

# Technical Series

IN BRIEF

## *Managing the transition cow*



DairyNZ 

# Contents

## 1 Transition cow nutrition

Management of a transition cow is often over-complicated. The key to successful pre-calving nutrition is set months earlier.

## 4 Optimising heifer management

Replacement heifers are the foundation of genetic improvement in the herd, but are a significant cost to the business. What are the secrets to raising them for optimum production?

## 7 Treasure the heifer

Heifers are the most susceptible cows in the herd to mastitis. What are the best, most practical ways to reduce the risk?

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# Transition cow nutrition – priming the herd to perform or just another way to spend money?

Management of a transition cow is hugely important, but is often over-complicated by inappropriate recommendations. The real key to successful cow transition is the management of body condition score (BCS) months earlier.

## What is a transition cow?

A cow within the six to eight weeks before and after calving.



John Roche, DairyNZ

## Keys to effective management

- Nutrition and management during the transition period are important, but success is set several months earlier!
- Mature cows should be BCS 5 and younger cows BCS 5.5 one month before calving
- The range in BCS within the herd is as important as the herd average
  - Preferentially manage thin and fat cows from late lactation to minimise the range
- Assess the herd twice weekly from one month pre-calving and draft cows showing signs of springing
- Manage feed intake of springing cows
  - Feed springing cows 80-90% of their requirements for metabolisable energy if BCS 5 or greater (Table 1)
  - If less than BCS 5, feed springing cows 100% of their metabolisable energy requirements (Table 1)
  - Do not over-feed springing cows!
- Supplement springing cows with 20 g magnesium/cow/day
- Supplement colostrum cows with 100 g calcium/cow/day.

The six to eight week period around calving that encompasses late pregnancy and early lactation is often referred to as the Transition Period. The cow transitions from a state of pregnancy and positive energy balance to a lactating state in negative energy balance.

There can be little doubt about the importance of this period for the dairy cow; failure to transition successfully can result in reduced dry matter intake and milk production, poorer reproduction, an increased incidence of metabolic and infectious diseases, many of which are inter-related, and to earlier culling.

The importance of nutrition and management of the cow during the pre-calving and early lactation periods has been debated for almost a century. At the World Dairy Congress in 1928, Robert Boutflour from the UK introduced a new term, encouraging farmers to “steam up” their cows the month before calving.

Subsequent research in New Zealand and the United States reinforced a belief that the “springing cow” should be fed as much as they are able to eat during the two weeks before calving.

The role of the pre-calving diet on the incidence of milk fever has also been a topic of considerable research since the mid-1960s. At first, it was believed that high pre-calving dietary calcium was the culprit and in the 1980s and 1990s a new

dietary prevention method was developed known as Dietary Cation-Anion Difference (DCAD) to reduce the incidence of milk fever.

These ‘facts’ about the importance of pre-calving energy balance and dietary mineral concentrations led to the development of pre-calving or ‘lead feed’ rations, wherein a cow is provided with a source of supplementary energy, protein, minerals, and vitamins during the two weeks before calving, on top of her usual base ration.

However, more recent experiments indicate that the conclusions that led to many of these recommendations were wrong:

1. The majority of the research was undertaken in North America and Europe, where the dairy production systems, milk production expectations, and the genetics of the cow are very different to those in New Zealand.
2. Many of the recommendations have originated from epidemiological studies, where patterns point to a conclusion but experimentation does not back it up.
3. There have been a large number of experiments over the last 15-20 years that provide considerable evidence to refute many of the recommendations that farmers receive from some advisers.

## Body condition score

There have been a considerable number of experiments undertaken globally to determine the optimum calving BCS and these were recently summarised in an award winning scientific review<sup>1</sup>. In short, mature cows should calve at a BCS of 5, while first and second calvers benefit in reproduction and health from being BCS 5.5.

Mature cows that are thinner than BCS 4.5 or fatter than BCS 5 at calving are at an increased risk of metabolic and infectious diseases after calving, like mastitis and metritis. Therefore, not only is the average BCS of the herd important, the range is equally important. The herd must be managed from March onwards to identify thinner and fatter cows for preferential treatment.

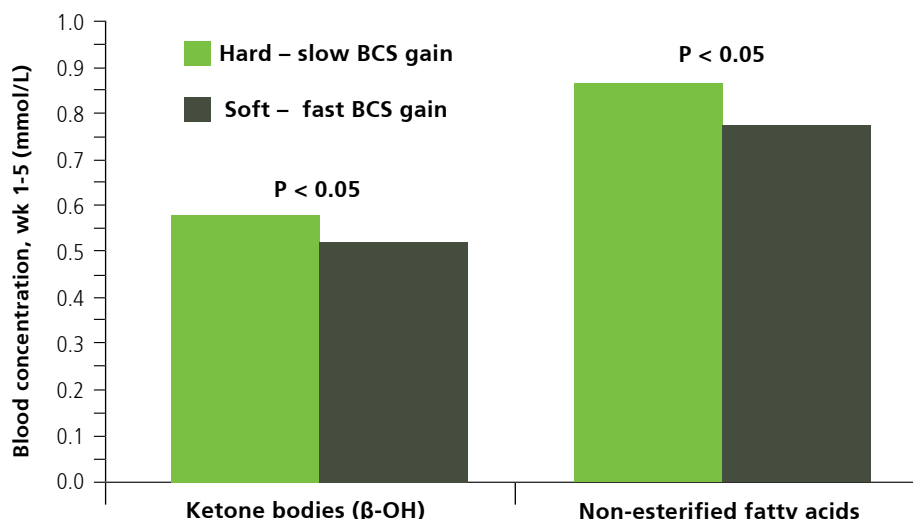
- Low BCS cows at calving (mature cows BCS < 4.5 and younger cows < 5) are at an increased risk of mastitis and metritis. To avoid a low BCS at calving, cows need an extended dry period as well as additional feed.
- High BCS cows at calving (mature cows BCS >5) are at an increased risk of both metabolic and infectious diseases, like ketosis, milk fever, and mastitis.
- High BCS can, sometimes, be more difficult to manage. These cows should be milked for as long as is practical and should be ‘limit fed’ during the dry period (i.e., fed no more than maintenance) to ensure that they don’t get too fat.

### Slow or fast condition gain – which is best?

**The speed at which a cow gains BCS during the non-lactating period does not affect the rate of BCS loss, the health or the production of the cow during the following lactation.**

In recent years, some farm advisers have suggested that cows that gain BCS quickly (soft fat) lose it quickly post-calving when compared with cows that gain BCS slowly through late lactation and into the dry period. This recommendation is based on an experiment in the United States<sup>2</sup>. However, an analysis of data available from experiments in New Zealand does not support this view. In fact, in an experiment undertaken in spring 2014, cows that gained BCS more quickly during the dry period had lower concentrations of fat in blood and may have even been metabolically healthier than those that gained BCS slowly. However, the effect was biologically small and, arguably, not very important. What is important is that rapid BCS gain during the dry period did not negatively affect the cow (see Figure 1; *unpublished data*).

**Figure 1.** Effect of speed of BCS gain in autumn on blood concentrations of ketone bodies ( $\beta$ -hydroxy butyrate) and non-esterified fatty acids during the first 5 weeks after calving (*unpublished data*).



### How much should I feed “springing cows”?

#### Springing cows should not be overfed.

As long as BCS targets have been achieved, cows should consume 80-90% of their metabolisable energy requirements in the weeks before calving. If less than BCS 5 one month before calving, cows should be fed to their requirements.

Irrespective of her pre-calving BCS, dairy cows should not be fed more than requirements in the two weeks before calving (see Table 1).

**Table 1.** Daily metabolisable energy (ME) intake (MJ ME/d) for cows during the last two weeks before calving. Note: these figures are dependent on their pre-calving BCS<sup>3</sup>.

Mid-lactation Lwt	Pre-calving Lwt	ME intake if BCS <5	intake of ME if BCS 5 or greater
350	400	95	80
400	460	105	90
450	520	115	100
500	580	125	105
550	630	130	110
600	690	140	120

#### DCAD and milk fever prevention

Milk fever is a multifactorial disease, making it difficult to isolate a specific cause.

**Magnesium supplementation:** Magnesium supplement reduces the incidence of milk fever significantly. In fact, it is probably the most important dietary component in milk fever prevention<sup>4,5</sup>. Research undertaken in New Zealand highlighted a dramatic reduction in the incidence of milk fever with pre-calving magnesium supplementation; average incidence of milk fever dropped from 6.1% to 1.3%<sup>5</sup>. Cows should be supplemented with approximately 20 g magnesium/day during the two weeks before calving.

**Calcium supplementation:** Supplementing cows with calcium (e.g., ground limestone) during the colostrum period increases blood calcium and reduces the risk of milk fever<sup>6</sup>. The majority of milk fever occurs in the 24-48 hours after calving. If cows can be supplemented with calcium during this period, the risk of classical milk fever decreases.

**Restricting food intake:** Restricting a cow’s metabolisable energy intake to 80-90% of their requirements in the weeks before calving increases blood calcium on the day of calving and the day after calving, reducing the risk of milk fever. The mechanism by which this works is, as yet, unknown, but the effect is consistent across pasture-based and TMR-based diets.

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# Optimising heifer management

Replacement heifers are the foundation of genetic improvement in the herd, but are a significant cost to the business. It is, therefore, important to rear them optimally. The question is, however, *what defines optimal?*



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## Summary

- Live weight (Lwt) targets for heifers have been set as 30, 60 and 90% of mature Lwt at 6 and 15 months, and immediately pre-calving (22 months).
- Analyses of Lwt databases indicate very large and long-term effects on lifetime milk production if the heifer is smaller than her target Lwt at calving.
- Targeted, controlled experiments, however, indicate that this reported effect of heifer size on milk production does not always occur.
- A combination of other factors during the rearing phase also affect future milk production, including adequate colostrum intake and parasite control, health and disease incidence, and pre-weaning growth rates.

There has been increased interest in heifer rearing during the last 12-24 months to tackle the problem of poorly grown replacement stock. Recently, a database analysis by McNaughton and Lopdell<sup>1</sup> reported that 56% of heifers were more than 10% below target live weight (Lwt) at first calving, highlighting that most heifers are failing to reach the targets.

The same authors then reported that for each 1% below this target calving Lwt, milksolids (MS) production was approximately 2 kg less<sup>2</sup>. If this lower milk production continues for 5 lactations, it would equate to a loss of over \$650/heifer over her lifetime or \$100 million/year nationally, at a \$6.00 average milk price.

Although similar results have been obtained from an analysis of Irish Lwt data<sup>3</sup>, a recent review<sup>4</sup> of New Zealand and international heifer-rearing studies indicates that heifer Lwt at first calving does not always affect milk production.

In fact, controlled experiments indicate that the effect of heifer size at calving on subsequent milk production is dependent

upon when the difference in Lwt gain is established<sup>4</sup>. Based upon these experiments, only 10-20% of the difference in MS production reported from the New Zealand and Irish database analyses is a result of nutrition post-weaning<sup>4,5</sup>. A combination of other aspects of the rearing phase are also likely to influence the future milk production of heifers, including adequate colostrum intake and parasite control, health and disease incidence, and pre-weaning growth rates.

### What should heifer Lwt be?

There is general agreement that, in ideal circumstances, heifers should be 85-90% of mature Lwt at their first calving<sup>4,5,6</sup>.

By mature Lwt, we mean the Lwt 4-5 months post-calving of a 4th lactation or older cow, when body condition and cow dry matter intake are stable and the weight of pregnancy is negligible. Therefore, the target of 85-90% of mature Lwt before calving accounts for the weight of pregnancy (calf foetus, uterus, foetal fluid, etc). It also accounts for the body condition score target for heifers of 5.5 at calving<sup>5</sup>.

To reach the end goal of 85-90% of mature Lwt at first calving, it is currently recommended that heifers should be 30, 60 and 90% of mature Lwt at 6 months, 15 months and 22 months of age (Table 1). This is a linear growth trajectory that ensures heifers are growing at a consistent rate, but does not take into account the inconsistency of feed quantity and quality in our pasture-based systems. Further studies that take these factors into consideration are required to define the optimal growth pattern to achieve the first calving Lwt target.

### Key findings

- The effect of heifer Lwt at calving is dependent upon when the difference in Lwt gain is established.
  - Heifers that are bigger at calving because they grew more quickly before mating produce no more milk than smaller herd mates, as long as puberty is reached by the planned start of mating.
  - Heifers that are bigger at calving because they grew more quickly after mating produce more milk (approx. 0.25 kg milksolids/kg Lwt) than smaller herd mates during their first lactation.
- Heifers that are small at calving because of insufficient feeding grow more in their first lactation and are closer to their target Lwt by the beginning of lactation 2.
- Therefore, small mature cows are not the result of poor feeding post-weaning as heifers.
- If small heifers end up as small mature cows, other potential reasons such as genetics, insufficient colostrum and ineffective parasite control need to be considered.

**Table 1.** Live weight (Lwt) targets for growing heifers to attain optimum first calving Lwt. Adapted from Troccon (1993)<sup>6</sup>, with heifer Lwt targets equal to 30, 60, and 90% of mature Lwt at 6, 15, and 22 months of age. Average required growth rates (GR; kg/day) for each period are presented in parentheses.

Age	Mature Lwt (kg)				
	450	500	550	600	650
Birth	30	35	40	45	50
84 days	90	100	110	120	130
(GR birth to 3 months)	(0.70)	(0.75)	(0.85)	(0.90)	(0.95)
6 months	135	150	165	180	195
(GR 3 months to 6 months i.e. post weaning)	(0.50)	(0.55)	(0.60)	(0.65)	(0.70)
15 months	270	300	330	360	390
(GR 6 months to 15 months/breeding)	(0.50)	(0.55)	(0.60)	(0.65)	(0.70)
22 months	405	450	495	540	585
(GR 15 months to 22 months/pre-calving)	(0.65)	(0.70)	(0.80)	(0.85)	(0.90)

# What are the most important factors in rearing heifers for future milk production?

## Colostrum

It is widely agreed that providing calves with sufficient colostrum early in life improves their health and productivity. Yet more than 40% of calves sampled in commercial herds in American, Australian and New Zealand studies failed to receive adequate colostrum<sup>4,7,8</sup>.

Although the volume of colostrum is very important, the timing of colostrum consumption relative to birth is probably the most critical factor in New Zealand. There are two reasons for this. Firstly, the colostrum quality declines between calving and first milking. Secondly, the calf's ability to absorb the antibodies in colostrum diminishes quickly with time post-birth. Therefore, calves need to receive approximately 10% of their birth weight (i.e., 3-4 L of colostrum) within 12 hours of birth to absorb adequate levels of the maternal antibodies. Importantly,

1. do not assume that calves suckle sufficient colostrum from their dams
2. the first milking of a cow is the highest quality colostrum (i.e. "gold" colostrum) for the calf
3. absorption of antibodies from colostrum declines post-birth to very low levels after 12 hours

**The recommendation is** that calves receive 10% of their birth weight (i.e., 3-4 L) in "gold" colostrum within 12 hours of birth. The earlier the better – the optimum is for calves to receive 2 L of "gold" colostrum from a freshly calved cow within the first 6 hours of life.

## Milk-fed calf

There is increasing evidence globally that accelerated growth during the first eight weeks of life has large effects on total lifetime milk production. Preliminary work in New Zealand has confirmed that greater growth rates during the pre-weaning period results in a 10% increase in milk production during the first lactation<sup>9</sup>. This production increase occurs despite a lack of effect of accelerated pre-weaning growth on heifer Lwt at first calving, but the effect on subsequent lactation performance is still unknown.

Similarly, the most economical way of increasing pre-weaning growth rates to achieve increases in lifetime production has yet to be determined for our pasture-based systems.

## Pre-puberty

Several experiments have reported that, as long as the animal has reached puberty before mating at 15 months of age, there is little to no advantage in milk production from increasing Lwt gain during the nine months following weaning (i.e., as rising 1 year olds)<sup>4,5</sup>.

Although increasing Lwt gain post-weaning results in an earlier onset of puberty, it reduces the duration of the pre-pubertal

mammary development phase, which negatively affects subsequent milk production. A New Zealand study<sup>5</sup> indicates that these effects can be offset in the first two lactations by a greater calving Lwt, but milk production is reduced in subsequent lactations as the difference in Lwt diminishes with time. Moreover, accelerated pre-pubertal growth isn't required if heifers are grown to reach Lwt targets at mating. This is because puberty is reached at ~45-50% of mature Lwt, whereas the mating target is 60% of mature Lwt (Table 1).

## Post-puberty

Experimental results indicate, on average, that there is an increase in milk production in the first lactation (but not subsequent lactations) from increased growth rates following puberty and breeding (i.e. as rising 2 year olds)<sup>4,5</sup>.

The most relevant research results for New Zealand indicate that, during their first lactation, heifers will produce 0.25 kg MS for every 1 kg greater Lwt at first calving that has been achieved by feeding for greater Lwt gains post-puberty<sup>5</sup>. The greater milk production is not due to a change in feed efficiency but because the smaller heifers divert energy to Lwt gain that would otherwise go to milk production. Therefore, the smaller heifers grow more in their first lactation and do not end up as small mature cows. If small heifers remain stunted as mature animals, factors other than underfeeding need to be considered, including genetic variation in Lwt, insufficient colostrum and ineffective parasite control.

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## Treasure the heifer

Heifers are most at risk of mastitis prior to calving. What are the best ways to reduce this risk?

### Key facts

- Heifers are more susceptible to mastitis than are cows
- Heifers that are infected at calving produce less milk during their first lactation compared with uninfected heifers
- Internal teat sealants, administered 4-6 weeks pre calving by trained personnel, have proven the most effective protection
- Regular teat spraying and/or milking within the first 12 hours after calving are low cost approaches that can also reduce the risk of clinical mastitis
- Herds that have more than 15 cases of clinical mastitis within 2 weeks of calving per 100 heifer calvings require proactive management to reduce heifer mastitis.

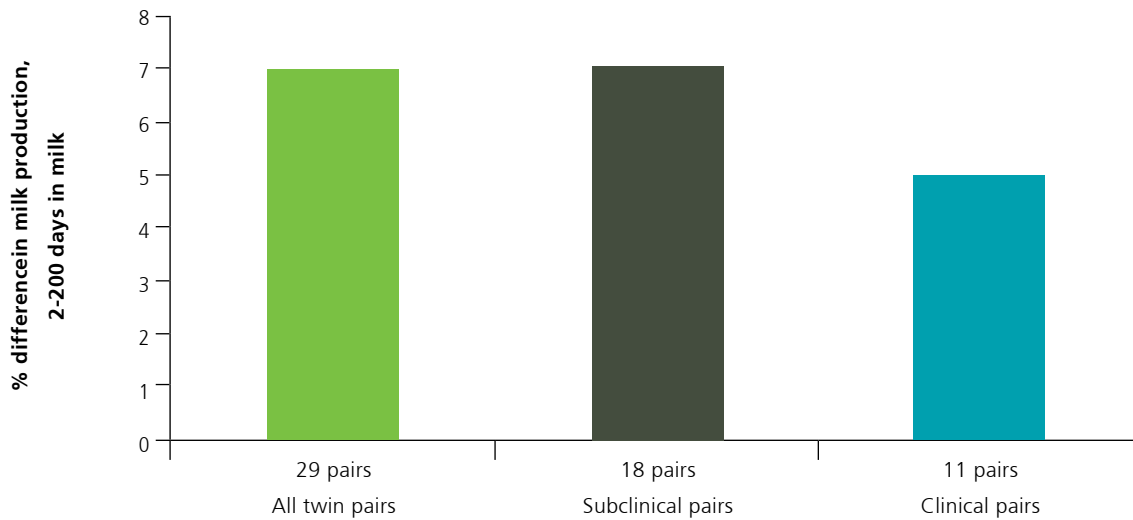


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Heifers are most at risk of mastitis prior to calving. As the udder develops in size, milk often leaks from open teat canals allowing in bacteria, such as *Streptococcus uberis* or coagulase negative staphylococci (CNS), resulting in infection before calving.

A study using the DairyNZ identical twin herd<sup>1</sup> identified that heifers which calved down with a subclinical *Strep. uberis* infection produced 7% less milk than their uninfected twin mates throughout their first lactation. Twins which were detected and treated for clinical mastitis due to *Strep. uberis* had similar losses (Figure 1).

**Figure 1.** Loss in milk production for infected identical twin heifers, compared with their uninfected twin pair, where one member had subclinical mastitis due to *Strep. uberis* at calving (n = 18 pairs) or one member had clinical mastitis due to *Strep. uberis* at calving (n = 11 pairs).



This degree of loss has not previously been reported because subclinical cases, which don't create visible changes in milk or the udder, are usually not detected. It is possible that damage to the milk producing tissues had occurred, prior to calving.

This research indicates that prevention of all *Strep. uberis* infections is important, not just the clinical cases. A number of approaches have been tested under research and field conditions.

They focus on four control points:

1. reducing the risk of udder oedema and milk leakage;
2. reducing bacteria at the teat end before calving;
3. placing a barrier at the teat canal to block entry of bacteria; or
4. supporting the animal to deal quickly with new infections.

### 1. Reducing udder oedema and milk leakage

Oedema is the swelling that occurs under the skin of the udder and sometimes along the belly in a heifer prior to calving. It is a significant risk factor<sup>2</sup> for heifer mastitis, but what causes it is poorly understood. Contributing factors appear to include:

- excessive feeding immediately prior to calving
- excessive dietary sodium or potassium levels
- over-fat heifers, and
- hereditary predisposition.

Extra hay or silage in the diet pre-calving has been reported to have no impact to aid oedema or reduce milk leakage<sup>3</sup>.

#### Twice daily calf pick up

Milking heifers within the first 12 hours after calving is another way that may reduce udder oedema and milk leakage. It may also reduce the chance of bacteria getting into the teat canal and causing infection.

In practice, this involves twice-daily pick up of new calves, and bringing freshly calved heifers in for milking at both the morning and afternoon milkings.

A NZ study<sup>4</sup> identified that halving the interval between calving and first milking, from 20 hours to below 10 hours, led to a 45% reduction in clinical mastitis, less subclinical mastitis and less udder oedema.

### 2. Reducing bacteria at the teat end

#### Teat spraying before calving

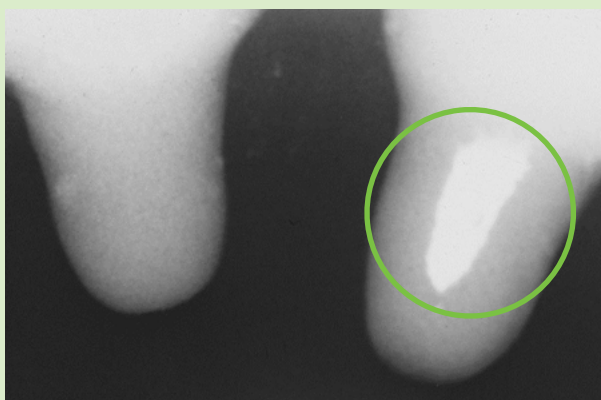
Using normal disinfectant teat spray at regular intervals before calving is a relatively low-cost approach for reducing the number of bacteria on heifer's teats. A NZ study<sup>5</sup> identified that applying an iodine-based teat spray three-times weekly for the last 3 weeks before calving led to reductions in the number of *Strep. uberis* on the teat-ends at 24-48 hours before calving. Although there were fewer *Strep. uberis* infections at calving and 50% fewer *Strep. uberis* clinical cases, the incidence of clinical mastitis caused by all pathogens was not significantly reduced.

### 3. Placing a barrier at the teat canal

#### Treatment with an internal teat sealant pre-calving

Using an internal teat sealant has proved to be the most effective strategy for reducing environmental mastitis in heifers. It involves introducing a non-antibiotic material into the udder about 4-6 weeks before calving to provide a physical barrier to the entry of bacteria (figure 2).

**Figure 2.** An x-ray image of teat sealant inside a teat.



Following calving, the calf strips out some of the teat sealant when suckling, and the rest is removed by manual stripping, before attaching the teat cups. However, milking staff need to be aware that flecks of teat sealant may persist in milk for some weeks after calving and may be incorrectly diagnosed as cases of clinical mastitis.

Two NZ herd studies<sup>6,7</sup> have proven the effectiveness of internal teat sealants.

Good hygiene at application is imperative and some vets provide technicians to perform the task. For herds with an above average rate of heifer mastitis (15% or more heifers clinical in the first two weeks after calving), this approach becomes cost effective.

#### External teat sealant ineffective

By contrast, application of an external teat sealant pre-calving has proved ineffective and cumbersome. The non-irritant latex, acrylic or polymer-based film which produced a thin layer over the teat had to be re-applied weekly and a New Zealand study showed that it didn't significantly reduce cases of clinical mastitis<sup>8</sup>.

## 4. Supporting the animal to deal quickly with new infections

Studies identified that treatment with long-acting antibiotics before calving showed no benefits. Treating with short-acting antibiotics just prior to calving or on the day itself were effective in reducing clinical mastitis, but it is an expensive option, and not recommended because of the risk of inhibitory substances contaminating milk.

#### Other options

Other helpful<sup>9</sup> strategies are based on common-sense. They include: keeping udders clean by managing pasture allocation following rain, reducing the risk of dystocia or retained foetal membranes, running separate heifer and cow mobs pre and post-calving to reduce bullying and pre-calving milking as a last resort for heifers with very tight udders. However the latter should be used with caution as it may increase the risk of a negative-energy balance in the pre-partum period.

### Which approach is best for your system?

The best approach for your herd will depend on a number of factors, which include:

- Gap in performance between current levels of clinical mastitis among first-calving heifers and industry targets
- Farm-specifics costs, management risk and likely benefits of each approach
- Availability of infrastructure for safe administration of internal teat sealants to heifers, four weeks before calving
- Availability of labour to pick up new-born calves twice per day and bring heifers in to be milked
- Practicality of teat spraying heifers' teats 2-3 times per week, for the last three weeks before they calve.

For herds with more than 15 cases of clinical mastitis within two weeks of calving, per 100 heifer calvings, SmartSAMM recommends steps are taken to more proactively reduce heifer mastitis.

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### **Early lactation milking frequency affects season's production<sup>1</sup>**

- This experiment characterised the immediate and long-term effects of milking cows once daily (1X) for a short period post-calving. The study was in response to farmer interest in 1X milking during the calving period to reduce workload and improve herd body condition score (BCS).
- It also investigated temporarily milking cows three times daily (3X) during early lactation as a tool to improve milk production efficiency in high-input systems.
- Milking individual cows 1X for 3 or 6 weeks immediately after calving reduced whole-lactation milksolids yield by 7% and 12%, respectively, compared with milking cows twice daily (2X) for the entire lactation.
- Milking 1X post-calving improved cow energy status, but BCS was not improved until 5 to 6 weeks in milk.
- Strategies to maximise the labour benefits of milking 1X, whilst minimising the loss of milk revenue, include 1X milking during the colostrum period or milking the herd 1X for a set time period, such as 2-3 weeks, from the planned start of calving.
- Short-term 3X milking at the start of lactation did not increase milksolids production in pasture-based cows.

### **Body condition score at calving affects indicators of health and metabolism in grazing dairy cows<sup>2</sup>**

- As part of a programme investigating the role of body condition score (BCS) in animal welfare, the authors used blood and liver tissue to examine the effect of calving BCS on metabolic health.
- Herds of cows calved at either BCS 3.5, 4.5, or 5.5.
- As expected, fatter cows produced more milk and lost more BCS in early lactation.
- The BCS 5.5 cows also had greater concentrations of ketone bodies in blood and more fat stored in their liver, indicating they were at a greater risk of ketosis and fatty liver disease, which can lead to other health complications.
- Changes in gene expression in liver were consistent with these findings, with genes involved in using fat for energy more highly expressed in fatter cows.
- Blood indicators of health combined with the gene expression analyses suggest that cows calving at a BCS of 4.5 are healthier than cows calving at either BCS 3.5 or 5.5.
- Combined with other studies, the results confirm that a target calving BCS of 5 for mature cows is most appropriate from a health and welfare perspective.
- Additional research studies confirm an advantage in health and reproduction if first and second calvers are 0.5 BCS units fatter at calving (i.e. BCS 5.5).

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