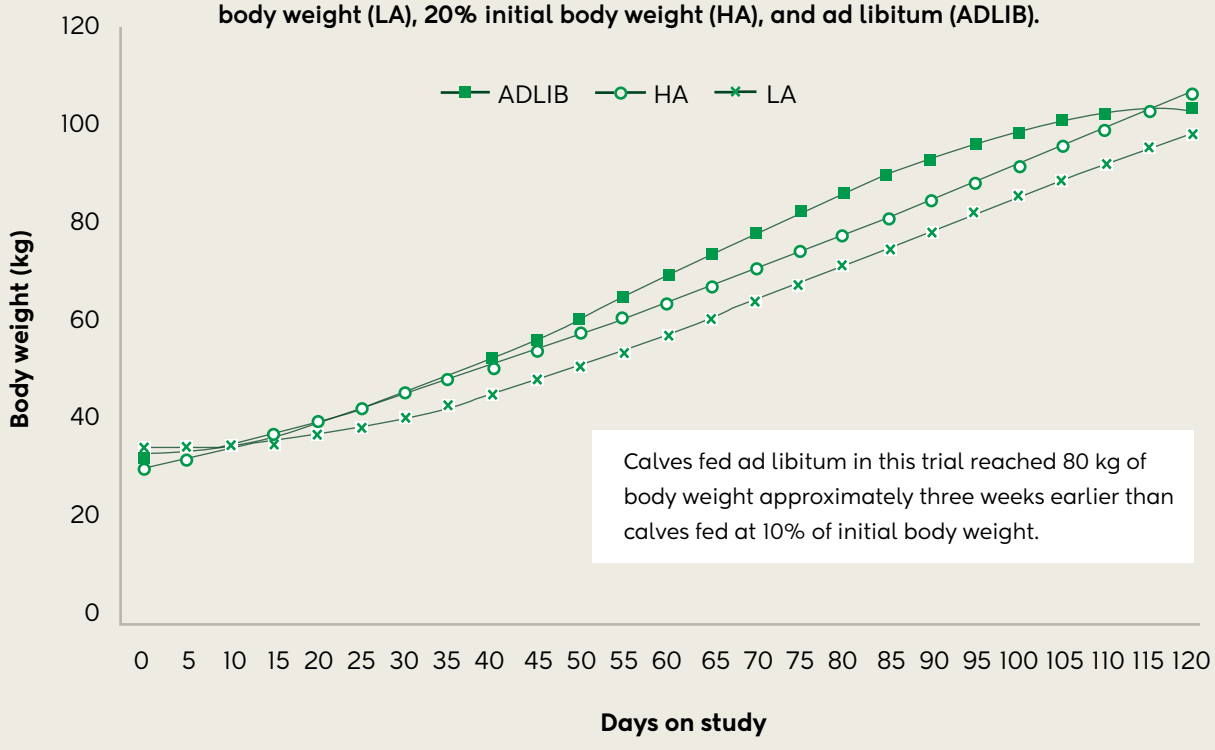
- detect health or nutritional issues early
- assess whether the feeding program is delivering target growth rates
- help determine when calves are ready for weaning
- identify poor performers that need additional attention
- make informed decisions about grouping and management

Growth rates should reflect the goals of the calf rearing system and the intended weaning date. A crossbred heifer with an average birthweight of 32kg and a target weaning weight of 80kg needs to grow 48kg in this period.

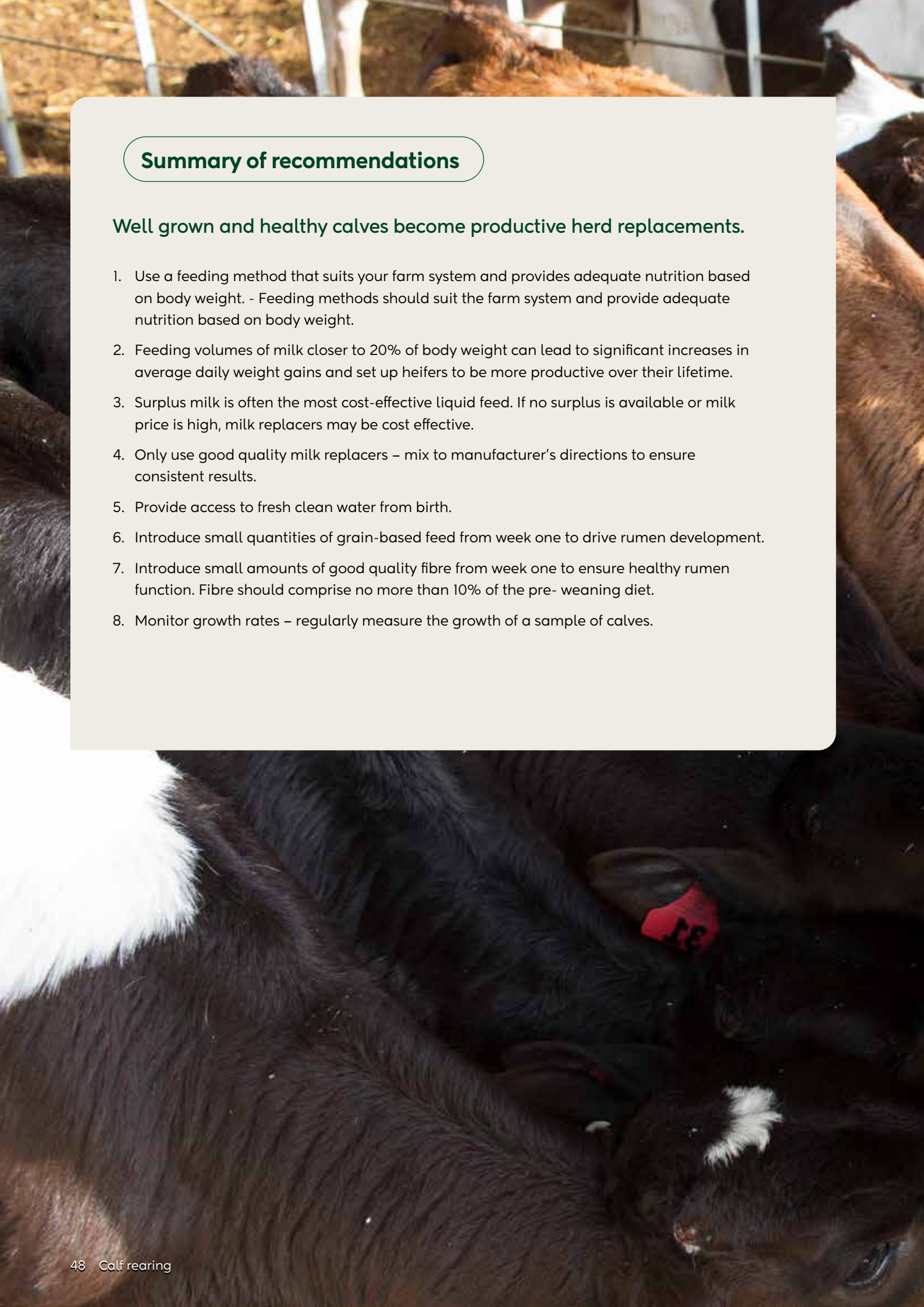
This will take eight weeks at 850g/day or 12 weeks at 570g/day.

Monitoring calves' feed intake and growth will help you adjust your system in response to seasonal variations such as weather, health challenges and increased feed requirements.

Body weight from day 0-120 of heifer calves fed milk replacer at 10% initial body weight (LA), 20% initial body weight (HA), and ad libitum (ADLIB).



Adapted from Groenendijk, M. (2019). The growth and development of dairy heifers fed a low, high and ad libitum allocation of milk replacer.



Summary of recommendations

Well grown and healthy calves become productive herd replacements.

1. Use a feeding method that suits your farm system and provides adequate nutrition based on body weight. - Feeding methods should suit the farm system and provide adequate nutrition based on body weight.
2. Feeding volumes of milk closer to 20% of body weight can lead to significant increases in average daily weight gains and set up heifers to be more productive over their lifetime.
3. Surplus milk is often the most cost-effective liquid feed. If no surplus is available or milk price is high, milk replacers may be cost effective.
4. Only use good quality milk replacers – mix to manufacturer's directions to ensure consistent results.
5. Provide access to fresh clean water from birth.
6. Introduce small quantities of grain-based feed from week one to drive rumen development.
7. Introduce small amounts of good quality fibre from week one to ensure healthy rumen function. Fibre should comprise no more than 10% of the pre- weaning diet.
8. Monitor growth rates – regularly measure the growth of a sample of calves.

04

Weaning management

Prepare calves well for weaning

- Ensure calves reach solid feed consumption targets before weaning
- Use solid feed intake and growth rates to determine the best time to wean
- Withdraw milk gradually
- Monitor calves closely post weaning
- Continue to provide heifers with good nutrition post weaning
- Closely monitor the health of calves pre and post weaning

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Importance of successful weaning

As mentioned in the feeding fundamentals chapter, there is a growing body of evidence that increased average daily weight gains in young calves increases milk yield at the first lactation and improves lifetime productivity and reproductive performance. Maintaining average daily weight gains above 0.5kg, combined with good weaning practices, can have significant positive impacts on heifer rearing outcomes.

Increasing the growth rate of a heifer between mating and first calving from 0.5 kg/day to 0.8 kg/day will result in an increase in the likelihood of insemination and the likelihood of conception in the first mating period following calving. Weaning plays a critical role in setting up replacement heifers for a productive future.

Doing a good job of rearing calves from birth to weaning and focusing on heifer growth rates from weaning to mating, will help achieve optimal liveweight targets for heifers.

Challenges of Weaning

Weaning is a challenging time for a calf for two key reasons:

1. The primary source of nutrients moves from liquid to solids.

2. Exposure to pathogens increases as the calf enters a new environment.

By the time weaning occurs, the development of the calf's rumen should be sufficient to permit good growth from a non-milk-based diet. This solid nutritional status is critical as change often induces stress. Stressors may include:

- changes in housing
- competition from other calves
- husbandry practices.

Good weaning practice has positive impacts on all aspects of calf welfare. This includes health and function, alongside a calf's affective state and natural state.

Affective state

– relaxed, calm and satisfied

Natural state (behaviour)

– lying and resting, grooming, playing, sucking

Health and function

– disease free, growing well

The health and welfare of the calf is challenged at weaning and requires careful management.

Weaning will be more successful if calves are exposed to only one stressor at a time, so weaning should not coincide with any other stressful event. Calves handle multiple, small periods of stress better than one big stressful event.

Good management of the weaning process ensures the ongoing health and welfare of calves. The benefits include:

- smooth transitions for calves
- reduced parasite and other disease problems
- improved growth rates and economic return from replacement heifers.

Approaches to Weaning

Successful weaning is about optimising pre-weaning milk intake (i.e. digestible energy) and post-weaning intake of solid feed.

Establishing a feeding strategy that enables a gradual and consistent transition from milk to a solid diet is crucial for maintaining steady growth and calf wellbeing, and ensuring the success of heifer-rearing programmes.

Gradual Weaning – Recommended

Gradual reduction of milk over several weeks makes for a smoother transition by minimising stress on calves and reducing disruption to growth.
Gradual weaning ensures there is sufficient time to develop solid feed intake capacity, stimulate rumen development, and maintain pre-weaning growth rates.
Gradual weaning requires more attention to detail and monitoring over a longer period but is the least stressful method for calves and produces the best post-weaning growth outcomes.

Abrupt Weaning – Use with Caution

Only use abrupt weaning if necessary and if rumen function is optimal. A calf must be eating at least 1 kg of solid feed daily.
Not suitable for calves being fed high milk volumes as they will not have sufficient time to increase solid feed intake and reach optimal rumen development.
More stressful and more likely to cause post-weaning weight loss

Indicators to support weaning decisions

The best time to begin weaning will depend on the milk feeding system but there are some important factors to consider. Weaning should take place when:

- adequate rumen development has occurred
- weight for age targets based on breed have been met
- calves are in good health and condition.

Adequate rumen development

The most critical factor in successful weaning is the calf's degree of rumen development. The rumen should be sufficiently developed to provide all the calf's nutritional requirements from a solid diet.

A minimum consumption of approximately 1kg of solid feed per day is generally accepted as appropriate, and calves should demonstrate this level of consumption over at least three consecutive days.

One of the best indicators for weaning is adequate intake of solid feeds.

It is now known that development of the rumen is driven by chemical stimulus, with physical stimulus playing a supporting role.

Chemical stimulus

- Volatile fatty acids from the breakdown of grain drive rumen development by encouraging the growth of small finger-like projections on the wall called papillae.
- Papillae allow nutrients to be absorbed – more papillae mean more surface area to absorb nutrients.
- Early introduction of grain or grain-based feeds stimulate rumen papillae development.

Physical stimulus

- Fibre (e.g. hay) is still important as it has a physical effect on the muscular layer of the rumen wall.
- Rumen papillae often become long or clumped when exposed to high levels of grain feeding without any fibre. Fibre found in forages helps groom the papillae via an abrasive type of effect.

The role of water

- Water supports solid feed intake, rumen development and improved growth rates.
- Water intake helps hydrate dry feed, facilitates the production of volatile fatty acids, and promotes rumen papillae development.
- It is important that calves have continued access to water when they move from calf housing into paddocks.

Timing

The timing of when gradual weaning commences matters. Beginning the weaning transition too early, before a calf has established appropriate solid feed intake, can result in reduced weight gains during the weaning period. Aim to start the gradual step-down at an age when the calf is already consuming some solid feed.

Calves that have not reached weaning weight or aren't consuming enough meal should be fed milk for a longer period before being completely weaned.

Weaning Age

Early weaning has some short-term economic advantages, such as reduced labour and housing requirements and reduced milk costs. However, early weaning often results in reduced growth rates of calves, and the early cost-savings are likely to be offset by reductions in lifetime productivity.

Weaning Age	Note
6–7 weeks	Generally not recommended for replacement heifers - only wean at this age if necessary. Calves can have reduced weight gains, and in some cases weight loss, due to insufficient solid feed intake to compensate for removed milk.
8-12 weeks	A common weaning age in seasonal calving herds rearing replacement heifers.
12 + weeks	Can be cost effective if surplus milk is available.

Weaning weight

Weaning weight can be used alongside assessment of rumen development to decide on weaning readiness.

No specific weaning weight has been defined by research, but commonly accepted weights used for weaning heifers are 70kg for Jerseys, 80kg for Crossbreds, and 90kg for Friesians. These weaning target weights are based on 2.5–3 times the calf's average birth weight, and at least 17.5% of expected mature weight based on their genetics (breeding value for liveweight). Refer to the InCalf Book on the DairyNZ website for further information.

Tips to reduce weaning stress

- Relocate or put calves outside before or after weaning.
- Wean during good weather if possible.
- Vaccinate and disbud calves at separate times, prior to weaning.
- Continue feeding meal for several weeks after removing milk to support nutrient intake while calves adapt to a full pasture diet

Implementing gradual weaning

Progressively reducing the volume or frequency of milk over time to allows calves to increase their intake of solid feed prior to full milk withdrawal and minimises stress.

A step-down approach can be implemented by reducing milk allowance each week, in multiple steps, leading up to the target weaning date. There are many ways to implement successful weaning but it is important to remove milk gradually so calves have time to adjust to each reduction in milk volume.

Continuing to feed meal for two weeks post weaning also supports a smooth transition. After two weeks, if pasture supply and quality are adequate to meet desired growth rates, meal may also be removed.

Refer to the table below for examples of gradual weaning.

This table is a guide and should be tailored to the calf rearing system of each farm.

Twice daily milk feeding system

Weeks 0-4	Week 5	Week 6-8	Week 9	Week 10	Week 11
6L twice a day: 3L morning 3L evening	4L morning 2L evening	5L OAD	4L OAD	3L OAD	Remove milk Continue feeding meal

Adlib milk feeding system

Weeks 0-5	Week 6	Week 7	Week 8	Week 9
Ad-lib	Transition to OAD & reduce milk by 25% *provide one teat per calf for OAD feeding	Reduce by 25%	Reduce by 25%	Remove milk if calves are eating meal consumption targets Continue feeding meal

Stockmanship and careful observation play a critical role in effective weaning, given that the evidence base in this area is still developing.

Monitoring calves post weaning

Monitor calves closely immediately post-weaning. Look for signs they haven't adjusted to a pasture diet, such as looking hollow or moving more slowly than the rest of the mob. Consider putting these calves back on milk or continue feeding meal for an extended period.

- If most of the mob fails to meet growth rates then review nutritional management.
- If there are only a small number of calves not achieving target weights, draft them out and provide higher levels of supplementation to improve growth rates.

Remember that well-grown heifers are generally more productive over their lifetime.

Continue to provide heifers with good nutrition post weaning

- Maintaining good nutrition throughout the calf's life is critical to lifetime productivity and seeing the full benefits of a well-managed calf rearing system. Growth rates give the best indication of whether heifers' nutritional requirements are being met.

Nutritional stages

- Weaning to nine months of age. Focus on lean growth (muscle and skeletal) and achieving 30% mature liveweight at six months. Lean growth results in increased frame size while maintaining a consistent body condition score. Improved skeletal development results in taller heifers that experience fewer calving difficulties. Try to capitalise on energy efficiency when heifers are young.
- From nine months to mating at 15 months of age. Focus on heifers achieving puberty (43-47% mature liveweight) one to two months pre-mating and continued growth to mating (60% mature liveweight at 15 months) to improve conception rates.

Monitor and weigh heifers regularly to make timely management decisions. Weigh heifers at a similar time of day, preferably in the morning. Entering data

into a recording system will allow for easier tracking over time. Your breeding company may provide target weights based on each animal's Breeding Value (BV) for mature liveweight. This provides individual growth targets for each animal.

Greater Exposure to Pathogens

Once a calf is having greater daily access to paddocks, exposure to pathogens is far more difficult to control. This is why vaccination and parasite control programs are so important for the ongoing health of calves.

- At weaning there is an increased risk of exposure to disease.
- Immunity from maternal antibodies has declined but the calf's own immunity is developing over time.

Monitoring the Burden of Disease

Disease can place a heavy burden on growing calves. The impact of disease in young heifers can include:

- reduced growth rates
- impact on future fertility
- effect on future milk production
- higher death rates.

It is important to continue monitoring the health of calves pre and post weaning.

Don't forget to check calves in distant paddocks or at graziers. Visually assess all animals regularly for signs of ill health.

Look for:

- drooling, coughing, nasal discharge, increased breathing rate – signs of airway disease
- scaly, peeling skin or warts indicate skin disease
- lameness, limping, non-weight-bearing on limb could be foot rot or an injury
- dull coat, scouring may indicate nutritional or parasite problems
- neurological signs including staggers, blindness, etc.

There are also several non-specific signs to look for including:

- Weight loss – poor appetite, tucked up or hollow appearance
- Behaviour – lethargic, standing away from mob, frequently lying down.

Addressing these issues quickly will protect growth rates and wellbeing of heifers.

All farms should have a calf health plan in place that includes parasite control and vaccination – vets can develop specific advice tailored to individual farms.

Refer to page 83 for more information about common parasites.

Summary of recommendations

Prepare calves well for weaning. Weaning can be a challenging time for calves so it needs to be managed carefully.

1. Make sure calves reach solid feed intake consumption targets before weaning.
2. Monitor growth rates and solid feed intake to determine the best time to wean calves.
3. Weaning should be a gradual process to minimise stress on the calf.
4. Feed heifers a good-quality diet post-weaning to achieve target liveweights at mating.
5. Monitor calves closely to ensure they are in good health pre- and post-weaning

05

Health management

Focus on good health

- Health management starts from birth
- Disease prevention is key to rearing calves that thrive
- Monitor calves carefully to identify issues early
- Know the causes of scours and other common calf diseases
- Have clear treatment protocols
- Have vaccination and parasite control plans in place
- Take care of your team

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Disease prevention - immediate care of newborn calves

Keeping a close eye on calves immediately after birth and over the first few days is important. If you spot problems, act early.

Pay particular attention to the following:

- If the calving was assisted – clean airways, stimulate breathing (e.g. pinch nose or tickle inside of nose with straw), position correctly (on sternum with legs either side up towards nose, rub with towel).
- Navel cord – spray with disinfectant early and again once they reach the calf shed.
- Colostrum intake – make sure all calves receive at least 10% of their bodyweight in high quality colostrum within the first 6-12 hours of life.
- Clearly identify – ensure all calves are clearly identified for traceability and treatment/health monitoring.

Congenital birth defects

A congenital defect is a defect that is present at the time of birth. A decision must be made as to whether the calf is viable and will be 'fit for purpose' and not suffer. The calf should be humanely euthanised if it is deemed to be suffering or non-viable.

Lots of calves with defects? Seek veterinarian advice.

Calf trailers

Trailers used to transport newborn calves often become contaminated with faecal material. They should be regularly pressure cleaned and sprayed with disinfectant. Non-slip flooring in the trailer e.g. rubber matting or old carpet, will allow calves to travel more comfortably.

Spraying the navel cord

Best practice for calf navel care in New Zealand involves immediate and thorough disinfection using a 7–10% iodine/alcohol-based spray or dip upon pickup from the paddock and again upon arrival at the shed to prevent infection. Key practices include using proper iodine (not teat spray), ensuring the navel dries and withers, and maintaining a clean, dry environment.

Key procedures for navel care

- **Disinfection Method:** Spray or dip the entire navel cord with 7–10% iodine immediately after birth and again when the calf arrives at the shed.
- **Best Products:** Use iodine/alcohol-based sprays, as they act as a disinfectant and help dry out the navel quickly. Do not use teat spray as the glycerine keeps the navel moist.
- **Frequency:** Treat navels at least twice - once in the paddock and once in the shed. Continue treating until the navel is dry and withered.
- **Hygiene:** Ensure the environment is clean, dry, and draft = draught to prevent infection.
- **Monitoring:** Regularly check for signs of infection (swollen, wet, or painful navels).

Colostrum for all calves

All calves should receive good quality colostrum as soon as possible after birth. Have a farm plan to manage colostrum according to the 5 Q's: Quality, quickly, quantity, sQueaky clean and quantify.

Key colostrum guidelines:

- **Quantity:** 10–15% of body weight in litres in the first 12 hours.
- **Timing:** As soon as possible, ideally within the first 6 hours.
- **Quality:** Use only first-milking colostrum, which has the highest antibody concentration. Only feed newborns 22% brix or higher.
- **Tube or Teat:** If a calf is weak, premature, or from an assisted birth, consider tubing 2 litres immediately upon arrival. Have a farm policy for feeding colostrum.
- **Storage:** Store in lidded drums, refrigerate at 4°C or use a method to preserve colostrum.

Why prompt intake matters

- **Immunity:** Calves are born without antibodies and must absorb them within the first 12 hours before gut pores close.
- **Health & Growth:** Adequate colostrum reduces disease risk, improves growth rates (up to 7kg difference at 6 months), and increases future milk production.
- **Environmental Factors:** In NZ's variable spring weather, calves may be born in cold, wet conditions, which can lower their willingness to suckle.

Refer to the Colostrum Management chapter for more information.

Reducing the risk of sickness in calves

A clean environment reduces the pathogen (bug) load that young calves are exposed to during their most vulnerable period. Good management of the calf rearing environment is therefore essential for disease prevention.

Refer to the Clean comfortable environment chapter for tips on keeping the calf rearing environment clean.

Identify sick calves quickly

The behaviour and appearance of calves can give an indication of their state of health. Pay close attention to how calves are behaving and interacting each day.

Look out for calves that:

- Sit away from the group
- Lay around more
- Have a fever
- Don't get up and move with the mob
- Are less interested in feeding, or drink slower
- Breathe faster
- Look bloated
- Have a rough, dull coat
- Look skinnier
- Cough
- Have a wet mouth or chin
- Grind their teeth
- Vocalise
- Have droopy ears
- Hold their tail up and strain
- Are lame or have a swollen joint
- Have a large swollen navel cord

If any of these symptoms are present, act quickly by following your treatment protocols.

Assessing temperature

A normal calf body temperature is 38.5-39.5. Taking the body temperature of a calf is an important part of assessing its health status. For an accurate temperature measurement, use a digital thermometer with a flexible tip.

- Apply lubricant to the thermometer
- Insert gently into the rectum of the calf – about 5cm deep. Push gently down so it is resting against the rectal tissue and not just sitting in faeces.
- Wait for the reading to stabilise (about a minute).

Record the temperature along with the time and date. If in doubt of the result, repeat the measurement.

Temperatures of 39.5°C or above can indicate that the calf is seriously unwell and requires a more thorough examination, possibly by a vet. Temperatures below 37.5°C can indicate a severely chilled, sick and/or dehydrated calf. Seek vet advice on how to further manage these calves.

You should take immediate action to warm cold calves using hot water containers, heat lamps or other forms of direct heat plus blankets to trap the heat in.

Calf diseases

Calf disease has major production and welfare impacts through increased death rates, slower growth, delayed first calving, higher rearing costs, and lower lifetime milk production.

In New Zealand diarrhoea (scours) is the main health concern. Umbilical disease (navel ill and joint ill), respiratory disease (pneumonia) and other health issues also need to be understood to be prevented, identified and treated.

Calf diarrhoea (scours)

Calf scours is caused by a mix of factors, including calf immunity, nutrition, environment, and exposure to disease-causing bugs. These pathogens are common on New Zealand farms, but their presence doesn't always lead to scours. Finding bugs in the environment or in faecal samples doesn't necessarily explain why a calf is sick.

The pathogens that cause scours are generally spread via calves ingesting faeces directly or consuming liquid or feed contaminated with faeces.

The common infectious causes of scours in the first 14 days of life are:

- E. coli K99
- Rotavirus
- Coronavirus
- Salmonella sp
- Cryptosporidium parvum.

These pathogens may all be present without obvious diarrhoea. You can purchase a rapid diagnostic **test** kit for detection of common **calf scour** bugs from your local agricultural retail store or your vet. Calf scours management needs to focus on early detection, supportive treatment, and limiting spread rather than solely relying on routine diagnostic testing.

Understanding the pathogens on farm can be useful for future prevention of scours and vaccination programmes.

Calf scour infectious agents

Pathogen	Typical age	Cause of infection	Possible symtoms	Treatment	Prevention	Zoonotic (can affect humans)
E.coli	Up to 5 days	Ingesting bacteria in faeces, calf pens, heavy contamination of environment.	Acute scours High Temperature Death	Supportive therapy Antibiotics	Pre-calving vaccination of cows	Yes
Rotavirus	7-21 days	Ingesting the virus in faeces, calf pens and from cow's dirty udders, heavy contamination of environment.	Acute scours, lethargic, depressed	Supportive therapy	Pre-calving vaccination of cows	Yes
Coronavirus	7-21 days	Ingesting the virus in faeces and from cow's dirty udders.	Acute scours, lethargic, depressed	Supportive therapy	Pre-calving vaccination of cows	No
Salmonella	Anytime	Ingesting bacteria in faeces, soil or water, dirty calf pens , heavy contamination of environment.	Acute, foul-smelling scours High temperature Death	Supportive therapy Antibiotics	Pre-calving vaccination of cows	Yes
Cryptosporidiosis	Over 5 days, often along with another pathogen	Ingesting the organism in faeces, soil or water, heavy contamination of environment.	Acute, pale, watery scours. High temp. Blood in faeces	Supportive therapy, Oral treatments	Pre-calving vaccination of cows (new in 2026)	Yes

Non-Infectious 'nutritional' Calf Scours

Nutritional scours is when calves have diarrhoea without an infectious agent causing the problem. It is usually caused by a breakdown in management routine, for example changes in milk volume, quality, composition or temperature. Calves with nutritional scours quickly become susceptible to infectious diarrhoea. Treatment of nutritional scours should be the same as for infectious scours – fluid replacement and supportive measures. Assessing management routines around feeding should be part of every investigation of diarrhoea in calves.

Treatment of scours

It is important that everyone on the farm understands how to correctly manage this common calf health problem. Early identification of the scouring calf followed by rapid, effective treatment is the key for success.

Treatment of calves with diarrhoea should be focused on correcting dehydration, electrolyte loss and maintaining energy intake.

Examine all scouring calves carefully - check for dehydration, ability to drink, temperature and other signs of illness.

Use electrolytes to correct dehydration

Dehydration is indicated by sunken eyes and a slower skin tent recovery. When the skin is pinched, dehydration is indicated if the skin takes longer than 3-4 seconds to return to normal.

Many different calf electrolyte preparations are available. Commercially formulated products should treat the calf for dehydration, electrolyte loss and acidosis. Homemade solutions are cheaper but less effective at treating calves with diarrhoea. Farmers should work with their veterinarian to identify the best electrolyte product for their situation on farm.

Other Ingredients

Other additives include vitamins, minerals, binding agents, prebiotics, probiotics and flavourings. The impact of these ingredients on the overall success of treatment is generally considered to be low. Binding agents or gels can produce better formed faeces which can be misleading as the calf may still be losing significant amounts of fluids.

Fluid therapy for scouring calves

Assessing the hydration status of the scouring calf is essential. Maintaining normal hydration ensures sufficient blood volume is available and adequate oxygen can be supplied to the tissues in the body, limiting complications.

Three factors should be considered when deciding how much fluid to give to a scouring calf:

1. What is the normal amount of fluid this calf needs to drink each day? A healthy calf needs to drink about 20% of its bodyweight daily. For an average crossbred calf in the first 14 days of life this is 6-6.5 litres per day.
2. How dehydrated is this calf? Accurately assessing dehydration does require some skill and experience. You need to consider how bright and alert the calf is, how strong is its suck reflex, how long the skin stays tented when pinched over the neck or chest, and how sunken the eyeballs appear.
3. How much fluid is this calf continuing to lose from the ongoing scouring? As the scour continues, so does the loss of fluid.

Assessing dehydration						
Dehydration (%)	**Behaviour**	**Suck Reflex**	**Skin Tent (seconds)**	**Sunken eyes**	**Mouth**	**Approx. Oral Electrolytes (litres)**
1–5	Bright and alert, standing and moving around	Normal	1–4	Minimal	Moist	2–3
6–8	Less active, sitting down more	Usually reduced	5–10	Separation of eyeball to lower eyelid margin by 2-4mm	Sticky	3–5
9+	Lying down, reluctant to move	None	11+	Obvious separation of 5mm+	Sticky-dry, cold	Requires IV fluids – Call vet

When to seek veterinarian advice:

Calves that are over 8% dehydrated (i.e. will not stand, poor or absent suckle reflex, cold, dry mouth, severely sunken eyes) cannot be properly rehydrated with oral electrolytes. Urgent veterinary attention is critical to provide intravenous fluid treatment.

Example fluid calculation

A 40 kg calf which is 1–5% dehydrated with a moderate scour requires the following fluid volumes:

> Maintenance: 4 litres | Correct dehydration: 2.5 litres | Ongoing loss: 2 litres| Total: 8.5 litres.

If this calf is still drinking 4.5 litres of milk per day it requires 4 litres (8.5 minus 4.5) of oral electrolytes to meet daily needs and correct dehydration.

Scouring dairy calves under 14 days of age typically require a total of 6–8 litres of fluid intake per day.

If calves do not drink the electrolyte, then they can be given them via an oesophageal feeder ('tubing'), but only if the calf is otherwise relatively alert and drinking milk.

The key to success – review each calf, each day

One day of intense treatment is usually not enough to guarantee success. Assess each treated calf daily and adjust its treatment (oral electrolytes/milk/other) daily. Of most importance is their behaviour and presence or absence of suck reflex.

Continue feeding milk to scouring calves

Maintaining sufficient energy intake is crucial to ensuring good outcomes for calves with diarrhoea. Even if good quality electrolytes containing glucose are used, they will not prevent energy deficiency. A litre of electrolytes will contain around 1.8MJ, compared to a litre of full fat cow's milk containing 2.5MJ. It is crucial calves continue to be fed milk when they have diarrhoea.

Continuing to feed milk improves recovery, growth rates, intestinal function and fat stores.

> When feeding electrolytes to calves, it's important to follow recommended wait times between milk and electrolyte feeds. Electrolytes are designed to support hydration and recovery but feeding them too close to milk can interfere with normal digestion and reduce nutrient absorption. As a general guide, allow at least 2–3 hours between milk and electrolyte feeds, unless otherwise advised. Always follow the instructions on the product label, as formulations can differ and some are safe to feed ad-lib alongside milk feeds. Sticking to these guidelines helps ensure calves get the full benefit of both milk and electrolytes, supporting health and growth during periods of stress or scours.

Fresh water access

Having fresh, clean water available to calves at all times is essential. Even when a calf that has diarrhoea is receiving both electrolytes and milk it is important they still have access to water as their fluid requirements may still not be met.

Protecting human health

Some of the pathogens that affect calves can also make people ill, so it is important to practice good hygiene. Use gloves and wash and dry your hands thoroughly after handling calves and before eating or drinking. Children or vulnerable people should not be in contact with sick calves.

Other calf diseases

Pneumonia

How does it present?

Pneumonia is a bacterial or viral infection of the lungs. Clinical signs may include fever, coughing, increased respiratory rate, drooling and wet chin and decreased appetite. Increased sitting or standing with head and neck extended and possibly sunken eyes may be seen in more severe cases.

How is it caused?

It is commonly caused by bacterial invasion of lung tissue following a viral infection, commonly with abscess formation. Accidental ingestion of liquid feeds onto lungs can be an initiating factor. Similarly, poor ventilation resulting in high levels of irritants in the inhaled air (i.e. ammonia from urine, soiled bedding and lime) can cause inflammation of lung tissue and allow bacteria to invade. Lungworm can precipitate pneumonia. Viruses can play a major role as an initial cause of lung inflammation. Stressors such as cold weather, poor nutrition, and overcrowding make calves more susceptible to viral infection.

How is it treated?

Treatment with appropriate antibiotics as soon as possible is usually recommended. Supportive treatment with NSAID's in = is encouraged. Fluid therapy may be warranted if dehydration or toxaemia is present. Consult your vet.

How do I prevent it?

- Provide calf rearing facilities with adequate ventilation, shelter from draughts and good air quality.
- Minimise ammonia levels by maintaining clean bedding.
- Use a broad-spectrum disinfectant effective against both bacteria and viruses.
- Avoid overcrowding of calf pens.
- Ensure high levels of staff competency in skills related to tube feeding calves their colostrum, milk or other liquids.
- Keep older calves free from internal parasites, including lungworm.

Umbilical Abscess

How does it present?

Commonly seen as painful swelling at umbilicus. Severe cases may also include fever, decreased appetite and sunken eyes. Pus may discharge from the umbilicus. Swelling is often hard in early stages but softens as condition progresses.

How is it caused?

Bacteria can enter an open umbilical cord shortly after birth and set up an infection. The practice of navel sucking can contribute to the problem.

How is it treated?

Treatment with appropriate antibiotics as soon as possible is usually recommended. Supportive treatment with NSAID is encouraged.
Need to differentiate from an umbilical hernia which is generally soft, non-painful. Hernias can often be reduced in size by rolling the calf on it's back and applying gentle pressure to the swelling. This is not the case for an abscess.

How do I prevent it?

- Provide and maintain a clean calving, calf transport and rearing environment.
- Spraying or dipping of umbilical cords with an effective disinfectant shortly after birth and repeating as necessary is considered best practice.
- Regular monitoring of umbilical cords for swelling, heat or pain should be carried out.
- Identify navel sucking calves and restrict behaviour.
- Be careful not to confuse an umbilical abscess with an umbilical hernia.

Joint ill

How does it present?

Signs include swollen, painful joint(s) with limping progressing to complete non-weight-bearing lameness. Additional signs seen are fever, decreased appetite, and dehydration in severe cases.

How is it caused?

Bacteria enter the blood stream and lodge in joints. Common belief is that bacteria enter the blood supply via the umbilical cord. It is now also understood that bacteria can also cross from the intestinal tract into the blood system particularly in severe or long-standing cases of scouring.

How is it treated?

Treatment with appropriate antibiotics is usually indicated. Surgical drainage may be appropriate. Consult your vet. Supportive treatment with NSAID's is encouraged. Euthanasia should be considered where severe non-weight bearing lameness is present or multiple joints are affected.

How do I prevent it?

- Spraying or dipping of umbilical cords with an effective disinfectant shortly after birth and repeating as necessary is considered best practice.
- Consider the judicious use of antibiotics in cases of scours with veterinary guidance.
- Calf scour prevention and rapid treatment of calf scours reduces the exposure of pathogens entering the blood stream of calves.

Preventing Johne's disease

Bovine Johne's disease is a chronic, incurable disease of adult cattle caused by a hardy, slow-growing bacterium called Mycobacterium paratuberculosis. Because there is no cure, control relies on reducing exposure to the bacteria, especially in young stock, which are most susceptible.

Minimising the spread from cow to calf is critical on New Zealand dairy farms. Key management practices include:

- **Prompt calf removal:** Remove calves from the dam as soon as possible after birth (ideally within 12 hours) to limit ingestion of contaminated faeces.
- **Colostrum management**: Feed only clean, low-risk colostrum. Avoid pooling colostrum and preferentially use colostrum from test-negative or low-risk cows.
- **Milk feeding practices:** Do not feed waste milk from cows of unknown or high Johne's risk status. Consider milk replacer or milk from low-risk cows.
- **Hygienic calving areas:** Keep calving paddocks and sheds clean, dry, and well-drained to reduce faecal contamination. Avoid overstocking and rotate calving areas where possible.
- **Separate age groups:** Keep young calves and replacement stock separate from adult cattle, particularly known or suspect animals.

Managing Sick Calves

Prevention of spread of diarrhoea and other diseases

Ideally, you should provide areas where sick calves can be held in isolation to minimise the risk of the disease spreading.

Cross infection can occur from:

- Direct contact – an infected calf transmits the disease to healthy calves.
- Indirect contact – exposure to material such as bedding, boots, hands, clothing or feeding equipment which has been in contact with a sick calf.

Be aware of the risks in moving sick and infectious calves:

- If illness is detected late and the sick calf is in contact with others, then it is highly likely that they are already infected – quarantine the whole group from other calves.
- Move the whole group away or alternatively leave neighbouring pens empty.
- Erect solid barriers to reduce the likelihood of calf-to-calf contact.
- It is good practice to attend to sick calves after dealing with healthy calves – feed them last as this limits the risk of spread of disease.
- Overalls, clothes and boots worn during contact with sick calves should be disinfected afterwards.
- Use separate feeding equipment for sick calves.
- Gloves should always be worn when handling sick calves and discarded afterwards.
- Any calf treated with antibiotics should be kept away from healthy, non-treated calves.

The use of antibiotics

Antibiotics are drugs used to control bacterial diseases – they don't have any effect on viruses. While important for treating certain calf illnesses, the decision to use antibiotics should be carefully considered.

Avoid blanket use or medicating large groups of calves if possible. Inappropriate or overuse of antibiotics may lead to bacterial resistance. The dairy industry is also very committed to ensuring that no calves sold for slaughter contain antibiotic residues. Unnecessary use of antibiotics also adds additional expense to the calf rearing operation.

The decision to use antibiotics must be made in conjunction with your veterinarian. As a general guide, use of antibiotics in a calf may be considered if:

- Prescribed by a veterinarian for that animal or condition
- Laboratory testing has determined (or there is a high suspicion) that bacteria are involved in the disease process
- The calf has other signs of disease in addition to diarrhoea (poor appetite, depression, fever).

The use of anti-inflammatories (NSAID's)

Calf scours and other disease are often painful and associated with inflammation. Calves given NSAID's (commonly known as pain relief injections) are likely to have a positive wellbeing effect. Studies indicate scouring calves treated with NSAID's show fewer pain-related behaviours, increased milk intake and suckling behaviour, and improved weight gain. It can help calves with a high body temperature (above 39.5'C) by reducing inflammation.

Alongside veterinarian advice, NSAID's should be included in all treatment plans.

Ensure that the label directions on any medications are closely observed. All medications should be stored as per label directions in a secure location.

Prebiotics, probiotics and other health remedies for sick calves

Just like humans, calves need to have the correct balance of bacteria and other microorganisms in their gut to assist in digestion and protect their intestinal health. This can be achieved following good management outlined in the nutrition chapter, reducing stress and minimising disease. Although many products containing prebiotics and/or probiotics are on the market, research has yet to demonstrate significant benefits from feeding them to sick calves.

Treatment protocols

Farms may manage scouring or sick calves in different ways, so make sure new staff are trained in your farm's approach. Having a clear, documented protocol helps keep practices consistent and ensures calves are managed appropriately, even when regular rearers are unavailable.

Treatment protocols can be developed with your farm veterinarian. Examples of things to include in a treatment protocol:

- Examining the calf and identifying the health issue.
- Taking samples.
- Ensuring the isolation area is prepared with deep, fresh bedding.
- Treat the calf – ensure they are warm, given electrolytes and NSAID's if needed, given antibiotics under the direction of your vet or farm manager. Ensure they have access to water.
- Identify the calf clearly with a consistent system (e.g. spray maker) and record details such as calf ear tag, date, clinical signs and treatment.
- Maintain hygiene – wash and disinfect gear and use disposable gloves.

A decision on all sick calves must be made. If treating them is not a viable option, they need to be humanely euthanised as soon as possible.

Monitoring illness and death rates in calves

Monitoring calf illness and death rates alongside growth rates is essential for understanding true system performance. Growth alone can mask underlying health issues—calves may appear to be gaining weight but still experience disease challenges that reduce lifetime productivity, delay age at first calving, and increase treatment costs.

Tracking morbidity and mortality provides early warning of problems with colostrum management, hygiene, nutrition, or environment, allowing timely intervention before losses escalate. When combined with measures such as liveweight gain, feed intake, and weaning age, these indicators give a more complete picture of calf health and management effectiveness, supporting better decision-making (such as vaccination programmes) and improved long-term herd performance.

Pre-weaning illness rates (morbidity)

Morbidity is a measure of how many calves are getting sick during the period from birth to weaning.

A = Total number of calves treated with either oral electrolyte, antibiotics or other medications

B = Total number of calves reared

Pre-weaning illness rate (%) = A/B x 100

Example: A = 30 calves treated, B = 100 calves reared: (30/100) x 100 = 30%

Pre-weaning calf death rates (mortality)

A = Total number of calves that died before weaning

B = Total number of calves born during calf rearing period (don't count calves which died prior to birth or during birth)

Pre-weaning calf death rate (%) = (A/B) x 100

Example: A = 17 calves died or were euthanised before weaning, B = 280 calves born: (17/280) x 100 = 6%

As a guideline, veterinarians would suggest a morbidity (illness) rate below 10% and a mortality rate under 3%. If you are experiencing higher rates, review your calf rearing system in conjunction with your vet.

Vaccination and parasite control plans

Protection against many diseases can be achieved through a well-designed vaccination plan. Vaccination and parasite control programmes should form part of the overall animal health plan, developed in consultation with a veterinarian. Maintaining accurate disease records supports monitoring and evaluating programme effectiveness.

Work with your veterinarian to create a robust and tailored preventative animal health plan. Three areas of focus are:

1. Vaccinating in-calf adult cows pre-calving to reduce the impacts of calf diarrhoea
2. Young stock vaccines to minimise disease impacts and risks to humans.
3. Internal parasite control programme to maximise growth and health of calves.

Vaccination and parasite control are critical for protecting calves, particularly through the early stages of life and around weaning:

- **Early protection fades quickly:** Immunity from maternal antibodies (via colostrum) declines over time.
- **Immune system still developing:** Calves do not produce strong levels of their own antibodies until around 4–6 weeks of age. Utilising pre-calving vaccines to provide some immunity to calf scours via colostrum is an approach used by many farmers.
- **Weaning increases risk:** Stress at weaning can weaken the immune system, making calves more vulnerable.
- **Greater exposure:** Moving to paddocks increases contact with pathogens and parasites.

A well-timed vaccination and parasite control programme helps bridge these gaps in protection and reduces disease risk.

Vaccination basics

Key points on vaccination timing:

Two-Dose Protocol: Most calf vaccines require two initial doses (a sensitiser and a booster 4-6 weeks apart) to ensure long-lasting protection. The first injection provides limited immunity, making the second injection critical for an immune response.

Maternal Antibody Interference: Vaccination too early can be compromised by immunity passed from the cow in colostrum. Waiting until 4 weeks of age is generally recommended to overcome this, though some vaccines are licensed for use from 2 weeks.

Always consult with your veterinarian for a vaccination program tailored to your farm's specific risks and history.

Keep in mind

- Choice of vaccine – some protect against multiple diseases (e.g. Clostridial diseases and leptospirosis).
- Storage – vaccines generally require refrigerated storage and should never be frozen.
- Discard at a set time – check the label for the recommended discarding time period after opening.
- Administration – use a clean, hygienic technique; follow label directions; avoid vaccinating in wet weather; needles must be sharp; wear gloves.
- Record all vaccinations.

Pre-calving vaccines for in-calf cows

Pre-calving vaccination of cows is a key tool in preventing neonatal calf scours in New Zealand. It works by boosting the dam's antibody levels so high-quality colostrum transfers protection to the calf.

The main pathogens targeted are **rotavirus, coronavirus, E. coli, salmonella and recently crypto,** the most common causes of early-life diarrhoea in NZ pasture-based systems. Vaccines are typically administered in late pregnancy (usually 3–12 weeks before calving depending on the product), ensuring peak antibody levels at calving. Protection is entirely dependent on effective colostrum management, so timing, colostrum quality, and prompt intake are critical. Vaccination does not replace good hygiene and calf-rearing practices but significantly reduces disease pressure when combined with them.

Vaccinating calves and young stock

Vaccination of dairy calves in New Zealand is used strategically to reduce the impact of key endemic diseases, particularly where risk is predictable within seasonal, pasture-based systems. Unlike pre-calving vaccines (which rely on colostral antibodies), calf vaccinations stimulate the calf's own immune response, so timing must consider interference from maternal antibodies and the calf's level of exposure.

The main diseases targeted in NZ dairy calves include **clostridial diseases (e.g. pulpy kidney, tetanus), Leptospirosis, BVD (Bovine Viral Diarrhoea), Salmonella spp., and in some herds pink eye or respiratory pathogens.** Ensure calves are **healthy and well-fed at vaccination**—poor nutrition or stress can reduce immune response.

Clostridial diseases

Clostridium species are bacteria commonly found in the environment that cause several often-fatal calf diseases, including blackleg, pulpy kidney, and tetanus. All calves should be vaccinated against the clostridial diseases.

Typical vaccine schedule for clostridial disease:

- 4-8 weeks: First vaccination
- 8-12 weeks: Second vaccination
- 12 months: Booster vaccination

Clostridial vaccines are most commonly available as a 5-in-1 product, but there are also other vaccines which cover a wider range of clostridial diseases i.e.10-in-1. Speak to your veterinarian about which option may be best for your calves.

Leptospirosis

Leptospirosis is a highly infectious bacterial disease affecting humans and most mammals. It is a significant human health risk causing flu-like symptoms or severe ongoing illness, especially for those who are regularly exposed to animal urine (i.e. dairy farmers, meat processing staff). New Zealand farmers have a responsibility to protect both people and animals on farm by taking appropriate preventative measures. There are multiple strains of this disease that can make both humans and animals unwell. The most common in New Zealand being Hardjo, Copenhageni, Pomona, Ballum, and Tarassovi, and more recently 'Pacifica', found through epidemiological studies to be present on New Zealand dairy farms.

Leptospirosis in people is often linked to unvaccinated animals. Vaccination reduces disease in animal populations and lowers the risk of transmission to people. Effective programmes need to be developed in consultation with a veterinarian and tailored to individual farm systems.

Bovine viral diarrhoea (BVD)

Vaccinating cattle against BVD mainly protects unborn calves from infection that can lead to persistent infections. Vaccination is especially important on farms where pregnant cattle may be exposed to BVD from PI (Persistently Infected) animals in the herd or from other properties. Programmes should be tailored to each farm with advice from a veterinarian.

Salmonellosis

This disease is caused by a bacterium. Salmonellosis is the most common disease associated with acute diarrhoea in adult dairy cows. Salmonella bacteria from cattle can also be transferred to humans, causing significant illness. Vaccination programmes are an effective way of protecting the herd against several common strains of Salmonellosis and can be helpful in reducing the number of sick cows, even once an outbreak of Salmonellosis occurs in a previously unvaccinated herd.

Pinkeye

Pinkeye (bovine keratoconjunctivitis) is an infectious eye disease associated most commonly with the bacterium Moraxella bovis. The condition is spread between calves by flies. Timing this vaccination in relation to expected emergence of flies is critical. Vaccinate with a single injection 3–6 weeks prior to the onset of each pinkeye season.

Managing parasites in calves

Internal parasites

Like other health challenges, calves are born with no protection from internal parasites, commonly referred to as 'worms'. It is the calf's own immune response to worms or 'fighting it off' that if left unchecked causes the ill thrift and scours we might see.

Anthelmintics (drenches), provided they are effective, remove most of the worm larvae and adult worms in the calf's gut. But drenches do not prevent the continual ingestion of worm larvae from the pasture. Worm management therefore needs to focus on reducing the larvae burden consumed from the pasture.

Production animals, including dairy cattle, are increasingly facing drench resistance, meaning our drench products are becoming less effective at managing internal parasites. We cannot rely on 'new' types of drenches coming, so it is up to all production animal farmers in New Zealand to understand drench resistance and have a plan that supports both the growth and health of their calves and limits the development of drench resistance.

When calves first go out onto pasture they have high risk infection with parasites, so it is important to have a comprehensive plan for the treatment and control of internal and external parasites. Oral drenches should be used as they provide more consistent and predictable parasite control in calves compared to injectable or pour-on products.

Remember, permanent calf paddocks can become highly contaminated by parasites. Wet, moist environmental conditions mean that young calves are inevitably exposed to parasites.

Faecal egg counting

Faecal egg count (FEC) testing is a valuable tool for managing internal parasites in young stock, as it provides an objective measure of worm burden and helps identify when treatment is needed.

By using FEC results to guide drench decisions, farmers can avoid unnecessary treatments, ensuring calves are only drenched when parasite levels are impacting performance. This targeted approach helps maintain the effectiveness of available drenches by reducing selection pressure for resistant worms. Over time, incorporating FEC testing into a parasite management plan supports better growth outcomes in young stock while helping to slow the development of drench resistance on farm.

Wormwise is a programme available for farmers in New Zealand to gain a better understanding of managing internal parasites.

Visit https://beeflambnz.com/sites/default/files/2026-03/Wormwisehandbook2026.pdf for more information.

Key practical points from Wormwise for NZ systems:

- **Main parasites:** Ostertagia (most production loss), Cooperia (younger calves), plus lungworm seasonally.
- **Highest risk period:** from spring through autumn as larvae build up on pasture.
- **Pasture is the main source of infection:** larvae live on the bottom few cm of pasture and are ingested during grazing.

In NZ pasture-based systems, effective parasite control is about **integrated management rather than routine drenching.** The goal is to minimise larval exposure, maintain growth, and slow the development of drench resistance—recognising that complete elimination of worms is neither practical nor desirable.

Protozoa (Coccidiosis)

- Coccidiosis (Eimeria sp) is a common parasite affecting newly weaned calves.
- In New Zealand, toltrazuril is registered as a single use treatment for calves with coccidiosis and as an aid in the prevention of coccidiosis. Common coccidiostats are monensin (Rumensin) and lasalocid (Bovatec). These are often additives to both calf milk replacers and calf meal to help prevent coccidiosis.
- Minimise calves' exposure to manure and contaminated environments to reduce the risk of coccidiosis.

Liver Fluke

Liver fluke (Fasciola hepatica) is an environmentally driven parasite of calves in parts of New Zealand, with infection risk linked to wet areas that support the mud snail intermediate host.

- **Risk is location-specific:** associated with wet, poorly drained paddocks, drains, and springs.
- **Production impacts are often subclinical:** reduced growth rates and poor thrift rather than obvious disease.
- **Seasonal pattern:** infection typically occurs late summer–autumn, with effects seen in winter.

Control is targeted: avoid high-risk areas and use well-timed flukicides, as routine drenching alone is insufficient

External parasites

External parasites are a common cause of irritation and production loss in New Zealand calves, and in some cases can transmit disease. The main concerns are **lice (most widespread), ticks, and tick-borne diseases such as Theileria,** with risk varying by region, season, and management.

- **Lice are the most common issue:** typically seen in winter, causing rubbing, hair loss, and reduced growth rates. The most common skin parasites seen on calves in New Zealand are the biting louse (Bovicola bovis) and the sucking louse (Linognathus vituli).
- **Ticks are a significant parasitic concern, with distribution varying by region:** Haemaphysalis longicornis (commonly called the cattle tick or bush tick) is widespread across the North Island and parts of the South Island, being more prevalent in warmer, coastal areas. It is capable of transmitting Theileria orientalis.
- **Theileria causes anaemia and ill-thrift:** spread by ticks, with greatest impact in naïve calves in endemic areas.

Control is strategic: use pour-ons or injectables when lice are present, manage tick exposure in risk areas, and minimise stress to reduce impact of Theileria.

Looking after your calf rearing team

Calf rearing is one of the most demanding periods on a dairy farm, combining long hours, high workload, and pressure to keep young animals healthy during a vulnerable stage. This pressure can increase significantly during disease challenges such as calf scours, where staff are dealing with sick calves, extra treatments, and emotional strain. Looking after yourself and your calf rearing team is just as important as looking after the calves. Well-supported people make better decisions, maintain higher standards, and are more resilient during tough periods.

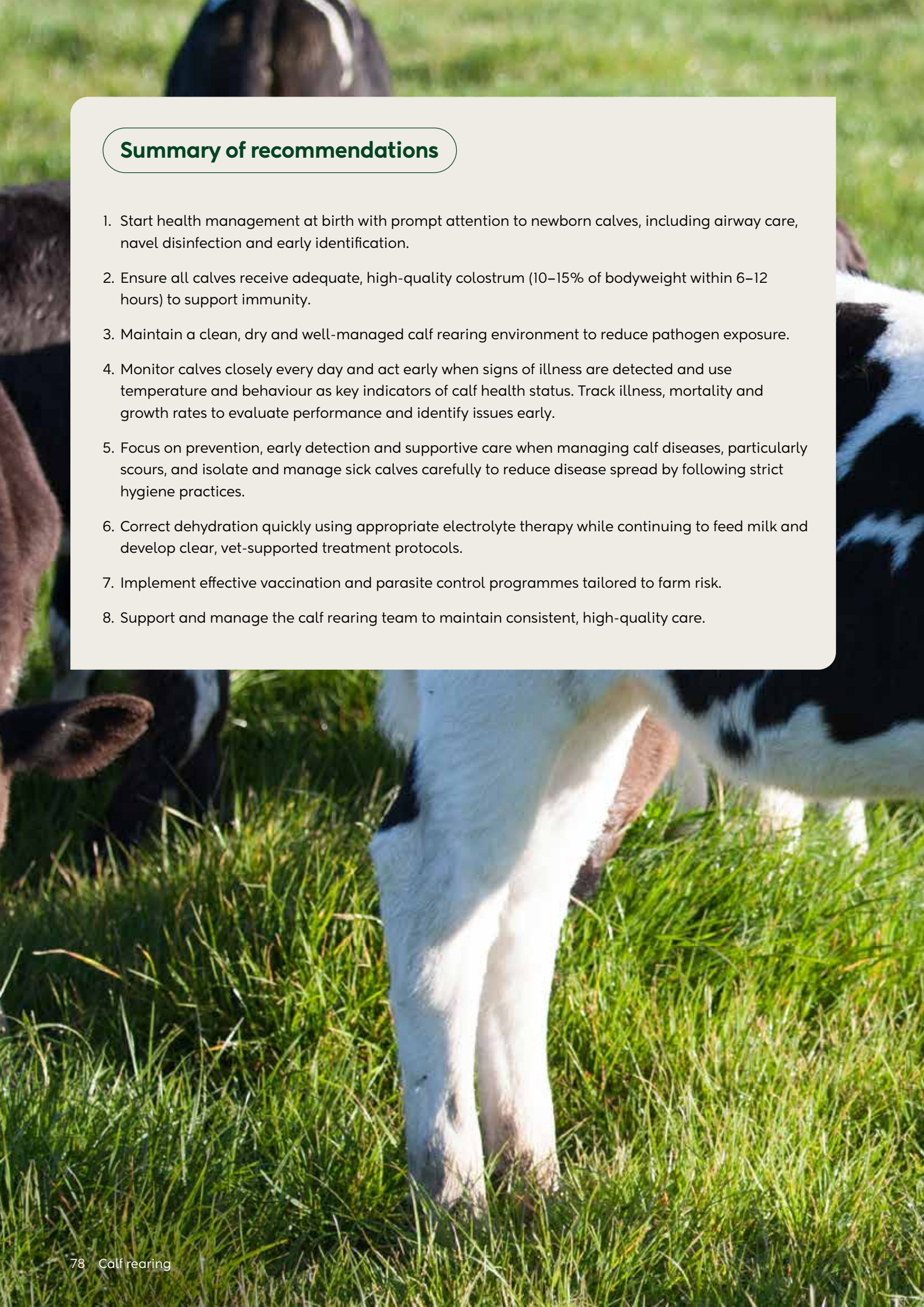
Practical tips to support your calf rearing team:

- Keep communication simple and regular: short daily check-ins help identify issues early and make sure everyone feels supported.
- Share the load: rotate tasks where possible to avoid fatigue, especially during disease outbreaks.
- Have clear treatment plans: written protocols reduce stress and decision fatigue when things get busy.
- Prioritise breaks and basic needs: regular meals, hydration, and rest are essential for maintaining performance.
- Create a supportive environment: acknowledge when things are tough—calf losses can be hard on staff.

When to ask for help:

- Rising calf illness or deaths that feel hard to control
- Staff becoming overwhelmed, fatigued, or making mistakes
- Uncertainty around treatment decisions or protocols
- Workload exceeding what the current team can realistically manage

Bringing in your vet, farm consultant, or extra labour early can prevent small issues becoming major problems and helps protect both calf outcomes and team wellbeing.



Summary of recommendations

1. Start health management at birth with prompt attention to newborn calves, including airway care, navel disinfection and early identification.
2. Ensure all calves receive adequate, high-quality colostrum (10–15% of bodyweight within 6–12 hours) to support immunity.
3. Maintain a clean, dry and well-managed calf rearing environment to reduce pathogen exposure.
4. Monitor calves closely every day and act early when signs of illness are detected and use temperature and behaviour as key indicators of calf health status. Track illness, mortality and growth rates to evaluate performance and identify issues early.
5. Focus on prevention, early detection and supportive care when managing calf diseases, particularly scours, and isolate and manage sick calves carefully to reduce disease spread by following strict hygiene practices.
6. Correct dehydration quickly using appropriate electrolyte therapy while continuing to feed milk and develop clear, vet-supported treatment protocols.
7. Implement effective vaccination and parasite control programmes tailored to farm risk.
8. Support and manage the calf rearing team to maintain consistent, high-quality care.

06

Traceability and transport

Set up routines that work from day one

- Identify every calf early and accurately
- Meet legal and compliance requirements
- Keep thorough treatment records
- Prioritise calf welfare before transport or sale
- Understand transport responsibilities

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Identification and traceability

Keeping accurate identification and traceability records for all calves is good practice, but it is also a legal requirement.

Record the birth date, sex and dam ID for every calf, whether they are herd replacements or intended for sale. Calves should be permanently identified as soon as possible after birth, and any calving complications, treatments or health issues during rearing should also be recorded.

Calves must be NAIT (*National animal identification and tracing*) tagged and registered within 180 days of birth or before they move off farm – whichever comes first. Bobby calves sent directly to slaughter don't require a NAIT tag but will require an ear tag supplied by the meat company prior to transport.

A method for easy identification of animals from a distance is vital for an efficient calf management system. In practical terms, this means staff can tell immediately if the calf is a replacement, has received treatment, or is destined for sale.

Use an identification system that works for you

1. Identify calves with a permanent identity tag as soon as practical after birth. Many farms use both a NAIT tag and a calf tag.
2. Use more than one method if possible, in case a tag is lost.
3. Make sure that all the tools for identifying calves are readily accessible in calf rearing areas.
4. All staff need to understand the identification system used.

Non-permanent, short term identification methods may consist of collars or a system of coloured paint markings. You might use these when picking calves up from the paddock or to mark calves that have had treatment or medication, or need to be monitored.

Having a good identification system means keeping records is easier. Keeping track of colostrum and disease management, such as Johne's, is important where calves are deemed at higher risk of exposure. Also, calves that experience difficult births or other complications are less likely to consume enough colostrum if unaided. Accurate identification of these calves can help ensure that they receive appropriate colostrum.

Regulations and responsibilities

As a Person in Charge of Animals (PICA), farmers must:

- tag animals with NAIT-approved tags that are in the correct place on their ear, and issued for that NAIT location
- register the animals in NAIT against the tag number applied to the animal
- check that every animal that must have a tag has one, and replace it if it's lost or damaged
- keep the details of each animal's tag up to date in NAIT.

There are other types of tags used for farm management, including:

- visual panel tags to help with identifying your stock
- if you have bobby calves, direct-to-slaughter tags issued by a meat processor

More information on tagging here: About tags and tagging | OSPRI

Animal Welfare regulations

The New Zealand Animal Welfare (Care and Procedures) Regulations 2018 provide a basis for consistent legislation and enforcement regarding livestock across New Zealand. Where there is a conflict with another standard, the welfare of livestock must be the first consideration, unless there is an occupational health and safety rrequirement. See the Ministry for Primary Industries website mpi.govt.nz/animalregs for more details.

The regulations apply to all people responsible for the preparation, care and management of livestock, including transportation. This includes farmers, transport companies, saleyards and meat processors.

Identify all calves

All calves must be identified – herd replacements AND those destined for sale or slaughter. You must:

- provide a unique and traceable identification for each calf
- record the date, dam, and sex of every calf born. This should be done as soon after birth as possible.

Identifying sale calves

Calves must be **at least 4 days old** before they can be transported to off farm.
A documented birth date and calf identification system enables all those involved to identify calves that are eligible for transportation and shows evidence of good practice. Bobby calves under 30 days old going directly to a meat processor do not need a NAIT tag or registration but will require a direct-to-slaughter tag issued by the meat company.

Accurate record keeping

Records must be kept for every calf, and they must be accurate and complete. Alongside compliance, the benefits of accurate records include:

- informed management and breeding decisions - the ability to accurately identify calves assists farmers with initial breeding decisions and ongoing health and production management
- less risk of selling calves with antibiotic residues
- confirmation of age of calves at sale
- evidence of control practices for calf diseases including Johne's disease
- ability to work out the costs of calf and heifer rearing.

A reliable and robust system of identification and traceability helps the industry gain access to export markets and assures customers of the food safety of dairy products – meat and milk. It is essential to keep accurate and complete records of all calves.

Identifying treated calves

All dairy farmers have a responsibility to ensure that young calves that may have antibiotic residues are not sent for slaughter.

Lack of clear identification increases the risk of accidentally treating sale calves with antibiotics. Whether you treat sale calves or herd replacements, you must:

- record every calf treatment
- record calf ID, date, treatment, and withhold period
- clearly mark each calf so that they are easily identifiable by all staff. Consider using additional methods of identification for treated sale calves in addition to NAIT/bobby tags
- a specific-coloured tag and highly visible paint markings are good options

Ideally, treated calves should be separated from non-treated calves. These steps will help ensure that withholding periods are adhered to and treated calves are not sold before the drug withhold period elapses.

Care before transport and sale

There is a chain of responsibility for livestock welfare in transport. It begins with the owner or person in charge and extends to the final receiver of the livestock. All parties inbetween also have a responsibility to the animals and must comply with the associated regulations. The Animal Welfare Regulations define a young calf as up to 14 days of age and has been separated from its mother. This chapter refers to how young calves should be cared for prior to and during transport.

Calves that are well cared for prior to sale cope better with transportation. A good standard of care also means:

- Calves are fit and healthy on arrival
- High animal welfare standards are maintained

Providing a high standard of care

Good on-farm management is essential as calves that are well cared for prior to transportation will arrive at their destination in better shape. Calves destined for sale need to be given the same standard of care as every other calf on the farm.

Calves less than four days old

Calves less than 4 days old must not be sold in a saleyard, sold privately and transported off farm, or consigned to an abattoir or processor. Calves less than 4 days old travelling without their dam should only be transported directly to an on-farm calf rearing facility. These calves must be:

- provided with thick bedding and room to lie down
- protected from cold and heat
- transported for no longer than 12 hours
- never be consigned through saleyards

Calves older than four days

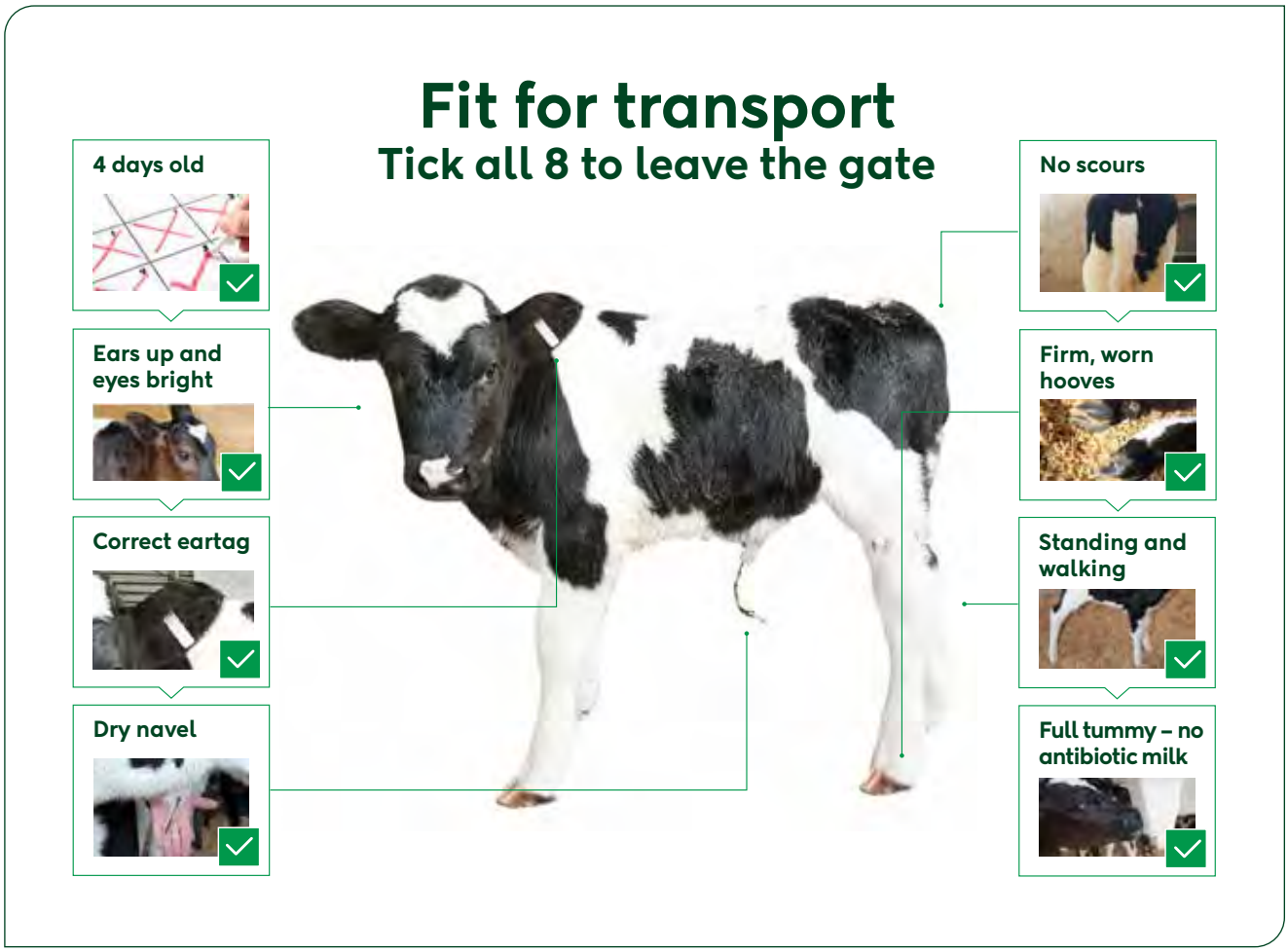
Select calves for sale with the following characteristics:

- Ears up, eyes bright
- Hooves are firm and worn, not soft and bulbous
- Dry and withered navel cord.
- Able to stand and walk
- No scours
- Not being treated for any illness and not under withholding period
- Feeding well on milk

Ensuring calves are fit for transport and sale

- The owner/person in charge must only supply calves that are fit for the intended journey. It is important that all calves arrive healthy.
- Sale calves must be at least 4 days old.
- Make sure calves receive a liquid feed within 2 hours of transport.
- Calves must be in good health, alert and able to rise from a lying position.
- Provide shelter and shade prior to pick up to keep calves dry, draught free and protected from cold/heat. Vehicles like trailers must provide protection from wind.
- All sale calves must be antibiotic free.
- Calves must be identified with an NAIT tag or bobby tag prior to transport.
- Records are important – you must have a system in place that shows evidence of good practice.

If there is any doubt on the suitability of a calf, then it should not be transported. It is always best to err on the side of caution and keep the calf until it meets all the standards.



Don't forget – sale calves must be free of antibiotic residues, have registered NAIT tags or direct-to-slaughter (bobby) tags and a completed animal status declaration (ASD).

Loading facilities & shelter requirements

Farmers, sale yards and processors must ensure calves under 14 days of age are loaded and unloaded using facilities that are safe and fit for purpose. Facilities can vary in design – such as ramps, raised platforms, tractor trays or similar, as long as they meet regulatory requirements.

Loading systems should enable calves to move on and off vehicles with ease, while reducing the risk of injury, slipping, falling or distress. Where trailers or utes have a deck height of less than 900 mm, calves may be carefully lifted on and off. Calves must have suitable shelter at all stages of the journey – before loading, during transport, and at their destination.

Summary of recommendations

1. Identify and record calves early.
2. Ensure all calves transported off farm are fit and healthy.
3. All calves consigned to a saleyard or to a processor must be at least 4 days old.
4. Ensure calves receive a liquid feed within 2 hours of transport.
5. Provide shelter prior to pick up.
6. Sale calves must be identified with a NAIT or direct-to-slaughter tag.
7. Handle calves gently and calmy.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07

Animal husbandry and biosecurity

Protect your calves and your farm

- Strong biosecurity protects calves and farm performance
- Manage disease risks proactively
- Disbudding improves long-term welfare and safety
- Use pain relief for disbudding
- Euthanasia requires clear policies and training

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Biosecurity for Calf Rearing Areas

Farm biosecurity aims to reduce risks to a farm business by limiting the introduction and spread of animal diseases, pests and weeds. Animal health, welfare, labour and financial benefits all flow from maintaining high levels of biosecurity.

The calf-rearing area is effectively a farm within the farm, housing your most vulnerable animals. Strong biosecurity is critical. Getting it right supports calf health and performance, while gaps can lead to significant disease and cost.

Having a clear biosecurity plan is a proactive way to reduce disease risk, maintain a clean environment, and protect young stock. Work with your vet to assess risks on your farm and develop practical strategies to manage them.

Some key steps to help you implement a biosecurity plan include:

- Calculate the risks
- Control the risks
- Communicate your plan.

Calculate the risks

What diseases do you know are present on your property and which ones are you at risk of getting? Known risks for most calf rearing environments are the common pathogens e.g. Rotavirus, Cryptosporidium, E.coli, Salmonella, internal parasites such as coccidiosis, and intestinal worms. These are discussed in more detail in the Health Management chapter. However, there are also other pathogens and health risks you may not know about, so you need to plan to manage them too.

Control the risks

Think about how disease could be brought into the calf rearing environment. Pathogens could arrive via an infected calf, through contaminated machinery or equipment, through contaminated people and clothing, via contaminated feed or milk, or by pests such as rodents or insects. You also need to consider how these diseases move between animals. Many common pathogens are spread through contact with infected faecal material. In the case of pinkeye, the infection moves from a weeping, infected eye to another calf's eye via flies.

Communicate your plan

All people having contact with your calf rearing environment need to know about your biosecurity plan. Your staff need to be educated on each step they must follow and have the plan available for their reference. Other visitors to the calf rearing environment such as vets, agents, and calf buyers also need to be informed about your plan. You can achieve this through direct discussions and/or indirectly through signage e.g. signs restricting access to the calf rearing area to authorised personnel, or indicating the mandatory boot washing station.

Have a farm zone policy for visitors

Use the red, orange, green system to map out zones on your farm.

Red

No go areas for visitors, tankers, livestock trucks (i.e paddocks and heifer rearing sheds). Red zones can only be entered after carrying out visitor biosecurity requirements.

Orange

Areas that have a mix of cows, farm staff, visitors and equipment (i.e. the milking shed and bobby calf sheds)

Green

Areas that have unrestricted access to visitors, their vehicles, tankers and livestock trucks but restricted access by cows (i.e. the milk tanker track, access tracks to houses on farm and bobby calf pick up points.

Disbudding Calves

Unless your calves are naturally polled (grow no horns), disbudding is a necessary husbandry procedure to improve animal welfare in the long term. It reduces the risk of bruising and hide damage, especially during yarding and transport, and makes cattle safer to handle.

The gene responsible for being 'polled' is dominant and the gene responsible for 'horn growth' is recessive. This means that an animal that inherits either one or two copies of the dominant polled gene from its parents will not grow horns. The polled gene is unusual in dairy breeds, but demand for polled animals and more widespread genetic testing is increasing the selection of high genetic merit bulls that carry the polled gene.

Calves are born with horn 'buds' and the correct term for removal of these is disbudding. Disbudding is usually carried out using a heated disbudding iron. At 8 weeks of age the buds start to fuse with the underlying bone. Therefore, the optimal age for disbudding is between 2 and 6 weeks of age, while the horn bud is still 'free floating'. Removal of horns after 8 weeks of age is called 'dehorning' and is usually performed using scoop dehorners of varying designs, or embryotomy wire for larger horns.

The Animal Welfare Care and Procedure Regulations require that pain relief, authorised by a veterinarian, must be used when disbudding calves. This procedure isn't limited to veterinarians – speak to your veterinarian or disbudding contractor about training and the supply of pain relief.

Research has shown that calves and farmers both benefit from the use of pain relief at the time of disbudding. Use of sedation and local anaesthetic means that it is safer and easier for the operator. Calves receiving effective pain relief experience less stress, recover faster, and have a minimal check in growth rate, which means bigger, stronger calves that can be weaned earlier. These gains help offset the additional cost of administering the medications.

Discuss pain relief options with your veterinarian to help reduce the pain and stress associated with disbudding.

Euthanasia

Euthanasia is an unpleasant, but necessary, fact of farming life. Euthanasia should be considered for any calf that is found to be in pain or to be suffering, where prompt treatment is not a viable option.

Basic requirements:

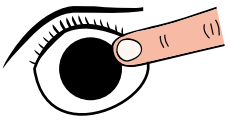
- Establish and follow a farm policy that outlines who can euthanise animals, when, where, and using what method.
- Make sure the farm team are properly trained and know how to use all equipment safely (and if using a firearm, hold a firearms licence).
- Follow the correct process to ensure death is achieved with minimum of pain, suffering and distress to the calf. You must ensure that immediate loss of consciousness followed by death while unconscious is the result – whichever method is used.

Confirmation of death

Regardless of the method chosen to euthanise the animal, the operator must confirm that the animal is dead. There are a number of indicators to confirm that death has occurred.

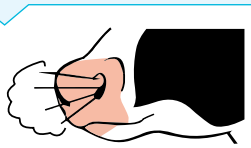
CHECK:

No blink reflex

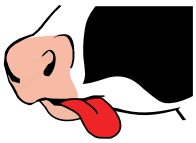


Pupils fixed and dilated

No regular breathing

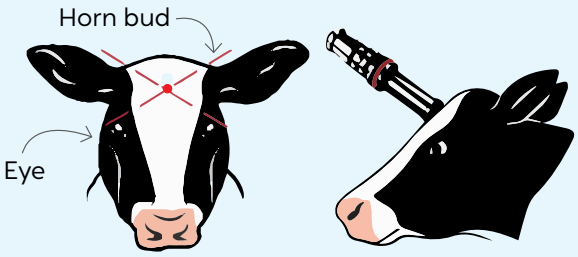


Jaw relaxed, tongue floppy



No heartbeat

When stunning cattle with a captive bolt, the only suitable target is the 'frontal target', which is positioned in the centre of the animal's forehead. Shown in the diagram below: imaginary lines are drawn from the middle of each horn/horn bud to the top of the opposite eye. The target is the point at which the two lines cross. The animal's neck should be straight. The angle of the captive bolt should be aimed so that the bolt is directed towards, and in line with, the neck.



Summary of recommendations

1. Biosecurity reduces the risk of disease, pests, and weeds, supporting animal health, welfare, and farm profitability.
2. A clear biosecurity plan helps prevent disease and maintain a clean environment.
3. Disbudding improves long-term welfare, safety, and animal value, and is best done at 2–6 weeks of age before horn buds attach to the skull.
4. Pain relief (sedation + local anaesthetic) improves calf welfare, recovery, and growth. Consult your vet for appropriate pain management.
5. Have a clear farm policy for euthanasia covering who, when, where, and how euthanasia is performed. Ensure staff are trained and equipment is used safely and correctly.

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