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A survey of recommended practices made by veterinary practitioners to cow-calf operations in the United States and Canada

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ABSTRACT

Practicing veterinarians (n = 148) who service commercial beef cow-calf herds responded to a survey describing general recommendations made to their clients in terms of vaccine protocol, health, and production practices. Responding veterinarians represented 35 states in the United States and 3 provinces in Canada. More than 50% of responding veterinarians devote over 50% of their practice to service commercial cow-calf producers. The largest group (33%) of veterinarians have been in practice for over 30 yr. Thirty-nine percent of responding veterinarians serviced more than 10,000 cows. Genetic advice is provided by 54% of practicing veterinarians. When vaccinating at branding, the most common recommended vaccines are clostridial (96%), infectious bovine rhinotracheitis (IBR; 94%), bovine respiratory syncytial virus (BRSV; 91%), parainfluenza-3 (PI-3; 90%), and bovine viral diarrhea (BVD) Types 1 and 2 (78 and 77%, respectively). When vaccinating before weaning, the most common recommended vaccines are IBR (99%), BRSV (98%), BVD Types 1 and 2 (96%), PI-3 (93%), clostridial (77%), and *Mannheimia haemolytica* (77%). When vaccinating after weaning, the most common recommended vaccines are BVD Type 2 (97%), IBR (97%), BVD Type 1 (96%), BRSV (96%), and PI-3 (91%). Over 60% of responding veterinarians recommended that the last preventative vaccine should be administered to cattle 7 to 21 d before shipping. The largest number of respondents (38%) recommended that the earliest age their clients should wean their calves is 90 to 120 d. Castrating bull calves at an age of 0 to 7 d was recommended by 34% of respondents. Calf nutrition is considered as extremely important during a preconditioning program by 82% of responding veterinarians.

Key words: beef, cow-calf, survey, veterinary practitioner

INTRODUCTION

Veterinary practitioners provide constant advice and recommendations to beef cow-calf operations across the United States and Canada regarding health, well-being, and production practices to gain satisfactory health status and optimum herd performance. Summarizing and reporting these recommendations provides valuable feedback to understand how best management practices are applied at the beef cow-calf herd level. These recommendations, over time, have been developed by academic researchers, practicing veterinarians, consulting veterinarians, and other animal health professionals. Currently, there are several published resources in the literature that provide recommendations made to feedlot managers by consulting veterinarians regarding animal health and well-being (Terrell et al., 2011; Terrell et al., 2014; Lee et al., 2015). In addition, similar publications exist for recommendations made by consulting nutritionists for nutritional recommendations in feedlot operations (Galyean, 1996; Galyean and Gleghorn, 2001; Vasconcelos and Galyean, 2007; Samuelson et al., 2016). Although there is limited and outdated published data (Sanderson et al., 2000) that provide a description of health and production practices employed by cow-calf producers, there is no published data that describe recommendations made by veterinary practitioners to cow-calf operations. Thus, the objective of this survey was to obtain descriptive data to describe recommended practices made by veterinary practitioners who service clients with commercial beef cow-calf operations in the United States and Canada in terms of vaccine protocols, health practices, and production practices.

MATERIALS AND METHODS

Institutional Animal Care and Use Committee approval was not required for this study because no animals were used. Approval to conduct this survey was granted by the Institutional Review Board at Kansas State University (IRB #8423).

The authors declare no conflict of interest.

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Survey Participants

Veterinary practitioners were contacted for participation in this study based on their individual participation in professional veterinary organizations. A total of 1,200 veterinarians were randomly contacted through the Academy of Veterinary Consultants and American Association of Bovine Practitioners respective email listservs. Veterinarians were sent an individual electronic invitation requesting their participation in the study. A total of 148 veterinarians completed this survey.

Data Collection

The survey was conducted during the month of September 2016. Data were collected using Kansas State University's web-based survey software Qualtrics Online (Qualtrics 2015, Version 2417833, Provo, UT). Invited veterinarians received a URL to access the survey via an email invitation. There was no information requested in the survey that identified individual veterinary practitioners, making responses completely anonymous. Participating veterinarians had 4 wk to access and complete the survey after receiving the original email invitation with the URL. An email reminder to complete the survey was sent to participants once at 2 wk after the survey was available to them.

The survey was composed of 42 questions covering areas of vaccine protocol, health practices, and production practices for beef cow-calf operations. Several questions gave the respondent the option to choose "Other" as an answer and type their response in a blank space. These responses were also included in the analysis.

Data Analysis

Response data collected from this survey were downloaded from the web-based survey software into a Microsoft Excel (Microsoft, Redmond, WA) spreadsheet for summarization and descriptive analysis. Graphs, tables, number of respondents per question, frequency of responses per question, means, minimum values, and maximum values were calculated for all questions using Microsoft Excel. Not all respondents answered all questions; therefore, the number of total responses to each individual question was expressed as a percentage of the number of answers to that question out of total survey responses.

RESULTS AND DISCUSSION

The United States produced a total of 11.5 million tonnes of beef during 2016, making it the number one beef producer in the world (USDA, 2017a). Beef cattle operations represented a total of 93.6 million cattle as of January 1, 2017, in the United States (USDA, 2017b). In 2016 the calf crop in the United States was estimated at 35.1 million cattle, and all cows and heifers that have calved represented 40.6 million cattle according to the 2016 USDA Cattle report (USDA, 2017c). Currently, there are less than 32 million head of beef cows widely dispersed throughout the United States on over 720,000 farms and ranches (USDA, 2017c).

The cow-calf operation is considered the first stage of the beef production process, and it takes slightly over 2 yr from the time cows and heifers are bred until their offspring are ready for slaughter (Comerford et al., 2013). As of 2012, there were almost 728,000 cow-calf operators in the United States according to the most recent Census of Agriculture (USDA, 2014). Although cow-calf operations are spread across the United States, the top 25 cow-calf operations during 2015, ranked by number of cows, were located in Florida, Texas, Wyoming, California, Hawaii, Idaho, Kansas, Missouri, and New Mexico (NCBA, 2015). Texas was the state with the greatest number of beef cows and calves under 205 kg and the largest calf crop (4.5, 2.0, and 4.3 million, respectively; USDA, 2017c) for 2016; however, 9 out of the top 25 cow-calf operators in the country were in Florida during 2015 (NCBA, 2015).

An increase in preventative healthcare and management measures among beef cow-calf operations in the United States has been the result of an integrated proposal that advocates to improve health, performance, and profitability for the beef industry. These recommended programs, commonly referred to as preconditioning or backgrounding, focus on optimal cow herd nutrition and health, early castration and dehorning, anthelmintic treatment, proper and timely vaccinations for calves, and the weaning of calves 30 to 45 d before shipping (Kirkpatrick et al., 2008). Preventative programs that reduce compounded stress have been shown to reduce incidence of bovine respiratory disease (**BRD**) in the feedlot (Cole et al., 1979; Roeber et al., 2001) and improve ADG in the preconditioning period (Bolte et al., 2009) and the finishing phase (Peterson et al., 1989).

Demographic Information

Table 1 provides general information and demographics of participating veterinary practitioners including states where they practice, proportion of their practice dedicated to cow-calf producers, years in practice, and number of beef cows serviced. A total of 148 veterinary practitioners responded to the survey, with most participants providing a response to the majority of questions. Responding veterinarians represented 35 states in the United States and 3 provinces in Canada. In the United States, 11% of veterinarians practiced in Kansas; 10% in Nebraska and Iowa; 6% in Oklahoma and South Dakota; and 5% in Missouri, Minnesota, and Texas (the remaining states represented less than 5% of total responses). In Canada, veterinarians practiced in Alberta, Ontario, and Quebec, but these represented less than 5% of the total response.

Over 50% of responding veterinarians devoted more than 50% of their practice to service commercial cow-calf producers (Table 1). The largest group (33%) of veterinarians had been in practice for over 30 yr. However, 26% of responding veterinarians had been in practice for only 0 to 5 yr. Similarly, Coetzee et al. (2010) reported that almost half of veterinarians (45.5%) participating in a castration method survey had been in practice for over 20 yr, and the second largest group of participating veterinarians (15%) had been in practice only 1 to 5 yr. More than 10,000 cows were serviced by 39% of these veterinarians' practices, whereas 25% of veterinarians serviced 5,000 to 10,000 cows each.

Vaccination Protocols

The most important component of a beef cattle herd health program is the use of vaccines as a management practice to avoid the spread of infectious diseases within the herd. Vaccinating cattle is a relatively common practice among cow-calf operations; however, not all United States cow-calf operations vaccinate their cattle, leaving

Table 1. Descriptive data about general information and demographics of responding veterinarians (n = 178) to a survey of recommended practices to cow-calf operations in the United States and Canada

Item	Responses (no.)	Responses (%)
States represented by responding veterinarians' practice (n = 136; 93% response rate)[1,2]		
Kansas	20	11.0
Nebraska	19	10.4
Iowa	18	9.9
Oklahoma, South Dakota	11	12.0
Missouri	10	5.5
Minnesota, Texas	9	9.8
Georgia	7	3.8
Montana	5	2.7
Alabama, Colorado, Illinois, Oregon, Virginia, Wisconsin	4	13.2
Alberta,[3] Arkansas, Florida, Idaho, North Carolina, North Dakota	3	9.9
Arizona, Kentucky, Ohio, South Carolina, West Virginia	2	5.5
Hawaii, Indiana, Louisiana, Michigan, Mississippi, Ontario,[3] Pennsylvania, Quebec,[3] Tennessee, Utah, Wyoming	1	6.0
Proportion of veterinarians' practice that is devoted to cow-calf producers (n = 146; 99% response rate)		
<10%	13	9
11 to 25%	16	11
26 to 50%	41	28
51 to 75%	46	32
>76%	30	21
Number of years that veterinarians have been in practice (n = 147; 100% response rate)		
0 to 5	38	26
6 to 10	20	14
11 to 15	13	9
16 to 20	13	9
21 to 25	2	1
26 to 30	12	8
>30	49	33
Number of beef cows serviced by practicing veterinarians (n = 147; 100% response rate)		
<1,000	15	10
1,001 to 2,500	17	12
2,501 to 5,000	20	14
5,001 to 10,000	37	25
>10,000	58	39

[1]The number of responses corresponds to the number of veterinarians that practice in each state.

[2]Percentage of total responses (n = 136); for rows with more than one state listed, the percentage shown reflects the sum of percentages from each individual state.

[3]Canada.

a significant portion of the beef cattle population susceptible to multiple preventable diseases (USDA, 2010). According to the USDA (2010), during 2007 only 68.9% of cow-calf operations vaccinated cattle. However, the 2016 CattleFax Cow-Calf Survey reported that 93% of surveyed operations in the United States have in place a vaccination plan for cattle, and Waldner et al. (2013) reported that most (85.3%) Canadian cow-calf producers vaccinate their calves before moving the herd to pasture.

When vaccinating calves for the first time at branding (Table 2), the most common recommended vaccines were clostridial (96%), infectious bovine rhinotracheitis (**IBR**; 94%), bovine respiratory syncytial virus (**BRSV**; 91%), parainfluenza-3 (**PI-3**; 90%), and bovine viral diarrhea (**BVD**) Type 1 and 2 (78 and 77%, respectively). For type of vaccine used at this time, 80% of veterinarians recommended modified live virus (**MLV**) vaccines and 12% recommended killed vaccines at this time. Another vaccine used by veterinarians but not listed was *Moraxella bovoculi* (2%).

When vaccinating calves for the first time before weaning (Table 3), the most common recommended vaccines were IBR (99%), BRSV (98%), BVD Types 1 and 2 (96%), PI-3 (93%), clostridial (77%), and *Mannheimia haemolytica* (77%). Ninety percent of veterinarians recommended MLV vaccines and 10% recommended killed vaccines at this time. Brucellosis (1%) was another vaccine that was not listed and that was used by veterinarians before weaning.

When vaccinating calves for the first time after weaning (Table 4), the most common recommended vaccines were BVD Type 2 (97%), IBR (97%), BVD Type 1 (96%), BRSV (96%), and PI-3 (91%). For this period of time 93% of veterinarians recommended MLV vaccines and 7% recommended killed vaccines. Other vaccines used by veterinarians but that were not listed included brucellosis (1%), *Brucella abortus* strain RB-51 (1%), and vibriosis–leptospirosis combo (1%).

Results from this survey regarding recommended antigens to vaccinate calves are similar to USDA's Beef 2007–08 report (USDA, 2010), where over 50% of cow-calf operations administered a clostridial vaccine to calves before weaning, over 30% of operations administered IBR and BVD vaccines before weaning, and over 25% vaccinated calves for PI-3 and BRSV. Survey results are also in agreement with recommendations made by Comerford et al. (2013), whom suggested that any health program should include vaccination for IBR, PI-3, BRSV, BVD, *Haemophilus somnus*, leptospirosis, and clostridial diseases. Similarly, Waldner et al. (2013) reported that the most commonly used vaccines by Canadian cow-calf producers to vaccinate calves were clostridial (84.6%) and BVD and IBR (55.6%). Furthermore, Woolums et al. (2014) reported that 87% of respondents to a survey of veterinarians that deal with nursing beef calf respiratory disease recommend a routine administration of respiratory vaccines to beef calves. However, USDA (2010) reported that during 2007, 60.6% of beef cow-calf operations did not vaccinate

Table 2. Descriptive data about vaccination, antigens, and type of vaccine recommended by practicing cow-calf veterinarians for calves at branding time in the United States and Canada

Item	Responses (no.)	Responses (%)
Antigens recommended for vaccinating calves for the first time at branding (n = 137; 93% response rate)		
Clostridial	131	96
Infectious bovine rhinotracheitis	129	94
Bovine respiratory syncytial virus	125	91
Parainfluenza-3	123	90
Bovine viral diarrhea, Type 1	107	78
Bovine viral diarrhea, Type 2	105	77
Mannheimia haemolytica	62	45
Moraxella bovis	43	31
Pasteurella multocida	36	26
Histophilus somni	25	18
Leptospirosis	7	5
Others not listed[1]	7	5
Mycoplasmal pneumonia	2	1
Vibriosis	1	1
Vaccine type recommended at branding time (n = 137; 93% response rate)		
Modified live (MLV)	121	88
Killed	16	12

[1]*Moraxella bovoculi*, autogenous *Moraxella bovoculi*, castrate or dehorn.

Table 3. Descriptive data about vaccination, antigens, and type of vaccine recommended by practicing cow-calf veterinarians for calves before weaning in the United States and Canada

Item	Responses (no.)	Responses (%)
Antigens recommended for vaccinating calves for the first time before weaning (n = 139; 95% response rate)		
Infectious bovine rhinotracheitis	137	99
Bovine respiratory syncytial virus	136	98
Bovine viral diarrhea, Type 1	134	96
Bovine viral diarrhea, Type 2	134	96
Parainfluenza-3	129	93
Clostridial	122	88
Mannheimia haemolytica	107	77
Histophilus somni	62	45
Pasteurella multocida	59	42
Leptospirosis	14	10
Moraxella bovis	13	9
Others not listed[1]	5	4
Mycoplasmal pneumonia	3	2
Vaccine type recommended before weaning (n = 141; 96% response rate)		
Modified live (MLV)	127	90
Killed	14	10

[1]Brucellosis.

calves for respiratory disease from birth until the time they were sold and over 30% of all calves were on these operations. It is very probable that these recommendations are made with the aim to prevent BRD, which is the most common cause of death for all production classes of cattle and calves in the United States (Woolums et al.,

Table 4. Descriptive data about vaccination, antigens, and type of vaccine recommended by practicing cow-calf veterinarians for calves after weaning in the United States and Canada

Item	Responses (no.)	Responses (%)
Antigens recommended for vaccinating calves for the first time after weaning (n = 120; 82% response rate)		
Bovine viral diarrhea, Type 2	116	97
Infectious bovine rhinotracheitis	116	97
Bovine viral diarrhea, Type 1	115	96
Bovine respiratory syncytial virus	115	96
Parainfluenza-3	109	91
Clostridial	70	58
Mannheimia haemolytica	59	49
Histophilus somni	44	37
Pasteurella multocida	36	30
Leptospirosis	18	15
Moraxella bovis	14	12
Mycoplasmal pneumonia	4	3
Others not listed[1]	4	3
Vibriosis	3	3
Vaccine type recommended after weaning (n = 122; 83% response rate)		
Modified live (MLV)	114	93
Killed	8	7

[1]Brucellosis, *Brucella abortus* strain RB-51, vibriosis–leptospirosis combo.

2013) and costs the beef industry millions of dollars every year on prevention, control, and death loss (Macartney et al., 2003). Radostits et al. (1994) and Woolums et al. (2014) reported that viruses isolated from calves affected with BRD included IBR, BRSV, BVD, and PI-3; bacterial pathogens also isolated included *M. haemolytica*, *Pasteurella multocida*, *H. somnus*, *Mycoplasma bovis*, and *Mycoplasma dispar*. Furthermore, in a survey of biosecurity practices of United States beef cow-calf producers, Sanderson et al. (2000) reported that 18% of producers vaccinated cattle against IBR, 17% vaccinated against BVD, 28% against leptospirosis, 20% against campylobacteriosis, 42% against brucellosis (for heifers), and only 1.1% vaccinated cattle against tritrichomonosis. The observed pattern of vaccination recommended by veterinarians and performed by beef cow-calf producers across the United

Table 5. Descriptive data about vaccination protocol practices recommended by practicing cow-calf veterinarians in the United States and Canada

Item	Responses (no.)	Responses (%)
Number of days before loading or shipping that the last preventative vaccine should be administered to calves (n = 144; 98% response rate)		
7 to 14	43	30
15 to 21	45	31
22 to 30	30	21
31 to 45	21	15
>45	5	3
Are bulls in the herd vaccinated at the same time as cows? (n = 146; 99% response rate)		
Yes	116	79
No	30	21
Annual booster antigens recommended for vaccinating the female herd (n = 146; 99% response rate)		
Infectious bovine rhinotracheitis	144	99
Bovine viral diarrhea, Type 2	143	98
Bovine viral diarrhea, Type 1	142	97
Leptospirosis	137	94
Parainfluenza-3	125	86
Bovine respiratory syncytial virus	118	81
Vibriosis	105	72
Clostridial antigens	63	43
Moraxella bovis	29	20
Others not listed[1]	16	11
Histophilus somni	7	5
Mannheimia haemolytica	3	2
Pasteurella multocida	2	1
Mycoplasmal pneumonia	1	1
Vaccine type recommended for annual booster vaccination of the female herd (n = 146; 99% response rate)		
Modified live (MLV)	103	71
Killed	56	38
Is a preventative scour vaccine for the breeding herd recommended as a regular part of the herd health protocol? (n = 146; 99% response rate)		
Yes	117	80
No	29	20
Antigens recommended to use as preventative scour vaccine for the breeding herd (n = 120; 82% response rate)		
Escherichia coli	110	92
Coronavirus	105	88
Bovine *Rotavirus*	104	87

[1]Brucellosis, *Salmonella*, anthrax, *Moraxella bovoculi*, Scourguard (Zoetis Inc., Kalamazoo, MI) or Guardian (Merck Animal Health, Kenilworth, NJ), scours, *E. coli*, *Rotavirus*, *Coronavirus*, *Clostridium perfringens*, anaplasmosis, autogenous pinkeye; depends by region or need.

States is most probably due to the fact that vaccines for BRSV, BVD, PI-3, and IBR are commercially offered in a single injection vaccine.

Responding veterinarians (30%) recommended that the last preventative vaccine should be administered to cattle 7 to 14 d before being loaded, shipped, and sold; 31% of veterinarians recommended to administer it 15 to 21 d; 21% of veterinarians 22 to 30 d; 15% of veterinarians 31 to 45 d; and only 3% of veterinarians recommended to administer the last preventative vaccines more than 45 d before loading or shipping. The majority of veterinarians (79%) recommended vaccinating bulls at the same time that cows get vaccinated (Table 5).

About 20% of cow-calf operations administered annual booster vaccines for cows and bulls during 2007 (USDA, 2010). In contrast, almost all participating veterinarians (99%) in this study recommended annual booster vaccination for the female herd. The most commonly recommended antigens administered as annual boosters to the female herd were IBR (99%), BVD Type 2 (98%), BVD Type 1 (97%), leptospirosis (94%), PI-3 (86%), BRSV (81%), and vibriosis (72%). Similarly, in 2007 over 23.8% of operations gave a BVD booster vaccine to cows and 20.3% to bulls (USDA, 2010). Furthermore, 28.10% of cow-calf operations regularly vaccinate cows and bulls against BVD, 24.6% against IBR, 22.6% against PI-3, 21.1% against BRSV, and 19.0% against *Campylobacter* (USDA, 2010). When administering booster vaccines to the beef herd, USDA (2010) reported that during 2007 over 60% of cow-calf operations used killed vaccines over MLV. A divergent trend was observed in this study, with 65% of participating veterinarians recommending a MLV vaccine and 35% recommending a killed vaccine when administering annual booster vaccines to the female herd (Table 5). Other antigens administered by a minority (11%) of veterinarians included anaplasmosis, *Moraxella bovis*, *Escherichia coli*, rotavirus, coronavirus, perfringens, *Moraxella bovoculi*, anthrax, salmonella, and brucellosis. The use of a preventative scour vaccine for the breeding herd was recommended by 80% of veterinarians as part of the herd vaccination protocol (Table 5), with *E. coli* (92%) being the most recommended antigen for the prevention of scours, followed by *Coronavirus* (88%) and bovine *Rotavirus* (87%; Table 5). Similarly, Waldner et al. (2013) reported that over 40% of Canadian beef producers administered preventative scour vaccination (*E. coli*, *Coronavirus*, and *Rotavirus*) and over 57% of producers administered clostridial vaccines to the female herd for prevention.

Health Practices

Table 6 provides descriptive data regarding general health practices for the cow-calf herd recommended by veterinary practitioners. The most commonly recommended practices by veterinarians as part of the BVD total control program were vaccination (99%), biosecurity (76%), testing and removal of infected animals (62%), and quarantine (52%). When their clients were keeping calves past weaning for backgrounding or grazing before selling, 68% of veterinarians did not recommend to administer additional booster vaccines. Similarly, Woolums et al. (2013) reported that almost 40% of cow-calf operations that had previously vaccinated calves against BRD pathogens administered booster vaccines to calves before weaning. When banding is recommended as a castration method, regardless of the time point at which castration was performed, 97% of veterinarians also recommended that calves receive a tetanus vaccine (Table 6). This is in agreement with survey data reported by Coetzee et al. (2010), where over 50% of responding veterinarians routinely used a tetanus toxoid injection at the time of castration. Similarly, in a research trial comparing different castration methods on growth performance of beef bulls, Rust et al. (2007) administered a vaccine containing a tetanus toxoid to cattle (n = 20) that were castrated using a high-tension elastic rubber band, with only one animal developing the disease and dying during the study.

The most commonly recommended fly control methods were herd spraying (72%), oil-based back rubbers (63%), and dust bags (52%; Table 6). However, veterinarians also recommended alternative methods such as pour-on products; fly tags; Permectrin CDS; feeding insect growth regulator (**IGR**); ear tags; LongRange; spot spray; fly baits; environmental control (predator flies); dewormers; and manure, bedding, and bale management. Similarly, over half of the cow-calf producers in the United States used a pour-on product for fly control (USDA, 2010). The use of insecticide-impregnated ear tags for fly control on cows and calves was also recommended by 76% of practicing veterinarians (Table 6).

Table 7 presents descriptive data regarding deworming practices recommended for the cow-calf herd by veterinary practitioners participating in this study. Nine out of every 10 operations in the USDA Beef 2007–08 publication reported to deworm all cattle and calves in the herd at least occasionally (USDA, 2010). Similar results are reported from this survey, where 93% of participating veterinarians recommended deworming the female herd as a regular practice. From these veterinarians who recommended deworming the female herd, 96% recommended to do it 1 to 2 times per yr. Over 80% of cow-calf operations in the United States followed this recommendation, with 5.1% of operations deworming cows less than once a yr, 38.2% of operations de-worming cows at least once a yr, and 43.5% deworming the cow herd more than once a yr (USDA, 2010). Furthermore, over 50% of veterinarians highly recommend the use of both injectable and pour on products for deworming of the female herd. Although the USDA reports that over 50% of cow-calf operations deworm calves once or more than once per year, almost 40% of them do not ever deworm calves (USDA, 2010). Deworming of calves was the second most common practice recommended by 64% of veterinarians at branding time, with injectable dewormers being the most recommended

type by 84% of participating veterinarians for this period. The most common practice recommended by veterinarians before and after weaning was deworming of calves (76 and 81%, respectively); an injectable dewormer mas the most recommended type of dewormer, recommended by 74% of veterinarians before weaning, whereas a pour-on was the most recommended (65%) type of dewormer after weaning (Table 7).

Production Practices

Genetic advice for ranchers and producers was provided by 54% of practicing veterinarians, and the majority of veterinarians (83%) recommended that all family members and employees should be trained on low stress handling (Table 8). Administering a growth implant was the most common practice recommended at branding by 75% veterinarians. However, the same practice was selected as the second most common one recommended by veterinarians before and after weaning (58 and 56%, respectively). According to findings reported by USDA (2008a), 9.8% of cow-calf operations in the United States gave calves an implant before weaning and 6.8% of operations implanted calves at weaning. The administration of probiotics to calves at branding and after weaning was only recommended by 1% of participating veterinarians (Table 8).

Creep feeding was recommended as a regular practice to clients by 60% of veterinarians (Table 8). In contrast, only 27% of cow-calf operations in the United States reported that calves had access to creep feed (USDA, 2008a). A majority (54%) of veterinarians recommended that it would be best if calves knew how to eat from a feed bunk (bunk broke) before marketing them or shipping to a backgrounding facility or a feedlot. Thirty-six percent of these veterinarians recommended to have bunk-broke calves depending on each individual client ranch's situation, marketing strategy, or facilities (Table 8). According to data reported by the USDA (2008a,b), the most common type of individual calf identification used by almost 40% of cow-calf operations was a plastic ear tag; at least 50% of calves were identified with a plastic ear tag in these operations. The use of an ear tag for calves as an identification method, which would include sire and dam information, was recommended by 69% of veterinary practitioners in this survey. In contrast, data from the USDA (2008b) reports that only 20% of cow-calf operations used plastic ear tags on calves for herd identification, with almost 30% of all cattle and calves in the operation being ear tagged for this purpose.

The largest number of respondents (38%) recommended that the earliest age at which their clients should wean

Table 6. Descriptive data about health practices recommended by practicing cow-calf veterinarians in the United States and Canada

Item	Responses (no.)	Responses (%)
Recommended practices as part of bovine viral diarrhea total control program (n = 147; 100% response rate)		
Vaccination	146	99
Biosecurity	112	76
Testing and removal[1]	91	62
Quarantine	77	52
Are additional booster vaccines recommended if clients keep calves past weaning? (n = 136; 93% response rate)		
Yes	43	32
No	93	68
Is administration of a tetanus vaccine recommended to clients when banding is used as a castration method? (n = 140; 95% response rate)		
Yes	136	97
No	4	3
Are insecticide-impregnated ear tags recommended for fly control on cows and calves? (n = 145; 99% response rate)		
Yes	110	76
No	35	24
Fly control programs recommended (n = 136; 93% response rate)		
Herd spraying	98	72
Oil-based back rubbers	86	63
Dustbags	71	52
Other	37	27
Individual animal paint ball application	14	10

[1]For persistently infected animals.

their calves was 90 to 120 d (Table 9). However, the last Beef report publication mentions that the average age at which calves were weaned on cow-calf operations was 207 d, with an average weaning weight of 241 kg for all calves (USDA, 2008b). Three-fourths of all United States operations' weaning age for calves is <230 d of age (USDA, 2008a,b). The 2 most common weaning methods recommended by veterinarians were a specific number of days weaned before selling (64%) and fence-line weaning (57%).

Castration of bull calves intended for beef production is a commonly performed management practice in livestock operations in the United States, accounting for approximately 16 million procedures per yr (USDA, 2015). Bull calves are routinely castrated at livestock operations to decrease secondary sex characteristics, minimize aggressive behavior, facilitate management, and improve beef quality (Faulkner et al., 1992; Rust et al., 2007; Gonzalez et al., 2010). At least 77% of all bull calves were castrated on almost 60% of all cow-calf operations in the United States during 2007 (USDA, 2008a). The majority of participating veterinarians (34%) recommended castrating bull calves at an age of 0 to 7 d, whereas 18% of veterinarians recommended to castrate at 2 to 3 mo of age, and 16% of veterinarians recommended castrating bull calves at branding (Table 9). These recommendations are in agreement with Bretschneider (2005), who reported that, based on observations of stress response, the younger the calf when castrated, the less stressful the procedure. This is regardless of the method used, recommending that castration occur at or shortly after birth. In contrast, data from the USDA

Table 7. Descriptive data about deworming practices recommended for the cow-calf herd by practicing veterinarians in the United States and Canada

Item	Responses (no.)	Responses (%)
Is deworming of the female herd recommended? (n = 146; 99% response rate)		
Yes	135	93
No	10	7
Number of times per year recommended to deworm the female herd (n = 136; 93% response rate)		
1 to 2	131	96
>2	3	2
Other[1]	2	2
Type of deworming product most highly recommended for the female herd (n = 143; 98% response rate)		
Injectable	80	56
Pour-on	72	50
Oral or paste	34	24
Deworming practices recommended at branding time (n = 76; 64% response rate)[2]		
Injectable[3]	64	84
Paste or oral[3]	14	18
Pour-on[3]	29	38
Deworming practices recommended before weaning (n = 86; 76% response rate)[4]		
Injectable[5]	64	74
Pour-on[5]	39	45
Paste or oral[5]	26	30
Deworming practices recommended after weaning (n = 62; 81% response rate)[6]		
Pour-on[7]	40	65
Injectable[7]	36	58
Paste or oral[7]	22	35

[1]Depends on need and fecal exam; before turn out.

[2]For deworming practices, number and percentage of responses correspond to the total number of responses (n = 119) to recommended practices at branding time.

[3]For type of dewormer, percentages of responses are calculated from number of responses for "Deworming" (n = 76).

[4]For deworming practices, number and percentage of responses correspond to the total number of responses (n = 113) to recommended practices before weaning.

[5]For type of dewormer, percentages of responses are calculated from number of responses for "Deworming" (n = 86).

[6]For deworming practices, number and percentage of responses correspond to the total number of responses (n = 77) to recommended practices before weaning.

[7]For type of dewormer, percentages of responses are calculated from number of responses for "Deworming" (n = 62).

(2008a) reports that cow-calf operations in the United States castrated calves at an average age of 77 d. However, most operations (74.5%) castrated bull calves at an age of <93 d, but almost 20% of operations did not castrate calves until they were over 122 d old. Several methods of castration exist (Bretschneider, 2005; Coetzee et al., 2010), each one having positive and negative attributes, but regardless of the preferred method of castration, cattle will undergo pain and stress during this procedure (Rust et al., 2007). The 2 most commonly used methods for castrating bull calves are either the surgical procedure or the rubber banding method (AVMA, 2014). Respondents were asked to rank castration methods from most to least preferred. Knife cut was selected as the preferred castration method at branding by 86% of veterinarians (n = 132), banding was selected as the preferred method by 11% of veterinarians (n = 114), burdizzo by 1% of veterinarians (n = 73), and no castration of bull calves at branding was the preferred recommendation of 27% of veterinarians (n = 22) (Table 9). At weaning, knife cut was the preferred castration method recommended by 67% of veterinarians (n = 123), banding was the second-most preferred castration method for 25% of veterinarians (n = 106), burdizzo was the next most preferred castration method for 15% of veterinarians (n = 65), and no castration of bull calves at weaning was the preferred recommendation of 61% of veterinarians (n = 36) (Table 9). In agreement with results from this survey, the USDA (2008a) reported that 49.2% of cow-calf operations in the United States used a surgical method when castrating calves, 47.3% preferred to use banding, and only 3.5% of operations preferred to use the burdizzo technique to castrate calves. Furthermore, Coetzee et al. (2010) reported that the most frequently used method of castration by the majority (57%) of veterinarians was the surgical procedure, followed by the banding procedure, which was used by 44% of veterinarians.

Poor nutrition practices within the beef cow herd can have a significant negative effect on calf health in the following year after birth (Larson et al., 2004). Recommended nutrition management practices by veterinary practitioners are summarized in Table 10. Calf nutrition was considered as extremely important during a preconditioning program by 82% of responding veterinarians. The mineral status of the cow during prebreeding and lactation stages was considered as extremely important by 63% of responding veterinarians because it is related to long-term

Table 8. Descriptive data about production practices recommended by practicing cow-calf veterinarians in the United States and Canada

Item	Responses (no.)	Responses (%)
Genetic advice provided for clients (n = 147; 100% response rate)		
Yes	79	54
No	68	46
Is low-stress handling techniques training recommended for all family members and employees (n = 144; 98% response rate)		
Yes	119	83
No	25	17
Other practices recommended at branding time (n = 119; 81% response rate)		
Calfhood implant	89	75
Probiotics	1	1
Other practices recommended before weaning (n = 113; 77% response rate)		
Calfhood implant	65	58
Other practices recommended after weaning (n = 77; 52% response rate)		
Calfhood implant	43	56
Probiotics	1	1
Is creep feeding regularly recommended to clients? (n = 144; 98% response rate)		
Yes	58	40
No	86	60
Should calves be “bunk broke” (know how to eat from a feed bunk) before marketing? (n = 144; 98% response rate)		
Yes	78	54
No	14	10
Maybe[1]	52	36
Is ear tag identification (used for sire and dam identification) for calves recommended? (n = 146; 99% response rate)		
Yes	101	69
No	45	31

[1]Depends on the situation and characteristics of each individual operation.

Table 9. Descriptive data about castration method ranking and calf management practices recommended by practicing cow-calf veterinarians in the United States and Canada

Item	Responses (no.)	Responses (%)
Earliest age ever recommended for weaning calves due to weather conditions or other cultural practices deemed necessary (n = 143; 97% response rate)		
31 to 60 d	4	3
60 to 90 d	32	22
90 to 120 d	55	38
120 to 150 d	42	29
>150 d	10	7
Type of weaning protocol recommended to clients (n = 143; 97% response rate)		
Recommended number of days weaned	91	64
Fence-line weaning	82	57
Abrupt drylot weaning or onto truck	15	10
Two-stage weaning with nose clips	12	8
Recommended age for castration of bull calves (n = 145; 99% response rate)		
0 to 7 d	48	34
<1 mo	5	4
1 to 2 mo	21	15
2 to 3 mo	26	18
>3 mo	8	6
Branding	22	16
Other[1]	11	8
Castration methods selected as best option for calves at branding time[2]		
1. Knife cut	113	86
2. Banding	12	11
3. Burdizzo	1	1
4. Do not recommend	6	27
Castration methods selected as best option for calves at weaning[3]		
1. Knife cut	82	67
2. Banding	26	25
3. Burdizzo	10	15
4. Do not recommend	22	61

[1]Other: 2 to 4 mo; 2 wk before weaning; 181.4 to 226.8 kg; soon as owner knows it will not be a breeding bull; spring (45.4 to 181.4 kg); turn out; <136.1 kg; depends.

[2]Number and percentage of responses reported for each castration method represent the responses that selected each method as the best option: knife cut (n = 132), banding (n = 114), burdizzo (n = 73), do not recommend (n = 22).

[3]Number and percentage of responses reported for each castration method represent the responses that selected each method as the best option: knife cut (n = 123), banding (n = 106), burdizzo (n = 65), do not recommend (n = 36).

calf health. Comerford et al. (2013) recommended providing cows with a trace mineral supplement and a source of Ca, P, Mg, and Se throughout the year. However, only 25% of veterinarians recommended to always supplement chelated minerals for the cow herd, although the majority (61%) of veterinarians only recommended chelated minerals "sometimes." Injectable vitamins for the breeding herd were not recommended by 55% of veterinary practitioners (Table 10).

IMPLICATIONS

It is of upmost importance to the authors to highlight the limitations of survey data presented in this paper. This survey reports recommendations currently made by a portion of the consulting veterinarians and practitioners that service cow-calf operations. The practices and recommendations reported in this survey may change over time due to a variety of factors. Reporting summaries of practices and recommendations made by consulting veterinarians provides a benchmark for standard operating procedures used in the beef cattle industry, and the summaries are useful resources for the industry and the scientific-academic community.

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Table 10. Descriptive data about nutrition management practices for the cow-calf herd made by practicing veterinarians in the United States and Canada

Item	Responses (no.)	Responses (%)
How important is nutrition for the calf during a preconditioning program or weaning? (n = 146; 99% response rate)		
Extremely important	119	82
Very important	25	17
Important	2	1
How important is mineral status of the cow (prebreeding and lactation) in relation to long-term calf health? (n = 146; 99% response rate)		
Extremely important	92	63
Very important	38	26
Important	13	9
Somewhat important	3	2
Are chelated minerals recommended for the cow herd? (n = 146; 99% response rate)		
Yes, always	36	25
Sometimes	89	61
Never	21	14
Are injectable vitamins recommended for the breeding herd? (n = 145; 99 response rate)		
Yes	65	45
No	80	55

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