

## Identifying Transition Cows at Risk and How Best to Manage Them

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### Take Home Messages

- Postpartum disease and lameness in dairy cows have implications for animal welfare, long-term milk production, reproductive health, and risk of culling. Despite decades of research, the incidence of these diseases remains unacceptably high.
- Changes in behaviour during transition can predict disease and lameness risk postpartum.
- Management practices can alter transition cow behavior.
- The transition cow environment should include low competition for feed; comfortable, clean, and dry spaces for lying and standing; and minimal social regroupings.

### Introduction

The periparturient period or “transition” phase (generally accepted as the period beginning 3 weeks prior to calving and ending 3 weeks following calving) is one of the critical points in dairy production where risks to animal welfare are highest (von Keyserlingk et al., 2009). During the transition period, cows face a number of stressors, including diet changes and social regroupings, and the physical, hormonal and physiological changes associated with calving and the onset of lactation. One of the main challenges for transition dairy cows

is a sudden increase in nutrient requirements to support the onset of lactation at a time when dry matter intake lags behind (Drackley, 1999).

Sickness in dairy cows can reduce production efficiency in 3 ways: 1) by reducing milk production, 2) reducing reproductive performance, and 3) by shortening the life expectancy through increased culling rates. During the transition period, dairy cows are vulnerable to metabolic and infectious diseases, making early detection of disease particularly valuable at this time. For example, metritis is commonly diagnosed within the first few weeks after calving. This disease reduces milk yield (Rajala and Gröhn, 1998) and impairs reproductive performance (Opsomer et al., 2000, Melendez et al., 2004), and the reproductive status is likely the single most important factor influencing culling decisions on farms (Gröhn et al., 2003).

The majority of research on health issues in transition dairy cows has focused on nutrition, physiology and metabolism. Despite great advances in our understanding of these areas, the incidence of disease after calving remains high. Research has indicated that cows with lower feed intakes are at higher risk of metabolic and infectious diseases during the transition period. However, changes in feed intake must ultimately result from changes in feeding behavior. Feeding behavior has been shown to predict morbidity in feedlot steers (Sowell et al., 1998 and 1999) and may be similarly useful for prediction of disease in transition dairy cows.

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The objectives of our transition cow research program are to gain a better understanding of the behavioral changes that occur during the transition period, to evaluate the relationships between behavior and intake during this period and how these measures relate to health status after calving. This conference proceedings reviews nearly a decade of research by our research group that shows how feeding and standing behavior change over the transition period and how knowledge of feeding behavior and dry matter intake (DMI) during the period before calving can be used to identify cows at risk for disease (specifically metritis and lameness) after calving.

### Feeding and Standing Behavior During Transition

In our first study, we investigated the changes in feeding and lying behavior of 15 transition dairy cows monitored from 10 days before until 10 days after calving (Huzzey et al., 2005). The daily time spent feeding was variable during the period before calving but averaged  $86.8 \pm 2.95$  min/day. After calving, the average feeding time dropped to  $61.7 \pm 2.95$  min/day. This drop may be explained by an increased feeding rate due to the switch to a higher energy postpartum diet. After calving feeding time increased at a rate of 3.3 min/day, most likely reflecting the rapid increase in DMI that occurs during this period to support increasing milk production (Kertz et al., 1991; Osborne et al., 2002).

The pre- and post-calving standing times determined in our study (12.3 and 13.4 hours/day respectively) were in general agreement with the findings of other researchers (Krohn and Munksgaard, 1993; Haley et al., 2000), suggesting that standing time during the transition period is not much different than during other stages of lactation. Healthy cows stood on average for 12.3 and 13.4 hours/day during the pre and postpartum period, which is not much different than during other stages

of lactation. There was a dramatic increase (80%) in the number of standing bouts from 2 days before calving to the day of calving (Huzzey et al., 2005). This result suggests that cows were more restless, likely due to the discomfort associated with calving, and suggests that special attention should be placed on cow comfort in the maternity pen. This may be particularly important for cows experiencing dystocia (Proudfoot et al., 2009b).

### Feeding Behavior Predicts Metritis

Metritis is an important postpartum disease due to its negative effects on the reproductive performance of dairy cows. The incidence of metritis or endometritis varies among studies from 8 to 53% (7.6%, Grohn et al., 1995; 53%, Gilbert et al., 2005; 16.9%, LeBlanc et al., 2002). This variation is likely due to differences in the diagnostic methods used to classify uterine infections. On the average dairy farm, disease detection is done by the veterinarian, but typically only during routine herd health checks. So in many cases, early warning signs of disease go unnoticed until such time that the disease is in its clinical stage.

In 2 studies, we assessed whether cows that became ill with metritis after calving behaved differently than healthy cows. In the first study, we followed 6 Holstein heifers and 20 Holstein cows housed in a free-stall barn and divided them into a prepartum and postpartum group. Although group size was kept constant, group composition was dynamic as animals moved between pens as they progressed through the transition period, as is typical of many commercial situations. An electronic feeder was used to continuously monitor the feeding behaviour of individual cows over the course of the study, and these data were used to estimate average daily feeding time. After calving, the cows were examined for metritis every  $3 \pm 1$  days, based on rectal body temperature and condition of vaginal discharge. Vaginal discharge (VD) was assigned a score from 0 to 4, based on a scale adapted from

Dohmen et al. (1995). As there is disagreement in the literature concerning which diagnosis criteria constitutes a case of metritis, 2 classifications were employed. Animals were classified as metritic if they showed a VD  $\geq 2$  plus fever ( $\geq 39.5^\circ\text{C}$  within 3 days before observation of VD  $\geq 2$ ) or acutely metritic if they showed a VD = 4 plus fever (Urton et al., 2005).

Of the 26 cows used in this study, 18 cows (69%) experienced some degree of pathological discharge (VD  $\geq 2$ ) with a range of onset from 3 to 15 days in milk (DIM). When we compared the feeding time of these cows beginning 2 weeks before calving, there were clear differences. Cows diagnosed with metritis/acute metritis spent less time feeding during both the pre- and post-calving period compared to healthy cows.

Recent research has shown that these changes can also be useful in detecting illness in dairy cattle, especially during the transition period when cows are particularly vulnerable to metabolic and infectious diseases. Figure 1 illustrates how patterns of feed intake differ for healthy cows and cows diagnosed with metritis. The most dramatic differences in the diurnal feeding pattern occur during times of highest bunk attendance between 0600 and 1800 hours.

In a follow up study, Huzzey et al. (2007) recorded the DMI of 101 cows from 14 days before calving to 21 days after calving. Cows that developed metritis or acute metritis ate less than healthy cows in the pre-partum period, up to 3 weeks before the disease was diagnosed. Feeding time was also measured and showed the same pattern. With every 10-minute decline in feeding time in the pre-partum period, the odds of cows becoming ill doubled.

The results of our research complement other studies that have examined the relationship between feeding behavior and health. Hammon et al. (2006) reported lower DMI, relative to healthy

animals, during the 2 week period before calving for cows that went on to develop puerperal metritis, and Quimby et al. (2001), with feedlot steers, indicated that reduced feeding behavior can be used to detect animal morbidity approximately 4.1 days earlier than identification by pen riders. This work provides clear evidence that reduced feeding time and DMI during the period before calving increases the risk of cows being diagnosed with metritis after calving. However, whether a reduction in intake and feeding time before calving is a cause of metritis, or an effect of something else going on during the prepartum period, is not known. Social behaviour in the pre-partum period was measured, as this is likely influenced by the many challenges during transition. Cows that developed postpartum metritis also engaged in fewer aggressive interactions at the feed bunk during the week prior to calving and avoided the feed bunk during periods when competition for feed was highest.

The average number of days from calving to the first signs of pathological discharge (VD  $\geq 2$ ) was  $5.3 \pm 1.9$  days (mean  $\pm$  SD) for cows with severe metritis ( $n = 12$ ) and  $9.1 \pm 3.9$  days for cows ( $P < 0.001$ ) with mild metritis ( $n = 27$ ). The average daily milk production was 18.3 lb/day less for the severely metritic and 12.5 lb/day less for the mildly metritic cows, compared to the cows that remained healthy throughout the 21 days after calving (Figure 2).

Long-term costs of metritis are often more difficult to quantify than short-term costs yet may be much greater, such as heavy milk losses, poor reproductive performance, and potentially culling of the animal. A recent short communication from our research group has estimated that cows with postpartum metritis produced less milk than healthy cows up to 20 wk into lactation, and cows that lasted 305 days lost about 1200 kg (2640 lb) of milk over their lactation (Wittrock et al., 2011). Cows in this study with postpartum metritis were also twice as likely to be culled – probably as a

combination of having lower milk yields as well as poor reproductive performance, since these are 2 of the most important factors that influence the decision to cull a cow (Figure 3).

Feeding behavior can also predict metabolic disease. In a follow-up study to the metritis work, Goldhawk et al. (2009) found that cows with low pre-partum intakes were more at-risk for subclinical ketosis after calving. Cows that later developed ketosis ate less, spent less time eating, and were less likely to be socially engaged at the feedbunk up to 2 weeks before calving.

Aside from the work we have undertaken on metritis and subclinical ketosis, we have also been interested in identifying risk factors that identify cows at risk for lameness. Historically, lameness has not been thought of as a transition cow disease, likely because most cases of lameness arise months into lactation. Recent work has provided evidence that physiological and behavioural changes during transition can increase the risk of lameness later in lactation (Knott et al., 2007; Cook and Nordlund, 2009; Proudfoot et al., 2010). Many severe cases of lameness are caused by claw horn lesions (e.g., sole ulcers and white line lesions), which take 8 to 12 weeks to develop. Thus, a sole ulcer that is diagnosed 12 wk after calving likely began developing, or was triggered, during transition. The high incidence of lameness cases after calving illustrates the need to focus on the transition period to prevent both infectious and metabolic diseases directly after calving, as well as lameness cases months after calving.

In a very recent study, we assessed whether transition cows at risk for lameness behaved differently than healthy cows (Proudfoot et al., 2010). Data loggers were fixed to the hind legs of cows and measured standing time 2 weeks before to 3 weeks after calving. Cows were then hoof scored monthly until 15 weeks in milk. Thirteen cows developed sole ulcers or severe sole

haemorrhages between 7 and 15 weeks after calving. The standing behaviour during transition of these cows was compared to 13 healthy cows. Cows with lameness after calving stood longer in the pre- and early postpartum period than healthy cows. Most of this difference was driven by higher time spent half in the stall (i.e., “perching” with the 2 front feet in the stall and 2 hind feet in the alley).

Ample evidence now suggests that detailed knowledge of behavior can help identify cows at risk for metritis, sub-clinical ketosis and lameness in transition dairy cows. This information can also guide the development of management practices that can: 1) help detect disease early and 2) help prevent disease by addressing management challenges during transition that might influence these risky behaviours (i.e., decrease feed intake and increase standing time).

The results described here provide the first evidence that social behavior may play an important role in disease susceptibility in dairy cattle. In this study, we observed that during the week before calving cows that go on to develop severe metritis displace others from the feed bunk less often than cows that remain healthy. In addition, during this period before calving, cows that later become ill spend less time eating and consumed less DM during periods when cows were highly motivated to access the feed [i.e. following the delivery of fresh feed, when feed palatability and quality were at their highest (DeVries and von Keyserlingk, 2005)]. Because bunk occupancy is also at its highest during these peak feeding times, it appears that cows that later develop severe metritis lack the motivation to compete for access to feed during these periods, and this may indicate that these cows are the socially subordinate individuals in the group.

During the transition periods, numerous changes occur, including frequent mixing and regrouping of animals. Socially subordinate cows may be unable to adapt to these frequent social

restructurings, and consequently, these cows may respond by reducing their feeding time and DMI and increasing their avoidance behavior in response to social confrontations. These behavioral strategies may put these cows at greater risk for nutritional deficiencies that impair immune function and increase susceptibility to disease. Future work in this area should focus on gaining a better understanding of individual responses to management practices, such as regroupings during the transition period, and how these management changes influence a dairy cow's susceptibility to disease after calving.

### **Accommodating the Vulnerable Transition Cow**

A number of management practices can influence the feeding and standing behaviour of transition dairy cows. For instance, overstocking the feed bunk increases standing time, waiting to gain access to the feed bunk (Huzzey et al., 2006), reduces the amount of time cows spend feeding, and reduces intake in healthy transition cows (Proudfoot et al., 2009a). When cows are given generous space to feed, subordinate animals are most likely to benefit (DeVries et al., 2004). Grouping strategy may also influence feeding behaviour; regrouping or mixing cows into new social groups can decrease feed intake as well as the number of aggressive interactions in which the new cow is involved (von Keyserlingk et al., 2008). Stimulating feeding can be done using a frequent delivery of fresh feed (DeVries and von Keyserlingk, 2005); cows fed 4 times per day spend about 30 min more time eating than cows fed once per day.

Dairy cows are also forced to adapt to numerous management challenges during the transition period. On typical North American dairy farms, the transition from pregnancy to lactation is marked by several social re-groupings and changes in diet. The first group change, approximately 3 wks before the cow's expected calving date, allows cows

to be fed a diet with the higher energy and nutrient levels required for parturition and lactation and occurs so that producers can closely monitor the cows as they approach their expected calving date. There is evidence, however, that regrouping has negative consequences on both behaviour and production. Recent work by our own group showed increased aggression and reduced milk production in the days immediately following regrouping (von Keyserlingk et al., 2008). One of our most recent studies also provides evidence that cows that were moved to a new pen and mixed with new cows and those that remained in their home pen and mixed with new cows show a decreased feeding rate and rumination time at regrouping. Moreover, cows that were moved also reduced their intake and number of lying bouts, and were more aggressive at the feeder (Schirmann et al., 2011).

A high standing time could suggest a deficit in the cow's environment; for instance, cows housed in pens with insufficient number of lying stalls, low bedding, wet bedding, or restrictive neck rails spend more time standing than those with dry stalls and less restrictive neckrails (Tucker and Weary, 2004; Fregonesi et al., 2007; Fregonesi et al., 2009). Cows that perch with their 2 front feet in the stall during transition are also at increased risk for lameness (Proudfoot et al., 2010); this behaviour has been linked with restrictive stall design (Tucker et al., 2005; Fregonesi et al., 2009).

Moving the neckrail further from the curb reduces perching behaviour and can reduce lameness cases (Bernardi et al., 2007). Although this practice comes at a hygiene cost (cows standing with all 4 feet in the stall will defecate and urinate more into the stall), there is no clear evidence that it increases the risk of mastitis. However, if this practice is utilized after calving, it is recommended that stalls be cleaned often, as fresh cows are at high risk for mastitis.

## Conclusions

Transition cows need adequate rest, appropriate nutrient intake, and a relatively stable social environment to stay healthy. Some risk factors for infectious and metabolic diseases postpartum and lameness in the few months after calving are related to housing and management. An optimal transition cow environment facilitates ample feed intake by reducing competition for feed and social regrouping, as well as accommodates these vulnerable cows with clean, dry, well-bedded, and unrestrictive standing and lying spaces.

### Take Home Questions:

- How much feed bunk space does each cow have in the prepartum pen?
- How many useable stalls are there in the prepartum pen?
- Are there enough stalls so that all cows can lie down at the same time?
- How many regroupings does each cow experience as she goes through the transition period?

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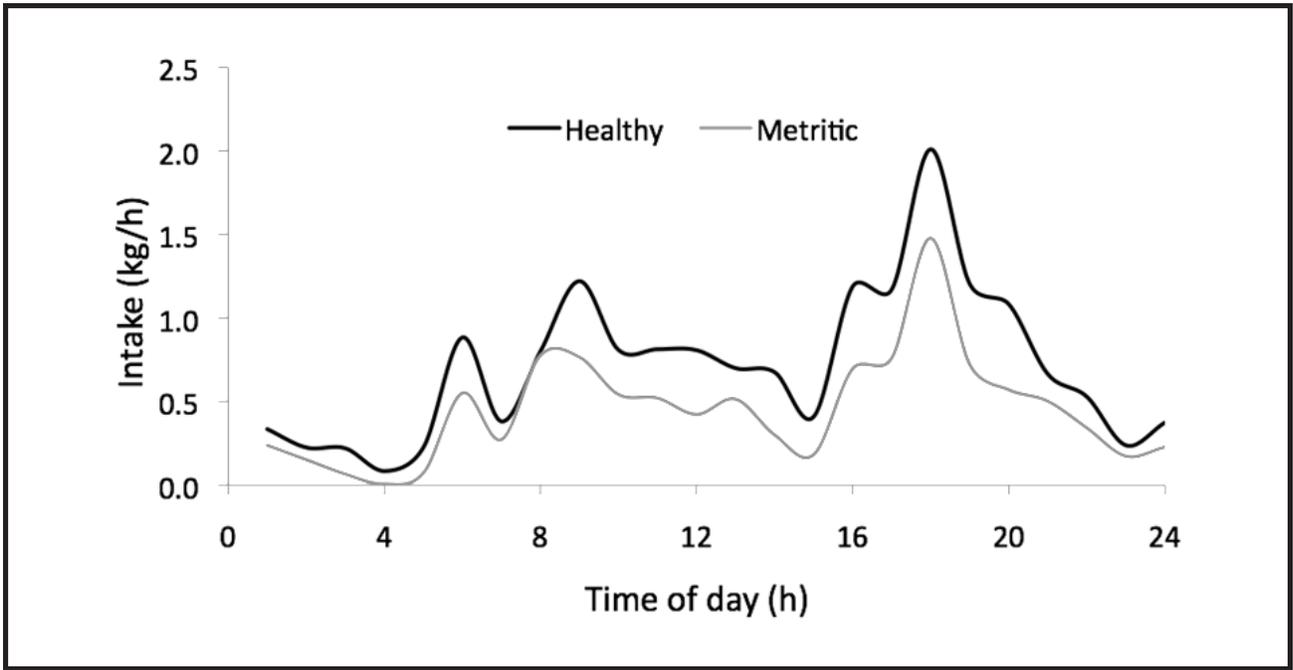
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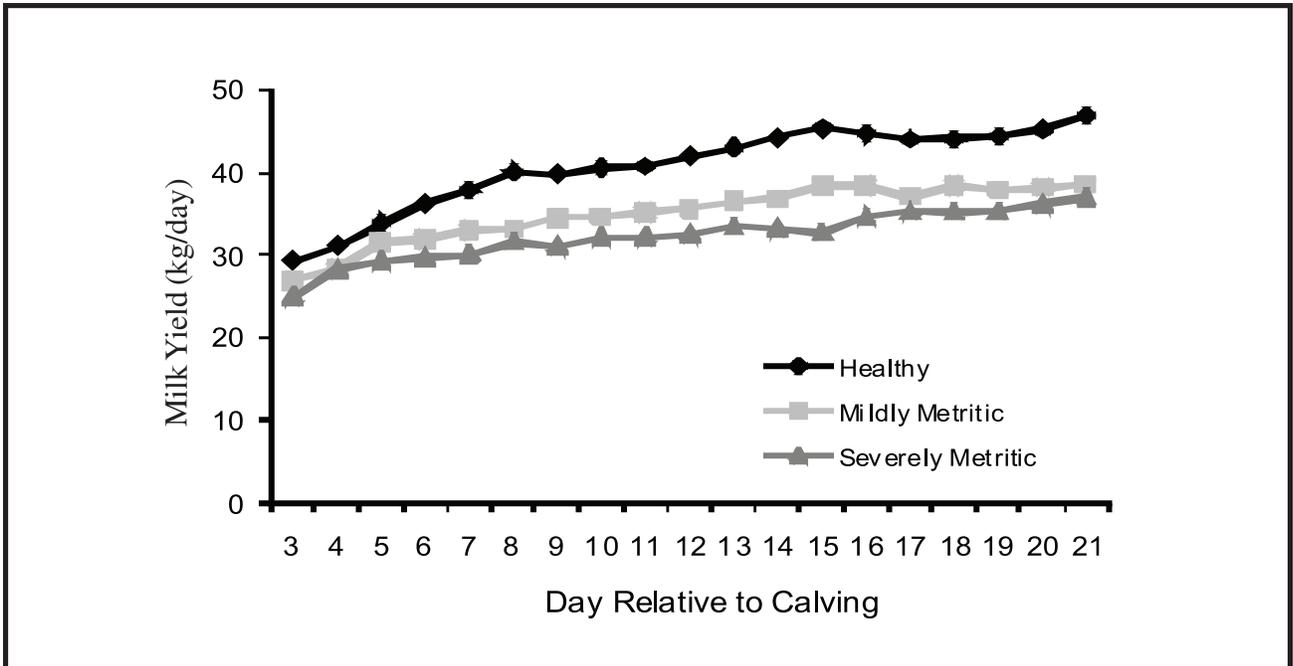
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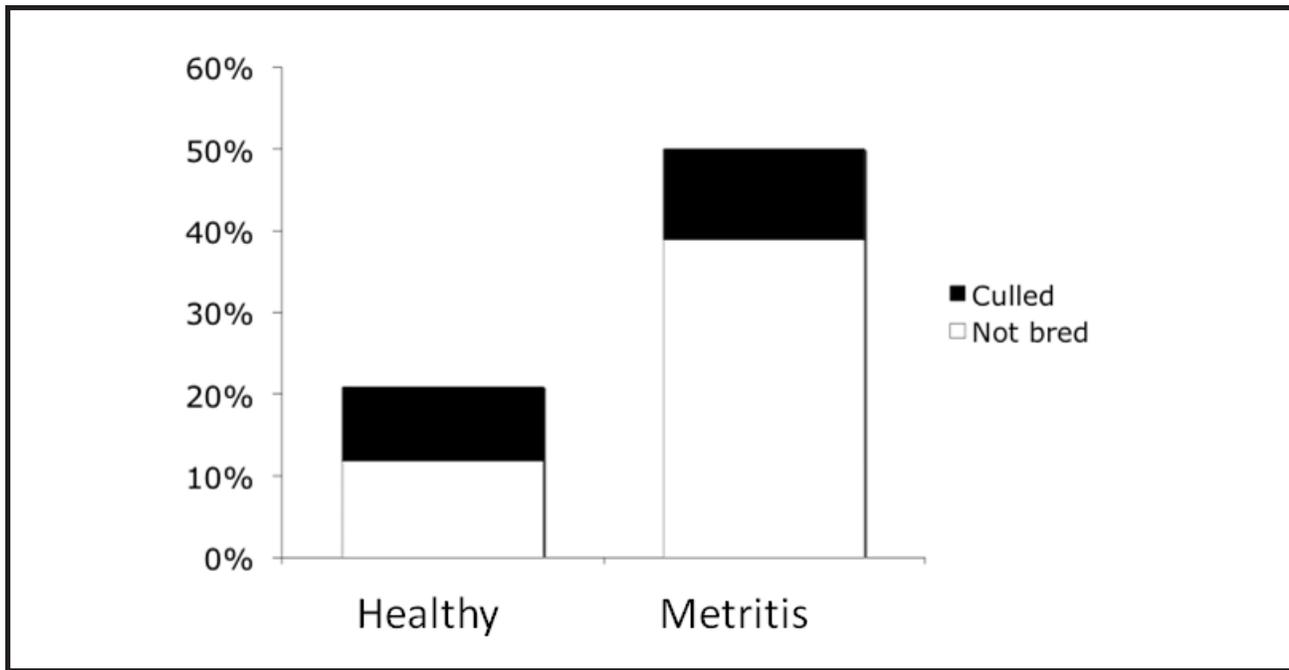
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**Figure 1.** Diurnal feed intake of cows that remain healthy and cows diagnosed with clinical metritis after calving (Healthy n = 45, Metritis n = 22) from 5 to 10 days after calving (see review by von Keyserlingk and Weary, 2010).



**Figure 2.** Average daily milk yield (kg) of healthy (n=23), mildly metritic (n=27) and severely metritic (n=12) Holstein dairy cows from 13 d before until 21 d after calving (adapted from Huzzey et al., 2007).



**Figure 3.** Cows that were diagnosed with metritis are twice as likely to be culled.