Consultant's Corner: Immune System Activation

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Controlling and preventing disease in livestock production has always been a challenge. Over time, we have developed production strategies, vaccines and antibiotics to help manage the effects of disease. Furthermore, our knowledge and understanding of the immune system continues to expand, helping us to better assess the effects of disease. But even armed with today's technologies, disease must be managed, since we are learning that it cannot entirely be eliminated.

Disease elimination has long been a goal of the livestock industry, just as it has in human medicine. Why is this? We know that disease within a population, whether it is livestock or human, carries with it the cost of morbidity and mortality. Morbidity — the relative incidence of disease within a population — is sometimes described as the "level of disease" when we look at animal populations. Costs associated with morbidity are treatment, increased feed requirements, decreased performance, increased facility costs and suboptimal market revenues. Morbidity can be an insidious cost as it is more difficult to quantify than mortality costs.

In contrast, mortality is easily quantified by even a rudimentary record system. It is shocking that some pork producers do not know the mortality rate in their herds. Costs associated with mortality are treatment, increased feed, labor and facility needs, lost revenues and carcass disposal.

MOVING TARGETS

Disease elimination is a noble goal, and in fact, is possible to a degree. Some pathogens can indeed be eliminated from a population or an area. The population may be as small as one group of animals (e.g., a cesarean-derived litter) or as large as the entire population within a geographic area (e.g., hog cholera eradication from the United States). However, we cannot eliminate all potential pathogens from our swine herds. A good example is the presence of *Strep. suis* in segregated early weaning (SEW) pigs.

The other reason we always will have to manage disease is because living organisms are continually moving and changing. Pathogens move or are transported into susceptible populations on incoming animals, people, vehicles or even the air. Bacteria and viruses may change or mutate to become pathogenic. Certainly the Porcine Respiratory and Reproductive Syndrome (PRRS) virus makes us aware that biology is dynamic. Consequently, there is no such thing as a truly "disease-free" pig in commercial pork production. While we may strive to attain disease-free status in certain populations, nature will continue to challenge us with infectious organisms.

Several major health-oriented pork production strategies have been used over time to control or eliminate disease. One of the earliest was simply to farrow seasonally and rotate pastures. This was done somewhat out of necessity to avoid problems associated with the weather, but also provided for group animal flow and elapsed time between groups. This production flow technique still can be used to produce replacement animals that are free of certain diseases (e.g., pseudorabies) if they are weaned at the proper age and moved into a controlled environment free of the targeted pathogen. This sound disease-control method is still a major component of all-in/all-out (AIAO) and group systems.

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The Specific Pathogen Free (SPF) program, started in the late 1950s, was a revolutionary

approach to producing breeding herds free of certain diseases. The term "disease-free" was used initially, but "specific pathogen free" was adopted a few years later. The strategy was to start new high-health herds from hysterectomy-derived pigs, which would create both a high-health breeding herd and high-health finishing pigs. This is still the objective today, and it is still a viable program. The challenge lies in the fact that it is difficult or impossible to keep all pathogens out of a swine herd. Over time, breeding herds tend to acquire more diseases and the health status of finishing animals shifts to that of their dams.

Another major strategy is medicated early weaning (MEW), which can eliminate from offspring certain diseases that are present in the dam. The MEW technique has led to other technologies such as modified MEW and SEW. MEW initially was developed for production of high-health breeder animals, but can be applied at the commercial level as well. MEW utilizes extensive vaccination, medication and weaning of very young pigs (5-8 days old).

Because of the intensive MEW protocol, SEW, which focuses on the physical separation of pigs and dams to avoid disease transmission, is more typically implemented at commercial operations. Normal breeding herd vaccination protocols are followed and some medications may be used on pigs. Pigs usually are weaned at 10-12 days of age. This strategy relies on providing good colostral and lactogenic protection to pigs so they can be weaned free of certain pathogens. However, since there is contact with the dam and all pigs do not have the same level of maternal antibody protection, disease levels in SEW pigs may vary from one group to another. Also, the pigs are exposed to internal parasite ova and external parasites if present in the dam.

Production strategies — from early strategies as simple as nomadic movement to today's technologies of SEW, AIAO and multiple-site production — have played an important role in managing the economic impact of diseases in swine operations. These strategies will continue to be refined and implemented at the commercial level — but they represent just one aspect of health management.

SEW is being used to help avoid disease transmission. Providing good colostral and lactogenic protection to pigs is essential for success.

IMMUNE SYSTEM ISSUES

Another aspect of health maintenance is management of the immune system.

The immune system is activated as a result of exposure to an antigen. Many compounds are antigenic and can stimulate the immune system. For example, the antigen could be a nonpathogenic or pathogenic bacteria or virus, an antigen in a vaccine, a feed protein or an aerosolized bacterial endotoxin. Consequently, the immune system is continually processing antigens.

The type of antigen determines the clinical signs observed in the exposed animal. For example, a nonpathogenic bacteria or a vaccine antigen may have relatively little or no deleterious effect on the animal, while exposure to a pathogenic antigen could severely affect the animal's performance. Sickness and death may occur before the disease is controlled by immune system response or therapeutic intervention.

Allan Schinckel and a team of researchers at Purdue University have conducted research on the effects of SEW treatment (with extensive vaccination) and conventional treatment on the performance of pigs. We know that when the immune system is activated by any means (vaccination, field virus, etc.), a series of events occurs. These events consume a certain amount of energy, and this use of energy may decrease performance. How much of the decrease in perform-

ance is due to immune system activation, and how much is due to the deleterious effects of disease on organ systems (e.g., tissue damage from infection) has not been determined. We know that disease negatively affects performance, but we have not quantified how much of this negative effect is due solely to immune system activation.

Consequently, the second aspect of health management is controlled stimulation of the immune system. We accomplish this with a properly designed and executed vaccination program. Gone are the days when everybody vaccinated for everything. In today's well-managed swine herds, the veterinarian helps the producer choose the best-quality vaccines that are appropriate for his herd. This selection is based on previous diagnoses and an assessment of biosecurity risks. Effort is made to minimize the number of injections and antigens, while providing suitable protection. We know that introducing disease to susceptible herds can be devastating. This is most apparent in high-health-status herds that have no immunity from previous natural exposure.

The third aspect of health management is antibiotic intervention. Even with sound production schemes and appropriate vaccination programs, there are cases where animals need antibiotic therapy. Production systems have biosecurity failures and unexplainable introduction of pathogens. And herds may suffer from outbreaks of diseases for which there are no vaccines. In these cases, the veterinarian needs to help the producer implement treatment programs based on proper pharmacological principles and appropriate withdrawal periods.

In summary, a comprehensive health management program is comprised of three major facets:

- Design and implement the production system to minimize the economic effects of disease. Organize animal group flow to reduce the impact of organisms inherent to the herd. Design the biosecurity program to restrict introduction of pathogens into the herd.
- Base the vaccination program on need and risk-benefit analysis using the highest-quality products available. The program should be intended to contain costs while reducing exposure to constant or catastrophic losses.
- Use antibiotics or anti-infectives strategically to control disease occurrences. They should be applied appropriately based on sound diagnoses and pharmacological principles.

The swine specialist can advise his or her clients in all three of these areas. Working as a team, they can position the producer's swine operation as a functional pork production system and a profitable business entity. ■