# 2023 Allen D. Leman
# Swine Conference Proceedings

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*The Allen D. Leman Swine Conference is an annual educational event for the global swine industry. It is internationally acclaimed for bringing science-driven solutions to the complex challenges facing the industry. Each year hundreds of participants from over 20 countries attend the Leman Swine Conference held in Saint Paul, Minnesota.*

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Organized by: The University of Minnesota College of Veterinary Medicine and University of Minnesota Extension

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**Presenter Name:** Torunn Aasmundstad, Norsvin Sa
**Author(s):** T. Aasmundstad, I. Andersen-Ranberg, J. R. Dunkelberger, E. Grindflek
**Title:** Novel phenotyping approaches to select for improved feet and leg quality in sows

Although the average sow mortality rate has increased for US sow herds the last decade, the reasons for sow death loss remains the same; unknown is the primary cause and feet, legs and structure is the secondary cause (Eckberg, 2022, Mote et. al, 2009, Segura-Correa et. al., 2011). Studies have indicated that osteochondrosis (OC) is an important cause of lameness in pigs (Reiland, 1978; Nakano et. al. 1987). Computed tomography (CT) scanner has the last 15 years been used to scan all boar selection candidates in Topigs Norsvin and proven to be a useful tool also for assessing osteochondrosis in pigs. Heritability of total OC score (from several joints) highly increased compared to slaughter house evaluation (Aasmundstad et. al, 2013). Furthermore, the pigs leg quality and how easy they walk/move are also important for the functionality of the animal. By using a linear scoring system for a set of well-defined traits together with genomic information, the company have been able to develop breeding values of high accuracy for selection of good legs and functionality (Aasmundstad et. al. 2014, Grindflek and Sehested, 1996).

Results presented here demonstrates that the implementation of an index selection for functional exterior and osteochondrosis has brought down the phenotypic level of OC in eight anatomical positions and the culling due to feet and legs in the Norwegian pig populations.

The trait “total score of OC” (OCT) is the sum score of OC based on assessment of OC on CT-images following the suggestions of Ytrehus et.al (2004). Phenotypic trends reveal that the average OCT in a maternal line has been reduced from 2.95 (2011) to 1.52 (2022). In the same material, the incidence of OC in the distal end of the right humerus, medial condyle (HRM) has decreased from 0.43 (Aasmundstad et. al., 2013) to 0.07 in 2022. For OC in the distal end of the left femur, medial condyle (FLM), the average score has decreased from 1.07 in 2016 to 0.52 in 2022. According to annual statistics in Norway, the frequency of culling due to feet and legs has been reduced from 17.9 % in 2011 to 10.5 % in 2022. The annual statistic is relevant since the maternal line and a hybrid with the maternal line is predominant in Norway (market share >90 %).

In conclusion, the genetic selection based on the sum OC assessment of CT-images together with genetic selection for structural soundness has been successful. The average of OC in the specific locations has been reduced in the maternal line and the annual statistics supports that the culling due to feet and legs has been reduced with 41 % in 11 years.

**Presenter Name:** Charlie Arnot, Center for Food Integrity
**Author(s):** Charlie Arnot
**Title:** Drivers of consumer and market acceptance of gene editing

Drivers of consumer and market acceptance of gene editing: While gene editing has tremendous potential to address some of the most pressing challenges in agriculture and creates opportunities for food companies to work with developers to design better inputs, the value of this exciting innovation will be driven by market and consumer acceptance. In this session, Charlie Arnot from the Center for Food Integrity will share insights from extensive consumer and market research as well as details on the market driven assurance program that has been endorsed by organizations across the value chain.

**Presenter Name:** Carly Bates, Iowa State CVM
**Author(s):** Carly Bates
**Title:** How low should the pH go?

Introduction: Colibacilosis or Escherichia coli (E. coli) infection is a leading cause of morbidity and mortality in weaned pigs. The disease interrupts the intestinal barrier which causes diarrhea, enterotoxemia and/or sudden death. Antimicrobial resistant E. coli is a growing concern as many challenging strains are multidrug resistant. Alternative treatments are being explored to combat the disease that do not involve use of antimicrobials, one of which is acidifying the drinking water to decrease/prevent the growth of E. coli. This experiment's goal is to understand what pH should be targeted or at what acidic pH does growth inhibition of the organism begin.

Methods & Materials: The study was completed in two phases. Phase one was to determine the target pH levels of media without contamination. Phase two was to determine growth outcomes in the various pH levels of media.

Phase one: 88% lactic acid and sterile water were mixed at a 1 to 10 dilution as a stock solution. The stock was then added to 100 mL of tryptic soy broth (TSB) in .05-2mL increments until 3, 4, 5, 6 and 7 pH levels were met and confirmed using a pH meter. The final amounts are listed in table 1. (Not shown) This was utilized to accurately assess the pH levels of the TSB without contaminating the test media. This phase was repeated twice for accuracy.

Phase two: After proper pH levels had been produced in each of the TSB containers (3, 4, 5, 6 and 7 pH) one colony of a F18 strain E. coli from a clinical case was obtained on an inoculating loop and place in the TSB and swirled vigorously. TSB without lactic acid added was inoculated and plated to act as a positive control. The TSB test containers were incubated for 24 hours at 37 degrees F. After incubation, the samples were removed from the incubator and diluted 1:10, 1:100, 1:1,000, 1:10,000, and 1:100,000 dilutions. These dilutions and the original inoculum were plated using .5 mL of the solution spread evenly over 5% bovine blood agar plates. Plates were incubated and evaluated after 12 hours. Colony counts and pictures were taken for a quantitative and visual representation of growth.

Results & Discussion: All plates at pH of 5, 6 and 7 had noticeable surface growth whereas plates at a pH of 3 and 4 had no visual surface growth. Providing evidence that the E. coli isolate's growth inhibiting point is at a pH of 4. At the 1:100,000 dilution, 5 pH had 398 colonies of growth while 6 and 7 had TNTC colonies indicating that a mild inhibition of growth begins near a pH of 5. Next steps are to understand E. coli's growth inhibition at pH's incrementally from 4.0 to 5.0 and gaining an understanding of in vivo enteric luminal pH when pigs are administered water of various pH's.

**Presenter Name:** Luiz Brito, Purdue University
**Author(s):** Luiz Brito, Allan P. Schinckel, Jay S. Johnson, Francesco Tiezzi, Christian Maltecca
**Title:** Opportunities to genetically select pigs for improved resilience and robustness

Pigs can experience various environmental challenges throughout their lives, including the weaning process, diseases, agonistic social interactions, and thermal stress. These stressors impact the health, welfare, and productivity of pigs, and consequently, the sustainability of the pork industry. There is large variability on individual pig responses to these challenges, which can be heritable and therefore, improved through genetic selection. Assessing the level of genotype by environment interaction on welfare and performance traits provide great opportunities for optimizing management strategies and selection for improved resilience to environmental stressors. Briefly, resilience can be defined as the ability of an animal to be minimally affected by environmental disturbances or quickly return to the unperturbed conditions. The adoption of genomic selection in pig breeding has increased the rates of genetic progress for productive and reproductive traits, but so far, few indicators of resilience and robustness have been included in current selection indexes. Development of sustainable breeding programs requires the identification of novel traits and genomic evaluation strategies to genetically select pigs for improved resilience under commercial conditions while maintaining production efficiency. Improving swine resilience requires the identification of heritable traits that can be measured in a non-invasive way at a low cost per animal. After identifying the genomic background of these traits, there is a need to understand their genetic relationships with economically important traits such as sow productivity. Over time, one needs to biologically validate the selection models through designed experiments and evaluation of genetic trends for the traits of interest. These steps require a multidisciplinary approach with experts from stress physiology, quantitative genomics, economics, statistics, engineering, and veterinary medicine. We will summarize our efforts in the areas of breeding and management strategies with a focus on heat tolerance in lactating sows. Lactating sows are at a greater risk of deleterious heat-stress effects due to substantial increases in litter size and, consequently, greater lactation demand and metabolic heat production. We have previously provided evidence of genetic variability for heat stress response based on routinely-recorded performance data and environmental gradient variables derived from public databases. We have identified novel phenotypes and biomarkers that better represent the behavioral and physiological mechanisms of heat stress response in both growing/finishing pigs and lactating sows. Heat stress and feed efficiency are regulated by biological networks that start with the host genotype, including the gut microbiome, and are manifested in behavioral changes, which ultimately affect animal productivity and welfare. We follow an integrated approach to study the biological background of heat stress connecting pig genomic, gut microbiome, behavioral measures, epigenomics, and deep phenotyping. We will: 1) provide a description of the environmental-gradient variables and critical periods fitted in genomic evaluations of heat tolerance and the accuracy of genomic breeding values; 2) describe the genetic background of indicators of heat tolerance and climatic resilience; and, 3) make recommendations for the implementation of genomic selection for improved heat tolerance in pigs. Lastly, we will describe the paths for breeding for improved resilience and robustness, main challenges and opportunities for pig breeders.

**Presenter Name:** Vienna Brown, USDA APHIS Wildlife Services
**Author(s):** Vienna Brown
**Title:** Feral swine in the US: National disease surveillance and ASF preparedness and response planning

The United States Department of Agriculture's (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) conducts large scale removal of feral swine within the United States. These highly invasive mammals are distributed across much of the U.S. and damage and disease risks associated with these animals are significant. The National Feral Swine Damage Management Program (NFSDMP) provides funding to all U.S. states and territories with feral swine populations for operational activities which results in the removal of over 100,000 feral swine annually. A subset of removed feral swine (~6,000) are opportunistically sampled for endemic diseases, such as pseudorabies and swine brucellosis, as well as foreign animal diseases, including African swine fever (ASF), classical swine fever, and foot-and-mouth disease. Additionally, the proximity of ASF to the United States, given the detection on Hispaniola, has resulted in a flurry of preparedness and response activities within the U.S. territories of Puerto Rico and the U.S. Virgin Islands, as well as the continental United States. Disease monitoring efforts will be described as well as ASF operational activities and surveillance streams.

**Presenter Name:** Jay Calvert, Zoetis
**Author(s):** Jay Calvert, Jose Angulo, Alvaro Aldaz
**Title:** Vaccination Strategies to Reduce PRRSV Recombination

Introduction:
With the increase in whole genome sequencing, it has become abundantly clear that many "new" PRRS viruses are actually the result of recombination between two or more existing strains of PRRSV-1 or PRRSV-2. Recombination between PRRSV-1 and PRRSV-2 has not been reported to occur in nature.
Methods:

It is well known that both species of PRRS viruses have a high mutation rate, but less well understood that they also have a very high rate of homologous recombination. This is due in part to the distinctive mechanism employed by PRRSV and other Nidoviruses to express structural proteins from subgenomic RNAs. These sgRNAs are generated when the RNA polymerase, with a nascent strand of newly synthesized RNA, detaches from one position on its genome-length RNA template and reattaches to a distant site on the same (or different) RNA template to continue RNA synthesis. This requirement for the polymerase to hop from one location to another makes Nidoviruses particularly prone to homologous recombination by the template-switching mechanism. Modified live vaccine viruses are not exempt from recombination, and it is not uncommon for whole genome sequencing to reveal that "vaccine-like" isolates from the field (based on ORF 5 sequencing) are actually recombinant viruses containing a vaccine-derived ORF 5 in the context of wild-type sequences. In several well documented cases, two vaccine strains have recombined with each other to produce a vaccine-like virus that is less attenuated than either vaccine parent.

Results and Conclusions:
Fortunately, recombination between strains of PRRS virus can only occur when both viruses infect the same cell (in the same pig), at the same time. Using this as a guiding principle, there are a variety of vaccine management strategies that can be used to reduce the opportunity for recombination between vaccine viruses and field strains, and between vaccine strains. These strategies will be discussed in the presentation.

**Presenter Name:** Jean Paul Cano, Pipestone Veterinary Services
**Author(s):** Jean Paul Cano, Mario Rodriguez, Gustavo Pizarro, Joel Nerem, Hermenegildo Santisteban, Miguel Olea, Ernesto Becerril, Manuel Santini, Abraham Lopez, Matias Fortini, Rocio Carolina Vasquez, Ivan Rodriguez, Ramon Francisco Ochoa, Luke Minion, Scott Dee, Karyn Havas
**Title:** Sonora-Mexico swine biosecurity certification program: A novel way to approach regional disease control

Sonora, located in the north west of Mexico, is the second pork producer state in the country creating about 375,000 tons of pork per year from 150,000 sows. The region has a privileged location, a desertic climate and a long history of producer collaboration to facilitate regional disease control and elimination; however, previous efforts have not been able to significantly reduce the incidence of PRRS or PED, for example. The current initiative designated as the Sonora Swine Biosecurity Certification Program aims to build the foundation of regional biosecurity and disease tracking needed to consider health improvement projects in the state. The Health Committee of the Sonora Pork Union, coordinating the project, achieved 100% of producers signing the participation agreement to share diagnostic data in real time and to allow committee's personnel to audit farm biosecurity and train farm staff in order to obtain the annual certification.

Participating producers have also agreed to pursue a biosecurity minimum standard defined as the "Top 10 Biosecurity Standards", including (1) specifications for the location of new buildings, (2) maximum number of production weeks per growing site, (3) negative source of semen and replacements, (4) use of a validated chemical mitigant in breeding herds and delivery of feed following a dynamic biosecurity pyramid, (5) segregation of transport vehicles contacting breeding herds, (6) contained clean area in the farms, (7) prohibition of rendering in breeding herds, (8) approved protocols for supply disinfection, (9) annual audits of farms, feed mills and truck washes and (10) training of all farm, feed mill and truck wash staff during the first 90 days of employment and annually.

Four boar studs, 63 breeding herds, 53 nurseries and 271 wean-to-finish/finishers totaling 395 participating commercial sites. In addition, 370 backyard pigs or family farms have been identified. Nine feed mills, nine transport decontamination facilities and seven slaughter plants operate in the state. By the end of July of 2023, 40% of the sites were PRRS positive (category I - unstable), 44% were stable (category II or III) and 16% were negative (category IV). At the same time, 9% were PED positive, 7% were stable and 84% were reported negative. The Health Committee has certified 38 auditor/trainers and 1,734 staff have received the biosecurity training course. With notable progress in biosecurity practices and a growing trend of exchanging disease status and genetic sequences, the producers and swine professionals of Sonora have initiated a regional initiative aimed at eliminating Porcine Epidemic Diarrhea (PED).

**Presenter Name:** Albert Canturri, University of Minnesota
**Author(s):** Albert Canturri, Maria Pieters
**Title:** Mycoplasma hyopneumoniae diagnostics by PCR: tips from the school of hard knocks

Molecular diagnostics aiming at determining the presence of Mycoplasma hyopneumoniae in clinical specimens are mostly based on the detection of nucleic acids of the pathogen by PCR. In general, a positive PCR result would be interpreted as that the pig from which the sample was collected was infected with M. hyopneumoniae. However, the environmental stability and resistance to degradation of DNA molecules, together with the high sensitivity of the PCR assays, can lead to diagnostic uncertainty and interpretation issues in certain epidemiologic scenarios.

Several recent studies have highlighted the importance that environmental sources of genetic material can have on PCR testing for M. hyopneumoniae. Our research group identified environmental contamination with vaccine products as the most likely origin of the detection of the bacterium in processing fluids1. Similarly, Hensch and collaborators showed that post-vaccination environmental contamination of samples was possible even with the collection of tracheal secretion samples, the preferred sample type for ante-mortem detection of this pathogen2. Additionally, Weidmayer and collaborators described the prolonged persistence of detection of DNA in the environment, showing that commercial bacterin DNA could be detected for up to 28 days after intentional deposition on farrowing stalls and heating mats under field conditions3.

The aforementioned findings emphasize that the persistence of DNA on surfaces can be also a source of sample cross-contamination when collecting deep tracheal secretion samples. Even though sampling materials, such as mouth speculums, laryngoscopes and scissors, are cleaned with disinfecting wipes between sampled pigs, it was unknown if this prevented DNA carry-over and cross-contamination of samples from which PCR testing is intended. Research performed in our laboratory showed that only bleach-based wipes achieved DNA decontamination of sampling materials, and thus, creating a sampling protocol including this measure could help minimize sample cross-contamination in tracheal secretion collection.

Contrarily to what has been shown ex vivo, the persistence of nucleic acid detection from non-viable M. hyopneumoniae in vivo, in the respiratory tract of pigs, has been less studied. In a recent experimental study performed at the Mycoplasma Reasearch Laboratory, we showed that in pigs with non-compromised mucociliary apparatuses and immune systems, the DNA of non-viable M. hyopneumoniae was rapidly sensed and cleared, being not detectable by PCR in the respiratory or the lymphatic systems only six hours post intratracheal inoculation.

A key method to investigate the eventual persistence of non-viable M. hyopneumoniae genetic material is a culture-independent diagnostic assay for the detection of exclusively viable M. hyopneumoniae cells. Such viability assay can be applied in situations where treatments or management practices are expected to affect the viability of M. hyopneumoniae in vivo.

1. Canturri, A, Vilalta, C, Sanhueza JM, Pieters, M. Longitudinal evaluation of Mycoplasma hyopneumoniae detection in processing fluids. In: American Association of Swine Veterinarians conference proceedings; 2022.

2. Hensch M, Kellen M, Maschoff A, Gauger P. Diagnostic problems with unexpected positive PCRs. In: Allen D. Leman Swine Conference Proceedings; 2021.

3. Weidmayer R, Murray D, Johnson L, Sponheim A, Pieters M. Environmental detection and persistence of a Mycoplasma hyopneumoniae bacterin. In: Allen D. Leman Swine Conference Proceedings; 2020.

**Presenter Name:** Albert Canturri, University of Minnesota
**Author(s):** Albert Canturri
**Title:** Value of histopathology in diagnostic investigations

Veterinary pathologists/diagnosticians still spend a large part of their time performing histologic examinations of tissues to investigate animal disease and mortality, even when advanced pathogen detection techniques, such as molecular biology assays, have become widely available. In porcine medicine and production, where the objective of disease investigations is to provide helpful, whole-herd information to the practitioners, histopathology can be an essential tool to reach a definitive diagnosis in some scenarios. In the increasingly frequent instance of multiple microorganism detection, including commensal symbionts, pathobionts and pathogens, histopathology remains the gold standard for assigning clinical-pathologic significance to those findings.

This presentation will provide a review of the good practices for tissue collection for histopathology and will familiarize the audience with the histologic processing of tissues, from fixation to slide preparation and reading. Additionally, examples of swine disease processes in which histopathology is useful or even required for a definitive diagnosis will be provided. Finally, histology-based techniques that allow pathologists to associate the presence of infectious agents to histologic lesions will be described.

**Presenter Name:** Cathy Carlson, University of Minnesota College of Veterinary Medicine
**Author(s):** Cathy Carlson
**Title:** What do you need to know about OCD to better manage this disease?

Osteochondrosis (OC) is an important disease of growing animals and humans and is of particular significance in swine due to its high prevalence, economic costs, and the fact that, although relatively easily treated surgically in other species, this option is not practical in pigs. Thus, the focus in swine is primarily on disease prevention. OC is most often manifested clinically by signs of lameness due to the formation of cartilaginous or osteo-cartilagenous flap formation in joints, most commonly the stifle and elbow, at which stage the disease is termed osteochondrosis dissecans (OCD). OC/OCD is a multi-factorial disease with potential contributions from heredity (including vascular supply to the joints and conformation), trauma, rapid growth, and nutritional factors. Heredity has well demonstrated and will be a focus of this presentation. On the contrary, extensive studies have demonstrated that, although OC/OCD occurs most commonly in animals in which rapid growth is promoted, the prevalence of lesions is not altered significantly by reducing growth rate by restricted feeding or by breeding animals with fast growth rates with those with slower growth rates. Similarly, although many nutritional studies have been performed, conclusive results have not been generated to implicate nutritional factors in the pathogenesis of this disease. The lesions have been clearly demonstrated to occur in highly specific predilection sites and are closely associated with the pattern of vascular supply to growth cartilage, a temporary tissue that is converted to bone during growth and is completely absent in adulthood. Focal failure of blood supply to growth cartilage results in an area of cartilage necrosis which is vulnerable to collapse and cleft formation, particularly when exposed to trauma. Small lesions, and those that are located in sites that are not exposed to trauma are highly likely to heal completely, but larger lesions and those that are exposed to trauma may undergo collapse and clefting, resulting in lameness and a permanent lesion in the joint. Prevention of trauma during the window of time when subclinical lesions are evident will likely reduce the prevalence of the clinical disease and allow healing to occur.

**Presenter Name:** Anna Cates, UMN
**Author(s):** Anna Cates
**Title:** Connecting soil, livestock, and environmental outcomes

Soil health involves understanding the full function of the soil- how biology interacts with the physical architecture. Cates will cover how these processes work in agricultural soil, what we hope to change with soil health principles, and how manure and livestock can alter processes and properties underground.

**Presenter Name:** Joseph Connor, Carthage Veterinary Service, Ltd
**Author(s):** Joseph Connor
**Title:** Historical PathogenHistorical Pathogen  Elimination Success Drives Future Strategies es Future Strategies

Our industry has realized growth in global markets by low cost production which is driven substantially by our ability to manage and over time eliminate economic diseases. U.S pork industry exports 30%+ of annual production.

Our industry has eliminated many diseases including CSF (classical swine fever), FMD (foot and mouth disease), PRV (Aujeszky's), and VE (vesicular exanthema) from the U.S. swine population. For individual herds successful elimination list is extensive including porcine reproductive and respiratory syndrome virus, Seneca Valley virus, transmissible gastroenteritis, porcine epidemic diarrhea virus, porcine delta coronavirus, Actinobacillus pleuropneumoniae, Brachyspira hyodysenteriae, influenza A-S, Leptospira sp, Bordetella, Pasteurella, Actinobacillus suis, and Streptococcus suis. Parasites that have been eliminated include Sarcoptes scabei, Haematopinus suis, Trichuris suis, Metastrongylus elongates, Stephanurus dentatus, and Oesophagostomum spp.

Elimination strategies intertwine a variety of protocols and procedures including biosecurity, biocontainment, sanitation, depopulation, partial depopulation, unidirectional flow, wean pig segregation, parity segregation, batching, medicated early weaning, modified medicated early weaning, herd closure, immunological, immunological plus therapeutics, confinement housing, and test and removal. These strategies evolve over time and depend on pathogen attributes of infectivity, virulence, pathogenicity, modes of transmission, vectors, environmental survivability, carrier states, and resistance to antimicrobials and disinfectants. Elimination generally initiates on a herd basis, expands to an area or region, then to a country, and finally to a continent. The cost of the strategies varies widely and disease elimination decisions should be predicated on prevention of reinfection and economics.

The success our industry has had eliminating diseases will be more important with a confirmation of any of the OIE recognized foreign animal diseases (FMD, CSF, and ASF) which would result in loss or interruption of markets having a direct and long-term economic impact.

**Presenter Name:** Erin Cortus, University of Minnesota
**Author(s):** Erin Cortus, Nancy Bohl Bormann, Melissa Wilson
**Title:** ManureDB: Accessing past and present U.S. manure nutrient data

ManureDB was created to collect and aggregate U.S. manure analysis data results to update manure book values over time. Most manure book values used today from the MidWest Plan Service (MWPS) and American Society of Agricultural and Biological Engineers (ASABE) were derived from samples prior to 2003. The University of Minnesota in partnership with the Minnesota Supercomputing Institute built a dynamic manure test database to accommodate the thousands of manure sample analysis results generated by commercial and research labs across the country, every year, while protecting the identities of manure sample suppliers. The database meets FAIR principles (Findable, Accessible, Interoperable, and Reusable). The data can be manipulated multiple ways, including by year, by animal type, manure storage type, and by state or region. With more than 422,000 samples in the database as of August 2023, we can compare analysis results from the past decade to book values published in 2004. This presentation shares the trends we see in manure nutrients relative to the past, and how we can continue to add value to these data in the future.

**Presenter Name:** John Deen, University of Minnesota
**Author(s):** John Deen
**Title:** Changes in US swine farm economics

Like China, the US swine industry is going through a time of major challenges. Historically, 1998 has been seen as the benchmark for Economic stress. However, 2023 going into 2024 has been argued to be an even more dramatic insult to the Financial well-being of swine farms. The financial insults during the current downturn are twofold. The first is a decrease in the consumer demand for pork, with An excess of Not only live pigs but also pork. Moreover, the industry has seen Increases in the cost of production through all major aspects of pork production.

**Presenter Name:** John Deen, University of Minnesota
**Author(s):** John Deen
**Title:** What techniques do other industries use to address process management?

All industries have the challenge of creating a predictable product stream that meets downstream needs. Robust manufacturing, quality management and operations research are just some of the disciplines that focus on creating consistent products, with some arguing that knowledge of downstream capabilities and needs are as important as focusing on one's own. With that focus, the economics of production systems become more complex but leads to greater efficiencies and greater demand.

**Presenter Name:** John Deen, University of Minnesota
**Author(s):** John Deen
**Title:** Wrap up session - Where do we go from here?

What did we learn, what did we miss? The Leman Conference  has always aimed to be a place of discovery and discussion, of creating those “Science-Driven Solutions”.  These solutions are rarely made in isolation, but they occur across farms, labs and time to constantly improve pig production.  What were the new questions, the new approaches, the significant incremental gains in understanding that this industry needs?  We will informally survey the participants for the highlights of the conference, as well as what challenges we need to address in the future.

**Presenter Name:** Hope Dohlman, Iowa State University College of Veterinary Medicine
**Author(s):** Hope Dohlman
**Title:** Evaluation of an absorbent mat for swine disease surveillance in weaning-age pigs

Introduction: Porcine reproductive and respiratory syndrome virus (PRRSV) is a pathogen with devastating impact on swine health and production. PRRSV causes reproductive failures in the breeding herd as well as respiratory illness in growing pigs. Samples collected from wean-age piglets are utilized as a surveillance tool for PRRSV eradication status on the sow farm, such as piglet blood, tongue tips, and processing fluids. However, collecting these samples requires adequate training and additional labor. There is an ever-pressing need for samples that can be collected efficiently and with little need for specialized skills or time commitment on behalf of farm teams. This need extends beyond the scope of PRRSV elimination and into surveillance of other pathogens including detection of PEDV (porcine epidemic diarrhea virus) or Lawsonia intracellularis. The uncomplicated method may also be used to surveil diseases that may enter a farm with incoming animal deliveries. The objective of this study was to analyze the level of detection of PRRSV material in wean-age piglets through the use of an absorbent mat.

Materials and Methods: This study was conducted at a confirmed PRRSV positive, 5,600 head sow farm in Illinois. Six randomly allocated wean pig loads were enrolled in the study. A 15” x 19” absorbent mat (New Pig, Tipton, PA) soaked with 400 mL of distilled water was utilized as the sampling method for the study. The mat was then placed on the floor in the center of the load chute prior to pig movement. Piglets were then allowed to cross over the mat to move into the trailer following normal loadout procedures. During a single loadout event, between 1200 to 1600 wean piglets crossed over the mat. When piglet movement was complete, the absorbent mat was collected and mat fluids were expressed into conical tubes. Mat fluids samples were then tested for PRRSV, PEDV, Lawsonia, and SIV via ddPCR (digital droplet PCR) at an external laboratory utilizing ddPCR testing.

Other Uses, Limitations, and Future Work: Dilution of the sample served as a factor, as distilled water was included in the retracted mat fluids. The absorbent mat is considered an indirect surveillance sample type, as piglets are shedding the pathogen and then tracking the pathogen over the mat while loading. There is also sample loss during piglet tracking and hoof impact. Future use of this sample type may include testing incoming animals off of a delivery.

Results: Completed results from this study have not been fully reported at the time of this abstract submission. Initial ddPCR detection was positive on several samples with the following ranges in copies per liter (cp/L): PRRSV 47-3,024; PEDV 44-6,394; Lawsonia 48-5,610. Additional testing results to be reported at a future date.

**Presenter Name:** Jenelle Dunkelberger, Topigs Norsvin
**Author(s):** Jenelle Dunkelberger, Tomas Stevens, Vishesh Bhatia, Jason Ross, Jack Dekkers, Egbert Knol
**Title:** Breeding robust sows for commercial conditions

The average sow mortality rate has drastically increased for US sow herds within the last decade. While numerous reasons for sow death loss are reported, 83% of sow mortality events can be explained by one of the following reasons: 1.) unknown/sudden death; 2.) feet/leg structure; and 3.) uterine prolapse (Ross, 2019). Developing solutions to address sow mortality remains challenging, due to the multifactorial nature of this trait and underlying, specific reasons.

Genetic variation in sow longevity was previously investigated by Topigs Norsvin. However, genetic variation in sow mortality due to vaginal/uterine prolapse, specifically, was recently evaluated in collaboration with researchers from Iowa State University. Genetic investigations of sow longevity and susceptibility to vaginal/uterine prolapse were conducted using data collected from commercial (purebred) sows in the US. Marker genotype information was available for each sow at each location, as well as detailed information regarding removal status, when applicable. This included information such as whether the sow died naturally, was euthanized, or culled, date and reason for removal, and parity of removal. Data from these farms are received by Topigs Norsvin on a continuous basis, which are used to estimate breeding values for two longevity traits: longevity to parity 2 and longevity to parity 5, both of which are included in the Topigs Norsvin Selection Index, with heritabilities of 8 and 13%, respectively (Iversen et al., 2020).

Genetic variation in susceptibility to vaginal/uterine prolapse, specifically, was investigated using data collected from these same farms. Initial genetic analyses of vaginal/uterine prolapse, defined hereafter as pelvic organ prolapse (POP), were conducted using 16,000+ individual removal records with three generations of pedigree data, collected over an eight-year timeframe. Results of these analyses showed that the heritability of POP was 22% on the underlying threshold scale (Dunkelberger et al., 2021). When this analysis was repeated using genomic data, the heritability estimate increased to 35% (Bhatia et al., 2023). The latter finding reflects the opportunity to better and more accurately capture relatedness between individuals using genomic vs. pedigree data, and suggests that susceptibility to POP is even more heritable than initially realized. Results of a genome-wide association study revealed that POP is highly polygenic in nature, i.e. affected by many genomic regions with small effects, which is typical of robustness traits (Bhatia et al., 2023).

In conclusion, sow mortality is a major concern for the US swine industry, which is due to various, complex underlying causes. The aim of this research was to investigate the potential of using genomic selection to breed sows for enhanced longevity. Results show that overall sow longevity, as well as one of the leading, specific causes of sow death loss can (and therefore should) be improved via genetic selection. However, heritability estimates indicate that the majority of phenotypic variation in these traits is due to environmental factors, confirming the need to identify and implement non-genetic solutions to supplement this approach. Research on POP was partially funded by the National Pork Board.

**Presenter Name:** Bradley Eckberg, MetaFarms, Inc.
**Author(s):** Bradley Eckberg
**Title:** Using data to impact your bottom line.

Throughout the swine industry there are thousands of data points being collected. Becoming easily overwhelming by an end user is not uncommon so it can be said that it is just easier to remember or to guestimate. What and where to look for information can be daunting but understanding the importance and relevance of data can give you the leg up to prevent a larger problem or to minimize a potentially larger one. Extracting, simplifying and delivering data to the appropriate end user can lead to a higher potential performance outcome.

**Presenter Name:** Jamil Faccin, Kansas State University
**Author(s):** Jamil Faccin, Mike Tokach, Robert Goodband, Joel DeRouchey, Jason Woodworth, Jordan Gebhardt
**Title:** Nourishing a long-term investment: Feeding the replacement gilt

What is the definition of success in a gilt development program? Proper gilt development can reduce culling rates and mortality, increase longevity, result in more mature sows that have greater immunity, maximize mammary gland development, and increase colostrum and milk production. Below, we list 5 key feeding strategies to achieve success with gilts.

1. Vitamins and minerals: Add more phosphorous than terminal lines, consider organic or chelated trace mineral sources, and add extra choline, pyridoxine, folic acid, and biotin.

Why? Phosphorus recommendation levels for bone mineralization are 8% higher than for growth performance. Organic trace mineral supplementation can reduce osteochondrosis incidence. The extra vitamins are involved in reproductive functions and often not included in finishing pig premixes.

2. Mammary development: From 90 d of age to puberty, do not restrict energy intake too much; Avoid overfeeding gilts in late gestation.

Why? Overfeeding gilts in late gestation will deposit more fat in mammary glands, reducing colostrum and milk production.

3. Fast-growing: Restrict growth of gilts prior to breeding when having gilts being bred over 160 kg.

Why? Avoid breeding gilts overweight by controlling the growth rate from 100 to 200 d of age.

a) Nutrition: Decreasing the energy content of the diet from 13 to 25%, or 10 to 20% the Lys:Cal can slow growth without affecting reproductive performance. However, it can delay puberty. Review diet formulas to make sure it does not have any ingredients/inclusions promoting faster growth. Diets with higher inclusion of fiber do not slow gilts' growth most of the time because of their capacity to compensate with higher feed intake.

b) Management: Use dry feeders with feed in meal form. Be cautious when reducing feeder space availability or increasing stocking density. Such strategies might stimulate aggressive interactions and ear and tail biting.

4. Flush feed: Only flush feed gilts that might not reach body weight target at breeding.

Why? Flush feeding only improves reproductive outputs when gilts are below the target weight for breeding. As an example, only flush feed gilts projected to be bred at second estrus but weighing < 120 kg at the first estrus. Flush feeding all gilts will result in an overweight herd with higher cost of body weight maintenance. Flush feeding for 7 days prior to breeding provides the greatest benefit in total born without increasing backfat.

5. Gestation: Early: Do not feed gilts below maintenance and growth requirements and avoid feeding more than 7.5 Mcal of NE/day. Late: Unless body condition is low, avoid bump-feeding.

Why? Over conditioned gilts can have lower litter size and have reduced feed intake and milk production in lactation. Bump feeding improves birth weight slightly but increases stillborn rate and lowers lactation feed intake and colostrum and milk production.

A simple way to persuade swine professionals about the importance of reaching excellence when managing and feeding gilts is the reminder that sows with remarkable lifetime performance certainly are a consequence of a successful gilt development program.

**Presenter Name:** David Fikes, FMI Foundation
**Author(s):** David Fikes
**Title:** Consumer Acceptance of Gene Edited Food Products.

With our research partners at Michigan State University, the FMI Foundation has executed two studies examining the level of consumer acceptance and willingness to buy gene edited food products. One study was performed pre-pandemic and the second report entitled Consumer Attitudes, Trust, and Acceptance of Bioengineered and Gene-Edited Food Under the National Bioengineered Food Disclosure Standard includes an examination of consumer reactions to the bioengineered label which was not covered in the initial report. The second report was released in 2022.

In my panel presentation I will review the key findings from our last report, with reference to areas that have seen some movement since the 2020 report. The key findings I will cover are::

- Consumer acceptance of gene-edited food remains low, but respondents who accessed the additional information had a higher willingness to pay (WTP) for gene-edited food especially when the BE label or QR codes are used than those who did not.

- Benefit messages increase consumer acceptance and WTP for gene-edited food products, and even result in a WTP premium for gene-edited foods over conventional lettuce, especially among consumers who seek additional product information and when the product displays the BE label or the QR code.

- Knowledge of new food technologies remains very low, and food labels are the most preferred and trusted information vehicles to acquire product information.

- Respondents trust and knowledge in different sources of information about new food technologies differs substantially, with respondents indicating a high level of trust in government agencies but not the U.S. Congress or (social) media.

- Respondents are in favor of having foods produced with new food technologies available in the market, support labeling of gene-edited food products, and back federal decision makers for labeling issues over state-based ones.

- Respondents consider gene-editing applications targeting diseases in animals, humans, and crops as highly important and applications targeting sensory or productivity indicators to be of low importance.

**Presenter Name:** Aaron Gaines, Ani-Tek
**Author(s):** Aaron Gaines
**Title:** Nutritional strategies to lower feed costs in grow-finish pigs

To cope with high diet costs there are several nutritional strategies that can be utilized to include diet formulation, ingredients, feed processing, and feed additives. Diet formulation should focus on ensuring expensive nutrient levels such as energy, lysine, and phosphorus are set at economic optimum. Corn coproducts, alternative ingredients, and synthetic amino acids should be utilized given the opportunity to lower diet costs. However, it is important that sources of these ingredients are well understood so pig performance is predictable. From a feed processing standpoint reducing corn particle size can improve feed efficiency and lower feed costs. Like particle size there is a significant value proposition with pelleting when feed prices are high. Feeding pelleted diets results in improvements in growth performance and feed efficiency. Other economic advantages to pelleting include: the ability to reduce particle size of cereal grains and have it flow well through feeding systems, increased use of lower cost alternative ingredients that may not flow in meal form, and lower transportation costs. Lastly, nutritionists must consider the use of feed additives as these technologies can result in significant feed cost savings when biological responses are adequately understood, and consequently, they are appropriately applied within a production system.

**Presenter Name:** Lucina Galina, Pig Improvement Company
**Author(s):** Lucina Galina
**Title:** Bringing a transformational technology to market: The PRRS-resistant pig

The porcine reproductive and respiratory syndrome (PRRS) is one of the most persistent and economically impactful swine diseases. Thirty years after discovering the PRRS virus (PRRSV), the industry struggles to control it despite significant efforts. Recent breakthroughs in gene editing have shown animals resistant to infection and, in so doing, created the potential to control epidemics. Using gene editing with CRISPR-cas9, a portion of DNA coding for a protein can be deleted. Unlike genetically modified organisms, in this case, DNA from another organism is not introduced to modify the genetic code. Evidence supports that CD163 is an indispensable monocyte and macrophage receptor, and specifically, its scavenger receptor cysteine Rich 5 (SRCR5) domain is crucial for PRRSV infection.1 CD163's main function is the clearance of cell-free hemoglobin and participation in inflammatory processes through a domain different than SRCR5, and no specific role has been associated with SRCR5 other than PRRSV infection.2 A founder population carrying an SRCR5 414 base pair deletion was used to build a commercial breeding population.3 Since the inheritance of the CD163 edited gene is recessive, homozygous pigs must be derived from homozygous dams and sires to carry the resistant genes. Homozygous, heterozygous, and null pigs were inoculated with four PRRSV isolates, including type I (SD13-15, SD01-08) and II (144 L1C, NVSL97 L8). The studies were conducted in BSL2 facilities at Midwest Veterinary Services in Oakland, NE. Veterinarians and caregivers who oversaw the inoculation and sample collection were blinded to the zygosity of the pigs. Weaned pigs arrived at the BSL2 facilities, acclimated for one week, and were intranasally inoculated with 3 mL of PRRSV (± 104 TCID50). Sera were taken before and at 3, 7, 10, 14, and 21 days post-inoculation. Clinical assessments were obtained, including daily temperatures, demeanor, and respiratory scores (0-3). PRRSV PCR and ELISA tests were conducted at the ISU VDL, and the diagnostician was blinded to the pig identifications. Overall, the type II isolates were more pathogenic than type I. No pigs showed demeanor or respiratory scores higher than 1. There were some differences, however, in the clinical assessments when comparing homozygous vs. heterozygous and null pigs, which were evident when pathogenic strains were evaluated. For example, heterozygous and null pigs inoculated with 144 1C had higher average temperatures and clinical scores than homozygous. The homozygous pigs were consistently negative by PCR across the bleeding times, while heterozygous and null pigs were positive. The homozygous pigs did not mount an immune response detectable by ELISA. In contrast, heterozygous and null pigs seroconverted. Additional studies using flagship isolates from contemporary US dominant lineages L1H, L1A, and L1E have shown consistent results. These outcomes suggest that gene editing may offer an unprecedented opportunity for controlling this challenging virus that has plagued the global swine industry for several decades.

1Whitworth et al., 2016, Nature Biotechnology; 2Burkard et al., 2017, PLOS Pathogens, 3Cigan et al., CABI Agriculture and Bioscience, 2022.

**Presenter Name:** Bri Golob, NOMV
**Author(s):** Bri Golob
**Title:** Developing Mental Health Resilience by Embracing Vulnerability to Build Community

Research suggests that an effective tool for improving mental health is through community which increases resilience by creating a sense of belonging, support, and purpose. This presentation will explore the relationship between vulnerability and community building among food veterinarians and livestock/poultry farmers. The session is designed to lay a foundation for ongoing efforts to cultivate emotional safety when discussing mental health among attendees.

**Presenter Name:** Charlotte Halverson, AgriSafe Netowrk
**Author(s):** Charlotte Halverson
**Title:** The Culture of Agriculture: A Look at Your Mental Wellness

Let's Get Talking!

The agriculture industry has a higher rate of death by suicide and highest lifetime risk of depression compared to other occupations. Per the National Rural Health Association, the rate of suicide among farmers is three and a half times higher than among the general population (Eisenreich, BS & Pollari, MHA). Even if suicide is not the end result, depressive symptoms can increase the farmer's risk of injury and increase the likelihood of developing chronic disease, impacting overall quality of life. This fact impacts producers, their families, communities, and the professionals they intersect with on a regular basis- on top of that list are veterinarians. And yes, veterinary practice is a significant part of that number.

Your long hours, your expertise, and your compassion are profoundly impacted, and you are not alone in this burden.

AgriSafe is a 501(c)3 national non-profit organization that aims to improve the health and safety of farmers, and rancher through our Total Famer Health® approach.

The AgriSafe mission is to provide education, conversation, and resources for your local and regional health care providers, including veterinarian professionals. In this presentation for the Leman Conference, we will share appropriate resources.

Among them will be an introduction to QPR (Question, Persuade, Refer) for Ag Communities. This gatekeeper approach is directed toward intentional community and personal conversations on suicide prevention. While our rural culture influences our behaviors and health beliefs, it may also serve as a barrier to a healthy lifestyle.

Another resource, FarmResponse®, is an on-demand continuing education program that provides the full range of competencies necessary to provide appropriate mental health care for producers and their families. This knowledge is critical for professionals across all disciplines who serve rural communities.

Mental wellness and suicide prevention are vital components to a healthy community. People who share a common goal can accomplish things quicker and easier than if they were working alone.

Let's Get Talking!

**Presenter Name:** Jenelle Hamblin, Manitoba Pork
**Author(s):** Jenelle Hamblin
**Title:** The path toward PED elimination in Manitoba

Elimination has been the chosen strategy for management of Porcine Epidemic Diarrhea (PED) in Manitoba since its first case in 2014. Regions of the province have then experienced significant PED outbreaks in 2017, 2019 and 2021/22. Manitoba Pork and Manitoba's Chief Veterinary Office (CVO) have and continue to work collaboratively to assist impacted farms and their veterinarians to navigate PED.

The Future of PED in Manitoba

Despite the sector's commitment and best efforts on PED elimination it became apparent that PED management efforts needed review. Dealing with a major outbreak every other year is not sustainable for the industry and an in-depth evaluation of PED management was required. Manitoba Pork convened a working group of industry stakeholders in early 2022 that included representation from producers, veterinarians, Manitoba CVO and Manitoba Pork.

The mandate of the working group was to:

1) Outline both short- and long-term objectives for managing PED in Manitoba.

2) Assess possible strategies that could be employed to manage PED.

3) Determine the impacts of the strategies used in the high-risk area on other areas of MB.

4) Provide outreach and messaging to the sector on PED management.

As a first step, the working group commissioned a review of PED management strategies. Completed by the Western College of Veterinary Medicine in April 2022, this review focuses on PED strategies employed in different jurisdictions across North America with examples including elimination, gilt exposure, endemicity, vaccines, and/or running positive flows. Based on this review, the working group decided that PED elimination remains the best option for Manitoba.

Development of a PED Elimination Plan

In 2022-2023, the working group collaborated with sector partners to develop an elimination framework titled Manitoba's PED Elimination Plan – A Sector Approach to Disease Management. The plan outlines an overall goal with associated objectives and prevention/intervention actions. Spanning five years (2022-2027), the plan is a living document that will be consistently reviewed to adjust strategies based on new experiences and learnings.

The goal is to eliminate 96% of PED infections in the high-risk area of Manitoba by 2027, done in a stepwise process by reducing the number of infections each year through prevention and intervention actions. These actions focus on surveillance, enhanced biosecurity, and rapid and aggressive elimination recommendations at the farm level. The plan also outlines areas of future consideration where industry can focus risk-mitigation efforts such as managing PED-infected manure, high traffic facilities, and exploring the use of vaccines. Currently, there are ongoing discussions around insurance (or other methods of compensation for elimination costs), as well as modelling work being done to support these recommendations.

PED elimination requires a sector-wide response. Manitoba Pork and the CVO will continue to work collaboratively with swine producers and their veterinarians to find effective and acceptable strategies. The Future of PED Working Group created a road map, and it will take commitment from all parties to achieve success.

**Presenter Name:** John Harding, University of Saskatchewan
**Author(s):** John Harding
**Title:** The emerging pathogen dilemma: association or causality?

The first known evidence of disease associated with PCV2 infection was in 1991 in a small family farm in NE Saskatchewan that experienced an outbreak of weight loss, dyspnea, tachypnea, jaundice in grower pigs. Experts failed to identify the cause at the time. The association with PCV2 was made retrospectively using immunohistochemistry (IHC) on archived paraffin embedded tissues after the characterization of postweaning multisystemic wasting syndrome (PMWS) in 1995/96 by Harding and Clark (1, 2). That characterization was based on the "index" case of PMWS/PCVAD in Canada in a 600 sow, high-health (PRRSV, M. hyopneumoniae, APP free) farrow to finish farm that experienced a 16-month outbreak of weight loss/emaciation, tachypnea, dyspnea and jaundice in 6 to ~13 week old pigs. The first association with PCV2 was made in late 1996 (3) and first detection and isolation of PCV2 from affected pigs made in 1998 (4). Lesions of PMWS, were experimentally reproduced in gnotobiotic piglets inoculated with either filter-sterilized homogenates of lymph node from an affected pig, or chloroform-treated virus culture filtrates (high and low passage)(5). PCV2 and porcine parvovirus (PPV) were subsequently isolated from tissue pools collected from inoculated pigs in all groups. Clinical signs and lesions were reproduced experimentally in colostrum-deprived pigs co-infected with purified PCV2+PPV virus (6). Immune stimulation was identified as a "pivotal event" inducing clinical signs and lesions when disease was experimentally reproduced in gnotobiotic pigs inoculated with purified PCV2 then immune stimulated with keyhole limpet hemocyanin in incomplete Freund's adjuvant (KLH/ICFA) with or without intraperitoneal injections of thioglycollate broth (7). The case definition (Table 1) was first proposed in 2000 (8) and affirmed in 2002 (9). The name PMWS was deemed inappropriate and replaced by porcine circovirus associated disease (PCVAD) in 2007 (10).

Table 1. Initial case definition as proposed by Sorden 20008

"Diagnosis of PMWS requires that a pig/group of pigs exhibit all of the following:"

• Clinical signs: wasting/weight loss/ill thrift/failure to thrive, with or without dyspnea or icterus;

• Histological lesions: depletion of lymphoid organs/tissues and/or lymphohistiocytic to granulomatous inflammation in any organ (typically lungs and/or lymphoid tissues, and less often liver, kidney, pancreas, intestine);

• PCV2 infection within characteristic lesions.

While Europe experienced waves of PCV2 outbreaks starting in 1994 in France with "wasting disease of piglets" (11) attitudes of PMWS in North America remained largely unenthused, and even hostile at times until the mid-2000's. While speculative to some degree, I believe the anti-PCV2 attitudes in North America from 1996-2004 were founded on four main factors: the absence of widespread outbreaks, intensive industry focus on PRRSV control, debate regarding the fulfillment of Koch's postulates, and discomfort with the "necessary but insufficient" disease paradigm. The objective of this presentation is to highlight important milestones related to the discovery of PCV2, discuss why it was controversial, review pertinent disease causation theories and discuss causation criteria best suited for future emerging pathogens/diseases for swine medicine.

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**Presenter Name:** Lauren Harper, Cornell University
**Author(s):** Lauren Harper
**Title:** Exploring the use of ultrasonography at palpable landmarks on sows to measure and track body composition

Swine production systems that minimize sow replacement rates are more profitable, yet the average replacement rate is between 40-50%. Most culled sows also have lower body caliper scores. Many of the main reasons for culling sows can be traced back to body condition (failure to breed, return to estrus, lameness, etc). Despite the importance of maintaining sow body condition, commonly applied monitoring methods are primitive and wrought with individual bias, such as visual body condition scoring (vBCS). The ideal monitoring system of sow body condition would not involve human labor or bias and would predict and understand fat and muscle mobilization beneath the surface. Ultrasonography at the last rib is commonly used to understand carcass quality in finisher pigs, but minimal work has been completed in sows. There are only moderate correlations between ultrasound measurements at the last rib and true carcass measurements, and alternative locations on the sow have not been investigated to gain a fuller understanding of individual sow fat distribution and mobilization during lactation. The goal of this work was to improve ground truth indices on muscle and fat deposition throughout the sow to be used in breeding decisions and further research. Specifically, there were two objectives within this study (1) to identify novel sow ultrasound landmarks and determine inter- and intra-observer repeatability, and (2) to use repeatable measurements to understand changes in fat and muscle depth through weekly scanning over a single lactation. For the first objective, 18 cull sows were randomly selected to be scanned and measured by two observers once daily over a 3-day period. Measurements included vBCS, weight, flank-to-flank weight estimates, body caliper at the shoulder, last rib, and hip, and height. Ultrasonographic measurements were taken at the last rib, hip, neck, shoulder, tail, flank, and 5 ribs cranial to the last rib (10th rib). The second objective used the same observers as the first, which repeated measurements weekly from the day before entering farrowing to weaning. Our preliminary results suggest that weight is insufficient to track changes in body condition loss in sows over lactation. The body caliper can also be used at the tips of the ilium (a palpable landmark) as a proxy for back fat over the last rib. The shoulder, neck, and ilium can be used as new ultrasound landmarks to understand sow body composition.

**Presenter Name:** Karyn Havas, Pipestone Research
**Author(s):** Karyn Havas
**Title:** Novel diagnostic sampling methods and type: A short review of research and implementation.

The first discussion in on the evaluation of meat juice conducted at the Makerere University Central Diagnostic Laboratory in Uganda. WOAH-recommended and approved USDA sample types are limited, and additional options are needed. Diagnostic results from meat juice and muscle swab samples were compared to spleen and spleen swab samples from pigs with at least two clinical or pathologic signs of African swine fever (ASF). Pools of meat juice, muscle swab and spleen samples were also evaluated (1 positive and 4 negative per pool). Meat juice had the highest positivity rate (72.4%) and it was significantly different than the other sample types. It was followed by spleen (50.1%), spleen swab (48.9%) and muscle swab (44.2%), which were not significantly different. Spleen samples had the lowest cycle threshold (Ct) value (21.9) and 100% of the pooled samples were correctly classified as positive. Meat juice had the next lowest Ct value (23.2), and one of the 72 pools was misclassified as negative. Muscle swabs had the highest Ct value (26.7), and five pools were misclassified as negative. Meat juice may be a viable sample type and should be further evaluated, particularly using a genotype II virus. A swine testing for ASF and classical swine fever monitoring program from on-farm mortalities was piloted by Pipestone Veterinary Services. The purpose was to understand how such a program would function if it would ever be needed for regionalization or compartmentalization in the US. Samples were submitted from pigs that met the USDA ASF Integrated Surveillance case definitions. The first phase had spleen samples collected using a low-exposure sample collection method. Producers sent 573 samples between September 2021 and April 2022. The main reasons for submission were lameness, off-feed, and lethargy, although neurologic signs, pigs with red skin, and increased mortality were also in the top ten. Sample collection on market pigs was most difficult, but, overall, most producers preferred spleen sampling to oral fluids when considering manpower, time, and ease. During the second phase, a subset of reliably participating farms collected 300 spleen samples as well as 295 oral fluid samples from the pen where the pig died or adjacent crates. Certified swine sampling program (CSSP) training was also provided. The main reasons for submission matched part one and neurologic signs, skin redness and increased mortality were still in the top ten reasons for a sample to be submitted. Responses from a survey showed that spleen samples were easier to collect on nursery pigs and oral fluids on market pigs. The respondents also said that the CSSP training also provided them with new information. Overall, for a successful on-farm monitoring program, the samples need to be easy to collect without causing environmental contamination, the paperwork needs to be clear and filled out in advance as much as possible, and there needs to be a purpose or return to the farmer as it takes time and resources.

**Presenter Name:** Tyler Holck, US SHIP
**Author(s):** Tyler Holck
**Title:** US SHIP update

US SHIP is being modelled after the National Poultry Improvement Plan (NPIP), a collaborative effort involving industry, state, and federal partners providing standards for certifying the health status of greater than 99% of commercial scale poultry and egg operations across the US.

US SHIP aims to establish a similar platform for safeguarding, improving, and representing the health status of swine across participating farm sites, supply chains, states, and regions. Such a working system is needed to support the current and future health assurance needs of the 21st century US pork industry.

The initial and principal objectives are to develop and implement an African Swine Fever (ASF)- Classical Swine Fever (CSF) Monitored Certification of US pork production operations (farm sites and slaughter facilities) modelled after the NPIP's H5/H7 Avian Influenza Monitored certification of US Commercial Poultry operations.

The US SHIP ASF-CSF Monitored certification aims to mitigate risks of disease introduction and provide a practical means for demonstrating evidence of freedom of disease (outside of foreign animal disease control areas) in support of ongoing interstate commerce and a pathway towards the resumption of international trade over the course of a trade impacting disease response and recovery period.

US SHIP is designed to be applicable across the full-spectrum of US pork industry participants from the small show pig farmer to the larger commercial producers, live animal marketing operations, and slaughter facilities. Deriving program standards that are relevant to and enabling participation across the full-breadth of US commercial pork industry participants is essential. A critical mass of participation is a foundational element necessary for being able to represent the health status of domestic pig production operations across supply chains, areas, states, and regions.

Initial participation in US SHIP has been very encouraging with 33 states establishing Official State Agencies (OSA) to administer the program (modelled after NPIP) representing all of the major swine states. Producers enroll their farms at the site level and as of July 31, 2023 the total number of sites enrolled in US SHIP was over 10,800 representing 68% of the US breeding herd and 61% of the growing pig herd!

An on-line biosecurity survey is completed by producers at enrollment. The survey includes questions regarding site biosecurity, feed biosafety, and transport sanitation with results serving to further inform US SHIP working groups on the current state of the industry with regard to biosecurity. An overview of those results will be shared during this presentation.

US SHIP also has the potential to establish health certification programs for domestic or endemic diseases such as PEDv and Mycoplasma, again modelled after NPIP. The foundation of biosecurity, traceability, and surveillance being developed for ASF/CSF is relevant for domestic diseases as well.

In summary, US SHIP will establish a national playbook of technical standards and associated certification recognized across participating states that centers on disease prevention and demonstration of freedom of disease outside of control areas in support of animal health, commerce, and trade. Future opportunities exist to establish valuable health programs for domestic diseases.

**Presenter Name:** Tyler Holck, US SHIP
**Author(s):** Tyler Holck
**Title:** How can US SHIP help advance control and elimination efforts of endemic diseases?

US Swine Health Improvement Plan (US SHIP) is being modelled after the National Poultry Improvement Plan (NPIP), a collaborative effort involving industry, state, and federal partners providing standards for certifying the health status of greater than 99% of commercial scale poultry and egg operations across the US.

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Considerations to establish new programs for domestic diseases such as PEDv and the potential to eradicate them will require three key elements:

- Platform for dialogue and confirmation of the "political will" and eventually certification standards for a domestic disease – the role of US SHIP.

- Science to know how/when/where to achieve success. Individual farm clean-up and prevention, regional clean-up and prevention, and eventually national clean-up and prevention.

- Tools such as vaccines, diagnostics, and measurements as well as financial support.

In summary, US SHIP is establishing a national playbook of technical standards and associated certification recognized across participating states that centers on disease prevention and demonstration of freedom of disease outside of control areas in support of animal health, commerce, and trade. Future opportunities exist to establish valuable health certification programs for domestic diseases with the potential for eventual eradication of endemic diseases impacting the health and well-being of our US swine industry.

**Presenter Name:** Bill Hollis, Carthage Veterinary Service
**Author(s):** Bill Hollis
**Title:** The Cost of PEDV to US producers and the Benefits of industry wide virus elimination

When PEDV was first introduced in 2014 there was nearly an industry wide panic of significant baby piglet losses and market disruption. Dr Lee Schulz and Dr Glynn Tonsor wrote a comprehensive analysis of the cost of the outbreak and the economic impact to the industry for the NIH in early 2015. While the actual percentage of piglet losses were eventually proven to be small (4-5% in total pig losses) the impact to the economics of the industry came at a time when export and domestic demand both peaked. The industry enjoyed a 10% increase in demand.

I believe this false sense of market recovery has allowed some to accept an endemic disease problem which we have the tools to eliminate.

COST

Breeding herd cost for example is a naive herd of 5000 sows which could easily lose one month of pigs. (12,500 pigs at $40 weaned pig value) is at least a $500,000 loss to this herd. This impact does not over the cost of labor and clean up as well as the potential of lost business should this be a weaned pig producer or gilt multiplier.

The most common three periods of exposure are weaned pig placement, feeder pig movement, and slaughter pig movement. I will outline these three and offer some ongoing opinion as to the producer impact in this area. Weaned pigs at normal 21 day age and above show a 5% increased mortality and 5 days of lost gain. Feeder pigs loss high cost feed into the pit, and also show growth loss but little mortality as a result. Slaughter weight pigs have the highest economic loss given the high cost of feed and the lost pounds during a presumed period of fixed marketing.

Using the same model of a 5000 sow farm which would have 75,000 pigs on feed we can begin to estimate the dollars lost from these three populations. Marketing groups would be close to 15% of the population at any given time. 15% active with PEDV would impact 11,250 slaughter weight pigs during an outbreak. If all the feed goes through the pig and directly into the pig for 3 days this represents 18 pounds of feed at 15 cents per lb. or about $2.70 per pig. Space cost for no growth during this period at 12 cents per day is another 36 cents total so easily the loss at slaughter is $3 per pig.

Weaned pig losses are economically even less if you consider the similar population of a 5000 sow farm and lateral introduction. 5% loss for 4 weeks of pigs is 625 pigs at $40 each this is only $25,000.

Unfortunately, the perceived low cost by comparison in the wean to market business has lulled us into a false sense of acceptance of this disease.

BENEFIT

My challenge to the industry is to consider mass vaccination of the entire growing pig population. The 5.5MM sow herd industry has a 5% industry break rate if we use the MSHMP data. 5% break rate is 55 sow farms in our example or a $27MM drag on the industry every year!

WL Hollis DVM

**Presenter Name:** Derald Holtkamp, Iowa State University
**Author(s):** Derald Holtkamp, Kate Dion, Kinath Rupasinghe, Peng Li, Chris Mowrer, Daniel Linhares, Gustavo Silva, Paul Sundberg, Megan Niederwerder
**Title:** Conducting effective outbreak investigations: Web-based industry-standard outbreak investigation instrument

In 2021, the Swine Health Information Center (SHIC) funded the development of a standardized outbreak investigation instrument. A working group of fourteen swine veterinarians was formed to develop the instrument and approach to conducting outbreak investigations. The working group aimed to create the industry-standard form and reporting instrument to; 1) assure that the most relevant information is being gathered, 2) enable the logging of data from the investigations in a database that can be analyzed quickly for associations and patterns, and 3) generate buy-in and increase the likelihood of adoption by the entire industry. The standardized outbreak investigation is conducted as an integrated biosecurity hazard analysis and epidemiological investigation. Hazard analysis applied to biosecurity on swine farms is a method of collecting and evaluating information on biosecurity hazards associated with introducing pathogens into a susceptible herd.

A white paper describing the scope, methodology, and terminology of the standardized outbreak investigation and the investigation and reporting instrument were reviewed by the American Association of Swine Veterinarians (AASV) Porcine Reproductive and Respiratory Syndrome (PRRS) Task Force and Transboundary and Emerging Diseases Committees and endorsed by the board of directors of the AASV in April 2023.

A web-based version of the standardized instrument, which makes it easy for veterinarians to use and capture data from the investigations in a secure industry-wide database, has recently been developed with funding from SHIC. The web-based program was developed by programmers in the Department of Veterinary Diagnostic and Production Animal Medicine at Iowa State University. In addition to the information entered into the investigation form, information may come from multiple sources, including uploaded files and images, weather data from publicly available weather sources, and animal movements from AgView. The web-based program will allow veterinarians to conduct outbreak investigations consistently and automatically generate reports. For a single producer or production company, the information from each investigation will be stored in a secure, searchable, and exportable database that will enable analysis of the information gathered over time. Anonymized data from the database will also be available for analysis. Every submission will strengthen the database, which can also be mined to find industry trends and opportunities to learn from the collective experience of the industry to answer questions like; what are the most frequent ways pathogens are introduced into swine herds, what are the significant biosecurity hazards and what are the common gaps in biosecurity.

To access the web-based program, contact Dr. Derald Holtkamp at holtkamp@iastate.edu or Chris Mowrer at clmowrer@iastate.edu. Access is initiated by setting up an account for a company or producer administrator, which may be a veterinarian. Once the account is set up, the company or producer administrator can start investigations and set up accounts for other users to start investigations and view stored investigation reports.

**Presenter Name:** Alexa Lamm, University of Georgia
**Author(s):** Alexa Lamm
**Title:** Current state of Agricultural Communications and Tips for Communication

We face a myriad of challenges when communicating evidence-based information about agricultural production practices in a manner we want to be perceived as trustworthy. Complexities associated with communication include a lack of public scientific trust, the steady stream of misinformation and disinformation available to consumers on a variety of communication platforms, and a general sense of difficulty processing the massive amounts of information we are presented with each day. Consumers are regularly faced with novel information as new technologies emerge while being asked to trust experts in uncharted territory in which the consumer has no experience or direct knowledge - especially related to the food they consume and what they choose to feed their families. While the public may trust scientists to deliver accurate information about the effects of agricultural technology on the food supply, they are skeptical about the effects of specific agricultural production practices on people, animals, and the environment. In addition, younger generations, such as millennials and Gen Z, hold strong opinions and are active in issues concerning agricultural advancements and the environment. Millennials, individuals born between 1981 and 1986, currently make up the largest living generation of adults in the United States and control markets through their purchasing and voting power. This generation of consumers are digital natives. They experience the world through technology and their identities are directly tied to their online personas. They often do not differentiate between in person and online interpersonal relationships and define trusted sources differently than the generations that came before them. Therefore, agricultural communication can no longer use a one size fits all model with a singular message expected to resonate with a general consumer audience. Instead, we must consider the primary audience trying to be reached and develop strategies for communication based on their needs. Specific needs of each audience include 1) identifying where the audience communicates – using the channel they use, 2) determining what messaging resonates based on their personal concerns, and 3) using the source they find credible – determining who they trust. Tips will be offered focused on identifying specific needs and then designing creative, innovative communication strategies to reach diverse audiences.

**Presenter Name:** Erin Larsen, Lincoln Memorial University College of Veterinary Medicine
**Author(s):** Erin Larsen
**Title:** Sparking new solutions to long-term problems in the agricultural work force

Attracting and retaining farm staff is one of the most pressing issues that the swine industry currently faces. Job satisfaction, working conditions, wages and benefits, career growth opportunities on the farms, and the health status of herds all have an impact on the overall retention of farm employees. Previous studies have found that high turnover rates can be costly for biosecurity compliance, animal health, productivity, and morale. In today's labor crisis, it is imperative to understand the environment that impacts employee retention. In 2022, a survey was created for farm employees that addressed a range of questions regarding job satisfaction. The study provided baseline results that indicated that farm employees have a passion for their jobs, working on a team, and achieving the farm's goals. This year, the survey was re-evaluated and adapted to allow for comparison of farms over time while also considering new topics. The objective of this project was to continue investigating links between employee perceptions, farm characteristics, recent events, and historic turnover rates in an effort to drive progress in employee satisfaction and retention. A 19-question survey was developed and delivered to 12 farms asking a range of questions regarding job satisfaction, growth opportunities, interpersonal relationships, compensation, work-life balance, working conditions, and technology use. Employees were instructed to circle one of four responses on a Likert scale. Staff members were asked to answer anonymously and managers were encouraged to leave the room as surveys were being administered. Surveys were offered in both English and Spanish. Survey responses were evaluated quantitatively using a 1-4 scale. A score of 1 represented a "Strongly disagree" result, and a score of 4 represented a "Strongly Agree" result. Three open-ended questions were asked regarding overall satisfaction and suggestions for improvements. Results were analyzed for trends between farms and compared to 2022 survey data. 4 of the 12 farms also utilize an innovative technology platform that is used through a mobile application. These farms were asked five additional Likert scale questions and three additional open-ended questions. An initial summary of results and discussion, along with a link to the full survey is provided within the supplementary document. Findings will be presented at greater length if this project is selected for presentation. Thank you for your consideration.

**Presenter Name:** Mickey Leonard, University of Minnesota
**Author(s):** Mickey Leonard, Catherine Alexander, Peter Bonney, Carol Cardona, Cesar Corzo, Marie Culhane, Timothy Goldsmith, Dave Halvorson, Rosemary Marusak, Miranda Medrano, Amos Ssematimba, Kaitlyn St. Charles, Margret Tavai-Tuisalo'o, Emily Walz, Sylvia Wanzala Martin
**Title:** What is acceptable risk?

During a foreign animal disease outbreak, ensuring the food supply is secure is an essential need for agricultural industries, thus, the Secure Food Systems team began developing risk assessments to understand the risk of continuity of business movements. Risk assessments are a useful tool to inform federal and state regulators of the risk of moving animals or animal products within or outside of a Control Area. Risk assessments offer overall risk ratings for a movement, which includes a range due to the uncertainty that exists from every movement having unique circumstances. Despite the existence of this uncertainty, true risk is able to be evaluated for every move by state and federal regulators when issuing movement permits by using the risk equation. Risk can be defined as an equation of the likelihood of disease spread and the consequence of that spread from a movement. The likelihood of disease spread of a movement is determined by analyzing practices to mitigate disease introduction, contamination, and spread, evaluating the chance of susceptible species being infected from the animal or animal product being moved, and calculating the probability of detecting the presence of a disease in an animal or animal product via surveillance testing. The consequence of the movement is determined by factors surrounding the move, such as, where the animal or product is being moved to, and what the animal or product is being moved for (e.g., to slaughter or to continued production).

While the risk equation will always stay true, the actual risk for every movement is variable since likelihood and consequence can fluctuate. Not all movements of the same type have the same likelihoods and consequences, so true risk must be evaluated on a farm-by-farm basis. Likelihood may change relative to the mitigations that are put in place to reduce the potential for virus introduction and spread. There are varying levels of mitigations that are put in place, peacetime industry practices, outbreak-specific measures, and targeted, enhanced measures, that when layered, could provide additional protection and reduce the likelihood. On-farm biosecurity measures are a key component to the likelihood level. Depending on the amount of mitigations and strict biosecurity measures put in place on each farm, likelihood may increase or decrease. Similarly, consequence can increase or decrease depending on the specifications for each movement. For example, if an animal or animal product is being moved to a location without other animals on-site, the consequence of unintentionally moving infected, but undetected animals or products is lower than if there are animals on-site.

Once all of the pieces of the risk equation are evaluated, consideration of risk by stakeholders occurs to determine if the risk is acceptable. Some risk is deemed unacceptable due to being very likely to contribute to spread, has a very high consequence if spread were to occur even if overall likelihood of spread is low, or combinations of the two. Producing resources for stakeholders to make this determination is an important part of considering what acceptable risk is.

**Presenter Name:** Chong Li, University of Minnesota
**Author(s):** Chong Li, Marie Culhane, Declan Schroeder, Montserrat Torremorell
**Title:** Influenza reassortment - survival of the fittest

Reassortment is a primary genetic evolution mechanism for the swine influenza virus to expand the genetic diversity in pig herds and results in an abrupt change of the virus phenotype or even its biological properties. Both the pigs themselves and the complex ecosystems they were raised in position the pig and swine farms as ideal hosts and sites from which reassortant viruses emerge. Most of our understanding of the presence of reassortants in individual pigs has been obtained under experimental conditions. However, we lack information about the level of reassortment that happens at the individual pig in the field and the difference in replicative fitness between naturally reassorted viruses. In the first part of this presentation, we will review the current knowledge on the factors contributing to influenza reassortment and onward transmission and published studies exploring influenza reassortment in pigs at experimental conditions. In the second part, we will present our latest research which assesses the extent of IAV reassortment and growth characteristics of reassortants obtained from naturally infected pigs in farm settings.

**Presenter Name:** Valeria Lugo, Universidad Nacional de Colombia
**Author(s):** Valeria Lugo Mesa, Nader M. Sobhy, Muhammad M. Luqman, Cesar Corzo, Sagar M. Goyal
**Title:** Survival of five strains of PRRSV in tap water at 3 different temperatures

PRRS is still considered one of the most economically important diseases of swine, with losses mainly related to poor reproductive performance and mortality. Currently, management and biosecurity measures are important strategies used to control PRRS, however, outbreaks are still common. Little information is available regarding viral stability in water and the possibility of this milieu to help disseminate the virus. In this study, we tested the survival dynamics of PRRSV in sterile and unsterile tap water at three different temperatures (4°C, ~25°C, and 37°C). Tap water obtained from laboratory faucet was collected in glass bottles, which were then labelled for the following conditions: autoclaved and non-autoclaved chlorinated tap water and autoclaved and non-autoclaved dechlorinated tap water. Sodium thiosulfate at 30 mg/L was used for dechlorination. Four strains of PRRSV-2 (1-7-4, 1-4-4 SD, MN-30100, VR-2332) and one PRRSV-1 (Lelystad) were grown in Marc-145 cells to titers of 104.5 to 105.5 TCID50/0.1 ml. Then, 750 µl of each virus was added to each 3750 µl-aliquot of the four different tap water samples, for a final 1:6 dilution. The mixed aliquots were tested for an initial titer by TCID50 microtitration assay and then placed at their respective temperatures for further sampling over time. At each time point, 500 µl of sample was collected, homogenized, and immediately titrated. Three replicates were run for each sample. Results show prolonged survival (>35 days) of all strains at 4°C with lower survival time at room temperature (3 to 7 days), and lowest survival at 37°C (< 1 day). These results indicate a potential risk of water as a PRRSV carrier, especially at cold temperatures.

**Presenter Name:** Sarah Lutz, Auburn University
**Author(s):** Sarah Lutz
**Title:** Pharmacokinetics of ceftiofur crystalline free acid in the first hour after single dose intramuscular administration in swine

Introduction

Swine practitioners consider many factors when implementing antibiotic regimens, including labeled pathogens, clinical breakpoints or minimum inhibitory concentrations, cost, ease of implementation, and withdrawal times. Duration of therapy is another factor to consider, especially with today's challenges in labor. Ceftiofur crystalline free acid (CCFA, Excede for Swine®, Zoetis) has proven duration of therapy of seven days in an APP challenge model. Previous studies also showed that CCFA reaches plasma concentrations of 2.23 ug/mL at 1 hour post-injection. This is above the MIC90 for Streptococcus suis, which is 2.0 ug/mL. However, little is known about the pharmacokinetics of CCFA at shorter time periods post-injection, specifically in the first hour. To understand how quickly CCFA reaches concentrations at or above MIC values for targeted bacteria, the objective of this trial was to study the pharmacokinetics of CCFA in the first hour after a single intramuscular dose.

Materials and Methods

Six, 21-day old pigs of mixed sex were selected, weighed, and enrolled from two litters. A labeled dose of 1 ml/44 lb (5.0 mg/kg) of CCFA was calculated for each pig. Blood was collected from each pig at 0, 5, 10, 15, 30, 45, and 60 minutes following administration of a single intramuscular dose of CCFA. All blood samples were collected into heparinized tubes and centrifuged to obtain heparinized plasma. The concentration of ceftiofur and its active metabolite, desfuroylceftiofur, in plasma were determined using a derivatization method and reversed phase high pressure liquid chromatography.

Results

Plasma concentrations are shown in Table 1. Chart 1 shows the mean plasma concentrations by time relative to MIC90 for Streptococcus suis (2.0 ug/ml). Mean concentration was 1.37 ug/ml at 5 minutes, 1.90 ug/ml at 10 min, 2.44 ug/ml at 15 min, 3.83 ug/ml at 30 min, 5.16 ug/ml at 45 min, and 6.71 ug/ml at 60 min.

Discussion

Based on MIC90 values for Streptococcus suis, CCFA achieved therapeutic plasma concentrations in all pigs by 30 minutes post-injection. Most pigs were above the threshold after only 15 minutes. Producers and practitioners can be confident that CCFA not only has a long duration of therapy, but also reaches therapeutic levels rapidly.

**Presenter Name:** Alexey Markin, National Animal Disease Center, USDA-ARS
**Author(s):** Alexey Markin, Sanket Wagle, Siddhant Grover, Oliver Eulenstein, Amy L. Baker, Tavis K. Anderson
**Title:** Making objective and informed influenza A virus strain selections

The use of next-generation sequencing technology and the USDA in-swine influenza A virus (IAV) surveillance help us understand and characterize the diversity of swine IAV circulating in swine in the US. A major challenge associated with genomic surveillance data is using the generated genetic sequences to inform vaccine composition and use. To address this problem, we proposed PARNAS, an objective and flexible algorithm to select most representative IAV strains from the sampled genetic diversity. To demonstrate its utility, we applied PARNAS to (i) select representative influenza A virus in swine genes derived from over 5 years of genomic surveillance data, and (ii) identify gaps in H3N2 human influenza A virus vaccine coverage, and (iii) quantify SARS-CoV-2 genetic diversity over time. PARNAS is available at https://github.com/flu-crew/parnas.

Another challenge that confounds effective vaccine deployment in IAV is reassortment and associated changes in genetic and antigenic diversity. Although the importance of reassortment is well-recognized, there are few tools that are easy to implement and enable tracking of within- and between-lineage reassortment. In practice, this has limited most studies to focusing on the hemagglutinin (HA) gene with limited consideration of other gene segments. To overcome this, we proposed TreeSort, a tool that employs rigorous hypothesis testing to detect reassortment among recent and ancestral IAV strains. TreeSort runs on top of a fixed segment phylogeny, e.g., an HA phylogeny, finds the branches on the tree where reassortment has occurred, and reports the gene segments that were involved in reassortment. We analyzed 1,700 swine H1 whole genomes and determined the preferential pairings between different gene segments based on the frequency of reassortment among the segments. There were strong pairings between HA and NA, and strong linkage in the polymerase complex of PB2-PB1-PA. However, HA and NA pairs frequently reassorted with different internal gene combinations. Individual internal genes were less likely to be involved in single-gene reassortment events. Additionally, using 10,000 human H1N1pdm09 genomes, we identified clade-defining reassortment events in the 5a.1 clade in 2020 and 2021. TreeSort enables (i) real-time tracking of IAV reassortment from human and animal hosts, (ii) studies to determine how specific genes compensate in response to reassortment events, and (iii) can be used to assess the impact and role of reassortment at the genome level in virus phenotype. TreeSort is available at https://github.com/flu-crew/TreeSort.

**Presenter Name:** Miranda Medrano, University of Minnesota
**Author(s):** Miranda Medrano, Marie Culhane, Carol Cardona
**Title:** Review of disease transmission pathways from feral swine to domestic pigs

Introduction: Feral swine are an invasive species in the United States (US) that cause damage to agriculture property, livestock, and natural resources (water and land). Feral swine have been reported in at least 35 US states and have an estimated population of more than 6 million. In addition to the environmental damage, feral swine can and may harbor numerous pathogens, both swine-specific and zoonotic. African Swine Fever (ASF) virus (ASFV) is arguably the pathogen of major concern. ASF is a foreign animal disease of high consequence, and although never diagnosed in the US, its introduction and subsequent spread would have myriad negative consequences for US domestic pig populations and the pork industry. In the US, the feral swine range map overlaps that of domestic pigs. Therefore, identifying the disease transmission pathways for which ASF can be transmitted from feral swine to domestic pigs is important for disease prevention.

Methods: To provide information regarding the ways infected feral swine could transmit ASFV to domestic pigs, a pathways analysis approach, similar to the approaches used in the risk assessment process by the Secure Food Systems team, was completed. The following pathways have been identified in the "Assessment of the Risk Associated with the Movement of Liquid, Cooled Boar Semen Within, Into, and Outside of a Control Area During an ASF Outbreak in the US" that is in development as potential pathways for ASFV transmission. The following pathways were explored for the transmission of ASFV from feral swine to domestic pigs.

1. Wild and peri-domestic animals

2. Mortality and cull management

3. Domestic animals

4. Insects and arthropods

5. Water

6. Feed and bedding

7. Aerosols

8. Vehicles and equipment

9. People

10. Biological materials

Results: Indirect and direct pathways of transmission were identified for all 10 pathways in published literature and case reports from countries outside the US that are ASFV positive and/or have eradicated ASFV.

1. Wild and peri-domestic animals: Feral Swine-Direct transmission; Other Wild Animals-Indirect transmission as fomites; Peri-domestic animals-Indirect transmission as mechanical vectors

2. Mortality and cull management: Direct Transmission-Contact with contaminated carcasses; Indirect Transmission-Hunting

3. Domestic animals: Indirect Transmission-Fomite

4. Insects and arthropods: Arthropods-Indirect Transmission via sylvatic cycle; Insects-Indirect Transmission as mechanical vectors

5. Water: Ingestion of contaminated water

6. Feed and bedding: Feed-Ingestion of contaminated feed; Bedding-Ingestion or inhalation of contaminated bedding

7. Aerosols: Inhalation of virus-laden air or ingestion of air particles

8. Vehicles and equipment: Fomite transmission

9. People: Fomite transmission

10. Biological materials: Direct transmission if biological material are contaminated with or contains viable ASFV and injected, ingested, or inhaled.

Conclusion: Some of the transmission pathways described in case reports are only theoretical and have not been shown to transmit ASFV experimentally. Therefore, these potential pathways need further elucidation. Additionally, it is expected that the pathways of transmission existent in the US from feral swine to domestic pigs will vary across the different regions and sectors of the US pork industry, and site-specific risk should be taken into consideration.

**Presenter Name:** Marcello Melini, UMN
**Author(s):** Marcello Melini, Mariana Kikuti, Montserrat Torremorell, Kimberly VanderWaal, Stephanie Rossow, Cesar A. Corzo
**Title:** Do all PRRSV variants have the same level of infectiousness?

Every year PRRSV (porcine reproductive and respiratory syndrome virus) spreads from farm to farm with some variants disseminating faster than others. Data on the degree of PRRSV variant infectiousness is scarce. We hypothesize that some variants are more infectious than others, which consequently results in higher transmission rates between pigs and farms. We, therefore, designed a study with the objective of comparing the degree of infectiousness among three PRRSV variants. These variants include the recently emerged PRRS L1C 1-4-4 variant, recognized for causing substantial production losses as per field observations, alongside two other variants, 2014 L1A 1-7-4 and 2000 L9 1-4-2 also known as MN 30-100. The proposed questions included whether or not these variants have similar levels of infectiousness, shedding patterns and cause similar tissue lesions in infected pigs. For each variant, thirty-six PRRSV ELISA and RT-PCR negative three-week-old barrows were randomly allocated to five challenge groups and one control group. Pigs were individually housed in separate rooms according to treatment groups. Pigs had no nose-to-nose contact but did share the same air space. All three viruses were grown in MARC-145 cells to a 105 TCID50/ml concentration and through 10-fold dilutions five different inocula concentrations were obtained ranging from 104 to 100 TCID50/ml. Pigs were intranasally challenged (1 ml per nostril) according to the group's selected virus concentration. Blood, nasal and rectal swabs were collected at day post challenge (DPC) 0, 1, 2, 4, 7, 11, 16, 21, 26, and 30 to assess infection and viral shedding through PRRSV RT-PCR. Researchers changed their gloves, masks, and gowns between sampling each pig. On DPC 11, two pigs from each group were euthanized, and tissues (e.g., brain, lung, lymph nodes) were collected for histopathological assessment. For this study, DPC 4 was chosen as the day to determine whether pigs had become infected. Using a probit model, the estimated median infectious dose 50 (ID50) (infective dose needed to infect 50% of exposed individuals) was 101.3 TCID50/ml (95% CI 100.4–102.2) for the L1C 1-4-4 variant, 102.3 TCID50/ml (95% CI 101.6–103.0) for the L1A 1-7-4 variant, and 102.6 TCID50/ml (95% CI 102.0–103.2) for the L9 1-4-2 variant. When adjusting for the TCID50/ml, the pigs challenged with L1C 1-4-4 were 13 (95% CI 3–16) times more likely to be RT-PCR positive on DPC 4 compared to pigs challenged with L9 1-4-2. Virus detection in nasal swabs began at 1 DPC and cycle threshold values decreased until DPC 7. Fecal shedding began at DPC 4 and peaked at DPC 7; intermittent nasal and rectal shedding patterns were similar for all viruses with slight differences between inoculum groups during the study period. Lungs have similar microscopic lesions regardless of dose, but the pigs infected with the L1C 1-4-4 were consistently more severe. Brain lesions were found in at least 1 pig within each concentration group in the L1C 1-4-4 challenged group, whereas this was limited to only 1 pig per variant in either the L1A 1-7-4 or L9 1-4-2 challenged groups. Heart lesions were mostly present in the L1C 1-4-4 variant group. Study results indicate that compared to the L9 1-4-2 and L1A 1-7-4 variants, the L1C 1-4-4 virus requires fewer viral particles to successfully infect half of the pigs by DPC 4. In addition, our data showed that the L1C-1-4-4 variant leads to more frequent and more severe tissue lesions in the lung, heart, and brain as compared to the other evaluated PRRSV variants.

**Presenter Name:** Maximino Montenegro, PIC PHIL
**Author(s):** Maximino M. Montenegro, Angel C. Manabat
**Title:** Challenges to successful control of ASF in the PHIL: Swine Practitioners' Perspective

African Swine Fever devastated the Philippine swine industry since its introduction in August 2019. By June 2023, it has spread to 17 (90%) regions, 66 (80%) provinces & 842 (57%) municipalities. ASF spread is continuing in commercial & backyard farms that have previously escaped the disease or have recurred, albeit unreported, in farms that repopulated.

In some provinces & cities, ASF has become a "political disease". Some local executives deny the existence of the disease and label it as Classical Swine Fever or any septicemic infectious bacterial infection.

After ASF hit China in August 2018, the BAI organized the ASF TWG composed of government veterinarians, private swine practitioners & swine industry stakeholders in September 2018 to prevent the entry of ASF into the country. The result was an ASF Preparedness Plan that was put into action in February 2019.

After the ASF outbreak in August 2019, a series of Administrative Orders (DAO) & Administrative Circulars (AC) were put into effect nationwide to control and stamp out the disease. The significant DA Orders & Circulars are 1) AC12 s.2019 Natl Zoning & Movement Plan for the Prevention & Control of ASF; 2) AO7 s.2019 Veterinary Quarantine Movement Protocol During Animal Disease Outbreaks/Emergencies (1-7-10); 3) AO7 s.2021 Implementing Guidelines for the "Bantay ASF sa Barangay" Program, 4) AO6 s.2021 Guidelines on the Implementation of Recovery, Rehabilitation & Repopulation Assistance Program for ASF affected & Non-ASF affected Areas.

Despite these stringent measures, the virus continued to spread throughout the country except for a few island provinces that has remained unaffected. Private swine practitioners viewed the failure to control the spread due to:

1. Failure to implement the ASF Preparedness Plan led to the entry of disease to the country by way of uncontrolled disposal of food wastes that were eventually fed to small holder swine farms in July 2019.

2. Training and knowledge dissemination regarding ASF, on how to prevent, identify and control the disease etc., did not reach many small hold farmers, leading to delayed reaction and reporting of cases.

3. Failure to monitor & restrict the movement of middlemen (viajeros) who control the swine industry supply chain (AC 12 s.2019 National Zoning & Movement Plan)

4. Failure to properly communicate & implement the surveillance & monitoring provisions of BABAY ASF (AO7s.2021 Bantay ASF sa Barangay Program or Prevent ASF in the Barrios)

5. Unsustainable indemnification policy & economic realities in the rural areas where small hold farmers tried to hide their pigs to avoid being culled. (AO7 s.2019 Veterinary Quarantine Movement Protocol During Animal Disease Outbreaks/Emergencies [1-7-10 protocol])

6. Regional Animal Disease Diagnostic Laboratories were ill equipped, overwhelmed by the volume of submissions, lacked trained staff and funds needed to purchase test kits.

7. Failure of border control & ineffective animal quarantine outposts – lack of personnel, security risks, aging Animal Extension Workers.

8. In municipalities bordering mountainous forested areas, the uncontrolled circulation of ASF virus between wild boars & domestic pigs & contributed to the spread of the disease.

9. Failure to properly implement the repopulation assistance program to benefit small holder farms. These small holder farms are the true economic engines of the rural areas & are instrumental in sending rural children to

universities. (AO6 s2021 Guidelines for the Implementation of Recovery, Rehab & Repopulation Assistance program for ASF affected & Non-ASF affected Areas)

10. And finally, lack of support, different policies or intransigence of some LGU executives down to the barangay level created confusion, paralyzed assistance & led to failure to control ASF in their localities.

These are the major challenges that contributed to failure to control ASF from the point of view of private swine veterinarians.

**Presenter Name:** Camille Moore, Swine Consultant
**Author(s):** Camille Moore
**Title:** Reasons for and conventional approach to "Bugs" elimination

R. Robitaille is a small production system totally integrated producing “niche” product for the Asian market. We are killing 600,000 pigs per year and producing 450,000 of those internally. In 2019 we develop a business plan to adapt all of our sow herds to met the loss housing system required in Canada by 2024 (now postponed to 2029). To do so the plan was to proceed at a depopulation and repopulation of our sow herds.

Our system is located in a very dense production area with many other producers. Our nursery and finisher get indirectly contaminated with Mycoplasma Hyopneumoniae, PRRS and swine influenza very often. When those contamination occur, the losses are mainly du to the secondary invader like Actinobacillus suis, Glaesserella parasuis and Strep. suis. Our goal was to “repop” our unit with sows exempts of those bacteria.

To produce the sows for our repopulation program we elected to populate a “nucleus” farm with caesarian derived, colostrum deprived piglets. Starting July 2020 and over a 5 months period, we did 108 c-section, produce 650 females and retained 500 at 21 days of age. From those we mated over 300 females to populate a 260 sows nucleus herd.

After the c-section and until 21 days of age piglets where kept in a quarantine section prior to the introduction in the main herd. At around 14 days of age, 4 piglets per batches (10 batches total) where scarify; tonsils, nasal swabs and joints swab collected. The following testing was performed on those samples: S. suis PCR (serotypes 1-9 + 14), GPS PCR (serotype 1,4,5/12, 7), A. suis PCR, and culture (focussing on GPS and Mycoplasma hyorhinis). All results where negative and all routine testing in the nucleus farm since then was also negative.

The nucleus farm used a batch farrowing every 4 weeks system. Until now 28 batches farrowed and the offspring had populated 3 multiplication units. The first commercial herd populated from a multiplication unit is du to farrow soon. In the nucleus farm, for pure line female, average daily gain from weaning to 275 lbs had been between 1.7 and 1.85 lbs per day.

The overall cost to produce the females at 21 days of age was 500,000 US$. We mated 300 females for the nucleus, so the price per mated female, at 21 days of age, was $1,666.00 US$. If health status is maintained in all commercial herds for 3 years after the repopulation, (450,000 pigs kill per year), we are looking at a cost of $0.37 per pig produce.

**Presenter Name:** Martha Nelson, National Institutes of Health
**Author(s):** Martha Nelson
**Title:** How Swine Production Practices Drive the Evolution of Influenza A Viruses

This talk will review how modern changes in swine production methods have altered the trajectory of influenza virus evolution in pigs, creating new challenges for swine producers and public health. In recent years, large-scale genetic sequencing of influenza A viruses has provided a highly detailed picture of mechanisms driving virus evolution in commercial swine. Long-distance animal movements allow new strains to quickly invade new regions and mix with previously circulating strains to create novel reassortant viruses that present new disease risks for swine and humans.

**Presenter Name:** Juan Carlos Pinilla, PIC
**Author(s):** Juan Carlos Pinilla, Brie Quick, Stacey Voight, Jose Piva
**Title:** The Art and Science of Weaning More and Better Pigs

As genetics continues to improve, both targets and management practices needs some update and upgrade. Not only do we push the pig to do more, but this also requires that our team members are more focused on sow management and piglet management.

With sows having higher total born comes the ability to wean more piglets. PWM management is a huge opportunity on a lot of farms. If you want to be some of the best producers, you should expect to have more than 66% of your sows weaning 14+ piglets. Today, world class management is having over 80% of your sows weaning 14+ QUALITY piglets.

Weaning good quality piglets is referred to piglets that are between 21 and 28 days of age and are weighing more than 9 pounds. Your goal should be that 95% of your weaned piglets are meeting that weight consistently. They should not only be able to drink but also want to drink within the first 12-18 hours and show activity and playfulness. There should be no lameness, hernial defects, or noticeable structural issues. The farm itself should be free of disease or if a non-multiplication farm at least be in a stable status. Be sure to keep integrity of the farrowing room and litters as well as helping to provide a strong piglet immunity with a proper vaccination program.

Understanding hurdles to more quality weaned pigs is the best way to overcome them. Health, genetics, metabolic status or feeding/nutrition inputs and outputs, and production and environmental management all play a role in the number of piglets weaned. A sow has the potential to start out with 35 follicles, but low ovulation rates, undesirable management techniques, and disease breaks can lead to a substantial decrease into what she actually farrows and then weans. 87% of follicle and embryo losses occurs when we can't see them.

There are many interactions and associations that can move the needle to a higher number of quality weaned pigs. We can break these interactions and associations up into things that are "artistically" related and things that are "scientific". Artistic interactions are ones where management practices are the shining factor that help move the needle, like stillborn control, colostrum management and intake, wean age, and sow care. Scientific interactions are ones that have been researched and shown to have positive or negative influences on piglet production, like TB/litter, piglets born per unit of time, factors against milk production and scour control. Now, just because there is a lot of science behind these factors, doesn't mean management technique doesn't play a role. For instance, sow care can play a role in factors against milk production. Both art and science go hand in hand in order to create quality weaned pigs.

**Presenter Name:** Christian Ramirez-Camba, Department of Animal Science, University of Minnesota
**Author(s):** Christian Ramirez-Camba, Pedro E. Urriola
**Title:** Optimizing amino acid intake to improve animal health while reducing nitrogen footprint

Nitrogen is an essential nutrient for plants, microorganisms, animals, and humans. In the form of amino acids, nitrogen is an essential component of body proteins, while other nitrogenous compounds provide physiological and metabolic functions essential for animal health. Yet, reactive forms cause pollution, climate change, and land degradation. Despite its lower atmospheric concentration (6%), nitrous oxide has a global warming potential that is nearly ten times that of methane and nearly three hundred times that of carbon dioxide, which are the two most significant contributors to climate change. Prioritizing enhanced nitrogen utilization efficiency should stand as a key objective in swine production to diminish the emissions of nitrogen-reactive compounds, such as nitrous oxide but also providing the essential nitrous compounds needed to pig health. Currently, a third of pigs die or are subjected to euthanasia between the peripartum period to the market, and 15% of sows are removed yearly. This rise in removal rates results in increased emissions of nitrogen-reactive compounds linked to unproductive pigs, leading to an overall decrease in nitrogen utilization efficiency at the farm level. In addition, increased mortality rates raise concerns about animal welfare and may increase the biosecurity risks associated with carcass disposal. To address the imperative of advancing towards a more sustainable swine production, we have introduced a novel nutritional paradigm shift: the linear-logistic model. This model arose through a data mining approach applied to empirical data involving pigs across multiple growth stages, alongside other livestock species, as well as rats, dogs, and humans. This new model for amino acid (AA) requirement estimation extends beyond the limits of conventional requirements, redirecting the focus towards the synthesis of biomolecules that support overall animal health. The essence of this approach centers in harnessing the phenomenon of AA catabolism that occurs beyond the threshold of maximum growth. The catabolism of AA results in the production of a myriad of essential biomolecules. These biomolecules are linked to enhancements in diverse functions like immunity, digestion, reproduction, and the general metabolic state of the animal. The linear-logistic model enables an accurate determination of AA levels that maximize the biosynthesis of these metabolites and their corresponding physiological roles. Initial findings indicate that AA requirements calculated using the linear-logistic model yields improved feed efficiency, increased growth rates, and reduced animal removal rates. Consequently, while the estimated AA requirements using the linear-logistic model are higher than the current requirements, these AA levels increase feed efficiency and survival rates, lowering nitrogen excretion and nitrogen-reactive compound emissions per unit of pork produced. Using the linear-logistic model to estimate AA requirements of pigs holds promise for advancing environmental sustainability while enhancing animals health. Simultaneously, it provides a path to reduce pig mortality, as well as associated economic, social, and potential biosecurity implications. The purpose of this presentation is to examine and discuss the effects of AA requirements determined by the linear-logistic model on different stages of pig production, and how these levels affect the efficiency of N utilization and, consequently, the N footprint in swine production.

**Presenter Name:** Chris Richards, Apiam Animal Health
**Author(s):** Chris Richards
**Title:** Sustainable Veterinary Medicine – Tackling the challenges of a dynamic industry

Apiam Animal Health is Australia's largest provider of veterinary services to rural and regional communities. Established in 1998 as a swine veterinary practice, Apiam has undergone rapid growth in recent years, now employing over 330 veterinarians servicing both the livestock industries and pet owners across 80 rural clinics, genetic services, diagnostic laboratory, and vaccine facilities.

At the same time, the veterinary industry has also undergone rapid changes, particularly around people demographics, workplace practices and the service expectations of farming clients and pet owners. With global disease challenges (both human and animal), increasing animal numbers and a shortage of veterinarians there have been plenty of challenges for the veterinary industry.

With an increasingly female and ethnically diverse veterinary work force and an increased focus on work-life interaction, the issues of shortage of veterinarians, increased stress levels and burnout, mental health, high student debt levels and industry retention of clinicians have challenged the industry to be able to achieve sustainable veterinary medicine.

Apiam has been tackling these challenges by focusing on understanding the drivers behind these trends and taking a people-centric approach to many of these challenges. The introduction of work practices such as compressed work weeks, paid parental leave, wellbeing programs and after-hours triage services has enabled the company to not only retain, but increase its veterinary workforce to meet the growing requirements for services.

Apiam has also been refining its' practices around managing the career pathways of veterinarians, ensuring that documented development plans form the basis to meet the changing career objectives through the various stages of a veterinary career. Combined with an understanding of an individual's lifestyle choices, its retention program is centered around a flexible and adaptive approach to work-life integration.

With 12 swine veterinarians, Apiam is the largest provider of veterinary services to the Australian swine industry, which has also seen rapid changes over the last 10 years with greater corporatization of the pig farming industry, changes to animal health product supply channels and development of new services by veterinarians. The swine industry will continue to evolve and with these changes, veterinarians will need to adapt their own service provisions. Areas such as integrating artificial intelligence (AI), a greater focus on biosecurity and epidemiology, sustainable antimicrobial use, animal welfare, caregiver competence, and developing the next generation of swine veterinarians are expected to be important roles for the swine veterinarian into the future.

The corporatization of livestock vet clinics is also being observed in other regions around the world. While the consolidation of veterinary clinics is well progressed across companion animal clinics, this trend is early stage in livestock practices. In addition to other regionalized groups such as Heritage Vet Partners (USA), global companies such as VetPartners (UK) and IVC Evidensia (EU and Canada) have entered the livestock veterinary market in recent years in what remains a highly fragmented industry seeking a sustainable veterinary medicine model.

**Presenter Name:** Chris Richards, Apiam Animal Health
**Author(s):** Chris Richards
**Title:** FAD Preparedness: The trail from a shaker pig to JEV

An outbreak of clinical disease caused by Japanese encephalitis virus (JEV) was observed concurrently across several piggeries in eastern Australia from February 2022 Clinical signs varied across farms and included prolonged gestation length, mummified and stillborn piglets, congenital abnormalities, and neurological abnormalities. Several veterinary groups across Australia identified these clinical signs over a 7-day period on piggeries that were located within the Murray Darling region, however in some cases geographically separated by thousands of kilometres. The Japanese Encephalitis virus was considered exotic to south-eastern Australia and as a result of the pathogen being confirmed, a Foreign Animal Disease (FAD) response was enacted.

Japanese Encephalitis virus (JEV) is a flavivirus, an enveloped positive strand RNA virus endemic in eastern and south-eastern Asia. This is a large group of viruses, often arthropod borne. JEV has been detected in sentinel pigs, mosquitos and a single human in the northern tropical tip of mainland Australia approximately 20 years ago, however, it had never previously been identified in south-eastern Australia, where the majority of the pig industry operates, or any other part of the country. JEV is a zoonotic mosquito borne pathogen. Waterbirds are the reservoirs, and the virus can spill over into pigs which may act as amplification hosts. Humans and horses are also dead-end hosts.

Clinical signs in south-eastern Australia were first observed in February 2022 with over 80 piggeries reported over the following four months as having clinical disease confirmed by laboratory testing. Some sows failed to farrow by day 117 and in some cases extended to 126 days. Sows with extended gestation periods were induced and they passed large number of mummified and stillborn piglets. This clinical sign was observed in all parities of sows with variation from 10% to 100% of piglet affected in each litter. Mummified piglets appeared bloated with ascites and there was a positive correlation between sows that tested serologically positive to JEV having entire litters of mummified piglets. Whether a sow within an affected herd showed clinical disease was dependent upon whether it has been infected with JEV through mosquito bite, and the stage of gestation when it was infected. Stillborn piglets presented with an array of congenital abnormalities including severe arthrogryposis and brachygnathia. Some piglets with these abnormalities were also born alive. Neurological abnormalities were a striking feature with cerebral and cerebella aplasia, hydranencephaly and meningocele. Some piglets were also born alive exhibiting congenital tremors.

The ability of the Australian pig industry to respond to an incursion by a foreign animal disease such as Japanese encephalitis was enhanced by the previous planning that had been undertaken by industry for other exotic animal diseases, as well as the relationship that existed with state government officials.

**Presenter Name:** Mike Roof, Iowa State University
**Author(s):** Mike Roof
**Title:** mRNA Vaccines - Facts and Myths

The use of vaccines in the animal health industry is vitally important for disease control, economic production, animal welfare, and control of zoonotic agents (ONE HEALTH). Despite the broad range of vaccines available to veterinarians today, there are still unmet needs and gaps in available tools. University and industry scientists continue to assess new technology and new approaches for vaccines that are essential to the swine industry.

Recently, there have been several states that have proposed legislation on vaccine use in animals (Arizona, Idaho, Missouri, North Dakota, South Carolina, and Tennessee) mainly focused on mRNA vaccines. If successful, these activities could limit the tools available now and in the future for veterinarians.

In some cases, these discussions are not based on scientific facts or an understanding of the USDA/CVB regulatory policy and so it is important that veterinarians and stakeholders in the animal health industry help educate the public and interested stakeholders.

- mRNA is the template which cells use to make proteins required for cell function and viability. mRNA has a VERY short half-life (seconds-hours) which is an evolutionary trait to ensure cells don't overexpress and a mechanism of biological balance and control.

- COVID vaccines such as those developed by CureVac use modified nucleotides and complex methods to stabilize such as nanoparticles and lipids. Despite this advanced technology, these vaccines still require storage at -70 C or they would degrade to the point of non-functional.

- mRNA does not incorporate into the genome of the host and there are no "Frankenstein" creation of new genetic material or altered host genomes.

- Unlike synthetically produced mRNA vaccines used in humans (COVID), there are currently no mRNA vaccines licensed by the USDA/CVB. The Sequivity product licensed and commercialized by MERCK is categorized by CVB as an RNA particle. In practical terms this is an alphavirus (Equine Encephalitis) virus that is defective. Like a MLV vaccine virus product, it can infect and delivery a viral payload, but the platform is defective and cannot create viable virus particles and so a non-replicating platform.

- Vaccine approval and use is ALREADY regulated by highly skilled and competent experts (CVB) and further legislative policy may not serve the animal health industry. This is true not only of mRNA vaccines, but ALL vaccines and ALL future vaccine technology. The CVB process considers not only host animal safety and efficacy, but also issues like shed, spread, environmental, and human safety. For GMO there is also a process of public review and comment via the Federal register.

The current situation is focused on RNA vaccine technology, but our industry needs to ensure that ALL relevant technology can be used to best support the animal health industry. Veterinarians play a critical role in education and ensuring that competent assessment is completed to ensure the best tools to control disease.

**Presenter Name:** Adam Schelkopf, Pipestone
**Author(s):** Adam Schelkopf, Joel Nerem, Gordon Spronk, Scott Dee, Jean Paul Cano, Cameron Schmitt, Hannah Walkes, Luke Minion, Karyn Havas, Jeff Blythe, Joseph Yaros
**Title:** Wean-to-market biosecurity standards: Creating, assessing towards, and benchmarking within a given standard for wean-to-market biosecurity practices.

The viability of the swine industry as it stands today rests on our ability to keep Foreign Animal Diseases out of the US swine herd. Individual producer operations are dependent on the prevention of infection with current endemic diseases such as PRRS, PEDV, Mycoplasma hyopneumoniae, and others. Biosecurity is at the core of our ability to control these diseases. For decades, researchers, scientists, and veterinarians have contributed to a vast body of research in swine diseases that provides us with the framework necessary to advance the industry in biosecurity. Yet today, the industry lacks a set of standards that define optimal biosecurity practices and commitments for wean-to-market swine facilities and producers.

The goal of our project was to take the next necessary step and define a set of standards for wean-to-market biosecurity practices. This standard would serve as the framework for development of an assessment tool that is applied to swine production sites to assess compliance relative to the standard. Scores of the assessment would be compiled into a benchmark to demonstrate compliance with the standard, as well as for individual sites to compare to their cohort. The development of this standard and assessment tool will allow for further research into the most important biosecurity practices, as well as understanding the impact of compliance with a standard on disease incidence.

**Presenter Name:** Declan Schroeder, University of Minnesota
**Author(s):** Declan Schroeder
**Title:** Application of new molecular tools to assess virus viability in production animals

Persistent viral infections routinely impose an inconvenient, always costly but thankfully not all too often catastrophic outcome on our modern food system. Managing viruses is key for all concerned if our objective is to meet the ever-growing demand to high-value animal protein. Whether it's the impact influenza A virus (IAV) has on the avian or swine industries, African swine fever virus (ASFV) on the swine or Deformed wing virus (DWV) on honey bees in both the honey and pollinator sectors - the negative impact and damaging cost to the individual producer, country and global economy cannot be overstated. The overarching research objectives of my lab is to develop molecular-based research tools, rooted in both the Life Sciences and Veterinary Medicine, to provide a mechanistic understanding as how to best intervene or mitigate the negative impact viruses may have on food animals and associated organisms in the modern food system. This is especially important as no global set of standardized analytical procedures at commercial or research laboratories exist to facilitate and accurately measure potential viable virus contamination in feed ingredients, complete feed, and even fomites. As a result, there is high uncertainty of the extent of virus contamination and the true risk it poses to the food production industry. Moreover, inactivation kinetics of viruses are often generalized and erroneously inferred based on the absence of sound real-world data or in some cases data based on unvalidated surrogate systems. Here I will discuss the benefits of using new cost-effective molecular tools in routine diagnostic workflows to produce a more reliable measure of "viability" to complement or in some cases negate the need for infectivity data.

**Presenter Name:** Abby Schuft, University of Minnesota
**Author(s):** Abby Schuft, Sally Noll, Kevin Janni, My Yang, Joaquin Alvarez Norambuena, Laura Davis, Erin Cortus, Montse Torremorrell
**Title:** Best practices for today's biosecure entry protocols

Biosecure entry and exit protocols have become standard practice in confinement animal production systems. There are three tiers to biosecurity which make biosecurity unique on each premises. Conceptual biosecurity is about adapting biosecurity needs to each farm-sites' specific circumstances. Structural biosecurity refers to tangible and fixed cost features of production. Operational biosecurity is the least dependable of the three biosecurity tiers because it relies on the behavior of people. Operational biosecurity is where a farm can manage liabilities identified through conceptual and structural biosecurity. This tier of biosecurity also includes teaching employees, visitors, and service providers about biosecurity expectations on a farm. Recent research at the University of Minnesota has investigated how biosecure protocols are taught to employees and visitors as well as the practicality and efficacy of biosecurity steps. One study evaluated three education methods used to teach protocols for biosecure barn entry and exit by evaluating the number of errors, length of time to complete, and how the education method affected compliance over time. Results show that the number of steps required in a biosecure protocol and the length of time between visits are more effective predictors of biosecure entry and exit errors than the method used to teach the protocols. Additional data showed preferences and needs of individuals as they completed various biosecure protocols. Observations recorded will inform farm owners and managers how to optimize unique needs at each premises. These include individual preferences for mobile device management, touching surfaces, and how a bench at the line of separation was crossed. A second study emphasizes the need for effective hand sanitation protocols to prevent the transmission of influenza between pigs and people. The experiments detected influenza on hands up to 120 minutes after handling influenza infected pigs. Their results showed that using an alcohol-based sanitizer and wearing gloves to be the most effective method at reducing influenza amounts on caregiver's hands when handling influenza infected pigs. The importance of biosecure entry and exit protocols have been well established. Recent research has shown the impact of teaching protocols as well as preferences for executing the procedures by individuals. Best practices for today's biosecure farm entry and exit should be established based on results discovered in various studies.

**Presenter Name:** Mark Schwartz, Schwartz Farms/University of Minnesota
**Author(s):** Mark Schwartz
**Title:** How is the lack of pig robustness affecting our farms?

Improvements in pig growth performance, feed efficiency and increased total born per litter are several parameters that illustrate the enhanced productivity experienced by pig producers because of genetic selection and precision nutrition applied over the past several decades. From 1980 to 2015, grow-finish phase growth performance increased from 1.27 to 1.60 pounds per day, and feed conversion (lbs. feed: lbs. live weight gain) improved from 3.2 to 2.6 (1) . Litter size has likewise increased dramatically over a similar time period (2, 3).

While pig producers have witnessed the improvement in production efficiency over time, a challenge to the industry is that of the increased mortality in the breeding animals, nursing piglets, and growing pigs. A common measure of robustness is the percent mortality of a breeding herd, in pre-weaning mortality of the nursing piglets, and in the percent mortality of closed groups of nursery or grow-finish pig populations.

Databases and benchmarking services indicate a dramatic increase in sow mortality, most notably over the past 10 to 12 years. Likewise, a similar upward trend in both the nursery phase and grow-finish phase mortality has been observed (4).

When producers experience elevated mortality at any phase of production, in addition to the financial impact, swine welfare and employee morale are also affected.

The increased mortality at the various phases of production has a cost to producers, and typically, this cost can be measured quite readily. These costs include treatment to individual animals and pig populations in the face of a disease outbreak, higher weaned pig cost with reduced output and the need for higher replacement rate in the breeding herd.

What is not as easily measured in quantitative terms is the effect of elevated mortality on the pig caretakers. In addition to the time required for mortality removal and management, there is the burden of dealing with these issues on a daily basis, especially when mortality events are clustered over time with disease outbreaks.

The challenge facing swine geneticists, researchers, consulting veterinarians and pig producers is to understand the factors driving the increased mortality at each phase of production and deliver solutions to improve this parameter to levels that are generally agreed upon as acceptable levels for the improvement in the robustness and enhancement in welfare, employee morale and productivity.

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4. MetaFarms 2022 Production Index Analysis

**Presenter Name:** Haley Schwecke, University of Minnesota
**Author(s):** Haley K Schwecke, Emily McDowell, Amanda Sponheim, Eduardo Fano, Joel Nerem, Robert Valeris-Chacin, Maria Pieters
**Title:** Mycoplasma hyosynoviae: serum profiles and ongoing research

Mycoplasma hyosynoviae (M. hyosynoviae) induced lameness in growing pigs is a continuous welfare issue [1]. The industry faces emerging concerns due to limited options for treatment against M. hyosynoviae. Thus, more research is needed to generate information on the epidemiology of this commensal bacterium. Therefore, our research group is conducting various studies to determine the natural antibody profile of M. hyosynoviae in clinically infected and non-clinically affected swine herds to evaluate the optimal treatment application options.

One clinically affected M. hyosynoviae 9,000-head sow farm and five nursery and/or grow-finish downstream barns were enrolled. In addition, a 9,000-head sow farm and five nursery and/or grow-finish downstream barns were selected based on the absence of M. hyosynoviae clinical signs. Blood (n=2,432) and colostrum (n=50) samples were conveniently collected from varying age groups (n=18 clinical) (n=17 non-clinical) categorized by dams, replacement gilts, and piglets. Samples were tested utilizing an indirect ELISA assay for M. hyosynoviae IgG detection [2]. The following number of samples were collected per age group: dams at service (n=132), midgestation (n=166), farrowing (n=133), weaning (n=134), replacement gilts 30 weeks of age (wks) (n=134), 25 wks (n=133), 20 wks (n=145), 15 wks (n=137), ten wks (n=135), five wks (n=103), newborn piglets (n=135), weaning piglets (n=151), colostrum (n=50), nursery pigs five wks (n=51), seven wks (n=110), eight wks (n=52), nine wks (n=106), ten wks (n=110), 12 wks (n=109), and finisher pigs 13 wks (n=50), 16 wks (n=52), 19 wks (n=103), 20 wks (n=51).

Percent positives of IgG S/P values per sample group clinical herd were: dams at service 93.0%, midgestation 97.4%, farrowing 99.0%, colostrum 100.0%, dams at weaning 100.0%, newborn piglets 86.4%, weaning piglets 92.0%, nursery seven wks 39.1%, nursery nine wks 28.3%, nursery ten wks 17.3%, nursery 12 wks 3.7%, finishing 19 wks 9.7%, gilts five wks 66.0%, gilts ten wks 13.7%, gilts 15 wks 1.0%, gilts 20 wks 11.7%, gilts 25 wks 12.0%, and gilts 30 wks 24.8%. Non-clinical herd: dams at service 100.0%, midgestation 100.0%, farrowing 100.0%, colostrum 100.0%, dams at weaning 96.9%, newborn piglets 96.9%, weaning piglets 84.3%, nursery five wks 52.9%, nursery eight wks 33.3%, nursery 13 wks 18.0%, nursery 16 wks 46.2%, gilts ten wks 6.1%, gilts 15 wks 9.1%, gilts 20 wks 38.2%, gilts 25 wks 48.5%, and gilts 30 wks 72.7%.

Dams showed the highest percent positives when comparing across pig categories in both herds. The percent positive of IgG antibodies decreased at approximately five weeks of age in the nursery pigs and remained low through the finishing pigs in the clinically affected herd. Whereas the percent positive of IgG antibodies in the non-clinical herd began to increase in the growing pigs at approximately 16 weeks of age. Results from this study may suggest that M. hyosynoviae antibodies are associated with protection from clinical signs. However, a greater number of herds need to be evaluated in order to confirm the repeatability of results. Similar results have been identified in previous investigations [3, 4]. The commensal nature of this bacterium makes antibody detection interpretation challenging.

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**Presenter Name:** Thad Shunkwiler, Minnesota State University, Mankato
**Author(s):** Thad Shunkwiler
**Title:** Bouncing Back: Fostering Resilience on the Farm

At a time in which the mental wellbeing of America has never worse, it becomes more important than ever to develop the emotional skill set to navigate these challenges. This workshop will explore resilience as a preventative measure for mental health on the farm. Participants will leave the workshop with resilience strategies to mitigate the stressors related to working in agriculture and learn about the new partnership between the Center for Rural Behavioral Health and Minnesota Pork which is aimed at improving emotional wellness for farmers.

**Presenter Name:** Casondra Snow, University of Minnesota
**Author(s):** Casondra Snow, Albert Canturri, Maria Pieters
**Title:** Minimizing sample cross-contamination for the detection of *Mycoplasma hyopneumoniae*

Introduction

Cross-contamination between samples is one of the most common pre-analytical errors and can cause misleading diagnostic results. Recent studies illustrating the issue of sample contamination emphasize DNA's significant resistance to degradation when on environmental surfaces, which is undoubtedly an important problem for PCR testing and posterior result interpretation.1 Current sampling recommendations include measures that aim at minimizing specimen cross-contamination.2 For example, materials used to collect tracheal secretion samples for the detection of Mycoplasma hyopneumoniae, including mouth speculums and laryngoscopes, should be disinfected between pigs. However, the disinfection method is not standardized, and although most commercially available disinfecting wipes may have bactericidal effects, it is currently unknown if they prevent DNA carryover between samples. Therefore, the objective of this study was to compare various disinfecting compounds in order to minimize sample cross-contamination in swine tracheal secretion collection.

Materials and Methods

Tracheal secretions were collected with various material sets from nursery pigs that had been experimentally inoculated with M. hyopneumoniae (n=36), for natural contamination. In parallel, 1:10 diluted M. hyopneumoniae culture was sprayed onto six separate material sets for artificial contamination. The sets included a mouth speculum, a laryngoscope blade, and a pair of scissors. Swabs were collected from each material. The material sets were thoroughly cleaned with one of the following treatment-based wipes: hydrogen peroxide, alkyl dimethyl benzyl ammonium chloride, bleach, alcohol, or phosphate-buffered saline (PBS). Following the disinfecting wipe, a PBS wipe was used to collect a post-cleansing sample from each material. The DNA was extracted from the pre-cleansing swabs, disinfecting wipes, and post-cleansing samples for both natural and artificial contamination, and a species-specific PCR was performed to detect M. hyopneumoniae. Ct values were compared with Kruskal-Wallis tests to determine statistical significance.

Results

Statistical difference between sampling materials was not achieved, with a p-value of 0.09 and 0.06 for the natural and artificial contamination respectively. Thus, data from various materials were grouped as replicates for each treatment group for this study. Starting Ct values were not statistically different between treatment groups for natural ($p= 0.50$) or artificial ($p = 0.79$) contamination. Of the naturally contaminated treatment groups, bleach and hydrogen peroxide A were the only disinfectants to produce negative PCR results ($p = 0.04$). Bleach was the only treatment to generate negative PCR results for the artificially contaminated materials ($p=0.02$).

Discussion and Conclusions

Results of this investigation suggested that bleach was the disinfectant that successfully removed all M. hyopneumoniae genetic material. These results seemingly agree with other studies on different bacteria.3,4 These results can be further applied for the development of a protocol for minimizing or eliminating sample cross-contamination with the use of bleach.

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**Presenter Name:** John Sonderman, PhD, DNA Genetics
**Author(s):** John Sonderman, PhD, Brady McNeil, MS, Jason Schneider, PhD
**Title:** Managing the Prolific Female during First Lactation

Gilts are the engine for productivity in a sow farm. Typically, gilts litters represent 25% or more of all production, with replacement rates ranging from 40 to 65%. A gilt's future productivity is based on how well they are managed prior to and during their first lactation. There are several challenges that can occur with gilt litters, including unfamiliarity with the farrowing stall, feeder, and watering system; lower immunity; increased incidence of Shaker pigs; lighter birth weight pigs; and lower feed intake.

Farrowing crates are new environments for gilts. This is especially true for gilts coming from gestating pens. It is critical to get females up a minimum of 1x per day during the pre-farrow period to observe them eating and drinking. The farrowing team should use this pre-farrow period to train gilts on how to find their feed and water.

Placing gilts near the front of the farrowing room helps ensure that they are observed more often as staff enter and leave the room. This increased activity can help gilts acclimate to the rhythm of the day. Actively farrowing females should be monitored every 20-30 minutes to check the progress of farrowing.

Although some herds still induce females to farrow, there are concerns with using this method. Inducing too early in gestation has been reported to reduce piglet birth weight and survivability, as well as reduce colostrum production and quality. If a farm needs to induce, it is critical for the farm to understand their average gestation length and only induce sows one day before the herd average.

After farrowing, the team should get the gilt up and observe her eating and drinking. Many farms will put gilts next to each other or mark their farrowing cards bright pink to identify her as requiring extra attention. Whether in an ad libitum system or hand feeding, monitoring her intake is critical. Gilts that do not eat well in farrowing will lose body condition, resulting in a higher incidence of drying up prior to weaning and a decreased likelihood of returning to estrous following weaning. If a sow is not eating well, the team should get her up multiple times per day.

Nutrition can also play a role. Many systems set their dietary levels of nutrients in farrowing based on the gilt requirements, which is affected by a lower feed intake. For example, a gilt needs 65 gms. of lysine intake in the first 7 days to have adequate LH production to stimulate estrous cyclicity. If possible, increasing lactation lengths can provide more time for the gilt to reach a positive energy balance increasing the likelihood of a short wean to estrous interval.

Additional topics to be discussed are specific interventions for gilts, managing teat inventory, wean age's effect on gilts, gilt specific feed curves, and performance data analysis.

**Presenter Name:** Randy Spronk, United States Meat Export Federation
**Author(s):** Randy Spronk, John Hinners, Maria Zeiba, Kelly Wicks
**Title:** Opportunities in Trade

Find out how your partnership with the U.S. pork industry is vital to developing export markets and what is at stake for value-added U.S. pork and pork variety meats this year and in the future. U.S. Pork exports' greatest contribution comes from international purchases of 'underutilized' products that are not traditionally consumed at large volumes in the U.S., including variety meats, bone byproducts, and pork cuts that are unfamiliar to American consumers.

With Mr. Spronk's presentation, you will have a deeper understanding of how U.S. trade agreements benefit the bottom line of the U.S. pork industry. In addition, you will learn what needs to take place following the opening of an international market and how the U.S. government and private industry works hand in hand to market U.S. pork in a competitive environment. Long term, the U.S. must aggressively engage in proactive trade policy, including trade agreements to break down barriers, both tariff and non-tariff. The U.S. will also need to lead, endorse, and facilitate rules-based trade in an effort to keep international markets open to U.S. pork.

Join us as we review industry initiatives, market conditions and export opportunities during Randy Spronk's presentation on the Opportunities in the Export Market during the 2023 Allen D. Leman Swine Conference in Saint Paul, Minn., from September 16 – 19, 2023.

**Presenter Name:** Kaitlyn St. Charles, Secure Food Systems Team, University of Minnesota
**Author(s):** Kaitlyn St. Charles, Catherine Alexander, Peter Bonney, Mickey Leonard, Miranda Medrano, Sasidhar Malladi, Amos Ssematimba, Sylvia Wanzala, Timothy Goldsmith, Cesar Corzo, Marie Culhane,
**Title:** Risk of ASF in boar semen - The full risk assessment results

Like all foreign animal diseases (FAD), African Swine Fever (ASF) is a high-consequence disease that would trigger an immediate regulatory response were the disease detected on a U.S. swine operation. When FAD outbreaks occur, state animal health agencies respond swiftly by containing and depopulating infected premises as well as by establishing Control Areas (CAs) around infected premises with the aim of minimizing disease spread. Farms caught in CAs are presumed to be at a higher risk of spreading disease than those outside of the area (i.e., those in the Free Area), thus farms in a CA are immediately issued a stop movement order. Animal and animal product movements from these farms can only resume when permits are issued by state animal health regulators.

In order to confidently move product out of and within CAs in a manner that will minimize potential disease spread, permit criteria for these movements should ideally be risk-based and involve farms to meet efficacious, product-specific biosecurity requirements prior to product movement as well as undergo evidence-based premovement testing requirements. Stringent permit criteria are especially essential for product movements that result in high consequences if infectious product is moved, e.g., movements of animal semen from a singular farm to multiple destination sites. Thoroughly and proactively estimating the risk that specific product movements will spread FADs is the first step towards generating permit criteria that will effectively minimize the likelihood moving virus between premises during an outbreak.

Here, we present the results of a risk assessment estimating the risk of boar semen moving ASF virus (ASFv) out of or within a CA during an ASF outbreak. Conducted in collaboration with a public-private workgroup consisting of swine industry veterinarians, state and federal animal health regulators, and subject matter experts, the risk assessment provides a descriptive rating for the overall risk of moving boar semen from a stud in a CA. The results of each likelihood contributing to the overall risk rating will be presented, including (1) the likelihood that ASFv would be introduced onto a boar stud in a CA resulting in (a) infection of donor boars and (b) contamination of semen produced on the stud; 2) the likelihood that, if ASFv-infectious boars are present but undetected on a stud, (a) infectious donor boars would be detected prior to the movement of semen off a stud and (b) that semen collected from uninfected boars would become contaminated; 3) the likelihood that semen couriers and vehicles would spread ASFv from an infected but undetected boar stud in a CA; and 4) the likelihood that semen produced by an ASFv-infectious boar would infect a susceptible sow and/or gilt.

**Presenter Name:** Karine Talbot, HyLife
**Author(s):** Karine Talbot
**Title:** Using New Technologies to Investigate Disease Outbreaks

As many other things we now do in our production system, it seems a lot started due to PEDV… We have always done a certain level of disease outbreak investigation; however, disease outbreaks were a rare occurrence and would not spread further than a few barns, usually from the same flow… This changed significantly when PEDV entered our system in 2017, again in 2019 and more recently in 2021-22.

Disease outbreak investigation requires time, effort, and to obtain as much accurate information as possible! These are three things we rarely have during a large-scale outbreak… We knew we had to do investigations much faster, not only to learn from our mistakes and how PEDV was entering the barns, but most importantly to prevent the next outbreak by stopping the spread and implementing proper biocontainment in farms at risk.

After a 6-month pilot project trying a geofencing and biosecurity software (Farm Health Guardian), we fully implemented the technology in spring of 2022 for all our locations (farms, feed mills, wash bays, slaughter plant, etc.) and enrolled our equipment and people; and that has been an incredible journey for our biosecurity and biocontainment. But what is a geofencing software and what does it do? A geofence is a virtual fence around a property. In this case, the software records movement of registered devices (ex: GPS in vehicles, a smartphone with the software app, etc.). The software then allows people with a certain level of user access to see who visited their sites and run various reports, including trace-in / trace-out reports and maps. For us, the implementation of this software drastically helped to get accurate and timely contact tracing during disease outbreaks (from hours to minutes!); increases employee engagement by giving them a sense of ownership and knowledge about who is at their site; gives us a tool to easily practice, train and audit disease outbreak scenarios using real data; gives us a visual tool to biosecurity processes and breaches; and it greatly improves our communication of an outbreak or barn under biocontainment (ex: phone banner).

The original objective of implementing this software in our production system was to help us with outbreak investigation and trace-in and out. But the use of this software has offered us so much more! Our biosecurity downtime chart is now included, and people can easily access it and quickly find how much downtime is required to visit sites. The app will “deny” people entry to certain site if they do not have the proper downtime (and send an alert to the vet team); the app provides a very useful map of all our sites (only available with proper user access); we can now add certain “rules” to only access certain sites (for example, specific truck can be allocated to high health sites and an alert is sent if they are detected on a site not listed as “approved”), and so much more!

**Presenter Name:** Karine Talbot, HyLife
**Author(s):** Karine Talbot
**Title:** The role of biosecurity in controlling PEDV

It's fairly obvious: biosecurity is key to avoid barns becoming infected with PEDV. But what about once you have it?

Biosecurity is made of 3 important components: Bioexclusion, Biocontainment and Biomanagement. Bioexclusion is the most well-known and talked about; it is the external biosecurity. It is all the steps taken to prevent infectious diseases from entering the herd. Biocontainment is all the steps taken to prevent infectious diseases from getting out of an infected barn and spreading to others. Lastly, biomanagement is the internal biosecurity. It is all the steps taken to prevent (or minimize) infectious diseases from spreading from infected pigs to non-infected pigs within the same barn.

In the fight against PEDV, all 3 parts are needed. PEDV is a different beast when it comes to biosecurity; it is extremely infectious and contagious, and very little is needed to infect a naïve barn. If strong bioexclusion and biocontainment are not in place ahead of an outbreak, PEDV will (can?) spread like wildfire…

The level of bioexclusion implemented is often based on a risk vs impact approach per barn; boarstuds, multipliers and sow barns usually have a higher level of bioexclusion protocols to protect them from diseases. But in a pig-dense area, does it still make sense to have low biosecurity levels in certain herds? If a finishing barn near a large sow barn breaks with PEDV due to poor biosecurity protocols, it will increase the risk for that sow barn, no matter how good their bioexclusion protocols are… To control disease like PEDV, everyone and every barn must have good biosecurity measures in place.

Biocontainment is also key to protect others against PEDV. Everything coming out of the herd becomes a potential risk to spread PEDV to others: people, tools and equipment, trucks and trailers, but also pigs… Where are these PEDV positive pigs going to be placed? Close to which barn? Whose barn? With PEDV (and many other diseases), it's never a "single herd problem". One producers' disease management decision will impact the neighbors around them, the neighbors where the positive pigs will be moved, and the industry in general (cross-contamination risks at feed delivery and feed mill, livestock trailers, cull sow assembly yard, slaughter plant, etc.).

Other key elements of a complete biosecurity program are the health monitoring (surveillance) and sharing of information. To have a chance in the fight against PEDV, we need to know which herds are positive (and not every case is obvious!) by performing routine surveillance. And that information must be shared between vets and producers in the area. As the popular saying goes: "knowing is half the battle"!

In summary, biosecurity is more than just protecting a herd from what could come in (bioexclusion); what's coming out (biocontainment) must also be considered! And to be successful in the fight against PEDV, both must be implemented in all type of herds (sow, nursery and finishing). It's much easier to protect herds in area where PEDV is NOT present!

**Presenter Name:** Jean-Pierre Vaillancourt, Université de Montréal, Québec, Canada
**Author(s):** Jean-Pierre Vaillancourt
**Title:** Improving biosecurity through Bob Morrison's legacy

All biosecurity measures aim at either reducing or eliminating sources of infection, or maintaining a separation between them and the herd we want to protect. This goes from changing boots to implementing regional biosecurity measures to minimize cross-contamination risks. In most cases, critical elements of biosecurity programs have to do with people. Human characteristics, attitude and beliefs may widely impact biosecurity compliance. Yet, too often, these are neglected or not considered a priority in the field.

Bob understood the importance of people. His legacy goes beyond technical discoveries or knowledge generation. He once wrote "…the biosecurity program for a sow farm is only as strong as its weakest link and filtering incoming air will not be a wise investment unless all other routes of viral introduction are eliminated."

Personality traits and emotional intelligence are two of the main determinants of compliance. Emotional intelligence refers to the level of self-awareness, self-management, social awareness, and relationship management in the context of job performance. High emotional intelligence has a positive impact on employee effectiveness and efficiency, better task coordination, and improved goal achievement. Emotional intelligence is also important for leadership, motivation, communication, decision making, interpersonal relationships, and change management. It is a learned characteristic that can be developed over time. Given its malleability, it is possible to modulate training programs, supervision and reinforcement of employees in order to have an impact on employee performance and compliance. A better understanding of personality patterns and emotional intelligence could help us modulate interventions. For example, the way we train people who are sensitive, stressed and resistant to change should be different from the way we train people who are calm and open to ideas.

Instinctively, Bob understood what was needed to successfully engage with all stakeholders within the industry. He knew that lack of knowledge by anyone about disease transmission is a major determinant of their perception of the level of risk the pigs are exposed to. This is why he emphasized learning as a way to substantially change people's perception of disease risks and, consequently, increase their awareness of the importance of biosecurity measures. Bob had the ability to convince stakeholders to share data, producing useful information that farmers and production staff could understand and use for decision making. His approach was based on integrity, honesty, being straightforward while respecting and showing empathy for people; he knew that showing that he cared could go a long way. He also knew that he needed to back up everything with valid data. He constantly tried to determine the cost-benefit of any intervention, so he could inform the decision process and positively impact people's behavior.

On-farm and regional biosecurity measures require a focus on who is involved. Bob understood the importance of gathering data, but also of understanding the individuals collecting them. Bob's ways of being and learning are worth considering for long-term improvement of biosecurity compliance.

**Presenter Name:** Kimberly VanderWaal, University of Minnesota
**Author(s):** Kimberly VanderWaal
**Title:** Chasing a moving target: Rapid evolution and spread of PRRSV in the U.S.

Porcine Reproductive and Respiratory Syndrome Virus 2 (PRRSV-2) continues to pose significant challenges to the swine industry worldwide. One for the foremost challenges to PRRSV control is its genetic and antigenic diversity that has resulted from its exceptionally high rate of evolution. The consequence of the rapid diversification of this virus is that successful PRRSV control often seems like a moving target. This talk presents highlights recent work aimed at unraveling the dynamic landscape of PRRSV-2 genetic variants and lineages, shedding light on their emergence, antigenicity, immune-mediated evolution and potential immune escape, and patterns of spread. Our findings illuminate mechanisms driving the continual evolution of PRRSV-2, including mutation, recombination, and selection pressures from host immune responses that drive changes at viral epitopes. Additionally, we examine the potential role of immunity in shaping the emergence of novel PRRSV-2 variants, highlighting the intricate interplay between the virus and host immune system. This work underscores the importance of large-scale sequence analysis in elucidating the complex dynamics of PRRSV-2, offering valuable insights for the development of strategies to mitigate its impact on the swine industry and animal health.

**Presenter Name:** Hiep Vu, University of Nebraska-Lincoln
**Author(s):** Hiep Vu, Hung Q. Luong, Hanh D. Vu, Huong T.L. Lai, Hoa T. Nguyen, Lam Q. Truong, Scott McVey
**Title:** Diagnostic testing and vaccine development for ASFV

Introduction

African swine fever virus (ASFV) continues to spread to many countries and regions, causing significant losses to the global swine industry. In Vietnam, the virus was initially detected in 2019 and has since become endemic. Although two live-attenuated ASFV vaccines have been recently approved in the country, their usage remains tightly regulated. Consequently, ASF control relies heavily on stringent biosecurity measures, including movement restriction, quarantine, and compulsive depopulation of affected herds. Rapid and reliable detection of ASFV-infected pigs is critical for the control of ASFV. Additionally, efforts are made to develop a safe and effective vaccine against this virus. This abstract presents results from two projects conducted in Vietnam, one focusing on assessing the performance of two pen-side diagnostic tests and the other exploring the mechanisms of vaccine-induced protection.

Method

Project 1: To evaluate the performance of a pen-side real-time PCR test for detecting viral genomic DNA and a lateral flow test for detecting viral antigens, ten ASFV-seronegative pigs were inoculated with a virulent ASFV strain currently circulating in Vietnam. Blood samples were collected from each pig every other day until they reach humane-endpoints (within 10 days). These samples were tested using the two pen-side diagnostic tests immediately after collection. Additionally, the samples were tested using a reference real-time PCR test.

Project 2: To elucidate mechanisms of vaccine-induce protection, thirty ASFV-seronegative pigs were divided into three groups: one group received an experimental live-attenuated vaccine (LAV), another group received two doses of an experimental killed virus vaccine (KV), and a third group was kept as non-vaccinated control. At 42 days post-vaccination, all pigs were challenged with a highly virulent ASFV strain and monitored for 21 days. Serum samples collected at 41 days post-vaccination were analyzed for reactivity against a panel of 29 viral structural proteins.

Results:

Project 1: The pen-side PCR test detected infected pigs from 2 days post-infection (dpi) and consistently detected infection until the end of the study (10 dpi). In contrast, the antigen test began detecting infection at 3 dpi and no longer detected infection at 10 dpi.

Project 2: The LAV vaccine conferred 100% protection against a lethal challenge with the virulent ASFV strain, while the KV vaccine did not confer the same protection. Pigs vaccinated with the LAV vaccine developed a broader antibody response against a diverse range of viral proteins than those receiving the KV vaccine. Notably, within the LAV-vaccinated group, a negative correlation was observed between the intensity of antibody reactivity against specific ASFV antigens and the levels of viral DNA in the blood following a virulent ASFV challenge.

Conclusion

Project 1: In the context of this study, the pen-side PCR test exhibited greater sensitivity and detected infected pigs earlier and for a longer duration after infection than the antigen test.

Project 2: Distinct antibody profiles were observed between pigs vaccinated with the LAV and those vaccinated with the KV vaccine. The viral proteins exclusively recognized by sera from the LAV group hold promise as potential markers of vaccine-induced protection.

**Presenter Name:** Sylvia Wanzala Martin, University of Minnesota
**Author(s):** Sylvia Wanzala Martin, Mickey Leonard, Catherine Alexander, Marie Culhane, Timothy Goldsmith
**Title:** Harvest Facilities - Understanding African Swine Fever (ASF) Pathways at Slaughter

To prevent introduction and/or mitigate the spread of a foreign animal disease, all potential routes of disease transmission must be understood and evaluated. If conducted proactively, a disease transmission pathway analysis can serve as a source of information for regulators and other stakeholders in determining the areas to assess for potential risk associated with specific animal industry activities that may occur during an outbreak (Evanson et al., 2015). The pathway analysis can also provide the framework for a more extensive risk assessment, which thoroughly evaluates the risks associated with each step of the pathway. The World Organization for Animal Health states that a disease transmission pathway analysis is essential to the design of an effective biosecurity plan, with priority given to mitigation of steps or pathways most likely to result in pathogen transmission (WOAH, 2021b). If African Swine Fever (ASF), were introduced into the United States, all components of the pork industry life cycle, from boar semen to pigs to market, would be impacted by state and federal disease response and control measures (USDA APHIS VS, 2023) ). In order to continue operating, a pork harvest facility located within or receiving animals from a disease Control Area (CA) would likely need to show that it does not pose a risk of furthering the spread of ASF. To begin to proactively evaluate the risk of ASF virus (ASFv) transmission from a pork processing facility, a harvest facilities pathway analysis was conducted to determine the potential pathways for ASFv into and out of the pork harvest facilities. The steps the slaughter facilities currently have in place that may mitigate ASFv risk pathway were ascertained. Fully understanding all the potential routes of ASFv transmission is an important first step when attempting to eliminate or reduce pathways for ASFv entry into and spread from harvest facilities. Identification of unmitigated ASFv entry or spread pathways may also help harvest facilities strengthen existing biosecurity protocols. Furthermore, some mitigation measures already in place may also be effective against ASF and, assuming the measures are successfully implemented, a harvest facility located within or receiving animals from an ASFv outbreak CA may continue operations. The scope of the project was limited to US pork harvest facilities that conduct on-site slaughter and include primal cuts among their products. A literature scan was conducted to outline the major inputs into and outputs from harvest facilities, which served as a basis for consultation and collaboration with two Midwestern US pork harvest facilities, selected to be representative of the majority of industry practices within the scope of the project, given the federal regulation of pork slaughter facilities (USDA, 2022). One facility represents an integrated company, with producers owning the facility, while the other obtains its slaughter pigs off of the open market. Through several meetings with subject-matter-experts from both facilities, we identified and evaluated inputs and outputs - and thus potential disease transmission pathways - for presumably standard US pork harvest facilities. For each input and output, the pathways were defined, and existing potential ASFv mitigations that are part of normal day-to-day operations, were identified, discussed, and researched, and steps along the pathways were labeled as fully mitigated, partially mitigated, unmitigated, and unknown. About 1/10th of all pathways were fully mitigated, 1/5th partially mitigated, another 1/5th were unknown and slightly over ½ of all pathways were unmitigated. The unmitigated and unknown pathways can assist public-private partnerships in their ongoing work regarding ASF preparedness.

**Presenter Name:** Paul Yeske, Swine Vet Center
**Author(s):** Paul Yeske
**Title:** How can we Eliminate PEDv from Infected Herds

Introduction:

Since the introduction of PEDv in 2013 to the US swine industry this disease has established itself and continues to remain in the swine population, as shown in both the MSHMP (Morrison Swine Health Monitoring Project) and SDRS (Swine Disease Reporting System)1,2.

Success rate for elimination at the herd level is high, with many herds successfully eliminating PEDv. The principle of load closure and homogenize followed by strict cleanup and good hygiene has worked well. We currently have the expertise to eliminate this disease from herds.

One of the biggest challenges is once PEDv starts circulating in the industry it does not take long for it to move. One factor is in transportation; this was demonstrated early in the outbreak in 2013 the packing plants were contaminated quickly, and trucks had higher likelihood of becoming positive after being at the plants3. This results in market channels including cull sows become contaminated quickly and can potentially be sources of infection.

Methods:

The industry has the tools to successfully eliminate this virus. There are good diagnostic tools and the samples necessary to test are easily collected by veterinarians and producers, I believe we have the tools and the technical expertise that the PEDv can be eliminated from herds. Load, closure and homogenize has been very effective means of elimination. With the closure time it has been reduced to as low as 90 days in some cases depending on specifics of the herd and diagnostic testing. Planning timing for herd elimination to complete in the middle of summer allows for lower numbers of virus and less pressure and the ability to do a better job of cleanup. An elimination program for a farm requires: cooperation between staff, communication, and good surveillance to be successful.

Discussion:

There is still a significant impact on the sow herds that are affected, and costs associated with cleaning up, stabilizing and going on to elimination. Herds that have chosen to live with the disease still have significant cost in keeping herds positive in on going monitoring and the effect on gilts that are exposed in new outbreaks that occur in the system because there is still active virus present. I believe we have the knowledge, diagnostics, and abilities to accomplish elimination not only from herds but the entire industry.

References:

1. Corso C. Morrison Swine Health Monitoring Project. 2022

2. Linhares D. Swine Disease Monitoring System. 2022

3. Lowe J. Role of Transportation in Spread of Porcine Epidemic Diarrhea Virus Infection, United States. Emerging Infectious Diseases 2014 (20) (5).

**Presenter Name:** Paul Yeske, Swine Vet Center
**Author(s):** Paul Yeske
**Title:** How to go about Sustainable Disease Elimination Programs: PEDv as an example

Introduction:

Since the introduction of PEDv in 2013 to the US swine industry this disease has established itself and continues to remain in the swine population, as shown in both the MSHMP (Morrison Swine Health Monitoring Project) and SDRS (Swine Disease Reporting System)1,2. There is a definite seasonal pattern to the disease with activity being the highest in winter months.1,2

Success rate for elimination at the herd level is high, with many herds successfully eliminating PEDv. The time frame for elimination is relatively short and can be done in 90-120 days. The principle of load closure and homogenize followed by strict cleanup and good hygiene has worked well.

One factor is in transportation, this was demonstrated early in the outbreak in 2013 the packing plants were contaminated quickly, and trucks had higher likelihood of becoming positive after being at the plants3. This results in market channels including cull sows becoming contaminated quickly and can potentially be sources of infection. Every year we see a limited number of sow farms becoming positive resulting in less than 9% of sow herd being positive with 2022 being one of the higher years.

Methods:

The industry has the tools to successfully eliminate this virus from individual herds. There are good diagnostic tools and the samples necessary to test are easily collected by veterinarians and producers, The incidence is relatively low. I believe we have the tools and the technical expertise to eliminate for the entire industry. A program such as this would take cooperation, communication, and surveillance to be successful. The use of a program such as US SHIP (US Swine Health Improvement Plan could be very effective in helping to facilitate this activity. This would be a way to use an endemic disease to test the mechanics of the system to see if it is ready to move forward when needed to address concerns as the industry had too.

Discussion:

My bias has always been to eliminate any disease that we can as an industry. I believe that long term this only makes the industry more sustainable. Although there are more severe economic diseases that impact herds every year. There is still a significant impact on the sow herds that are affected, and costs associated with cleaning up, stabilizing and going on to elimination. I believe we have the knowledge, diagnostics, and abilities to accomplish this. It is a matter of resolve to do so. I think it is a good opportunity to test US SHIP and see how this tool can work for the industry. It will take a lot of preparation and organization and communication to get this done but I think it is time, and can be done in short period of time.

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1. Corso C. Morrison Swine Health Monitoring Project. 2022

2. Linhares D. Swine Disease Monitoring System. 2022

3. Lowe J. Role of Transportation in Spread of Porcine Epidemic Diarrhea Virus Infection, United States. Emerging Infectious Diseases 2014 (20) (5).

**Presenter Name:** Paul Yeske, Swine Vet Center
**Author(s):** Paul Yeske
**Title:** Keeping Robust Sows Healthy

Introduction:

Increasing sow mortality in the industry has continued to be a challenge for the entire industry with averages continuing to climb as we look at databases1,2. This has increased the conversation about the need for more robust sows. Understanding why, when and how sows are lost from the herd is one of the most important things we can understand. How we can better retain sows in the herd is important to herd productivity especially when young sows exit too early. A significant part of sow robustness is how herds prepare gilts to enter the herd. There are no short cuts to this process without consequences. Every herd will have a different formula for how to properly have gilts enter the herd. This will be based on the unique attributes of the farm and herd health profile of each herd, no one size fits all program.

Keeping sow herds healthy is an ongoing challenge for all herds and producers. This certainly starts with a complete biosecurity program (made up of a good bioexclusion and biocontainment plan). As we look at risk, it can be broken down into how likely it is to cause a pathogen to enter and infect the herd and how frequently we do the activity.

Methods:

Animal introductions into the herd is the greatest risk, therefore doing vet-to-vet communication with source herds, adequate isolation and surveillance to ensure these animals arrive safely into the herd. Understanding the farms health profile is important with ongoing monitoring and records review. Developing a vaccination and exposure plan for gilts to acclimate into the herd is critical to have as part of the introduction plan.

Identifying sows at risk early on in need of treatment and making sure they get properly taken care of is key to retaining them in the herd. Maintaining proper body condition is also important.

Periodic comprehensive review of the herds biosecurity program is important to ensure that protocols that are put in place are being followed. Herds that have filtration is a very good tool but must be properly managed to be able to function as expected.

Discussion:

It would be great if we could have such a robust animal, that we didn't have to do any of these procedures, but this is just not a reality. Making sure we have a sound biosecurity protocol is an important step to keep pathogens out and allow animals to express their full genetic potential. Making sure replacements get started right is a big key and then continued observation to correct problems on going will help us make these animals more robust and allow herds to meet their goals.

References:

1. MetaFarms Production Index 2023

2. Benchmark 2023