Final Report to the AASV Foundation Board

Comparison of standard and bench entry protocols for prevention of environmental contamination due to personnel entry in a commercial swine facility

Cassandra Fitzgerald, BS; Kimberlee Baker, BS; Amanda Anderson; Rachel Stika; Daniel Linhares, DVM, MBA, PhD; Derald Holtkamp, DVM, MS

Funded in 2016 in the amount of $12,500

Contents

1. Abstract accepted for oral presentation in Student Seminar

Comparison of standard and bench entry protocols for prevention of environmental contamination due to personnel entry in a commercial swine facility

Cassandra Fitzgerald[1], BS; Kimberlee Baker[1], BS; Amanda Anderson[1]; Rachel Stika[1]; Daniel Linhares[1], DVM, MBA, PhD; Derald Holtkamp[1], DVM, MS

[1]*Iowa State University CVM*

Introduction

The swine industry continues to struggle with the introduction of emerging transboundary pathogens as well as endemic disease. Failing to prevent novel pathogen introductions into herds results in economic losses for producers. On-farm employee entry is one of the most frequent events that occurs on swine farms and can pose significant risk for pathogen entry. The addition of a bench entry system is an additional layer of biosecurity that is being used to lower the risk of pathogen transmission from contaminated footwear and ante-rooms. However, no research has been done to date to evaluate if the addition of a bench is effective at reducing environmental contamination on the clean side of showers in swine farms. The objective of this study was to determine if installing a bench entry system in swine facilities was effective at preventing entry of swine pathogen contaminated particles from on-farm personnel footwear using a fluorescent powder as a model for the contaminated footwear.

Materials and Methods

A control group (NoBench) and a treatment group (Bench) were evaluated in this study. Fluorescent powder (Glo Germ™, Moab, Utah) was used to simulate swine pathogen contaminated particles and was spread on the floor of the hallway leading to the shower. During Bench treatment days, a bench was installed in the hallway immediately before the shower room and after the fluorescent powder. During NoBench treatment days there was no bench installed after the fluorescent powder. Both treatments had a shoe rack placed in the same spot between the fluorescent powder and bench area. The entry of four female employees was monitored for 20 study days (10 Bench, 10 NoBench). Environmental contamination was measured each day at 4 sampling points by counting the number of squares with contamination using a grid. The sampling points were before the bench (A), after the bench (B), on the clean side of the shower (C) and dirty side of the shower (D). After each study day, all fluorescent powder was removed to ensure no residual powder contaminated the next study day's results.

Results

Sampling points were analyzed for significant differences in environmental contamination using the ANOVA procedure (SAS® 9.4; SAS® Institute Inc., Cary, NC). The mean number of contaminated squares was significantly ($P<0.05$) lower for the Bench treatment group at sampling point B (directly after bench) but not at any of the other sampling points.

Discussion

The bench entry inconsistently reduced the level of contamination in this study, highlighting the need to focus on compliance and execution. Employees were instructed and monitored for proper use of the bench. However, the employees in this study frequently touched the bottom of their shoes, transferring the contaminant to their hands and to whatever their hands touched subsequently. Personnel clothing also needs to be considered. Pants that were long enough to drag on the ground led to high levels of contamination shown on one Bench day in this study. Lastly, this study highlights the importance of layering biosecurity practices. On two NoBench treatment days, fluorescent powder was found on the clean side of the shower, but was never found on Bench treatment days. Individual practices, that are partially effective in isolation, when layered with other practices can substantially reduce the risk of pathogen introduction.

2. Draft (rough) of manuscript to be submitted to JSHAP

Comparison of standard and bench entry protocols for prevention of environmental contamination due to personnel entry in a commercial swine facility

Cassandra Fitzgerald, BS; Kimberlee Baker, BS; Amanda Anderson; Rachel Stika; Daniel Linhares, DVM, MBA, PhD; Derald Holtkamp, DVM, MS

CJQF, KB, AA, RS, DL, DJH: Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University College of Veterinary Medicine, 1600 South 16th St., Ames, IA 50011.

2.1. Introduction

The United States swine industry accounts for more than 35,000 direct and 515,000 indirect jobs and is worth approximately $22.5 billion (2012 census of agriculture. United States Department of Agriculture. http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Hog_and_Pig_Farming/. Published May 2014.). The continued introduction of new virus isolates into herds as well as failure to eliminate endemic disease puts the industry's profitability and ability to provide jobs at risk, along with complicating disease management and elimination programs. The United States swine industry continues to struggle with the introduction of emerging infectious and transboundary diseases as well as endemic diseases. This is evidenced by the 2005 introduction of porcine circovirus type 2 (PCV2), the 2013 introduction of porcine

epidemic diarrhea virus (PEDV), the increased incidence of Senecavirus A (SVA) in 2015, and the unsuccessful eradication of porcine reproductive and respiratory virus (PRRSV). Despite three decades of research, approximately 20% to 40% of breeding herds in the United States undergo a new PRRS outbreak each year (Swine Health Monitoring Project 1/15/2016. SHMP. http://www.cihedging.com/assets/cih/hogmargin/SHMP.pdf) costing the industry $664 million dollars in lost productivity annually (Holtkamp D, Kliebenstein J, Neumann E, et al. Assessment of the economic impact of porcine reproductive and respiratory syndrome virus on United States pork producers. J Swine Health Prod 2013;21:72-84). In order to prevent ongoing and future debilitating economic losses the industry must identify and correct biosecurity gaps and risk factors to be able to reduce the risk or prevent introduction of pathogens, or new isolates of pathogens, into herds.

On-farm employee entry is one of the most frequent events that occurs on swine farms and can pose significant risk for pathogen entry when specific biosecurity protocols are not properly implemented and complied with (Canon A, Gerardy K, Mowrer C, et al. PRRS, SVA, Emerging and Transboundary Diseases – Systematically Investigating Swine Disease Outbreaks with the Outbreak Investigation Program. In Proceedings: James D. McKean Swine Disease Conference. Ames, IA. 2015; 94-97). A substantial amount of early research on swine biosecurity protocols was done with respect to PRRSV and demonstrated that PRRSV can be transmitted from personnel and fomites related to personnel (such as footwear, coveralls, and gloves) to PRRSV-naïve pigs causing a clinical infection. (Otake S, Dee SA, Rossow KD, et al. Transmission of porcine reproductive and respiratory syndrome virus by fomites. J Swine Health Prod. 2002;10:59-65.; 6.Dee SA, Deen J, Rossow KD, et al. Mechanical transmission of porcine

reproductive and respiratory syndrome virus throughout a coordinated sequence of events during cold weather. Can J Vet Res. 2002;66(4):232-239.; 7.Dee S, Deen J, Pitkin A, et al. Evaluation of four intervention strategies to prevent the mechanical transmission of porcine reproductive and respiratory syndrome virus. Can J Vet Res. 2004;68(1):19-26.; 8. Pitkin A, Deen J, Dee S. Further assessment of fomites and personnel as vehicles for the mechanical transport and transmission of porcine reproductive and respiratory syndrome virus. Can J Vet Res. 2009;73(4):298-302.). Otake et al demonstrated that if no biosecurity measures were taken, personnel that contacted PRRSV positive pigs could transmit PRRSV to naïve pigs; but if contaminated personnel changed boots, coveralls, and washed hands prior to contacting sentinel animals, PRRSV was not transmitted. This resulted in the recommendation that swine personnel, at very minimum, change clothing and boots between sites and if possible, shower in and out of the facility. Based on this research, many breeding herds in the United States implemented a shower-in-shower-out protocol to enhance biosecurity on swine sites. When the shower-in-shower-out protocol is complied with 100% of the time, personnel entry should be of little risk; however, in reality, compliance with biosecurity protocols will never be 100%.

Another source of swine pathogen-contaminated material is personnel footwear. Dee et al demonstrated that clean boots could be contaminated with PRRSV by contacting the same surface where boots carrying PRRSV contaminated material were placed (7.Dee S, Deen J, Pitkin A, et al. Evaluation of 4 intervention strategies to prevent the mechanical transmission of porcine reproductive and respiratory syndrome virus. Can J Vet Res. 2004;68(1):19-26.). There is an increased risk of tracking PRRSV or another swine pathogen through the shower room and

into the swine facility on farms where personnel take their footwear off in an ante-room, and proceed to walk across that same surface in their stocking or bare feet to the showers.

The addition of a bench entry system is an additional layer of biosecurity that is being used to lower the risk of pathogen transmission from contaminated footwear and ante-rooms. However, no research has been done to date to evaluate if the addition of a bench is effective at reducing environmental contamination on the clean side of showers in swine farms. The objective of this study was to determine if installing a bench entry system in swine facilities was effective at preventing entry of swine pathogen contaminated particles from on-farm personnel footwear using a fluorescent powder as a model for the contaminated footwear.

2.2. Materials and methods

Study Design

A control group (NoBench) and a treatment group (Bench) were evaluated in this study. The design of this study was a randomized block design, with blocks determined by day of the week, Monday through Friday. The entry of four female employees into the swine facility on a single day through the same shower stall was the experimental unit.

Site setup

The site used in this study has a dirty side comprised of an entryway leading to a hallway consisting of six showers. The last shower (shower 6) was the shower used in this study and includes a dirty side with lockers, a shower stall, and a clean side that leads into the clean side of the farm. The level of contamination in this study was evaluated at four sampling points: A) hallway before bench; B) hallway after bench, C) dirty side of shower room, and D) clean side of

shower room. Each of the four sampling points was marked inconspicuously on the floor to ensure that data collection would not vary from each study day at each sampling point.

Study materials

This study used a fluorescent powder (Glo Germ; Glo Germ Co, Moab, UT) to simulate swine pathogen contaminated particles and to assess the rate of environmental contamination after each study day. Glo-Germ powder consists of particles that are around 5 microns in size, which is similar to the particle size of many pathogens. It appears white to the naked eye and fluorescent under ultraviolet (UV) lighting.

The bench used in this trial during the Bench treatment was representative of a typical bench entry system. The bench was constructed from pine wood and was painted with an oil-based primer (KILZ®, Santa Ana, CA) and a gloss oil-based porch and floor paint (Valspar paint®, Salem, NH) to ensure that it could be properly cleaned after each study day so no residual fluorescent powder was left. The bench dimensions were 96.52cm x 27.94cm x 50.8cm and had completely covered sides except for hand holes on each of the four sides used to remove the bench during the NoBench treatment days.

The two grids used in this trial to evaluate the level of environmental contamination were 90cm x 75cm and were divided into 270, 5cm x 5cm squares. They were constructed with PVC pipes (Silver-Line® Plastics; NC, OK, and FL) .48cm x 5.08cm metal eyelets (Stanley Hardware) and flat plastic string (Rexlace®, Pepperell, MA). The grids were coated with a fluorescent paint (Krylon®) that shows up under UV light but was not the same color as the fluorescent powder used. One grid was used for evaluating the clean side of the shower and remained on the clean

side of the farm for the duration of the study, and one grid was used for evaluating the dirty side of the shower and remained on the dirty side of the farm for the duration of the study.

Treatments

During the NoBench treatment days, two researchers would arrive at the site prior to any farm personnel. One researcher would shower in to the clean side of the farm using shower 5 and would inspect the clean side of shower 6 (sampling point D and surroundings) for any residual Glo-Germ powder using a UV light. If any residual Glo-Germ powder remained from the previous replicate the researcher would re-clean the area using a bucket of water and soap (Dawn® Ultra, The Procter & Gamble Company, Cincinnati, OH), a sponge (Lysol®, Reckitt Benckiser LLC, Parsippany, NJ), water taken from the clean side of the site, and a clean towel. After re-cleaning the researcher would re-inspect the area for any residual Glo-Germ. If any residual Glo-Germ still remained the researcher would repeat the re-cleaning and re-inspecting process until no residual Glo-Germ remained. The researcher would then shower out using shower 5 and would proceed to inspect the hallway before the bench (sampling point A), hallway after the bench (sampling point B), dirty side of shower 6 (sampling point C), and surroundings to confirm that there was no Glo-Germ residue from the previous replicate. If any residual Glo-Germ powder remained from the previous replicate the researcher would re-clean the area using a bucket of water and soap, a sponge, water taken from the dirty side of the site, and a clean towel. This process was repeated until all areas were free of residual Glo-Germ.

After confirmation that no residual Glo-Germ remained from the previous replicate, the researcher then sprinkled four grams of Glo-Germ in a 45cm X 104.5cm area on the floor in the hallway 118cm prior to the entry to shower 6. A removable outline made of PVC pipes (Silver-

Line® Plastics; NC, OK, and FL) was used to ensure Glo-Germ was sprinkled in the same location for each replicate. Four female personnel would then enter the facility, walk down the hallway to the showers in their footwear, walk through the Glo-Germ to the shoe rack that was placed in the same location every study day in the hallway before where the bench would be placed during Bench treatment days, remove footwear and place on shoe rack, and would walk through the doorway into shower 6 following the swine facility's normal entry protocol. Socked feet from the personnel may have contacted the same surfaces that their outer footwear did. Personnel then proceeded to shower-in per normal protocol. Personnel were monitored as they entered the facility each study day to ensure that entry protocol procedures were followed. If a protocol deviation occurred the data from that replicate was not included in statistical analysis and that study day was re-done on the same day of the week a different week.

After the four farm personnel entered the swine facility, the level of contamination was evaluated at the four sampling points. The researcher placed the grid at a specific spot marked inconspicuously on the floor at each of the four sampling points and assessed the environmental contamination at this same spot for each sampling point throughout the study to eliminate any variation. The lights were turned off and a UV light was used to illuminate the grid and any Glo-Germ powder within the grid. The researcher then systematically went through every square in the grid calling out which squares contained Glo-Germ while the second researcher recorded the squares in the grid containing Glo-Germ using the data collection form. After the number of squares within the grid were counted the researcher then captured three photos under UV light at that sampling point to record that data collection. This

was repeated for each sampling point. In order to record sampling point D, the researcher would shower through shower 5 after sampling points A-C were collected and would conduct data collection the same as sampling points A-C using the grid that stayed on the clean side.

After taking data collection at sampling point D, the researcher would use a bucket of soap, sponge, water taken from the clean side of the site, and would clean the sampling point area and the surroundings. After cleaning procedures, the area was inspected with a UV light to ensure no residual Glo-Germ powder remained. If there was any residual Glo-Germ the area was re-cleaned and re-inspected until no residual Glo-Germ remained. The researcher would then shower out using shower 5 and clean the hallway before the bench, the hallway after the bench, and the dirty side of the shower with a bucket of soap, a sponge, water taken from the dirty side of the site, and dried with clean towels. After cleaning procedures, the area was inspected with a UV light to ensure no residual Glo-Germ powder remained. If there was any residual Glo-Germ the area was re-cleaned and re-inspected until no residual Glo-Germ remained in the sampling point areas or the surroundings.

2.3. Results and Discussion

The counts of contaminated squares at each sampling point were analyzed for significant differences between treatment groups using the ANOVA procedure (SAS® 9.4; SAS® Institute Inc., Cary, NC). The mean number of contaminated squares was significantly ($P<0.05$) lower for the Bench treatment group at sampling point B (directly after bench) but not at any of the other sampling points.

The bench entry inconsistently reduced the level of contamination in this study, highlighting the need to focus on compliance and execution. Employees were instructed and monitored for proper use of the bench. However, the employees in this study frequently touched the bottom of their shoes, transferring the contaminant to their hands and to whatever their hands touched subsequently. Personnel clothing also needs to be considered. Pants that were long enough to drag on the ground led to high levels of contamination shown on one Bench day in this study. Lastly, this study highlights the importance of layering biosecurity practices. On two NoBench treatment days, fluorescent powder was found on the clean side of the shower, but was never found on Bench treatment days. Individual practices, that are partially effective in isolation, when layered with other practices can substantially reduce the risk of pathogen introduction.