

**Survey of Canadian Dairy Producers: Knowledge
and Attitudes towards Food Safety and the
Canadian Quality Milk Program and Reported
Use of Good Production Practices**

Final Report

July-22-09

Study Authors:

Ian Young
PhD Student
Department of Population Medicine
University of Guelph

Dr. Andrijana Rajić
Senior Epidemiologist and Adjunct Professor
Laboratory for Foodborne Zoonoses
Public Health Agency of Canada

Dr. Steve Hendrick
Assistant Professor
Department of Large Animal Clinical Sciences
University of Saskatchewan

Dr. Sarah Parker
On-Farm Food Safety Research Chair
Saskatchewan Agriculture
Department of Large Animal Clinical Sciences
University of Saskatchewan

Dr. Scott McEwen
Professor and Graduate Coordinator
Department of Population Medicine
University of Guelph

Dr. J.T. McClure
Associate Professor
Department of Health Management
University of Prince Edward Island

Dr. Javier Sanchez
Epidemiologist
Animal Health Risk Assessment
Canadian Food Inspection Agency

Sponsors / Contributors:



Table of Contents

1.	Executive Summary	5
2.	Project Overview	6
3.	Materials and Methods	6
3.1.	Questionnaire description and administration	6
3.2.	Data entry and analysis	6
4.	Results	7
4.1.	Producer and herd characteristics	7
4.2.	Canadian Quality Milk program	7
4.3.	Knowledge and attitudes towards pathogens, diseases and hazards.....	7
4.4.	Attitudes towards farm visitors and industry stakeholder knowledge.....	8
4.5.	Attitudes towards industry good production practices	8
4.6.	Reported use of good production practices	8
4.7.	Open-ended comments	8
5.	Discussion of Key Findings	9
6.	Conclusion.....	10
7.	Acknowledgements:	12
	References.....	13
	Appendix: Tables and Figures	15
	Table 1: Respondent characteristics.....	15
	Table 2: Producer reported history of education in food safety and dairy health management and attitudes towards unpasteurized milk, antimicrobial resistance and communication methods	16

Table 4: Producer open-ended comments	20
Figure 1: Producer responses to whether each pathogen or disease can be transmitted from cattle beef or milk to humans.	21
Figure 2: Producer concern that each pathogen or disease could cause a negative economic impact on their herd.....	22
Figure 3: Producer concern that each pathogen or disease could cause a consumers to become ill	23
Figure 4: Producer choice of the most important control point for each pathogen, disease or hazard	24
Figure 5: Producers’ perceived likelihood that different types of farm visitors could introduce disease into their herd.....	25
Figure 6: Producers’ perceived knowledge of different stakeholders about the on-farm food safety practices that are required to achieve safe milk.....	26
Figure 7: Producers’ perceived usefulness of different industry practices to achieve safe milk ..	27
Figure 8: Producers’ perceived usefulness of different herd management practices to achieve safe milk.....	28
Figure 9: Producers’ reported use of good production practices	29
Figure 10: Producers’ reported use of good production practices	30
Figure 11: Producers’ reported use of pest control practices.....	31
Figure 12: Producers’ reported use of livestock mortality disposal methods.....	32
Figure 13: Diseases and health indicators considered by producers before purchasing replacement cattle.....	33

1. Executive Summary

Postal questionnaires were administered to all dairy producers participating in Dairy Herd Improvement (DHI) organizations in 2008 to identify producer knowledge and attitudes towards food safety and the *Canadian Quality Milk* (CQM) program and use of good production practices (GPP). The response rate was 20.9% (2185/10474).

The key findings from survey respondents are summarized below:

- Two-thirds of producers (67.6%) reported that they were participating in CQM, 61.4% of whom indicated that the requirements were easy to implement.
- Most producers (88.7%) reported that they or their families consume unpasteurized milk from their bulk milk tank and 36.3% indicated that consumers should be able to purchase unpasteurized milk in Canada.
- Two-thirds of producers (66.7%) were concerned that antimicrobial resistance might make it harder for them to successfully treat sick cattle.
- Most producers reported that *Salmonella* (74.2%) and *Escherichia coli* (73.0%) could be transmitted through contaminated beef or milk to humans, but most were not sure or did not think that *Brucella* (70.3%) and *Cryptosporidium* (88.5%) could be transmitted via these routes.
- Veterinarians were rated as very knowledgeable about on-farm food safety (OFFS) (90.9% answered 4 or 5 on a five-point scale) and a favoured (73.1%) source of information about food safety. In contrast, only 13.2% and 30.2% of producers, respectively, indicated that consumers and government personnel are knowledgeable about OFFS.
- Most producers (85.0%) reported using cats as a pest control method in their barns. For livestock mortality disposal, 65.0% and 38.0% indicated using a collection service and burial, respectively. Nearly 40.0% of respondents indicated that they purchase replacement cattle, and somatic cell count scores was the main health indicator considered before purchase.
- Over 70% of producers reported that they sometimes, often or always clean and disinfect maternity, calf and weaned calf pens, while only 34.1% and 53.1% reported that they provide visitors and employees, respectively, with clean clothes and boots.

The Dairy Farmers of Canada has taken important steps towards ensuring safe milk in Canada through the implementation of CQM, but we recommend that CQM be reviewed to ensure that essential GPP reflect those that have been shown to be important for disease control based on current scientific evidence. Targeted continuing education of dairy producers is warranted based on the findings from this study. A strategy that addresses the resource limitations of producers with smaller herds should be developed to ensure feasible implementation of CQM on all dairy farms in Canada.

2. Project Overview

Food safety is a shared responsibility that requires collaboration from all stakeholders along the fork-to-fork continuum (13). Major commodity groups in Canada have recently developed their own commodity-specific on-farm food safety (OFFS) programs that are based on hazard analysis critical control point (HACCP) principles (15). The Canadian dairy industry's program is called *Canadian Quality Milk (CQM)* (15). It is mandatory in most provinces and is currently being implemented on farms across Canada, with mandatory deadlines for producer registration varying by province and ranging from 2007 in Prince Edward Island to 2012 in Quebec (3). To optimize CQM implementation, producers should be aware of the microbiological and chemical hazards associated with dairy production and have positive attitudes towards food safety and the program.

The purpose of this project was to identify dairy producer attitudes towards food safety and the CQM program and use of additional good production practices (GPP) using a postal questionnaire administered in the early stages of CQM implementation.

3. Materials and Methods

3.1. Questionnaire description and administration

A questionnaire was developed to acquire information on the knowledge and attitudes towards food safety, attitudes towards CQM and use of GPP by dairy producers in Canada. It was based on results of a pilot consultation survey of 26 bovine practitioners in Canadian Maritime provinces in 2006, and consisted of 35 questions divided four sections: 'demographics', 'CQM program', 'GPP' and 'food safety knowledge and attitudes'.

Canada's two DHI organizations, CanWest DHI and Valacta, mailed the questionnaire to all dairy producers (n=10474) participating in dairy herd improvement (DHI) organizations in Canada in 2008, representing roughly 70% of all dairy producers in the country (2). In Alberta, British Columbia, Manitoba, Ontario and Saskatchewan, questionnaires and reminder letters were mailed from January 11 to March 14 and March 15 to May 2, 2008, respectively. In New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island and Quebec, they were mailed from February 20 to March 26 and July 14 to August 26, 2008, respectively. As an incentive, producers could fill out a ballot for eight separate cash draws of \$100. The ballots were detached from the questionnaires before data entry to keep responses anonymous. The questionnaire was administered in English in all provinces except Quebec and in French-speaking regions of Ontario and New Brunswick, where a French version of the questionnaire and reminder letters were sent. This study received ethical approval from the University of Saskatchewan Behavioural Research Ethics Board (Protocol #07-263).

3.2. Data entry and analysis

Questionnaire responses were entered into an electronic database (Access 2003, Microsoft Corporation, Redmond, WA), and entry validation checks were performed on all questionnaires by manually comparing the database and hard-copy versions. Open-ended French responses were

translated to English, and all comments and ‘other’ responses were coded in Microsoft Access. Extra categories were created if several respondents identified a particular ‘other’ response. For each variable, descriptive statistics were calculated using complete cases only. Analysis was performed in Stata 10 (Stata Corporation, College Station, TX).

4. Results

4.1. Producer and herd characteristics

The final response rate was 20.9% (2185/10474). The average number of litres of milk picked up per farm every two days was 2993.2 (standard deviation [SD]=2334.9). The average herd size of respondents was 61.8 (SD=179.2). Additional respondent demographic information (age, gender, organic status and herd size) is shown in Table 1. The number of respondents with education in dairy health management or food safety and their attitudes towards unpasteurised milk consumption, antimicrobial resistance (AMR), disease testing and food safety information sources are shown in Table 2. Nearly 90% of producers said that they or their families consume unpasteurized milk and 36.3% indicated that consumers should be able to purchase unpasteurized milk in Canada (Table 2). Two-thirds of producers (66.7%) were concerned that AMR might preclude successful treatment of sick cattle (Table 2). Most producers (73.1%) said that they would like to receive future information about food safety from their veterinarian (Table 2).

4.2. Canadian Quality Milk program

Roughly two-thirds of producers (67.6%) said that they were participating in CQM, although only 21.2% of these producers said that their farm is officially registered (Table 3). The median year for producers’ reported participation and official registration with CQM was 2007. Producers’ attitudes towards the program and reasons for participation or non-participation are shown in Table 3. The mandatory nature of the program was the main reason that producers said that they joined it or plan to join it in the future (Table 3).

4.3. Knowledge and attitudes towards pathogens, diseases and hazards

Producers’ knowledge of the transmission potential of eight different pathogens and diseases is shown in Figure 1, while their concern that four of these pathogens and diseases could cause a negative economic impact on their herd or consumers to become ill is shown in Figures 2 and 3. Most producers thought that *Salmonella* (74.2%) and *Escherichia coli* (73.0%) can be transmitted through contaminated beef or milk to humans, while most did not think that *Brucella* (70.3%) and *Cryptosporidium* (88.5%) can be transmitted in these ways. Nearly 60% of producers were very concerned that bovine viral diarrhoea (BVD) could cause a negative economic impact on their herd (Figure 2), whereas most producers were not highly concerned that any pathogens or diseases could cause consumers to become ill (Figure 3). Most producers thought that the farm is the most important control point for six different diseases and potential hazards (Figure 4).

4.4. Attitudes towards farm visitors and industry stakeholder knowledge

Most producers did not think that it was likely that any farm visitors could introduce disease into their herd (Figure 5). Most producers thought that veterinarians were very knowledgeable (90.9% answered 4 or 5 on a five-point scale) about the OFFS practices in the dairy industry (Figure 6). Producers also rated themselves and processors as knowledgeable about OFFS (Figure 6). In contrast, only 13.2% and 30.2% of producers, respectively, indicated that consumers and government personnel are knowledgeable about OFFS (Figure 6).

4.5. Attitudes towards industry good production practices

Producers' attitudes industry and herd management GPP to ensure safe milk are shown in Figures 7 and 8, respectively. Other than lowering the fat content of milk, most producers indicated that 10 industry GPP are very useful to ensure safe milk (Figure 7). Similarly, most producers thought that four herd management practices are very useful to ensure safe milk, although fewer producers indicated that time-temperature recorders are useful (Figure 8).

4.6. Reported use of good production practices

Producers' reported use of 18 GPP measured on a five-point scale (from never to always) is shown in Figures 9 and 10, while their use of pest control, livestock mortality and replacement cattle practices are shown in Figures 11, 12 and 13, respectively. More than 70% of producers reported that they sometimes, often or always separate cow and calf pens, clean and disinfect maternity, calf and weaned calf pens, dry teats at milking with one cloth per cow, use artificial insemination and vaccinate their cattle annual for BVD (Figures 9 and 10). In contrast, the majority of producers reported that they rarely or never ensure transport trucks for cull cows are clean, deliver mortalities to the end of the laneway for pickup, use biosecurity signs on barn doors, provide visitors and employees with clean clothes and boots, ensure employees frequently wash their hands and keep dogs and cats out of the barns (Figure 10). Most producers (85.0%) reported using cats as a pest control method in their barns (Figure 11). For livestock mortality disposal, 65.0% and 38.0% indicated using a collection service and burial, respectively (Figure 12). Nearly 40.0% of respondents indicated that they purchase replacement cattle, and somatic cell count scores was the main health indicator considered before purchase (Figure 13).

4.7. Open-ended comments

Open-ended comments were noted by a small number of producers at the end of the questionnaire and are summarized in Table 4. The most frequently noted comment was that consumer knowledge of food safety should be increased (n=71). Other frequently noted comments were that CQM is too costly of that there should be a financial incentive for participating (n=69), that food safety and OFFS are important (n=67) and concerns regarding the safety and price of imported milk producers (n=50) (Table 4).

5. Discussion of Key Findings

Nearly 90% of respondents reported that they or their families consume unpasteurized milk from their bulk milk tanks, which is higher than what has been previously reported in the USA (8, 9, 10). Although producers were not asked why they consume unpasteurized milk in this study, previous research has shown that many farm families drink raw milk because they believe it tastes better, is cheaper or more convenient to access than pasteurized milk, or because of perceived health or nutritional benefits (9, 10). The sale of raw milk for public consumption is illegal in Canada, although roughly one-third of producers reported that consumers should be able to purchase raw milk. This is a concern since unpasteurized milk is known to carry zoonotic pathogens such as *Campylobacter*, *Salmonella*, toxin-producing *Escherichia coli* and *Listeria*, and unpasteurized milk continues to cause a large number of outbreaks of foodborne disease in North America and Europe (6, 7).

Producers were highly concerned about the impacts of AMR in their industry, which also corresponds to previous research (16, 20). In addition, most producers correctly identified that *Salmonella* and *E. coli* can be transmitted through beef or milk to humans and that BVD cannot be transmitted in this way. However, awareness of *Brucella* should be improved, as younger producers may not be familiar with this pathogen since its eradication from Canadian cattle. Knowledge of *Cryptosporidium* should also be improved, as roughly 70% of producers were unsure if it can be transmitted from dairy cattle to humans through beef or milk and 60% were not concerned that it could cause consumers to become ill.

Most producers considered veterinarians to be the most knowledgeable and favourable source of new information about OFFS, indicating that veterinarians should have an important role in future continuing education of producers. On the other hand, consumers and government stakeholders were seen as less knowledgeable about OFFS in dairy production, and several (n=71) commented that consumer knowledge and awareness of food safety should be increased. Future efforts should be made to enhance communication and knowledge exchange between producers, consumers and the government.

Producers had positive attitudes towards implementing industry programs and initiatives to ensure safe milk production, and roughly three-quarters (75.9%) thought that meat and milk should be tested for zoonotic pathogens. In Canada, there is currently no routine testing for zoonotic pathogens in milk, although all milk is tested for bacterial inhibitors (including antimicrobial residues) and, in some cases, for generic bacterial counts or indicator bacteria (4). Testing for specific pathogens might be useful if part of a specific pathogen control program (e.g. HACCP), for milk that is to be used for unpasteurized cheese production or for other organisms, such as *Mycobacterium avium* subsp. *paratuberculosis*, that could survive the pasteurization process. However, the cost-benefit of this type of approach would have to be evaluated before any regulatory action is considered.

While roughly two-thirds of producers (67.6%) reported that they are participating in CQM, only about 21% of these producers (and 12.9% of all respondents) said that their farm was officially registered. This is higher than the official national status (3%) reported in December 2007 (3). However, it is likely that additional farms were registered between the end of 2007 and

time of questionnaire administration (spring/summer 2008), contributing to the increased percentage found in this study. Nearly 40% of producers who reported participation in CQM noted that the minimum requirements were difficult to implement, indicating that there are still barriers towards implementation of CQM that should be further investigated and addressed.

Most producers perceived a low risk of disease introduction into their herd associated with farm visitors. In addition, while most producers reported that they clean and disinfect maternity cow, unweaned and weaned calf pens, a lower percentage reported that they use biosecurity signs on doors and provide visitors with clean clothes and footwear. Controlled visitor access is an important component of most biosecurity programs, as farm visitors can be the source of zoonotic pathogens such as *Salmonella* that can be transferred to dairy cattle if proper precautions are not taken. For example, the improper use of protective clothing by veterinarians has been shown to be a risk factor for diseases caused by bovine herpesvirus type 1, BVD virus, *Salmonella dublin* and *Leptospira* on Dutch dairy farms (19).

While 84.4% of producers reported that they do not (selected 1 or 2) add antibiotics to feed or milk replacer, over 80% of producers reported that they treat all clinical cases of mastitis. Although research has shown that the prevalence of AMR in mastitis-causing bacteria such as *Staphylococcus* is low on dairy farms in the USA (11, 18), the extensive use of antimicrobials for disease prophylaxis and treatment of mastitis could contribute to the selection of antimicrobial-resistant bacteria in dairy cattle (5, 14). Producers and veterinarians are encouraged to use antimicrobials judiciously to minimize AMR selection pressure on bacteria in dairy cattle.

Most producers (85.0%) reported that they use cats for pest control and 73.5% reported that they do not (selected 1 or 2) keep cats and dogs out of their barns. Producers should be educated on the potential risks of using cats as a primary pest control method in their barns, as cats can be a source of zoonotic pathogens that can infect cattle or people, such as *Salmonella* and *Coxiella burnetii* (the agent of Q fever) (12, 21). The practice of leaving cattle mortalities for scavengers (reported by 6.4% of producers) should be discouraged, as it could lead to the spread of diseases between scavenger species, cattle and other animals, and, in most cases, contravenes regulations concerning mortality disposal.

Roughly 40% of producers said that they purchase replacement cattle, and more of these producers gave consideration to somatic cell count scores (67.7%) than to the infection or vaccination status of BVD (40.7%), Johne's disease (27.2%) or other diseases (e.g. bovine leukosis and *Neospora*) before purchasing cattle. Replacement cattle have been identified as a risk factor for increased prevalence of *E. coli* 0157 and *Salmonella* in Dutch and Californian dairy herds, respectively (1, 17). Producers should be encouraged to consult with their veterinarian and consider a broader range of health status indicators before purchasing and introducing replacement cattle into their herd.

6. Conclusion

The DFC has taken important steps towards ensuring safe milk in Canada through the development and application of the CQM program. While this questionnaire has identified that

overall attitudes of the producers towards several food safety topics were positive, knowledge gaps were also identified, including a lack of awareness of *Cryptosporidium* and brucellosis and in the risks that farm visitors could introduce disease. Furthermore, there is a need for increased communication and knowledge exchange between producers and stakeholders further along the food chain, particularly consumers and government personnel. While many producers reported that they use GPP such as cleaning and disinfection of cow and calf pens, improvements could be made in the use of other important GPP such as visitor and employee use of protective clothing and pest control methods other than barn cats. This survey will be a useful benchmark for measuring changes in producer awareness of food safety issues and use of GPP over time, and the results can be used to prioritize future producer outreach and educational initiatives.

7. Acknowledgements:

We would like thank CanWest DHI and Valacta for their participation and for mailing questionnaires and letters to producers, Ian Weinrich for development of the electronic database, Heather Desjardins for assistance with survey printing, Jessica Fung, Amanda Waldner, and Corinne Sawatzky for data entry and validation, Jean-Francois Tetreault and Erica Pufall for translation of the questionnaire and French open-ended responses, respectively, and the Public Health Agency of Canada for funding this study.

References

1. Berge, A. C. B., D. A. Moore, and W. M. Sischo. 2006. Prevalence and antimicrobial resistance patterns of *Salmonella enterica* in preweaned calves from dairies and calf ranches. *Am. J. Vet. Res.* 67:1580-1588.
2. Canadian Dairy Information Centre. August 3 2008. Enrollments of milk recording. Available at: http://www.dairyinfo.gc.ca/_english/dff/dff_2/dff_2a_e.htm.
3. Dairy Farmers of Canada. December 2008. Canadian Quality Milk Program (CQM) – Provincial Summaries. Available at: <http://www.dairygoodness.ca/NR/rdonlyres/58DA4ECC-D890-4F4F-8916-6FEDE0EC7FC3/0/CQMProvSummariesDec07.pdf>.
4. Dairy Farmers of Ontario. August 1 2008. Dairy Farmers of Ontario Policies. Available at: <http://www.milk.org/Corporate/pdf/Publications-DFOPolicyBook.pdf>.
5. DeFrancesco, K. A., R. N. Cobbold, D. H. Rice, T. E. Besser, and D. D. Hancock. 2004. Antimicrobial resistance of commensal *Escherichia coli* from dairy cattle associated with recent multi-resistant salmonellosis outbreaks. *Vet. Microbiol.* 98:55-61.
6. Gillespie, I. A., G. K. Adak, S. J. O'Brien, and F. J. Bolton. 2003. Milkborne general outbreaks of infectious intestinal disease, England and Wales, 1992-2000. *Epidemiol. Infect.* 130:461-468.
7. Headrick, M. L., S. Korangy, N. H. Bean, F. J. Angulo, S. F. Altekruze, M. E. Potter, and K. C. Klontz. 1998. The epidemiology of raw milk-associated foodborne disease outbreaks reported in the United States, 1973 through 1992. *Am. J. Public Health* 88:1219-1221.
8. Hoe, F. G., P. L. Ruegg. 2006. Opinions and practices of Wisconsin dairy producers about biosecurity and animal well-being. *J. Dairy Sci.* 89:2297-2308.
9. Jayarao, B. M., S. C. Donaldson, B. A. Straley, A. A. Sawant, N. V. Hegde, and J. L. Brown. 2006. A survey of foodborne pathogens in bulk tank milk and raw milk consumption among farm families in Pennsylvania. *J. Dairy Sci.* 89:2451-2458.
10. Kaylegian, K. E., R. Moag, D. M. Galton, and K. J. Boor. 2008. Raw milk consumption beliefs and practices among New York State dairy producers. *Food Protection Trends* 28:184-191.
11. Makovec, J. A., P. L. Ruegg. 2003. Antimicrobial resistance of bacteria isolated from dairy cow milk samples submitted for bacterial culture: 8,905 samples (1994-2001). *J. Am. Vet. Med. Assoc.* 222:1582-1589.
12. Marrie, T. J., A. MacDonald, H. Durant, L. Yates, and L. McCormick. 1988. An outbreak of Q fever probably due to contact with a parturient cat. *Chest* 93:98-103.

13. OIE Animal Production Food Safety Working Group. 2006. Guide to good farming practices for animal production food safety. *Rev. Sci. Tech.* 25:823-836.
14. Pol, M., P. L. Ruegg. 2007. Relationship between antimicrobial drug usage and antimicrobial susceptibility of gram-positive mastitis pathogens. *J. Dairy Sci.* 90:262-273.
15. Rajić, A., L. A. Waddell, J. M. Sargeant, S. Read, J. Farber, M. J. Firth, and A. Chambers. 2007. An overview of microbial food safety programs in beef, pork, and poultry from farm to processing in Canada. *J. Food Prot.* 70:1286-1294.
16. Raymond, M. J., R. D. Wohrle, and D. R. Call. 2006. Assessment and promotion of judicious antibiotic use on dairy farms in Washington State. *J. Dairy Sci.* 89:3228-3240.
17. Schouten, J. M., M. Bouwknegt, A. W. van de Giessen, K. Frankena, M. C. De Jong, and E. A. Graat. 2004. Prevalence estimation and risk factors for *Escherichia coli* O157 on Dutch dairy farms. *Prev. Vet. Med.* 64:49-61.
18. Tikofsky, L. L., J. W. Barlow, C. Santisteban, and Y. H. Schukken. 2003. A comparison of antimicrobial susceptibility patterns for *Staphylococcus aureus* in organic and conventional dairy herds. *Microb. Drug Resist.* 9 Suppl 1:S39-45.
19. van Schaik, G., Y. H. Schukken, M. Nielen, A. A. Dijkhuizen, H. W. Barkema, and G. Benedictus. 2002. Probability of and risk factors for introduction of infectious diseases into Dutch SPF dairy farms: a cohort study. *Prev. Vet. Med.* 54:279-289.
20. Vanbaale, M. J., J. C. Galland, D. R. Hyatt, and G. A. Milliken. 2003. A survey of dairy producer practices and attitudes pertaining to dairy market beef food safety. *Food Protection Trends* 23:466-473.
21. Veling, J., H. Wilpshaar, K. Frankena, C. Bartels, and H. W. Barkema. 2002. Risk factors for clinical *Salmonella enterica* subsp. *enterica* serovar Typhimurium infection on Dutch dairy farms. *Prev. Vet. Med.* 54:157-168.

Appendix: Tables and Figures

Table 1: Respondent characteristics

Characteristic	Total	N (%)
Producer age:	2126	
<30		318 (15.0)
30-45		899 (42.3)
46-60		843 (39.7)
>60		66 (3.1)
Producer gender:	2110	
Male		1832 (86.8)
Female		278 (13.2)
Organic farm:	2107	
No		2032 (96.4)
Yes		75 (3.6)
Herd size ^a :	2170	
<36		538 (24.8)
36-50		711 (32.8)
51-65		378 (17.4)
>65		543 (25.0)

^a The mean herd size was 61.8, with a standard deviation of 179.2.

Table 2: Producer reported history of education in food safety and dairy health management and attitudes towards unpasteurized milk, antimicrobial resistance and communication methods

Question	Total	Yes (%)	No (%)
Have completed a course in dairy health management	2140	1431 (66.9)	709 (33.1)
Have completed a course in food safety	2131	560 (26.3)	1571 (73.7)
Self-perceived as knowledgeable about food safety in dairy production	2143	1809 (84.4)	334 (15.6)
You or your family consume unpasteurized milk from the bulk milk tank	2115	1875 (88.7)	240 (11.4)
Consumers should be able to purchase unpasteurized milk	2126	772 (36.3)	1354 (63.7)
AMR ^a is making it harder to successfully treat sick cattle	2126	1417 (66.7)	709 (33.4)
(If yes) Most important factor causing AMR ^a in dairy cattle:	1112		
Antibiotics in feed		195 (17.5)	
Treating sick cattle		117 (10.5)	
Mastitis therapy		449 (40.4)	
Improper use of antibiotics ^b		237 (21.3)	
Other		114 (10.3)	
AMR ^a in humans is linked to AMU ^a in the dairy industry	2101	212 (10.1)	1889 (89.9)
Meat and milk should be tested for zoonotic disease agents	2074	1574 (75.9)	500 (24.1)
(If yes) Who should pay for the testing?	1574		
Producers		259 (16.5)	1315 (83.6)
Processors		460 (29.2)	1114 (70.8)
Consumers ^b		142 (9.0)	1432 (91.0)
Government		1041 (66.1)	533 (33.9)
No opinion		154 (9.8)	1420 (90.2)
Would like to receive food safety information in the future via:	2185		
Websites		840 (38.4)	1345 (61.6)
Veterinarians		1597 (73.1)	588 (26.9)

Education courses	790 (36.2)	1395 (63.8)
Newsletters	1263 (57.8)	922 (42.2)
Newspaper/magazines	1096 (50.2)	1089 (49.8)
Other	54 (2.5)	2131 (97.5)

^a AMR, antimicrobial resistance; AMU, antimicrobial use.

^b Category created from producers' open-ended responses.

Table 3. Producers' reported participation in the Canadian Quality Milk program and reasons for participation or non-participation

Question	Total	Yes (%)	No (%)
Participation in CQM ^a	2104	1423 (67.6)	681 (32.4)
<i>If participating in CQM^a</i>			
Officially registered/validated CQM ^a farm	1324	280 (21.2)	1044 (78.9)
Participation was mandatory	1355	1066 (78.7)	289 (21.3)
If not mandatory, why join? ^b	237		
Program will be mandatory		109 (46.0)	
Ensure safe milk / promote industry standards		81 (34.1)	
Incentive		25 (10.5)	
Other		22 (9.3)	
CQM ^a requirements easy or difficult to implement	1317		
Easy		809 (61.4)	
Difficult		508 (38.6)	
<i>If not participating in CQM^a</i>			
Why not participate?	603		
Do not see a benefit		144 (23.9)	
Going to join / in process of joining ^c		143 (23.7)	
Program not yet available / didn't know about it ^c		131 (21.7)	
Too many records to keep		57 (9.5)	
Not mandatory ^c		39 (6.5)	
Too many changes to make / too difficult		32 (5.3)	
Too expensive		24 (4.0)	
No time / never got around to it ^c		20 (3.3)	
Other		13 (2.2)	
Plan to join CQM ^a in the future	622	441 (70.9)	181 (29.1)
Why join in the future? ^b	382		
Program will be mandatory		263 (68.8)	
Ensure safe milk / promote industry standards		72 (18.8)	
Other		47 (12.3)	

^a CQM, Canadian Quality Milk.

^b Open-ended question (all categories created from open-ended responses).

^c Category created from producers' open-ended responses.

Table 4. Producer open-ended comments

Comment code	N ^a
Concerns	
Food safety / price of imported milk products	50
Government involvement in / regulation of OFFS ^b	29
Antibiotic use in dairy industry	28
Food safety standards at other parts of food chain	22
Industry costs	21
People lack immunity / environment is too sterile	21
Producers being asked to do too much / being blamed	18
OFFS ^b programs are not practical / lack common sense	17
Animal feed safety / animal by-products in feed	10
Recommendations	
Consumer awareness of food safety issues should be increased	71
Producer/industry awareness of food safety issues should be increased	48
Milk should be tested for zoonotic pathogens	17
Canadian Quality Milk program	
Too costly / should have financial incentive	69
Program is not effective or necessary	30
Too much paperwork involved	29
Should only be required for producers shipping 'poor quality' milk	15
General comments	
Noted the importance of food safety / OFFS ^b	67
Noted the high food safety standards in Canada	49
Noted importance of animal welfare / farm hygiene in OFFS ^b	33

^a N=the number of times a comment was raised (multiple topics were raised by some producers). Only comments with a frequency of ≥ 10 are shown here.

^b OFFS, on-farm food safety.

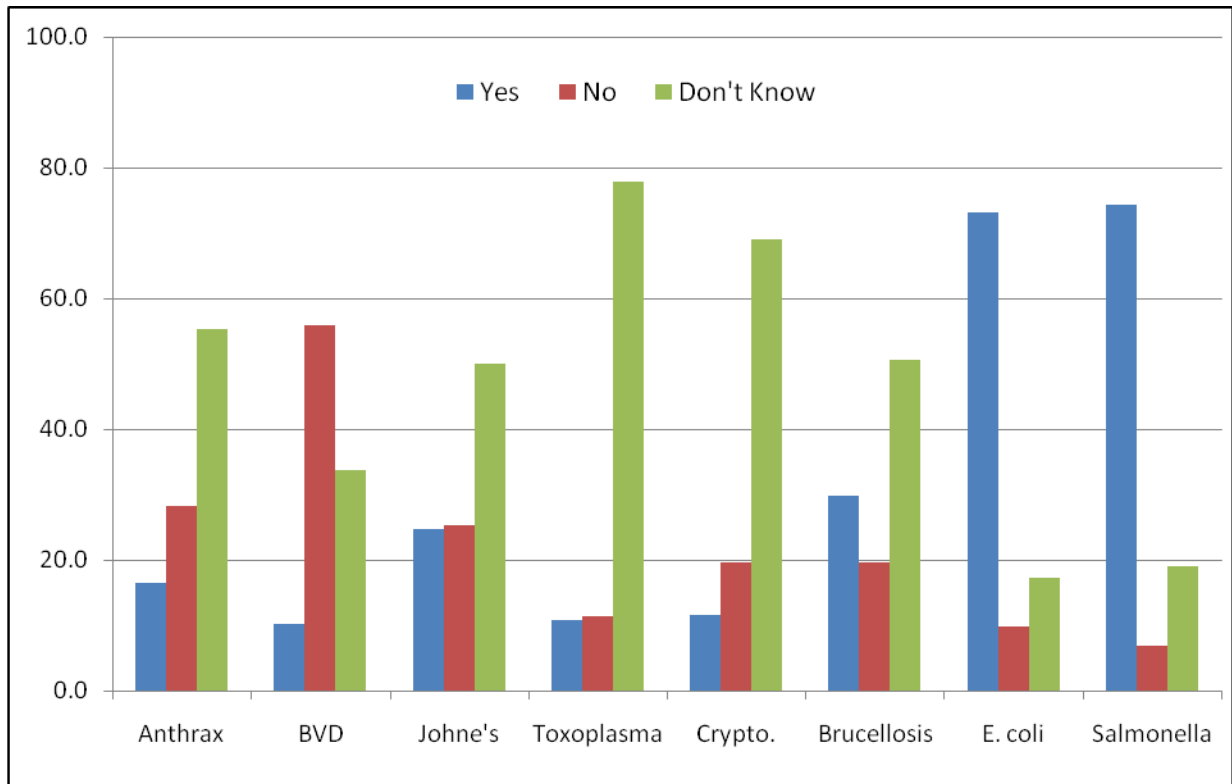


Figure 1: Producer responses to whether each pathogen or disease can be transmitted from cattle beef or milk to humans. BVD=bovine viral diarrhoea; Crypto.=*Cryptosporidium*; Johne's=Johne's Disease; Salm.=*Salmonella*.

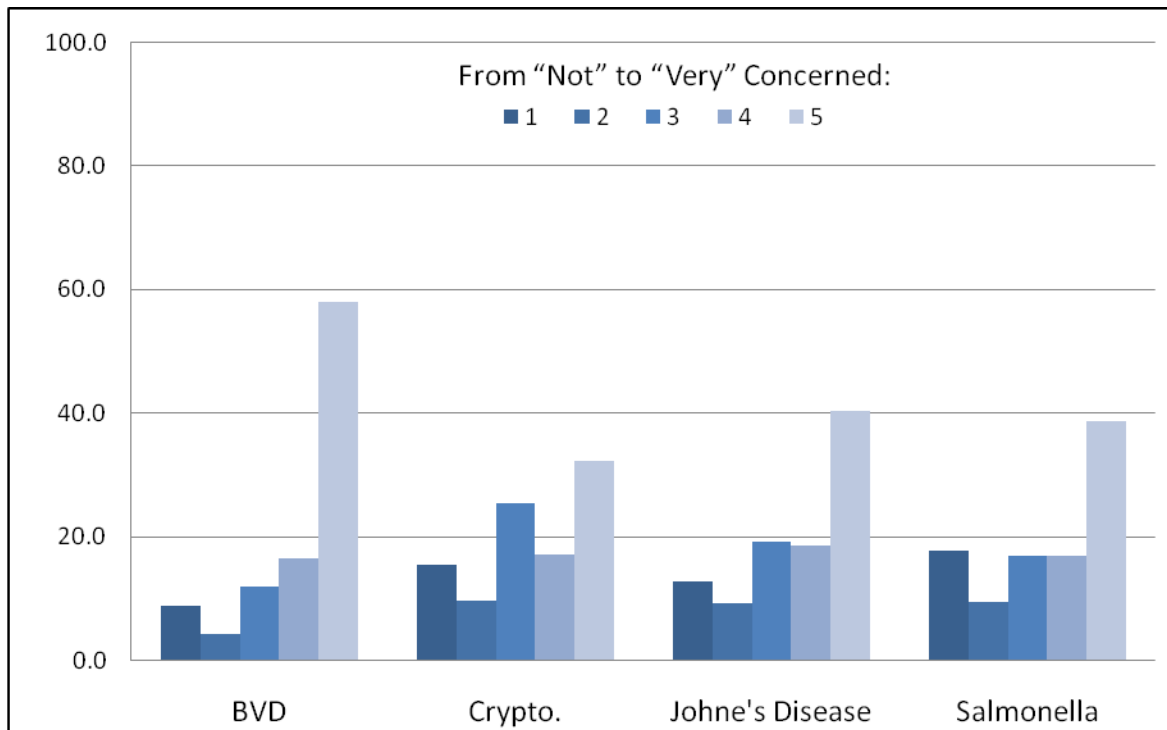


Figure 2: Producer concern that each pathogen or disease could cause a negative economic impact on their herd (five-point scale from 'not' to 'very' concerned). BVD=bovine viral diarrhoea; Crypto.=*Cryptosporidium*.

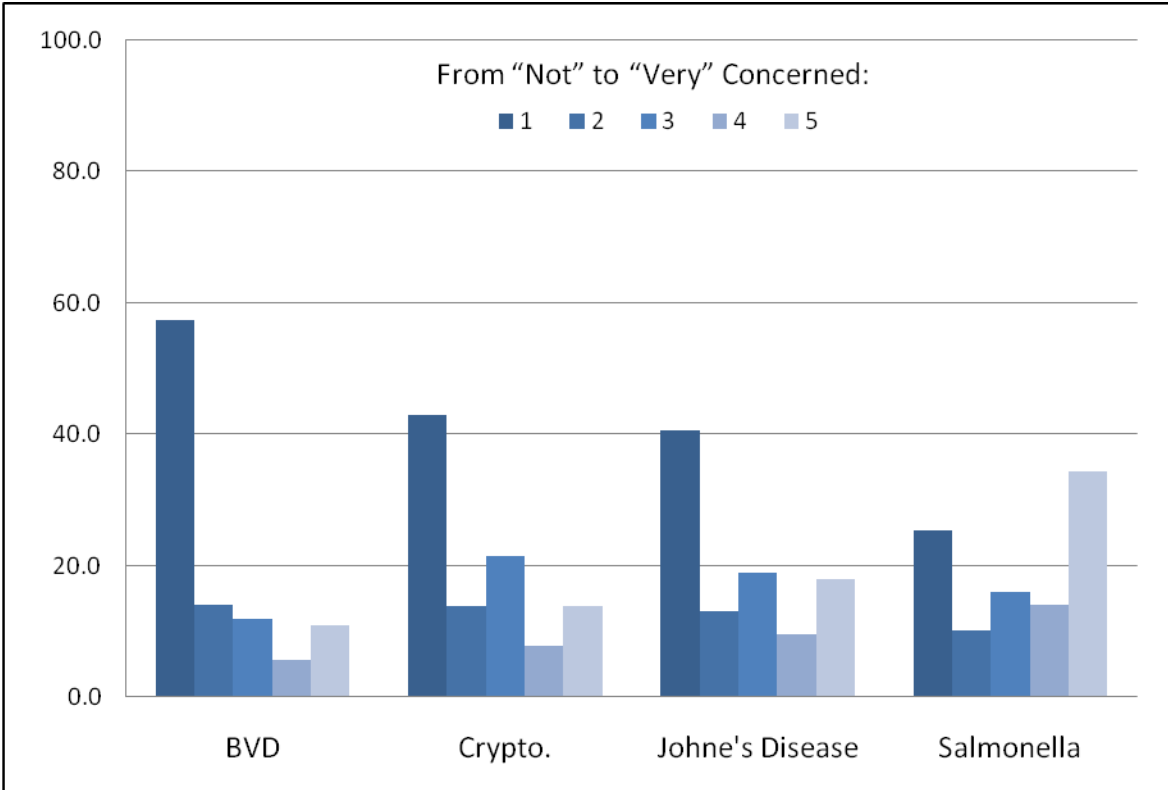


Figure 3: Producer concern that each pathogen or disease could cause a consumers to become ill (five-point scale from 'not' to 'very' concerned). BVD=bovine viral diarrhoea; Crypto.=*Cryptosporidium*.

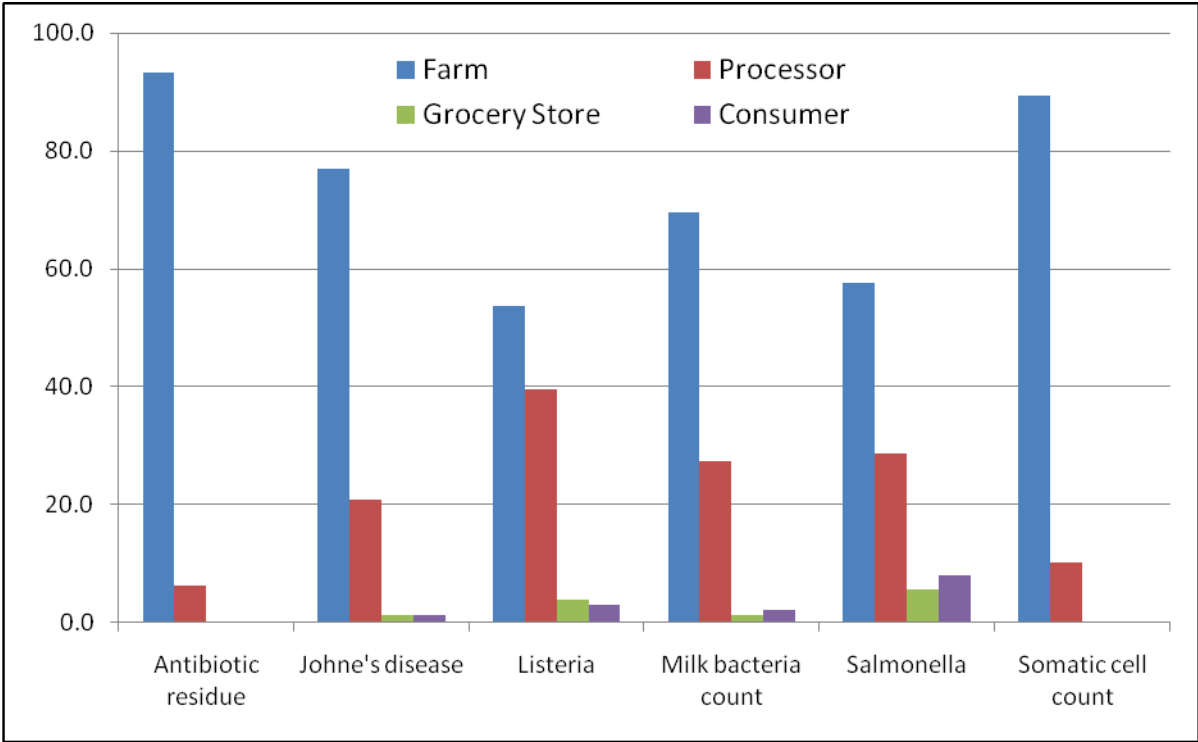


Figure 4: Producer choice of the most important control point for each pathogen, disease or hazard (from 'farm', 'processor', 'grocery store' or 'consumer').

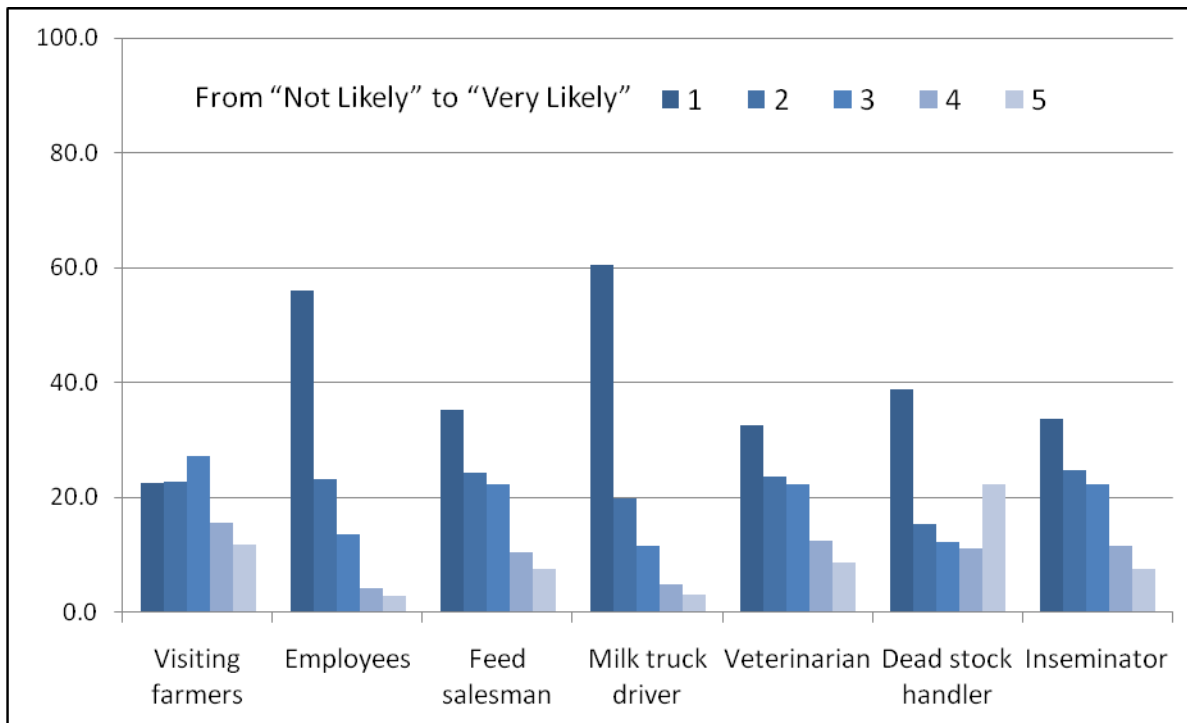


Figure 5: Producers' perceived likelihood that different types of farm visitors could introduce disease into their herd (from 'not likely' to 'very likely').

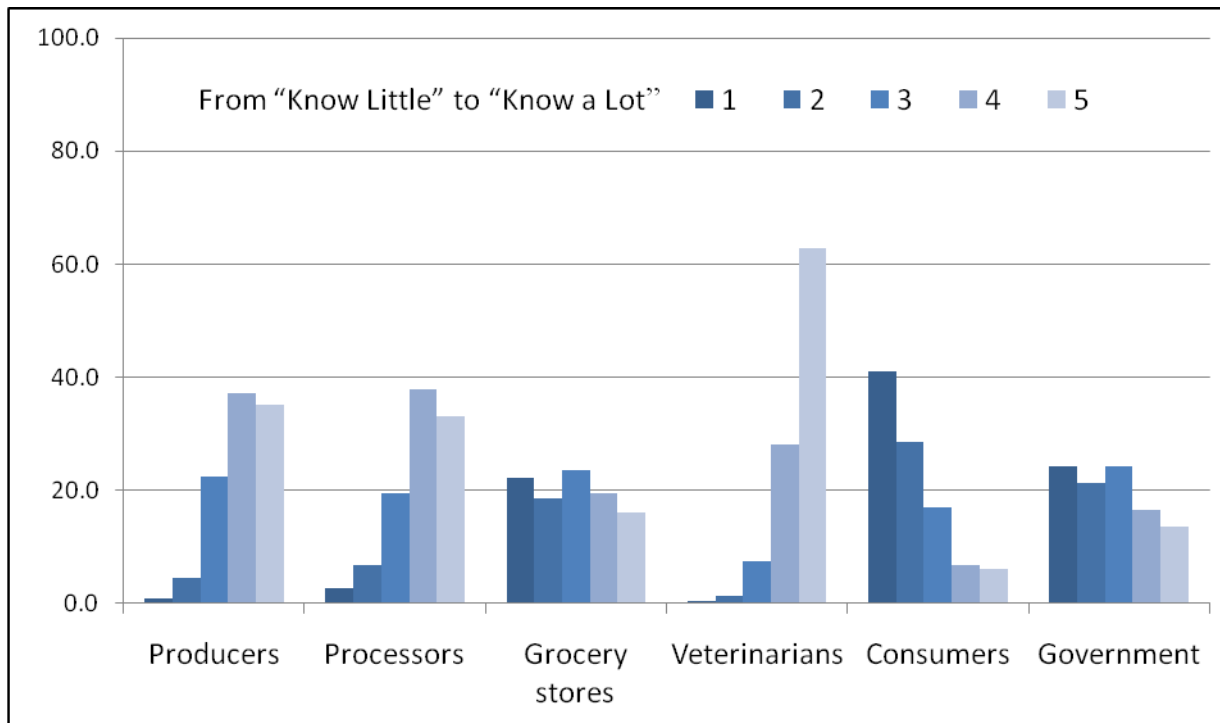


Figure 6: Producers' perceived knowledge of different stakeholders about the on-farm food safety practices that are required to achieve safe milk (from 'know little' to 'know a lot').

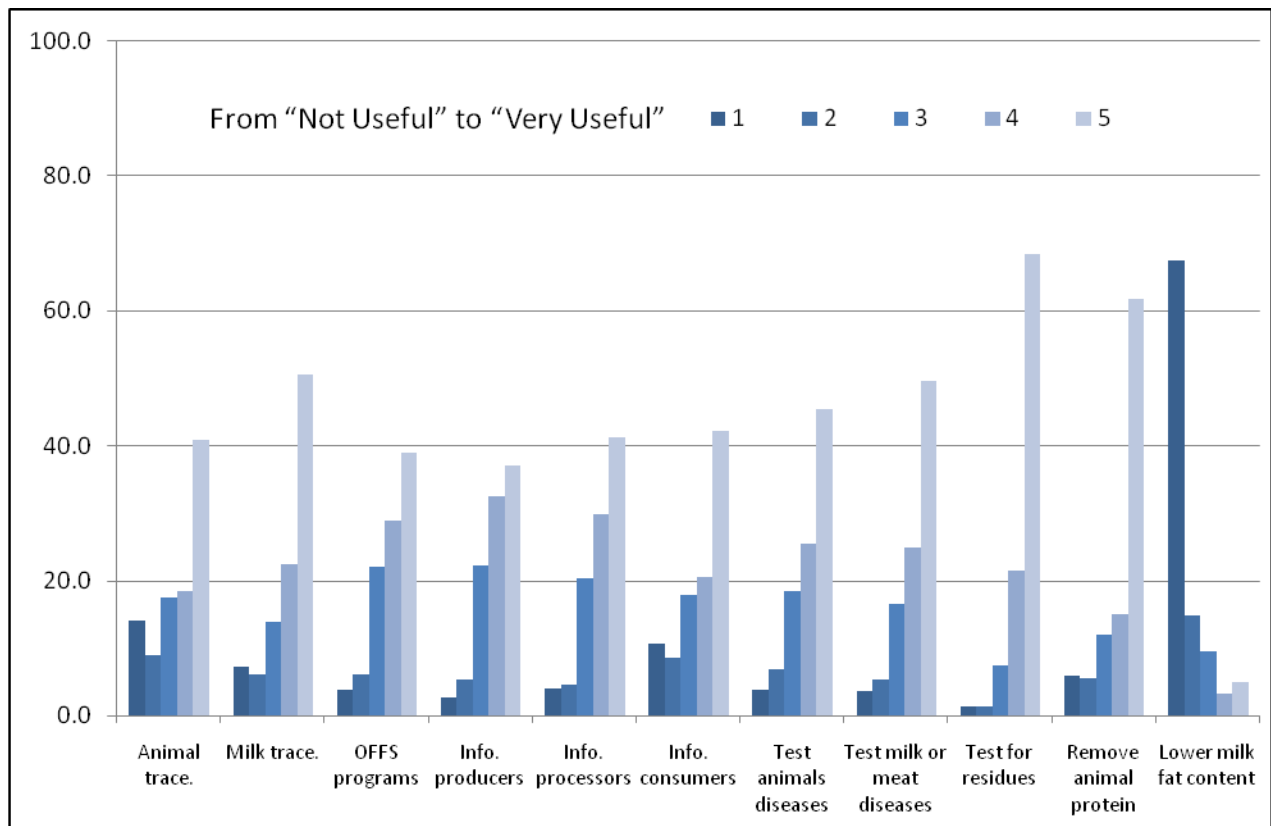


Figure 7: Producers' perceived usefulness of different industry practices to achieve safe milk (from 'not useful' to 'very useful'). Diseases=zoonotic diseases; info.=provide food safety information to; OFFS=on-farm food safety; trace.=traceability.

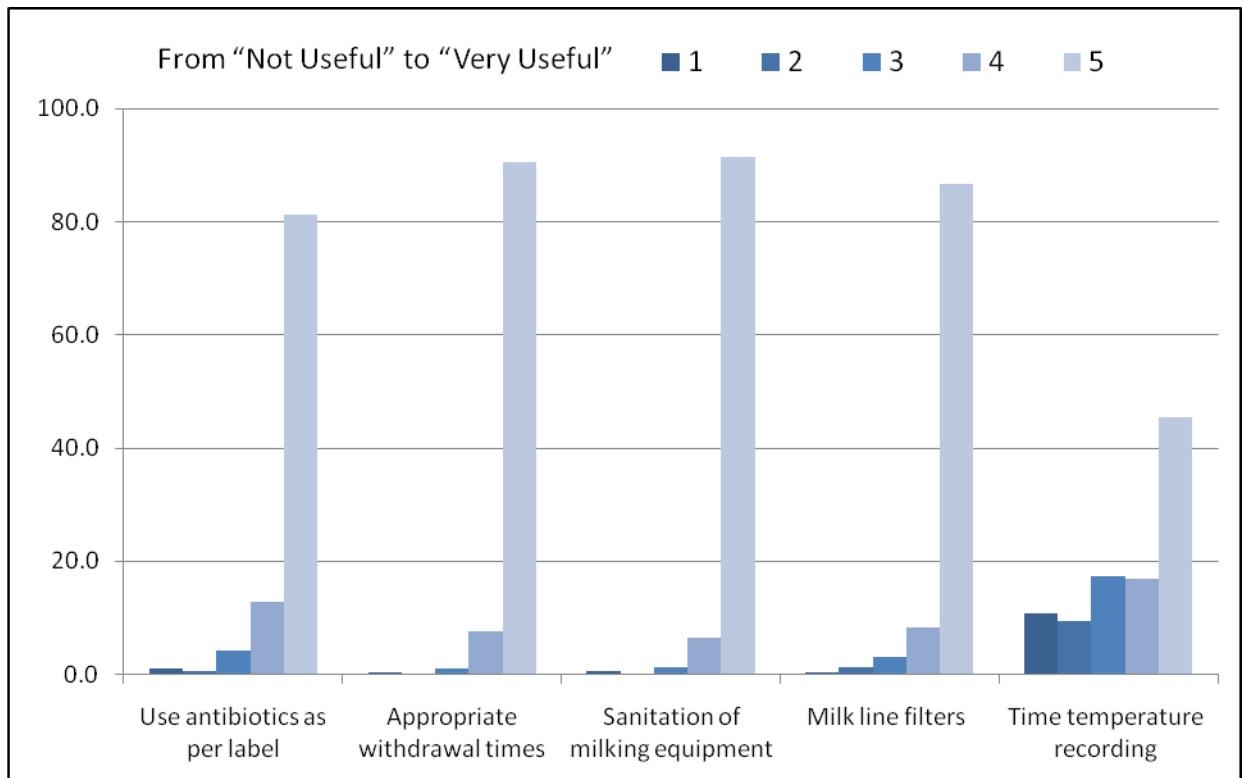


Figure 8: Producers' perceived usefulness of different herd management practices to achieve safe milk (from 'not useful' to 'very useful').

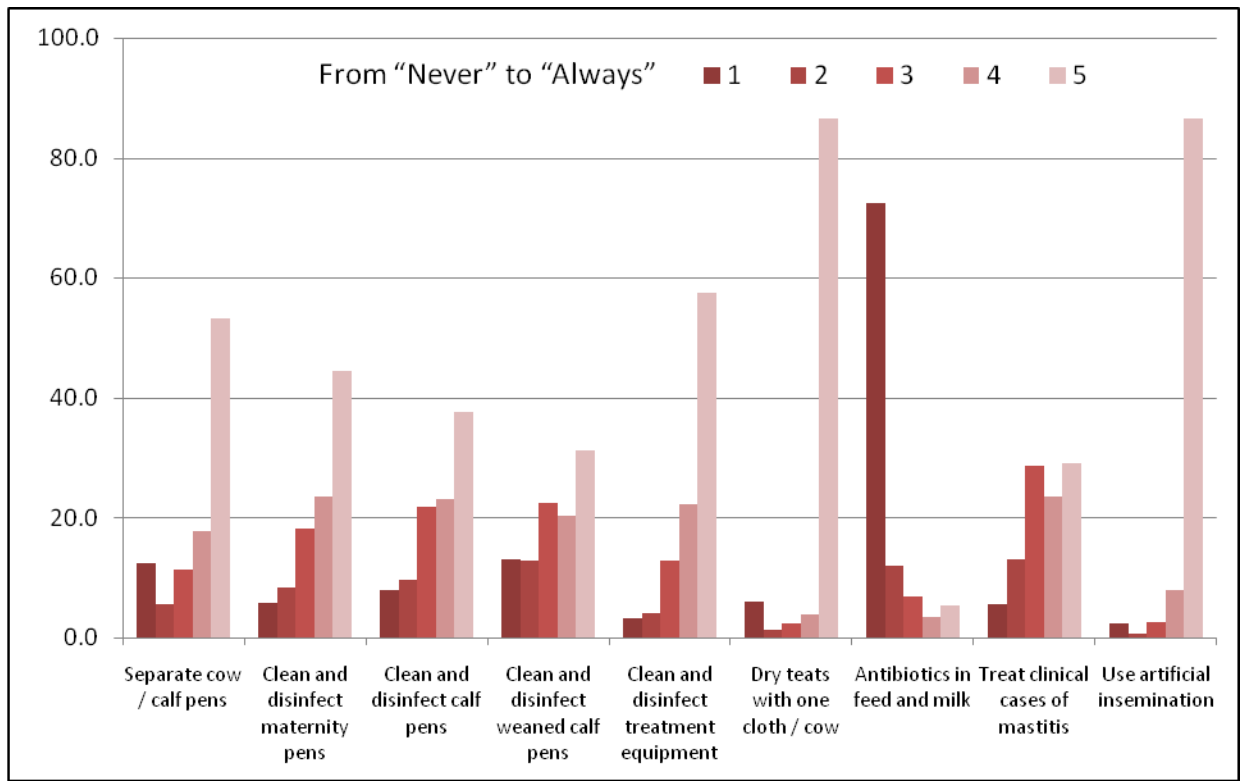


Figure 9: Producers' reported use of good production practices (from 'never' to 'always').

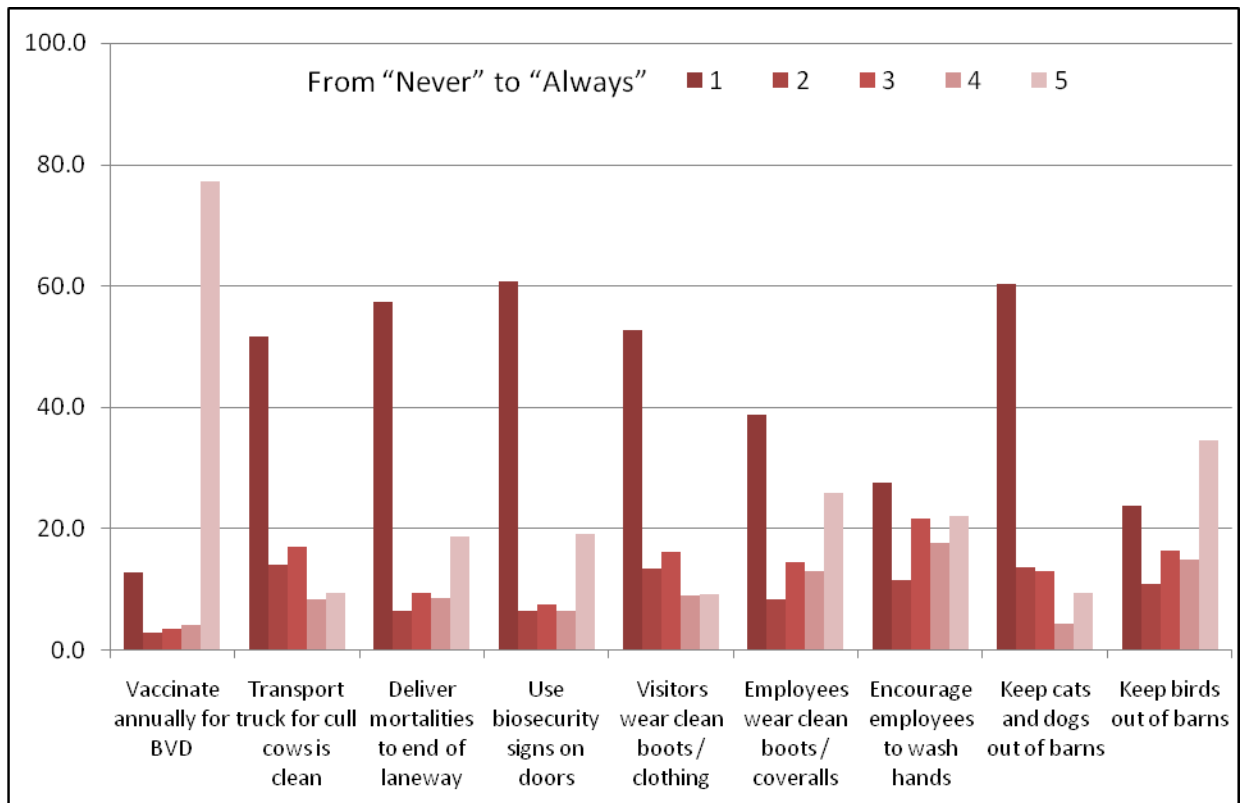


Figure 10: Producers' reported use of good production practices (from 'never' to 'always'). BVD=bovine viral diarrhoea.

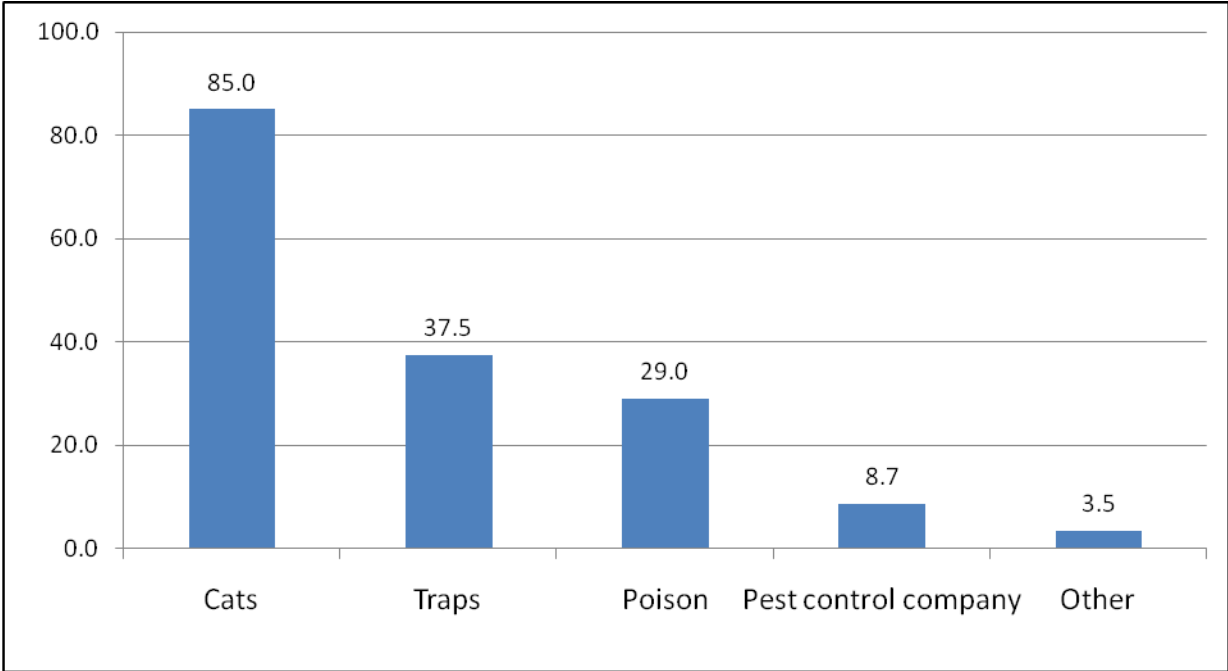


Figure 11: Producers' reported use of pest control practices.

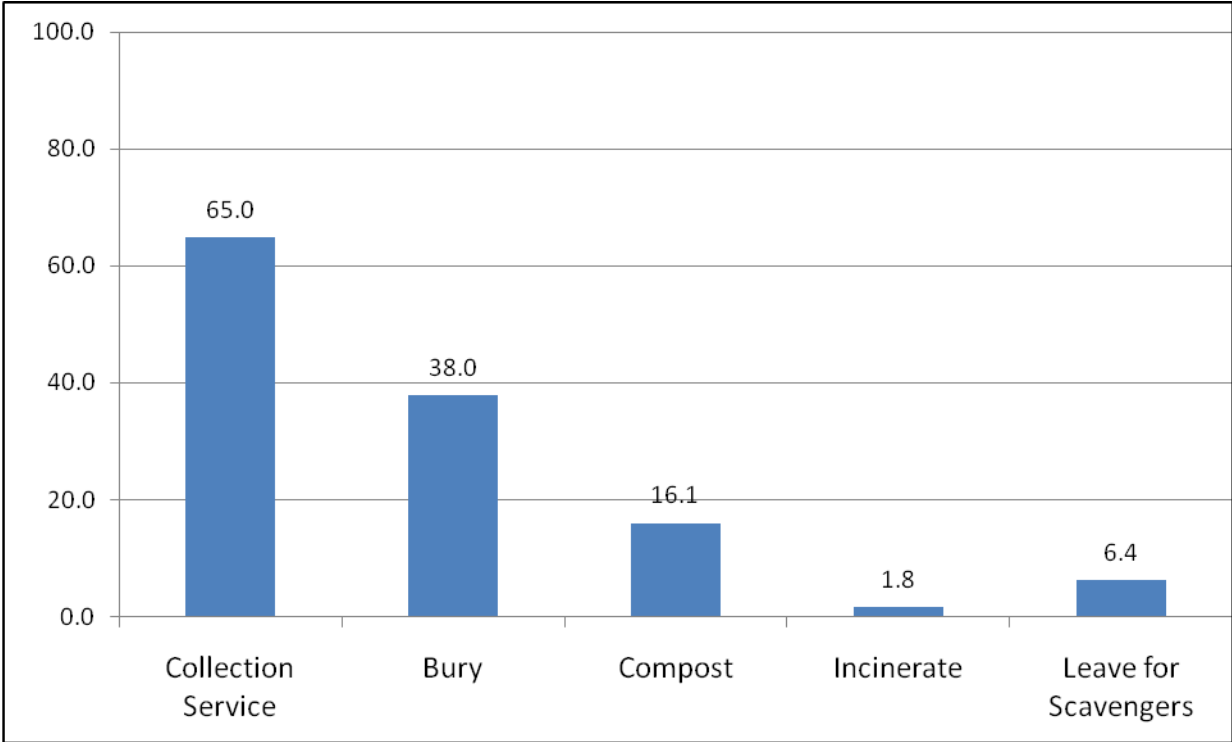


Figure 12: Producers' reported use of livestock mortality disposal methods.

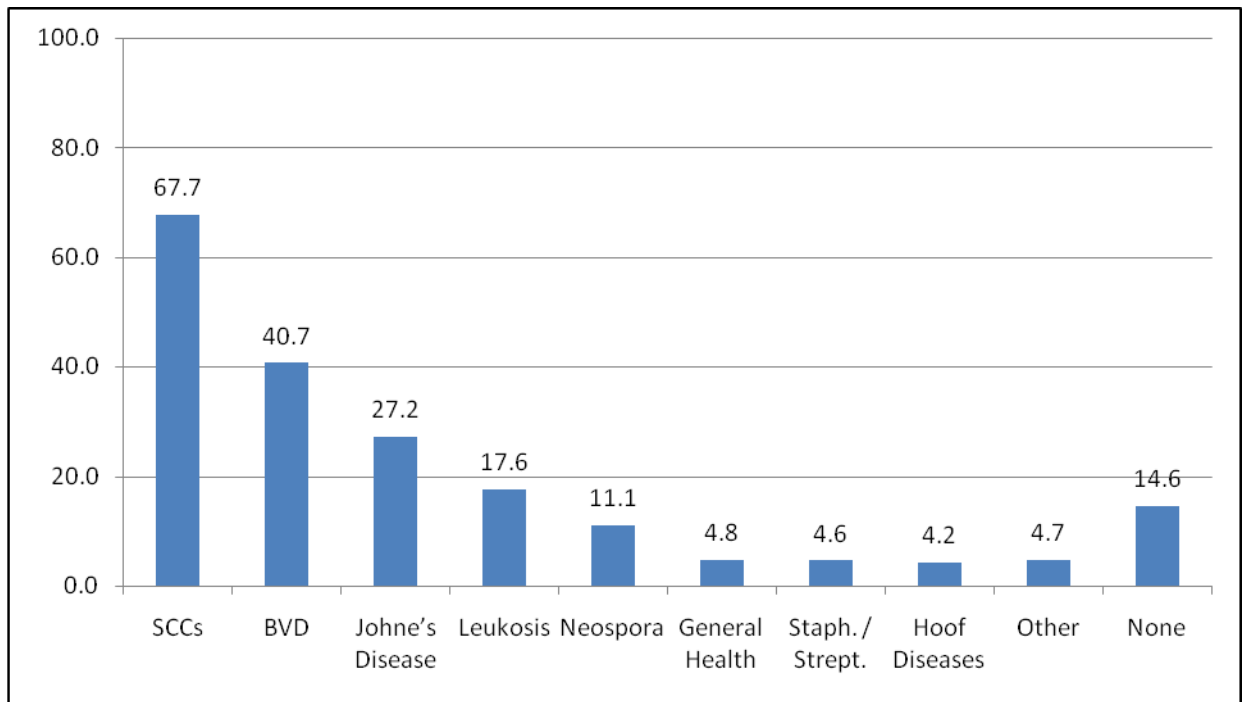


Figure 13: Diseases and health indicators considered by producers before purchasing replacement cattle. Out of 61.0% of producers who reported that they purchase replacement cattle. BVD=bovine viral diarrhoea; SCCs=somatic cell count scores; Staph.=*Staphylococcus*; Strep.=*Streptococcus*.