Special Reports

Biosecurity practices of beef cow-calf producers

Michael W. Sanderson, DVM, MS, DACT; David A. Dargatz, DVM, PhD, DACT; Franklyn B. Garry, DVM, MS, DACVIM

Objective—To evaluate biosecurity practices of cow-calf producers.

Design—Cross-sectional survey.

Sample Population—2,713 cow-calf operations were used in phase 1 of the study, and 1,190 cow-calf operations were used in phase 2.

Procedure—Producers were contacted for a personal interview between Dec 30, 1996 and Feb 3, 1997 regarding their management practices. Noninstitutional operations with 1 or more beef cows were eligible to participate in the study. Producers who participated in the first phase of the study and who had ≥ 5 beef cows were requested to continue in the study and were contacted by a veterinarian or animal health technician who administered further questionnaires. All contacts for the second phase of the study were made between Mar 3, 1997 and Apr 30, 1997. Additional data on use of various vaccines, testing of imported cattle for brucellosis, *Mycobacterium paratuberculosis*, bovine viral diarrhea, and tuberculosis as well as potential for feed contamination were collected during the second phase of the study.

Results—Producers commonly engaged in management practices that increased risk of introducing disease to their cattle such as importing cattle, failing to quarantine imported cattle, and communal grazing. Producers inconsistently adjusted for the increased risk of their management practices by increasing the types of vaccines given, increasing the quarantine time or proportion of imported animals quarantined, or increasing testing for various diseases in imported animals.

Conclusions and Clinical Relevance—Cow-calf herds are at risk for disease exposure from outside sources when cattle are introduced to the herd, and producers do not always adjust management practices such as vaccination schedules and quarantine procedures appropriately to minimize this risk. Veterinary involvement in education of producers regarding biosecurity risks and development of rational and economical biosecurity plans is needed. (*J Am Vet Med Assoc* 2000;217:185–189)

Biosecurity generally refers to the efforts put forth to prevent the introduction of pathogens or toxins that have the potential to damage the health of a herd of cattle or the safety and quality of a food product. A closely related concept is biocontainment, which is the effort to control the spread of disease or intoxication within a herd. Many food animal veterinarians have begun to emphasize production medicine in their practices. As such, veterinarians involved in production medicine are more often emphasizing the role of management and nutrition for the health of the herd. Although production-medicine programs have included vaccination plans, they have not typically emphasized biosecurity or prevention of the introduction of disease into the herd. Additionally, vaccination programs are typically only generally applied and are not tailored to the risks of the specific operation. With an increasingly global marketplace and increasing pressure on producers and veterinarians to minimize antimicrobial use, biosecurity is an important component of an integrated production-management program. Biosecurity programs may be efficiently integrated with Hazard Analysis Critical Control Point-like programs to control food quality and safety and minimize antimicrobial use in cattle. There is little information available in veterinary literature regarding current biosecurity practices of beef cow-calf producers. Our study is based on a recent survey on management and biosecurity practices of US beef cow-calf producers.[1] The purposes of the study reported here were to identify current biosecurity practices of beef cow-calf producers, the current management adjustments producers make to decrease biosecurity risks, and to provide direction for veterinary intervention to decrease herd disease risk and the risk of quality and safety defects of beef products.

From the Department of Clinical Sciences, College of Veterinary Medicine, Kansas State University, Manhattan, KS 66506 (Sanderson); the Centers for Epidemiology and Animal Health, USDA:Animal and Plant Health Inspection Service:Veterinary Services, Fort Collins, CO 80521 (Dargatz); and the Department of Clinical Sciences, College of Veterinary Medicine & Biomedical Sciences, Colorado State University, Fort Collins, CO 80523 (Garry).

Materials and Methods

Data source—Data regarding cattle health and management of cow-calf operations were collected as part of the USDA:Animal and Plant Health Inspection Service National Animal Health Monitoring System's Beef '97 survey. In the first phase of the study, a stratified random sample of 4,092 operations that were expected to have beef cows was selected from 23 states by the USDA-National Agricultural Statistics Service from their database of farm operations (**Appendix 1**). National Agricultural Statistics Service enumerators attempted to contact all of the selected operations regarding eligibility and willingness to participate. All contacts were made between Dec 30, 1996 and Feb 3, 1997. Noninstitutional operations with 1 or more beef cows were eligible to participate in the study. Institutional herds such as those operated by universities, governmental agencies, or prisons were excluded from the study. For operations that met the inclusion criteria for the study and were willing to participate, the enumerators administered a questionnaire.

Data were collected on the number of cattle in various age classes that were introduced into the operation. Producers who participated in the first phase of the study and who had ≥ 5 beef cows were asked to continue in the study; they were then contacted by a veterinarian or animal health technician, who administered further questionnaires. All contacts for this phase of the study were made between Mar 3, 1997 and Apr 30, 1997. Additional data regarding use of various vaccines, testing of imported cattle for various diseases, and potential for feed contamination were collected during the second phase of the study. The state of residence for the herd was grouped on the basis of geographic regions of the country with similar climate and management practices (**Appendix 2**).

Statistical analyses—Statistical analyses were performed by use of specialized software for analyzing survey data.[2] Population estimates for both phases of the study were calculated according to standard techniques by weighting the data according to the sampling design.[3] Briefly, data were weighted to account for the initial sampling probability and any survey nonresponse to obtain unbiased population estimates. The stratification and clustering in the sample design was accounted for by estimating the variance for the population parameters. A χ^2 test[4] was used to evaluate differences between population estimates of cross-classified data on management practices. Odds ratios and 95% confidence intervals were calculated on cross-classified variables by use of weighted estimates to measure the association between risk factors and management practices. Values of $P < 0.05$ were considered significant.

Results

Data collection—Data from questionnaires were collected from 2,713 operations during phase 1 of the study. The reference population for phase 1 of the study included 77.6% of the operations with beef cows in the United States and 85.7% of all beef cows in the United States. Of the 2,713 operations participating in phase 1, 1,190 operations continued into phase 2. The reference population for phase 2 of the study included 85% of all beef cows in the United States and 66.3% of operations with beef cows in the United States.

Importation of cattle—Significant differences were detected across regions in the proportion of all cattle imported and in the proportion of beef cows imported (**Table 1**). Producers, in general, adjusted to the disease risk when introducing cattle from outside operations by increasing the use of vaccines. Operations that imported cattle that had previously been bred were significantly more likely to vaccinate their herds against **infectious bovine rhinotracheitis (IBR)**, **bovine viral diarrhea (BVD)**, brucellosis, leptospirosis, and *Tritrichomonas foetus* than operations that did not import cattle (**Table 2**). Among operations that imported heifers or cows that had previously been bred, 62% of producers incorporated vaccination against brucellosis into their management program for replacement heifers that were to be kept for breeding. Producers commonly imported (purchased, leased, or borrowed) nonvirgin bulls for breeding purposes, and producers with small herds (< 50 cows) were significantly more likely to import nonvirgin bulls than producers with larger (≥ 50 cows) herds. Producers who imported nonvirgin bulls for breeding purposes were significantly less likely to vaccinate cows against campylobacteriosis and also were less likely to vaccinate against *T foetus* ($P = 0.08$) than producers who did not import nonvirgin bulls (**Table 3**). Statistical control for communal grazing exposure did not affect the relationship between importing virgin bulls and vaccinating against campylobacteriosis or trichomonosis.

Quarantine of imported cattle—Among producers who introduced cattle from outside sources, a limited number of producers quarantined all new cattle (**Appendix 3**). Producers who quarantined newly introduced beef cows into their herds were significantly less likely to test cattle for brucellosis than producers who did not practice quarantine procedures (odds ratio = 0.4; $P < 0.01$). No other significant differences were found in testing or vaccination require-

Table 1—Proportion of producers who imported cattle during 1996 by class of cattle and region

Cattle type imported	Region					
	All	West	North-central	South-central	Central	Southeast
Any cattle*	38.7%	51.2%	58.4%	31.3%	46.5%	28.7%
Beef cows*	13.6%	9.1%	16.3%	14.8%	19.7%	8.7%
Bred beef heifers or cows	17.0%	15.0%	18.0%	19.0%	19.0%	13.0%

*Significant ($P < 0.05$) differences detected between proportions of herds that imported cattle across regions.

West = California, Colorado, Montana, New Mexico, Oregon, and Wyoming. North-central = Kansas, Nebraska, North Dakota, and South Dakota. South-central = Oklahoma and Texas. Central = Arkansas, Illinois, Iowa, and Missouri. Southeast = Alabama, Florida, Georgia, Kentucky, Mississippi, Tennessee, and Virginia.

Table 2—Calculated odds ratios (OR) for the proportion of producers who vaccinated cattle on the basis of breeding status when imported into the herd

Vaccination	Import any cattle		Import bred cows/heifers		
	Yes	No	Yes	No	OR (95% CI)
IBR	26%	15%	N/A	N/A	2.0 (1.2–3.5)*
BVD	25%	15%	N/A	N/A	1.9 (1.1–3.2)*
Brucellosis (heifers)	N/A	N/A	62%	42%	2.3 (1.3–4.1)*
Leptospirosis	N/A	N/A	40%	26%	1.9 (1.0–3.4)*
Campylobacteriosis	N/A	N/A	25%	19%	1.5 (0.8–2.5)
Tritrichomonosis	N/A	N/A	3.4%	0.5%	6.3 (1.1–34.7)*

*Significant ($P < 0.05$) differences detected.

CI = Confidence interval. IBR = Infectious bovine rhinotracheitis. BVD = Bovine viral diarrhea. N/A = Not applicable.

Table 3—Calculated OR for vaccination against *Campylobacter* spp and *Tritrichomonas foetus* on the basis of whether nonvirgin bulls are imported for breeding purposes

Vaccination	Import non-virgin bulls		
	Yes	No	OR (95% CI)
Campylobacteriosis	20%	36%	0.4 (0.3–0.8)*
Tritrichomonosis	0.5%	2.1%	0.3 (0.1–1.2)

*Significant ($P < 0.05$) differences detected.

Table 4—Proportion of producers who vaccinated cattle against specific diseases (by region)

Vaccination	Region: All	West	North-central	South-central	Central	Southeast
IBR*	18%	23%	33%	11%	24%	12%
BVD*	17%	22%	33%	9%	25%	12%
Leptospirosis*	28%	37%	51%	18%	42%	16%
Campylobacteriosis*	20%	29%	50%	6%	34%	8%
Tritrichomonosis*	1.1%	3.3%	0.6%	1.9%	0.5%	0.2%
Brucellosis (heifers)*	42%	74%	61%	51%	43%	14%

*Significant ($P < 0.05$) differences detected between regions. *See* Table 1 for key.

ments of imported cattle between producers who practiced quarantine procedures and those that did not.

Communal grazing risk—Among all herds, 11% were allowed some sort of communal grazing and were exposed to other herds of cattle. Producers in the western region of the United States were significantly more likely to allow cattle to graze communally (24%) than producers in other parts of the country (9%). Producers who allowed communal grazing were less likely to vaccinate against leptospirosis than producers who did not allow communal grazing. The proportion of producers who vaccinated their herds for all other diseases (IBR, BVD, brucellosis, campylobacteriosis, and trichomonosis) was similar whether herds were allowed communal grazing or not. The proportion of producers who vaccinated their cattle was significantly different across regions for all vaccines examined **(Table 4)**.

Feed contamination—Manure handling equipment was reportedly used to feed heifers that were < 12 months of age, irregularly (less than weekly) or regularly (weekly), by 12.4% of producers, whereas 87.6% of producers reported they never used manure handling equipment to feed heifers < 12 months of age.

Discussion

The swine[5] and poultry[6] industries have begun to address biosecurity issues as has the dairy industry[7]; however, little data exist on biosecurity practices of beef cow-calf herds. The implementation of biosecurity programs in beef and dairy herds have been reviewed,[8] and research reports from Canada suggest maintenance of a minimum-disease beef herd is possible through strict biosecurity and biocontainment practices.[9] Analysis of the survey results reported here suggests that beef cow-calf producers and veterinarians have many opportunities to improve biosecurity practices.

According to the Beef ’97 survey, producers commonly imported some sort of cattle into their herds during 1996. During 1996, 38.7% of producers imported some class of cattle into their herd (**Appendix 4**). Of producers who imported cattle, 30% added > 25% of their Jan 1, 1997 inventory, and 47% added > 10%.[10] This large number of producers who import cattle and the high proportion of the herd imported provides substantial opportunity for introduction of disease to the herd if proper biosecurity measures are not practiced.

Quarantine of incoming cattle is one management practice that may decrease the likelihood of introducing certain diseases to the herd. Quarantine was defined in our questionnaire as separation of imported cattle from the resident herd. For diseases with short incubation times and no inapparent carrier state such as bovine respiratory syncytial virus and BVD in nonpersistently infected animals, quarantine may be effective. Quarantine provides a period where incubating clinical disease, if present, may be expressed before animals are introduced to the resident herd. For diseases such as *Mycobacterium paratuberculosis,* brucellosis, leptospirosis, neosporosis, and leukosis, quarantine is not an effective biosecurity measure because of the inapparent carrier state in which animals are clinically normal but still carry and potentially shed the organism. In these instances, the inapparent carrier may not be detected during the quarantine period unless the animals are tested. Producers who were included in the Beef ’97 survey commonly did not quarantine all cattle that were introduced into their herds. The proportion of producers who quarantined cattle varied with the class of cattle imported, but less than a third of producers quarantined all classes of cattle that were imported (Appendix 3). Data were not collected regarding the movement of personnel, equipment, or other animals between the quarantine area and the resident herd. If such movements take place, they could be a source of disease transmission from the quarantined herd to the resident herd.

Testing of imported cattle can be useful in decreasing risk of introducing disease into the herd. Tests must be carefully evaluated to ensure their application will help achieve the desired goal of decreasing risk of disease entry with an acceptable cost. Test performance and usefulness will depend on the sensitivity and specificity of the test and on the prevalence of the specific disease in the source herd. Even tests with high sensitivity and specificity may not provide notably reduced risk when applied as screening tests to cattle in herds with low prevalence of infection. The resulting test results will have low negative-predictive values (ie, negative test results will have a low probability of being correct). An alternative to testing imported cattle may be testing of the source herd and subsequent importation only from those herds certified free of specific disease or with low likelihood of disease. A model for such an approach would be the voluntary Johne’s (*M paratuberculosis)* disease herd-status program.[11] Of producers in our survey that imported cattle, 39% tested cattle for brucellosis prior to entry into their herds, but only a small percentage tested for *M paratuberculosis*, BVD, or tuberculosis.[12] It is not clear whether the proportion of producers testing for brucellosis prior to entry into the herd was a reflection of regulatory requirements or a conscious decision by producers to manage risk. Producers who implemented quarantine procedures were less likely to test incoming cattle for brucellosis, which suggests they were choosing quarantine for risk management rather than using all available methods to minimize the risk of introducing disease into their herds. Unfortunately, because of the latent nature of infection with brucellosis, infected cows may not be detected during the quarantine period without testing. This suggests that producers may misunderstand the benefits and limitations of quarantine.

Vaccination of the resident herd is another way to manage risk from imported cattle and has been the most common way veterinarians and producers have attempted to mitigate biosecurity and biocontainment risks.[13] Unfortunately, clinical-trial data on the effectiveness of most vaccines is limited, and vaccination should not be looked on as the only, or even primary, means of decreasing risk of disease. Even under optimal conditions, not all cattle will respond to vaccination nor will all that respond to vaccination be protected from infection. Vaccination programs, however, can be useful adjuncts to other management practices. Producers may vaccinate the resident herd to increase immunity to pathogens that may be introduced by imported cattle or may require vaccination of imported cattle prior to entry into the herd to decrease introduction of disease agents. A previous study suggested that producers who imported cattle were no more likely to vaccinate than producers who did not import cattle.[14] Producers who participated in this survey who imported cattle were more likely to vaccinate resident cattle than producers who did not import cattle. This suggests that producers and their veterinarians are cognizant of the risks of introducing cattle from outside operations and are attempting to decrease the risk of disease through herd vaccination. Producers participating in this survey that imported beef cows and quarantined them were no more likely to require cattle to be vaccinated for IBR, BVD, or leptospirosis before entering the herd than producers who did not quarantine imported beef cows. A notable exception to this was producers who imported nonvirgin bulls for breeding purposes. A remarkably large proportion of producers (61%) reported in the Beef '97 survey that they purchased, leased, or borrowed nonvirgin bulls for breeding purposes. Only 25% of those who imported nonvirgin bulls for breeding purposes had all of them tested for *T foetus*.[1] Current protocols for testing bulls for trichomonosis appear to be sensitive in detection of infected bulls.[15] Importing nonvirgin bulls into the breeding herd is a clear risk for introduction of venereal diseases carried by bulls, including trichomonosis and campylobacteriosis, resulting in decreased reproductive performance. Producers who imported nonvirgin bulls for breeding were significantly less likely to vaccinate their herds against campylobacteriosis and were less likely to vaccinate against trichomonosis, compared with producers who did not import nonvirgin bulls for breeding. The relationship between importing nonvirgin bulls and vaccinating against campylobacteriosis and trichomonosis was not affected by whether herds were allowed communal grazing. Overall, this suggests a perception of low risk or lack of understanding of disease-transmission risk by producers who use nonvirgin bulls. Alternately, perceived ineffectiveness or high cost of vaccination or a management choice to forego vaccination in the face of higher risk management practices may account for this difference.

Communal grazing where multiple herds share a common grazing area is common in the western United States. Communal grazing allows contact of a herd with a large number of animals outside the herd and increases the potential for disease exposure and transmission. In 1 study performed in the northwestern United States, increased numbers of herds that were allowed to graze together were associated with an increased risk of infection with *T foetus*.[16] Management realities may preclude many producers from changing this high-risk behavior; however, cooperative programs to test all bulls in communal grazing situations and culling of all bulls that have positive test results for trichomonosis may be helpful in controlling the risk of infection with *T foetus*. We found that producers did not adjust for the increased risk of disease associated with communal grazing by increasing frequency of vaccination. This may be attributable to a lack of understanding of the risks involved with communal grazing or perceived ineffectiveness or high cost of vaccines.

Many producers who participated in the Beef '97 survey stated they did not prevent access of dogs, cats, birds, or rodents to grain and protein supplements fed to cattle.[12] Fecal contamination of feedstuffs may provide for transmission of various organisms, including *Neospora caninum*[17] and *Salmonella* spp. Fecal contamination of feed may also occur by using manure-handling equipment to feed cattle. Producers were not asked whether they used manure-handling equipment to feed mature cows, but 12.4% did report using manure-handling equipment for feeding heifers. Feeding heifers with equipment used for handling manure may increase the risk of infection with *M paratuberculosis* as well as salmonellosis by increasing fecal contamination of feedstuffs. Prevention of fecal contamination of feedstuffs may be important in minimizing prevalence of pathogens known to infect humans such as *Escherichia coli* O157:H7 and *Salmonella* spp, although critical control points for bacterial preharvest food safety are not yet known.[18] Producers in general do not seem to recognize the importance of preventing fecal contamination of feed to minimize the transmission of disease.

The purpose of our analysis was to investigate the biosecurity practices of cow-calf producers. The data presented here do not address the cost-effectiveness of biosecurity programs. Data that quantitate the risk or cost of introducing disease to a herd are generally not available. Each component of a biosecurity program should be evaluated by the criteria of cost and effectiveness necessary in preventing disease as well as the willingness of the producer to accept the risk of introducing disease to a herd. Risk of introducing disease, cost of disease once introduced into a herd, and willingness by the producer to accept these risks will be different for each operation. To identify rational biosecurity programs, research is needed to provide estimates of the risk of introducing disease into a herd, the economic effect of introducing disease, and the effectiveness of management strategies to reduce this risk. The costs and benefits of biosecurity will likely be quite different between commercial cow-calf herds and seed stock herds. In some instances, risk of disease introduction or effectiveness of biosecurity practices will likely be too low to justify biosecurity programs. At this point, we lack adequate data to know which, if any, biosecurity practices are worthwhile. Biosecurity will likely become more important as food safety and quality, international trade concerns, and efficient production pressures increase. Development of biosecurity plans must be specific to the individual operation and may be best developed by formal risk analysis procedures.[19] Veterinarians can play an essential role in identifying and implementing proper biosecurity plans. Reliable data are needed regarding the risk of disease introduction in individual herds, the effect of disease if introduced, and the effectiveness and cost of control options. For veterinarians to be useful in establishing cost-effective biosecurity programs, they may need additional training in epidemiology, economics, and risk analysis.

References

1. USDA:APHIS:VS. *Part I: reference of 1997 beef cow-calf production management practices*. No. N233.697. Fort Collins, Colo: Centers for Epidemiology and Animal Health, 1997.
2. Shah BV, Barnwell BG, Bieler GS. *SUDAAN user's manual, release 7.0*. Research Triangle Park, NC: Research Triangle Institute 1996;6-1–6-40.
3. Dargatz DA, Hill GW. Analysis of survey data. *Prev Vet Med* 1996;28:225–237.
4. Agresti A. Two way contingency tables. In: Agresti A, ed. *An introduction to categorical data analysis*. New York: John Wiley & Sons, 1996;16–52.
5. Moore C. Biosecurity and minimal disease herds. *Vet Clin North Am Food Anim Pract* 1992;8:461–474.
6. Shane SM, Halvorson D, Hill D, et al. *Biosecurity in the poultry industry*. Kennett Square, Pa: American Association of Avian Pathologists, 1995.
7. Rauff Y, Moore DA, Sischo WM. Evaluation of the results of a survey of dairy producers in dairy herd biosecurity and vaccination against bovine viral diarrhea. *J Am Vet Med Assoc* 1996;209:1618–1622.
8. Thomson JU. Implementing biosecurity in beef and dairy herds, in *Proceedings*. 30th Annu Meet Am Assoc Bov Pract 1997;8–14.
9. Lees VW. Developing a model specific pathogen-free beef herd, in *Proceedings*. 6th Int Symp Vet Epidemiol Econ 1991;364–366.
10. USDA:APHIS:VS. *Part II: reference of 1997 beef cow-calf health and health management practices*. No. N238.797. Fort Collins, Colo: Centers for Epidemiology and Animal Health, 1997.
11. Bulaga LL. U.S. Voluntary Johne's disease herd status program for cattle, in *Proceedings*. 102nd Annu Meet US Anim Health Assoc 1998;420–433.
12. USDA:APHIS:VS. *Part III: reference of 1997 beef cow-calf production management and disease control*. No. N247.198. Fort Collins, Colo: Centers for Epidemiology and Animal Health, 1998.
13. Spire MF. Immunization of the beef breeding herd. *Compend Contin Educ Pract Vet* 1988;10:1111–1117.
14. Sanderson MW, Gay JM. Veterinary involvement in management practices of beef cow-calf producers. *J Am Vet Med Assoc* 1996;208:488–491.
15. Parker S, Campbell J, Ribble C, et al. Comparison of two sampling tools for diagnosis of *Tritrichomonas foetus* in bulls and clinical interpretation of results. *J Am Vet Med Assoc* 1999;215:231–235.
16. Gay JM, Ebel ED, Kearley WP. Commingled grazing as a risk factor for trichomonosis in beef herds. *J Am Vet Med Assoc* 1996;209:643–646.
17. McAllister MM, Dubey JP, Lindsay DS, et al. Dogs are definitive hosts for *Neospora caninum*. *Int J Parasitol* 1998;28:1473–1478.
18. Hancock DD, Lynn TV, Besser TE. Feasibility of preharvest food safety control. *Compend Contin Educ Pract Vet* 1997;19(suppl):S200–S207.
19. Bridges V. Risk analysis—an introduction and its application in APHIS:VS, in *Proceedings*. 102nd Annu Meet US Anim Health Assoc 1998;242–247.

Appendix 1

States included in stratified random sampling of 4,092 operations with beef cows: Alabama, Arkansas, California, Colorado, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Montana, Mississippi, Missouri, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Tennessee, Virginia, and Wyoming.

Appendix 2

Geographic regions of the US with similar climate and management practices for beef cows:
Southeast = Alabama, Florida, Georgia, Kentucky, Mississippi, Tennessee, and Virginia.
Central = Arkansas, Illinois, Iowa, and Missouri.
South-central = Oklahoma and Texas.
North-central = Kansas, Nebraska, North Dakota, and South Dakota.
West = California, Colorado, Montana, New Mexico, Oregon, and Wyoming.

Appendix 3

Percentage of operations that quarantined all imported cattle of a specified class during 1996

Class of cattle	(%)
Unweaned calves	53.5
Beef heifers—weaned, not bred	49.3
Bred beef heifers	43.6
Beef cows	33.8
Weaned bulls	26.8
Weaned steers	56.5
Dairy heifers and cows	43.0
Any cattle or calves	32.7

Adapted from: USDA:APHIS:VS. *Part II: reference of 1997 beef cow-calf health and health management practices.* No. N238.797. Fort Collins, Colo: Centers for Epidemiology and Animal Health, 1997.

Appendix 4

Proportions of producers importing specific classes of cattle and proportions of cattle imported in each class during 1996

Class of cattle	Operations importing cattle (%)	All new cattle imported (%)
Unweaned calves	5.8	9.1
Beef heifers—weaned, not bred	7.9	36.9
Bred beef heifers	4.1	3.5
Beef cows	13.6	12.2
Weaned bulls	21.8	4.2
Weaned steers	4.1	32.4
Dairy heifers and cows	0.6	1.7
Any cattle or calves	38.7	NA

NA = Not applicable.
Adapted from: USDA:APHIS:VS. *Part II: reference of 1997 beef cow-calf health and health management practices.* No. N238.797. Fort Collins, Colo: Centers for Epidemiology and Animal Health, 1997.