J. Dairy Sci. 100:1–5
https://doi.org/10.3168/jds.2016-12201

Short communication: Detection and monitoring of metritis in dairy cows using an automated grooming device

R. Mandel,*†[1] C. J. Nicol,‡ H. R. Whay,‡ and E. Klement*
*Koret School of Veterinary Medicine, Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University, Rehovot 76100, Israel
†Department of Environmental Systems Science. Institute of Agricultural Sciences, ETH Zürich, Zurich 8092, Switzerland
‡School of Veterinary Science. University of Bristol, BS40 5DU, UK

ABSTRACT

Metritis, a prevalent disease on dairy farms, is negatively associated with reproduction, milk production, and the welfare of cows. The objective of this study was to evaluate the efficacy of monitoring low-resilience activities (i.e., behaviors that typically decrease when energy resources are limited or when the cost involved in the activity increases; e.g., brush usage) in the early detection of metritis. Data on daily brush usage (i.e., proportion of cows using the brush and the duration of usage) were collected from 28 metritic and 60 control cows 28 d postpartum using an automated monitoring system developed for the purpose of this study. During the first week following partum (before clinical diagnosis), we found no differences in brush usage between sick and control cows. However, 8 to 21 d postpartum (the week of clinical diagnosis and the first week of medical treatment), a lower proportion of metritic cows used the brush compared with control cows (0.49 compared with 0.64, respectively, at brushes installed away from the feed bunk). In addition, the daily duration of brush usage was 50% lower among cows diagnosed with metritis compared with control cows 8 to 28 d postpartum (44 s/d compared with 88 s/d, respectively). The results of this study suggest that on-farm monitoring of low-resilience behaviors, combined with existing systems that monitor core behaviors (e.g., activity and rumination), may serve as an improved method for detecting events that compromise the welfare of animals. The slow recovery of low-resilience behaviors following medical treatment (wk 4) might serve as a particularly useful indicator of progress of recovery from disease.
Key words: automated brush, cattle welfare, low-resilience behavior, sickness behavior

Short Communication

On the modern dairy farm, technology is commonly used to assist farmers with feeding, milking, detecting estrus behavior, and moving cows through automated individual recognition gates. A more recent trend is the use of technology to monitor the health state of individual cows by monitoring changes in physiological (e.g., milk yield, milk pH, BW, body temperature) and behavioral (e.g., rumination and activity meters) parameters associated with prevalent diseases such as clinical mastitis, lameness, and metabolic problems (reviewed in Rutten et al., 2013). Existing systems focus on measuring changes in the most basic and essential behaviors of cows (also referred to as core behaviors), such as those that are associated with food consumption (rumination tags) and basic features of movement (number of steps per time unit and lying duration as measured with activity loggers). By focusing on changes in core behaviors (e.g., daily duration of rumination), a low rate of false alarms can be achieved, thus reducing the chances of farmers neglecting the system's warning signs. However, because these types of behaviors are essential for the short-term survival of the animal, they are expected to decrease only at a relatively later stage of disease (Littin et al., 2008), to facilitate a fever response ("sickness behavior"; Hart, 1988), or when a sufficient degree of pain or lethargy is induced. The cost of such an approach is thus the low level of sensitivity during the early stages of disease, when physical signs of illness are poorly pronounced. An additional challenge that arises with the use of core behaviors as a measure of health condition is their rapid recovery following medical treatment. Once an animal is treated for an illness and the levels of core behaviors recover back to baseline, the animal is assumed to be fully recovered and therefore fit to be integrated back into the production line.

An alternative approach that could potentially improve detection of illness and provide more information on the recovery phase is to combine on-farm measures

Received October 25, 2016.
Accepted March 13, 2017.
[1]Corresponding author: roi.mandel@mail.huji.ac.il

of core behaviors with measures of low-resilience behaviors (also referred to as luxury activities—i.e., behaviors that typically decrease when energy resources are limited or when the cost involved in the activity increases; McFarland, 1999; see also Dawkins, 1990). Low-resilience behaviors are expected to decrease earlier than core activities and could therefore enable early detection of diseases (Littin et al., 2008; Weary et al., 2009). By monitoring change in low-resilience behaviors (e.g., the use of climbing resources such as a rope and ladder) in female R6/1 transgenic Huntington's disease mice, researchers were able to detect signs that precede clinical signs of disease (Littin et al., 2008). In addition, low resilience behaviors would be expected to have a longer recovery phase, compared with core behaviors, which can recover rapidly following medical treatment (e.g., mastitis; Sepúlveda-Varas et al., 2014). The aim of the current cohort study was to determine the association between brush usage and metritis in the first 28 d following partum, before and after medical treatment. Our hypotheses were that cows diagnosed with metritis would use the brush less compared with healthy cows and that the use of distant brushes (i.e., brushes installed away from the feed bunk) would be more indicative of morbidity than the use of brushes that were installed adjacent to the feed bunk (i.e., the difference in brush usage between the sick group and the control group would be higher; Mandel et al., 2013).

The study was carried out at a commercial dairy farm in the northern Negev of Israel from May 2015 to February 2016 (9 mo). Brushing activity was collected from 240 Holstein dairy cows. Among these, 106 cows calved during that period. Cows were kept in 3 groups according to their lactation status (first lactation, second lactation, and third lactation or higher). All groups were kept in loose-housing cowsheds bedded with dried manure. First, second, and third or higher lactation groups (70–80 cows/group) were housed in 90.0 × 16.6 m cowsheds. Cows were fed a TMR twice a day at 0800 and 1600. Water was available ad libitum from 6 water troughs (18 cm of trough/cow) in each cowshed. Cows were milked 3 times a day at 0400 to 0600, 1100 to 1300, and 1900 to 2100. A routine veterinary examination was carried out at 7 to 14 d postpartum for all cows that calved during the data collection period (n = 106 cows) with the aim of detecting signs of metritis. After the perineal area was thoroughly cleaned and disinfected, each cow was comprehensively examined through intravaginal and transrectal palpation by the farm's veterinary surgeon assigned by Hachaklait Veterinary Services Ltd. (Caesarea, Israel). Cases of retained fetal membranes were defined as the presence of placental tissues 24 h or more after calving as observed by a trained farm employee or the attending veterinarian. Ketosis was diagnosed by placing a drop of urine obtained with a disposable plastic catheter on a reagent strip (Ketostix, Ames, England) and comparing the color of the reaction after 15 s with a standardized color chart. Cows with urine acetoacetate concentration ≥15 mg/dL were recorded as ketotic (Goshen and Shpigel, 2006). Cows diagnosed with retained fetal membranes or other postpartum diseases (e.g., ketosis) and health risk conditions (e.g., lameness) were excluded from the statistical analysis. In the present study, we did not differentiate between puerperal metritis and clinical metritis. Clinical diagnosis of metritis was based on characteristics of vaginal discharge (obtained by manual examination of the vagina) and on cervical and uterine examination by palpation of the rectum. Affected cows had a flaccid, nonretractable uterus that was located in the abdomen; a cervical diameter of >75 mm; and a watery or purulent, fetid vaginal discharge (Goshen and Shpigel, 2006). All cows diagnosed with metritis were treated with 5 g of chlortetracycline i.u. twice per week for 2 wk (Goshen and Shpigel, 2006). Dates of disease diagnosis and medical treatment (provided by the farm's veterinarian) were collected from the Israeli management information system for the national dairy and beef herds. Clinical examination revealed signs of metritis in 37 out of 106 cows that calved during the course of the experiment. Nine cows diagnosed with metritis were additionally diagnosed with ketosis, retained fetal membranes, or lameness and were therefore excluded from the analysis. Among the 28 metritic cows included in the analyses, 13 cows were in their first lactation and 15 cows were in their second lactation or higher. The control group comprised 60 (out of 69) cows that calved during the course of the experiment and were found to be negative for metritis, lameness, or other postpartum diseases. Among the control cows, 20 cows were in their first lactation and 40 cows were in their second lactation or higher.

Six months prior to the beginning of the experiment, 6 rotating brushes (swinging cow brush SCB, DeLaval International AB, Tumba, Sweden) were installed in the dairy farm. Two brushes were installed in each group. To improve the detection of stress and morbidity (Mandel et al., 2013), 1 brush was installed 3 m from the food bunk (referred to as the near brush) and the other was installed 16 m from the food bunk, on the opposite side of the yard (referred to as the distant brush).

Data on daily brush usage (in seconds) were collected automatically using a brush monitoring system tailored for this purpose. The system was based on the technol-