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Biosecurity to prevent mechanical transmission of swine pathogens: Threat or fiction?

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Introduction

Biosecurity and sanitation practices are implemented on many pork production units to prevent the introduction of pathogens to the herd or to groups of pigs within the herd. These protocols must take into consideration a multitude of risks for pathogen introduction. Many decisions regarding biosecurity protocols on pork production units are currently based on producer and veterinary experience and opinion, not on scientific research. Not knowing the extent to which biosecurity measures need to be implemented to prevent the transmission of porcine pathogens is an important problem because, until that information is known, pork producers will run one of two risks:

- Expenditure of time and money on unnecessary biosecurity measures
- Insufficient biosecurity measures that place the pig population at risk for economically devastating disease outbreaks

The argument often presented is that all biosecurity measures, even if not effective, are important because implementation of biosecurity protocols sensitizes personnel to biosecurity issues. The biosecurity mind-set of the personnel is thought to enable workers to pay more attention to details that, if performed sloppily, might place the herd at risk of infection. I wholeheartedly agree that we must encourage our colleagues to pay attention to these details in their work. As most biosecurity procedures have not been validated, we must do the best we can with the information that we have to date. However, I feel that a dangerous precedent is set when, in an effort to give the impression that we are doing everything possible to prevent biosecurity breaches, we recommend procedures that science has shown to be ineffective. Encouraging people to perform biosecurity tasks that are known to be worthless damages our credibility. For example, one would not ask personnel to vaccinate a herd for pseudorabies using a modified live vaccine that had been mixed and then stored for two weeks at 90°F just to give the perception that by vaccinating the pigs, they were doing everything possible to prevent an outbreak of pseudorabies. Eventually, employees and clients will recognize the hoax, and your future recommendations will not be heeded.

The goal is to put science into biosecurity protocols. We realize that bigger issues, such as siting, pig proximity, and aerosol transmission, offer risks that we cannot control in many cases. Thus, our research has focused on the details within production units that we can control—specifically, the role of people as mechanical vectors in transmitting porcine pathogens. These details are important because we most likely track pathogens among groups of pigs before we observe the clinical signs of an outbreak.

Boot baths

Farm personnel use boot baths with the goal of preventing mechanical transmission of pathogens among groups of pigs. However, in the author's experience, boot bath maintenance on most facilities is poor, and frequently boot baths are grossly contaminated with organic matter. People commonly avoid stepping into boot baths or simply step through the bath without stopping to clean their boots.

Literature on boot bath use is scarce and usually limited to the authors' opinions on proper procedure. Quinn[1] recommended phenolic detergents for use in boot baths. He suggested that effective utilization of boot baths consisted of cleaning boots in a preliminary bath filled with dilute detergent, followed by immersion of clean boots to a depth of 15 cm for at least one minute in a second bath filled with detergent. Quinn[1] advocated that large units prepare new boot baths daily or when visibly contaminated and small units prepare new boot baths every three days.

We recently evaluated Cidex Formula 7*, Nolvasan(r), Chlorox(r), Betadine solution, 1Stroke Environ(r), and Roccal-D Plus, utilizing various boot bath protocols.[2] Basic principles of proper boot bath use learned from these experiments include the following:

- Scrubbing visible manure from boots enhanced removal of significant numbers of bacteria. Simply walking through a boot bath will not reduce bacterial counts. Standing in a boot bath for up to two minutes without scrubbing off the manure did not significantly reduce bacterial counts except when a cost-prohibitive disinfectant (Cidex Formula 7*) was used.
- With respect to reducing bacterial counts, scrubbing visible manure off in a water bath was as efficacious

as scrubbing manure off in a bath of the disinfectants. Although not tested, detergents may make manure removal easier.

- Scrubbing off manure in a clean disinfectant boot bath (1Stroke Environ) reduced the bacterial count more than scrubbing boots in a contaminated boot bath.
- Boots that have been scrubbed free of manure and then soaked in Roccal-D Plus for five or more minutes met the standard for disinfection.[3]

In a separate study,[4] the efficacy of VirkonS as a boot bath disinfectant was examined. Results were similar in that stepping through or standing in VirkonS without removing organic material first did not disinfect boots. However, removal of visible manure using a hose or brush and then dipping clean boots in a boot bath of 1% VirkonS was effective.

Time constraints make proper use of boot baths within production units difficult. However, spending time and money to implement boot bath procedures on a farm without using them correctly is a waste of resources. Although going through the motions of stepping in a boot bath has benefits of increasing employee awareness of biosecurity and maintaining a clean workplace, this insufficient biosecurity measure may place the pigs at risk for infection from contaminated boots.

In conclusion, boot stations with hoses and brushes will facilitate manure removal. Disinfectants should be selected based on efficacy, cost, ease of use, and environmental friendliness. The intention of this research was not to have everyone stop cleaning boots but to encourage the use of effective footwear cleaning protocols.

People as vectors

People flow into and within production units comprises a large component of biosecurity; however, little research is available to support common policies regarding people movement. Sellers, et al.[5] sampled people who had contacted animals infected with FMDV. More FMDV was isolated from the nose than the mouth of these people. Virus was isolated from the nose of one person at 28 hours but was not isolated after 48 hours. Nose blowing or washing was not effective in eliminating the virus, and cloth or industrial masks were not effective in preventing inhalation of the virus. Transfer of the virus between people was documented after persons in contact with infected animals spoke to unexposed colleagues in a box for four minutes. One year later, Sellers, et al.[6] reported that FMDV could be transferred from infected pigs via human beings to susceptible cattle. Results from Seller's work appear to be the origin for the "48 hour rule" used by many producers even though different viruses and bacteria may be harbored for longer or shorter periods by humans. Wentworth, et al.[7] recorded transmission of SIV to human caretakers. In this study, pig-to-human transmission occurred despite the use of Animal Biosafety Level 3 containment practice (coveralls, boots, goggles, gloves, hairnets, and dust masks).

In contrast, Goodwin[8] reported that the culture of breath and hair samples from a person exposed to pigs experimentally infected with *M. hyopneumoniae* did not result in re-isolation of *M. hyopneumoniae*. Additionally, the authors[9] could not detect pig-to-human transmission of *S. suis* using throat swab samples collected from farm personnel who were working in close daily contact with infected pigs.

Our investigations[10] of people as mechanical vectors for PRRSV were less conclusive. Although people did not transmit PRRSV from pigs with acute PRRS to uninfected pigs under the conditions of our study, there was some evidence that people could be contaminated with PRRS viral RNA after contact with infected pigs. PRRS viral RNA was detected in saliva and fingernail rinse samples of 2 of 10 people immediately after exposure to PRRSV-inoculated pigs, on a third person (fingernail rinse) at five hours, and a fourth person (nasal swab) at 48 hours after exposure to infected pigs. Further studies should address these findings using virus isolation instead of nRT-PCR to determine if the PRRSV RNA found on people is infectious.

Thus, it would appear that the risk of transmitting diseases back-and-forth between human beings and swine varies with the pathogen. Quantification of the risk of transmission of common porcine pathogens and individual strains of these pathogens on an individual basis is essential.

Practical implications

Further research is needed to validate biosecurity methods used in pork production. Once effective biosecurity procedures are defined, producers and veterinarians can develop protocols for production units commensurate with the greatest risks for that farm, keeping in mind that removal of visible manure is central to all biosecurity efforts whether the contaminated surface is a boot, clothing, truck, or skin.

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