Dairy RESEARCH REVIEW™

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Issue 38 – 2024

In this issue:

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Welcome to the latest issue of Dairy Research Review.

Technological innovations feature strongly in this issue with research on different health management strategies for calving disorders in relation to sensor-based health alerts, use of on-animal sensors to predict paddock-level pasture mass, which is an important metric for grazing management, and the effectiveness of a virtual fencing technology to allocate pasture and move cows to the milking shed.

Another strong theme in this issue is animal health. The relevant selections are a retrospective study that identifies themes in lameness control on NZ dairy farms, a database analysis that assesses genetics related to stillbirth and preweaning mortality in Australian dairy cattle, an observational study that identifies management practices that could help dairy farmers to improve the health and production outcomes of selective dry cow therapies, and two retrospective studies of spontaneous humeral fractures in NZ dairy cattle that respectively investigate the epidemiology of fractures and possible on-farm predisposing factors.

We hope that you enjoy this issue of **Dairy Research Review**. We value your input and appreciate your comments and feedback.

Kind regards

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Research Review thanks AgriHealth for their sponsorship of this publication, and their support for ongoing education for animal health professionals.

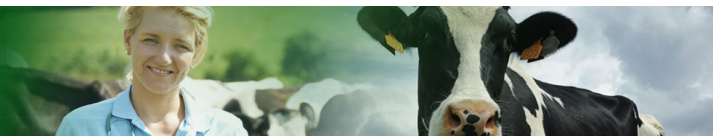
Long-term effects of 3-nitrooxypropanol on methane emission and milk production characteristics in Holstein-Friesian dairy cows

Authors: van Gastelen S et al.

Summary: The objective of this study was to assess the efficacy of 3-nitrooxypropanol (3-NOP) as a feed additive on the characteristics of methane (CH_4) emission and milk production from dairy cows receiving 3-NOP in their diet for a full year, covering all lactation stages and the dry period. Dietary supplementation with 3-NOP resulted in reductions of 21%, 20%, and 27% in CH_4 production, yield, and intensity, respectively. The anti-methanogenic effect of 3-NOP was influenced by diet type, diet composition, nutrition value, and duration of 3-NOP supplementation within a specific diet type. 3-NOP supplementation increased milk fat, milk protein, energy-corrected milk, and fat- and protein-corrected milk yields, and also improved feed efficiency.

Comment: This study looked at the long-term effect of feeding the enteric methane inhibitor 3-NOP, which inhibits the catalysation of the last step of the CH_4-forming pathway of rumen archaea (inhibits methyl-coenzyme M reductase). This study fed cows 3-NOP in their diet for a full lactation. The average dose of 3-NOP per day was about 70mg of 3-NOP/kg dry matter (DM) eaten. This was achieved by giving 45g of a premix per kg DM fed each day as part of a mixed ration. How, or if, this is achievable in a pasture-based system is not clear. 3-NOP treatment resulted in a reduction of CH_4 production, yield, and intensity of 21%, 20% and 27%, respectively. The higher quality rations had faster fermentation and increased propionate production; this may result in fewer methanogens in the rumen and less methyl-coenzyme M reductase to be inhibited by 3-NOP, which might explain the greater reduction in CH_4 seen on high-quality compared to low-quality diets. While this additive may not be applicable to NZ systems, if it becomes a commercial reality for other milk producers and it works as well as it does here, we may be at a disadvantage when it comes to selling our milk products if we cannot demonstrate CH_4 reductions of a similar magnitude.

Reference: J Dairy Sci. 2024;107(8):5556-5573
Abstract



Can lameness prevalence in dairy herds be predicted from farmers' reports of their motivation to control lameness and barriers to doing so? An observational study from New Zealand

Authors: Mason WA et al.

Summary: This cross-sectional study randomly enrolled and surveyed 101 dairy farmers from eight regions to identify barriers and motivators to controlling lameness in pasture-managed dairy herds and to describe the relationship between whether dairy farmers believed lameness to be a problem on their farm and on-farm lameness prevalence as evaluated by a trained external observer. Overall, 46% of the farmers surveyed believed lameness was minor or not a problem on their farm and 40% believed lameness to be a moderate problem. Farmers who perceived lameness to be a major problem had a lameness prevalence of 3.3% while those that perceived lameness to be minor or not a problem had a lameness prevalence of 2.3%. All motivators to control lameness were considered important by the farmers and they considered few barriers to be important at preventing them from controlling lameness. The most important motivators were feeling sorry for lame cows and pride in the health of their herd. The most important barriers were lack of time and skilled labour.

Comment: This study looked at whether farmers believed lameness was an issue on their farm and what the lameness prevalence was, and what motivates farmers to control lameness. I was surprised the median prevalence of lameness (lameness score of ≥2) was 2.7% (range 0.4% to 13.2%). Interestingly, the median prevalence did not statistically change from spring (2.99%) to summer (2.57%). I expected these values to be much higher but perhaps as a vet I see a biased sample of farms when dealing with or thinking about lameness. Perhaps the farmer respondents have a more realistic view of the amount of lameness as 46% perceived lameness as a minor problem or not a problem; 40% perceived it as moderate problem. The median prevalence of lameness for farmers that perceived lameness as a major problem or as a minor problem or not a problem had median lameness prevalences of 3.3% and 2.3% respectively. The top three motivating factors for investing time and resources into improving lameness were pride in a healthy herd, feeling sorry for lame cows, and feeling guilty for lame cows. Most farmers (80%) responded that these were very or extremely motivating. "Could lose assurance plan" ranked seventh out of eight motivating factors (but still more than half of farmers ranked this as very or extremely motivating). The three biggest barriers to managing lameness reported were lack of time, lack of skilled labour, and poor foot crush facilities. For the impact lameness has, farmers ranked pain and suffering for the cow (100% said very or extremely important), poor reproductive performance, and poor body condition score as the three most important. I think what I take from this paper was that it seems farmers are very interested in the welfare of their cows, and any discussion about lameness should take this into consideration along with the monetary drivers of reproductive performance and a need to tick boxes for assurance plans, etc.

Reference: J Dairy Sci. 2024;r;107(4):2332-2345
Abstract

Effects of 2 wintering practices on behavioral and physiological indicators of welfare of nonlactating, pregnant dairy cattle in a pasture-based system

Authors: Schütz KE et al.

Summary: The aim of this study was to compare behavioural and physiological indicators of welfare in pregnant non-lactating dairy cattle in two different wintering practices. Eighty cows were enrolled from a single dairy herd and randomly assigned to either pasture with hay bales (n=40) or kale crop grazing (n=40) following dry-off. Both groups of cows had physiological parameters that were within normal ranges, except for numerically higher levels of non-esterified fatty acids (NEFA) and lower white blood cell (WBC) counts in kale crop cows. In terms of behavioural parameters, cows managed on pasture with hay spent more time lying in postures indicative of greater thermal comfort and were observed ruminating more compared with cows on kale crop. Cows on pasture with hay also had comparatively higher skin and surface temperature and cleaner coats.

Comment: Winter grazing is under scrutiny from both an environmental and cow welfare perspective. This study compared cows that were wintered on kale or on pasture and hay sometimes known as "bale grazing". Bale grazing involves preplaced bales of hay (30 large bales per hectare) on a paddock with the bales opened up as each break is offered. Breaks are opened every second or third day. This tends to result in a cow being offered in the region of 16 m^2/day compared to about 8 or 9 m^2/day if on kale. The cows can use the bales as shelter and do lie on it, but it is not known if this improves the cows' welfare. This paper measured physiological and behavioural outcomes that represent welfare. Cows on pasture and hay spent more time, when they were lying, in positions that were "indicative of greater thermal comfort" and they also had higher skin temperature and were cleaner. In this study, there was no surface water pooling so both surfaces likely provided similar lying opportunities; it is possible this may not be the case if the environment was wetter. The difference in skin temperature could be explained (if there is a relationship between skin and core temperature) by the hay being a thermal insulator from the ground when lying down and/or the cows on hay ruminated more especially at night, which produces heat. This is despite the cows on hay/pasture receiving 31 megajoules of metabolisable energy less per day than the kale cows. It will be interesting to see how bale grazing stacks up environmentally and economically, but it does seem to improve welfare even in this study where the environmental conditions were not terribly adverse.

Reference: Dairy Sci. 2024;107(9):7079-7091
Abstract

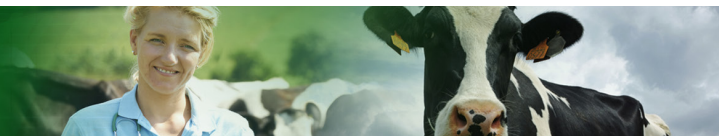
Evaluation of sensor-based health monitoring in dairy cows: Exploiting rumination times for health alerts around parturition

Authors: Simoni A et al.

Summary: These researchers examined the accuracy of health alerts triggered by a sensor-based accelerometer system and the effectiveness of two management strategies on a commercial dairy farm. Multiparous Holstein cows were randomly allocated to conventional (CON; n=199) or sensor-based (SEN; n=201) management groups at calving and monitored for disorders during a minimum of 10 days in milk (DIM). The majority of health alerts (87%) occurred on DIM 1. Overall, the data obtained showed that the SEN monitoring strategy was associated with greater sensitivity and specificity of the health alerts than the CON strategy. Discrepancies between the number of health alerts and initial diagnoses were observed for both groups during the peripartum period. The data also suggested that the rumination curve during the peripartum period might serve as an indicator for cows with disorders.

Comment: In this study all cows had an ear tag accelerometer (Smartbow) that generated health alerts. Half of the cows were monitored "conventionally" post calving (CON), i.e., the alerts generated by the tags were not accessible to the people doing the health monitoring, which happened daily. The CON monitoring included rumen fill, manure consistency, auscultating for a displaced abomasum, temperature, vaginal, and udder exam for the first 10 days. The other half of the cows (SEN) had the alerts accessible and were examined when an alert was generated for the first 16 days. In addition, 68 cows in the SEN group were blood tested at 0 and 3 DIM for blood calcium and at 3 and 10 DIM for ketosis. More than three-quarters (79%) of cows had a health alert generated by the tags. For the CON monitored cows the most frequent diagnoses made were fever of unknown origin (n=17) and retained placenta (n=12). For the SEN cows, "rumen dysfunction" (n=29) and lameness (n=16) were the most frequent diagnoses. A health alert was present for 70% of the ketosis cases diagnosed via the blood samples (incidence 35%) taken from the subset of SEN cows. Similarly, a rumination alert was present for 75% of hypocalcaemia cows (incidence 39%). Nearly half (42%) of the cows that suffered from hypocalcaemia had at least one other diagnosis, reinforcing the "gateway disease" role that milk fever has. Interestingly, the presence of fever did not affect rumination times in the case of metritis. A decrease in rumination time might be a better indicator of what is happening in the digestive system than an indicator of inflammatory processes that result in a fever. Temperature was a primary part of the CON monitoring protocol. In this study there was a "high rate of false positive health alerts", which reflects the duration of the study as it only included the first 16 days of the lactation when there are big changes occurring in daily rumination. On this farm, the SEN monitoring compared to CON monitoring did not significantly increase the number of diagnoses in the first 16 days of lactation. But was "CON monitoring" on this farm is quite different to, or at least more formalised, than what my farms do? Finally, the cows that had an alert, with a diagnosis, took the longest to recover from the initial decline in rumination.

Reference: J Dairy Sci. 2024;107(8):6052-6064
Abstract



Farm management and husbandry practices associated with spontaneous humeral fractures in New Zealand dairy heifers

Authors: Wehrle-Martinez A et al.

Summary: In this case-control study, the researchers used a farm-based survey to identify characteristics of the NZ dairy system associated with the risk of spontaneous humeral fracture in dairy heifers. A questionnaire was used to compare retrospectively how frequently the exposure to a risk factor was present on farms that had cases of humeral fractures in dairy heifers (case farms) with farms that did not (control farms). Based on 35 responses from case farms and 33 responses from control farms, the researchers identified cows being Holstein-Friesian Jersey crossbreed (HFxJ) as a possible risk factor associated with spontaneous humeral fracture in NZ dairy heifers.

Comment: I presume I am not the only one out there wondering what are predisposing heifers on some farms, and not others, to experience these fractures, or why has it occurred this year and not last year? In this paper a survey is quoted in which fractures affect 9.7% of herds with an average in-herd prevalence of 2.1% so I cannot be alone. Contrary to my experience, the survey mentioned 7.4% of herds experienced fractures in second-lactation cows. These fractures seem almost unique to NZ – so presumably something about how we farm our replacements is an important risk factor. This paper reports on a survey completed by farmers that had fractures and those that did not. In the final model two potential farm-level risk factors were identified. The first was farms that had the predominant breed being HFxJ. From 1998 to 2008 the proportion HFxJ cows in the national herd increased 16% and in following decade they increased by 14.7% and made up approximately 50% of the national herd in 2021. This does not actually tell us the proportion of herds where HFxJ is the predominant breed but describes the national herd, although I suspect the trend probably holds true for individual herds. It is important to remember fractures have been reported in Jerseys, Holstein-Friesians, and Ayrshires but farms that reported having experienced fractures were more likely to have HFxJ as the predominant bred on the farm. Perhaps there is something about farms that elect to use cross breeding rather than being a cross bred? The second risk factor was farms that allowed early access to pasture as calves (later access to pasture being protective). The authors point out that within both the North and South Islands the case farms were located further north than control farms, and perhaps this is why calves were out of the sheds earlier? This study "found no support" for a reported difference in growth checks, health issues, or fodder beet feeding between case and control farms.

Reference: N Z Vet J. 2024;72(2):96-102
Abstract

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An assessment of the epidemiology and herd-level impact of the fractured humerus epidemic in New Zealand dairy cattle, 2007-2015: Results from four studies

Authors: Hunnam JC et al.

Summary: These researchers integrated data from four independent quantitative studies to estimate the herd and within-herd incidence of fractured humeri in NZ dairy cows during the period 2007–2015. Combining the data from the four studies using a multi-method approach demonstrated that spontaneous humeral fractures in first- and second-lactation dairy cows were prevalent in NZ between 2011 and 2015 and that their occurrence was more common than previously thought.

Comment: This paper pulled results from four studies. A national case series, a case series from a pet food processor, a case series from Anexa, and a national telephone survey. The paper confirms that spontaneous fractures are a serious and widespread problem and that it may have worsened between 2011 and 2015. Contrary to my belief/experience, the national case series and telephone survey suggested there is a similar incidence of fractures in first- and second-lactation cows. The most frightening finding of this paper was that fractures occurred on 9.7% of farms in the 2014/15 season with a mean within-herd incidence of 2.6%. The authors extrapolated out that nationally this could mean 2,700 first-lactation heifers experience fractures. Interestingly, there was a difference in the farm incidence rate from the Anexa data set and what was estimated. I think I see this also, as it is not until I ask farmers about heifers with fractured legs they tell me about them. Maybe we do not get told about them as there is nothing we can offer. The authors discuss underreporting as a problem and perhaps this has resulted in the NZ dairy industry not recognising the extent, and severity of this condition. Perhaps if we ask our clients about heifer fractures and they realise they are not alone, some funding might materialise to see if we can work out what we can change to make this problem go away. It seems to be a NZ problem so maybe we need to be pushing it along if we think it is an issue.

Reference: Animals (Basel). 2024;14(3):524
Abstract

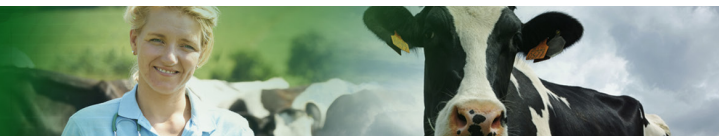
Genetic evaluation for stillbirth and preweaning mortality in Australian dairy cattle

Authors: Axford MM et al.

Summary: To estimate genetic parameters and estimated breeding value (EBV) for stillbirths (SB) direct, SB maternal, and preweaning mortality (PWM) for Australian Holstein and Jersey cattle, these researchers used farmer-recorded calving data, calf identity, pedigree, culling records, and EBV available in DataGene's Industry for Good Centralized Data Repository from the year 2000 onward. Calving records from around 2.25 million Holstein and Jersey dams were analysed. Incidences of SB and PWM in female dairy calves with Holstein or Jersey dams were 3.9% and 2.2%, respectively. The coefficient of genetic variation (CV%) was 11.7–14.5 in Holstein and 15.4–23.0 Jersey cows, suggesting the need for improved calf health traits. Calving ease was strongly correlated with SB in Holsteins. Calf size appeared to be breed dependent; average-sized calves were more likely in Holsteins while in Jersey cattle SB was higher in smaller calves compared with larger calves.

Comment: The fate of calves born on Fonterra dairy farms now needs to be recorded. This study looked at the heritability of SBs (die ≤24hours of birth) and PWM. The main effects associated with SB were calf sex, gestation length, hypocalcaemia at calving, calf birth weight, twins, dry period length, parity, and season. The incidence of SB was 6.8% (8.2% and 5.3% for males and females, respectively). The incidence of SB was higher in calves born to Jersey dams than Holstien dams (8.2% and 6.4%) but as Jerseys had low recorded dystocia the higher SB rates in Jersey calves may not be driven by a calf trait but by a dam trait. The replacement females were then followed through to examine PWM. Almost all calves (98%) survived to weaning. The loses were greater in Jersey calves than in Holstien calves (4.1% vs 1.9%). The heritability of these traits was estimated at between 1% and 5% depending on what breed. I think this paper reveals there is enough variation and heritability to be able to select for reduced SB and PWM but, as in Australia, I suspect we need to up our game in recording SBs and PWM. Perhaps this will be an unintended outcome of Fonterra's requirement to know the fate of all calves born.

Reference: J Dairy Sci. 2024;107(9):6994-7008
Abstract



The effectiveness of a virtual fencing technology to allocate pasture and herd cows to the milking shed

Authors: Verdon M et al.

Summary: Over a 4-week period, these investigators evaluated the effectiveness of a virtual fencing (VF) technology (Halter) to manage groups of mid-lactation dairy cows at pasture and to herd the cows to the milking shed. Training with the VF system occurred over 10 days, after which the cows were managed with the technology for a further 28 days. The VF technology was successful in containing dairy cows on a 24-hour pasture allocation and guiding the cows to the milking shed for milking twice per day. Cows started responding to the sound cue alone when in the paddock within 1 day and learned to move from the paddock to the shed unassisted by 4 days of training. After training was complete, 90% of cows spent ≤1.7 min/day out of zone, corresponding to ≤0.15% of the daily paddock time out of zone, and most cows received ≤1 low-energy electrical pulses per 100 sound cues when held in zone. During transitions to the milking shed, most cows received ≤3 pulses per 100 sound cues (≤1 pulse every four transitions).

Comment: The first surprise in this paper was that VF prototypes were first developed in the 1970s, but as we know they have only become a commercial reality in the last 10 years. This study looks a Halter and the time taken to train a cow to stay in her allocated zone and to make her way to the shed. Halter sends a GPS location for each cow twice per second. If a cow leaves her zone (crosses the VF) the collar emits a continuous sound, if the cow does not stop and return to the zone the intensity of the sound increases and eventually is followed by an "electrical stimulus" of ≤0.18J of pulses delivered over 20µsec. The duration of the sound before the electrical pulse and the strength of the pulse are variable depending on the individual cow's "reactivity". The sound stimuli are either on the left-hand side or the right-hand side to guide the cow to the left or right to return to the allocated zone. The collars also have three vibration patterns: a long one to alert a cow to either move to the shed or leave the current break; a shorter one after a sound cue to tell the cow she was headed in the right direction; and a third one to encourage consistent movement towards the shed if she stopped. There are safeguards that stop the collars giving cues, such as if cow is moving faster than a walk, the cow had not moved "substantially for a period of time", or a cow had received a number of consecutive pulses. This study looked at how quickly cows learn to respond to the collars. This paper backs up what clients tell me, i.e., "it only takes a couple of days". There are numerous ways "learning" was measured such as time out of zone and duration of sound alerts, but the ones I found most reassuring were the number of pulses per day, and pulses per sound cue. By four weeks, 50% of cows were receiving ≤15.7 sound cues and ≤0.67 pulses per day and most animals were getting <3 pulses per 100 sound cues with about 50% of cows getting no pulses per week.

Reference: J Dairy Sci. 2024;107(8):6161-6177
Abstract

INDEPENDENT COMMENTARY BY

Independent Commentary by Hamish Newton

Hamish Newton graduated from Massey University with a BVSc in 1998 and started working in mixed practice at the Veterinary Centre – Oamaru. **FOR FULL BIO CLICK HERE.**

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On-animal sensors may predict paddock level pasture mass in rotationally grazed dairy systems

Authors: Edwards JP et al.

Summary: In this proof-of-concept study, the researchers investigated whether pasture mass or allocation could be predicted using behaviour classifications from on-animal sensors. Four groups of 25 cows each were assigned to different pasture allocations (ranging from 80% to 120% of their energy requirements) over two 20-day experimental periods (late spring and late summer). Rumination time was identified as the most critical behaviour for predicting paddock-level pasture mass. Post-grazing pasture mass (kg dry matter/ha) was the best predicted metric.

Comment: On animal devices ("wearables") use accelerometers to capture movements and use algorithms to classify periods of time as behaviours such as eating, ruminating, and activity. The objective of this study was to see if pasture mass or allocation could be predicted using behaviour classifications from wearables. Each cow used had an IceCube pedometer (on their right hind leg), CowManager ear tag, smaXtec SX2 rumen bolus, and an eShepherd combined with an AfiCollar (to reduce the weight of the sensors around the neck). The eShepherd had the virtual fencing functionality turned off and it was there as a "passive monitor". There were positive correlations (r = 0.95–0.96) between rumination times recorded by Aficollar, CowManager, and smaXtec. This measures the strength of the relationship and it is important to note that there were large differences in the mean daily rumination times from 90 to 130 min/day and differences in feeding times recorded (134 min/day and 61 min/day) between the highest and lowest sensor recorded mean values in the late spring and late summer, respectively. No sensors were good at predicting pre-grazing pasture mass, but post-grazing pasture mass was best predicted by sensors that recorded rumination and eating times (AfiCollar, smaxTec, and Cowmanager; [R^2 = 0.58]). I think it is important to note that cows in this study had 24-hour breaks – whether predictions would hold true on 12-hour breaks I do not know as rumination does not occur only when cows are in their break, and much of it occurs at night. This paper to me suggests what are "rumination targets" for one wearable may not be appropriate for another wearable and, if you are using wearables, you will still need to assess your post-grazing residuals manually.

Reference: Comput Electron Agric. 2024;219:108779
Abstract

The association between somatic cell count and selective dry cow therapy, milking routine, and dry cow management practices in early-lactation cows from 21 commercial grazing dairy herds

Authors: Clabby C et al.

Summary: The objectives of this observational study were to assess the association between selective dry cow therapy (DCT), milking routine, and dry cow management with somatic cell count (SCC) in early-lactation cows from 21 commercial grazing dairy herds. Data from 2,016 multiparous cows in 21 spring-calving grazing dairy herds were available for analysis. The data revealed an inconsistency between herd-level intramammary infection (IMI) and the proportion of internal teat sealant (ITS) use between farms, which can be explained at least partially by *Staphylococcus aureus* being identified as being the major cause of cow-level IMI. Analysis of the data identified other cow- and herd-level management practices that could help dairy farmers improve the effectiveness of selective DCT and lower early lactation SCC.

Comment: This Irish study looked at the performance of over 2,000 multiparous cows from 21 dairy farms where the farmer had made the decision on what cows got what DCT at the previous dry-off event. Nearly half (47.6%) of cows got an ITS (herds ranged from 17.7% to 86.8%) and the balance got an antibiotic plus internal teat sealant (AB+ITS). Herds were pasture based, with seasonal calving, but were housed during the dry period. Herd testing occurred ≥4 times a year and they had a bulk milk SCC <200,000 cells/mL. Milk samples were taken from each quarter pre dry off (at a mean of 36 days prior to dry off). 19.7% of cows had an infection (herd range: 9.8–39.5%) and the most common cow-level pathogen was *S. aureus* accounting for 86.1% of the infections. I do not know but I am not sure this is what we would find in many NZ herds? The mean SCC was 55,000 cells/mL in cows that got ITS and 197,000 cells/mL for the AB+ITS cows, but 11.8% of ITS cows had an IMI found during the quarter sampling. This suggests that in high *S. aureus* prevalence herds identifying infected cows using herd test data and mastitis history is problematic and you likely miss the chance to cure some of these carrier cows during the dry period.

Reference: J Dairy Sci. 2024;107(9):7106-7120
Abstract