An advisory tool to improve management practices affecting calf and heifer welfare on dairy farms

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ABSTRACT

We developed an advisory tool addressing 10 critical areas of calf and heifer management, including calving management, care to newborn calves and painful procedures, colostrum management, cow-calf separation, calf feeding, weaning, calf housing, heifer feeding, heifer housing, and general monitoring. Targets and indicators for each critical area were validated by a panel of experts and maximum scores were assigned based on experts' opinions and reviews of scientific literature. The tool was tested on 28 Quebec dairy farms for feasibility and repeatability between 2 observers. Farmers were asked to test colostrum quality, measure blood IgG concentrations, and record health events. The on-farm evaluation included an interview on management practices and an evaluation of conditions in the barn. Scorings and recommendations were discussed with producers. The usefulness of our on-farm welfare tool was evaluated by the producers themselves during a final debriefing. We reached the main goals of a successful advisory tool of calf and heifer management to improve welfare on dairy farms. We respected the targeted time limit of a 3-h visit covering all aspects of our tool including data collection on management and environment, scoring, practical demonstration with producers, and debriefing. We had no problems collecting management- and environment-based data and had high repeatability of qualitative environment-based measures (kappa value > 0.6). Our tool helped to detect problems and to discuss these problems with the producers; producers scored below 50% for some targets in calving management, care to newborn calves and painful procedures, colostrum management, and calf feeding. The targets were realistic so producers were not discouraged. All producers were convinced of the usefulness of our tool for identifying areas of calf and heifer management in need of improvement. They were also convinced of the usefulness of our tool as an advisory tool for technical advisors and veterinarians. Six months after the on-farm visit, recommended practices were implemented in many of these areas. Voluntary improvements in animal welfare can be facilitated by using appropriate tools to educate producers and help them change their attitudes toward calf management and animal welfare.

Key words: on-farm tool, welfare, management, calf

INTRODUCTION

In response to growing public interest in farm animal welfare, the European Union has enacted legislation to protect farm animals during slaughter, transport, and rearing (Veissier et al., 2008). However, because there are differences between farms in the level of animal welfare achieved and in the types of welfare problems encountered, a legislative approach, which defines minimum requirements for all farms, may not be effective at solving problems that are specific to individual farms. Animal welfare audits based on a hazard analysis at critical control points approach (e.g., von Borell et al., 2001; Stull et al., 2005) may be more effective in helping to identify problems on a specific farm and helping the farm improve its practices. Once problems have been identified, there is a need for intervention at the farm level to improve the welfare of the animals.

The first step in a strategy to improve animal welfare at the farm level is to conduct a risk assessment that identifies the main risks to animal welfare within a particular population of farms (Whay, 2007). Mortality and morbidity are high among dairy calves in North America (USDA, 2008), which is costly (Tozer and Heinrichs, 2001) and causes concern for the welfare of these animals. However, whereas welfare assessment schemes are available for dairy cows (e.g., Whay et al., 2003), none are yet available for calves and heifers. In a previous survey of calf and heifer management practices on Quebec dairy farms (Vasseur et al., 2010), we identified several management practices commonly used that could adversely affect calf welfare.

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Table 1. Main characteristics of our sample (no. of herds = 28)

Characteristic	Sample
Breed, %	
Holstein	79
Ayrshire	21
Size, %	
Small ($\leq$100 head)	43
Large (>100 head)	57
Milk production, kg/cow per year	$9{,}492 \pm 1{,}069^{1}$
Full-time employees, %	
1	11
2	43
3	35
>3	11
Person in charge of calves and heifers, %	
Producer	60
Other	40
Age of person in charge of calves and heifers, yr	42 ± 12^{1}
Agricultural education of person in charge of calves and heifers, %	
None	40
High school	36
College or higher	24

[1]Mean $\pm$ SD.

The objective of this study was to assess an advisory tool that has been developed to help dairy producers detect problems with their calf and heifer rearing methods that pose a risk to animal welfare and to encourage producers to adopt better practices. In our assessment of this tool, we considered both the feasibility of using it on farms and the likelihood that it would be implemented by advisors and producers. We established several goals that would need to be met if the tool was to be implemented successfully. One set of goals dealt with the feasibility of using the tool on commercial dairy farms. First, use of the tool on farms should be completed within a realistic time limit. We considered that 3 h on farm is the maximum time for a visit that would be considered acceptable by both producers and advisors, mainly from a financial point of view. Second, the data should be easily collected and the measures taken should be repeatable. To be used routinely by both producers and advisors, measures need to be easily taken at the farm level, and if qualitative measures are involved, then their assessment should be repeatable enough to ensure a uniform evaluation between different advisors. The second set of goals dealt with the likelihood that the tool would be used by advisors and producers. For the tool to be used, the targets set need to be realistic so that dairy producers should be able to meet them without becoming discouraged. However, the targets should not be so low that real problems are not detected. Furthermore, the producers should consider the advisory tool as being useful to them. The final goal was that use of the tool should result in changes in management where necessary. We assessed our tool based on the extent that these goals were met.

MATERIALS AND METHODS

Farm Sampling

Twenty-eight dairy farms located within 100 km of Laval University (Quebec City, Quebec, Canada) volunteered to participate in our project. We chose farms that were representative of the range of farm sizes in Quebec. Table 1 shows the main characteristics of our sample.

Development of the Tool

Identification of Critical Areas of Management. Our methodology was inspired by hazard analysis of critical control points approaches applied to animal welfare (e.g., von Borell et al., 2001). Based on the results of our previous epidemiological survey in Quebec (Vasseur et al., 2010), we identified several critical areas where producers used management practices that could adversely affect calf welfare and where improvements could be made. The critical areas identified were calving management, care to newborn calves and use of painful procedures, colostrum management, cow-calf separation, calf feeding, weaning, calf housing, heifer feeding, heifer housing, and general monitoring (Tables 2, 3, and 4).

Determination of Targets. Each of these 10 critical areas comprised several targets that producers should reach to improve their management practices

Table 2. Critical areas, targets, maximum possible score attributed to each target, and descriptions of indicators comprising measures taken during the interview with the producer and indicators comprising measures taken by the observers during the visit to the barn

Critical area	Target	Maximum score	Indicator comprising measures taken during interview with producer (n)	Indicator comprising measures taken by observer during visits to barn (n)
Calving management	High calving surveillance level	35	Calving checks (2)	
	Use of calving pen on a regular basis	30	Calving area type and use (1)	
	Appropriate calving pen management for sick animals	8	Calving area used as hospital pen (1)	Calving area cleanliness estimation (1)
	High calving pen cleanliness level	18	Calving area litter management (2)	Calving area dimensions (1);
	Comfort and ergonomic quality of calving pen	9		safety hazards (1)
Care to newborn calves and painful procedures	Immediate disinfection on a regular basis	44	Navel disinfection timing (1)	
	Immediate identification on a regular basis	8	Calf identification timing (1)	
	Appropriate painful procedure management	48	Use of a dehorning standard operating procedure (4); dehorning timing (1); use of analgesic, anesthetic, or sedative for dehorning (1); tail docking (1)	
Colostrum management	First feeding within first 4 h of calf's life	33	First colostrum meal timing (1)	
	Monitoring of quantity ingested at first feeding	11	First colostrum meal quantity (1)	
	Feeding of at least 4 L of first-milking colostrum within first 12 h of life	18	Total colostrum quantity (1); use of first-milking colostrum (1)	
	Use of a method by means of which a controlled quantity of colostrum can be given	11	Method (1)	
	Feeding of a smaller quantity (up to 2 L) only in case of difficulty and colostrum of excellent quality; otherwise, use of esophageal feeder	7	Alternative method (1)	
	Routine assessment of colostrum quality with a colostrometer	6	Evaluation of colostrum quality (1)	
	Routine supply of adequate stocks of frozen colostrum	11	Stocks of colostrum (2)	
	Routine verification of immunity transfer	3	Check of passive transfer (1)	

Table 3. Critical areas, targets, maximum possible score attributed to each target, and descriptions of indicators comprising measures taken during the interview with the producer and indicators comprising measures taken by the observers during the visit to the barn

Critical area	Target	Maximum score	Indicator comprising measures taken during interview with producer (n)	Indicator comprising measures taken by observer during visits to barn (n)
Calf feeding	Milk feeding plan followed	9	Milk feeding quantity known by producer (1)	
	More than 8 L of milk fed per calf per day	22	Milk feeding quantity (1)	
	Frequency of feedings and use of a nipple	8	Milk feeding method (1)	
	Hospital milk not used	8	Use of waste milk (1)	
	Access to water beginning on d 2 of life	11	Water access (2)	
	Clean, functional waterers, unrestricted access	10		Waterers cleanliness (1); waterers accessibility (1)
	Feeding plan followed	9	Solid feeding standard operating procedure (1); solid feeding quantity known by producer (1)	
	Access to concentrates at all times	12	Grain access (1)	Presence of grain in feeders (1)
	Clean, functional feeders, unrestricted access	11		Feeders cleanliness (2); feeders accessibility (2)
Weaning	Age and concentrate consumption adequate for weaning	55	Age at weaning (1); grain consumption at weaning (1)	
	Adoption of progressive weaning method	45	Type of weaning (1)	
Calf housing	Housing unit allows calf to be comfortable	65		Possibilities given by housing systems to animals (1); dimensions (1)
	High cleanliness level and adequate quantities of bedding	35	Litter management (3)	Covering material and litter (1); cleanliness estimation (2)

Table 4. Critical areas, targets, maximum possible score attributed to each target, and descriptions of indicators comprising measures taken during the interview with the producer and indicators comprising measures taken by the observers during the visit to the barn

Critical area	Target	Maximum score	Indicator comprising measures taken during interview with producer (n)	Indicator comprising measures taken by observer during visits to the barn (n)
Heifer feeding	Clean, functional waterers, unrestricted access	44		Waterers cleanliness (1); waterers accessibility (1)
	Feeding plan followed	17	Feeding standard operating procedure (1)	
	Access to forage feed at all times	21	Ad libitum roughage feeding (1)	Presence of roughage in feeders (1)
	Clean, functional feeders, unrestricted access	18		Feeders cleanliness (2); feeders accessibility (2)
Heifer housing	Housing unit allows heifer to be comfortable	70		Possibilities given by housing systems to animals (1); dimensions (1)
	High cleanliness level and adequate quantities of bedding	24	Litter management (3)	Covering material and litter (1); cleanliness estimation (2)
	Access to pasture	6	Pasture access (1)	
General monitoring	Mortality and morbidity record carefully kept	44		Health events records (4)
	Monitoring of animals' growth	40	Routine growth evaluation (1)	
	Hoof monitoring	16	Hoof monitoring (1)	

and animal welfare (Tables 2, 3, and 4). Targets were based on the available scientific information. For example, considerable research has shown that the timing of the first meal of colostrum is critical because optimal absorption of immunoglobulins occurs before 4 h of age and decreases rapidly after 12 h (Weaver et al., 2000). Thus, we defined a target (Table 2) as "first feeding of colostrum within first 4 h of calf's life" for the critical area "colostrum management."

Definition of Indicators. Once targets were established, we then defined indicators (Tables 2, 3, and 4; Mitchell et al., 1995) that consisted of 1 or a combination of measures that determined the extent to which a target is reached (which could range from 0 to 100%). These indicators were based on answers to questions that were asked in the interview of the producer and on observations that were made during a visit to the facilities housing the calves and heifers (Tables 2, 3, and 4).

The answers to the questions during the interview were either qualitative nominal (e.g., "Do you check colostrum quality using a colostrometer?" Answer: yes vs. no), qualitative ordinal [e.g., "When do you provide colostrum for the first time?" Scale of answers: 1 ("within 2 h of life") to 5 ("never")], or continuous (e.g., "Which quantity of colostrum is given for the first feeding?" Answer: number of liters of colostrum).

During the visit to the rearing facilities, the observer scored conditions in the barn using a questionnaire. The answers to the questions were either qualitative nominal (e.g., "Are there any safety hazards in the calving area?" Answer: yes vs. no), qualitative ordinal [e.g., "How much accumulated manure is there in the calving area?" Scale of answers: 1 ("none") to 5 ("entire area contaminated")], or continuous (e.g., "What are the dimension of the calving area?" Answer: number of meters of calving pen length and width).

The answers to the interview questions and the observations taken during the visit were then used to assess the extent that the targets had been reached. For example, the indicator for the target "first feeding of colostrum within 4 h of calf's life" was the producer's answer to the question "When do you give colostrum for the first time?" Possible answers were A) within 2 h of life (target reached at 100%), B) between 2 and 6 h (66%), C) between 6 and 12 h (33%), D) the day after the birth (0%), and E) never (0%).

Some questions could be used in only some situations. For example, the question on the accumulation of manure in the calving pen was relevant only if a calving pen was in use, which we could not predict would be the case in any given visit. This question was used in discussions with the producer but did not enter in the scoring. Where possible, we checked the answers

to the questions posed in the interview. For example, if the producers claimed to disinfect the calves' navels with iodine, then the observer should be able to find iodine in the barn and identify the name of the product and the location and cleanliness of the container. When discrepancies were found, these were discussed with the producers to clarify their practices.

The questionnaires used for the collection of data and the observations were tested previously on 115 dairy farms in Quebec (Vasseur et al., 2010) and reviewed and tested again in 60 farms in central Europe (Winckler et al., 2006). In identifying the critical areas, targets, and indicators, we relied on several recent reviews of the factors affecting calf welfare (EFSA, 2006; Rushen et al., 2008; NFACC, 2009).

Design Validation of the Tool by a Panel of Experts. We organized a focus group of 6 experts of several fields related to dairy production (an agronomist, a dairy producer, a veterinarian, a technical advisor, and 2 researchers). The first objective of this meeting was the design or conceptual validation of our tool (Bockstaller and Girardin, 2003) to judge the scientific quality of the construction of the tool. The expert group examined and discussed the questions, indicators, and critical areas until the group reached a consensus. The group then assigned maximum possible scores for each target (see Score Assignment). We also submitted for review all the components of our tool (e.g., data recording sheets, material distributed to producers) until the group arrived at a consensus. The second objective of this meeting was a discussion of the recommendations to be provided to producers. The full list of questions and variables measured during the survey of the facilities is available from the first author and is publicly available online (www.agrireseau.qc.ca/bovinslaitiers).

Score Assignment. We assumed that all critical areas are equally important for animal welfare and so we gave them equal weighting and assigned a maximum possible score of 100 to all of them. We then asked each of the 6 experts to independently weight the targets within each critical area and give each a maximum possible score so that the sum of all scores of the targets with each critical area added up to 100. We then took the median of the scores from the 6 experts (Tables 2, 3, and 4). Within a specific target, we considered all indicators as equally important. Therefore, to obtain a maximum possible score for each indicator, we divided the maximum score for the target by the number of indicators.

During the visit to the farm, we scored each farm for each critical area and target based on the producer's answers to the questions on management and on the evaluation of the conditions in the barn. This scoring

was discussed with the producer at the end of the on-farm visit. For each target we explained the research that had been done, which supported our scoring. We provided a report to the producers, who could forward it to advisors or consultants.

Tasks Assigned to Producers. To encourage the producers to take an active part in the project, we asked them to take and test samples of calves' blood and of colostrum and to record health events. Each producer involved in the study was trained to fill records and perform the required tests, and standard operating procedures were provided. The tasks assigned to producers included the following:

a) Filling complete records of the newborn management. We asked producers to record all steps of newborn calf management in a "calf passport." The 5 steps of the newborn management recorded were 1) information related to birth and calving (intervention at calving, birth timing, and calf seen suckling), 2) identification (calf and dam), 3) checking dam's colostrum quality (time of sampling, quality test), 4) colostrum feeding (timing, quantity, origin, and method), and 5) checking passive transfer of immunity (blood sampling and Ig test).

b) Taking samples of colostrum. Producers were asked to keep 5 samples of colostrum to test the colostrum quality (poor, medium, or high quality) by using a colostrometer (Kruuse Colostrum Densimeter, Langeskov, Denmark), which we supplied to them, and to report these results in the calf passport.

c) Taking blood samples. Producers were asked to take a blood sample following recommended procedure (Vasseur et al., 2009a) for 5 calves 24 to 48 h after colostrum feeding and to test the Ig levels in blood using an easily used kit (Whole Blood Calf IgG Midland Quick Test Kit, Midland BioProducts Corp., Boone, IA). This was to check the passive transfer of immunity (pass vs. fail). Producers were asked to record the result in the calf passport.

d) Keeping health and mortality records. Farmers were asked to record each instance of calf mortality and morbidity (diarrhea, respiratory disease, or other, and treatments) during a 6-mo period.

Sequence of the On-Farm Visit. The on-farm visit was conducted in 6 steps and we targeted a total duration of 3 h. Steps included 1) interview with the producer on management (evaluation of management practices; target duration: 30 min), 2) tour of facilities with the producer (target duration: 15 min), 3) evalua-

tion of conditions in the barn (target duration: 1 h), 4) scoring (target duration: 5 min), 5) checking colostrum samples with the producer (target duration: 15 min), and 6) debriefing with the producer (target duration: 30 min).

On-Farm Test of the Tool

Feasibility and Interobserver Repeatability Analysis. The feasibility analysis was based on the timing (e.g., did we respect the targeted 3 h-time limit?) and our ability to take the measures (e.g., did we have physical constraints to collecting data?). We also tested interobserver repeatability of qualitative environment-based measures (e.g., judging cleanliness of a nonweaned calves pen using a scale of definition of cleanliness). We used 2 well-trained observers who used the tool simultaneously but independently on the 28 farms and we compared the 2 sets of scores.

Effectiveness as Judged by the End User. The final step of our on-farm visit was an interview to collect producers' perception of the usefulness of our tool. We asked questions about the ease of use, the time and cost involved, the producer's degree of interest, and the routine use of tested material (calf passport, colostrometer, Ig blood test, and health record). We also asked questions on the overall diagnostic tool and scoring system (e.g., the relative scores attributed to targets). We used scales of perceptions (qualitative ordinal data) and open questions (e.g., "Do you have suggestions to improve calf passport? Yes/no and explain your answer"). Producers could point out the weaknesses of the indicators and components of the tool as a diagnostic or decision aid tool. The effectiveness was also judged by analyzing producers' scoring. To have realistic targets, we aimed to have most scores in the middle of the range (i.e., if most producers scored close to 100%, we probably missed problems, whereas if most producers scored close to 0%, then our targets were probably unrealistic). In addition, we judged the extent to which our recommendations had been adopted after 6 mo. This was tested with a short survey conducted during a final meeting of results presentation to our sample of 28 producers or by phone 6 mo after the on-farm visit. This short survey asked questions about 15 targeted practices (e.g., "Do you routinely apply a record of mortality and morbidity events?"); the answers proposed to producers were qualitative nominal (e.g., yes vs. no).

Statistical Analysis. Descriptive statistics were used to analyze producers' scoring; the minimum, 25th percentile, median, 75th percentile, and maximum were calculated. Percentages were calculated for the analysis of the questionnaires and producers' perception. Kappa

Table 5. The mean duration of each step of the visit

Step, min	No. of herds	Mean	SD
Evaluation of management practices	28	29	12
Tour of facilities with producer	28	19	8
Evaluation of conditions in the barn	28	30	11
Scoring	27	25	6
Test colostrum quality with producer	23	43	26
Debriefing with producer	26	50	16
Total visit	25	187	54

coefficients were calculated for interobserver repeatability analysis using the SAS statistical package (version 9.1, SAS Institute Inc., Cary, NC). A single kappa value (**K**) was calculated if each observer took only 1 measure on each farm. In some cases, each observer took more than 1 measure on each farm. For example, "litter quantity" in calf housing was assessed a total of 40 times for the 28 farm visits because there was more than 1 pen per farm so 1 measure was taken for each pen. In this case, a kappa value was calculated for each measure and the median kappa value was calculated. In some cases, measures could not be taken on all farms. For example, "litter quantity" in calving pen was assessed a total of 16 times for the 28 farms; indeed, only 16 farms had a calving pen. We followed Harbison et al. (2002) and Rousing and Waiblinger (2004) in using the following classification for the interpretation of kappa value: high concordance (high repeatability between 2 judges; K > 0.6), moderate concordance (0.6 > K > 0.4), and low concordance (K < 0.4).

RESULTS AND DISCUSSION

We present our results in terms of whether we achieved the main goals related to the feasibility of using the tool on commercial farms and the likelihood that it would be used by advisors or producers to improve management practices.

Duration of Visit

The time needed to conduct the on-farm visit is a determining factor of the feasibility of the tool. Our goal was to complete the visit in no more than 3 h. In the case of an audit, 3 h (equivalent to a half-working day for a dairy producer, excluding milking) is probably the maximum time that is acceptable from a practical and financial point of view. Table 5 shows the duration of each step of the visit (mean ± SD). We came close to meeting our goal with total visit duration of 3 to 4 h. However, debriefing took twice as long as expected (around 1 h instead of 30 min), mainly because the producers were interested in understanding all the steps of

our tool and the scoring in detail, which led to much discussion between the producers and the observers. This discussion is good but it increased the duration of the visit. However, this tool should encourage discussion between producers and advisors about areas in need of improvement, and this was the case.

Checking colostrum samples took a long time (about 40 min), but this step could be removed in routine use of the tool. We wanted to ensure that producers went through all steps of good colostrum management because colostrum management was identified as a major area in need of improvement in our risk factor assessment (Vasseur et al., 2010) and is an important area of concern for calf and heifer welfare (e.g., EFSA, 2006; NFACC, 2009). As a result of the visit, all producers understood very well the importance of checking colostrum quality, which was reflected in the producers' perceptions and long-term effects of the tool.

Ease of Data Collection and Repeatability of Qualitative Assessments

No major problems were encountered in collecting the management- and environment-based data. This is likely because both questionnaires were well developed and well tested before this experiment.

To judge the accuracy of any measure, especially qualitative measures (e.g., judging the cleanliness of a pen), it is necessary to test the repeatability between several observers (e.g., Lensink et al., 2003; March et al., 2007). If a variable is not repeatable between 2 observers, this would result in errors of judgments and so this variable could not be used in an on-farm assessment tool that required several users (De Rosa et al., 2003). The qualitative environment-based measures (evaluation of conditions in the barn) included judgments of the quantity of cover litter, the accumulation of manure, the cleanliness of the pens, and the cleanliness and accessibility of feeders. We obtained high repeatability (K > 0.6) for all qualitative environment-based measures (Table 6 **[AU1: Renumbered tables (was Table 10); verify new table order.]**) except for judging the accumulation of manure and judging the quantity of litter in heifer housing, for which we obtained only moderate repeatability (0.6 > Kappa value > 0.4). To improve these assessments, we have now developed visual charts (not tested on the farms involved in this study) to help standardize judgments between observers and between farms for future use of the tool.

Having Realistic Targets

For the tool to be useful, the targets set should be realistic and not be so high as to discourage produc-

Table 6. Repeatability between 2 observers for qualitative environment measures describing calving pen, calf housing, and heifer housing

Measure	K	N[1]
Calving pen		
Litter quantity	0.854[2]	16
Manure accumulation	0.807[2]	16
Pen cleanliness	0.898[2]	16
Calf housing		
Milk bucket/distributor cleanliness	0.863[2]	24
Waterer cleanliness	0.582[2]	22
Waterer accessibility	0.854[2]	28
Roughage feeder cleanliness	0.524[2]	21
Roughage feeder accessibility	0.565[2]	28
Grain feeder cleanliness	0.596[2]	23
Grain feeder accessibility	0.867[2]	27
Litter quantity	0.652[3]	40
Manure accumulation	0.389[3]	40
Pen cleanliness	0.532[3]	40
Heifer housing		
Waterer cleanliness	0.618[3]	80
Waterer accessibility	0.618[2]	28
Roughage feeder cleanliness	0.667[3]	82
Roughage feeder accessibility	1.000[3]	83
Grain feeder cleanliness	0.786[3]	83
Grain feeder accessibility	1.000[3]	83
Litter quantity	0.309[3]	102
Manure accumulation	0.338[3]	103
Pen cleanliness	0.734[3]	103

[1]Total number of measures taken.

[2]Kappa value when the pair of observers took only 1 measure/farm.

[3]Median kappa value when the pair of observers took more than 1 measure/farm.

ers. However, the targets should not be set so low that all producers reach them easily even if they have real problems on their farm. We considered that the targets would be realistic if average scores were in the middle of the range. That is, if most producers scored close to 100%, we probably missed problems. Alternatively, if most producers scored close to 0%, then our targets were unrealistic.

Producers had median scores between 52 and 78% for all 9 **[AU2: Previously stated as 10 critical areas; please verify.]** critical areas (Table 7). Indeed, the 25% lowest scoring producers (25th percentile) scored up to 50% on 7 of the 9 critical areas and the maximum score

of 100% was reached on 3 of the 9 areas. Most producers didn't reach targets (below 50%) in some areas of calving management, care to newborn calves and painful procedures, colostrum management (Table 8), calf feeding (Table 9), and heifer housing (Table 10), and no producers (score 0%) were able to reach 6 targets (out of a total of 39). Although we did not choose a representative sample of Quebec farms, the farms in our sample appeared to be typical of Quebec farms. We found the same management problems in our sample as we had seen in a previous epidemiological survey, which did involve a representative sample of Quebec dairy farms (Vasseur et al., 2010). The management practices that we identified included no use or inappropriate management of the calving pen; no systematic monitoring of the newborn; lack of pain control during painful procedures such as dehorning; no check of colostrum quality, intake, and passive transfer; no teat provided to satisfy the calf's motivation to suck; use of unpasteurized waste milk for unweaned calves; poor hygienic condition of heifer housing; and no pasture access. Therefore, we concluded that our tool would help producers or advisors identify practices that affect animal welfare and help the producers improve their management. Our targets were realistic so producers would not be discouraged from trying to improve their management.

Encouraging the Involvement of Producers

We evaluated the producers' perceptions of our tool because they are the end users of the tool and the best judges of the usefulness of an advisory tool. All producers (100%) agreed that this tool was easily usable at the farm level and could help improve practices by giving new ideas and new material to reach targets of a good management. A majority (68%) were in favor of using this tool for an animal welfare accreditation; the 43% against this idea mentioned that an accreditation involves too much record keeping and that they already have too much with the compulsory on-farm food safety

Table 7. The minimum, 25th percentile (P25), median, 75th percentile (P75), and maximum score (%) reached by producers for each critical area

Critical area	No. of herds	Minimum	P25	Median	P75	Maximum
Calving management	28	22	35	52	73	100
Care to newborn calves and painful procedures	28	6	36	56	64	86
Colostrum management	28	31	53	58	65	85
Calf feeding	28	30	50	59	74	94
Weaning	28	46	63	68	72	100
Calf housing	28	38	59	65	76	96
Heifer feeding	28	40	66	78	83	94
Heifer housing	28	44	58	73	77	83
General monitoring	28	0	56	68	100	100

Table 8. The minimum, 25th percentile (P25), median, 75th percentile (P75), and maximum score (%) reached by producers for each target for the critical areas

Critical area	Target	No. of herds	Minimum	P25	Median	P75	Maximum
Calving management	High calving surveillance level	28	51	69	69	100	100
	Use of calving pen on a regular basis	28	0	0	50	100	100
	Appropriate calving pen management for sick animals	28	0	0	0	50	100
	High calving pen cleanliness level	28	0	0	22	67	100
	Comfort and ergonomic quality of calving pen	28	0	0	22	67	100
Care to newborn calves and painful procedures	Immediate disinfection on a regular basis	28	0	38	50	100	100
	Immediate identification on a regular basis	28	0	0	0	0	100
	Appropriate painful procedure management	28	13	25	38	88	100
Colostrum management	First feeding within first 4 h of calf's life	28	33	67	100	100	100
	Monitoring of quantity ingested at first feeding	28	0	45	45	45	100
	Feeding of at least 4 L of first-milking colostrum within first 12 h of life	28	0	50	50	50	100
	Use of a method by means of which a controlled quantity of colostrum can be given	28	0	100	100	100	100
	Feeding of a smaller quantity (up to 2 L) only in case of difficulty and colostrum of excellent quality; otherwise, use of esophageal feeder	28	0	0	100	100	100
	Routine assessment of colostrum quality with a colostrometer	28	0	0	0	0	100
	Routine supply of adequate stocks of frozen colostrum	28	0	0	73	80	100
	Routine verification of immunity transfer	28	0	0	0	0	0

program Canadian Quality Milk (Dairy Farmers of Canada, 2003).

Concerning the steps of the visit, 93% of producers agreed that the questionnaire on management took an acceptable amount of time and all producers (100%) agreed that the questionnaire was very important because it helped to evaluate routine management. All producers (100%) agreed the evaluation of conditions in the barn took an acceptable amount of time (although the producers were not present for the data collection) and all of them (100%) considered it very important to check environment-based data (e.g., size of calving pen). All producers (100%) were very satisfied with the scoring; indeed, producers liked the approach by critical areas and targets and liked to have scores assigned. Finally, all producers (100%) perceived the debriefing to be very satisfying and very important; indeed, producers liked this period of discussion where they received explanations of the scoring and recommendations.

Concerning the material provided (Figure 1), all producers (100%) were in favor (easy to use, interest) of the calf passport and the colostrometer and thought of implementing them routinely. All producers (100%) planned to implement routine supply of stocks of colostrum. Checking immunity transfer was not an easy task for approximately half of the producers (46%) and the chief difficulty was in taking blood samples. However, only 6 producers (out of 28) asked for support and only 2 producers were still unable to take samples, even with help. This was probably the most difficult part of our tool because producers are not used to taking blood samples from newborn calves. In future uses of our tool, it might be advantageous to involve veterinarians in this step. However, the majority (61%) of producers were convinced of the interest of checking immunity transfer. The concept of regularly checking Ig status, and the fact that commercial Ig kits are available, were new to the producers. Our goal in introducing these was to help producers to understand the direct effect of colostrum management on calf health and welfare and therefore the potential risks associated with poor management. For example, 3 producers experienced a negative test (i.e., FPT [AU3: Please spell out FPT.]); they explained that quality of colostrum was insufficient or that first colostrum feeding was delayed, and one producer used to routinely give only 0.5 L of colostrum. These 3 producers definitely understood the consequences of these actions when presented with data on the actual Ig status of their calves.

Even though the mortality and morbidity recording was considered as easy to do by all producers (100%), not all of them (77%) considered themselves assiduous enough to keep adequate records, but all of them (100%) thought of implementing it routinely. Keeping

Table 9. The minimum, 25th percentile (P25), median, 75th percentile (P75), and maximum score (%) reached by producers for each target for the critical areas

Critical area	Target	No. of herds	Minimum	P25	Median	P75	Maximum
Calf feeding	Milk feeding plan followed	28	0	100	100	100	100
	More than 8 L of milk fed per calf per day	28	0	56	64	100	100
	Frequency of feedings and use of a nipple	28	0	0	0	0	100
	Hospital milk not used	28	0	0	0	100	100
	Access to water beginning on d 2 of life	28	0	55	55	100	100
	Clean, functional waterers, unrestricted access	28	0	30	55	80	100
	Feeding plan followed	28	0	44	100	100	100
	Access to concentrates at all times	28	50	50	50	100	100
	Clean, functional feeders, unrestricted access	28	0	36	55	75	100
Weaning	Age and concentrate consumption adequate for weaning	28	16	33	49	49	100
	Adoption of progressive weaning method	28	0	100	100	100	100
Calf housing	Housing unit allows calf to be comfortable	28	51	58	68	80	100
	High cleanliness level and adequate quantities of bedding	28	14	60	61	74	100

records is something perceived as difficult for producers because it is often seen as an extra workload instead of a necessary part of calf rearing. Without good records of calf morbidity and mortality, it is difficult to judge the effectiveness of the producer's management on a long-term basis. Furthermore, the producers themselves do not know the results on their farm (e.g., we found that calf mortality was underestimated by 20–50%, and 94% of producers perceived calf mortality as not being a problem; Vasseur et al., 2009b). This led us to provide materials to producers to help them develop the habit of keeping health records (goal 5).

Effectiveness at Changing Management Practices

The second way of judging the effectiveness of our tool (goal 3 for the first level) is through its long-term effect in changing management practices. Figure 2 shows the extent to which producers used various management practices before and 6 mo after the on-farm visit. These 15 practices were those that we were most interested in changing [i.e., these were the major risk factors detected in our risk factor assessment (Vasseur et al., 2010) and assessment by others (e.g., EFSA, 2006; NFACC, 2009)].

The importance of newborn calf monitoring seemed to be well understood by producers; many continued to use the calf passport to record newborn events, and 57 and 79% proceeded to practice immediate calf identification and navel disinfection, respectively. These were major improvements because before the on-farm visit, immediate calf identification and immediate navel disinfection were performed by only 14 and 43% of producers, respectively. The implementation of the

Table 10. The minimum, 25th percentile (P25), median, 75th percentile (P75), and maximum score (%) reached by producers for each target for the critical areas

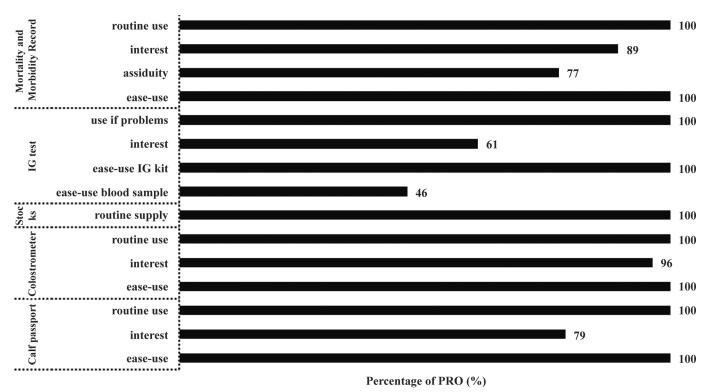| Critical area	Target	No. of herds	Minimum	P25	Median	P75	Maximum
Heifer feeding	Clean, functional waterers, unrestricted access	28	25	75	75	75	100
	Feeding plan followed	28	0	100	100	100	100
	Access to forage feed at all times	28	52	100	100	100	100
	Clean, functional feeders, unrestricted access	28	33	56	67	67	67
Heifer housing	Housing unit allows heifer to be comfortable	28	51	68	89	99	100
	High cleanliness level and adequate quantities of bedding	28	0	25	31	41	75
	Access to pasture	28	0	13	33	33	100
General monitoring	Mortality and morbidity record carefully kept	28	0	75	100	100	100
	Monitoring of animals' growth	28	0	0	100	100	100
	Hoof monitoring	28	0	0	100	100	100

Figure 1. Percentage of producers pro (in favor of) calf passport, colostrometer, stocks of colostrum, Ig test, and record of mortality and morbidity.

calf passport was a surprise because producers generally considered record keeping to be an extra workload. Indeed, early monitoring is a recommended practice to ensure individual follow-up and therefore an optimization of the newborn calf management (Quigley et al., 1996).

Major improvements were found for colostrum management. Six months after the on-farm visit, a first feeding of colostrum at 2 h after birth was done by 75% of producers (vs. only 39% before the visit), a first feeding of 4 L was done by 39% (vs. 4% before), a colostrometer was used by 29% (vs. 4% before), and stocks of colostrum were supplied by 64% (vs. 57% before); however, only 4% of producers continued to check immunity transfer on a routine basis. These increases showed the effectiveness of our advisory tool at improving most areas of colostrum management. Asking producers to take an active part in the project by training and learning new methods and by encouraging themselves to test that the information we provided was verifiable was a good way to change attitudes and to implement good practices to improve welfare.

We were interested in surveying the implementation of a feeding plan with a qualified advisor for calves because we found in our previous study (Vasseur et al.,

2010) that most Quebec producers continued to apply traditional restrictive feeding (e.g., bucket-fed, low quantities of milk or replacer twice daily) despite the demonstrated advantages of feeding larger amounts of milk (Jasper and Weary, 2002; Khan et al., 2007). Six months after the on-farm visit, 81% implemented a feeding plan for unweaned calves (vs. 68% before) and 82% for weaned calves (vs. 79% before). However, despite increased risk for transmission of infectious pathogens to cattle and humans (Selim and Cullor, 1997), only 52% of producers did not use unpasteurized waste milk for calf feeding compared with 43% before the visit.

A standard operating procedure for dehorning was implemented by 57%, whereas 50% implemented one before the visit. Hoof monitoring and growth evaluation were still high, with 82 and 86% of producers, respectively, performing them. Finally, 75% of producers implemented a record of mortality and morbidity, which is a welcome improvement. In our on-farm tool, we scored only for the good use of the record provided because only 10 producers kept a record for mortality and morbidity before the visit. Although producers generally found it time consuming to fill records, they finally adopted the practice.
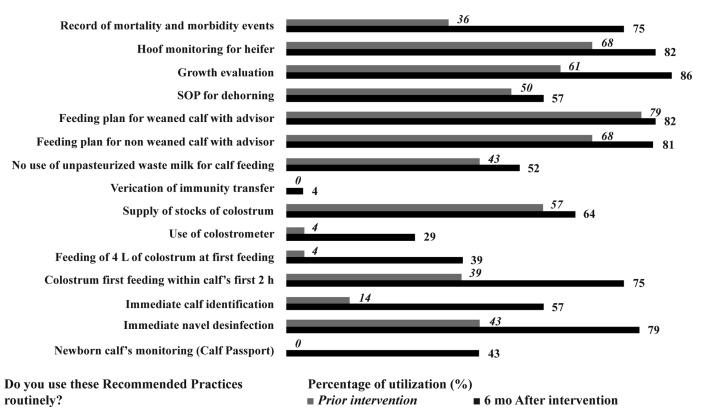
Figure 2. Percentage of producers that reported using in routine some recommended practices prior to and 6 mo after the on-farm intervention (no. of herds = 28).

CONCLUSIONS

We reached the main goals of a successful advisory tool of calf and heifer management to improve welfare on dairy farms. We respect the targeted 3 h-time limit. We had no problems collecting management- and environment-based data, and the repeatability of qualitative measures was usually good. Our tool was effective at identifying both good practices and problems, and our targets could realistically be reached by producers. The end users of our tool (i.e., producers) were convinced of the effectiveness of our tool as a diagnostic and aid decision tool. Our tool was effective at initiating changes in management practices.

An initial advisory approach for improving calf welfare is promising. Once necessary changes in management practices are voluntarily initiated as a result of producers changing their beliefs, attitudes, and behaviors (Dockès and Kling-Eveillard, 2006), the introduction of third-part audits (e.g., animal welfare accreditations by retailer) and legislation will have less of a negative effect on the dairy industry.

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