

Dairy RESEARCH REVIEW™

Making Education Easy

Issue 34 – 2023

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Using Dairy Research Review for CPD points

Reading relevant veterinary articles such as those in Dairy Research Review is a valuable way to keep current and can become part of your CPD record. Simply record the activity on your activity record and create a reflective record by writing a few sentences about what you learnt and how this impacts your practice as a veterinarian.

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Welcome to the latest issue of Dairy Research Review.

This issue features two studies of the metabolome, the set of small molecule metabolites within a biological sample, in dairy cows. One study looks at the association of uterine and serum metabolomes with metritis and the other assesses the serum metabolome of cows with sole lesions. Also included in this issue is research on the effects of different NSAIDs on endometrial cells, association between milk flow rate and cow comfort, and psychological impact of NZ's *Mycoplasma bovis* eradication programme on rural veterinarians.

We hope that the research featured in this issue of **Dairy Research Review** is professionally beneficial. Please keep your comments and feedback coming!

Kind regards

Hamish Newton

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

Global contributions of milk to nutrient supplies and greenhouse gas emissions

Authors: White RR et al.

Summary: Utilising data from the United Nations Food and Agriculture Organization (FAO), the aim of this analysis was to characterise the global contributions of fluid milk to human-edible nutrient supplies and the environmental impacts of food production, specifically greenhouse gas (GHG) emissions and water use. The key finding was that, compared with other foods, milk was among the highest in terms of nutrient-to-calorie ratio for many amino acids, phosphorus, calcium, and riboflavin. There were, however, environmental trade-offs associated with milk production globally. Dependencies between GHG emissions and ruminant milk and meat were found but not between water withdrawal and milk production.

Comment: This paper used a mass of data from the FAO. It looked at the global production of milk and milk's contribution to the world's human population's nutrient supply. I found it pretty hard to get my head around some of the statements about how important milk is to feeding the world. For example, it was calculated that liquid milk provides the requirements for calcium and phosphorus for 35% of the world's population, but whether it actually gets to 35% of the population is not stated. I thought it more interesting that the US dairy industry has agreed to reduce its GHG emissions to net zero by 2050, this will entail a reduction of 23% of absolute emissions. It seems that the Americans are struggling to work out how to do this (as we are) as "Most strategies aimed at minimising CH₄ emissions to date, however, have proven ineffective or detrimental to animal production goals".

Reference: *J Dairy Sci.* 2023;106(5):3287-3300

[Abstract](#)

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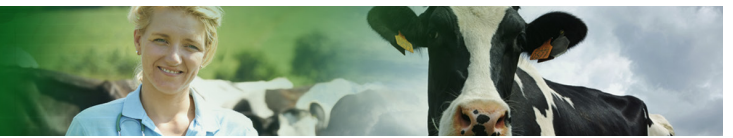


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Downer cows: a reanalysis of an old data set

Authors: Lawrence KE et al.

Summary: These NZ researchers compared the performance of two predictive models for predicting survival in periparturient downer cows. The first model, developed by [Clark et al.](#) and published in 1987, used a dataset containing missing values, while the second, new model was developed based on the same dataset but using modern data imputation and analytical methods. The predictive ability of the new model developed using the imputed data was contrasted with the original prognostic model by testing them both on a second smaller but complete data set, collected simultaneously with the development of the original model. The researchers' re-analysis demonstrated that the original prognostic formula developed by Clark et al. performed as well as the modern model built on an imputed data set. It should therefore remain an important component of the clinical examination of downer cows.

Comment: I found this article a bit sobering or perhaps more of a reality check. In the paper's introduction, the survival rates of downer cows reported in studies of greater than 200 cows ranged from 33 to 37%. The authors kindly remind the reader that a "competent dairy practitioner, following a thorough and systematic clinical examination, should be able to correctly identify and euthanise those animals with a hopeless prognosis" (namely, "limb/pelvic fractures, hip dislocations, severe neuropathies, and severe toxic conditions such as gangrenous mastitis or salmonellosis"). This still leaves a proportion of cows where a diagnosis and prognosis remain elusive. This paper re-examined two data sets collected in the mid-1980s. It appears that the original model to predict survival was not improved by new statistical methods. What is great is that in the supplementary material there is a spreadsheet to download where you can put in days recumbent and aspartate transaminase and urea values and the probability of survival is given. This seems a great tool to help decide on which cows, which in addition to the obvious ones, warrant euthanasia sooner than may have been the case without this additional data. This should be a win for cow welfare and farmer workload.

Reference: *N Z Vet J.* 2023;71(2):65-74

[Abstract](#)

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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. He then worked in mixed practice in the UK before starting a PhD at Bristol University examining factors that influence the cure of intramammary infections in the involuting mammary gland. Upon completing his PhD in 2007 he returned to the Veterinary Centre – Oamaru and became a partner in 2008. He now spends most of his working time dealing with dairy cows.



Moral distress in rural veterinarians as an outcome of the *Mycoplasma bovis* incursion in southern New Zealand

Authors: Doolan-Noble F et al.

Summary: This qualitative study was conducted to assess the impact of NZ's *Mycoplasma bovis* eradication programme on rural veterinarians (n=6) by exploring their experiences and the repercussions of those experiences. The study revealed that the lived experience of the veterinarians had been negatively impacted, characterised by psychological distress. The findings emphasise a need to consider how the system will address future exotic disease incursions to minimise potential adverse emotional effects on the rural veterinarian workforce.

Comment: "A qualitative social science research methodology, guided by the philosophical paradigm of pragmatism, was used to collect data." This is not what many of us are used to reading or even considering; however, if you have dealt with the *M. bovis* response in some capacity this paper might make the frustrations you felt seem validated. It is also a good read to get some understanding of what we might deal with (unknowingly?) if it results in "moral distress". Moral distress can occur if "the individual has not been part of a decision-making process but has to convey and perform decisions made by others, losing their ability to act as an independent moral agent". Perhaps the value you will get from reading this paper is that sometimes the frustrations (that I assume we all feel are "normal") could be due to this idea of moral distress and acknowledges the "complicated ethical structure veterinarians are embedded in, with responsibilities to animals, animal owners (clients), their peers and colleagues, and society as a whole" and that we "have to work within a very complex moral landscape due to society's changing values and expectations – particularly the ethics of human/animal relationships, and of food production generally".

Reference: *N Z Vet J.* 2023;71(3):116-127

[Abstract](#)

Cellular proliferation and apoptosis in *Staphylococcus aureus*-infected heifer mammary glands experiencing rapid mammary gland growth

Authors: Baker PH et al.

Summary: The objective of this study was to measure the degree of cellular proliferation and apoptosis in the epithelial and stromal compartment of uninfected and *Staphylococcus aureus*-infected mammary glands that were hormonally stimulated to grow rapidly. One mammary gland in each of eight non-pregnant heifers was randomly selected and infused with *S. aureus* while another mammary gland was designated as an uninfected control. The findings of mammary tissue analyses suggested that *S. aureus* intramammary infection impairs mammary epithelial growth via reductions in mammary epithelial cell number and by preventing its expansion into the mammary fat pad. These factors are likely to lead to a lower first-lactation milk yield during periods of rapid mammary growth.

Comment: This study looked at the effect of infusion into non-lactating mammary glands, hormonally stimulated to grow rapidly, with *S. aureus*. The mammary tissues examined were from heifers 11 to 14 months old six days after infusion with *S. aureus*. The inflammation seen the examined tissues was not severe (which may explain some of the underwhelming findings) and clinical signs of mastitis were not seen. It does seem hard to infect a dry gland and get clinical signs! When the measures of cell proliferation and apoptosis are taken together in this study, infection with *S. aureus* resulted in impaired mammary epithelial cell proliferation and reduced expansion into the mammary fat pad. These changes would likely result in impaired performance. So, infection of heifers with *S. aureus* seems likely to damage future performance and you probably will not even notice infected heifers. These researchers did not and they put the bugs in!

Reference: *J Dairy Sci.* 2023;106(4):2642-2650

[Abstract](#)

Comparison of calf morbidity, mortality, and future performance across categories of passive immunity: A retrospective cohort study in a dairy herd

Authors: Crannell P & Abuelo A

Summary: In this retrospective cohort study, the records from 4,336 dairy calves on a commercial dairy farm were analysed to compare dairy calf morbidity, mortality, growth until weaning, and reproductive efficiency until first calving under four categories (poor, fair, good, and excellent) of transfer of passive immunity (TPI). Associations of the TPI categories with disease events (diarrhoea or pneumonia), reproduction indices, first-lactation milk yield and growth at weaning were evaluated by survival analysis and mixed models. A proportional decrease in the hazard of diarrhoea as TPI category improved was observed. The data indicated that the four proposed categories of TPI can assist in reducing the incidence of diseases that occur early in life (i.e., diarrhoea). However, their effect on other diseases or future performance is unlikely to be as marked in herds with good colostrum and calf feeding management.

Comment: The authors in the introduction of this paper point out that transfer of passive immunity (TPI) has traditionally been classified as either “adequate” or “failed”. “However, whereas the prevalence of failed TPI has decreased over the last decades, this decrease has not resulted in a paralleled reduction in calf morbidity before weaning.” This paper examined the classification of TPI as “excellent” (>6.2 g/dL), “good” (>5.7 g/dL), “fair” (>5.1 g/dL), and “poor” (<5.1 g/dL). “Fair” was 5.1–5.7 g/dL STP, and traditionally a cut off of >5.2 or 5.5g/dL was used to define “adequate” TPI. So, in effect the threshold to be considered to have received adequate TPI was also raised if “good” or “excellent” translates to “adequate”, which it does in my mind. The paper looked at morbidity, mortality, growth weaning, reproductive efficiency, and first lactation milk yield. The reference category was “excellent” and the hazard ratio increased for diarrhoea, respiratory disease, any disease, and mortality and as the categories went from good to fair to poor. There was not a detectable effect on the performance measures (weight gain, reproduction, milk yield, etc.). The data for this study came from only one farm and there were only 5.6% calves with poor versus 39.9% with excellent TPI, so the lack of effects found (with notable exception of diarrhoea) might reflect the apparent good colostrum management on this farm. It seems probable that using categories (and “raising the bar”) will result in reduced a incidence of disease that occurs early in life (diarrhoea) – whether there is an effect on outcomes later in life is unclear. If you are routinely classifying groups of calves based on some measure of colostrum immunity you may want to consider raising the threshold you use and reporting more than just the proportion “failing”.

Reference: *J Dairy Sci.* 2023;106(4):2729-2738

[Abstract](#)

Effect of milk flow rate switch-point settings on cow comfort and milking duration

Authors: Upton J et al.

Summary: These researchers quantified the effect of four milk flow rate (MFR) switch-point settings on milking duration, milk yield, and cow comfort in a spring calving grass-based dairy herd. Significant differences were apparent in cow comfort, as indicated by cow stepping during milking, across treatments, for morning milkings but not for the shorter afternoon milkings. Daily milk duration was 14% shorter, average MFR was 19% greater, dead time was 10% shorter, and low flow time was 88% shorter for the MFR switch-point setting of 0.8 kg/min compared with 0.2 kg/min.

Comment: Yet another paper on what effect increasing the flow rate at which automatic cup removers are triggered to remove the cups are set to. This paper is from Ireland and points out that herringbone sheds are increasing in size but the labour in the sheds is not so there is the potential for overmilking and inefficiencies due to extended row times. This paper is almost a review article of all the work done in NZ over the last 15 odd years showing the benefits of setting a higher flow rate thresholds for cup removal, which has fed into the concepts of MaxT (maximum milking time) and the efforts of DairyNZ to increase milking efficiency. This paper did try and assess “cow comfort” by analysing the number of kicks or steps during milking at the four flow rates analysed (0.2, 0.4, 0.6, and 0.8 kg/min). There was no consistent reduction in kick steps as the cut-off point increased. Increasing the cut-off point unsurprisingly resulted in reduced milking times (especially the morning milking). There was no effect on milk yield, which was explained by the cut point being an average flow over a 20 second period. The actual flow at the point of cup removal was on average 32% lower than the set threshold.

Reference: *J Dairy Sci.* 2023;106(4):2438-2448

[Abstract](#)



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Analysis of immune-related microRNAs in cows and newborn calves

Authors: Hue DT et al.

Summary: In this study, which was carried out on a large commercial dairy farm, five milk-borne immune-related microRNAs (miRNAs) were quantified in cow blood, colostrum, and milk, and in neonatal calf blood prior to and after being fed colostrum. The objective was to determine (i) whether the miRNAs are absorbed from the dam blood into the colostrum or produced in the mammary gland; and (ii) whether they are absorbed from the colostrum by the neonatal calf or synthesised by the calves themselves. The results revealed that the five miRNAs were present at high levels in colostrum two hours postpartum and then declined throughout the lactation period. There was no evidence that the miRNAs were transferred from the cow blood to the colostrum, suggesting that they were synthesised in the epithelial cells of the mammary gland. Transfer of these immune-related miRNAs from the colostrum to the calf blood was not observed.

Comment: This paper reminded me that colostrum is far more than IgG and that immunology is such a rapidly evolving discipline that there is stuff they write about routinely I had no idea was a thing; in this example, “immune-related miRNAs”. It turns out that newborn calves’ blood is already full of the specific miRNAs examined in this paper and a cow produces miRNAs in the udder to put into the colostrum at a greater concentration than in milk. The colostrum miRNAs were not absorbed by the calf into the blood stream though. “MicroRNAs regulate a wide range of biological processes, including immune function, by affecting mRNA expression and stability” and “immune-related miRNAs regulate gene expression in many types of immune cells, including T and B cells, macrophages, and monocytes”. What role these miRNAs have in calf development is unclear, but it does seem odd that a cow goes to go to the effort of producing them and packaging them into exosomes (to protect them from digestion?) and exporting them into colostrum. No answers today but perhaps in the future we will be measuring these and using them as predictors of immune function or health?

Reference: *J Dairy Sci.* 2023;106(4):2866-2878

[Abstract](#)

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Effect of nonsteroidal anti-inflammatory drugs on the inflammatory response of bovine endometrial epithelial cells *in vitro*

Authors: Crookenden MA et al.

Summary: These researchers established an *in vitro* model of uterine inflammation (pilot experiment) and then used it to assess the efficacy of five NSAIDs (meloxicam, flunixin meglumine, aspirin, ketoprofen, and tolfenamic acid) before experimentation *in vivo*. The observation of an apparent ability to prevent an increase in uterine inflammation *in vitro* resulted in flunixin meglumine, meloxicam, and tolfenamic acid being recommended for further investigation *in vivo*. Serum amyloid A (SAA) was demonstrated to be a useful marker of uterine inflammation and was lowered in response to NSAID treatment, which was consistent with mRNA expression of three SAA isoforms. Other genes whose expression was reduced by NSAID treatment included those involved in the eicosanoid pathway and inflammatory mediators, suggesting that NSAIDs affect endometrial inflammatory processes.

Comment: This paper reports on an *in vitro* study looking at the effect that different NSAIDs had on endometrial cells that were in a mix of inflammatory substances to mimic uterine inflammation. There is a good summary in the introduction about what we think happens with different NSAIDs (e.g. half-lives and volume of distributions) and the actual effects on reproductive outcomes along with the different mechanisms or pathways that different NSAIDs work on. Three NSAIDs, meloxicam, flunixin, and tolfenamic acid were best at reducing inflammation. Between these three NSAIDs there were differences in mRNA expression depending on the NSAID used, highlighting potential differences in efficacy for treating uterine inflammation. As an *in vitro* trial this tells us nothing about what will happen in real life but does add to a growing body of evidence that NSAIDs could be useful in the treatment of postpartum uterine infection, and that the different NSAIDs do work differently.

Reference: *J Dairy Sci.* 2023;106(4):2651-2666

[Abstract](#)

Serum ¹H nuclear magnetic resonance–based metabolomics of sole lesion development in Holstein cows

Authors: Barden M et al.

Summary: This observational study compared the serum metabolome of dairy cows that developed sole haemorrhage (SH) and sole ulcers (SU), both types of sole lesion, in early lactation with the metabolome of cows that remained unaffected with the primary objectives of (i) determining whether the serum metabolome could predict the presence, or future development, of SH and SU; and (ii) identifying any metabolites related to these lesions. Analysis of the serum metabolome, as characterised by ¹H proton nuclear magnetic resonance spectroscopy, was unable to reliably predict the presence or future development of sole lesions. There were a small number of metabolites potentially associated with sole lesion development, although due to poor prediction accuracies these metabolites are unlikely to fully explain the differences between affected and unaffected animals.

Comment: Metabolomics is a group of techniques (in this case proton nuclear magnetic resonance) that detects many low molecular weight metabolites. It was hoped that this technique could be used to detect cows with sole lesions (sole ulcer and sole haemorrhage) or predict whether a cow would develop a sole lesion (“there is an assumed lag of approximately two months between instigating pathology in the corium and the detection of visible sole lesions”). The technique used in this study could not reliably differentiate animals that did or did not have sole lesions or those that went on to develop sole lesions. This study only provides “limited support” that there is “a major metabolic component in the aetiopathogenesis of sole lesions”. It seems we still need to consider mechanical trauma when thinking about lameness but perhaps in the future we will be using metabolomic techniques to diagnose or predict other conditions.

Reference: *J Dairy Sci.* 2023;106(4):2667-2684

[Abstract](#)

Differences in uterine and serum metabolome associated with metritis in dairy cows

Authors: Figueiredo CC et al.

Summary: These researchers characterised the uterine and serum metabolomes associated with metritis in dairy cows at the time of diagnosis and evaluated the shift in the uterine metabolome from diagnosis until five days after antimicrobial treatment, compared with cows without metritis. They concluded that the establishment of metritis in dairy cows is associated with local disturbances in amino acid, lipid, and carbohydrate metabolism in the uterus. The lack of observed differences in the uterine metabolome of cows with and without metritis on day five indicates that processes implicated with the disease are re-established by day five after diagnosis and treatment. No major differences in the serum metabolome of cows with and without metritis were observed at the time of diagnosis.

Comment: Cows found with metritis (reddish or brownish, watery, and fetid discharge from a Metrichex device) had the metabolome of what was lavaged out of the uterus examined on day of diagnosis and five days later. The serum metabolome was also obtained on day of diagnosis and five days later. The uterine metabolome was different between affected and unaffected cows at the day of diagnosis but not different by day five. The differences in metabolome of affected cows were associated with the metabolism of proteins, lipids, and carbohydrates, and were speculated to be from bacterial growth. The serum metabolome was not massively different between the affected and non-affected cows in this study, but no cows were severely affected by metritis in this data set. While the measuring of the metabolome does not yet appear to be clinically useful, it does give clues to what processes are occurring in the infected uterus and what is happening in the unaffected uterus, which may lead to novel approaches to cure or prevent metritis.

Reference: *J Dairy Sci.* 2023;106(5):3525-3536

[Abstract](#)