The role of recording and evaluating calf traits for improved sustainability

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Abstract

In a grazing system, about one-quarter of the costs associated with rearing dairy heifers are incurred between birth and weaning. In addition, the risk of mortality is considerably higher during this period which influences farm profitability as well as consumer attitudes towards the dairying industry. Genetic tools, such as estimated breeding values, can contribute towards improved outcomes for calves and easier calving routines for farmers. Stillbirth and heifer livability are two examples of calf traits. Acknowledging the astute ability of calf rearers to differentiate between calves that are easy or difficult to rear, a farmer-scored trait of calf vitality is under investigation. This study describes variation in calf vitality scores amongst a group of Australian Holstein herds. .

Keywords: calf vitality, calf health, dairy cattle breeding.

Background

In the Australian dairy context, sustainability is described as enhancing farmer livelihoods, improving the wellbeing of people, providing best care for all our animals and reducing environmental impact (Dairy Australia, 2020). Heifers often comprise around one-third of the total herd and are costly to rear. In a recent analysis, the cost of heifer rearing was estimated to be between AU$1190 (75% grazing) and AU$1718 (zero grazing) per heifer, of which $315 is incurred between birth to weaning in both systems (Shannon *et al*. 2022). Reducing stillbirth, calf morbidity and mortality can improve profitability by spreading costs over a larger number of healthy animals to be sold or retained as herd replacements. At the same time, farmers have an obligation to provide the best care for calves.

There is strong evidence that breeding values are useful genetic tools to improve the production and longevity of dairy cows (Veerkamp and van Pelt 2020) and thereby contribute to improved sustainability. In a specific calf example, the genetic trend for calving ease in Holstein bulls demonstrates a 1% increase in normal or easier calvings for every 5 years since 2000 in Australia. Easier calving is beneficial to both cows and their calves (Eaglen *et al*. 2011; Eaglen *et al*. 2013; Murray and Leslie 2013). A further example is found in the heritability of the calf survival trait that is estimated to be 5% for survival to 10 months in the UK (Winters 2019), 0.72% for survival to 18 months in the USA (Neupane *et al*. 2021), 0.60% for survival to 365 days in the USA (Gonzalez-Peña *et al*. 2019) and 4.2% for survival to first calving in Denmark (Fuerst-Waltl and Sørensen 2010) in Holsteins. Finally, stillbirth heritability estimates are also varied but are generally higher (1-12%) as summarised by Cole *et al*. (2007). It seems clear that breeding for calf traits can also contribute to sustainability.

In the analysis of stillbirth, calf survival and calf health traits, there is often insufficient data for a robust analysis, especially in countries where data recording is not enforced through legislation or strict quality schemes. So, the question becomes what calf trait recording initiatives could be implemented to increase the quality and quantity of calf health data that improves the genetic evaluation of calf traits and ultimately lifts calf performance?

Introducing Calf Vitality Score

A research project is underway to better understand the genetic variation in stillbirth, calf morbidity and mortality in Australian dairy calves. The project has already recruited more than fifty herds, of which six herds formed an early pilot group to test data collection processes. Several farmers in the early pilot group requested the opportunity to record something more than stillbirth, morbidity and mortality. They wanted to record calves that were exceptionally easy to rear in contrast to calves that were dull, sluggish and difficult to teach to drink. Using Australian colloquial language, calf rearers describe them as calves that were 'Rippers' or 'Duds'. As a result, the data collection was broadened to include a subjective calf vitality score.

Subjective trait measures are successfully used in the genetic evaluation systems of various countries. An example is the farmer scoring of milking speed, temperament and likeability in Australian dairy cattle with heritability estimates of 0.18-0.26 in Holstein and 0.25-0.29 in Jerseys (Beard and Jones 1991; Beard 1993; Visscher and Goddard 1995). Beard and Jones (1991) reported that Likeability, as a 'catch all' trait is a useful trait in models that predict early survival in animals without complete phenotypes. Despite the subjectivity of their scoring, these workability traits are influential in current breeding indexes (Byrne *et al*. 2016).

Given there is already familiarity with workability traits, we used a similar scoring scale as the base for a new Calf Vitality Score and modified to include aspects of behavioural scoring in beef cattle (Parham *et al*. 2019; Ceballos *et al*. 2021) and health scoring in humans (Streiner 2015). Key features of a successful scoring system will likely have the following characteristics:

- Clear terminology that is easily understood by observers.
- Simple definitions that can be memorized.
- Categories that are sufficiently different from each other.
- 3-5 categories.

The four-category calf vitality score is described in figure 1 where A-Ripper/Great, B-Good, C-Dull/Sick/Dud, D-Dead. The visual representation of the score is presented to support the needs of people with a range of learning styles. The consensus of the pilot group was that the calves should be scored for calf vitality within the first month of life.

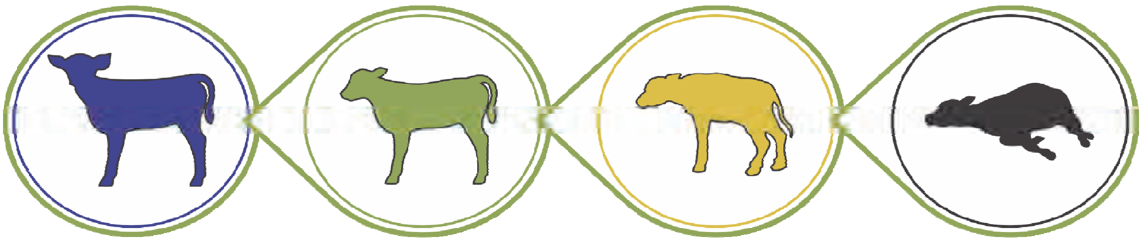

Figure 1. Calf Vitality Score.

Materials and methods

Six commercial dairy herds located in South-Eastern Australia were recruited in Spring 2020 as pilot participants, of which three recorded calf vitality scores. Farmers were asked to record calf identity, pedigree, calving dates, calf fate (stillbirth), calving ease, calf size, health and treatment events to weaning, deaths, deformed calves and calf vitality score. All stillborn calves were recorded, regardless of breed or gender. Health and vitality records were collected for dairy heifers and bulls kept for rearing. It is important to note that the calf vitality score was co-developed, with farmers, during the collection period.

Participation in the project was voluntary. Participants were invited to participate if they were passionate about calf health, willing to:

1. collect the required data;
2. provide feedback and information to the project, had calves that are predominantly sired by an AI sire and used Holstein, Jersey or Red Breed sires.

Data was supplied in a wide variety of paper-based and electronic formats but compiled into a Microsoft Access database (Microsoft) and then analysed in R Studio (RStudio Team 2021). Health and treatment events were included in this analysis so that a health event could be a diagnosis (such as scours) and/or treatment for an illness (such as treatment for scours), as recorded by the farmer. Herds were predominantly Holstein and were located within 15 km of each other meaning that calves were likely to be exposed to similar weather conditions, although management practices are expected to vary. Subsequently, we calculated summary statistics such as means and standard deviations for each herd and repeated for the overall group..

Results

There were 228, 127 and 171 recorded calves in each of 3 herds with calf vitality scores totalling 506 calves born between July and October 2020. As shown in Table 1, the mean mortality for each herd was 11, 35 and 2% including stillbirths. Stillbirths were 8, 31 and 2% respectively.

The most recorded health events were scours (37% of calves) and pneumonia (1% of calves). Calf vitality scores were recorded for 452 calves with means and ranges of Score A 32% (15-77), Score B 56% (0-73), Score C 8% (0-24) and Score D 3% (0-4). No animals with a Score A had a recorded health event. The prevalence of health events increased with subsequent scores as shown in Figure 2. Fifty-seven percent of calves with a Score B had at least one health event and this increased to 67% and 87% for Scores C and D.

Table 1. Mortality, stillbirth and calf vitality scores in 3 pilot herds.

	Herd A	Herd B	Herd C	Overall
Mortality				
Observations	228	127	151	506
Mean (±SD)	0.114	0.354	0.020	0.146 ± 0.354
Stillbirth				
Observations	228	127	151	506
Mean (±SD)	0.079	0.307	0.020	0.119 ± 0.324
Vitality				
Observations	203	98	151	452
Score A	0.241	0.765	0.146	0.323
Score B	0.714	0	0.728	0.564
Score C	0	0.235	0.086	0.080
Score D	0.044	0	0.040	0.033

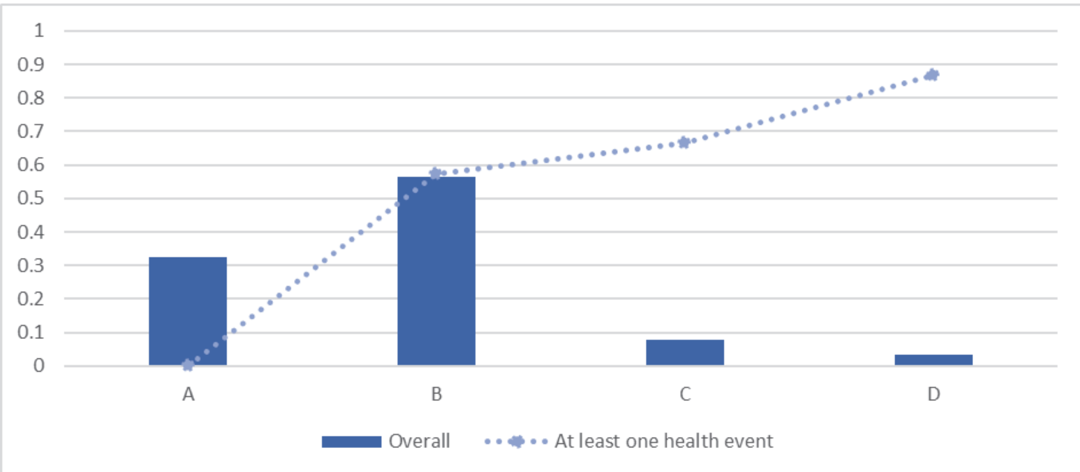

Figure 2. Mean proportions of calf vitality scores and recording of illness in 3 pilot herds.

Discussion

Farmers in the pilot group were co-developing the calf vitality scoring system during the first season of collection. The scale, descriptions, timing of scoring and recording spreadsheets were developed as the scoring was taking place. This is the likely reason for different scoring patterns between herds, as indicated by the range in mean scores. However, early indications suggest that the scoring system made sense as there were zero calves with Score A that also had a recorded health event. They were accurately recorded as 'Rippers'. In contrast, 87% of calves with Score D had a recorded health event.

While this is an early indicator that the scoring system could be useful, it also suggests that the variation in vitality scores could be so strongly linked to health events that recording health events alone could be of close to equal value. Herd recording systems are already in place for recording health events in dairy heifers. Relying on health event recording would avoid further software development tasks that would be required to systematically collect calf vitality scores nationwide. However, current recording systems typically exclude records for beef cross heifers and bulls. From a sustainability perspective, adequately managing and monitoring the health and welfare of these calves are equally as important as dairy replacements.

Following this pilot, the calf vitality score descriptions, images, recording sheets and timing of scoring were refined for use in subsequent calvings and in a much larger group of herds. For example, farmers reported that the best time to score was after the first week of life but it needed to be done before 4 weeks when differences became less obvious. Secondly, images were drawn and refined to provide a visual representation of each score. Further analysis of the larger collections that followed in 2021 and 2022 are expected to provide further insight to the value of calf vitality scoring.

Conclusion

Results from the pilot herds show that it is possible to score calf vitality as an additional piece of information in calf recording routines. Early indications suggest that calf vitality scoring is helpful in increasing engagement with farmers that can lead to improved calf health data recording. Higher quality and quantity of calf health records, for complete cohorts, will be useful to improve the benchmarking of sustainability metrics like mortality and morbidity as well as producing new genetic breeding tools. However, it is too soon to assess the value of calf vitality as an independent score. Continued collection of calf vitality scores in 2021 and 2022 has provided a larger volume of data which will be later analysed to determine the value of vitality scoring in genetic predictions of calf health traits, over and above conventional health recording.

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References

Beard K (1993) Genetic evaluation for milking speed, temperament, likability and survival in Australia. In 'Interbull meeting. Arhus, Denmark'. Available at file:///C:/Users/vick3rw/Downloads/165-Article%20Text-329-1-10-20120221.pdf [Accessed 25/02/2021].

Beard K, Jones, L (1991) 'Traits affecting survival of cows in australian dairy herds, 9th Conference Australian Association of Animal Breeding and Genetics ' Melbourne, Australia.

Byrne TJ, Santos, BFS, Amer, PR, Martin-Collado, D, Pryce, JE, Axford, M (2016) New breeding objectives and selection indices for the Australian dairy industry. J Dairy Sci 99, 8146-8167.

Ceballos MC, Góis, KCR, Sant'Anna, AC, Wemelsfelder, F, Paranhos da Costa, M (2021) Reliability of qualitative behavior assessment (QBA) versus methods with predefined behavioral categories to evaluate maternal protective behavior in dairy cows. Applied animal behaviour science 236, 105263.

Cole JB, Wiggans, GR, VanRaden, PM (2007) Genetic Evaluation of Stillbirth in United States Holsteins Using a Sire-Maternal Grandsire Threshold Model. J Dairy Sci 90, 2480-2488.

Dairy A (2020) Dairy Sustainability Report 2020. Dairy Australia, Melbourne, Australia. Availableat https://www.dairyaustralia.com.au/about/collaboration-partners/australian-dairy-sustainability-framework#.YoLu3vhByUk.

Eaglen SAE, Coffey, MP, Woolliams, JA, Mrode, R, Wall, E (2011) Phenotypic effects of calving ease on the subsequent fertility and milk production of dam and calf in UK Holstein-Friesian heifers. J Dairy Sci 94, 5413-5423.

Eaglen SAE, Coffey, MP, Woolliams, JA, Wall, E (2013) Direct and maternal genetic relationships between calving ease, gestation length, milk production, fertility, type, and lifespan of Holstein-Friesian primiparous cows. J Dairy Sci 96, 4015-4025.

Fuerst-Waltl B, Sørensen, MK (2010) Genetic analysis of calf and heifer losses in Danish Holstein. J Dairy Sci 93, 5436-5442.

Gonzalez-Peña D, Vukasinovic, N, Brooker, JJ, Przybyla, CA, DeNise, SK (2019) Genomic evaluation for calf wellness traits in Holstein cattle. J Dairy Sci 102, 2319-2329.

Microsoft 'Microsoft Access for Microsoft 365.'

Murray CF, Leslie, KE (2013) Newborn calf vitality: Risk factors, characteristics, assessment, resulting outcomes and strategies for improvement. Vet J 198, 322-328.

Neupane M, Hutchison, JL, Van Tassell, CP, VanRaden, PM (2021) Genomic evaluation of dairy heifer livability. J Dairy Sci 104, 8959-8965.

Parham JT, Tanner, AE, Wahlberg, ML, Grandin, T, Lewis, RM (2019) Subjective methods to quantify temperament in beef cattle are insensitive to the number and biases of observers. Applied animal behaviour science 212, 30-35.

RStudio Team (2021) 'RStudio: Integrated Development Environment for R.' (PBC, Boston, MA:

Shannon P, Musson, J, Scott, BA, 2022. How much does it really cost to rear a heifer? Dairy Australia,

Streiner DL (Eds GR Norman, J Cairney (2015) 'Health measurement scales: a practical guide to their development and use.' (New York, New York : Oxford University Press:

Veerkamp R, van Pelt, ML (2020) Advances in dairy cattle breeding to improve longevity. In 'Advances in breeding of dairy cattle.' (Eds Jvd Werf, J Pryce.) pp. 337-353. (Cambridge, England : Burleigh Dodds Science Publishing:

Visscher PM, Goddard, ME (1995) Genetic Parameters for Milk Yield, Survival, Workability, and Type Traits for Australian Dairy Cattle. J Dairy Sci 78, 205-220.

Winters M, 2019. Calf Survival Index. Agriculture and Horticulture Development Board, Warwickshire, UK. 2.