Beef: Cow-Calf Split Session II

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Benchmark: A Beef Cow-Calf Production and Health Monitoring System

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Introduction

A wide variety of systems are covered under the topic of animal disease monitoring, and the major considerations in the design and implementation of monitoring systems have been described elsewhere (1,2).

In recent years, there has been much activity and advancement in the area of animal disease monitoring. For large scale systems, much of this activity has been centered in government agencies, probably because of the time and expense and necessary expertise, involved with developing monitoring on a large scale such as a national program. An excellent review of the nature and evolution of large scale disease monitoring systems in the USA is available (3). The stated objectives of these national systems has varied from keeping a finger on the pulse (health) of the national herd, to guiding disease control efforts, to justifying and rationalising expenditures on research, and—in a few instances—as an early warning system for disease outbreaks and/or outbreaks of exotic diseases (2).

Private practitioners might rightfully ask what value these large scale monitoring systems have for them and their clients. In this regard, in discussing national systems, it has been stated that "producers need information on the economically important diseases in their area, how various management practices affect these diseases, and the most cost effective means to prevent or control them." (3) Yet, most national systems are being designed to operate around, not through, the private practitioners, and the data will not assist in identifying the disease and production status of individual herds in a manner that aids effective problem solving. Indeed, the centrally planned large scale systems treat monitoring as separate from the other activities involved in a health management program. One notable exception is the system being implemented in Prince Edward Island, known as APHIN (Animal Productivity and Health Information Network) in which private practitioners are active collaborators with government veterinarians in a unified system (4). This lack of private practitioner involvment may not be inappropriate, given the current stage of development, but it is hoped that such involvement will occur in the near future.

A number of wet-labs at this conference and publications from others, for example in Australia, provide a great deal of information on systems for individual producers (5,6,7,8). To implement a system successfully requires a great deal of knowledge about the nature of the local industry, disease, management, economics and so forth (9). However, in designing and implementing a monitoring system as part of a health management program, it is well to note that many farmers have an aversion to data recording, most do not see value in historical data, most tend to make decisions based on physical evidence rather than data, and that in designing the system we need to consider the typical, not the advanced articulate producer (10). The caveat that we must be aware of the producers ability and objectives is often made; we would stress that it should not be forgotten.

Our bias is that the system should be sufficiently decentralized to meet the major needs of a variety of producers, yet have sufficient centralized planning and data sharing to allow the manipulation and analyses of the volume of data necessary to identify factors influencing health status and to assist in indentifying optimal health management strategies. Indeed the monitoring system and the health management program should be closely integrated. Continuous monitoring can also reveal the extent to which the objectives of health management have been reached. Certainly, the monitoring system should incorporate production data as well as data on disease.

It is essential to quantify the effects of disease on production, and it is equally important to realize that the level of production (production efficiency if available) is often the best screening test for health status. In this paper we would like to portray systems that can serve the major needs of individual herd owners and veterinarians, and by data sharing can also meet the needs of provincial and federal governments for large scale monitoring systems.

Epidemiologic Considerations

From an epidemiologic perspective it is important that the system provides general information on at least four of the five Ws; that is, the *who* (host factors), *when* (temporal factors), and *where* (geographic factors), for each what (disease or production problem). These data should provide initial answers to the *why* (determinants) of health, at least in terms of the common climatic, demographic, management, and feeding factors (2). Due to economic and practical constraints, in-depth studies of individual or subsets of farms should not normally be part of a monitoring program, although data on selected investigations could form the basis for case studies in continuing education programs.

Because of the central importance of the collection, management, manipulation, and interpretation of data (ie, monitoring), it is this feature that we will expand on in this paper.

A first feature of importance is that since beef cows are fed, housed and managed on a herd, rather than an individual basis, the herd is the primary unit of concern. Hence, we must monitor a sufficiently large number of herds so that herd production levels and disease frequencies can be precisely estimated, and that potential associations between management factors and production and disease, at the herd level, can be identified with reasonable power. This point appears to be down-played, if not forgotten, in many discussions of monitoring. Private practitioners should still proceed to offer monitoring as part of their health programs. The problems and successes identified will have to be managed on an individual basis until some of these herd-level studies have been completed (see references 5-8 for examples).

Determination of the necessary number of herds (sample size calculation) for descriptive purposes is relatively straightforward, but it is often more difficult for explanatory (analytic) purposes given that both the frequency of the putative determination and their effects are unknown.

The number of units, in our case herds, that one needs to gain precise information about production or disease levels is based on the usual Student's t-test which can be solved for "n" to give:

$$n = 4S^2 / l^2 \quad (2)$$

where l is the maximum difference you wish the sample result to depart from the true mean, and 4 reflects a 95% level of confidence in the result (use 8 for 99% confidence). Note that S^2 is the between-herd variance in the parameter to be estimated. For example, if the between-herd variance in pounds of calf weaned per cow bred is 900, and we wish to estimate the average pounds of calf weaned per cow bred within plus or minus 10 lbs, the required number of herds is 36.

For testing hypotheses the same basic formula applies except that now we have two groups to compare, and we need to set our requirements for power—the ability to detect a specified difference between two means (eg level of production in herds with and without a disease problem). This leads to an approximate formula which at type I error of 5% (95% confidence) and power of 80% is:

$$n = 16S^2 / (\text{Difference in means}) \quad (2)$$

For example, if we want to assess the effect of a health program on the lbs of calf produced per female bred, if we think the program will produce at least a 20 lb per female increase, then with the same variance (900) as before the number of farms required is 36 per group (ie. 36 herds on the program and 36 not on the program).

In practice, sample sizes often reflect reasonable approximations, after balancing both theoretical and practical considerations. Monitoring systems using too few herds will not be able to provide precise estimates of the health of herds, nor will they be able to identify reasons for the variability in health and production at the herd level.

An Example Monitoring System: Benchmark

The remainder of this paper describes a monitoring system based on the cooperation of farms, private practitioners, government personnel, and university veterinarians to monitor the health and production of the beef cow-calf industry in the province of Ontario, Canada. The project, called BENCHMARK, is a three year study designed to describe existing production and disease levels, the current management practices used in the industry, and to examine the association between these management practices and health. The project was designed both as a research project combining descriptive and analytic epidemiologic features and as a vehicle to enhance the skills of collaborating veterinarians and producers in ongoing production and health monitoring. This latter aspect is important. We believe it essential to integrate the monitoring system with the ongoing production management and health care delivery of the collaborating farms, so as not to create parallel or competing recording and information systems. Data and information overload must be avoided, else the system will not be used. Our chief interest lies in the adult breeding herd, in the

management and productivity of first calf heifers, and in the health and survival of calves to weaning. The collaborating farms are also providing data on the benefits and costs of preconditioning calves.

Our study farms were selected, from a sampling frame of approximately 1450, in a formal random manner. In the initial stages, 300 volunteers were selected for the project. Of these, 50 were no longer in business, leaving 250 available for participation, 193 (77%) of these agreed to collaborate in the study, and 181 have been collaborators for two years. An additional 50 herds were selected purposively through collaborating private practitioners. Some of the characteristics of the randomly selected farms and their manager/owner are shown in Table 1.

Table 1. Characteristics of Beef Cow-Calf Herds in Ontario, 1986. (n = 182 herds, 192 management groups of cattle)

Location in Ontario	
Central 21%, Eastern 19%, Southern 12%, Western 48%	
Owned by Manager 90%	
Off-farm work by manager:	None 56%, Part 10%, Full 34%.
Post-secondary school education	30%
Age of manager	46 ± 12 yrs.
Years of Cow-Calf Experience	18 ± 10 yrs.
Percent of work effort directed to cow-calf herd	73 ± 28%
Use records in management of herd	56%
Have other livestock	58 %
Have cash crops	28%
Primary Calving Months: March 15%, April 42%, May 20%	
Use hired help:	part-time 17%
	full-time 7%
Family members help with herd	86%

BENCHMARK was designed to supplement a government supported beef herd improvement program (BHIP). The BHIP concentration on weighing calves at weaning so that future breeding stock can be selected on this basis. Cows and calves are uniquely identified, and assistance with weighing is provided by the BHIP. However, since the program focused primarily on weaning weights, data on cows that did not wean a calf, or cows that weaned a calf at a time outside of the 'weighing period" were often not included in the data base. The caveat is that if using data from another source, one must realize the strengths and limitations of those data. Thus, in order to obtain the necessary data, our study began with a complete census of the herd, and this is repeated on an annual basis in order to detect and confirm any changes in herd membership and size.

With regard to disease recording, we rely primarily on farmer recorded diagnoses. Usually the diagnosis is specific only to anatomic site (eg. pneumonia, mastitis, sore foot, etc) and is accompanied by a treatment. If possible, the individual's identity is recorded to allow differentiation of a case from a treatment and for purposes of future decision making on an individual basis. On many farms only herd level disease frequencies are recorded; that is, a count of disease frequencies which can be related to a population at risk, but not to an individual animal. Given that the herd is the unit of concern, this is not inappropriate, and it also ensures that recording is kept to the minimum. It is also important to note that clinical disease is not a common event in our study. Given this low frequency and the fact that clinical disease may not provide useful clues about the true extent or nature of health problems, it is often desirable to incorporate surrogate measures of disease, such as serologic testing, as part of the monitoring system. Tissue or blood samples from a few (3-4) animals per farm will provide sufficient information about the prevalence of putative pathogens in the industry as a whole. More samples will be required to provide firm estimates of prevalence, or incidence, on individual farms. Unfortunately, such sampling was not possible in BENCHMARK.

Data collection methods were adapted to both the need to collect information from a large number of producers, not accustomed to data recording, and the level of intended decision making on each farm. The system is flexible so that a variety of producer recording schemes can be accommodated. Pocket and/or clipboard diaries were provided for on-farm recording and portable photocopiers were employed during farm visits to capture information from these diaries, government supplied weigh sheets, breeding charts and any owner designed recording system. Information on management was collected by formal surveys; short general surveys were conducted by mail, detailed surveys were conducted by personal interview and inspection (eg, the latter included such items as inspecting and scoring the body condition of the breeding females, and inspecting the calving area for drainage, protection from the elements, etc). Because three veterinarians were involved in the study, considerable effort was expended in pilot studies to standardize recording and assessment of herd management factors. The surveys themselves went through many iterations. pilot trials, modification and reassesssment before being widely used in the study. One cannot overestimate the time and effort required to produce a useful survey form/questionnaire.

Although our emphasis is on the herd, some decisions need to be made on an individual animal basis. For example, in order to emphasize genetic improvement data on the parent's, or the offspring's performance are needed. Likewise, to consider the health history of an individual, in the decision to cull a particular animal or not, requires individual animal data, and analyses have been directed towards the factors which are important in the individual animal culling procedure (11).

In the Ontario cow-calf industry, both data recording and management decisions are focused on the calving, breeding, and fall weighing and culling (selective removal)

periods. Both producers and their veterinarians require a rapid turnaround time between data input and report output, particularly during the fall weighing and culling period; this suggests that a de-centralized data management system, involving local veterinary practitioners and animal science advisors is appropriate. Our intent is to institute educational programs for private practitioners to enable them to collect and utilize farm data on production and disease. Our belief is that if the system meets the objectives of the farmer and his/her veterinarian, that the groundwork for a useful hierarchical monitoring system will be in place. Once such a system is established, researchers, government and academic veterinarians will have access to accurate, representative data on the beef cow-calf industry.

Although this study is a pilot study, we believe it can guide future decisions on the design and implementation of a large scale monitoring system. Certainly, we will have identified the current levels of production and disease, and the major "macro" determinants of them. This will provide considerable focus both for future in-depth investigations, as well as future monitoring programs. (A spreadsheet program is being developed to assist in monitoring beef herds, and will be available in early 1989. Contact the senior author if interested in obtaining this program.)

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