Implementing Biosecurity in Beef and Dairy Herds

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Introduction

The common disease prevention and control practices employed by the majority of beef and dairy herds today are inadequate to meet the future demands. They rely on visual observation, regulatory compliance, vaccination, and limited attention to biosecurity of the herds making animal additions.[1]

Bovine practitioners have been encouraged to increase their participation in nutritional, genetic selection, and financial and production record analysis for beef and dairy herds. Different surveys have indicated that cattle owners continue to look to the bovine practitioner primarily for the diagnosis and treatment of diseases and addressing the needs of the individual animal. Veterinarians can strengthen their position in the decision-making team by providing a herd biosecurity and biocontainment risk management assessment and protocol.

For this article, *biosecurity* will refer to attempts to prevent the entry of pathogens considered potentially harmful to the health and well-being of the herd. Practitioners are encouraged to expand the principles to include such things as genetics and nutrients. *Biocontainment* will refer to controlling the elements within a given population of cattle. Biocontainment strategies should apply to the management of epidemics within a herd and should address biosecurity failures.

Disease Impact

The impact of introducing and/or controlling certain pathogens within a cattle herd is dependent on producer marketing strategies. The commercial herd where ownership is retained to slaughter will not have the same concerns about infectious bovine rhinotracheitis as the herd that provides animals for international trade. When estimating the impact of a disease, one needs to integrate the estimated risk and economic consequences.[2] The loss of marketing options can severely impact economic opportunities.

With increased scientific information available on the pathogenesis, transmission and diagnoses of diseases such as bovine virus diarrhea (BVD),[3] leptospirosis,[4] paratuberculosis (Johne's), bovine Herpesvirus-1 infections[5] and others, the liability associated with selling infected animals will increase. Recently, a veterinarian denied sale of a group of yearling cattle known to have had previous mucosal disease mortality. He required that the remaining cattle be screened for persistent BVD infection. The screen identified 8 of 134 animals as persistently infected. Two of these animals died 2 weeks after being identified. This type of situation could occur from infected or contaminated replacement breeding stock, semen, colostrum, or other marketing options. Dorn recommended that if a person has purchased animals from a herd or has a herd containing animals tested positive for 0157:H7 *E. coli,* they should only sell tested negative animals for breeding stock.[6]

Pathogens considered in most herd biosecurity and biocontainment programs include *Anaplasma marginale*, bluetongue virus, BVD, BHV-1, bovine leukosis virus (BLV), *Mycobacterium paratuberculosis, M. bovis, Brucella abortus,* BHV-4, *Salmonella* sp., rotavirus, coronavirus, *Moraxella bovis, Staphylococcus aureus, Streptococcus agalactiae,* vesicular stomatitis virus, parasites (coccidiosis, cryptosporidiosis, lice), fungal infections, and genetic diseases.

Many production units are involved with international trade and need advice on diseases that will limit their access to markets. The Office of the International Epizootics (OIE) is the focal point for international disease reporting.[7] The OIE list A diseases are 15 highly contagious, notifiable animal diseases capable of crossing frontiers and thus becoming a threat to those countries either planning on or already engaged in international trade. They are either immediately reported to the OIE when they occur in a country or a zone regarded as free from the disease, or are detailed in the monthly report of the country concerned.

List A diseases are foot-and-mouth (FM), vesicular stomatitis (VS), rinderpest, peste des petits ruminants, contagious bovine pleuropneumonia, lumpy skin disease, Rift Valley fever, bluetongue, swine vesicular disease, sheep pox and goat pox, African horse sickness, African swine fever, hog cholera, fowl plague, and Newcastle disease.

OIE list B comprises 96 diseases considered important to the national economy and which have significant effects on trade. Those associated with cattle are anaplasmosis, babesiosis, bovine brucellosis, bovine genital campylobacteriosis, bovine tuberculosis, cysticercosis, dermatophilosis, enzootic bovine leukosis, hemorrhagic septicemia, infectious bovine rhinotracheitis (IBR), theileriasis, trichomoniasis, trypanosomiasis, bovine malignant catarrhal enteritis, and bovine spongioform encephalopathy (BSE).

Management Assessment

Control of contagious animal diseases is a major concern of most beef and dairy producers. The choice of control methods eventually lies with the manager of the herd. Decisions vary widely depending on the attitude of the manager. Improved insight into the risks and potential consequences of certain management practices may promote a more thoughtful approach.[8]

Nielen, *et al*[9] found that the average Netherlands livestock farm during the winter had 92 contacts every 2 weeks. Many of these were social but over 25% resulted in contact with livestock. Swine operations had considerably fewer contacts than cattle or combined swine and cattle operations.

If veterinarians had information on the risks to the health of the herd that certain types of management represents, they could target education and prevention strategies. James, *et al*[10] suggests that acceptance of sound beef health programs could be improved by developing a greater awareness of producer motivations. How managers combine their strategies, goals, and actions vary and are manager specific.[11]

One should attempt to assess the acceptable risk for a unit. Acceptable risk is a management decision about the permissibility of hazard or the level of risk management is willing to accept. Risks associated with abortion, pregnancy rates during infection, duration of infection, delayed heat, risk of congenital defects, reduction of feed intake and milking ability, effect on marketing, legal liability, and mortality rates should be considered.

During the management assessment, assigning a biosecurity level (Table 1) to the herd may be helpful for communication and data management reasons.

Table 1. Levels of Biosecurity

1—Closed herd [specific pathogen-free (SPF) herd]
2—No entry or reentry of animals
3—No entry of new animals but reentry allowed
4—Entry of new animals (known medical records) and isolation
5—Entry of new animals (known medical records) and no isolation
6—Entry of new animals (no medical records) and no isolation

Environmental Assessment

Sources of pathogens from infected animals include feces, urine, nasal and ocular discharges, saliva, exhaled breath and sputum, milk, semen, uterine fluids, fetal tissues, blood, and tissues from live and dead animals. These sources provide the pathogens that can contaminate the environment. Feed and water supplies, including pastures and natural water reservoirs, feeding utensils, manure disposal sites, the air in barns, bedding, ground surfaces, equipment used in the handling and management of animals, and streams and rivers, can all act as contaminated environments. They also are the source of pathogens for intermediate and amplifier hosts that are involved in the transmission of some infectious diseases.[12]

Disease management strategies are facilitated by mapping the pasture and holding areas, water sources, drainage, housing, feed and grain source and storage, and temporal placement of cattle. These can include recommendations on avoiding areas with high concentrations of parasites such as coccidia.[13] When possible, document any unique trace element levels for the region. For example, use of high selenium areas can lead to decreased conception rates and/or weak and unthrifty calves.[14]

The establishment of isolation areas have been shown to be effective in controlling diseases and should be used for potential herd additions and diseased animals. Visually evaluating the planned use of housing prior to calving or weaning will allow the veterinarian an opportunity to point out ways to avoid previously documented or potential health problems.

An assessment of contact with other groups of cattle, exotics, and wildlife should be conducted. *M. bovis* is a re-emerging disease. Many infected animals have been in contact with exotic hoofstock carriers. One should not permit their direct contact with domestic cattle.[15] The history of fencing problems with neighboring cattle should be determined.

Herd Assessment

It is advisable to determine the status of the herd in relation to the pathogens and diseases under consideration prior to implementing a biological control program. Programs to prevent the entry of a disease condition already present in the herd or to eradicate a non-existing pathogen are not uncommon. To establish a baseline for the disease prevention, health records including diagnostic laboratory findings and clinical observations are needed.

The relevance of serology in disease diagnoses is debated at all levels, but serology remains a tool available to the practitioner. Vaccination histories and the longevity of antibodies are important in interpreting serologic test results. Repeated tests usually are necessary for reasonable interpretation.

Much of the debate about the limited value of serology[16] focuses on individual(s) and not on herds. Profiling herds seroconversion over time could contribute significant insight as to pathogen activity in a population. A serum bank can be established by filling semen straws with serum and storing in a minus 70 degrees C freezer for future reference. Serum can be retrieved and the straws re-frozen. Serum could be collected on animals such as herd additions when complying with regulatory requirements. Over time, this could be an invaluable service offered to clients.

Biosecurity Entry and Reentry

The Animal Disease Research Institute at Lethbridge (ADRI-L) in southern Alberta has developed and maintained a specific pathogen-free herd since 1984. This herd serves as a model for biosecurity and surveillance without vaccination in a beef herd.[17] This type of intensive management would be practiced rarely, but the procedures provide many examples of how to lower risk factors for traditional cattle herds.

Table 2 provides a list of potential contacts to consider when assessing herd biosecurity. The ages of animals entering the herd should be considered when assessing risk. The younger the animal, the higher the probability of it being persistently infected with BVD or naive to the BVD and BHV-1 viruses.[13] Johne's screening tests now being used are more sensitive for animals over 3 or 4 years of age. Younger animals are more likely to be carriers of rotavirus, coronavirus, and parasitic diseases such as coccidiosis and cryptosporidiosis. They are more susceptible to nematode infestation.

Brunner[18] suggests the purchase of bred dairy heifers, not cows. He states they are easier to isolate upon arrival than milking cows. However, this may not be the same for a beef herd concerned about the entry of Johne's or BVD.

Table 2. Biosecurity Considerations

Herd additions:	
	Calves
	Open heifers/cows
	Bred heifers/cows
	Bulls
	Cow/calf pairs
	Embryo recipients
	Semen
	Colostrum/milk products
	Feed
Herd traffic (in/out):	
	Embryo transfer units
	Semen collection facilities
	Personnel
	Equipment
	Vaccines
Waste management:	
	Spread of fertilizer
	Rendering

Bulls are common beef herd additions. Consideration should be given to introducing only virgin bulls and/or use of artificial insemination with semen from bulls of the highest health status. All bulls should be cultured for *Tritrichomonas foetus* regardless of age.[19] Polymerase chain reaction assays have been shown to identify *Leptospira* spp., BVD, and IBR in bull semen.[4,5] Embryos are the preferred method for introducing germplasm into herds when preventing the spread of infectious diseases is a primary concern. Only cows that pass the strictest health tests should be used as embryo recipients. If the policy stated in the *Manual of the International Embryo Transfer Society* is followed, biosecurity should be assured.[12]

Independent and state-sponsored heifer development programs should be closely monitored to assure that adequate disease detection and control practices are provided to avoid major health problems. Guidelines should be formed for risk communication and avoidance for herds involved beyond the regulatory health requirements and vaccinations. A strategic plan for reentry of these commingled animals should be provided.

Isolation and Quarantine

Health certificates provide a path to retrospectively document responsible parties. When purchasing animals, one should always require regulatory compliance. However, issuance of a health certificate cannot be considered absolute assurance that the animal(s) is disease free.

Acquiring a medical history of the source herd is rarely done in the cattle industry. The purchaser, with the assistance of his/her veterinarian, should document through the seller and/or the attending veterinarian the status of the source herd in relation to diseases of concern. With the increased concern over disease spread and the difficulty in identifying carrier animals with diseases like Johne's, the attending veterinarian can be placed in difficult situations.

The type of biosecurity policy and vaccination program the source herd follows should be no less strict than that of the buyer. The vaccination protocol and special testing requests of the buyer should be performed 21 days prior to shipment.

Some isolation and quarantine management practices for consideration are listed in Table 3. The age of the additions, vaccination history, health status of the source herd, and susceptibility of the receiving herd will all influence the need for specific isolation recommendations.

The identification of inapparent carriers of pathogens can be costly, time-consuming, and difficult to accomplish. The pathogens most commonly screened for include Johne's, BVD VI, leukosis, bluetongue virus, anaplasmosis, brucellosis, salmonellosis, and *Mycobacterium bovis.*

The use of the Johne's ELISA, and/or fecal culture are the most common screening techniques used for this infection today. The ELISA is not very sensitive for young non-clinical animals. The fecal culture also lacks sensitivity in this same group and takes 16 weeks to perform. Purchasing animals from a herd in the voluntary Johne's certification program that is at or above the buyer herd level is advisable.

Table 3. Isolation/Quarantine Management

* Length 60 days
* Strict control of contact (traffic, fencing)
* Identification
* Serum bank
* Vaccinate on arrival for IBR, BVD, lepto, campylobacter
  * Re-vaccinate 30 days prior to herd entry if required
* Internal (1) and external parasite control
  * Consider repeat in 21 days
* Fly control when appropriate (tags, sprays, pour-ons)
* Consider placing an ionophore in the ration 30 days prior to entry and the use of prophylactic antibiotic treatment
* Test 30 days prior to entry for carriers of pathogens of special interest

Bovine virus diarrhea carriers can be identified by virus isolation, ELISA screen,[13] or polymerase chain reaction (PCR) testing. Some animals that have been shown to have BVD antibodies are negative on virus isolation, but positive on PCR. When pregnant cattle are added, the infection status of the calf should be determined at birth.

Entry of persistently infected animals is not the only concern. Single insemination with semen from a bull tansiently infected with the BVD virus has been shown to precipitate viral transmission throughout the female population.[20]

After an epidemic of BVD in 1993, a survey of management practices of Pennsylvania dairy producers was conducted.[21] The biosecurity factors considered in the survey included if the producer participated in shows and fairs, purchased replacement animals, and isolated replacement animals. It was found that over 40% of the herds purchased animals and did not isolate. Over 50% added replacement animals with unweaned calves being the most common.

Eighty-two percent of the Pennsylvania dairy producers stated they routinely vaccinated their herd, but it was found that only 27% adequately vaccinated. Forty percent of the inadequately vaccinated herds fell in the group that added replacements and did not isolate. It was found that the larger the herd, the more apt it was to adequately vaccinate. All lactating dairy replacements should be cultured twice at a 2 week interval for contagious mastitis pathogens, i.e. *S. aureus* and *Streptococcus agalactiae,* before they are put into the regular milking string.

IBR is routinely controlled through vaccination. It is important that the herd additions and the nucleus herd are both adequately protected prior to commingling. An IBR virus isolated from the semen of a bull was inoculated into susceptible cattle using different routes. Cattle artificially inseminated did not develop clinical signs, but did transmit the virus to contact cattle. The isolate induced severe signs of rhinotracheitis and vulvovaginitis in cattle that were inoculated by the intravaginal, intranasal, or intravenous routes, but the fetus was not infected. It is hypothesized that this strain may be a transgenic mix of field and vaccine strains of the virus.[22]

Evidence from a study in the Netherlands suggests that the vaccine virus from a temperature-sensitive live virus vaccine may be transmitted to susceptible animals.[23] Polymerase chain reaction tests have been used successfully to identify IBR virus in bull semen.[5]

Timing of Herd Additions

A survey of 551 cow/calf producers in NE, CO, ND, and SD[24] was conducted in 1994 to assess management factors affecting the incidence of calf diarrhea. Herds that introduced purchased animals during the calving season, including pregnant females, cow/calf pairs or calves, had higher rates of calf scours than herds that did not introduce purchased animals during the calving season. Calves were more commonly introduced during the calving season than females or pairs, and are grafted by producers onto cows that have lost their own calves. However, the association applies to all introductions of animals during the calving season. Heifers' calves had higher rates of scours than those of adult cows. Calves in herds with heifers vaccinated against common scour causing viruses had a higher rate of calf scours than those with unvaccinated heifers.

The introduction of animals prior to calving was not associated with a greater risk of calf scours. It was suggested that any introductions of pregnant females or cow/calf pairs should occur prior to the beginning of the calving season. In addition, if the introduction of calves for grafting is economically important, then management to prevent scour problems may be required. Appropriate management might include the use of isolation or quarantine facilities during the calving season, and only purchasing calves from a single, known source.

Figure 1 illustrates how the trimesters of pregnancy overlap when a 60 day breeding season is scheduled. This potentially places a certain percentage of the cow herd in each of the trimester for 5 months. This provides approximately an 80 day post-calving period with calves from 21 to 82 days of age at the start of the breeding season. The most appropriate time to make herd additions or commingle groups may be when the youngest calf is >3 weeks of age. In this example, it would be around the start of the breeding season. From this, one can visualize the potential susceptibility of fetuses with the use of longer or shorter breeding seasons. The fetal immune system is developed significantly at 200 days. In this example, all fetuses will be at last this age 3 weeks prior to the start of calving.

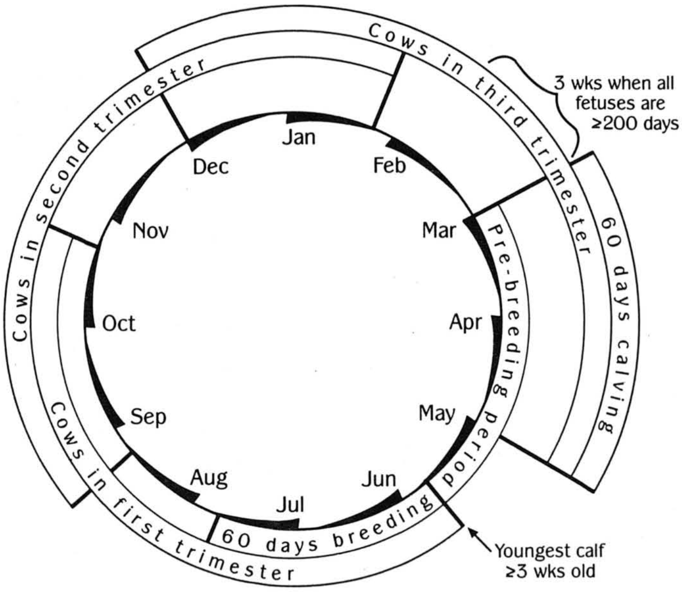

Figure 1. Overlap of trimesters of pregnancy using a 60 day breeding season.

The advantages and disadvantages of a tightly managed breeding season have commonly focused on marketing, labor, and environmental factors. The length of the breeding season and improved first service conception could influence the success of risk management for avoidance of particular diseases.

Biocontainment

Biocontainment in cattle production units commonly involves the control of enteric, reproductive and/ or respiratory pathogen(s) within segments of a herd. The cattle industry appears to rely on new feed additives or biologicals to control the situation. The veterinary practitioner is challenged to think outside the traditionally accepted practices to improve disease management.

Immunizing and managing to reduce stress in a verifiable manner should be standard components of the herd health programming. For the cow/calf producer, it should be the primary health management practice for the breeding herd. It should not be considered any different than adequate nutrition, genetics, etc.

Biocontainment practices can be difficult to implement as they frequently require change from traditional practices. One should consider cleanliness and facilities for restraint, treatment, and isolation. Cross-contamination with water, manure, feed, equipment, etc. from other groups of cattle occurs frequently when the same help is responsible for different groups of cattle in the feedlot and/or cow/calf herds. This can be reduced by starting activities with the highest health status first (young calves), then older, and sick calves last. **Use strict sanitation practices if personnel must go back to any group.**

Managing the group size, age distribution within groups, and calf flow can significantly reduce the risk of a disease outbreak in feedlots, cow/calf herds, and dairies. Developing a clear protocol to be followed in the face of an outbreak can reduce losses.

When attempting to control neonatal calf diarrhea in a beef herd, one should consider rotating the feeding and bedding areas of the cows during the winter to avoid pathogen buildup.[25] Rotaviruses and coronaviruses[26] have been shown to be carried and transmitted through environmental contamination by adult carriers. Cows should not be moved into the calving area more than 2 weeks prior to the start of calving. This helps avoid unnecessary spread and buildup of pathogens.

Figure 2 represents a typical calving flow chart. The post-calving area in most calf flow schemes creates an hourglass effect that exposes most calves to pathogens in the herd. This area frequently is a holding area to assure the calves and cows are not experiencing complications prior to turning them into a larger area. The post-calving area has been eliminated in Figure 3.

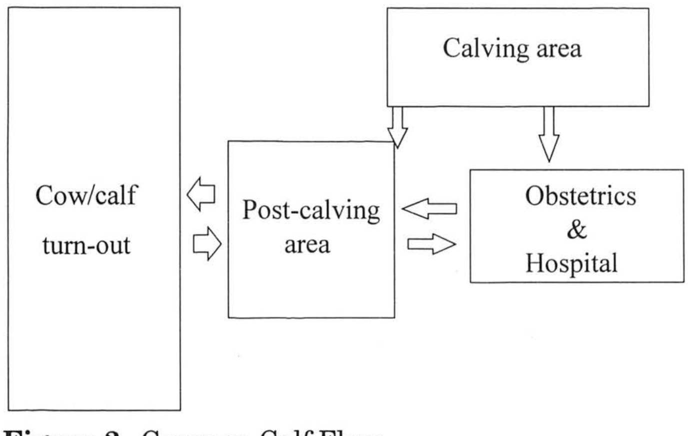

Figure 2. Common Calf Flow

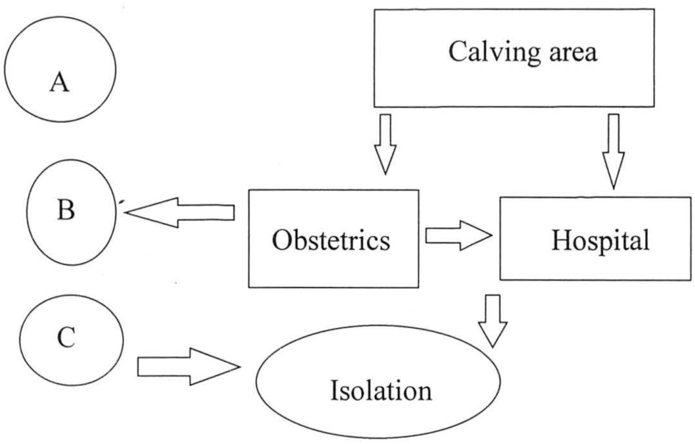

Figure 3. Proposed Calf Flow

A restraint area is usually an all purpose facility. It is used for OB assistance, milking and bonding, injuries, weather shelters, navel ill, scours, and respiratory disease treatment. The parturition process is natural and should not be considered an unhealthy event.

A separation between the calving restraint area and a hospital area is recommended as depicted in Figure 3. Cattle that enter the hospital area should go to an isolation area and not commingle with the original group until the youngest calf is at least 3-weeks-old.

The cow/calf pair should be removed as soon as possible from the calving area into a pre-breeding group. This group should be managed in an all in/all out style. Once the group reaches and acceptable number, it is closed. The calving area should be rotated or designed to prevent pathogen buildup.

Health Monitoring

The resources required for maintenance of the biosecurity and biocontainment program will vary from herd to herd. Regular review of the protocol, facilities, environment, records, and goals of the herd managers should be conducted by the bovine practitioner.

Necropsies should be performed on all deaths of unknown cause and accurate documentation provided for all health related situations. Health monitoring may include the use of serological screening, sentinel animals, and visual walk through of the operations.

Conclusion

With the increased emphasis on a global market, quality control, market share, and producer accountability, disease prevention and control will gain increased attention. The bovine practitioner has a greater opportunity to serve the cattle industry than any time in the past century.

The five most common veterinary services requested by producers have been shown to be, in order of importance, individual animal diagnosis, providing drugs and vaccines, vaccination consultation, reproductive consultation, and assistance in managing herd health through whole herd diagnostic services.[1] These services can be coordinated and strengthened through individualized herd biosecurity and biocontainment programs monitored by the bovine practitioner.

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Abstract

Ultrasonographic findings in cattle with pleuropneumonia

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The clinical, ultrasonographic and radiographic findings in three cows and one bull with pleuropneumonia are described. All the animals had fever, indigestion, tachypnoea and abnormal lung sounds. Percussion of the thoracic wall elicited signs of pain and tests for foreign bodies were positive. Ultrasonographic examination revealed an accumulation of anechogenic to hypoechogenic fluid in the pleural space in the ventral thorax of all the animals. In one animal, echogenic bands of fibrin were observed between the thoracic wall and pulmonary surface. In another, parts of the right lung were not inflated because of severe bronchopneumonia. Radiographic examination revealed a pleural effusion, apparent as a horizontal fluid line, in three animals. In addition, the increased radiopacity in parts of the dorsal lung fields and increased bronchial and peribronchial markings suggested bronchopneumonia. In three animals, the radiographs revealed linear foreign bodies in the reticulum, suggesting that the pleuropneumonia was caused by the penetration of the foreign body into the thoracic cavity. A diagnosis of pleuropneumonia was made in all the animals of the basis of the clinical, ultrasonographic and radiographic findings and the analysis of the pleural fluid. The diagnosis was confirmed at slaughter in three of them; the fourth animal was treated and was clinically healthy when it was discharged.