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Optimising pig herd health and production

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E-CHAPTER FROM THIS BOOK

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Surveillance on swine farms using antemortem specimens

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1 Introduction

Surveillance is the process of tracking health and productivity parameters over time to understand population health dynamics and to make better decisions on disease control. To be thorough, we note that monitoring and surveillance are not quite the same. Specifically, monitoring is the systematic collection and evaluation of population data over time, whereas surveillance is monitoring along with a plan prepared and ready for implementation if a specific threshold or disease condition is identified (Salman, 2003). Although they are not synonymous, monitoring and surveillance are generally used interchangeably in daily life and, for simplicity, in this review (Paskins, 1999).

The aim of this chapter is to provide a general, non-mathematical overview of infectious disease surveillance on swine farms based on testing. Because farms vary in size, structure, management, and surveillance goals, there is no 'one-size-fits-all' surveillance plan that can fit all circumstances and meet all objectives. Rather, the design and implementation of a surveillance program should be driven by the producer, ideally working in conjunction with an animal health specialist, and tailored to meet the specific objectives of the production system. Bedrock principles should guide the design process,

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which should be periodically reviewed after the surveillance program is initiated:

- Surveillance objective(s) should be clear and shared by all involved.
- The process – from sample collection to data interpretation – should be simple, clearly understood, and easily performed.
- The process should produce timely, accurate, interpretable and actionable results.
- The process must provide a return on investment through the reduction or avoidance of disease losses and/or enhancement of the value of the product.
- The process should be adaptable and able to meet new objectives as they are identified.

2 Overview

Representative sampling, testing a subset of randomly selected individuals to establish the status of the entire population, was the first step toward efficient surveillance. First described in 1895 (Kruskal and Mosteller, 1980), statistical sampling was rarely used in livestock surveillance until a synopsis by Cannon and Roe (1982) made the concepts accessible and understandable to field veterinarians. Subsequently, surveillance sample sizes based on binomial sampling distributions were routinely designed into swine disease control programs, for example, the U.S. pseudorabies (Aujeszky's disease) eradication program (Anderson et al., 2008), and became an integral part of the thought processes of swine health specialists.

The two key assumptions underlying binomial sampling are (1) the population is homogeneous, that is, randomly selected pigs in the population have an equal chance of being positive, and (2) the pigs in the population are 'independent,' that is, the infectious disease status of one pig is not predictive of the status of another (Wroughton and Cole, 2013). These assumptions were sometimes true in the smaller herds of the past, but are rarely true today because pigs on commercial production sites are separated into buildings, rooms, and pens by age, production stage, and/or function, with little interaction between groups. The result is the heterogeneous distribution (clustering) of disease within a production site. That is, some groups may be positive and others negative for the pathogen of interest, on the same farm at the same point in time. In addition, because infectious agents are most commonly spread from pig to pig, pigs in the same pen or barn are likely to be of similar status (Rotolo et al., 2017). It follows that, because pigs in physical proximity are likely to share the same disease status, they are not independent.

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To account for this population structure and the non-random disease distribution, at least to the degree possible, it is useful to design surveillance based on 'epidemiological units,' that is, groups of animals on the site that share a common environment and/or a comparable risk of exposure to the pathogen of interest (OIE, 2021). For example, in the U.S. pseudorabies (Aujeszky's disease) eradication program, '*each segregated group of swine on an individual premises* … (was) *considered a separate herd*.' Thus, according to the program guidelines, a farm could consist of one or more 'herds' (epidemiological units). Regardless of the number, each 'herd' was sampled according to the official (binomial sampling) protocol, for example, 29 pigs were sampled in each barn holding ≥ 1000 animals to achieve a 95% probability of detection at 10% prevalence (USDA, 2003).

A further complication to surveillance is the continual turnover of animals on swine farms. The production cycle is short for both market pigs (six months from birth to market) and breeding stock; that is, the turnover in finishing barns may approach 250% per year and breeding herds replace 40–50% of females annually (Stalder et al., 2004). As a point of contrast, human population turnover in 28 European countries for 2016 ranged from a low of 2.4% in Italy to a high of 8.5% in Luxembourg (Eurostat News, 2017). Further, as animals complete the production cycle, replacement animals are introduced, either through birth or from other farms. If replacements are immunologically susceptible to an infectious agent on the farm, they will eventually become infected and perpetuate the pathogen on the farm. If new replacements are infected with a pathogen not present on the farm, the risk is that it will spread to the remainder of the herd. This is a common scenario, that is, moving animals between herds is the most frequent route of PRRSV spread (Pileri and Mateu, 2016). Thus, sampling and testing must be sufficiently frequent in order to accommodate the rate of population turnover and the continual introduction of replacements.

3 Collecting production data

Pig producers have long recognized the value of data. For example, British pig producers in the 1920s used records to identify prolific sows that produced fast-growing, early-maturing progeny with good carcass characteristics (Woods, 2012). With the appearance of specialized pig farms in the mid-twentieth century, the goals of surveillance were broadened to include other health and productivity parameters (Alexander, 1971; Muirhead, 1976). This was, in part, a response to new disease challenges. That is, indoor housing alleviated health and welfare issues associated with outdoor pig production by providing better parasite control, nutrition and protection against extreme weather. However, confinement also changed the ecological balance among pigs, pathogens, and their environment and, in some circumstances, led to

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