Benchmarking calving management practices on western Canada cow–calf operations[1]

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ABSTRACT: Benchmarking current calving management practices and herd demographics in the western Canadian cow–calf production system helps to fill the gap in knowledge and understanding of how this production system works. Further investigation into the relationships between management decisions and calf health may guide the development of management practices and protocols to improve calf health, especially in compromised calves after a difficult birth. Therefore, the objectives of this cross-sectional study were to describe current calving management practices on western Canadian cow–calf ranches and to investigate the association of herd demographics with herd-level incidence of calving assistance, morbidity, mortality, and use of calving and colostrum management practices. Cow–calf producers were surveyed in January 2017 regarding herd inventory and management practices during the 2016 calving season. Ninety-seven of 110 producers enrolled in the western Canadian Cow-Calf Surveillance Network responded. Average herd-level incidence of assisted calvings was 4.9% (13.5% heifers, 3.2% cows), stillbirths was 2.1% (3.3% heifers, 1.9% cows), preweaning mortality was 4.5%, and preweaning treatment for disease was 9.4% (3.0% neonatal calf diarrhea, 3.8% bovine respiratory disease, 2.6% other diseases). Greater than 90% of producers assisted calvings and would intervene with colostrum consumption if the calf did not appear to have nursed from its dam. Late calving herds (i.e., started calving in March or later) had significantly lower average herd-level incidence of assistance, treatment for disease, and mortality ($P < 0.05$). In earlier calving herds (i.e., started calving in January or February) producers had shorter intervals between checking on dams for signs of calving or intervening to assist with a calving ($P < 0.05$). In early calving herds, producers were more likely to perform hands-on colostrum management techniques such as placing the cow and calf together or feeding stored, frozen colostrum ($P < 0.05$). There were no associations between herd size and herd-level incidences or management techniques ($P > 0.05$). This study suggests that in western Canada earlier calving herds are more intensively managed, whereas later calving herds are more extensively managed. Herd demographics may be important to consider when investigating factors associated with management strategies, health, and productivity in cow–calf herds.

Key words: beef cattle, benchmarking, calving management, colostrum management, cow–calf

[1]The authors appreciate financial support from the Canadian Beef Cattle Industry Science Cluster (funding provided by the Beef Cattle Research Council and Agriculture and Agri-Food Canada), Alberta Agriculture and Forestry, the University of Calgary Anderson Chisholm Chair in Animal Care and Welfare, as well as Dr. Pearson's stipend support by the University of Calgary Eyes High Scholarship. We thank Dr. Sarah Parker for her contributions to survey logistics.

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Received April 12, 2019.

Accepted June 20, 2019.

Transl. Anim. Sci. 2019.3:1446–1459
doi: 10.1093/tas/txz107

INTRODUCTION

Alberta, Saskatchewan, and Manitoba are the predominant beef producing provinces, producing roughly 77% of the beef animals in Canada (Canfax Research Services, 2018). Within the cow–calf sector, calf health and survival are critical (Murray et al., 2016). Herd-level factors such as the month calving season began and herd size were associated with an increased risk of treatment for disease (Woolums et al., 2013; Murray et al., 2016) and month calving season began and dam housing were associated with a higher risk of mortality (Ganaba et al., 1995; Sanderson and Dargatz, 2000; Waldner, 2014). At the individual level, a difficult birth increases the risk of diseases and preweaning mortality (Sanderson and Dargatz, 2000; Mellor and Stafford, 2004). Difficult births have also been associated with decreased transfer of passive immunity (Waldner and Rosengren, 2009; Barrier et al., 2013). Calves with failure of transfer of passive immunity have a higher risk of preweaning morbidity, mortality, and decreased weight gain (Dewell et al., 2006; Waldner and Rosengren, 2009). Good quality and timely administration of colostrum are important to the health and productivity of compromised calves (Filteau et al., 2003; Homerosky et al., 2017). Despite these North American studies, calving management practices vary greatly depending on region, operation size, and available facilities (NAHMS, 2009). Calving and colostrum management practices and relationships between management practices and calf health on western Canadian cow–calf operations have not been sufficiently described nor explored. Filling this gap in knowledge provides the opportunity to better understand how these production systems work and to potentially guide the development of future protocols. Therefore, the objectives of this study are to benchmark current calving and colostrum management practices on western Canadian cow–calf operations and to investigate the relationship between herd demographics and herd-level incidence of calving assistance, treatment for disease, mortality, and frequency of calving and colostrum management practices.

MATERIALS AND METHODS

The study was approved on 9 January 2017 by the University of Calgary Research Ethics Board (REB16-1142). Producers enrolled in this study were participants in the Western Canadian Cow–Calf Surveillance Network (WCCCSN), which consisted of a convenience sample of approximately 110 herds from the provinces of Alberta, Saskatchewan, and Manitoba. Producers were contacted through veterinary practices. Herds were selected to reflect the 2011 Census of Agriculture (Statistics Canada, 2011) to represent the geographic distribution and herd size of herds with at least 100 breeding females. In addition, producers were enrolled based on willingness to participate. In the WCCCSN, producers were asked to complete 3 to 4 surveys per year and to allow biological sampling of their herd every other year (Moggy et al., 2017; Waldner et al., 2017).

The survey for this study consisted of 51 questions. The first section included questions regarding number of workers, herd demographics (start and end of calving season, herd size), and cow and calf inventory. The second section of questions pertained to management factors such as: pregnant cow management, calving management, calving protocols, colostrum management, mismothering and crossfostering, and breeding management. The full survey can be accessed by contacting the corresponding author.

A pilot survey was circulated to a total of 5 cow–calf producers, veterinarians, and researchers. The survey was then revised for clarity prior to being distributed to the WCCCSN producers. Paper copies of the surveys were mailed to WCCCSN participants and an online version was also available. Data were recorded in commercially available spreadsheet software (Microsoft Excel, Microsoft Corporation, Redmond, WA) prior to analysis. Only winter/spring calving season inventory data and management practices were reported. Questions that were unanswered by respondents as well as questions where respondents marked more than 1 answer for a single-answer question were excluded from the descriptive analysis, so the number of herds reported for each question varied.

Herd Demographics and Animal Inventory

The month of the start of calving season was determined by the date on which the second full-term calf was born in the herd. April and May were combined due to the small number of herds (<5) that started calving in May. Total herd size was estimated by adding the number of heifers calved to the number of cows that calved. Animal inventory was calculated for calving assistance, stillborn calves, treatment for disease, and mortality. The frequency of assisted animals comprised of the number of calves assisted at birth for each herd divided by the total number of calves born (live or dead) on each herd for heifers or cows, respectively. The frequency of stillborn calves comprised of the number for the stillborn calves divided by the total number of born calves (live or dead) on each herd for heifers or cows, respectively. The frequency of treated calves in the preweaning period comprised the number of calves treated for each category of disease [neonatal calf diarrhea (NCD), bovine respiratory disease (BRD), or other diseases] divided by the total number of liveborn calves in each herd. The frequency of dead calves in each age category comprised the number of dead calves in the age category (i.e., 1 to 7 d of age, 7 to 30 days of age, 30 days to weaning) divided by the total number of eligible live calves in that category (i.e., total number of live calves minus the number of stillborn calves and of calves that died in previous mortality age category) in each herd.

Pregnant Dam Management

Respondents were asked to self-identify which type of housing for heifers and cows best fit their operation for the production periods: breeding to pregnancy diagnosis, overwintering period, and 2 mo prior to the start of the calving season. Categories were as follows: extensive grazing (cattle are housed on large land areas with a relatively large number of acres per animal and the main feed source being grazing or green feed), small pasture (cattle are housed on a small land area with a relatively low number of acres per animal with supplemental feed and/or grains provided as the main feed source either on the ground or in a feeder or feed bunk), or dry lot [cattle are housed in a cattle-dense dry lot (feedlot) with all feed and/or grains provided in a feeder or feed bunk].

Calving Management

Calving management questions included the timing when dams were moved to the calving area (i.e., >6 wk, 3 to 6 wk, 1 to 3 wk, <1 wk before calving), what reasons dams were moved into a calving barn either prior to or after calving (i.e., signs of impending calving, needing calving assistance, cold weather, mismothering, bad udder, crossfostering), the timing when dams were moved out of the calving area, the frequency that dams were checked for signs of calving (i.e., <30, 30 to 60, 60 to 90, 90 to 120, >120 min), which circumstances prompted a producer to intervene with calving assistance [i.e., feet or water bag (amniotic sac) showing, no progression by the dam, no assistance for heifers or cows], how soon intervention occurred, and under what circumstances the producer decided to call a veterinarian for assistance (i.e., when they discover something is abnormal, after they had attempted to deliver the calf but were unsuccessful, only if surgery was needed, or they do not call a veterinarian for calving assistance).

Calving Protocols

The techniques producers used to resuscitate a calf were ranked and reported as a count for each category. These included whether the producer rubbed the calf vigorously, hung the calf over fence or gate, poured water in the calf's ear, or poked the nose of the calf with a finger or straw. Respondents indicated the information they recorded at calving (i.e., birth date, identification number, calving ease, birthweight, other) and how they recorded that information (e.g., paper, computer, etc.). The drugs or other treatments that were administered to dams or calves after a difficult delivery (i.e., antibiotics, nonsteroidal anti-inflammatory drugs, vitamins, etc.) were reported as well as the procedures performed (e.g., dehorning, castration, etc.) or products administered (e.g., vitamin and minerals, pain mitigation, etc.) to all calves within the first week of life.

Colostrum Management

Producers were asked to respond to which criteria they used to verify whether a calf had received colostrum and to rank techniques in the order they were most commonly used to ensure calves received colostrum (i.e., placed the cow and calf together, restrained the cow and allowed the calf to nurse, bottle-fed calves, or tube-fed calves). The source of colostrum used to assist calves with colostrum consumption (i.e., the dam's colostrum, a colostrum replacer product, frozen colostrum, or dairy colostrum) was also ranked in the order they were most commonly used.

Mismothering and Crossfostering

Respondents reported dam's behavior that commonly resulted in mismothering, the procedures performed to encourage bonding, and how dams that exhibited mismothering were managed. Techniques for fostering a calf onto a new dam were ranked by respondents and frequencies for each category and rank were calculated.

Breeding Management

Breeding management questions included selection criteria and traits of bulls used to breed heifers. A Likert scale for reasons to cull a dam based on management issues such as aggressive behavior, lameness and bad foot conformation, bad udder conformation, mismothering, not pregnant, and poor body condition was reported, and a frequency for each likelihood score was calculated.

Associations between Herd Demographics, Herd-level Incidence, and Key Management Practices

Data were analyzed using STATA 14.1 software (StataCorp LP, College Station, TX). Descriptive statistics were calculated for all variables, and tests for normality were performed on continuous variables. For normally distributed variables, means and standard deviations (SD) were calculated, and for non-normally distributed variables, medians, and interquartile ranges (IQR) were calculated. The range for variables was described, and proportions of animals affected within a herd or by dam parity (i.e., heifer or cow) were calculated. The associations between herd demographics and herd-level incidences were investigated using Wilcoxon rank-sum tests. Herd demographics investigated as predictor variables included: herd size (small <300 dams; large ≥300 dams) and month calving started (early = January or February; late = March, April, or May) for heifers or cows, respectively. The correlation between herd size and month calving started was assessed using a Spearman rank correlation test. Continuous outcome variables for herd-level incidence included percentage of heifers requiring calving assistance, percentage of cows requiring calving assistance, overall percentage of dams requiring calving assistance, percentage of stillborn calves born to heifers, percentage of stillborn calves born to cows, percentage of total stillborn calves, percentage of calves treated for disease, percentage of calves born to heifers that died preweaning, percentage of calves born to cows that died preweaning, and overall percentage of calves that died preweaning. The association between herd demographics and key management practices were assessed using Fisher exact (if a group had a count less than 5) or chi-square tests. Pairwise comparisons of significant associations were performed using a Bonferroni correction test. Key management practice outcomes included: colostrum management, resuscitation techniques, the frequency heifers or cows were checked during daylight or nighttime hours, time to assist after an amniotic sac or feet have been visualized for heifers and cows, time to assist after no progression has been visualized for heifers and cows, and no calving assistance of cows. Multivariable linear and logistic regression models were attempted but are not reported because of issues with collinearity and frequent violation of model assumptions. The significance level was set at $\alpha = 0.05$.

RESULTS

Herd Demographics and Animal Inventory

Ninety-seven of 110 producers from Alberta (n = 49, 50.5%), Saskatchewan (n = 29, 30%), and Manitoba (n = 19, 19.5%) responded to the survey. The majority of producers defined their herds as commercial (n = 72, 74.2%), whereas the remainder defined their herds as either both commercial and purebred (n = 20, 20.6%), or just purebred (n = 5, 5.2%). Most producers did not have seasonal workers (median = 0, IQR 0 to 1, range 0 to 3) and most had 2 full-time workers (IQR 1 to 2, range = 0 to 10). The median herd size was 226 (IQR 158 to 337) and ranged from 37 to 2,615 calving dams. Only 4 of the 97 herds (4.1%) calved in both the spring and fall. Eighteen of 92 (19.5%) herds started calving heifers in January, 18/92 (19.5%) herds started calving heifers in February, 34/92 (37%) herds started calving heifers in March, and 22/92 (24%) of herds started calving heifers in April or May. Two herds did not calve out heifers in 2016. Seventeen of 95 (17.9%) herds started calving cows in January, 19/95 (20.0%) herds started calving cows in February, 32/95 (33.7%) herds started calving cows in March, and 27/95 (28.4%) herds started calving cows in April or May. The mean calving season length was 58.9 d (SD 19.7) for heifers and 85.6 d (SD 26.2) for cows. Heifer calving season

Table 1. Demographics of heifer, cow, and calf inventory during the 2015 to 2016 production cycle[1]

Inventory category	Median	Interquartile range	Range	Average herd-level incidence
Dams that calved				
Heifers	35	26 to 62	7 to 400	—
Cows	192	133 to 291	24 to 2,325	—
Dams that died during calving season				
Heifers	0	0 to 0	0 to 3	0.4%
Cows	0	0 to 1	0 to 5	0.4%
Dams that died from the end of calving season to the fall				
Heifers	0	0 to 0	0 to 4	—
Cows	0	0 to 1	0 to 20	—
Dams that aborted[2]				
Heifers	0	0 to 1	0 to 10	1.7%
Cows	1	0 to 4	0 to 50	1.4%
Total calves born[3]				
Heifers	35.5	27.5 to 68	7 to 400	—
Cows	200	135 to 301	24 to 2,325	—
Live calves born				
Heifers	34	25 to 62	6 to 287	—
Cows	190.5	133 to 292	23 to 2,305	—
Stillborn calves[4]				
Heifers	1	0 to 2	0 to 18	3.3%
Cows	3	2 to 6	0 to 26	1.9%
Calves that died 1 to 7 days of age				
Heifers	0	0 to 1	0 to 5	0.7%
Cows	1	0 to 2	0 to 10	0.7%
Calves that died from 7 to 30 days of age				
Heifers	0	0 to 1	0 to 8	1.1%
Cows	1	0 to 2	0 to 11	0.6%
Calves that died from 30 days to weaning				
Heifers	0	0 to 1	0 to 38	1.3%
Cows	1	0 to 3	0 to 30	0.9%

[1]Data collected from 97 cow–calf ranches surveyed through the Western Canadian Cow–Calf Surveillance Network.

[2]Dams that gave birth to a calf that was not full term.

[3]Calves born alive and dead.

[4]Calves that were born dead but full term, or alive but died by 24 h of age.

ranged from 10 to 129 d and cow calving season ranged from 37 to 189 d. Table 1 describes animal inventory during the 2015 to 2016 production cycle.

Overall, the average herd-level incidence of calving assistance was 4.9%. The incidence of calving assistance in heifers was 13.5% (median = 4.5 calves, IQR 2.0 to 8.5 calves, range = 0 to 60 calves per herd) and in cows was 3.2% (median = 4 calves, IQR 1 to 10 calves, range = 0 to 30 calves per herd). Very few dams [0.2% overall, 0.7% of heifers (range = 0 to 3 heifers per herd), and 0.15% of cows (range = 0 to 3 cows per herd)] required a caesarian section to deliver their calves. The average herd-level incidence of twins born to heifers and cows was 1.4% (median = 0 sets of twins, IQR 0 to 1 sets of twins, range = 0 to 6 sets of twins per herd) and 2.5% (median = 4.5 sets of twins, IQR 2 to 7 sets of twins, range = 0 to 20 sets of twins per herd), respectively.

The average herd-level incidence of preweaning treatment for disease was 9.4%. Three percent of calves (median = 2 calves, IQR 0 to 6 calves, range 0 to 144 calves per herd) were treated for NCD, 3.8% (median = 4 calves, IQR 1 to 10 calves, range 0 to 249 calves per herd) were treated for BRD, and 2.6% (median = 2 calves, IQR 0 to 5 calves, range 0 to 70 calves per herd) were treated for other diseases. The average herd-level incidence of preweaning mortality was 4.5%. The percentage, median, IQR, and range of calves that died by age group is shown in Table 1.

Pregnant Dam Management

The majority of heifers and cows were housed in an extensive grazing management system from breeding to pregnancy confirmation and in small pastures during the overwintering period. The

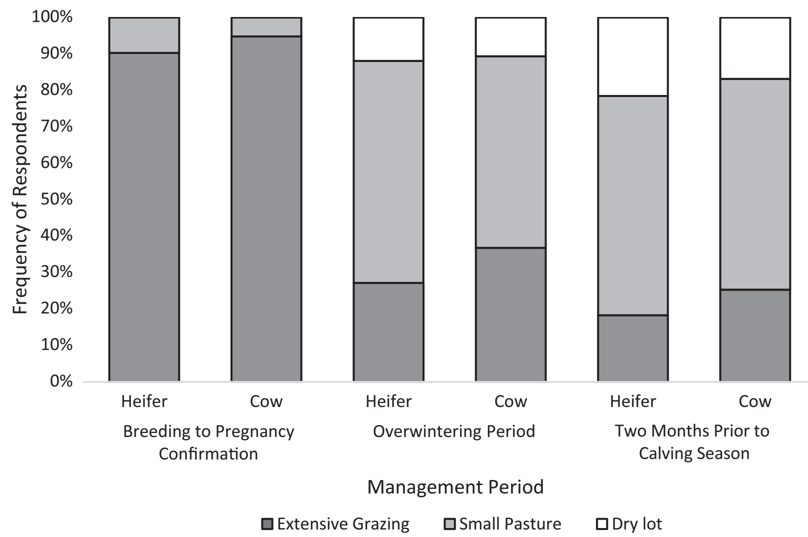

Figure 1. Frequency of respondents self-identifying the type of housing of heifers and cows at different management periods from breeding to prior to calving on 97 cow–calf ranches surveyed through the Western Canadian Cow–Calf Surveillance Network. Extensive grazing was defined as cattle housed on large land areas with a relatively large number of acres per animal and the main feed source being grazing or green feed. Small pasture was defined as cattle housed on a small land area with a relatively low number of acres per animal with supplemental feed and/or grains provided as the main feed source either on the ground or in a feeder or feed bunk. Dry lot was defined as cattle housed in a cattle-dense dry lot (feedlot) with all feed and/or grains provided in a feeder or feed bunk.

majority of heifers were managed in either small pastures or dry lots 2 mo prior to calving, whereas cows typically continued to be managed on small pastures. Figure 1 describes the frequency of producers' responses for pregnant dam housing during these 3 precalving periods.

Calving Management

The majority of respondents moved heifers (66.6%, 62/93) and cows (76%, 73/96) to designated calving areas <1 to 3 wk prior to calving. Most of the time, heifers (56.5%, 52/92) and cows (55.8%, 53/95) were only moved into the barn if they needed assistance with parturition. Table 2 describes the management decisions prior to calving for heifers and cows. Most respondents assisted at least one of their heifers (95.7%; 89/93) or cows (89.6%; 86/96) with calving during the 2016 calving season. Very few respondents do not assist their heifers (2.1%; 2/95) or cows (6.3%; 6/95) with calving. Table 3 describes how frequently respondents would check heifers and cows for signs of calving and when they would intervene with calving assistance. Seventy-five percent (71/95) of producers would call a veterinarian for a difficult calving only after they had attempted to deliver the calf but were not successful. Only 3.2% (3/95) would not call a veterinarian for calvings.

Calving Protocols

The majority of producers (58.3%, 56/96) record calving information in a calving notebook or by paper records only, 37% (36/96) of producers recorded calving information on paper and then transferred it to a computer, and 6.3% (6/96) entered calving information directly into a computer or hand-held electronic device. Date of birth (94.8%, 91/96), calf identification number (89.6%, 86/96), and calving ease score at calving (73.9%, 71/96) were the information most commonly recorded at calving. Less than half of producers surveyed recorded birthweight (43.8%, 42/96) and other things (5.2%, 5/96) such as calf sex, coat color, udder score, and dam temperament.

Various procedures were employed to resuscitate a calf and were ranked (Fig. 2). Other methods of resuscitation reported included blowing air into the calf's nose, chest compressions, using a calf resuscitating device, and epinephrine, and were used by 23.2% (23/96) producers. After a difficult calving, many producers administered an NSAID or antibiotics to dams (Table 4). The most commonly used NSAID reportedly used was meloxicam (53.5%, 23/43) and the most commonly reported antibiotic used was oxytetracycline (51.4%, 18/35) followed by penicillin (14.5%, 5/35). Forty-five percent of producers also administered an NSAID to calves after a difficult delivery (Table 4), the majority used meloxicam (46.5% 20/43). The majority of producers responded that all calves born received visual identification tags (92.7%, 89/96), were castrated (56.3%, 54/96), and received vitamin and mineral injections (44.8%, 43/96) within the first week of life. A small proportion of producers (8.3%, 8/96)

Table 2. Respondents report of management practices pertaining to dam movement to and from the calving area and calving barn usage for heifers and cows[1]

	Heifers		Cows	
Dam management in the calving area	Percent	Count	Percent	Count
When are dams moved to the calving area prior to calving?				
Calving occurs where overwintered	10.8	10/93	10.4	10/96
>6 wk	5.4	5/93	4.2	4/96
3 to 6 wk	17.2	16/93	9.4	9/96
1 to 3 wk	38.7	36/93	41.7	40/96
<1 wk	27.9	26/93	34.3	33/96
When are dams moved into the barn during calving?				
Signs suggest calving within 24 h	10.9	10/92	7.4	7/95
Active calving	16.3	15/92	13.7	13/95
Only if dam needs assistance	56.5	52/92	55.8	53/95
I do not bring dams into the barn	16.3	15/92	23.1	22/95
When are cow–calf pairs moved into the barn after calving?[2]				
Cold weather	59.5	53/89	54.4	49/90
Mismothering	61.8	55/89	65.6	59/90
Bad udder	29.2	26/89	52.2	47/90
Crossfostering	58.4	52/89	65.6	59/90
Other	19.1	17/89	20.0	18/90
When are cow–calf pairs moved out of the calving area?				
Moved as soon as possible	21.1	19/90	17.0	16/94
Moved in batches every 24 h	15.6	14/90	18.1	17/94
Moved at >24 h but less than 1 wk after birth	22.2	20/90	19.2	18/94
Moved in groups every 1 to 2 wk	18.9	17/90	12.8	12/94
Remain in calving area until the end of the calving season	13.3	12/90	15.9	15/94
Pairs stay in calving area, uncalved dams are moved to a fresh pasture	1.1	1/90	5.3	5/94
Other	7.8	7/90	11.7	11/94

[1]Data from 97 cow–calf ranches surveyed through the Western Canadian Cow-Calf Surveillance Network.

[2]Question was formatted as check all that apply.

disinfect the navels of calves within the first week of life.

Colostrum Management

The majority of respondents verified if a calf had received colostrum by visualizing the calf nursing (93.7%, 89/95), determining if the cow's udder did not look full (83.2%, 79/95), or assessing if the calf appeared full (44.2%, 42/95). Only 3.2% (3/95) of respondents did not check to see if the calf received colostrum. The most common techniques ranked first to ensure a calf received colostrum included: restraining the cow and helping the calf nurse (43.2%, 41/95), placing the cow and calf together in a pen (41.1%, 39/95), and tube feeding (24.2%, 23/95) or bottle feeding the calf (18.9%, 18/95). Only 1.1% (1/95) of respondents reported not intervening with colostrum consumption in their calves. The majority of respondents ranked the number one source of colostrum for the calf as being from the calf's dam (68.7%, 66/96) followed by a colostrum replacement product (38.5%, 37/96). Nine percent (9/96) of producers indicated that they sometimes used dairy colostrum as a source of colostrum for calves.

Mismothering and Crossfostering

Overall, very few dams were managed for mismothering (1.2%). Heifers had a higher frequency of being managed for mismothering at 3.6% (median = 1 heifer, IQR 0 to 2 heifers, range 0 to 12 heifers per herd) than cows at 0.8% (median = 1 cow, IQR 0 to 2 cows, range 0 to 20 cows per herd). The most common behaviors ranked highest for mismothering included cow not allowing calf to nurse (39.4%, 37/94) followed by the cow abandoning the calf (28.7%, 27/94), having twins and rejecting one or both calves (26.6%, 25/94), and the cow showing aggressive behavior toward her calf (18.1%, 17/94). The majority of producers would either give a heifer one more chance (37.6%, 35/93) or closely monitor her at the next calving season (34.4%, 32/93) if she had mismothered her calf, whereas the majority of producers would remove cows from the herd

Table 3. Respondents report of management decisions pertaining to the frequency producers check dams for signs of calving and how long they waited before intervention with calving assistance for heifers and cows[1]

	Heifers		Cows	
Management decisions for calving and intervention	Percent	Count	Percent	Count
How often are dams checked during daylight hours?				
At least hourly or every 1 to 2 h	25.3	24/95	21.2	20/94
3 to 6 times a day	56.8	54/95	50.0	47/94
Twice daily	11.6	11/95	24.5	23/94
Once daily or other	6.3	6/95	4.3	4/94
How often are dams checked during nighttime hours?				
At least hourly or every 1 to 2 h	18.5	17/92	19.3	18/93
3 to 6 times a day	32.6	30/92	28.0	26/93
Twice daily	16.3	15/92	14.0	13/93
Once daily or other	32.6	30/92	38.7	36/93
How long do you wait to assist when water bag (amniotic sac) or feet are showing?				
<60 min	34.5	29/84	29.6	24/81
60 to 90 min	39.3	33/84	34.6	28/81
90 to 120 min	17.9	15/84	18.5	15/81
>120 min	8.3	7/84	17.3	14/81
How long do you wait to assist when no progression is seen?				
<60 min	34.5	29/84	29.6	24/81
60 to 90 min	39.3	33/84	34.6	28/81
90 to 120 min	17.9	15/84	18.5	15/81
>120 min	8.3	7/84	17.3	14/81

[1]Data collected from 97 cow–calf ranches surveyed through the Western Canadian Cow–Calf Surveillance Network.

(53.8%, 50/93) if she was managed for mismothering or closely monitor her at the next calving season (25.8%, 24/93). The most common procedures ranked first to be used to manage mismothering included housing the cow and calf together (56.4%, 53/94) followed by restraining the cow in a chute and assisting the calf to nurse (50.0%, 47/94). Few producers ranked keeping calves separate but close and confined (9.6%, 9/94), sedating the cow with a drug (2.1%, 2/94), or crossfostering the calf onto another cow (2.1%, 2/94) as common methods to manage mismothering.

During the 2016 calving season, few calves (0.3%) were fostered onto new dams due to mismothering (median = 0 calves, IQR 0 to 1 calves, range 0 to 12 calves per herd). The proportion of calves fostered onto a new dam due to twinning was 1.1% (median 2 calves, IQR 1 to 4 calves, range 0 to 40 calves per herd) and the proportion of calves fostered due to death of the dam was 0.2% (median = 0 calves, IQR 0 to 1 calves, range 0 to 3 calves per herd). The most common highest ranked procedures used to manage crossfostering included placing the dead calf's hide onto the foster calf (56.3%, 54/96) followed by placing the cow and calf together (36.6%, 34/95) and placing the placenta from the foster cow onto the new calf (20%, 19/95). Few producers ranked scent masking powder (6.3%, 6/96), putting grain on the foster calf (6.3%, 6/95), or sedating the foster dam (5.2%, 5/96) as methods to manage crossfostering.

Breeding Management

When selecting a bull to breed replacement heifers, the majority of producers reported the bull's birthweight (33.7%, 32/95) or expected progeny difference (EPD) for calving ease (24.2%, 23/95) as the most important traits. Less frequently reported answers included physical appearance (13.7%, 13/95), other traits not listed (10.5%, 10/95), breed reputation for calving ease (9.5%, 9/95), and pedigree (8.4%, 8/95). The more frequently selected reasons for cows to be culled from the herd include aggressive behavior toward people, bad foot conformation, bad udder conformation, mismothering behaviors, and a nonpregnant diagnosis at fall pregnancy confirmation (Table 5).

Associations Between Herd Demographics, Herd-level Incidence, and Key Management Practices

Herd size, categorized as small or large, was not correlated with the month calving started for heifers (rho = 0.029, $P = 0.8$) and cows (rho = 0.11,

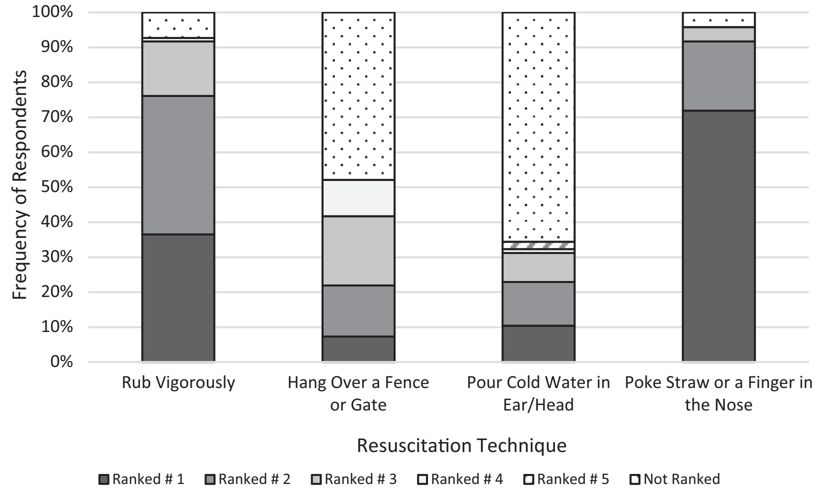

Figure 2. Frequency of respondents ranking resuscitation techniques from most to least commonly used on 97 cow–calf ranches surveyed through the Western Canadian Cow–Calf Surveillance Network.

Table 4. Respondents report of treatments administered to the cow or calf after a difficult delivery[1]

	Calf		Cow	
Treatments administered for a difficult delivery[2]	Percent	Count	Percent	Count
Nonsteroidal anti-inflammatory drug	44.7	43/96	44.8	43/96
Antibiotics	10.5	10/95	36.5	35/96
Vitamins or minerals	—	—	2.1	2/96
Vitamins ADE injection	31.3	30/96	—	—
Selenium/vitamin E injection	35.4	34/96	—	—
Lidocaine epidural	—	—	2.1	2/96
Oxytocin	—	—	28.1	27/96
Dip navel	8.3	8/96	—	—
Other	4.2	4/96	6.3	6/96
Do not administer anything	34.4	33/96	33.3	32/96

[1]Data collected from 97 cow–calf ranches surveyed through the Western Canadian Cow-Calf Surveillance Network.

[2]Questions were formatted as check all that apply.

Table 5. Frequency of respondents reporting the likelihood they will cull cows for various behaviors or conditions[1]

	Very Unlikely		Unlikely		Possible		Likely		Very Likely	
Behavior or condition	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count
Aggressive behavior	4.2	4/95	3.2	3/95	12.6	12/95	15.8	15/95	64.2	61/95
Bad foot conformation	2.1	2/95	1.1	1/95	14.7	14/95	43.2	41/95	38.9	37/95
Bad udder conformation	2.1	2/96	0	0/96	8.3	8/96	38.5	37/96	51.1	49/96
Calf dead at birth	5.5	5/91	10.9	10/91	45.1	41/91	13.2	12/91	25.3	23/91
Lameness	1.1	1/94	10.6	10/94	30.9	29/94	37.2	35/94	20.2	19/94
Mismothering behaviors	2.1	2/96	1.0	1/96	32.3	31/96	36.5	35/96	28.1	27/96
Not pregnant in the fall	3.2	3/95	1.0	1/95	2.1	2/95	7.4	7/95	86.3	82/95
Poor body condition	2.1	2/95	10.5	10/95	43.2	41/95	18.9	18/95	25.3%	24/95

[1]Data from 97 cow–calf ranches surveyed through the Western Canadian Cow-Calf Surveillance Network.

$P = 0.3$). The month calving started for heifers was highly correlated with the start of calving month for cows (rho = 0.88, $P < 0.0005$). Herds that started calving heifers in later months had lower average herd-level incidence of calving assistance and preweaning treatment for disease than those herds calving heifers in earlier months (Table 6). Herds that started calving cows in later months had lower herd-level incidence of calving assistance, stillbirths, preweaning treatment for disease, and total preweaning mortality compared with those herds that started calving in earlier months (Table 6).

Table 6. Comparison of early (January or February) and late (March, April, or May) start of calving and herd-level incidence of calving assistance, stillbirths, and preweaning treatment for disease and mortality by dam parity (heifer or cow)[1]

	Early		Late		
Herd-level incidence	Median	Interquartile range	Median	Interquartile range	*P*-value
Calving assistance					
Heifer	18.2%	10 to 28.6	7.9%	3.6 to 13.3	<0.0005
Cow	5.3%	2.2 to 8.4	1.3%	0.6 to 2.2	<0.0005
Stillbirth					
Heifer	3.1%	0 to 5.9	1.5%	0 to 3.5	0.08
Cow	2.1%	0.9 to 3.5	1.3%	0.7 to 2.1	0.01
Preweaning treatment for disease					
Heifer's calves	8.3%	3.3 to 20.6	3.4%	0.8 to 6.9	0.0008
Cow's calves	5.9%	3.3 to 20.6	3.2%	0.8 to 8.2	0.001
Preweaning mortality					
Heifer's calves	2.4%	0 to 6.0	0.6%	0 to 3.6	0.1
Cow's calves	1.9%	1.3 to 3.5	1.8%	1.1 to 3.0	0.02

[1]Data from 97 cow–calf ranches surveyed through the Western Canadian Cow–Calf Surveillance Network.

Producers that had later calving heifer and cow herds were less likely to place a cow and calf together to encourage colostrum consumption [heifer and cow: odds ratio (OR) = 0.16, $P = 0.001$] or to feed frozen colostrum (heifer: OR = 0.41, $P = 0.04$; cow: OR = 0.3, $P = 0.01$). There was no difference between early and late calving herds and resuscitation techniques ($P > 0.05$). Producers with earlier calving heifer herds were more likely to check on heifers and cows more frequently during daylight and nighttime hours than those with later calving herds (Table 7). The odds that producers would intervene with a heifer calving after observing the amniotic sac for 60 to 90 min instead of <60 min was 4.3 times higher in early calving herds compared to late calving herds ($P = 0.002$; Table 8). There were no other differences in how long producers waiting to intervene with calving based on when their herd calved (Table 8). There was no association between early and late calving herds and whether or not producers assisted cows with calving ($P = 0.25$).

There was no association between herd size and average herd-level incidence of calving assistance, disease, mortality, or management techniques ($P > 0.05$).

DISCUSSION

This survey describes calving and colostrum management practices on western Canadian cow–calf ranches. In general, this survey indicates that the majority of respondents followed many recommended calving and colostrum management practices but that record-keeping and herd-level incidences of morbidity and mortality could be improved. Producers with earlier calving herds have higher incidence of calving assistance, stillbirth, treatment for disease, and morbidity, but there was no association with herd size. Producers with earlier calving herds use more intensive calving and colostrum management techniques than producers with later calving herds as well.

In this study, over 90% of producers moved their heifers and cows to a designated calving area, in contrast to 40% of U.S. herds surveyed (Dargatz et al., 2004). A specialized calving area to maintain calving dams is important to increase observation intervals, allow timely intervention, and provide protection from the elements (Dargatz et al., 2004). Although a specialized calving area may allow for increased observation intervals and timely intervention if needed, decreased uterine motility and incomplete cervical dilation have been associated with environmental stressors such as frequent presence of an observer and confined calving spaces in heifers and ewes (Bontekoe et al., 1977; Dufty, 1981). The majority of producers of herds surveyed checked their heifers and cows multiple times a day, which was similar to a U.S. survey where producers would observe heifers 3.6 times and cows 2.5 times in a 24-h period (Dargatz et al., 2004).

Timely intervention is important to decrease the severity of dystocia, risk of nerve damage and recumbency of the dam, and negative consequences of a prolonged delivery for the calf (Nix et al., 1998; Mee, 2004; Lombard et al., 2007). The recommendation that a calving be assisted after 70 min after the amniotic sac was visualized or 65 min after feet were visualized to decrease the risk of calf stillbirth was based on normal calving

Table 7. Comparison of early (January or February) and late (March, April, or May) start of calving and frequency of respondents reporting key management practices such as frequency of checking dams for signs of calving for heifers and cows[1]

	Early	Late		Pairwise comparisons: odds ratio[2] (*P*-value)		
Management decisions for frequency of checking dams for signs of calving	Count, %	Count, %	*P*-value	1 to 2 h vs. 3 to 6×/d	1 to 2 h vs. 1 to 2×/d	3 to 6×/d vs. 1 to 2×/d
Frequency of checking heifers during daylight hours			0.003			
At least hourly or every 1 to 2 h	17	7		6.6 (0.001)	—	—
3 to 6 times a day	14	38		—	19.4 (0.001)	—
Once to twice a day	1	8		—	—	2.9 (0.1)
Frequency of checking cows during daylight hours			0.0001			
At least hourly or every 1 to 2 h	16	4		9.1 (0.001)	—	—
3 to 6 times a day	14	32		-	84.0 (<0.0005)	—
Once to twice a day	1	21		-	-	9.2 (0.002)
Frequency of checking heifers during nighttime hours			0.0005			
At least hourly or every 1 to 2 h	12	5		2.9 (0.004)	—	—
3 to 6 times a night	13	16		—	32.5 (<0.0005)	-
Once to twice a night	0	14		—	—	12.4 (0.004)
Frequency of checking cows during nighttime hours			0.0001			
At least hourly or every 1 to 2 h	14	4		4.1 (0.02)	—	—
3 to 6 times a night	12	14		—	42.0 (<0.0005)	—
Once to twice a night	0	13		—	—	12.1 (0.004)

[1]Data from 97 cow–calf ranches surveyed through the Western Canadian Cow–Calf Surveillance Network.

[2]Odds ratios are interpreted as the odds of checking at the less-frequent interval rather than the more-frequent interval was this many times higher in late calving herds compared with early calving herds.

Table 8. Comparison of early (January or February) and late (March, April, or May) start of calving and frequency of respondents reporting key management practices such as frequency of calving intervention for heifers and cows[1]

	Early	Late	
Management decisions for calving intervention	Count, %	Count, %	*P*-value
Time to assist heifer when water bag (amniotic sac) or feet are showing			0.011[2]
<60 min	8	19	
60 to 90 min	21	11	
90 to 120 min	3	11	
>120 min	3	4	
Time to assist cow when water bag (amniotic sac) or feet are showing			0.43
<60 min	11	13	
60 to 90 min	13	15	
90 to 120 min	6	8	
>120 min	3	11	
Time to assist heifers when no progression is seen			0.48
<60 min	19	31	
60 to 90 min	6	13	
90 to 120 min	8	6	
>120 min	2	4	
Time to assist cows when no progression is seen			0.58
<60 min	18	22	
60 to 90 min	8	20	
90 to 120 min	3	4	
>120 min	5	7	

[1]Data from 97 cow–calf ranches surveyed through the Western Canadian Cow-Calf Surveillance Network.

[2]Pairwise comparison reported in text.

times in Holstein cows (Schuenemann et al., 2011). The majority of western Canadian cow–calf producers in this survey would assist a heifer or cow in less than 90 min if they appeared to have a prolonged or difficult calving while in comparison, the majority of U.S. producers allowed heifers to labor 2.8 or 3.5 h for cows prior to assistance (Dargatz et al., 2004). Producers of earlier calving herds had greater odds of intervening with a heifer calving after observing the amniotic sac for 60 to 90 min instead of <60 min compared with late calving herds. This may be due to the fact that producers of earlier calving herds are more likely to be observing dams for signs of calving more frequently and so may wait slightly longer before assisting with a calving in comparison to producers of later calving herds that may not have seen that dam as recently and may intervene slightly sooner. Although in this study the frequency of observations and interventions for calving assistance was not investigated as a risk factor for the average the herd-level incidence of calving assistance and stillbirths, it may be an important factor affecting stillbirth rates in beef calves and should be investigated in future studies.

The average herd-level incidence of calving assistance in this survey was 4.9%, with 13.5% assistance of heifers and 3.2% assistance of cows. A previous Canadian study demonstrated an overall herd-level assistance risk of 8.8% in western Canadian cow–calf herds surveyed in 2001 (Waldner, 2014). Our survey findings were similar to reports from U.S. cow–calf herds that reported a 4.8% overall assistance risk, with 11.6% assistance of heifers and 4.3% assistance of cows (NAHMS, 2009). The majority of difficult calvings are influenced by maternal body size, calf size, and sire qualities (e.g., confirmation, birthweight, etc.; Meijering, 1984). In the present study, the majority of producers selected bulls to breed to their heifers based on the bull's birthweight and calving ease EPD. Management decisions such as bull selection may influence the incidence of calving difficulties on cow–calf operations (Meijering, 1984; Larson et al., 2004; Funnel and Hilton, 2016). Although the incidence of calving assistance was low (4.9%) in this population, over 90% of producers assisted at least one heifer or cow, indicating that calving assistance and the associated management are widespread issues faced by producers on cow–calf operations.

Individual risk factors associated with calving assistance have been well studied (Meijering, 1984; Mee, 2004), but herd-level management and demographics have not. In this study, later calving herds had lower herd-level calving assistance risk for both heifers and cows. The findings of the present study are similar to a previous study that found that individual calves born in January or February had a higher calving assistance risk than those born in March and April (Waldner, 2014). This association may be due to more extensive calving management practices used by producers with spring calving operations in Alberta (Pang et al., 1998). Alternatively, it may be related to a lack of record-keeping, as 26% of herds surveyed in this study did not record calving ease score, a subjective score of the degree of calving difficulty and required level of assistance. Proportions of calving assistance in early calving herds vs. late calving herds did not differ in a previous study conducted in Alberta, Canada (Pang et al., 1998); however, there were few assisted calvings reported in that study population. That study also differed from the present one in the definition of "early calving season." Pang et al. (1998) defined early calving season as starting in April and a late calving season as starting in May and June, whereas in the present study, early calving started in January and February and late calving started in March, April, or May.

Having an assisted calving, being born to a heifer or cow older than 10 yr old, and being born of a twin are risk factors associated with stillbirth in beef calves (Waldner, 2014). In previous Canadian studies, the stillbirth risk ranged from 2.7% to 4.4% (Ganaba et al., 1995; Waldner, 2014), which was greater than the overall herd-level stillbirth risk of 2.1% (heifers = 3.3% and cows = 1.9%) in our study. Risk of mortality in the first day of life has been reported to range from 4% to 13% and half of all preweaning deaths occur within the first 24 h of life (Berglund et al., 2003; Johanson and Berger, 2003). Mortality associated with an assisted or cesarean-born calf has been reported as high as 30% to 50% (Nix et al., 1998). Later calving herds had lower herd-level stillbirth and mortality risks in this survey. Decreased stillbirth risks are reported in herds with frequent calving supervision (Hodge et al., 1982); however, later calving herds in this survey supervised calvings less frequently than early calving herds. We hypothesize that stillbirth risks may have been lower in late calving herds due to an underreporting of stillbirths by extensively managed herds who monitor dams for signs of calving less frequently. Increased stillbirth risk is also seen in herds with higher incidence of dystocia and those that calve in small pens (Dufty, 1981; McDermott et al., 1992), as described in early calving herds in this study.

In this study, the herd-level treatment for disease was 9.4%, with 3.0% of calves being treated for NCD, 3.8% for BRD, and 2.6% for other diseases. This is similar to a previous study reporting 4.9% calves were treated for NCD and 3.0% for BRD (Murray et al., 2016). Risk factors for increase in herd-level incidence of calfhood disease in that study were as follows: not intervening at parturition, castration using small elastrator bands, and larger herd size. Similarly, in the current survey, a lower incidence of calves being treated for disease was observed in later calving herds, which also had a lower herd-level calving assistance risk. This may be due to more extensive management techniques such as less confinement, which is associated with lower morbidity (Sanderson and Dargatz, 2000) and less-frequent management interventions for treating disease.

Calves experiencing a difficult birth have a higher risk of morbidity and mortality in the preweaning period (Lombard et al., 2007). Inadequate transfer of passive immunity through colostrum consumption contributes to an increased risk of preweaning morbidity (Larson et al., 2004; Waldner and Rosengren, 2009). This may be due to increased time to stand and nurse or decreased absorption of colostral immunoglobulins (Vasseur et al., 2009; Barrier et al., 2012). Therefore, management techniques to decrease the risk of inadequate transfer of passive immunity and subsequent morbidity and mortality are important (Filteau et al., 2003; Murray et al., 2016). Murray et al. (2016) found that in herds where producers verified that the calf nursed and who intervened with colostrum administration had lower mortality in calves in the first week of life. Although the majority of beef producers in this survey do confirm colostrum ingestion and intervene with various methods of colostrum consumption, in later calving herds, producers were less likely to perform laborious colostrum intervention strategies such as placing the cow and calf together or feeding stored, frozen colostrum. This suggests that producers who have earlier calving herds may practice more intensive colostrum management techniques than those who have later calving herds.

Although this study reports current calving and colostrum management techniques, it was not possible to perform multivariable regression modeling to investigate more fully the risk factors for herd-level incidence of morbidity and mortality due to issues of collinearity, a lack of variability within the data, and frequent violations of model assumptions. Future studies looking at the associations between management factors could help fill in the gap in knowledge of herd-level risk factors for calf health. Also, the results of this study should be interpreted with caution as unmeasured herd characteristics and management factors not investigated may influence the relationships found. It is important to note that the majority of producers keep paper records and only recorded calving date and calf ID, clearly indicating that data collection by cow–calf producers could be improved and be used to benefit their decision-making process. As such, herd-level incidence of calving assistance, morbidity, and mortality may be underestimated.

Overall, this survey described current calving and colostrum management practices and found that although the incidence of calving assistance is low, the majority of producers do assist at least one calving and check to make sure calves consume colostrum. It also demonstrates how intervention strategies may differ between producers who have early and late calving herds and suggests that those who calve earlier have more intensively managed herds. Herd demographics may be important to consider when investigating risk factors associated with management strategies in cow–calf herds.

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