CAN WE USE BEHAVIOR AS A WAY OF IDENTIFYING COWS AT RISK FOR DISEASE DURING TRANSITION?

Marina von Keyserlingk and Daniel Weary

Animal Welfare Program, University of British Columbia, 2357 Main Mall, Vancouver, BC (Email: marina.vonkeyserlingk@ubc.ca)

INTRODUCTION

There has been much interest in defining the relationship between behavior and animal health (Weary et al., 2009). Behavioral signs have long been considered indicative of illness. For example abnormal feeding and drinking behavior and decreased activity are often considered to be indicative of more general malaise (e.g., Baumgartner and Ketz-Riley, 1999). Until recently almost all behavioral assessments of illness have been based upon subjective clinical evaluation. Animals are judged ill when they appear depressed, listless, or off feed (see Hornbuckle, 1992; Speirs and Wrigley, 1997). These indicators are often based on the accumulated experience of livestock handlers. Unfortunately, subjective evaluations can be prone to poor reliability.

Surprisingly, there is little scientific research that specifically addresses the value of behavior as a disease indicator. Valid behavioral indicators are those that clearly identify illness. These can be positive (i.e., behaviors that increase in frequency or magnitude when the animal is ill) or negative indicators (i.e., behaviors that reduce in frequency or magnitude with illness). In this paper we will show how the development of sensitive behavioral indicators can improve our ability to identify ill health. We will focus our discussion on the transition dairy cow to discuss how behavior can be used to predict, identify, and assess health problems.

THE TRANSITION COW

A major challenge for dairy producers and veterinarians is to maintain healthy dairy cows during the transition period. The transition period is typically defined as the period from 3 weeks before until 3 weeks after calving. During this time there are many physiological, metabolic and endocrine challenges related to parturition and the onset of lactation that increase the cows susceptibility to disease. Dairy cows also must adapt to numerous management challenges. The transition from pregnancy to lactation is marked by several social regroupings and changes in diet. These changes are necessary as cattle must transition to a higher energy diet in order to support the onset of lactation however there is evidence that regrouping has negative consequences on both behaviour and production. Phillips and Rind (2001) reported that regrouped animals had shorter feeding times, longer standing times and decreased milk production relative to cows kept in a stable group. When new cows are introduced to a pen the group dynamics change and this can lead to increased levels of aggression among individuals as social relationships become established (von Keyserlingk et al. 2008).
These challenges likely contribute to the high incidence of metabolic and infectious

diseases observed in dairy cows after calving. In a review of 25 studies related to transition cow health, Ingvartsen et al. (2003) summarized the incidence of common production diseases (Table 1) The incidence reported is of clinical diagnosis; however, many diseases occur in subclinical forms (Ingvartsen, 2006). Incidence measures also depend on the quality and accuracy of the farm's herd health records. Therefore, it is likely that the actual percentage of dairy cows developing illnesses after calving is higher than reported in current studies.

Table 1. Mean and range for incidence of selected periparturient health disorders[1].

Disorder	Mean (%)	Range (%)
Milk Fever	4.6	0.2 – 8.9
Displaced abomasums	2.1	0.6 – 6.3
Ketosis	4.1	0.2 – 10
Retained placenta	7.8	3.1 – 13
Metritis	10.8	1.7 – 43.8
Mastitis	17.6	2.8 – 39

[1]Adapted from Ingvartsen et al. (2003)

FEEDING BEHAVIOR AND INTAKE PREDICT METRITIS

As parturition approaches cows are moved again, this time to a maternity pen where they are usually isolated from the herd. Social isolation in unfamiliar surroundings has been shown to elicit stress responses in dairy cows in the form of increased heart rate, high cortisol concentrations, and increased vocalizations. After calving the calf is removed and the cow is moved again. This time she joins the lactating herd and is fed a new diet.

As veterinary examination of post-partum cows is relatively infrequent on most farms (commonly once every two weeks), many cases of transition disease may go unnoticed. Producers can use urine or milk tests to monitor the health of their animals, but frequent administration of tests on a herd-wide scale can be costly and time-consuming. Moreover, no such tests are available for diagnosing inflammatory uterine disease (metritis or endometritis), one of the most common disorders after calving. It has been suggested that animals that experience moderate metabolic stress after calving might sacrifice immune function for the sake of maintaining lactation. Therefore, the common practice of using daily milk yield as a general indicator of animal health is likely insensitive for identifying sick or at-risk animals. More sensitive methods of monitoring animal health or risk for disease during the transition period are needed.

Metritis is an important disease, in part because of its negative effects on the reproductive performance. The incidence of metritis or endometritis varies among studies from 8 to 53%. 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 in its clinical stages. In one study we investigated the changes in feeding and lying

behavior of 15 transition dairy cows monitored from 10 d before until 10 d after calving (Huzzey et al., 2005). The daily time spent feeding was variable over the pre-calving period, but averaged 86.8 ± 2.95 min/d.

Cows reduced feeding time by about one hour a day after calving. Lower feeding times after calving may be explained by an increased feeding rate due to the switch to a higher energy diet immediately after calving. During the post-calving period cows increased their feeding time by approximately 3.3 min/d, most likely reflecting the rapid increase in dry matter intake that occurs during this period.

Cows stood on average for 12.3 and 13.4 h/d during the pre and post partum period suggesting that standing time during the transition period is not much different than during other stages of lactation. Thus access to a dry, comfortable standing area is important, and should not be overlooked, particularly as this is known to reduce the risk of lameness. We did, however, note a dramatic increase (80 %) in the number of standing bouts from d-2 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. It has been estimated that between 2 and 23% of cows in a herd experience a difficult calving (dystocia) that requires farmer or veterinarian assistance (Mee, 2008). Understanding the behavioral cues associated with dystocia may thus help producers improve calving management by facilitating earlier intervention or assistance, thereby lessening the chance of more severe complications with calving.

In two subsequent studies we set out to test the prediction that cows exhibiting lower or reduced feeding behavior during the pre-partum transition period would be at greater risk for developing disease post partum. In the first study, we followed 6 Holstein heifers and 20 Holstein cows housed in a free-stall barn, and divided them into a pre-partum and post-partum group. Although group size was kept constant, group composition was dynamic as animals moved between pens as they progressed though the transition period, as is typical of many commercial situations. An electronic feeding was used to continuously monitor the feeding behavior of individual cows over the course of the study, and this data was used to estimate average daily feeding time. After calving the cows were examined for metritis every 3±1 d, based on rectal body temperature and condition of vaginal discharge.

Of the 26 cows used in this study 18 cows or 69% experienced some degree of pathological discharge (Vaginal Discharge score ≥2) with a range of onset from 3-15 DIM. Cows diagnosed with either metritis or acute metritis spent less time feeding during the post-calving period (d+2 to d+19 relative to calving) than did their healthy counterparts. These results suggest that feeding behavior may be a more sensitive indicator of disease than measures of individual feed intake.

Pre-partum feeding was able to account for a significant proportion of the variance in acute metritis, with cows doubling their risk of developing metritis with every 10-min decrease in pre-partum feeding time. The results of our next study undertaken by Huzzey

et al. (2007) indicate that feeding behaviour and DMI, particularly during the week before calving, can also identify cows at risk for post-partum metritis. We also provide the first evidence that cows that go on to develop post-partum metritis, engage in fewer aggressive interactions at the feed bunk during the week prior to calving and avoid the feed bunk during periods when competition for feed is highest. Moreover, cows that became ill with sub clinical and clinical metritis produced less milk during the first 28 weeks of lactation.

SOCIAL BEHAVIOR PREDICTS METRITIS

In the Huzzey et al. (2007) study we also provide the first evidence that social behaviour before calving may be related to the incidence of metritis after calving was demonstrated. During the week before calving cows that were later diagnosed with severe metritis engaged in fewer aggressive interactions at the feed bunk (i.e. displaced others from the feed bunk less often) and had reduced feeding times as well as intakes during the periods following fresh feed delivery, a time when cows are highly motivated to eat. Cows that were diagnosed with severe metritis after calving appeared to be less motivated to compete for access to the feed before calving. This lack of motivation may indicate that these cows are socially subordinate and unwilling to engage in interactions with more dominant individuals.

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.

CONCLUSION

Despite decades of research in the area of transition cow health and management the high incidence of health disorders around calving continues to negatively affect cow milk production and reproductive performance. The ability to identify the first signs of herd distress could lead to prompt intervention and consequently disease prevention; this would greatly improve farm profitability. Presently, dairy producers lack objective tools to measure how management, dietary, and environmental stressors around the transition period impact health and performance. Future progress in this area must combine our understanding of nutrition, metabolism, physiology, immunology and behaviour to determine the relationships between these stressors and disease and to develop management strategies that will reduce the incidence of disease after calving.

ACKNOWLEDGEMENTS

We thank Julie Huzzey and Katy Proudfoot and the many current and past members of The University of British Columbia's Animal Welfare Program, for their numerous

contributions to the data summarized in this paper. This conference proceedings is an updated version of a chapter first written for the Dairy Summit conference to be held December 2-3, 2009 at the Radisson Hotel in Green Bay, WI. The Animal Welfare Program is funded by Canada's Natural Sciences and Engineering Research Council Industrial Research Chair Program with industry contributions from the Dairy Farmers of Canada, Westgen, Pfizer Animal Health, Cattle Industry Development Fund, the BC Milk Producers, BC Dairy Foundation, BC Dairy Education and Research Association, and Alberta Milk.

REFERENCES

Baumgartner, W., and C. J. Ketz-Riley. 1999. Klinishe Propädeutick der inneren Krankeiten und Hautkrankheiten der Haus- und Heimtiere. 4th ed. Verlag Paul Parey, Berlin, Germany.

Cook, N. B., T. B. Bennett and K. V. Nordlund. 2004. Effect of Free Stall Surface on Daily Activity Patterns in Dairy Cows with Relevance to Lameness Prevalence. J. Dairy Sci. 87:2912-2922.

Hornbuckle, W. E. 1992. General physical examination of the cat and dog. Page 3 in Handbook of Small Animal Practice. 2nd ed. R. V. Morgan, ed. Churchill Livingstone, New York, NY.

Huzzey, J. M., M. A. G. von Keyserlingk, and D. M. Weary. 2005. Changes in feeding, drinking, and standing behaviour of dairy cows during the transition period. J. Dairy Sci. 88:2454-2461

Huzzey J. M., D. M. Veira, D. M. Weary, and M. A. G. von Keyserlingk. 2007. Prepartum behavior and dry matter intake identify dairy cows at risk for metritis. J. Dairy Sci. 90: 3220-3233.

Ingvartsen, K. L., R. J. Dewhurst and, N. C. Friggens. 2003. On the relationship between lactational performance and health; is it yield or metabolic imbalance that causes production diseases in dairy cattle? A position paper. Livest. Prod. Sci. 73:277-308.

Ingvartsen, K. L. 2006. Feeding- and management-related disease in the transition cow: Physiological adaptation around calving and strategies to reduce feeding-related diseases. Anim. Feed Sci. Tech. 126:175-213.

Lidfors, L. M., D. Moran, J. Jung, P. Jensen and H. Castren. 1994. Behavior at calving and choice of calving place in cattle kept in different environments. Appl. Anim. Behav. Sci. 42:11–28.

Mee, J. F. 2008. Prevalence and risk factors for dystocia in dairy cattle: a review. Vet. J. 176: 93-101.

Phillips, C. J. C., and M. I. Rind. 2001. The effects on production and behaviour of

mixing uniparous and multiparous cows. J. Dairy Sci. 84:2424-2429.

Speirs, V. C., and R. H. Wrigley. 1997. Clinical Examination of Horses. W.B. Saunders, Philadelphia, PA.

Tucker, C. B. and D. M. Weary. 2004. Bedding on geotextile mattresses: how much is needed to improve cow comfort? J. Dairy Sci. 87:2889-2895.

Urton, G., M. A. G. von Keyserlingk, and D. M. Weary. 2005. Feeding behaviour identifies dairy cows at risk for metritis. J. Dairy Sci. 88:2843-2849.

von Keyserlingk, M.A.G., D. Olineck, D.M. Weary. 2008. Acute behavioral effects of regrouping dairy cows. J. Dairy Sci. 91:1011-1016.

Weary, D. M., J.M. Huzzey, and M. A. G. von Keyserlingk. 2009. Board-invited review: Using behavior to predict and identify ill health in animals. J. Anim. Sci. 87:770-777.