Integrated BVD Control Plans For Beef Operations*

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Introduction

More than 60 years ago an enteric disease of cattle was described in North America that was characterized by outbreaks of diarrhea and erosive lesions of the digestive tract.[1] The disease was called bovine viral diarrhea virus or BVD. The virus causing BVD was named bovine viral diarrhea virus (BVDV). Diseases in cattle resulting from infection with BVDV cause economic losses throughout the world. These economic losses are realized through decreased performance, loss of milk production, reproductive wastage, and increased risk of morbidity and mortality. Because of increasing realization of the serious impact that BVDV can have, efforts to control this virus have been steadily increasing. As we learn more about BVDV, there is also an increasing realization that successfully controlling BVDV requires a management program that involves multiple components and is customized to fit the goals and capabilities of each producer. By developing a complete program, the risk of BVDV associated losses can be significantly reduced.

Why Control BVDV –Importance

First, BVDV virus causes significant losses to the cattle industry. Second, we as an industry have excellent tools, some relatively new, to greatly improve control of BVDV. Third, by using planned approaches using these tools for BVDV control and working together as an industry we can utilize these tools to control this virus and thereby increase our ability to sustain cattle businesses and compete in domestic and foreign markets.

Production and economic losses related to BVDV span all aspects of the beef and dairy industries in North America. From a beef herd perspective, costs of PI presence have been estimated to range from $14.85 to $24.84 USD per year per cow exposed to a bull in a published 10 year farm profitability model.[2] A recent feedlot study in high risk cattle found fatality losses of $5.26 USD, performance losses of $88.26 USD and costs of PI exposure in feedlot cattle ranging from $41.84 to $93.52 USD per animal.[3] Production and economic losses can be significant.[2-4]

Losses of productivity, including economic costs, extend throughout all phases of production in cattle enterprises. Pregnancy rates of cow herds with PI calves present have been measured at 5% lower than cow herds with no PI calves present.[4] Immunosuppressive effects of the virus affect animals acutely diseased with the virus. This potentiates losses from secondary infections, including bovine respiratory disease, especially in feedlots, increased risk for neonatal calf diarrhea, and other infectious diseases of cattle.[6-8] Control by individual operations at the cow/calf level can impact all sectors of beef production.

Cattle persistently infected with BVDV are defective individuals who adversely affect other cattle. Control strategies, especially prevention, reduces prevalence of PI animals in cattle populations, also decreasing their effects, costs and risks to individual animal owners as well as the industry as a whole. It is possible that large numbers of the cattle population become exposed during their lifetime even though PI animals are relatively rare.[9] In a recent feedlot study, a 0.4% prevalence rate of PI calves resulted in exposure to 62% of the animals in the feedlot population.[3] Some European countries are engaged in BVD eradication efforts. It is possible that international markets in the future may favor cattle from populations where BVD is eradicated.

Management decisions related to rising priority for BVD control can be made using program approaches that embrace biosecurity and biocontainment principles.[10] Factors influencing selection of specific strategies include past BVD related losses, risk for future BVD related losses, risk tolerance and others.

Relatively new resources, including diagnostic tests, improved vaccines and better developed strategies for disease prevention are key for improved BVDV control, and even eradication, if chosen. Excellent tests utilizing IHC, ELISA and PCR technologies have become readily available to the industry.[11] Vaccine development has focused on prevention of birth of PI calves and vaccines with data and labeling related to PI prevention (fetal protection) are available. Testing alone does not eliminate all risk for BVDV infection and vaccination alone will not prevent birth of all PI calves in the event exposure occurs. Therefore, it is critical that control strategies utilize these resources in a planned, systematic manner to achieve production and health related goals.

Components of a BVDV Control Program

Since the initial discovery of BVDV, intense research has led to a firm understanding of the virus and associated disease. Despite many unanswered questions, our current knowledge is such that successful BVDV control programs have been developed. It is clear that BVDV control needs to be multidimensional and cannot rely on one thing, such as vaccination. Therefore BVDV control needs to be a comprehensive programmed approach. This approach starts with first understanding the virus, its associated clinical presentations and how it might affect an operations productivity or the ability to market animals. With this understanding, producers are better able to analyze risk and therefore make more informed decisions. Second, it involves setting goals related to BVDV control. Thirdly, it involves using the tools currently available for BVDV control to meet those goals.

Importance of Setting Goals

The first step in a BVDV control program is to identify the final goal for the operation. Setting a reasonable target is necessary to insure program success in both the short and long term. Initial goals may range from eliminating BVDV from a herd with an existing problem to keeping the virus from entering a herd that is currently BVDV free. Achieving these two goals may require very different diagnostic testing, vaccination, and biosecurity plans. Therefore, goals should be determined using information about the herd BVDV status, current management practices, and the likelihood of future introduction of the virus (based on animal movement and biosecurity practices). If the herd BVDV status is unknown, a testing strategy to determine the presence of the virus can help optimize the control program.

Due to the nature of the disease, production targets should be based on long-term consequences of the proposed control program. When uncontrolled, the virus can persist for long periods of time in breeding herds due to the production of PI animals. Even after a control program is initiated, elimination of the virus may take until after the next breeding season. Keeping BVDV out of a negative herd is also a constant challenge; therefore, the goals of the control program should be for the long-term health of the herd.

The final step in goal setting is to determine how success will be measured. Objective criteria such as performance measures, reproductive rates, number of health problems, or number of BVDV positive animals can all be used to gauge the changes the control program has made in the herd. Accurate records throughout the process can help provide information on the long-term viability of the control program.

Tools available for controlling BVDV

The tools available for controlling BVDV include a multitude of diagnostic tests for detecting both acute and persistent infections, vaccines available in a variety of combinations with other important disease causing pathogens, and biosecurity practices.

Diagnostic tests - A firm understanding of the disease is required to select the appropriate diagnostic tests, strategies and samples and then make sound interpretations of the results. BVDV diagnostics are used for essentially two reasons. The first is to identify if BVDV is the cause of or part of a clinical problem that has been identified. A variety of diagnostic assays are available for identifying virus in blood samples taken from sick animals or tissue samples taken at necropsy.[12] The most common assays used to detect BVDV in clinically affected animals include virus isolation, fluorescent antibody assays and PCR. In addition, detection of an immune response to BVDV (antibody titers) can be useful in situations where previous information about an animal's immune status is available. The second use of BVDV diagnostic assays, and the most important use in a BVDV control program, is for the identification of PI's. Cattle that are persistently infected with BVDV continuously shed large amounts of virus and serve as the major mechanism to spread the virus in the cattle population. By identifying and eliminating PI's, the risk of BVDV transmission is reduced significantly. Persistently infected cattle can be identified by detecting virus in either blood or tissue samples. Again, a variety of assays have been developed that can be used to detect PI's. The most commonly used sample for identifying PI's is skin. A small notch of skin, often take from the ear, can be submitted to diagnostic labs where different tests can be used to detect virus. Any animal testing positive should be isolated and retested in 3-weeks before being classified as persistently infected. Test most commonly used for screening for PI's include immunohistochemistry (IHC), antigen capture ELISA, and PCR. With the development and refinement of new technologies, such as pooled PCR, the cost of screening large numbers of animals has been reduced significantly, making it increasingly practical for producers to routinely include PI testing in their BVDV control program.

Vaccines - Although no vaccine is 100% efficacious, judicious use of BVDV vaccines is a sound management practice to reduce the risks associated with BVDV infections.[13] Vaccination has a role in preventing acute infections that under some circumstances can result in severe disease. Under stressful conditions cattle are more susceptible to BVDV and suffer more severe consequences. Therefore, in stressed cattle, such as calves entering a feedlot, it is beneficial to induce immunity to BVDV through immunization before onset of the stressful event(s). For reproductive herds, BVDV vaccines should be used to reduce the risk of fetal infection including those resulting in persistent infections. Vaccines for BVDV should be applied in a manner that provides a high level of immunity to the dam just before breeding and throughout gestation. Both killed and modified-live vaccines BVDV vaccine are available; both have been shown to be safe when used according to the manufacturer's label. In general, MLV vaccines are believed to be more effective and should be incorporated into vaccine programs at appropriate times. Vaccines that contain modified live non-cytopathic BVDV should be used with caution in breeding herds as they have the potential of causing persistent infections. Because of their ability to stimulate greater breadth of immunity against the diverse strains of BVDV that may be encountered in the field, vaccines containing both type 1 and type 2 strains of BVDV are recommended.[14] Vaccines are manufactured in a variety of combinations to facilitate incorporation into many different management schemes.

Biosecurity - BVDV control programs need to adapt management practices to prevent or limit the introduction of BVDV into a herd. Biosecurity measures are most important for the breeding herd, but should not be overlooked in fed cattle situations. The goal of biosecurity is to greatly reduce, not necessarily eliminate, the risk of BVDV being introduced into a farm by identifying risks, understanding how important the risks are, and then managing those risks that are most important to BVDV control.

The most common means by which BVDV is introduced to a herd is through addition of cattle from outside the herd. New herd additions may be infected acutely or persistently infected with BVDV. Newly purchased cattle should be screened for the presence of the virus and preferably isolated from the rest of the herd until test results are available. This is especially important when purchasing young stock, i.e. replacement heifers or bulls, as the prevalence of PI cattle is highest in younger animals. An important point to remember is that newly acquired cattle that are pregnant may test negative for BVDV, but their unborn fetus may be a PI (recall that an acute BVDV infection between day 50 and 125 of gestation can result in the development of a PI fetus). Therefore, a comprehensive program should not only test dams, but also test all newborn calves.

Producers that exhibit cattle are at a high risk of bringing BVDV back to their herd. Show cattle should be isolated upon return to the farm for 3-4 weeks. Similarly, other contact with cattle of unknown background should be considered a risk, including sharing of bulls or fence line contact with neighboring cattle.

Semen from acutely infected or PI bulls can be contaminated with BVDV and can serve as a source of virus introduction into a farm. Bulls used in the commercial production of semen for artificial insemination are screened routinely. However, bulls collected privately are often not screened for BVDV.

BVDV is not very stable outside of cattle and is susceptible to common disinfectants. However, virus has been isolated from manure up to 3 weeks at temperatures slightly above freezing (41 F).[15] Thus, precautions should be taken to prevent potential BVDV contaminated objects (boots, vehicles, equipment) from entering a livestock premise.

Other ruminant species, both domestic (i.e. sheep) and wild (i.e. white-tail deer), can become infected with BVDV and potentially serve as a source of transmission. With increasing evidence that wildlife can serve as a reservoir of many economically important diseases, management strategies to limit wildlife interaction with cattle should be considered.

BVDV Risk Analysis and Control

Beef cattle production is in many ways a risky business. One of the risks is disease introduction and the resultant loss of return. Risks are defined by a probability of occurrence and a magnitude of loss associated with that occurrence. The magnitude of loss is termed the impact. We can try to decrease the probability that an unwanted risk happens, or decrease the impact if it does. So for BVDV control there is a probability that BVDV will be introduced to the herd –and there is the cost of disease if it is introduced – the impact. There are also costs associated with attempts to decrease the probability or impact. So there are costs associated with control and costs associated with an outbreak.

Risk analysis is a method to simulate the consequences of different strategies, in our case different prevention strategies in terms of their use in controlling long term economic risk.

The goal then is to identify the most appropriate strategy which is a combination of how much that strategy decreases the risk and how much it costs. It is an interplay of both the biology (how do we change the risk and impact of disease) and how much does it cost us to get that change in risk. One way to look at it from a biosecurity and biocontainment standpoint is that we are attempting to decrease the probability of an outbreak and the magnitude should one occur. That is really a function of risk management in biosecurity and biocontainment.

Risk analysis is a way to identify the most cost-effective management to control the risk from a particular issue. We need to look critically at which practices are effective and economic. A quantitative risk analysis approach is an attempt to try and rigorously look at, what things pay and what things don't. A recently developed risk analysis model was designed to assess BVDV risk and identify optimal management strategies.[16,17]

Specifically related to BVDV, the risk for BVDV introduction into the herd occurs each year dependent upon the management practices of the ranch. There's always some risk that you will introduce BVDV to the herd. The actual occurrence of disease is an occasional event for most herds, but depending on how the herd is managed and what their import profiles are like, the actual amount of risk varies. If we are going to establish a prevention plan those costs add up every year. We will pay for the prevention plan every year to control risk from the occasional outbreak. So how do you balance annual costs of prevention against occasional losses and at the same time account for the complexity of the biological system and the effectiveness and cost of prevention? One way to do that is by a risk analysis process. We need to try and be able to capture an appropriate amount of that complex biology, tie it together with economics, and present it in a way that is helpful in making production decisions for producers and practitioners.

If we import 50 bred heifers every year, the probability that an individual heifer is PI is low, but, multiplied by 50 heifers one could expect about 20% of the time to purchase one PI heifer out of those 50. Over multiple years the probability of importing at least one PI into the herd becomes high. These heifers are pregnant, so you get two animals for each import, a heifer and a fetus. If you buy 50 bred heifers every year the probability that you are getting at least one fetus that is PI is about 25%. If you import 50 bred heifers every year for 10 years, the probability of importing one or more PI BVD heifers or fetuses into the herd over 10 years is over 95%. By participating in the fairly risky practice of importing pregnant heifers, you are almost sure you are going to import at least one PI.

So we are pretty sure we are going to get a PI if we import 50 pregnant heifers every year – but what impact does that have? What affect will that have on our productivity and profitability? Does that impact justify spending on a risk-prevention program? We also have to consider how effective the risk prevention program would be to be cost effective. It has to save more than it costs. Simulation can calculate the average cost of disease over, say 10 years, and compare to the average cost of prevention. Our goal is to look over the long run how risk and interventions affect profitability and determine what our most economic risk management strategies are.

Putting it all together - Simple Targeted BVD Control

The productivity of any farm is impacted more by implementing sustainable disease control programs than by simple possession of information by the decision makers. Thus, each producer is encouraged to determine if BVDV is circulating in their herd. If BVDV is detected in the herd, producers are encouraged to implement appropriate protocols to minimize the negative impact of infection or eliminate circulating virus on the farm. If BVDV is not present in the herd, producers are encouraged to implement appropriate biosecurity protocols to keep their herd free of BVDV. Producers are encouraged to consult with their veterinarian to determine the most appropriate schedule to re-evaluate the presence or absence of BVDV on the farm and reassess the most biologically appropriate and cost-effective control measures.

Selection of vaccination protocols for each farm should be based on (a) risk of disease introduction, (b) reliability of protection afforded by the vaccination protocol, (c) cost of vaccine, (d) cost of vaccine administration, (e) safety of the vaccination protocol, (f) ease with which vaccination protocols are integrated with other management procedures, (g) any temporally associated transfer of animal ownership and (h) effectiveness of communicating the value of prior immunization. While understanding the reliability of protection afforded by vaccination protocols is critical, other listed factors should be carefully considered in selecting a protocol which can be implemented correctly and sustained on specific farms. In conclusion, appropriate management practices and vaccination protocols should be selected specifically for each farm to maximize animal health and profitability in the face of unique disease risk**.**

Summary

BVDV can have a significant effect on all aspects of cattle production. Research has furthered our understanding of the virus, helped develop new diagnostic tools and refine management strategies. Cattle producers now have multiple tools to help in developing a BVDV control program. Successful control and prevention programs integrate multiple tools and do not rely on just one strategy. Successful integrated BVDV control programs will ultimately improve productivity, performance, health, welfare and ultimately economic return.

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