

Voluntary sentinel surveillance: building a longitudinal disease surveillance network with cow-calf herd owners in Western Canada

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Abstract

Current population-level information on disease prevalence and herd management is limited for extensively managed cow-calf herds in Canada. A longitudinal disease surveillance network was developed in western Canada through the voluntary participation of cow-calf herd owners in the provinces of Alberta, Saskatchewan and Manitoba. Since there are no complete sample frames for this industry accessible to researchers, efforts focused on recruitment of volunteer participants through veterinary contacts. A network of sentinel cow-calf herds was successfully established and we have estimated prevalence for a number of production limiting diseases and important management practices. The network of research participants has provided a 'living laboratory' for addressing a number of critical questions for the beef industry.

Keywords: *Beef cattle, longitudinal, sentinel surveillance*

Introduction

While national surveillance efforts focus on animal diseases of importance in an international setting, many management practices, productivity measures, and diseases of importance to animal health are not addressed outside of individual research projects. Identifying appropriate participants for individual research projects is expensive and time consuming. There is no complete and available listing of Canadian cow-calf herds that can be accessed by researchers to create a formal random sample.

Canadian cow-calf herds have variable contact with veterinary practitioners and industry organisations. A regular Canadian census collects data on industry metrics, including size, but does not offer an easily accessible point of contact with individual herd owners. In addition to the difficulty in recruiting herds, there are additional challenges to collecting surveillance data from cow-calf herds. Canadian cow-calf production occurs over a widely dispersed geographic area often a great distance from the nearest laboratory. Most cow-calf herds are extensively managed and the animals are only confined and handled a few times per year; this can create challenges in collecting biological samples at specific times during the production cycle.

The cow-calf industry in Canada has an interest in establishing baseline estimates for a number of issues. Some

questions include updating disease prevalence estimates and establishing estimates for emerging or understudied diseases. Estimates of productivity and management practices are also important for establishing industry benchmarks. The establishment of a longitudinal cohort of volunteer privately-owned herds would substantially improve the feasibility of collecting field data over time for disease surveillance and specific research questions. As new diseases emerge or new tests for diseases are developed, the sample bank would provide an available source of samples representative of cow-calf herds in Western Canada.

Materials and methods

In Canada, approximately 80% of cow calf production occurs in the three prairie provinces of Alberta, Saskatchewan and Manitoba. Funding was obtained to recruit 120 cow calf herds in these provinces for a surveillance network that would enroll participants for five years. Veterinarians in these provinces were asked to identify cow calf herd owners that were interested in participating. Herds were recruited in 2014 and 2015 to represent the geographic and herd size distribution identified from the 2011 Canadian Census of Agriculture. All herd owners were contacted by phone, the network was described and their interest in participating confirmed.

Herd management and production information was collected from herd owners via questionnaires delivered by paper or on-line, depending on the preference of the herd owner. Herd owners were contacted as necessary to encourage return of surveys and to fill in missing or unclear responses. Questionnaires have been delivered on an ongoing basis asking questions to follow the productivity cycle (breeding, pregnancy checking and calving) as well as targeted questions related to management practices and approaches. Herd owners were paid a nominal fee for completed surveys and for providing animals for biological sample collection. Three to four surveys were distributed each year by regular mail and online. Herd owners could choose to opt out of a specific survey or sample collection. In addition, costs for veterinary work to collect samples were also paid by the research funding. Funding for testing the samples was not part of the primary surveillance network grant but has been obtained through separate funding applications.

Serum and fecal samples were collected from pregnant cows in the fall of 2014 and will be collected again from pregnant

heifers in 2016 by herd veterinarians at the time of pregnancy checking. Blood samples were processed at the research laboratory and serum aliquots were stored at -80C. Fecal samples were aliquoted and submitted for culture and AMR testing and the remainder was frozen at -80C.

Additional project funding was secured for sampling bulls for two reproductive diseases, *Tritrichomonas foetus* and *Campylobacter fetus* subsp. *venerealis* (Cfv). Herd veterinarians were asked to collect preputial scrapings from bulls and submit them to the research laboratory for testing.

Results

Initial recruitment efforts identified 115 herd owners from 41 veterinary clinics who were sent the initial questionnaire and surveillance network documents. Five withdrew before completing any documentation. Seven more agreed to sample collection but did not complete surveillance documentation and withdrew from the network.

Biological samples were collected from 103 herd owners who had also completed surveillance network enrollment and returned initial questionnaires on productivity. Those samples were available for further testing as funding was secured. This sample set has been examined for antibodies to a number of infectious agents as well as nutritional deficiencies. To date, samples have been tested for *Mycobacterium avium* subsp. *paratuberculosis*, bovine leukosis virus, *Neospora caninum*, and *Ostertagia ostertagi*.

In addition, stored serum samples were tested for trace mineral status. Serum concentration data was then linked to survey data describing mineral supplementation and subsequent calving performance. The same herds will be followed over time for changes in productivity and mineral status.

Having an accessible group of recruited herds facilitated an additional project that involved sampling herd bulls for venereal disease. Interested herd owners (n=78) agreed to participate in testing bulls for *T. foetus* and Cfv: 735 bulls were sampled between March and July, 2015.

Access to this cohort of herds has also allowed for the development of specific projects investigating herd management. Focussed questionnaires were developed for each project. These focussed questionnaires could be relatively short and efficient as baseline herd data had previously been collected. The participants have been surveyed on antibiotic and antiparasitic administration practices, mineral supplementation, approaches to economic management, and attitudes and practices related to animal care.

Following the successful recruitment of 103 cow-calf herd owners in Western Canada, the surveillance network has initiated two further attempts to recruit participants and has experienced some withdrawals from the network. Twenty-one additional herds have been recruited for the project and

14 herds have been lost to follow-up to as of February, 2017.

Of recruited herd owners, only 28 volunteered to complete the questionnaires through an on-line survey tool. Of those, three had regular connection problems and were unable to easily finish questionnaires; sometimes requiring telephone follow up to obtain missing information. Usually, more than half of responses, for paper based or on-line questionnaires, are returned within three weeks of receipt of the questionnaire. The remaining responses require reminders, with the return period often stretching over four months for the latest returns.

Discussion

The establishment of the research network and a dedicated group of cow-calf herd owners willing to answer ongoing and focused questions, along with a willingness to provide access to animals for biological sampling has allowed for the collection of a number of different types of information relevant to the cow-calf industry in Canada.

As with many surveillance efforts, the study population is not truly random. Volunteer bias is an issue that needs to be considered for data from cow-calf herds that form this surveillance network. Herds were recruited through veterinary practices to approximate the geographic distribution and herd size characteristics of the Western Canadian cow-calf herd. Random selection, where participation is voluntary, also creates bias through refusals to participate. These herds utilise veterinary services, including pregnancy checking, and are interested enough in research activities to engage with the project. We therefore expect that this recruited group of cow-calf herd owners may be a more engaged or motivated group of herd owners than a true random sample of all cow-calf herd owners. We suggest that these herd owners may innovative and more likely to utilise findings from the research.

While these results do not necessarily represent the entire cow-calf industry, they do provide a good look at the type of cow-calf herd owners who are most likely to lead the industry forward. Recruitment of a dedicated group of veterinarians and herds owners has been critical in past projects to the collection of complete and accurate data and to optimise herd retention (1,2).

Disease prevalence estimates were one of the first outcomes reported from the surveillance network. Samples are available and have been tested as targeted funding was obtained. Estimating the frequency of management practices and linking productivity data to test results is more challenging; complete information for all participants is not always available. Participants might have missed completing a particular survey or individual questions. Some participants were recruited in time for sampling but after a previous relevant questionnaire had been administered. Some of this can be rectified with follow up phone calls or e-mail, but some information is not captured in the records of the herd owners in the same format as the questions being asked.

A substantial benefit of the existence of the network is the ability for additional projects to access representative cow calf herds to request information or access animals for sample collection. A simple question can be included in a current survey and the research started in a timely fashion. Many research projects find that recruitment of participants is the most time-consuming and difficult part of the process, especially in the absence of easily accessible sample frame information.

One of the challenges faced by the network is in balancing the number of times herd owners are contacted for information during the year while asking questions at the appropriate times during the current production cycle. While most cow-calf herds in western Canada have a concentrated breeding and calving period, the timing of the start of the calving season varies greatly among herds. This increases the challenge of finding the optimal time for distributing questionnaires, especially those requesting production and disease data. Questionnaires need to be timed such that most, if not all, owners have collected the necessary information, but not so long after that the information is hard for them to recover or that the chances of recall bias are unacceptable for questions where they do not have written records.

Record keeping among herds in the study varies from counts of important outcomes to individual animal computerised records. While detailed information on individual animal attributes and dates of specific events may be available in some herds, in others only counts of events are available for a particular production cycle. Similarly, not all herd owners pregnancy test all of their cows, some of the herd owners only pregnancy test a subset of the herd and a few owners do not pregnancy test. While in previous surveillance initiatives, we have required individual records from all participating herds (1, 2), the financial resources required to compensate herd owners and manage the resulting data were not considered reasonable for the number of herds and long term goals of this network.

Another challenge with maintaining the surveillance network and timely reporting of the results is that while some herd owners promptly reply, others require multiple contacts to have material returned and completed. This means that with 2-4 items being sent out each year, at any given time those herd owners may have multiple outstanding items.

The collection of biological samples represents another unique challenge to disease surveillance in cow-calf herds. Groups of animals are typically only be handled once or twice during the year, and not necessarily at the ideal time for collection of samples. Pregnancy testing is typically the most convenient time for sample collection and usually occurs sometime after cows are moved from more widely dispersed summer grazing to relatively more confined fed conditions during the winter. This is not ideal for assessing some questions (i.e. trace mineral status as a risk factor for pregnancy) but represents what is often the only window of

opportunity. Collection and shipping of biological samples during fall pregnancy testing can be complicated by extreme environmental conditions. Samples can freeze and blood samples can lyse during transport if not properly insulated.

Despite the increasing availability of rural internet access for Canadians, not all herd owners can easily connect to an on-line survey tool. The advent of cell-phone applications to collect information in a more continuous flow has the opportunity to bypass this limitation. However, not all herd owners may be willing to participate in this.

Maintaining the network requires continuous work: encouraging herd owners to respond and provide complete information, working with veterinarians to identify new herds to participate, recruiting new participants as current participants withdraw, and providing results as they become available. However, far more work is involved in initiating the network and developing the first contacts for all of these herd owners. In addition, as we work with herd owners, question delivery and format is refined so that better information is collected. If this was conducted as separate research projects with new recruitment, the shared learning between researchers and participants would be lost.

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