The value proposition for precision livestock farming applied to swine disease management.

Dr. Derald Holtkamp, MS, DVM

MSD
Animal Health

By now, everyone is familiar with the phrase precision livestock farming. I will resist the temptation to state a definition from Wikipedia or other sources since there is no agreement on a standard definition for precision livestock farming. However, precision crop farming is arguably more advanced than it is for livestock, and many of the applications of precision crop production have been directed at managing plant diseases. In this article, the value proposition for precision livestock farming applied to swine disease management is explored.

The Value of Knowledge

Economics is the study of how individuals and businesses make resource allocation decisions. Pause a moment and contemplate how you, your clients, or your employer decide to allocate resources to animal health inputs (e.g., vaccines, antimicrobials, biosecurity investments, etc.). What information do you rely on, and how good is that information? How much money is at stake if you make a poor decision?

When economists attempt to model businesses' resource allocation decisions, given the business's objective is to maximize profit, they sometimes assume the decision-makers have perfect knowledge, which simplifies their models. In theory, perfect knowledge leads to perfect decisions for maximizing profit. Imperfect decisions leave money on the table. In the context of animal health input decisions, a swine producer has nearly perfect knowledge if they know exactly how much disease is occurring, how much it costs the business, and how much animal health interventions, such as a vaccine or antimicrobial, reduce the cost of disease. In the real world, producers never have perfect knowledge. Arguably, producers and their veterinarians currently have a relatively poor understanding of how much disease is costing and, consequently, a poor basis on which to make profit-maximizing decisions. This is true even in countries with relatively good diagnostic capabilities.

So why not just get better data and analytical capabilities to monitor and manage disease? Unfortunately, that requires resources (time and money) as well. Consider if we want to understand better the disease status and the impact of disease on productivity in the wean-to-market phase of production. Most producers are already collecting reasonably good data on productivity, but data to characterize the disease status is rarely collected consistently. Without the ability to characterize the disease status of herds over time, it is impossible to know how much productivity is lost due to disease. With current technology, the disease status could be estimated by routinely observing clinical signs, conducting necropsies, or performing diagnostic tests. Diagnostics provide the most objective information, but diagnostics alone may not be sufficient to characterize populations' disease status fully. Diagnostics are also costly, and routinely testing enough pigs in the population frequently enough to be highly confident in the results is often cost-prohibitive, even with the recent development of population-based sampling methods like oral fluids and processing fluids.

Precision Livestock Farming is About Making Decisions with Better Knowledge

So how do we get better knowledge to monitor disease that is not cost-prohibitive? That is where precision livestock farming comes in. In the context of monitoring disease, technologies that can help producers get and analyze better data about the disease status of pigs to move closer to that perfect knowledge that economist dream about fall squarely under the umbrella of precision livestock farming. Technologies to remotely monitor coughing, changes in posture, feed and water consumption, time spent at feeders and drinkers, the pig's environment, vital signs (e.g., body temperature, heart rate, respiration rate, and blood oxygen levels) all have the potential to better monitor the disease status of pigs. These technologies may be combined with artificial intelligence and strategic use of diagnostics (i.e., done in response to other indications of a change in disease status) to characterize the disease status of pigs over time more precisely. Down the road, inexpensive, easy-to-use pig-side diagnostic tests to detect the presence of pathogens are also likely to be developed, making it cheaper and easier to strategically use diagnostics.

It is unreasonable to expect perfect knowledge, but with better knowledge about disease status and the impact of disease, what decisions could be made better? I am frequently asked to conduct cost-benefit analyses of various animal health interventions, such as vaccines. I am often struck by how much uncertainty surrounds the estimation of the economic benefit. The major economic benefit typically arises from an expected improvement in productivity. That is where the cost of imperfect knowledge becomes very apparent. For example, consider the decision to vaccinate groups of pigs for PRRSV that are negative for the virus at weaning. The vaccine will only benefit groups of pigs that become infected during the growing phase. The timing of the infection also matters as productivity losses caused by PRRSV tend to be greatest in pigs infected at a young age, declining as the pigs get older. Consequently, the vaccine may be expected to produce a greater benefit in groups of pigs that are infected early. Not knowing how often groups of pigs are infected or when adds a significant amount of uncertainty in estimating the expected benefit. It is like playing a game of darts blindfolded. The only time we will be confident in hitting the board (making the correct decision) is when the board is very big (the expected improvement in productivity is very large under any circumstances). Knowing how frequently and when PRRSV is introduced would facilitate a more precise cost-benefit analysis of the vaccine and increase the likelihood of a correct decision that increases profitability. The correct decision will either yield an improvement in productivity by reducing the impact of PRRV or save the producer money that would have been spent on the vaccine.

Knowing the disease status of pigs in near-realtime would enable producers to intervene and allocate resources quickly to reduce the impact of the disease on productivity. Timely interventions, such as water medications, individual pig treatments, and adjustments to the environment, could be implemented when changes in a herd's disease status occur. Tracking the productivity improvements in response to the intervention over time would allow the producer to determine if the benefit of the interventions exceeds the cost. In addition, for decisions involving antimicrobials, knowledge of the disease status of pigs in near-realtime provides a justification for prudent use of the antimicrobials.

Assessing biosecurity on swine farms is another area where better knowledge about the disease status of herds would lead to better decisions to improve profitability. In the United States, relatively little attention has been paid to biosecurity in the wean-to-market phase of production. That is beginning to change, but deciding where to make biosecurity investments is hampered by not knowing when viruses, such as PRRSV and PEDV, are introduced. Conducting outbreak investigations on farms can help isolate specific events, such as transport of pigs, repair events, etc., that may have been associated with the outbreak. A key piece of information needed to conduct an effective outbreak investigation is knowing when the virus was introduced into the herd. Knowing when viruses are introduced into groups of growing pigs would help identify events that are more frequently associated with the introduction of virus so that biosecurity resources can be allocated strategically to improve control measures for those events.

Opportunities Will be Plentiful

Precision livestock farming is about finding new ways to create knowledge that I expect will dramatically change how we manage swine disease. New technologies are coming that will make acquiring data and analyzing it easier, cheaper, and more valuable. Like all technologies, adoption will occur slowly at first, and experience will determine which yield enough value to justify the cost. The transition will not be easy and will have wide-ranging implications. It will require veterinarians and other specialists with a new set of skills. Higher education will need to adapt programs to train the next generation of young professionals. Animal health companies will also need to adapt to help producers and veterinarians employ precision livestock farming technologies to use their products more effectively and efficiently. There will be no shortage of opportunities.