An introduction to biosecurity of cattle operations

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The emphasis of this introductory article is to familiarize the reader with the terminology and broad concepts of biosecurity and biocontainment. This issue of the Veterinary Clinics of North America: Food Animal Practice has been prepared to provide a framework of considerations in developing biosecurity plans focused on various types of disease agents that may be introduced into or spread within cattle operations.

Definition of biosecurity and biocontainment

Biosecurity is the outcome of all activities undertaken by an entity to preclude the introduction of disease agents into an area that one is trying to protect [3,7]. For example, entities involved in developing biosecurity plans range from the national government to an individual farm operator and include all the levels in between. Disease agents of interest may include infectious agents and noninfectious agents such as toxicants. The area being protected by a biosecurity plan might be the nation, a region, or a local farm operation. The control of disease agents that are already present on a farm operation (e.g., precluding the transfer to new groups of animals) is usually called biocontainment.
Historical perspective and background on biosecurity

Interest in and discussion of biosecurity have expanded immensely in recent years. Much of this heightened awareness has been driven by world events, such as the occurrence of bovine spongiform encephalopathy in the United Kingdom and outbreaks of foot-and-mouth disease around the world. Other trends that have stimulated more interest in biosecurity are the changing demographics of agricultural operations, the disease agents being considered for control, and other concerns about the use of disease control technologies in livestock operations. Cattle operations in the United States continue to grow larger. In many cases, especially for dairy operations, the rate of expansion of individual operations is beyond what can be supported by internal replacement, so operations have been forced to introduce animals or, in some cases, whole herds from outside sources into their existing production system. Furthermore, cattle operations have become more specialized, focusing on the production of beef or milk and purchasing more of their inputs, such as feeds, from other specialized operations. The reliance on external inputs to the system leads to a loss of direct control of the production of those inputs and the potential that those inputs contain disease agents such as *Salmonella*.

Some of the disease agents of interest, including respiratory pathogens, require a multifaceted approach to control. Some infectious disease agents, including certain clostridial diseases, have been controllable using a single strategy such as vaccination. There are no effective vaccines, however, to protect against disease agents such as *Mycobacterium avium* subsp. *paratuberculosis*. This also applies to many of the food safety pathogens, including *Salmonella* spp. and *Escherichia coli*. To deal with disease agents in the harvest and postharvest arena, the Hazard Analysis and Critical Control Point (HACCP) approach has been adopted.

There is also concern regarding the use of chemical agents for the control of diseases and production in livestock populations. Antimicrobial resistance is a growing issue in human clinical medicine [1,4,5]. The role that antimicrobial use in animals plays in the emergence of resistant human pathogens is unknown; however, livestock producers and veterinarians are being encouraged to use antimicrobials judiciously to preserve the effectiveness of antimicrobials in veterinary and human health care settings [2]. Part of the judicious-use principles call for an emphasis on disease prevention. Disease prevention activities take into account the epidemiologic triad for disease occurrence. The triad consists of the individual host or animal, the disease agent, and the environment. One must recognize that the activities that affect the arms of the triad are potentially synergistic. Activities directed at improving specific or nonspecific immunity of the host may improve the ability of the host to resist the introduction of the agent if exposure occurs. Activities directed at the agent are primarily meant to limit the exposure of the host to the agent. Activities directed at environmental management also limit the potential risk that the agent will be sustained in the environment at an adequate level to result in animal disease. All of these activities are potential components of a biosecurity plan.

Most of the well-defined biosecurity programs in which livestock producers and veterinarians have become involved up to the present time have been those organized or mandated by government agencies. Examples include the tuberculosis, brucellosis, hog cholera, and pseudorabies eradication programs. For these programs, there was a broadly based conviction that the producers’ livelihoods and the public were best served by organizing, funding, and enforcing strict disease control guidelines through government intervention. Similarly, considerable effort and resources are applied toward maintaining national freedom from numerous foreign animal diseases that currently are not present in the United States. For the numerous reasons just cited, it seems that circumstances are developing that make voluntary, producer-specific biosecurity programs increasingly attractive. Such individualized programs could be beneficial to the producer. One clear benefit of well-designed health management programs that incorporate biosecurity and biocontainment principles is the reduction of costly disease problems and enhancement of productivity and profitability. Beyond that, food safety concerns and the development of trace-back systems and accountability systems may provide additional compelling reasons for producers to document that risk reduction steps have been implemented, similar to the HACCP programs used by food processors. These efforts may be particularly important for producers seeking new markets for their livestock and other products. A challenge for the future will be analyses of cost-benefit and risk-benefit ratios for specific disease or pathogen reduction programs.

The concepts of biosecurity are not new. Without question, technological advances in the areas of vaccinology, therapeutic drugs, and diagnostic testing have improved our ability to control disease immensely. Even before these recent advances, however, there were remarkable efforts and successes in the control of some diseases. In 1892, contagious bovine pleuropneumonia was eradicated from the United States [6]. This eradication occurred 6 years before the etiologic agent was identified as a *Mycoplasma* organism. Such success was dependent on exploiting knowledge of the epidemiology of the disease in the natural setting.

With the availability of effective vaccines and therapeutics, perhaps practitioners have become too reliant on disease control that comes in a bottle as opposed to concentrating on the other components of disease control. Areas that must be considered include the health status of animal introductions (temporary or permanent); the quality of feed; the quality of animal drinking water; the risk posed by exposure to wildlife; the risk posed by caretakers, service providers, and visitors; the risk posed by arthropods; the role equipment may play in the introduction or spread of disease agents; and the risk of wind-delivered pathogens.
The development of a biosecurity plan for a cattle operation can be likened to HACCP or a risk-analysis activity (Table 1). Development of the plan should commence with a risk assessment in which the problems or agents of concern are identified, their likely effect is quantified, and the likelihood of their introduction is estimated. Based on this exercise, a prioritized list can be made for the disease agents of most interest. Subsequently, a targeted risk management plan can be developed for those agents of highest priority. The success of the plan can be ensured only if there is adequate risk communication activity. Risk communication includes communicating the management plan to all levels of the production team and to the suppliers and the customers. The production team has an obvious role in carrying out the biosecurity activities and in communicating any changes to the plan that are needed. Suppliers of feed and other products must be partners in the management plan so that disease agents are not inadvertently introduced with inputs to the operation. Customers can be partners in the biosecurity plan in that there may be marketing advantages for the animals or products produced under a good biosecurity plan. The operation supplying the animals becomes the source (supplier) for the next phase of the chain, whether the product is in the form of seedstock or replacements or even food and other products.

Clearly, the biosecurity plan must be individualized for each operation. Each operator has a different set of concerns and different perceptions of risk. Each individual production unit also has its own windows of vulnerability. The following articles in this issue of the Veterinary Clinics of North America: Food Animal Practice present a few of the concepts to be considered in developing a biosecurity plan based on the body system and age of the animal or means of disease agent transmission. Certain articles are meant to present some of the overarching principles of a biosecurity plan.

References


