Going beyond estrous detection with digital technologies

JoDee Sattler for *Progressive Dairy*

AT A GLANCE

From heat detection to transition cow health and metabolic disease, monitoring systems are opening up a world of data possibilities.

Digital technologies: They're not just for activity monitoring anymore.

Automated devices that track physical activity changes, with a focus on detecting estrus, date back to the 1970s. Today, digital technologies monitor so much more, including somatic cell count (SCC), bodyweight, locomotion score, body condition score, beta-hydroxybutyrate concentration (in milk), feed intake, feeding time, rumination time, lying time and temperature (skin, vagina or rumen). Digital technologies' presence in dairy herds will likely grow considerably because the generated data will produce actionable interventions that will help dairy producers increase efficiency.

"Expected changes in reproductive performance and profitability following implementation of automated monitoring devices (AMD) are highly dependent on a dairy herd's current reproductive performance," explained Ricardo Chebel, University of Florida Department of Large Animal Clinical Sciences. "It is critical to compare fertility outcomes in cows managed with specific AMDs with that of cows managed with timed artificial insemination [AI] programs, detecting estrus based on mounting devices (i.e., tail paint or chalk and estrous-detection patches) and different combinations of these methods."

Predict reproductive outcomes

With limited research in how AMD data may be used to predict reproductive outcomes and appropriate reproductive management for a particular cow, University of Florida researchers found that estrous characteristics detected at less than or equal to 41 days in milk (DIM) is associated with pregnancy hazard. "Cows with low rumination nadir at estrus recorded at less than or equal to 41 DIM had median interval from calving to pregnancy of 109 days, whereas those with high rumination nadir at estrus recorded at less than or equal to 41 DIM had median interval from calving to pregnancy of 130 days," reported Chebel.

AMDs can also measure a cow's heat index (HI) intensity. This is important because researchers found that a higher HI is associated with increased pregnancy rate. The unpublished data show a 21-day advantage for high-HI cows compared with low-HI cows.

A recent study looked at AMDs and their influence on pregnancy risk for AI and embryo transfer (ET). Surprisingly, the 2020 study discovered positive effects of AMD on pregnancy risk in cows receiving AI and ET. Improvement in pregnancy per service with AMD was greater for cows receiving ET (first service = 51.4%, second service = 34.5%) than cows receiving AI (first service = 16.7%, second service = 18.2%). Experts speculate that the improved estrous detection accuracy resulting from using AMD may have improved estrous cycle synchrony of recipients and the stage of development of embryos. This may have led to the improvements in pregnancy per service.

Enhance transition cow health

Despite a multitude of studies investigating optimal transition cow management, particularly nutritional strategies, postpartum morbidity remains a challenge. In the U.S., postpartum morbidity averages 45%, and the risk of pregnancy to first postpartum service is less than 40%.

For the past two decades, typical transition cow management included daily rectal temperatures and physical exams. Chebel is hopeful that AMD data will allow dairy managers to forgo these labor-intensive protocols. In other words, AMDs should help reduce lock-up times and consequently enhance animal comfort.

As cows approach parturition, dry matter intake (DMI) continuously decreases to a low on calving day. Concurrently, rumination falls during the days preceding calving. If all goes right – also known as a healthy fresh cow – rumination takes a steep increase after parturition. On the other hand, if rumination does not swing upward, peripartum health disorders such as subclinical

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hypocalcemia and ketosis, retained fetal membranes, metritis, displaced abomasum, indigestion and, in some cases, mastitis may ensue.

AMDs monitor changes in rumination overall and changes in rumination based on an individual cow's history. This information determines when alerts are sent.

Staff photo.

Diagnose metabolic, digestive disorders

Research in 2016 demonstrated that AMDs possess a high sensitivity for diagnosing metabolic and digestive disorders, and severe cases of metritis and mastitis. "It is imperative to understand that, to date, automated systems produce alerts for cows that likely have health disorders, but these alerts are not pathognomonic – that is, not specific to a particular disease," noted Chebel. "Thus, once an automated device generates an alert, the cow in question must be examined by an experienced veterinarian or herdsperson for proper disease diagnosis."

Chebel added, "Despite the sophistication of digital technologies, in herds with intense health-screening strategies, adding AMDs to the health-screening program may not improve survival, reproduction and/or production."

Researchers in 2020 added AMD-generated information to a health-screening protocol of postpartum cows and evaluated if it would be possible to improve their survival and reproductive and productive performance. In this experiment, adding the AMD information did not improve survival and milk yield. However, it reduced the risk of pregnancy by 150 DIM. "The negative effect of AMD alerts on the risk of pregnancy by 150 DIM is likely a spurious finding because the two treatments did not differ regarding the incidence of subclinical and clinical diseases," said Chebel.

Contrary to what had been hypothesized, the interval from the first AMD alert to disease diagnosis was not reduced. For cows not diagnosed with clinical disease but that triggered an AMD alert, they were more likely to receive supportive therapy (e.g., oral and intravenous fluids, transfer of rumen fluid from a healthy cow to a sick cow, vitamin B complex). The study's researchers concluded that in herds that have intense postpartum health-screening strategies, adding AMD alerts may not prove beneficial to cow performance. A question remains – What should be done with cows that trigger AMD alerts but do not present subclinical or clinical signs of disease?

Alterations in rumination patterns

The researchers in 2016 demonstrated that the intensity of alterations in the pattern of rumination and activity may indicate disease severity. "Alterations in rumination patterns around disease diagnosis were associated with significant milk losses compared with cows not diagnosed with diseases," reported Chebel. "Yet no milk yield differences were observed between cows with no clinical disease and cows with clinical disease and no alteration in rumination."

For cows diagnosed with metritis in the 2016 study, researchers observed severely altered rumination and activity patterns. Also, these cows had greater haptoglobin concentration and were more likely to be classified as do not breed or were sold by 60 DIM than those with minor rumination and activity alterations.

Current research is looking at additional data so scientists can refine prediction algorithms. One application is to predict antimicrobial treatment success. This will help dairy managers decide whether or not to treat a sick cow. In other words, will the cow respond and be cured?

Admittedly, digital technologies generate a plethora of data. While exciting, all of this information can be overwhelming. "For these systems to be used to their maximum potential, the data must be processed and generate information that is easy to understand and provide options to resolve the issue at hand," concluded Chebel. "Unquestionably, the best-understood use of these technologies is for estrous detection. But to limit their applicability to alert for cows that only need AI seems wasteful. By integrating AMD-generated data, recorded on-farm cow data, environmental data and diet information, it is possible to foresee situations in which we will be able to tailor the management of cows according to their needs."

This is a summary of Dr. Ricardo Chebel's presentation from the 2020 Dairy Cattle Reproduction Council (DCRC) annual meeting.