Practical feedlot epidemiology for veterinarians

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Abstract

Epidemiology is integral to making informed data-based management decisions in a sustained business or scientific model. The most common uses of applied epidemiology in production medicine include monitoring and surveillance, forecasting, research trials, economic and sensitivity modelling, retrospective analysis and disease investigation. Using epidemiological tools to understand population level outcomes and disease trends/patterns is of limited value if this acquired knowledge does not ultimately drive actionable decisions to improve on-farm outcomes. Establishing a decision-making process is an important component of veterinarian/producer relationships. Understanding the process by which each decision is made so that the underlying strengths, limitations and implications are known may be as important as the decision itself. These proceedings describe practical application of epidemiologic principles and examples of decision-making methodologies used to guide sustainable food animal health and production.

Key words: feedlot, epidemiology, decision-making

Introduction

The SARS-CoV-2 (Covid-19) pandemic has brought many principles of epidemiology to the forefront of societal consciousness. As production veterinarians engaged in population medicine, we are no stranger to these principles. However, understanding basic epidemiology, and actually applying epidemiological tools to guide effective decision-making, are two different things. It is important to understand how to use these tools, as they are arguably more valuable than most, if not all, of the physical tools we carry in our vet boxes.

Feedlot epidemiology

Rather than only using epidemiological tools in an ad hoc manner, such as in response to a disease outbreak, epidemiology is integral to making informed data-based management decisions in a sustained business or scientific model. In other words, epidemiological analysis forms the basis for making decisions on herd health and production activities, as well as disease investigations and small and large-scale clinical trials. Accurate information to characterize animal health and production is crucial to practicing food production medicine.

To successfully apply epidemiological principles, information requirements must be defined. Furthermore, accurate and efficient data collection methods must be developed, outcome measures and desired outputs must be defined, and analysis methods should be defined or thought through prior to collecting data. This requires a comprehensive understanding of the production system of interest. Once information requirements have been determined, there is a wide range of possibilities in how collected data may be used, depending on the application of interest or opportunity available. The most common uses of applied epidemiology in production medicine include monitoring and surveillance, forecasting, research trials, economic and sensitivity modeling, retrospective analysis and disease investigation.

Monitoring and surveillance is key to assessing animal health and production outcomes over time and requires a defined monitoring system, defined critical levels at which management action will be taken, and predefined management/intervention actions. Collecting simple descriptive information is straightforward; however, to properly interpret this information, it is necessary to appropriately define the population of interest. For example, if risk of death in a feedlot is not time-dependent, then the number of animals entering the feedlot is a suitable population to monitor. However, if risk of death in a feedlot is time-dependent, then animal days may be a more appropriate population to monitor. The data collected for monitoring animal health and production measures also provides the basis for predicting animal health and production outcomes and costs. For example, predicted morbidity rates in some calves can be used to forecast resources required to meet anticipated animal health and production needs.

Data collected using epidemiologic tools also provide baseline information that can be used to generate animal health and production research questions. Data collected for routine monitoring and surveillance can also be used retrospectively to track long-term trends. Finally, disease investigations remain an important service to food production clients. Disease investigations also provide an opportunity to develop a productive business relationship by providing a detailed epidemiologic description to clearly define the problem and develop sound recommendations. Furthermore, investigations highlight the importance of data collection, storage and monitoring systems for animal health and production.

Decision-making

Using epidemiological tools to understand population level outcomes and disease trends/patterns is of limited value if this acquired knowledge does not ultimately drive actionable decisions to improve on-farm outcomes. Establishing a decision-making process is an important component of veterinarian/producer relationships. However, understanding the process by which each decision is made so that the underlying strengths, limitations, and implications are known may be as important as the decision itself. For the sake of discussion, these decision-making processes can be broken down into six example methods: Method I – Casual Observations, Method II – First Principles, Method III – Decision Tree Analysis, Method IV – Benchmarking, Method V – Evidence-Based, and Method VI – Commercial Field Trial Results. It is important that the strengths, limitations and implications of the process by which each decision is made be known, to ensure that the correct method is used for the scenario at hand.

In **Method I** – Casual Observations, anecdotal evidence, or crude comparisons are used to make decisions. This method can be used to assess whether we "can" do something, but is not very useful for deciding if we "should" do something unless extremely large differences are present. **Method II** – First Principles, uses foundational principles or assumptions from specific disciplines as the basis for a course of action without much

consideration for validation. Going one step further, **Method III – Decision Tree Analysis**, begins to tie in the economics of a decision, and when available, uses known or expected probabilities of different outcomes to determine expected costs of each decision. **Method IV – Benchmarking**, can be useful for monitoring and forecasting, and has some value for making decisions in systems that are well-defined with little natural variability. However, this method becomes less useful as a decision-making tool in systems with a high degree of natural variability, such as those seen in cattle production.

A commonly used method in cattle production and veterinary medicine is the "Evidence-Based Approach" (Method V). Evidence-based decision making aims to apply evidence gained from the scientific method to certain parts of medical practice and production. Many systems have been developed to stratify evidence by quality. In general, these systems all follow a similar hierarchy, with the most valuable and highest quality evidence being derived from properly designed, randomized, controlled trials. Multiple trials following this design can be evaluated together using meta-analyses and systematic reviews to provide an even higher level of quality and value.

As noted above, Method VI – Commercial Field Trial Results, is a subset of the Evidence-Based Approach and utilizes data from commercial field trials as the basis of the decision-making process. This method requires relevant data describing important production variables. Data generated from these trials can then be used to build economic models that accurately simulate all aspects of production to apply a dollar value to each decision. Results from small-pen field trials or trials performed in a research setting are useful for screening multiple options and/or refining the specific hypothesis to be tested in a large-pen commercial trial. The use of the large-scale commercial setting allows for strong external validity, meaning that results are more directly applicable to the production systems used in commercial cattle production. As part of the economic modeling done with the observed results, an economic sensitivity analysis can be performed to further determine the relative value of different decisions in varying production and economic scenarios.

Conclusion

In summary, practical application of epidemiology and an appropriate decision-making framework are crucial to sustainable food animal health and production, and form the basis for establishing long-term productive relationships with commercial producers.

Acknowledgments