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Health, Welfare, and Behavior

Barriers to recording calf health data on dairy farms in Ontario

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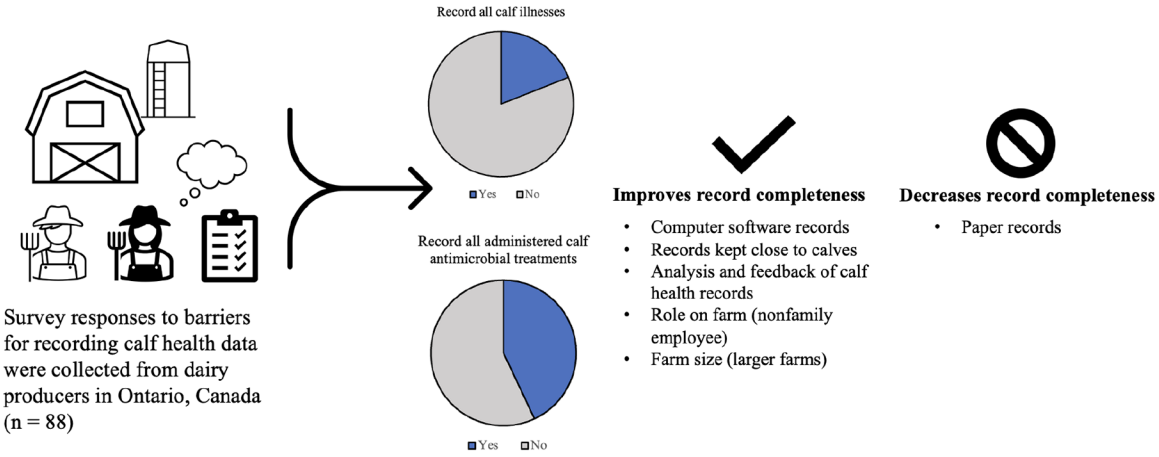
Graphical Abstract



Summary

An online survey was completed by a convenience sample of 88 dairy producers in Ontario, Canada, to investigate barriers for dairy farmers for recording calf illnesses and treatments. Fewer than a quarter of farms surveyed recorded all calf illnesses and fewer than half of farms recorded all administered antimicrobial treatments. We identified several factors associated with a producer's likelihood of recording calf illnesses and treatments, such as recording with a computer software system, keeping records in close proximity to the calves, and being a nonfamily employee. Several barriers were also identified, including lack of feedback from analysis of recorded calf data, records not being located near the calves, and records in a paper booklet.

Highlights

- The majority of dairy farms had incomplete calf health records.
- Paper calf health records are less complete than computer software records.
- Records analysis and feedback motivates farmers to record calf health data.
- Recording practices are improved when calf health records are kept near calves.

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Abstract: Establishing accurate illness and treatment rates in dairy calves is crucial, yet calf health records are often incomplete. Thus, the objective of this study was to investigate barriers for dairy farmers for recording calf illnesses and treatments on dairy farms in Ontario, Canada. An online survey was completed by a convenience sample of 88 Ontario dairy farms in 2022, with 34 questions regarding farm demographics, current practices surrounding record keeping and analysis, and factors that would improve recording compliance. Multivariable models were built to assess associations between explanatory variables and the following outcomes: likelihood of making management or treatment protocol changes based on records analysis, factors that would increase the use of electronic recording methods, and whether all calf illnesses and treatments are recorded. Pearson's chi-squared tests were also used to investigate associations between explanatory variables and whether the respondent agreed or disagreed with a proposed reason for why a calf illness or treatment would not be recorded on their farm. Producers had 3.45 times greater odds of recording all antimicrobial treatments if they used a computer software system compared with those that did not. With respect to anti-inflammatory treatments, producers had 3.11 times greater odds of recording these treatments if records were located in the calf barn than elsewhere. Nonfamily employees had 6.08 times greater odds of recording all supportive therapy treatments than farm owners. When calf health records were kept in the calf barn, respondents were less likely to report that illnesses were not recorded due to time constraints (5% vs. 36% if records were elsewhere) or because calf health records were not analyzed (10% vs. 34% if records were elsewhere). On farms that recorded calf treatments in a paper booklet, respondents were more likely to report that treatments were not recorded because calf health records were not analyzed (44% for paper records vs. 21% for other systems). The most commonly indicated factors that would increase recording of illness were recording with a mobile app (27% of respondents) and for the recording system to be easy to use (31% of respondents). Overall, these data indicate that recording may be improved by keeping calf health records in close proximity to the calves and using a recording method that allows for data analysis. An easy-to-use mobile app may also improve recording if it could be used in the calf barn, provide data analytics, and allow for time-efficient data entry.

Minimizing dairy calf illness is important for maximizing future production, as morbidities are associated with reduced growth rate, delayed pregnancy, and reduced first lactation milk yield (Aghakeshmiri et al., 2017; Dunn et al., 2018; Abuelo et al., 2021). Additionally, calves are frequently treated with antimicrobials; in Canada, 74% and 96% of dairy producers reported using antimicrobials to treat diarrhea and respiratory disease, respectively (Uyama et al., 2022). Similarly, in the United States, Urie et al. (2018) documented that 69% and 88% of calves with digestive disorders and respiratory disease were treated with antimicrobials, respectively. With antimicrobial use becoming an increasing public concern, it is important to gain an accurate understanding of the extent and nature of antimicrobial use in calves through calf health records. Furthermore, complete and accurate calf health records could allow for data analysis and consequent management changes to decrease morbidity and antimicrobial use. Unfortunately, calf health records from commercial dairies are often incomplete. Hyland (2022) identified that only 15% of dairy farms that were enrolled in Dairy Herd Improvement in Ontario, Canada, had accessible calf health records. Moreover, Uyama et al. (2022) found that only half of Canadian dairy farms had complete treatment calf health records in a format that could be analyzed.

Currently, there is limited knowledge of the barriers to recording illnesses and treatments in dairy calves. However, on sheep, beef, and mixed farms, Doidge et al. (2021) identified several barriers to recording treatments, including forgetfulness, multiple workers present without a clear responsibility to record, and not prioritizing due to lack of time. Moreover, if treatments were administered en masse, individual animal identifications went unrecorded (Doidge et al., 2021). Due to the effects of illness in calves on future production, the high proportion of antimicrobial use in diseased calves, and the public concern regarding agricultural antimicrobial use, further exploration is required to determine the barriers to recording calf health data on dairy farms.

The objective of this study was to investigate the barriers to complete and accurate recording of calf health events, especially illnesses and treatments, on dairy farms in Ontario, Canada. We hypothesized that producers would not be motivated to record illness and treatment events in calves for 2 reasons: (1) calf health records are not analyzed and (2) drug withdrawal times may not be a motivator as dairy heifer calves are nonlactating and are rarely sold for meat.

A survey was developed to gather information regarding producer and farm demographics, current morbidity and treatment

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recording practices, and calf health data analysis practices, which was collected through a 10-min online questionnaire (Qualtrics, www.qualtrics.com). This study was approved by the Research Ethics Boards at the University of Guelph (Ontario, Canada; REB #23–01–021). The survey was electronically distributed by veterinarians from 4 different clinics in Ontario to a convenience sample of dairy producers from April 2022 until August 2022. No sample size calculations were performed; sample size was based on convenience and willingness of veterinary clinics to distribute the survey to their client base. Eligibility criteria for study participation were working on a licensed Ontario dairy farm, literate in English, and raising their own replacement heifers at least until weaning. In addition, only one respondent per farm was eligible to participate and individual participant information was anonymous.

The survey (complete questionnaire is available in Supplemental File S1; https://doi.org/10.5683/SP3/W8KKF9, Edwards et al., 2023) contained 25 multiple-choice and 9 open-text questions divided into 5 areas of interest: (1) participant and farm demographics; (2) calf illness recording practices, specifically the proportions and types of illnesses that are recorded; (3) calf treatment recording practices, including the proportion of antimicrobial, anti-inflammatory, and supportive therapy (e.g., oral electrolytes, parenteral fluids, probiotics) treatments that were recorded; (4) recording methodologies (e.g., calf card, paper booklet, mobile app, computer software system, other) and location of records (e.g., main office, calf barn, home/house, phone/tablet, other); and (5) factors that would increase the consistency and completeness of recording illnesses and treatments. The survey was pretested by 2 producers for clarity. No changes were made following the pretest. Respondents were able to select multiple recording methods in the survey if they used more than one. All recording methods were subsequently recategorized as a binary outcome, where the respondent did or did not use each method. This was performed for all respondents and all recording method options. Additionally, respondents were able to select multiple locations for where calf health records were kept; however, due to lack of variability, this variable was recategorized as records kept in the calf barn or elsewhere.

Survey data were exported from Qualtrics into Excel (Microsoft Corporation 2022, Redmond, WA) and surveys were manually examined for errors and completeness. Multiple-choice or open-text responses that contained errors or were incomplete were excluded from the analyses. Variables were renamed and labeled, and multiple-choice responses were converted to numeric values to facilitate analysis. Finally, responses to 2 open-ended questions about factors that would increase the likelihood of recording calf illnesses and treatments were inductively coded and classified for quantitative analysis. Data were then imported into STATA 17.0 (StataCorp LP, College Station, TX) for analysis.

Descriptive analyses were performed for all quantitative variables. Pearson's chi-squared tests were used to investigate the association between explanatory variables and whether the respondent agreed or disagreed with a proposed reason for why a calf illness or treatment would not be recorded on their farm.

The proportion of recorded calf illnesses, antimicrobial treatments, anti-inflammatory treatments, and supportive therapy treatments were transformed from a continuous scale to a binary outcome (records 100% or does not record 100% of illnesses or treatments) due to lack of normality, which was assessed using the Shapiro-Wilk test. Univariable logistic regression models were then built to assess the association between explanatory variables and these binary outcomes. Additionally, factors that respondents indicated would increase the usage of electronic recording methods were also explored using a logistic regression model. Variables screened in univariable analysis for each outcome evaluated included producer education level, calf housing type, frequency of veterinary visits, number of milking cows (herd size), the respondent's role on the farm, the method of recording calf illnesses and calf treatments, the location of calf health records, and the likelihood of receiving actionable recommendations based on their calf health records. In each model, continuous variables were assessed for the assumption of linearity graphically and adjusted for nonlinearity by assessing if the variable had a quadratic relationship with the outcome, and where the relationship was not quadratic in nature, the variable was categorized into 3 or 4 equal quantiles. Any variable with $P < 0.20$ in the univariable analysis was considered for inclusion in multivariable models. The multivariable models were built through a backward stepwise elimination process, with variables with $P \leq 0.05$ retained in the final model, along with variables identified as confounders if their removal led to a >25% change in the coefficient of another significant variable. The final logistic regression models were assessed using Hosmer-Lemeshow goodness-of-fit tests where continuous variables were included, and Pearson goodness-of-fit tests when only categorical variables were included in the final model.

Among the 4 veterinary practices, the survey was shared with 120 dairy farms, of which 89 responded to the survey. One response was excluded from analysis because the respondent did not raise their own replacement heifers until weaning, leading to a response rate of 73% (n = 88/120).

Respondents were primarily owners (74%), 30–39 yr old (39%), and had completed college (48%). The most common housing and milking system for lactating animals was freestall (82%) and conventional parlor milking system (46%), respectively. Regular farm visits by a veterinarian were most commonly performed at least every 2 wk (89%) and the majority of farms (69%) were enrolled on milk recording services through Lactanet (Sainte-Anne-de-Bellevue, Québec, Canada). Additionally, most respondents reported having precision dairy technology for adult cattle, such as activity monitors (91%) and rumination monitors (61%). The median (range) number of lactating cows was 93 (28–453) and the median (range) number of dairy replacement animals was 100 (15–520). Most respondents (61%) housed preweaning calves indoors, of which 56% were housed in individual pens, 5% paired in pens, and 39% in group housing (Supplemental Table S1; https://doi.org/10.5683/SP3/W8KKF9, Edwards et al., 2023).

The median (range) proportion of total calf illness events that was recorded was 75% (0–100%), whereas the median proportion of recorded administered antimicrobial, anti-inflammatory, and supportive therapy treatments was 95% (0–100%), 80% (0–100%), and 0% (0–100%), respectively. When the variables were dichotomized, 19% of respondents recorded all calf illness events, and 43%, 38%, and 13% of respondents recorded all antimicrobial, anti-inflammatory, and supportive treatments, respectively.

Seven percent (n = 5/75) of respondents used calf cards, 53% paper booklets, 9% a mobile app, 47% computer software systems, and 11% used other methods to record calf illness events. Similarly, for treatment recording methods, 7% (n = 5/73) of re-

Table 1. Results from a multivariable logistic regression model evaluating the odds of recording 100% of antimicrobial treatments administered to calves using data from a survey of 88 dairy farms in Ontario, Canada

Variable	Description	Odds ratio	Odds ratio 95% CI	*P*-value
Location of calf health records	Location other than calf barn	Referent		
	Calf barn	3.11	0.95–10.15	0.06
Method of recording	Other method of recording	Referent		
	Computer software system	3.45	1.18–10.14	0.02

spondents used calf cards, 55% paper booklets, 10% a mobile app, 48% computer software systems, and 11% used other treatment recording methods. Producers kept calf health records in the main office (60%, n = 49/82), calf barn (28%; n = 23/82), house (1%; n = 1/82), phone/tablet (4%; n = 3/82), or other location (7%; n = 6/82). After collapsing recording location variables, 28% (n = 23/82) of producers kept calf health records in the calf barn and 72% kept records elsewhere. The frequency of receiving actionable recommendations from calf health records was reported to be always by 20% (16/81) of respondents, most of the time by 22%, about half the time by 10%, seldom by 19%, and never by 30%.

Respondents had 3.45 times greater odds of recording all antimicrobial treatments if they recorded treatments using a computer software system compared with those that did not (Table 1). Additionally, compared with those that kept calf health records elsewhere, respondents who kept calf health records in their calf barn had 3.11 times greater odds of recording all anti-inflammatory treatments (odds ratio [**OR**] 95% CI: 1.03 to 9.41, $P = 0.05$) and tended to have 3.11 times greater odds of recording all antimicrobial treatments (Table 1). Finally, respondents tended to have lower odds of recording all anti-inflammatory treatments using a paper booklet compared with other methods (OR = 0.40, 95% CI: 0.14 to 1.10, $P = 0.08$). With respect to supportive therapy treatments, nonfamily employees had 6.08 times greater odds than owners to record all of these administered treatments (Table 2). Also, for every 10 additional milking cows, producers tended to have 10.10 times greater odds of recording all administered supportive therapies (Table 2).

Time constraints were reported as the reason calf illnesses were not recorded by 28% (n = 23/81) of respondents. Respondents who kept their calf health records in the calf barn were less likely to report that illnesses were not recorded due to time constraints (5% vs. 36% if records were elsewhere; $\chi^2 = 7.15$, df 1, $P < 0.01$).

Overall, 28% (n = 23/81) of farms reported that illnesses were not recorded because those data were not analyzed. Respondents who kept their calf health records in the calf barn were less likely to report that an illness was not recorded because the calf health records were not analyzed (10% vs. 34% if records were elsewhere; $\chi^2 = 4.42$, df 1, $P = 0.04$). Over one-third (36%, n = 28/78) of farms reported that treatments were not recorded because calf health records were not analyzed. Respondents who recorded calf treatments in a paper booklet were more likely not to record treatments because the calf health records were not analyzed than those who used other means of recording (44% for paper records vs. 21% for other systems; $\chi^2 = 4.05$, df 1, $P = 0.04$).

Respondents were asked what factors would increase their likelihood of recording calf illnesses and treatments. Of the 88 completed surveys, 71 respondents provided open-text answers for that question. Approximately one-quarter (n = 19/71, 27%) of respondents reported that using a mobile app would increase illness recording compliance and almost one-third (n = 22/71, 31%) suggested that the ease of use of the recording system was important for improving recording. The other 73% and 69% of responses for improving illness and treatment recordings, respectively, were varied. Other suggestions for improving illness recording included time-efficient recording systems (n = 8/71; 11%) and for the recording software to perform trend analyses (n = 3/71; 4%). Alternate suggestions for improving treatment recording were similar and also included time-efficient recording systems (n = 6/68; 9%), for the recording software to perform trend analyses (n = 7/68; 10%), and the ability of the recording system to communicate with current farm software (n = 2/68; 3%). When investigating factors to increase the likelihood of recording calf treatments, 69 of 88 individuals responded. Approximately one-third (n = 21/69, 31%) of respondents reported that recording via a mobile app and that the ease of use of a recording system (n = 21/69, 31%) were important for improving treatment recording.

We identified several factors associated with a producer's likelihood of recording calf illnesses and treatments, such as recording with a computer software system, keeping records in close proximity to the calves, and being a nonfamily employee. Several barriers were identified, including lack of feedback from analysis of recorded calf data, records not being located near the calves, and records in a paper booklet. To our knowledge, this is the first study to explore factors that influence the likelihood of dairy producers recording illness and treatment events in dairy calves.

Few farms in the current study had complete calf health records, which is similar to what has been reported by others. In a study examining calf health monitoring in Norway, only 47% of dairies had complete calf illness records (Gulliksen et al., 2009), whereas

Table 2. Results from a multivariable logistic regression model evaluating the odds of recording 100% of supportive therapy treatments administered to calves using data from a survey of 88 dairy farms in Ontario, Canada

Variable	Description	Odds ratio	Odds ratio 95% CI	*P*-value
Role of respondent	Owner	Referent		
	Nonfamily employee	6.08	1.18–31.22	0.03
	Family member other than owner	2.76	0.45–17.10	0.28
Number of milking cows	Every 1 cow increase	1.01	1.00–1.02	0.07

in Wales, only 39% of farms recorded any calf illnesses (Atkinson, 2015). In both the Norwegian and Welsh studies, a greater proportion of illness recording was reported than in the current study, which may be due to differences in medication administration practices and the categorization of data. In Canada, the majority of livestock treatments are administered by farm personnel, whereas in Norway, the majority of treatments are administered by a veterinarian (Rajala-Schultz et al., 2021). It is possible that these veterinarian-administered treatments result in a more complete calf health record database compared with producer-administered treatments. Despite these discrepancies, recording of treatments is substantially incomplete. We also speculate that the variation in recording completeness across treatment modalities was influenced by the ramifications of antimicrobial usage, the severity of disease, as well as withdrawal times, where treatments without withdrawal times were especially poorly recorded.

Farm and respondent demographics influenced recording practices such that nonfamily employees had greater odds for recording all administered supportive therapy treatments compared with owners. Also, as farm size increased, there was a tendency for all supportive therapy treatments to be recorded. This is consistent with Kayitsinga et al. (2017) where larger herds were more likely to record treatments. Data on the motivations of family and nonfamily employees are sparse (Xi et al., 2015); however, in businesses with family ownership, nonfamily employees are less likely to express discretionary behaviors (Ramos et al., 2014). This may be due to nonfamily employees feeling obligated to follow employer protocols, whereas an owner has the flexibility for protocol drift without employer reprimand.

The majority (~54%) of respondents reported using a paper booklet for recording calf illnesses (n = 40/75) and treatments (n = 40/73), which was associated with incomplete recording. Although studies investigating producer motivations and barriers for recording data are scant, in previous studies investigating data quality, there were more errors in paper than electronic records (Menéndez González et al., 2010).

The location of calf health records was associated with producer recording practices. Keeping records in close proximity to the calves tended to improve the likelihood of recording illness events as well as antimicrobial and anti-inflammatory treatments. Time constraints are a significant factor on farms and have been previously reported as a reason not to record animal data in other agricultural industries (Doidge et al., 2021). Additionally, we suspect that keeping calf health records close to the calves improves record completeness, allowing data entry to occur soon after an illness is identified or a treatment is administered, thus minimizing the time required to record data as well as the opportunity for forgetfulness. Data entry close to the time and place of its generation is referred to as point-of-care data capture (Niland et al., 2006) and has been shown to drastically improve data accuracy in human medicine (Haan et al., 2004).

Lack of calf health records analysis was a common barrier to recording illnesses and treatments. We speculate that feedback based on records analysis fosters interest and accountability, and without demonstrated utility, producers are less willing to spend time recording data. An audit-and-feedback system is a common strategy used in human health care to change behaviors and increase protocol compliance. This strategy has been demonstrated to be effective when feedback is timely, individualized, and nonpunitive (Hysong et al., 2006). Furthermore, records analysis has been shown to be important to farmers. A survey of cow-calf operators in the United States reported that 32% of respondents would pay for veterinarians to analyze their health records and provide management advice based on the data (Jumper et al., 2022).

In this study, lack of data analytics, using paper booklets, and not keeping records near calves were barriers to recording calf health data. These findings also fit with respondents' suggestions for improving illness and treatment recording practices. Respondents most commonly identified a mobile app and a recording system's ease of use as factors that would improve the likelihood of recording both illnesses and treatments. This is consistent with Jumper et al. (2021), who reported that 58% of Mississippi cow-calf survey respondents were interested in using a mobile app to keep cattle health and production records. A mobile app would facilitate point-of-care data capture and an easy-to-use data recording system would minimize the time required for data entry. Moreover, the digital recording and sharing capabilities of a mobile app could facilitate records analysis by providing access to structured data. Structured data has the capability for storage, queries, recall, and analysis by computer (Raghupathi and Raghupathi, 2014). Additionally, structured data allow for easy and efficient data processing and analysis compared with unstructured data, such as that of paper records (Tayefi et al., 2021).

A limitation of this study is that producers self-reported the proportion of calf illnesses and treatments that are recorded on farm. As a result, recall bias may have contributed to inaccurate responses where producers over- or underreported the proportion of illnesses and treatments that were actually recorded. Additionally, there may be noncausal associations that were not controlled for due to the smaller sample size of this study as well as additional confounders that were not included within the survey. Because the survey was disseminated to a convenience sample, it also may not be representative of all dairy producers in Ontario. The demographics of survey respondents differed from that of the National Dairy Study (2015) where 62% of Ontario dairy farmers housed their cows in a tiestall facility and 62% used a pipeline milking system. This discrepancy may result from the convenience sampling of farms primarily located in the southwestern region of Ontario where farm sizes are larger, thereby resulting in fewer tiestall and pipeline operations. Furthermore, it is possible that since the National Dairy Study there have been barn renovations or new barns have been constructed, thus changing the demographics toward more loose housing. Due to our method of electronic survey distribution, producers who do not use technology on farm may be underrepresented in the current study. A final limitation to consider is that we did not explore the priority and ideologies of the producer or their veterinarian, which may be influential in recording practices and should be investigated in future research.

We identified opportunities and challenges in capturing accurate data on calf illness and treatment events on commercial dairy farms. Less than a quarter of farms surveyed recorded all calf illnesses and less than half of farms recorded all administered antimicrobial treatments. However, there may be opportunity to reduce calf morbidity and improve treatment recording practices by ensuring that calf health records are kept in close proximity to the calves, that the method of recording allows for data analysis, and that analysis is actually performed and reported to the farmer. Furthermore, producers may be motivated to record more illnesses

and treatments if an easy-to-use mobile app were available in the calf barn and facilitated useful feedback to farm personnel.

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Notes

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