



A survey of practices and attitudes around cull cow management by bovine veterinarians in Ontario, Canada

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ABSTRACT

The removal (culling) of dairy cows from the farm is a regular and required management practice. The main objectives of this study were to describe the involvement of bovine veterinarians in Ontario, Canada, in dairy cull cow management decisions, their expectations of current producer practices, and their perspectives on welfare issues and best management practices for cull dairy cows. Between February and May 2021, a province-wide survey was conducted among all members of the Ontario Association of Bovine Practitioners (OABP), with questions addressing veterinarians' background and demographics, veterinary clinic characteristics, cull cow management, down cow management, and learning preferences. The response rate for the survey was 25.1%, with 45 responses meeting all eligibility criteria. Dairy veterinarians would like to have greater involvement in cull cow management; when asked for desired involvement in culling decisions, 57.5% of veterinarians would like to be involved in culling decisions most of the time or always. Most (70.0%) veterinarians believed that cull cow welfare has improved over the last decade. However, most respondents also identified at least one area of management (farm of origin, transportation, auction, slaughter) as currently being a high risk to cull cow welfare. Given the frequency of their visits, trust by dairy producers, and knowledge, herd veterinarians are among those in the best position to improve the care of cull dairy cows. Information generated from this survey can be used to inform the development of improved decision-making tools for culling cows, and this, along with increased veterinarians' involvement in cull cow management, could improve the economic and welfare outcomes of culling decisions for dairy producers.

Key words: culling, fitness for transport, compromised cow, cull cow, animal welfare

INTRODUCTION

Approximately one-third of dairy cows are removed from dairy herds annually in Canada (32.4%; CDIC, 2020) and the United States (33.8%; USDA, 2014). These cattle are considered cull cows, and their management remains a serious welfare concern in the dairy industry. The journey of cull dairy cows to slaughter presents significant challenges to animal welfare, particularly due to handling, transport, commingling, states of market housing, and deprivation of feed and water (Stojkov et al., 2018). In the past, the management and welfare of cull dairy cattle received little research attention, but recently these topics have been of high interest within the dairy industry (Stojkov et al., 2018; De Vries and Marcondes, 2020; Roche et al., 2020; Cockram, 2021).

The most cited reasons for culling dairy cows, such as low production and reproduction, are not directly related to health and may be associated with the supply of replacement heifers and goals for genetic progress (CDIC, 2020). However, mastitis, feet and leg problems, and other illness or injury are responsible for about one-quarter of culling decisions for cows in Canada (CDIC, 2020). These reasons for removal from the herd may be associated with reduced welfare before culling that is exacerbated by the journey to slaughter. Moorman et al. (2018) found that 27.2% of scored cows at auction had unacceptable hocks, 40.5% had unacceptable body condition, and 72.7% of cows had an unacceptable gait. In Moorman et al. (2018), acceptable conditions of cull cows meant hocks with no or minor swelling, hair loss, or balding, BCS >2, and a gait with no limp present in at least 4 strides. Similarly, Stojkov et al. (2020a) observed that about one-third of cows at livestock markets had unacceptable or poor overall fitness due to

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body condition, gait, udder condition, or injury. As in Canada, the condition of cull dairy cows internationally has often been reported as poor. Dahl-Pedersen et al. (2018) reported that one-fifth of cows became lame or more lame during transport and had significant increases in milk leakage and wounds from transport in Denmark. Harris et al. (2017) reported that 9, 43, and 23% of cull cows in the United States were extremely thin, had a leg defect (e.g., swollen joint), and were lame, respectively. Furthermore, in the United States, Edwards-Callaway et al. (2019) reported that 9% of dairy cattle arriving at slaughter had at least one welfare issue identified.

The state of welfare of cull cows has been identified by industry and regulatory stakeholders as an area of concern, and in Canada, new regulations (from Canadian Food Inspection Agency; **CFIA**) and heightened emphasis on cull dairy cows in the revised Code of Practice (National Farm Animal Care Council; **NFACC**) have been brought in to address this. The CFIA regulates the humane transportation and treatment of animals in Canada through regulations, enforcement, and support of the NFACC in the development of Codes of Practice (NFACC, 2009; CFIA, 2020). In addition to addressing the industry's internal ethical beliefs of acceptable animal care, improvement of cull cow management is needed to meet consumer expectations that farmed animals experience lives free from pain (Spooner et al., 2014; Sumner et al., 2018).

The process of managing cows leaving the farm, regardless of their destination, is called "cull cow management." Culling cows from the herd makes room for younger cows with superior genetics and productivity to enter the herd (Dijkhuizen et al., 1985; Hadley et al., 2006). However, replacement of cows for higher productivity is not the only reason, or even a commonly stated reason, for the removal of a cow from the herd (CDIC, 2020; Cockram, 2021). There are a variety of commonly reported reasons for removing a cow from the herd, and culling decisions are, by their nature, multifactorial. Thus, the complexity of these decisions highlights an opportunity for improved management. Dairy farmers believe veterinarians are trustworthy and knowledgeable in animal health and welfare, and they are also influenced by consultation with veterinarians, leading to improved dairy cull cow management (Pothmann et al., 2014; Wilson et al., 2021). The objectives of this study were to describe veterinarians' involvement in dairy cull cow management decisions, expectations of current producer practices, and perspectives of major welfare issues and best management practices for cull cows in Ontario, Canada. Furthermore, we looked to

determine if there were predictors for whether some veterinarians were more or less likely to be sales barn inspectors and familiar with regulations.

MATERIALS AND METHODS

Study Design

An online survey was conducted between February and May 2021 to collect data on the current expectations, recommendations, and perspectives of Ontario veterinarians for cull cow management. Human research ethics approval was granted by the University of Guelph (Guelph, ON, Canada; REB no. 20-11-023). With the collaboration of several dairy researchers from the Ontario Veterinary College, the survey was developed to address key management questions based on previously conducted research and industry interest. Before active data collection, the survey was pretested by 3 recently retired bovine veterinarians. Recruitment for participants was completed through the Ontario Association of Bovine Practitioners (**OABP**) email newsletters. A recruitment statement outlining the scope and objectives of the study was presented through the organization, and a \$10 gift card was offered to the first 10 respondents as an incentive to complete the survey.

Eligibility criteria for participation were being a currently practicing veterinarian in Ontario who had completed work with dairy cattle within the past 12 mo. The survey was available in English and could be completed online (Qualtrics; <https://www.qualtrics.com/>) or by telephone. The survey was administered provincially between March and May 2021, and it was available for completion by 179 members who were actively practicing veterinarians at the time. The survey consisted of 75 questions with sections focusing on individual and clinic demographics, cull cows, down cows, and personal values; it was estimated to take about 30 min to complete (Supplemental File S1; <https://doi.org/10.5683/SP3/UJDIB3>; Marshall, 2022). Question types used were multiple choice, Likert scale, sliding scales, ranking, text, and open-ended comment boxes. Both quantitative and qualitative questions were used within the questionnaire for the cull cow and learning preference sections. To avoid biases, survey design methods included limiting questions presented per page and randomizing multiple choice questions. For this study, demographic and cull cow-related questions ($n = 36$) were used in analysis, and outcomes of interest for use in logistic regression models were familiarity with regulatory changes and being a licensed veterinary sales barn inspector.

Statistical Analyses

The survey data were downloaded from the survey software, imported, and then cleaned in Excel (2018; Microsoft Corp.). To facilitate analysis, variables were renamed and labeled, Likert scales were compressed, and variables were converted from text into numeric values for ease of use in data analysis software. Once completed, the data set was imported into STATA IC15 (2013; Stata Corp LP) for analysis. All analyses were planned (Supplemental File S2; <https://doi.org/10.5683/SP3/UJDIB3>; Marshall, 2022), including methods used for descriptive analyses, regression modeling, and thematic analysis.

For all quantitative variables, descriptive analyses were performed, including data counts, means, medians, standard deviations, and maximum and minimum values. Demographic information of responding veterinarians was compared with overall membership information provided by the OABP, reflecting membership as of January 2021. The primary variables of interest were the self-reported number of farms and cattle that a clinic and veterinarian served, satisfaction with their cull cow management and regulations knowledge, importance of different factors for cull cow management (ability of the cow to stand, BCS, drug withdrawal time, lactation status, lameness, mastitis, reproductive status, temperature, other disease/injury/illness, other), familiarity with transportation regulations, estimates of their clients' cull cow management practices, and their actual and desired involvement in cull cow management with their clients. Likert scale questions were collapsed from 5 points into 3 points: "very important/important," "moderately important," and "unimportant/of little importance" or "always/most of the time," "some of the time," and "rarely/never" to simplify analyses.

To investigate the relationship between explanatory variables and the outcomes of familiarity with regulatory changes and being a licensed veterinary sales barn inspector by the Ontario Ministry of Agriculture and Rural Affairs (OMAFRA), logistic regression models were constructed. Licensed sales barn inspectors are private veterinary practitioners who are contracted by OMAFRA to be responsible for examining livestock, facilities, and handling techniques at sales barn facilities to meet the standards set by the government, including Codes of Practice (OMAFRA, 2021). Logistic regression analysis was used to investigate factors that affect the odds of veterinarians being informed of regulatory changes and becoming sales barn inspectors. Both were investigated because we suspected that veterinarians familiar with regulatory changes and that have been licensed to inspect sales barns by the OMAFRA may

be more likely to be informed on the management of cull dairy cows (OMAFRA, 2021). In each model, assumptions of linearity were assessed graphically using scatterplots of residuals and adjusted for nonlinearity if needed. Univariable analyses were completed using a liberal P -value (<0.20) used as a cut-off for determining predictor variables having unconditional association with the outcome. The significant variables in univariate analyses were offered to the multivariable models. Variables with a significant P -value (<0.05) were retained in the final model, along with variables identified as confounders either through a priori consideration using causal diagrams or coefficient changes ($>20\%$) when removed from the model. Scatterplots were used to identify outliers and assess standardized residuals. The final models were assessed using Hosmer-Lemeshow goodness-of-fit tests. Three survey questions had open text responses, which required qualitative evaluation. These questions were regarding comments on cull cow standard operating procedures (SOP), desired involvement in cull cow management with producers, and comments on general cull cow management; the text was analyzed using thematic analysis. Thematic analysis was used to identify codes (interpretive labels), and broader categories of these codes were organized in relation to major themes (Braun and Clarke, 2006; Garrison, 2011).

RESULTS

A total of 45 survey responses from Ontario bovine veterinarians were collected from online responses for a response rate of 25.1%. Most participants ($n = 30$) answered the majority of the questions; however, due to the survey being structured so that questions could remain unanswered, some questions had fewer responses than others.

Demographics

A comparison of the demographics between the study response population and membership of OABP is provided in Table 1. The most identified category of age by respondents was between 30 and 39 yr (40.0%), with age ranging from 20 to >70 yr. Of respondents that identified their gender, half identified themselves using the pronouns he/him ($n = 15$) and half as she/her ($n = 15$). Approximately 90% ($n = 40$) of respondents identified the veterinary school they attended as being the Ontario Veterinary College, and the mean year of graduation (\pm SD) was 2008 ± 11 . Respondents reported working across Ontario, including the following regions: Southwestern (55.0%), Central (10.0%), Eastern (27.5%), and Northern (7.5%). Regardless of

animal species worked with, respondents identified their veterinary practice as employing an average of 5 (± 3) veterinarians. The average number of dairy farms a clinic serviced was 85 (± 88). The number of farms for which a respondent personally provided regular service each month (e.g., herd health) averaged 18 (± 14), and the number visited for any service type averaged 57 (± 50) farms. The average number of cows on farms that veterinarians serviced was 86 (± 26) lactating cows and 20 (± 11) dry cows. The majority of respondents (68.9%) indicated that most of their working hours were spent working with dairy cattle. The mean proportion of time spent working with the animal groups beef, companion animal, equine, small ruminant, and other (e.g., swine, poultry, and camelids) were 13.7, 6.6, 9.0, 3.9, and 0.3%, respectively.

Cull Cow Management

Respondents were asked about their involvement in the management of cull cows on the farms of their dairy producer clients. Veterinarians indicated that they were not often involved in the establishment, review, or update of producers' SOPs for cull cows, and respondents indicated, on average, they were involved 35.5, 30.0, and 28.5% of the time, respectively. Of those that provided further comments on cull cow SOPs, the consensus was that SOPs were not comprehensive enough for individual farms, and veterinarians were not consulted during their development. Respondents were asked the actual and desired regularity of their involvement in cull cow decision-making with producers. The most commonly noted current (actual) level of involvement in decision-making with producers about cull cows was "some of the time" (80.0%). Although the most commonly reported desired level of involvement in cull cow decision-making with producers was "most of the time" (48.8%), some respondents (7.3%) identified they would like to "always" be involved in cull cow management decisions with their producers. When respondents commented on the details of the involvement in producer cull cow decisions they desired, 2 themes were identified: educating and advising. These veterinarians desired increased involvement in the development of SOPs, to be consulted on individual cases (mostly those causing producers confusion), and to further educate producers on cull cow management. Finally, respondents approximated the proportion of cull cows they examined within the last year that were shipped for each given primary reason. On average, according to veterinarians, the most likely reasons for a cow to be removed from the herd were reproductive status and lameness as identified by respondents (Figure 1).

Table 1. A comparison of demographic factors between the membership of the Ontario Association of Bovine Practitioners (OABP) and the study population of respondents to the cull cow management survey sent to the membership

Item	Study population (n = 45), no. (%)	OABP (n = 1,791), no. (%)
Age ¹ (yr)		
<30	10 (22.2)	
30–39	18 (40.0)	
40–49	7 (15.6)	
50–59	7 (15.6)	
≥ 60	3 (6.7)	
Pronoun ¹		
He/him	15 (50.0)	72 (44.0)
She/her	15 (50.0)	107 (56.0)
They/them	0	0
Graduation year ¹		
1960–1969	0	4 (2.0)
1970–1979	1 (2.2)	13 (7.0)
1980–1989	2 (4.5)	23 (13.0)
1990–1999	6 (13.3)	27 (15.0)
2000–2009	10 (22.2)	31 (18.0)
2010–2019	24 (53.3)	68 (38.0)
2020–2021	2 (4.5)	13 (7.0)
Location		
Southwestern	22 (55.0)	108 (60.0)
Central	4 (10.0)	16 (9.0)
Eastern	11 (27.5)	48 (27.0)
North	3 (7.5)	7 (4.0)

¹Source: R. Cudmore, OMAFRA, Ontario, Canada, personal communication, September 27, 2021.

The proportion of producers that complete assessments and implement special management practices for cull cows before leaving the farm was estimated by veterinary respondents. As identified by respondents, the proportions of producers that check or assess lameness, drug withdrawal time, mastitis, temperature, and other before shipping a cow were 73.4, 95.5, 53.0, 27.2, and 36.8%, respectively, on average. Some other assessments that respondents reported that producers were checking included reproductive status, assessing body condition, and milk production. Finally, respondents estimated the average proportion of producers that, before shipping, dry off cows, feed for improved body condition, or provide alternative housing for improved health of cull cows were 28.8, 23.9, and 28.6%, respectively.

Transportation and Destinations

Respondents were asked to allocate a level of importance of cull cow management factors affecting cow fitness for transport immediately before loading. The fitness factors included the ability of a cow to stand and stay standing for the duration of the trip; BCS; drug withdrawal time; lactation status; lameness; mastitis; reproductive status; temperature; other disease, injury,

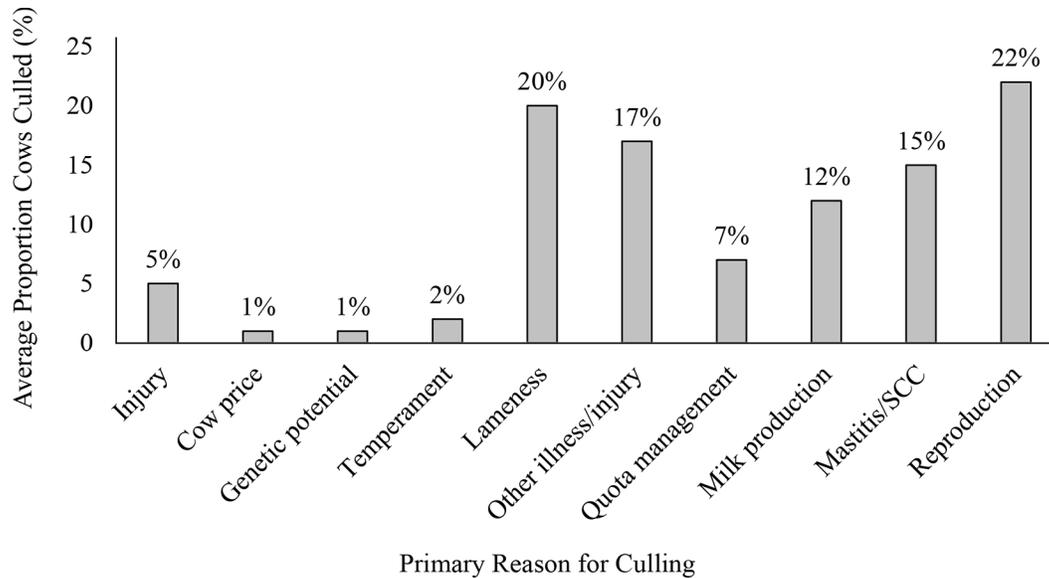


Figure 1. Proportion of cull cows examined by respondents ($n = 30$) that were removed from herds for each primary reason in the last 12 mo.

or illness; and other (Figure 2). The factors that all or almost all respondents identified as being important or very important were drug withdrawal (100%), lameness (96.7%), and ability of a cow to stand (96.6%).

The availability of alternative destinations for cull cows beyond a sales yard were assessed. Most respondents identified sending a cull cow directly to slaughter (96.7%), slaughter on farm (70.0%), and euthanasia (by either the veterinarian or personnel on farm; 100%) as being alternatives to the sales yard available in their practice area. A consensus from comments regarding cull cow management was poor access to direct-to-slaughter facilities, which is detrimental to cull cow welfare. Poor access to direct-to-slaughter destinations for cull cows is a risk to cull cow welfare because of animals only fit to be sent directly to slaughter then being sent to auction markets (Stojkov et al., 2018).

To determine the perceived length of time a cull cow spends between the farm of origin and slaughter, respondents were asked to estimate the length of time that cull cattle are in the market system before slaughter. The average length of time respondents estimated that cows spend between leaving their farm of origin to slaughter was 6 d (± 3).

Welfare

Respondents' perception of change in the welfare of cull cows over the last decade was evaluated, with most respondents identifying either improvements of "much better" (40.0%) or "somewhat better" (40.0%). Respondents were asked to identify their assigned importance of different factors to the welfare of cull cows

(Figure 3). The factor ranked as the most important by the majority of respondents (80.0%) was producer education.

We asked respondents to indicate the risk posed to cull cow welfare by management factors at auction, the farm of origin, slaughter, and truck/transportation on a 4-point scale from high (1) to low (4). The most commonly selected area of management classified as being high risk to cull cow welfare was truck/transportation, with 30.0% of respondents identifying it as being of high importance. The area of least importance to cull cow welfare was auction/market, with about 46.7% of respondents ranking it as a 3 or 4 on the scale of risk. The average risk scores assigned by respondents were 2.3, 2.1, 3.7, and 1.9 for auction, farm of origin, slaughter, and truck/transportation, respectively.

Knowledge Level

Most respondents (82.5%) stated that they were familiar with changes to the transport regulations included in the Health of Animals Act, which was published in February 2020. Respondents' self-identified familiarity with regulatory changes was evaluated for use in a regression model but no significant predictor variables were found. Respondents were asked if they were licensed by OMAFRA as a veterinary sales barn inspector (yes or no), with 31.1% identifying themselves as being licensed. Using logistic regression modeling, we investigated associations between responses to survey questions and having this license. Using a Likert scale, satisfaction with current cull cow transport regulations knowledge, level of involvement in cull cow

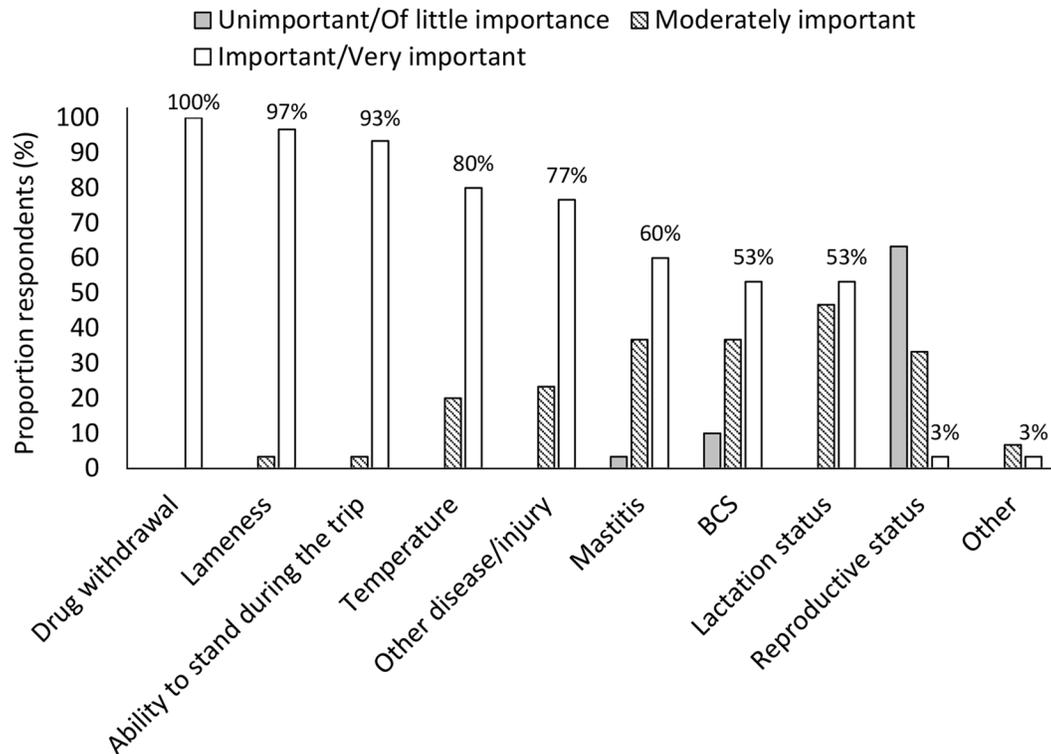


Figure 2. Proportion of veterinary respondents' ($n = 30$) views on the importance ("important/very important," "moderately important," and "unimportant/of little importance") of factors affecting assessment of cow fitness for transport immediately before loading.

decision-making with producers, and perceived change of welfare for cull cows over the last decade were assessed and found significant in univariable analysis. These explanatory variables were offered to a multivariable model along with the potential confounders age and the average number of cows in the herds of respondents' clinic services. In the final model, the sole significant variable was satisfaction with knowledge of cull cow transportation regulations. Respondents who were more satisfied with their knowledge of cull cow transport regulations were at increased odds of being an OMAFRA licensed veterinary sales barn inspector (odds ratio = 204; 95% CI = 1.38, 30,297; $P = 0.037$). Gender identification and the average number of cows in each herd that a clinic services were identified as confounders in this relationship by constructed causal diagrams and a difference $>20\%$ in the coefficients of knowledge satisfaction when removed from the model; thus, these were retained in the final model.

Continuing Education

Regarding cull cow management, the topics of interest that respondents were most interested in learning more about were developing SOPs to use on farm (63.3%) and management strategies to optimize cow

health before transport (80.0%). A minority of respondents were interested in learning more about assessing fitness of cows for loading and transport (30.0%) and transportation regulations (37.0%). Conferences were the most preferred method for learning new information, with 87.5% of respondents selecting this option. Fewer respondents were interested in receiving continuing education materials through email articles (53.3%), industry magazines (16.7%), printed booklets (33.3%), smart device applications (36.7%), website (26.7%), and journal articles (53.3%).

DISCUSSION

To our knowledge, this is the first study to explore the involvement and perspectives of veterinarians regarding dairy cull cow management. This study aimed to identify current cull cow management practices that Ontario bovine veterinarians recommend and their involvement in cull cow management with dairy farmers. Using the information collected from this study, we aimed to inform the development of training tools for veterinarians to use to educate their clients on best practices for the management of cull dairy cows.

The study population (Table 1) was found to closely reflect membership of the OABP. Therefore, we believe

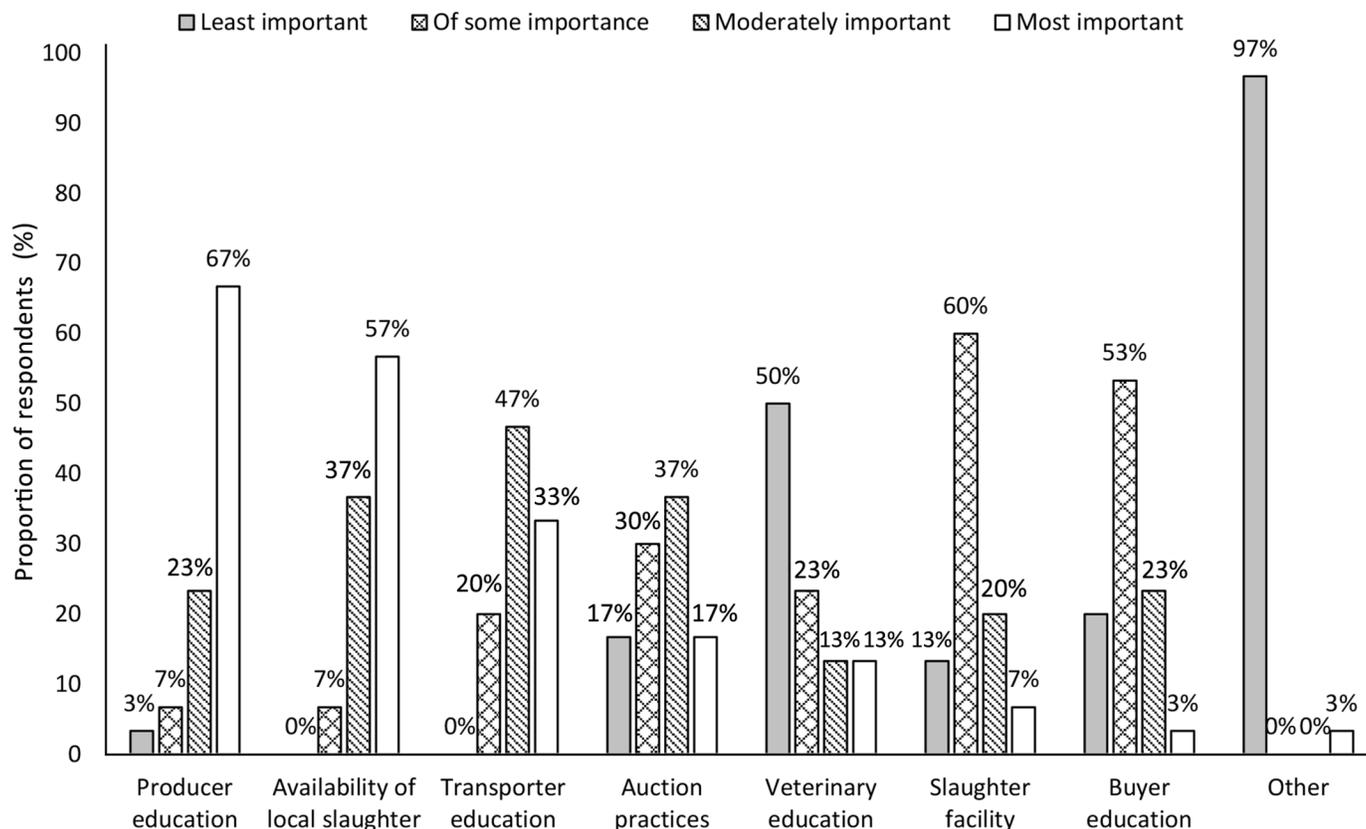


Figure 3. Proportion of veterinary respondents' ($n = 30$) views on the importance [8-point scale from most (1) to least (8) important: 1 or 2 = "most important," 3 or 4 = "moderately important," 5 or 6 = "of some importance," and 7 or 8 = "least important"] of factors affecting the welfare of cull cows.

it is representative of the Ontario bovine veterinarian population.

Veterinarians are trusted advisors to dairy producers, with their farming clients often considering them the best source of information (Kauppinen et al., 2010; Leach et al., 2010; Pothmann et al., 2014). The consultation of veterinarians by farmers is important for compliance with regulations and uptake of recommendations such as the Dairy Farmers of Canada's proAction initiative. Thus, we anticipated that most veterinarians would have some level of involvement in creating cull cow management protocols for their clients; however, we found that most veterinarians have not been involved in creating or updating their clients' cull cow SOPs. Only about one-third (34.4%) of respondents answered they had viewed most producers cull cow SOPs. Meanwhile, most respondents stated that they desired to be more involved in cull cow management decisions with producers; when comparing the current and desired level of involvement in culling decisions, 50% more respondents desired to be involved either "most of the time" or "always." With the most-identified high-risk area of management for cull cows

being the farm of origin, veterinarians should recognize the opportunity to use their advisory skills to mitigate the risk to the welfare of cull cows and the stress of cull cow management for producers (Van der Leek, 2015; NFAHW, 2017; Stojkov et al., 2018).

Some veterinarians indicated that most of their dairy clients were not assessing cull cows for lameness (10%), mastitis (30%), or temperature (66%) immediately before a cull cow leaves the farm, even though these are expected practices to avoid the shipment of unfit or compromised animals based on CFIA transport regulations (CFIA, 2020). The industry's own animal care quality assurance program, proAction, states that farm personnel must ensure animals do not have a fever, acute or gangrenous mastitis, or classes of lameness >3 for shipment (NFAACC, 2009; DFC, 2021). Respondents indicated that they see producer education as being the most important factor contributing to the state of welfare for cull cows, and that they desire to be involved in the education of producers regarding cull cow management. Research has shown that veterinarian communication is highly valued by farmers, thus cull cow welfare may be improved on farms with increased

counseling between veterinarians and farmers (Kleen et al., 2011; Hall and Wapenaar, 2012; Ritter et al., 2019). Furthermore, previous research suggests that farmers create SOPs to comply with assurance programs, but these management tools are not being refined to be farm-specific and are not being regularly used (Mills et al., 2020). Therefore, these findings highlight another opportunity for veterinarians to help to improve animal welfare and compliance with management requirements of cull cows by educating their clients during regularly scheduled meetings with farm personnel (Kleen et al., 2011; Ritter et al., 2015).

Respondents identified the primary reasons why potential cull cows they examined were eventually removed from farms. Reproductive status and lameness were the most common reasons for culling. Generally, these responses are consistent with reports by the Canadian Dairy Information Centre, which reports reproductive performance and feet and leg problems as being among the top 3 reasons for culling cows in Canada (CDIC, 2020). The mean proportions of animals being removed from herds due to reproduction and lameness were somewhat higher than nationally reported proportions. Numerous regions worldwide report that the largest proportions of dairy cows have been culled due to reproduction and lameness, including New Zealand (Kerlake et al., 2018), Europe (Seegers et al., 1998; Rilanto et al., 2020), and the United States (USDA, 2014). The higher proportion indicated by respondents may be due to regional differences for culling cows, or it may be that veterinarians are more likely to examine cows with reproductive or feet and leg health concerns. Therefore, veterinarians appear to generally recognize the major reasons for the removal of cows from dairy herds.

Both BCS and lactation status were less highly ranked as important to cull cow welfare compared with the ability of a cow to stand, drug withdrawal time, and lameness (Figure 3). This is likely due to these factors being recent additions to cull cow management recommendations (CFIA, 2020; DFC, 2020). That respondents highly ranked the importance of the ability of a cow to stand for the duration of transportation, BCS, and drug withdrawal time reflects the long-term presence of these being required for the transportation of cows within the industry (NFACC, 2009). The lesser importance assigned to some factors for cull cow welfare by respondents may result in veterinarians not regularly advising farmers on the importance of some fitness assessments. Finally, body condition and lactation status were considered least important by veterinarians, which may mean they are less likely to promote to producers the assessment of these factors for their cull cows,

reflecting noncompliance with proAction requirements identified by previous studies (Moorman et al., 2018; Stojkov et al., 2020a).

Local facilities for cows to be sent directly to slaughter were identified as being available for nearly all the farms that veterinarians provide service to, which conflicts with the poor access to send cows directly to slaughter for many farms (Stojkov et al., 2018; Cockram, 2021). In contrast, veterinarians noted that direct-to-slaughter options were available to 96.7% of their dairy clients, whereas only 36.6% of operations in the United States send cows directly to a slaughter plant (USDA, 2014). Yet, those that commented on cull cow management almost unanimously pointed to the availability of local slaughter facilities as being an issue for cull cow welfare. This reflects previous publications that point to issues in capacity for the Ontario meat industry (Charlebois and Summan, 2014; Grier and Mussel, 2014; Stojkov et al., 2018, 2020b). The identification of transportation as being the riskiest point of the journey of a cull cow to slaughter reflects sentiments within the literature from researchers and industry (Stojkov et al., 2018; Roche et al., 2020; Cockram, 2021). From previous research investigating cull cow management, most respondents stated that the suffering of cows may be reduced with increased availability of direct and local places for slaughter because it can reduce the time of transport and time to slaughter (Stojkov et al., 2018; Edwards-Callaway et al., 2019; Roche et al., 2020; Cockram, 2021).

Respondents more satisfied with their knowledge of transportation regulations for cull cows were at higher odds to have licenses to inspect sales barns by OMAFRA. One possible explanation for this is that to become licensed to inspect sales barns, veterinarians were required to familiarize themselves with regulations regarding the humane transport of animals (OMAFRA, 2019). Conversely, it is possible that veterinarians who become licensed inspectors receive training, resulting in their increased knowledge satisfaction. Thus, it is reasonable that these respondents were more likely to indicate they were more satisfied with their knowledge of cull cow transportation requirements. This suggests that training for all bovine veterinarians around humane transport regulations would be beneficial.

For the development of continuing education materials, the preferences of respondents for learning more about developing SOPs and management strategies to use to enhance cull cow health for transport should be considered, as well as the interest of respondents in attending conferences, specifically webinars, as a tool for knowledge transfer.

Survey Limitations

With an online survey being the method of data collection, there is a risk that the responses may differ from actual practice due to respondents giving socially desirable answers or different veterinarians being more likely to participate due to their availability or regularity of their use of online resources. Recall bias could have occurred throughout the survey; for example, in answers to questions regarding specific estimates of proportions of producer practices. Some veterinarians may define some terms differently, meaning that questions may be interpreted somewhat differently by individuals. With a response rate of 25% from all OABP members and the data being collected within the last year, these data may not fully represent the beliefs and practices of dairy veterinarians in Ontario in 2022. A desirable response rate for surveys is generally >50%, which means there is a risk that nonresponse bias affected our results (Kelley et al., 2003; Nulty, 2008). However, similar response rates in bovine veterinary populations have been previously reported (Midla et al., 2007; Cattaneo et al., 2009). Although survey respondents' demographics aligned well with that of the OABP membership, this study was completed using the responses of 45 veterinarians, representing just 25.1% of the OABP membership; therefore, caution should be considered when extrapolating these results to a larger population.

CONCLUSIONS

The marketing and transportation of compromised cows continues to be an issue for cow welfare. Veterinarians within Ontario recognize that there are risks for cull cow welfare at every point of the journey from transport to sale and slaughter, with welfare risks being highest at the farm of origin and during transportation. To address risks related to animal welfare, the management of cull cows may be improved through increased interactions of veterinarians with their dairy farming clients. Veterinarians may increase the applicability and use of SOPs by helping to make them farm-specific and stressing the importance of their use. This would allow producers to both meet requirements created by government and industry and improve cull cow welfare. Finally, the findings of this study will contribute to the development of tools to convey recommendations for cull cow management.

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