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JSHAP SPOTLIGHT

Dr Marie Culhane

University of Minnesota College of Veterinary Medicine

Dr Culhane earned a BA (91), DVM (97), and PhD (07) from the University of Minnesota and is currently a professor in the Veterinary Population Medicine Department. Marie's research focus is the antigenic and genetic characterization of influenza A viruses of swine and turkeys, the pathogenesis of unique influenza A virus infections in swine and turkeys, and the possible impact these viruses may have on current control and vaccination protocols in the US livestock and poultry industries. Marie serves on the JSHAP Editorial Board to give back to the AASV and exercise her editing and critical review skills. As a bonus, she has found some other people who enjoy debating the use of the Oxford comma!

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Finding silver linings

I think I promised in an earlier message to not use the 2020 vision comparison again. However, I have used "hindsight is 20:20" for years before this, so I think I deserve some leeway. Especially as I reflect on this past year as AASV President and the past year as a private practice swine veterinarian. Wow, what we have learned! We learned to communicate with family and friends via Zoom, before 2020 who even knew about Zoom? We certainly learned how to eat more meals at home!

My optimistic side says to look for a silver lining in the past year's turmoil. This past year's pandemic does have some silver linings. Technology has afforded us plenty of opportunities. With smartphones, tablets, and laptops, we all have video communication readily available. However, is this the same as live in-person visits? I contend electronic communication is better than no communication, however nothing can replace a veterinarian in a pig barn. Sight and sound are 2 of the senses that can be transmitted via digital communication. Scent, feel, and taste have yet to have a good electronic substitute. I know of multiple examples where the diagnosis of the problem was made with a sense that cannot be transmitted via electronic means. Feeling a bone fracture with minimal effort on a necropsy due to calcium deficiency? Smelling strong ammonia when walking through a barn breaking with *Actinobacillus pleuropneumoniae*? Acidic smell of scours during an outbreak of transmissible gastroenteritis or porcine epidemic diarrhea? These are things that producers walking through barns daily may not notice. As Dr Rodibaugh has always mentored me: get in the barns, see the pigs. Nothing can replace the diagnostic capabilities of a good swine veterinarian. Walk though, determine activity level, cough level, temperature variation, high ammonia, high humidity, drafts, any diarrhea? All this occurs before the first necropsy. Answers to these variables with a necropsy generally leads to a good idea as to what the diagnosis will be pending lab results.

Another technology advantage that has become more useful with the pandemic is the web identification system and emailing of shipping labels. Producers can simply call in a request and the vet can email the necessary info to them for samples to be submitted, anything from tissue to blood to oral fluids. Diagnostic results can be received within 24 to 48 hours in most cases.

While the actual message may be delivered electronically, the gestures and facial expressions are more difficult to read on a screen. I really will miss the late evening dinners and adult beverages with my AASV friends at this year's annual meeting. The personal connections made are invaluable to me and many others. I know I will be trying to give a quick call to some of the people I see only once a year at AASV Annual Meeting.

"While 20:20 may indicate perfect vision, the year 2020 will go down as one of the most imperfect in our lifetimes."

As planning began for the 2021 AASV Annual meeting, I was hopeful that we could bookend the pandemic. That did not happen, but by the time you are reading this we will have completed the virtual Annual Meeting. Prior to 2020, having an entire conference virtually was unheard of. Since others have already had experience and providers have done other meetings, I believe ours will be successful. Now my hope is that we can end the pandemic and attend the 2022 AASV Annual Meeting in Indianapolis in person. By that time, maybe enough people will be vaccinated that we all can feel safe to travel and mingle with hundreds of others.

While 20:20 may indicate perfect vision, the year 2020 will go down as one of the most imperfect in our lifetimes. But hopefully the struggles result in all of us learning some things to cope with challenges life throws at us.

Jeff Harker, DVM
AASV President

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Progress during a pandemic

I certainly hope you enjoy the first virtual AASV Annual Meeting! Many thanks to the staff and this years' all-star Planning Committee. The COVID-19 pandemic presented additional challenges, but as usual, our association and its members were able to overcome the obstacles. The AASV Annual Meetings are something I look forward to attending. I find them refreshing and motivating. I will admit there are some components of preparing and traveling that I will not miss, but I will certainly miss seeing all of you! I think we would all benefit from a smile, greeting, or quick conversation with our peers.

You do not need me to remind you what a frustrating year this has been. Our industry was faced with an unforeseeable crisis and we scrambled for solutions. At times, it felt like those solutions arrived at a snail's pace, but despite the many restrictions placed on us due to the pandemic we continued to move forward. I emailed a few people and asked for their organizations' accomplishments. I am proud to report that there simply is not enough room in this article to share them all. The collaboration between AASV, National Pork Board (NPB), Swine Health Information Center (SHIC), National Pork Producers Council (NPPC), US Department of Agriculture-Animal and Plant Health Inspection Service, academia, our state pork producer associations, and state veterinarians has been unprecedented. It is wonderful to see everyone working together to help with the crisis this pandemic created, and to better prepare us for a foreign animal disease (FAD) introduction. I decided to highlight a few of these accomplishments, but please know the list is not all-inclusive.

In response to the processing disruption due to the COVID-19 pandemic, the NPB put together a depopulation task force. They funded a literature review on methods of swine depopulation and to better understand or expand the options available, they funded 11 research projects on the subject. The AASV developed and published several resources for veterinarians including: position statements on Pig Welfare During Stop Movement Situations and Strategies for Responding to Processing Disruption Due to the COVID-19 Pandemic. They developed a Farm Crisis Operations Planning Tool which highlights key resources and supplies that may be affected during an emergency and facilitates planning for veterinarians and producers on how to implement emergency operation plans (this tool was co-published with NPB, NPPC, and SHIC). They provided recommendations for euthanasia and depopulation and links to AVMA's guidelines and flowchart on the subject. They produced a checklist or quick reference for veterinarians tasked with assisting producers with depopulation and offered two webinars on depopulation methods. Resources published by other industry organizations, such as external links on farm security, CO2 planning tools and vaporizer construction, a list of CO2 providers, captive bolt and gunshot fact sheets, a statement from the US Food and Drug Administration on the use of sodium nitrite and methods to alter animal growth, were shared. Both AASV and NPB have a vast array of information on COVID-19 and public health and wellness on their websites. While created and compiled during the COVID-19 market disruption, these resources will also be useful during an FAD outbreak. Take a moment to check them out.

"It is wonderful to see everyone working together to help with the crisis this pandemic created, and to better prepare us for a foreign animal disease (FAD) introduction."

A collaborative effort between AASV, NPB, and Iowa State University is underway to develop and implement national training programs to get personnel ready to respond to an FAD. The SHIC has also had a very productive year. They have validated that oral fluids can be used to identify pseudorabies and differential wild type from vaccine viruses. A SHIC-funded study conducted by Iowa State University showed us the advantages of staged loading in reducing the risk of pathogen introduction into our barns. They have done research in Vietnam to determine if oral fluids can be used for African swine fever (ASF) detection and surveillance and are funding research to improve the detection of low levels of nucleic acid in oral fluid samples. They have evaluated the risk of ASF viral transmission by rodents and determined the time and temperature required for inactivation of ASF virus on livestock trailers. A tremendous amount of information has been provided and more research is underway concerning the risk of FAD introductions through feed ingredients. Suggested ingredient holding times have been published and potential additives evaluated. The NPB and SHIC are funding a project, with the collaboration of NPPC and AASV, to identify gaps in US pork industry national biosecurity including evaluating foreign travelers, imports, domestic transportation of animals, and market channels to mention a few.

The list goes on with many more gaps to be addressed and questions to be answered, but we are certainly better prepared today than we were this time last year. If we keep up the pace and continue working together, we will successfully navigate through the obstacles that lie ahead.

Mary Battrell, DVM
AASV President-elect

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COVID-19 parallels

As I write this in mid-January, the COVID-19 vaccine rollout has been underway for just over one month. By all accounts, vaccination is going much slower than anticipated. The Trump administration had vowed to have at least 20 million Americans vaccinated by the end of 2020. According to the US Centers for Disease Control and Prevention, only approximately 11 million people have received a COVID-19 vaccine dose to date. President Biden has promised to vaccinate 100 million Americans in his first 100 days in office. It is yet to be seen whether his administration will be any more successful than his predecessor's. The blame game and finger pointing has begun – the federal government blaming the states for not being better prepared and the states claiming insufficient federal funding and lower than promised vaccine availability.

Watching this unfold makes me draw parallels with what we might face in the swine industry if we were to implement a large-scale vaccination program for foot-and-mouth disease or classical swine fever. Although on a somewhat smaller scale (roughly 60 million pigs managed by approximately 63,000 farmers) and pigs rather than people, we would face many of the same challenges faced in the COVID-19 vaccination effort. We would likely face limited vaccine supply (especially early in the outbreak), distribution challenges, prioritization questions, the need to give multiple vaccines, regulatory issues regarding record keeping, and deciding who can administer the vaccine given potential personnel shortages. As with the COVID-19 effort, the end-user will be subject to decisions made at the state and federal level and subject to the resources available.

Given the challenges of administering a vaccine to protect human beings in a pandemic with comparatively unlimited access to resources, imagine the challenges the swine industry is likely to face. Agriculture officials at the state and federal levels need to be watching carefully as this COVID-19 vaccine response continues and work with swine producers and veterinarians to determine how similar challenges can be addressed to better prepare and protect the swine industry. In addition, the need to ensure adequate vaccination will most likely be an international effort involving all North America.

Obviously, the swine industry has some advantages with regards to vaccination. Vaccine administration could be accomplished by producers assuming government officials allow that to occur under veterinary oversight. Likewise, our well-established network of distribution could facilitate vaccine shipments. Again, this assumes government officials are willing to take advantage of that existing resource.

We have also seen the challenges public health has faced with COVID-19 diagnostics and surveillance. In the swine industry, we face these same issues. Who to sample, how many to sample, what samples to take, what tests to run, who can move, where can they go, and under what circumstances, to name a few. Addressing these questions in the face of an ongoing outbreak is highly inefficient and slows the entire response effort thus further jeopardizing business continuity across the swine industry. In some ways, the delays we have seen in the COVID-19 response are understandable, SARS-CoV-2 was an entirely new virus. In fact, I think one of the bright spots in this pandemic is the speed with which public health was able to develop, approve, and implement diagnostics and vaccines. Classical swine fever, foot-and-mouth disease, and African swine fever do not get that same pass. These are known viruses that have been very well researched.

Limitations to an effective foreign animal disease response are well documented and have served as the basis for decades of debate and collaboration. Not having answers to the simple questions previously mentioned is inexcusable. We should already have an effective, agreed upon, and exercised strategy in place for the detection and response to the introduction of a foreign animal disease. The fact that we continue to debate many of the same gaps in response is disheartening and frustrating.

Interestingly, it took a human pandemic impacting the ability to market our pigs for industry and government officials to begin to identify and develop the resources necessary to facilitate a large-scale disease response. An example is depopulation and carcass disposal. These have been identified as gaps in our response capabilities for decades but only just now have we begun to take steps to ensure access to the resources necessary to ensure the industry can accomplish those critical tasks. However, there are still not sufficient resources available nationally to address these issues. In addition, basic questions remain unanswered involving surveillance, animal movements, testing, and vaccination strategies.

The COVID-19 pandemic remains a tragic episode for global public health. The vaccination rollout failures expose the challenges associated with poor federal leadership and variable state response capabilities. We have the time now to shore up those issues through collaboration among state and federal officials and the swine industry. Those of us responsible for responding to a similar outbreak in animal health are hopefully watching this COVID-19 response and learning from the obvious parallels so we do not make the same mistakes.

Harry Snelson, DVM
Executive Director

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Pivot

The new buzz word, and all of its derivations, in my work circles is *pivot*. My colleagues in clinical practice have been working harder than ever with many pivoting their clinical tasks to be delivered with a more telemedicine approach. My colleagues in academia have been working harder than ever with most pivoting to deliver curriculum in a virtual format. We have all pivoted in our jobs and personal lives.

I pivoted back to my message from the March-April 2020 issue, titled "Recognition," to reflect upon what I felt was important to write about in early 2020. I wrote the March-April 2020 message just prior to the realization that we were about to enter a global pandemic and that all of our lives were about to change, eg, pivot. Now one year later, I feel that message warrants repeating and so I simply want to bring a section of it here again:[1]

> It seems that today's work force is expected to do more with less and workload is increasing with a seemingly unlimited ceiling. Veterinary medicine, regardless of which area of the profession you are involved with, is not immune to such workload pressures. Personnel are the most valuable asset of any organization regardless of job description, ie, veterinary technician, administrative staff. There have been review papers published in the human nursing literature documenting that staff workload has a direct relationship with adverse patient outcomes, hospital mortality, and medical mistakes.[2] Other job satisfaction surveys have reported that employees would rather have more staff to allow for more time to be spent with patients or customers and better communication between staff and upper management.[3]

Now it is perhaps even more obvious that today's work force is indeed expected to "do more with less" but now in a virtual environment. Spending time directly with people is now, for many, in a virtual environment. I usually use the November-December issue of JSHAP to thank my reviewers, editorial board, and journal staff. But I wanted to send another thank you to everyone involved with the journal. Schedules are busy, everyone has pivoted, and the journal success is attributed to all those who contribute.

"I wrote the March-April 2020 message just prior to the realization that we were about to enter a global pandemic and that all of our lives were about to change, eg, pivot."

This message will reach you just after the virtual 2021 AASV Annual Meeting. I am looking forward to the meeting and "Navigating the Future...Together." I am also looking forward to less pivoting - it is starting to make me dizzy.

I hope you enjoy this issue.

Terri O'Sullivan, DVM, PhD
Executive Editor

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ORIGINAL RESEARCH PEER REVIEWED

Tonsil scrapings for porcine reproductive and respiratory syndrome virus detection in growing pigs under field conditions

Heather L. Walker, BS; Andrew S. Bowman, DVM, PhD, DACVPM; Juliana B. Ferreira, DVM, MSc, DVSc; Sarah W. Nelson, MS; Monique Pairis-Garcia, DVM, PhD; Andreia G. Arruda, DVM, PhD

Summary

Objective: The main objective of this study was to describe the use and limitations of tonsil scrapings (TS), oral fluids (OF), nasal swabs (NS), and environmental swabs (ES) to detect porcine reproductive and respiratory syndrome virus (PRRSV).

Materials and methods: Two PRRSV-positive growing pig farms using different PRRSV control strategies were enrolled in this study. Sampling began approximately 52- and 21-days post PRRSV exposure for farms 1 and 2, respectively, and occurred once a month for four months using fixed spatial sampling. Samples for OF and ES were collected at the pen level and TS and NS samples were collected at the individual level. All samples were tested using reverse transcriptase-polymerase chain reaction (RT-PCR).

Results: A total of 192 samples were collected over the study period: 48 TS, 48 OF, 48 NS, and 48 ES. Overall, 20 TS (41.6%), 0 OF (0.0%), 6 NS (12.5%), and 1 ES (2.1%) tested RT-PCR positive for PRRSV throughout this study.

Implications: Tonsil scraping samples yielded more positive PRRSV RT-PCR results for longer time periods when compared to OF, NS, and ES for PRRSV detection in growing pigs. Tonsil scraping samples tested RT-PCR positive for PRRSV up to 168 days post exposure. Oral fluids, NS, and ES sampling methods for PRRSV detection in growing pig populations, particularly months after the initial infection or vaccination, should be used with caution given low RT-PCR positive samples found in this study.

Keywords: swine, tonsil scrapings, porcine reproductive and respiratory syndrome virus detection, porcine reproductive and respiratory syndrome diagnostics

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Resumen - Raspados de amígdalas para la detección del virus del síndrome reproductivo y respiratorio porcino en cerdos en crecimiento en condiciones de campo

Objetivo: El objetivo principal de este estudio fue describir el uso y las limitaciones de los raspados de amígdalas (TS), fluidos orales (OF), hisopos nasales (NS) e hisopos ambientales (ES) para detectar el virus del síndrome reproductivo y respiratorio porcino (PRRSV).

Materiales y métodos: En este estudio se registraron dos granjas de cerdos en crecimiento positivas al PRRSV que utilizan diferentes estrategias de control de PRRSV. El muestreo comenzó aproximadamente 52- y 21-días después de la exposición al PRRSV para las granjas 1 y 2, respectivamente, y se realizó una vez al mes durante cuatro meses utilizando un muestreo espacial fijo. Las muestras para OF y ES se recolectaron a nivel de corral y las muestras de TS y NS se recolectaron a nivel individual. Todas las muestras se analizaron mediante la reacción en cadena de la polimerasa con transcriptasa reversa (RT-PCR).

Resultados: Se recolectaron un total de 192 muestras durante el período de estudio: 48 TS, 48 OF, 48 NS, y 48 ES. En total, 20 TS (41.6%), 0 OF (0.0%), 6 NS (12.5%), y 1 ES (2.1%) fueron positivas a la RT-PCR para PRRSV a lo largo de este estudio.

Implicaciones: Las muestras de raspado de amígdalas produjeron resultados positivos a la RT-PCR de PRRSV durante períodos de tiempo más prolongados en comparación con OF, NS, y ES para la detección de PRRSV en cerdos en crecimiento. Las muestras de raspado de amígdalas dieron positivo en RT-PCR para PRRSV hasta 168 días después de la exposición. Los métodos de muestreo de fluidos orales, NS y EE para la detección de PRRSV en poblaciones de cerdos en crecimiento, particularmente meses después de la infección o vacunación inicial, deben usarse con precaución debido a las bajas muestras positivas para RT-PCR encontradas en este estudio.

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This article is available online at **http://www.aasv.org/shap.html**.

Walker HL, Bowman AS, Ferreira JB, Nelson SW, Pairis-Garcia M, Arruda AG. Tonsil scrapings for porcine reproductive and respiratory syndrome virus detection in growing pigs under field conditions. *J Swine Health Prod*. 2021;29(2):72-80.

Résumé - Grattages des amygdales pour la détection du virus du syndrome reproducteur et respiratoire porcin chez des porcs en croissance dans des conditions de terrain

Objectif: Le principal objectif de la présente étude était de décrire l'utilisation et les limitations des grattages des amygdales (TS), des fluides oraux (OF), des écouvillons nasaux (NS), et des écouvillons d'environnement (ES) pour détecter le virus du syndrome reproducteur et respiratoire porcin (PRRSV).

Matériels et méthodes: Deux fermes de porcs en croissance positives pour le PRRSV et utilisant des stratégies différentes pour maitriser le PRRSV furent recrutées dans cette étude. L'échantillonnage débuta approximativement 52- et 21-jours post-exposition au PRRSV pour les fermes 1 et 2, respectivement, et fut effectué une fois par mois pendant 4 mois en utilisant un échantillonnage spatial fixe. Les échantillons d'OF et d'ES furent prélevés au niveau de l'enclos et les échantillons de TS et NS furent prélevés au niveau individuel. Tous les échantillons furent testés en utilisant une réaction d'amplification en chaîne par la polymérase avec la transcriptase réverse (RT-PCR).

Résultats: Un total de 192 échantillons furent prélevés au cours de la période d'étude: 48 TS, 48 OF, 48 NS, et 48 ES. Globalement, 20 TS (41.6%), 0 OF (0.0%), 6 NS (12.5%), et 1 ES (2.1%) se sont avérés positifs par RT-PCR pour le PRRSV au cours de l'étude.

Implications: Les échantillons de grattage d'amygdales ont généré plus de résultats positifs par RT-PCR pour le PRRSV pour de plus longes périodes lorsque comparé à OF, NS, et ES pour la détection de PRRSV chez des porcs en croissance. Les échantillons de grattage d'amygdales se sont avérés positifs par RT-PCR pour le PRRSV jusqu'à 168 jours post-exposition. Les méthodes d'échantillonnage pour OF, NS et ES pour la détection de PRRSV dans les populations de porcs en croissance, particulièrement les mois après l'infection initiale ou la vaccination, devraient être utilisées avec précaution étant donné le faible nombre d'échantillons positifs par RT-PCR trouvés dans cette étude.

Porcine reproductive and respiratory syndrome (PRRS) is the costliest disease currently affecting the North American swine industry with an estimated financial damage over $600 million annually.[1] This disease is caused by an RNA virus of the same name and has two predominant strains affecting the swine industry worldwide; the Eurasian strain (Type I) and the North American strain (Type II), both of which have been found in the United States. The Type II PRRS virus (PRRSV) strain is the most prevalent in North America and thus more likely to cause outbreaks.[2] As the name implies, the virus clinically manifests in primarily two bodily systems, the reproductive and respiratory systems. At the growing and finishing phases, affected pigs show slower growth rates, lower feed conversion, and an overall weakened appearance.[3] One team estimated that grower/finisher pigs endemically infected with PRRSV could result in elevated mortality and a decreased average daily gain of 17 to 35 g/d, ultimately leading to a projected $360 million loss in revenue annually.[1]

Porcine reproductive and respiratory syndrome virus has the innate ability to reside and proliferate in the lymphatic system,[4] and after infecting a host, the virus undergoes several phases in which it travels to and infects various lymphatic organs (eg, spleen, thymus, and tonsils).[3] Bodily dissemination of the virus allows for viremia development and viral shedding through a variety of routes including saliva, nasal secretions, mammary gland secretions, urine, feces, and semen.[3] Even though these excretions can be used to detect PRRSV in infected animals, the duration of shedding for each route is usually short, transient, or both.[5]

Accurately determining herd-level PRRSV status is important for animal movement and disease prevention and control. As such, herd-level testing protocols are commonly applied to describe the disease status of a herd based on diagnostic testing from a sample population of the herd.[6] The most widely used detection methods for declaring PRRSV herd-level status in growing pig populations include serum and oral fluid (OF) testing.[7] Even though serum sampling is the gold standard for PRRSV status determination in growing pigs,[6] OF testing has become popular over the past years because it is a convenient sample type that can be conducted by farm personnel with minimal training.

Oral fluid testing has successfully shown 90% to 100% virus detection via reverse transcriptase-polymerase chain reaction (RT-PCR) at 7 to 21 days post infection (dpi); however, the sensitivity of OF testing for PRRSV is negatively proportional to the post exposure time[8] and represents a challenge for detection once PRRSV reaches low levels at the population level. In such cases, due to the potential for false negatives, a herd could be incorrectly declared PRRSV negative resulting in downstream consequences pertaining to disease spread and surveillance.

Additional sampling methods for PRRSV have also been investigated in the past including nasal swabs (NS) and environmental swabs (ES). However, studies have shown that nasal shedding may be strain-dependent, only detected via RT-PCR sporadically,[9,10] and at a maximum of 49 dpi.[11] In contrast to NS, Vilalta and colleagues[12] reported that swabbing in the farrowing environment allowed for detection of PRRSV for up to 14 and 17 weeks post exposure at processing and weaning, respectively.

It has been shown under experimental conditions that PRRSV can persist in lymphoid tissues for long periods of time[13] and can be detected over 150 dpi[14]; but for practical reasons, lymphoid tissue sampling is not commonly considered among strategies for determination of herd-level PRRSV status.[6] Tonsil scraping (TS) may be an alternative to lymphoid tissue collection and has been validated as the sampling method of choice for various foreign animal diseases.[15] In addition, tonsil sampling can be effective in isolating PRRSV in pigs infected for longer time periods. Wills et al[4] initially reported the isolation of PRRSV from experimentally inoculated pigs via TS samples up to 157 dpi. In addition, Allende et al[16] measured viral persistence from experimental PRRSV infection in a small group of pigs via tonsil biopsy samples up to 150 dpi and others[13] have detected PRRSV in tonsil samples at 251 dpi. Although these studies demonstrate efficacy of TS for PRRSV detection, no studies to date have been published using this methodology under field conditions. Therefore, the main objective of this study was to describe the use and limitations of TS, OF, NS, and ES to detect PRRSV, and to compare PRRSV detection in TS samples from a PRRSV vaccinated and nonvaccinated farm.

Materials and methods

This research project was approved under North Carolina State University IACUC protocol 18-167-T.

Farm descriptors

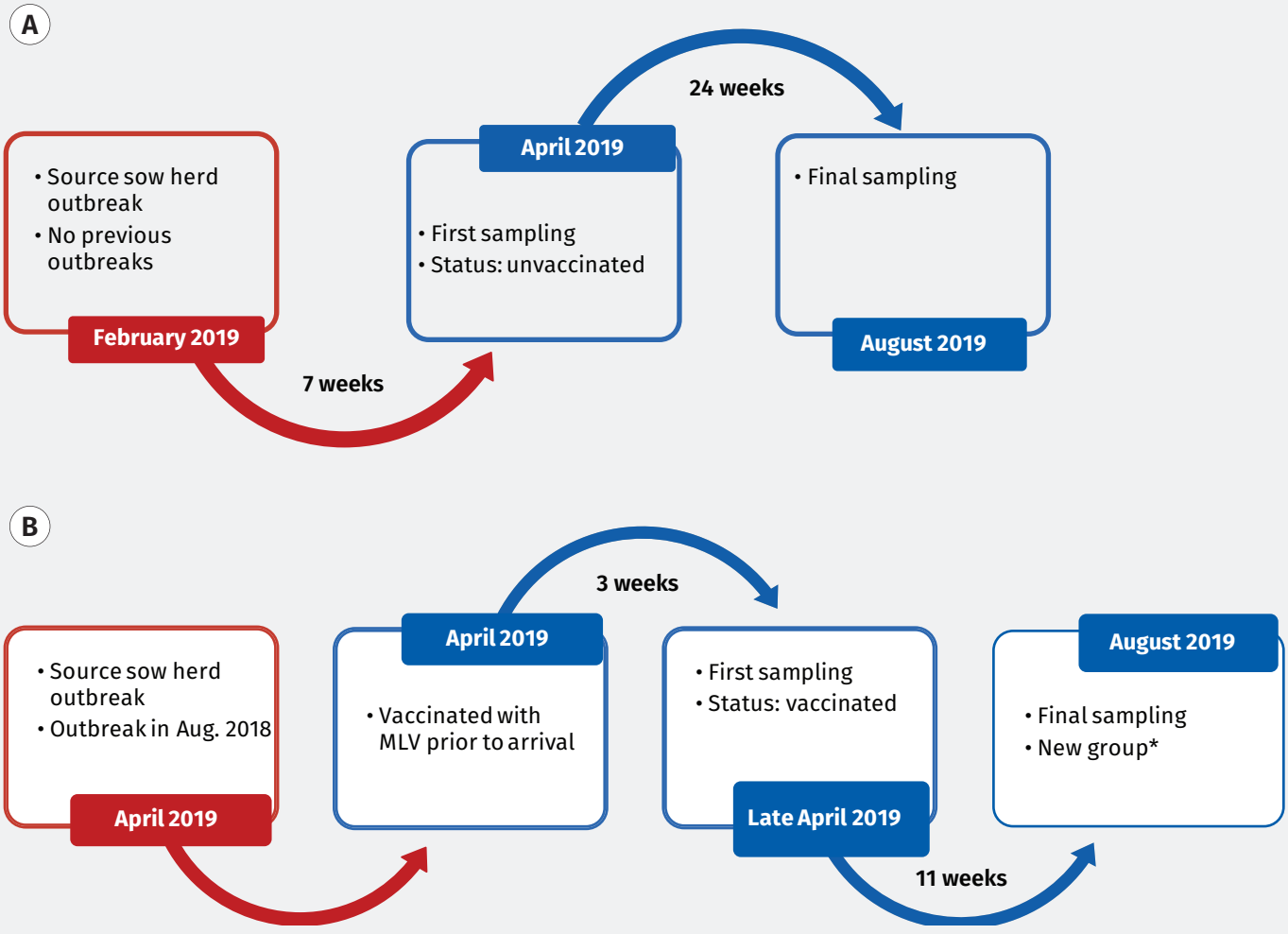
Two farms located in North Carolina were enrolled in this study. The inclusion criteria included farms located within a three-hour drive from the collaborators (for sampling purposes) that had a PRRSV outbreak within 60 days prior to the start of the study. The first farm (farm 1; unvaccinated) was a single-sourced 3500-head wean-to-finish facility composed of 4 barns with all-in/all-out pig flow. The source sow farm was presumed PRRSV negative, as no PRRS outbreaks were ever reported prior to this study. At the end of February 2019, a PRRS outbreak was confirmed on the source farm with a virus restriction fragment length polymorphism (RFLP) type 1-7-4. Transferring pigs from the source farm to farm 1 occurred throughout the month of March. No PRRSV vaccination was administered prior to or at the time of the outbreak on the source sow farm or on farm 1. The second farm (farm 2; vaccinated) was a single-source 2800-head finisher facility that was also composed of four barns utilizing an all-in/all-out pig flow. The source sow herd had a history of PRRS outbreaks with PRRSV RFLP type 1-7-4; with the last two confirmed PRRS outbreaks occurring in August 2018 and April 2019. Due to the previous PRRSV confirmation, a vaccination protocol was already in place on the source sow farm: sows were vaccinated 4 times per year and piglets were vaccinated at processing (4-6 days of age), with a 2 mL and 1 mL dose of a modified live PRRS vaccine (MLV; Ingelvac PRRS MLV; Boehringer Ingelheim), respectively.

Upon discovery of the April 2019 outbreak, the farm staff immediately began vaccinating the source sow herd with the MLV and implemented herd closure. These management strategies, along with sampling collection times, are shown in Figure 1.

Sample collection

Sampling for farms 1 and 2 was conducted between May and August of 2019, with up to 4 sampling events for each farm. Farm 1 was divided into 44 pens per barn and farm 2 was divided into 36 pens per barn, each pen consisted of 15 to 20 pigs (Figure 2). This study utilized a fixed spatial sampling technique for sample collection[17] with markers placed within each barn to indicate the sampling areas (Figure 2), representing approximately 30 to 40 pigs per sampling area (two pens of 15-20 pigs sharing a

Figure 1: Timeline for porcine reproductive and respiratory syndrome management strategies and sampling for A) farm 1 and B) farm 2. The pigs on farm 2 were vaccinated with a commercially available modified live vaccine (MLV). *Due to the timing of collections, farm 2 was in the process of shipping pigs to market during the June and July collections; thus, a new group of pigs (following the same vaccination protocol) were placed prior to the last collection in August.



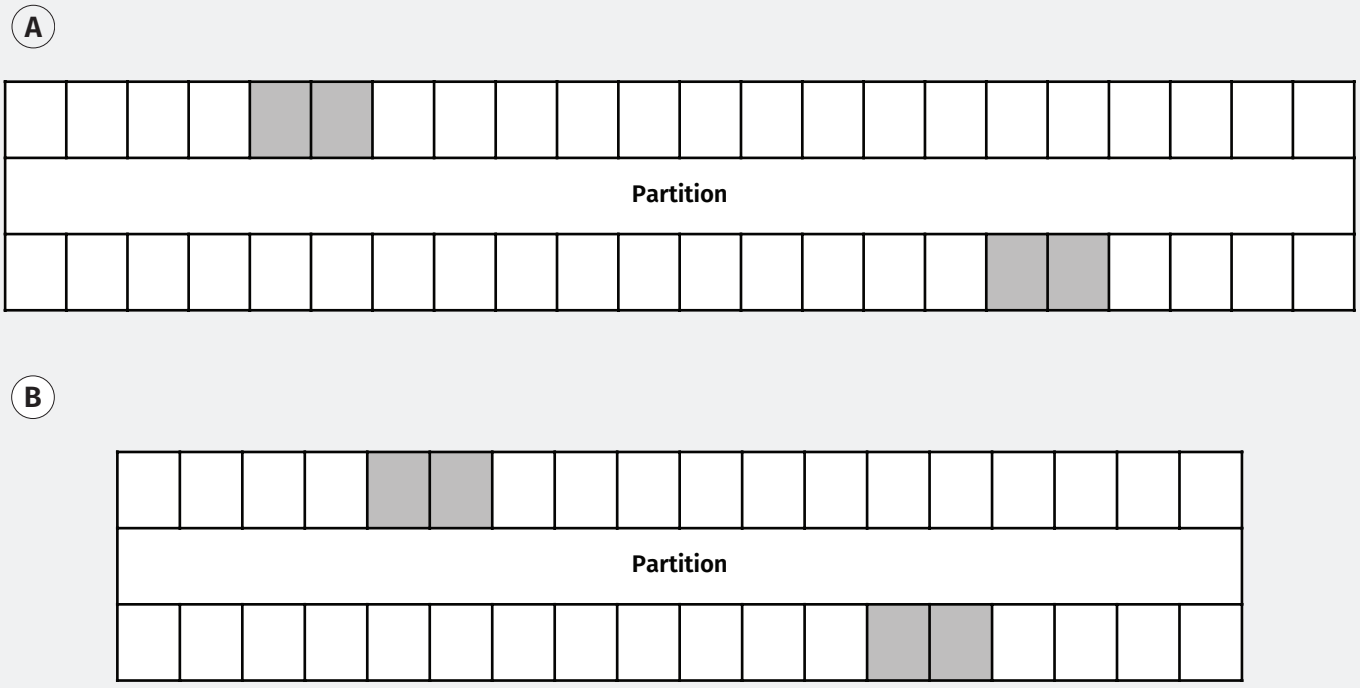
division that allowed nose-to-nose contact). Eight sampling areas (representing 2 pens each) were chosen in each farm, 2 per barn. During each monthly visit, 4 sample types were collected from each sampling area: OF, TS, NS, and ES. All sampled pens contained healthy pig populations. The OF and ES samples were collected on a group-level basis. Oral fluids were collected by placing a rope on the metal gate of two adjoining pens for approximately 15 to 20 minutes to allow pigs to chew on the rope, as stated in previous literature.[18] The end of the rope was then placed in a plastic bag to collect the fluids and poured into a glass vial for later processing. The ES were collected by wiping the feed troughs and waterers with a gauze pad as previously described.[12] The gauze pad was then placed into a vial containing 10 mL of brain-heart infusion (BHI) media for later processing. The TS and NS were collected from one individual animal in the pen using physical restraint with a snare and without any specific selection. For TS collection, a metal speculum was used to open the mouth of the pig and an elongated metal spoon was used to scrap the oropharyngeal region along the palatine tonsil of the pig[4]; the oropharyngeal fluid collected on the spoon was transferred to a vial containing 3 mL of BHI media with the aid of a sterile cotton swab as described by previous work.[4] The speculum was disinfected with Lysol or Clorox wipes prior to each use and a new spoon was used with each new TS collection. After the TS sample was collected, the same pig was used for NS sampling. A sterile NS was placed in the nose of the pig and swirled in each nostril for approximately 3 seconds per nostril; the swab was then placed in 3 mL BHI media. It should be noted that the pigs selected for the individual samplings were not specifically chosen based on any clinical signs indicative of disease; but simply according to interest in interacting with the snare and therefore being snared successfully in a timely manner. It should also be noted that pigs were not individually identified and, therefore, there is a chance that the same animal was sampled over different sampling events. After collection, all samples were placed in a cooler with ice, transported to North Carolina State University College of Veterinary Medicine within 3 hours, and kept in a refrigerator for 1 to 3 days before being shipped to The Ohio State University College of Veterinary Medicine. The OF samples were centrifuged at 1200*g* for 10 minutes (Sorvall Legend RT Centrifuge Machine; Thermo Scientific) to remove any debris prior to the RT-PCR testing.

PRRSV RT-PCR

Samples were tested for the presence of PRRSV by RT-PCR using standard protocols. Extraction of the samples were performed using the Omega Mag-Bind RNA extraction kit (Omega Bio-tek Inc) with a MagMAX Express 96 Magnetic Particle Processor (Applied Biosystems) using a laboratory-modified procedure with a company preloaded program (AM1836_DW_100_v2).[19] During the lysis step, the lysis/binding solution was combined with 10 µL of magnetic bead mix before extraction and elation in lysis enhancer (10 µL/reaction). Additionally, this procedure utilized 2 washes with 400 µL VHB Buffer (Omega Bio-tek Inc) and 500 µL SPR Wash Buffer (Omega Bio-tek Inc) for wash 1 and 2, respectively.

The samples were assayed using the VetMAX NA and EU PRRSV polymerase chain reaction kit (Applied Biosystems). Each run also contained 2 positive controls and 2 negative controls. The positive control came from a mix of 2 µL Xeno RNA Control, 2 µL NA PRRSV Control RNA, 2 µL EU PRRSV Control RNA, and 94 µL Nucleic Acid dilution solution. In the two positive-control wells, 7 µL of the positive-control mix was combined with 18 µL of the reaction mix. Each sample well included 12.5 µL Multiplex RT-PCR buffer, 2.5 µL PRRSV Primer Probe Mix V2, 2.5 µL Multiplex Enzyme Mix, 0.5 µL Nuclease-free water, and 7 µL of the sample collected for a total volume of 25 µL per well. Sample plates were loaded onto a 7500 Fast Real-Time PCR system (Applied Biosystems)

Figure 2: Barn layout for A) farm 1 and B) farm 2 sampled in this study. Each farm had four of the represented barns and each square represents one pen and the shaded area indicates the sampling area utilized within the barns.



with the following cycling conditions: stage 1 was 1 cycle of 48°C for 10 minutes, stage 2 was 1 cycle of 95°C for 10 minutes, and stage 3 was 40 cycles of 95°C for 15 seconds followed by 60°C for 45 seconds. Cycle threshold (Ct) values were calculated for each sample by setting the threshold at 5% of the positive control at cycle 40. Samples with a Ct of ≤ 37.0 were considered positive and samples with a Ct between 37.1 and 40 were considered suspect based on values described by previous work.[20]

Statistical analysis

Statistical analysis was conducted using STATA 14.2 (StataCorp LP). Descriptive statistics were used to describe the detection of PRRSV-positive samples over time for both farms and for the different sampling methods. All analyses were conducted at the sample level. First, a Fisher's Exact test was used to test the association between detection of PRRSV in TS and the predictor of interest, farm. Furthermore, to address the clustering of samples within sampling events and potential confounding effects, a multivariable exact logistic regression model was built using a forward stepwise regression approach, with estimations of median unbiased estimates (MUE).[21] This model also attempted to investigate the association between detection of PRRSV in TS and farm, but while accounting for sampling event (1-4) and total number of samples collected. Prior to addition to the final model, correlation between those variables was tested using the Spearman correlation test and a cutoff of 0.8. Confounders were defined as variables that changed the coefficient of our main variable of interest (farm) by 20% or more once removed from the model, and in such case it was retained in the final model regardless of statistical significance. Statistical significance was declared at $P < .05$, and a statistical trend was declared as $.05 \leq P < .10$.

Results

There was a total of 192 samples collected over the study period: 48 TS, 48 OF, 48 NS, and 48 ES. Farm 1, the unvaccinated farm, had 12 PRRSV RT-PCR positive TS (4 positive samples occurring in each of the first and second sampling events and 2 positive samples in each of the third and fourth sampling events) and 2 PRRSV RT-PCR positive NS (1 positive sample in each of the third and fourth sampling events; Figure 3 and Table 1). The two animals that tested positive by NS were also positive by TS. Farm 2, the vaccinated farm, had 8 PRRSV RT-PCR positive TS (2 positive samples in the first sampling event and 6 positive samples in the third sampling), 4 PRRSV RT-PCR positive NS (1 positive sample in the second sampling and 3 positive samples in the third sampling), and 1 PRRSV RT-PCR positive ES (occurring in the third sampling event; Figure 3 and Table 1). From the 4 animals that tested positive by NS, 3 also tested positive by TS. While a small proportion of NS and ES tested RT-PCR positive (12.5% [6 of 48] and 2.1% [1 of 48], respectively) these sampling methods did not consistently show positive results throughout the study period. Overall, there were 20 TS, zero OF, 6 NS, and 1 ES test RT-PCR positive for PRRSV throughout this study with 48.1% (13 of 27) of the positive samples occurring on the last sampling event (Table 1). There were several samples in each sampling category that tested RT-PCR PRRSV suspect positive.

Figure 3: Total number of samples collected RT-PCR PRRSV-positive samples for the 4 different sample types (tonsil scrapings, nasal swab, oral fluid, and environmental swab) over the four sampling events. RT-PCR = reverse transcriptase-polymerase chain reaction; PRRSV = porcine reproductive and respiratory syndrome virus.

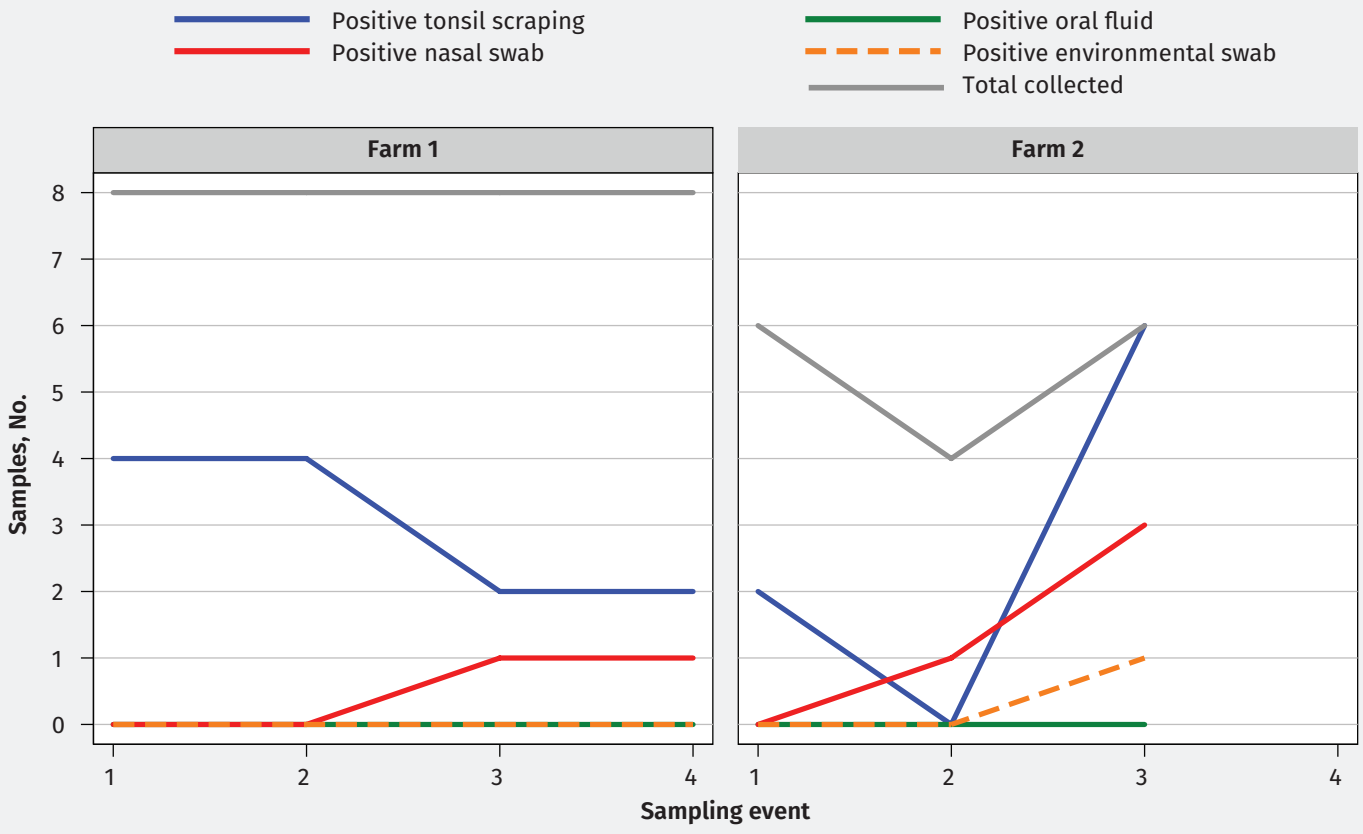


Table 1: Proportions of RT-PCR PRRSV-positive samples for the different sample types assessed in this study

	Sampling event*	Tonsil scraping, No. (%)		Oral fluid, No. (%)		Nasal swab, No. (%)		Environmental swab, No. (%)	
		Positive	Suspect†	Positive	Suspect†	Positive	Suspect†	Positive	Suspect†
Farm 1‡	1 (n = 8)	4 (50.0)	1 (12.5)	0 (0)	1 (12.5)	0 (0)	0 (0)	0 (0)	0 (0)
	2 (n = 8)	4 (50.0)	2 (25.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	3 (n = 8)	2 (25.0)	2 (25.0)	0 (0)	1 (12.5)	1 (12.5)	0 (0)	0 (0)	0 (0)
	4 (n = 8)	2 (25.0)	1 (12.5)	0 (0)	0 (0)	1 (12.5)	0 (0)	0 (0)	0 (0)
	Total (n = 32)	12 (37.5)	6 (18.75)	0 (0)	2 (6.3)	2 (6.3)	0 (0)	0 (0)	0 (0)
Farm 2‡	1 (n = 6)	2 (33.3)	3 (50.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	2 (n = 4)	0 (0)	1 (25)	0 (0)	0 (0)	1 (25)	0 (0)	0 (0)	0 (0)
	3§ (n = 6)	6 (100.0)	0 (0)	0 (0)	2 (33.3)	3 (50.0)	1 (16.7)	1 (16.7)	1 (16.7)
	Total (n = 16)	8 (50.0)	4 (25.0)	0 (0)	2 (12.5)	4 (25.0)	1 (6.3)	1 (6.3)	1 (6.3)

* Sampling took place from May to August 2019.

† Suspect positive samples with a Ct value between 37.1 and 40.

‡ Farm 2 received the PRRSV vaccine and farm 1 did not.

§ New group of pigs.

RT-PCR = reverse transcriptase-polymerase chain reaction; PRRSV = porcine reproductive and respiratory syndrome virus; Ct = cycle threshold.

The Ct values for the positive and suspect positive samples have been summarized in Table 2, highlighting the mean and range for each sampling category and event.

A reduced number of samples were collected from farm 2 due to operating procedures at the facility. During the second sampling month, the pigs at farm 2 had reached market weight and were removed from the facility. A new group of pigs from the same source sow farm were brought into the facility for the last sampling event (sampling 3). Thus, there were no samples collected on farm 2 for the fourth sampling and all samples collected during the third sampling were from a new group of pigs.

Over the 4-month study period, 13 of 16 sampled areas (considering both farms) tested PRRSV RT-PCR positive at least once with TS sampling (Table 3). All farm 2 pens that were sampled during the third event (pen 3 to pen 8) tested positive on PRRSV RT-PCR using TS (Table 3).

Analysis using a Fisher's Exact test showed no association between farm and a positive TS RT-PCR ($P = .36$). However, the multivariable exact logistic regression model accounting for sampling event and total samples taken on that sampling event showed there was a tendency ($P = .09$) for farm 2 to have higher odds of PRRSV detection on TS compared to farm 1 (odds ratio [OR] = 16.21). In this final model, the total number of samples taken in a sampling event was positively associated with the odds of PRRSV being detected in TS (OR = 3.26).

Discussion

Tonsil scraping samples yielded more positive PRRSV RT-PCR results over time for longer time periods when compared to the current commonly used sampling method, OF testing. To date, TS methods for PRRSV detection via RT-PCR have not been explored under field conditions for PRRSV diagnostic testing to determine herd-level PRRS status. This study described different sampling methods to detect PRRSV in growing pig populations under field conditions for farms utilizing different PRRS management strategies.

There was a difference in PRRSV detection between the 4 sampling methods: TS, OF, NS, and ES. Our findings corroborate similar research that showed an eventual decrease of PRRSV present in lymphoid tissues after 3 to 4 months post exposure[4,13,16]; nonetheless, we were able to detect PRRSV with TS up to 168 days post PRRSV exposure. Tonsil scraping was the only sampling method to consistently have positive samples over the four sampling events, despite being tested at the individual level in the conditions of this study. Although TS utilized only one pig per pen to determine herd status, we hypothesize that virus persistence in lymphoid tissues might explain the higher prevalence when compared to OF, which tests a larger number of pigs simultaneously. Additionally, considering the sensitivity of OF testing decreases over time,[22] TS proved to be a promising sampling method for long-term detection of PRRSV.

The determination of an accurate diagnostic method to detect PRRSV in grower pigs, especially in low PRRSV-prevalence scenarios, is vital to declare disease freedom as severe consequences can arise from inadvertently introducing PRRSV in negative populations. Our results compliment those of Horter et al[23] who reported that reverse transcriptase-nested polymerase chain reaction TS were the most effective assay-specimen combination to detect PRRSV in persistently infected animals.[23] The transition between diagnostic tools (in this case OF to TS) based on the stage of the infection and the nature of the disease is well described by Henao-Diaz et al[24] who suggests that it is vital to the relationship between the various disease transition states of PRRSV and the ability to detect infection based on those states, especially in cases of persistent infections. They

Table 2: Mean (range) of Ct values from RT-PCR PRRSV-positive and suspect positive tonsil scraping, oral fluid, nasal swab, and environmental swab samples from both farms

Sampling event	Tonsil scraping		Oral fluid		Nasal swab		Environmental swab	
	Ct, mean (range)	n	Ct, mean (range)	n	Ct, mean (range)	n	Ct, mean (range)	n
1	37.1 (35.9-38.8)	10	37.6	1	-	0	-	0
2	35.9 (31.6-38.3)	7	-	0	35.4	1	-	0
3	32.7 (27.6-38.3)	10	37.6 (37.1-37.9)	3	36.4 (34.2-38.2)	5	36.95 (36.8-37.1)	2
4	35.4 (33.2-37.7)	3	-	0	36.7	1	-	0
Total	35.2 (27.6-38.8)	30	37.6 (37.1-37.9)	4	35.97 (34.2-38.2)	7	36.95 (36.8-37.1)	2

Ct = cycle threshold; RT-PCR = reverse transcriptase-polymerase chain reaction; PRRSV = porcine reproductive and respiratory syndrome virus.

Table 3: Representation of RT-PCR PRRSV-positive tonsil scraping (represented by +) samples for each pen

Sampling event	Farm 1 (unvaccinated) pen								Farm 2 (vaccinated) pen							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	-	-	-	+	+	+	+	-	+	-	-	-	+	-	NA	NA
2	-	+	+	-	+	+	-	-	-	-	-	-	NA	NA	NA	NA
3	-	+	-	-	-	-	+	-	NA	NA	+	+	+	+	+	+
4	-	-	-	-	+	-	+	-	NA	NA	NA	NA	NA	NA	NA	NA

PRRSV = porcine reproductive and respiratory syndrome virus; RT-PCR = reverse transcriptase-polymerase chain reaction; NA = no samples were collected for that sampling event due to pig flow from the finisher farm to slaughter.

continue to conclude that with PRRSV specifically, the probability of detecting an infection is based heavily on the diagnostic method chosen and should be recognized prior to test selection.[24] The current study also highlights the potential for additional research focusing on testing TS sampling in field conditions, as most research has only been conducted on experimentally inoculated animals or using postmortem TS procedures.

Results from this study should be considered given the limitations of the study. Firstly, it should be noted that the BHI mixture utilized in this study was not precisely measured prior to adding it to the TS, NS, and ES samples. While every effort was made to ensure that the proper volume was used for each sample, some samples could have been more diluted than others, which could play a role in PRRSV RT-PCR detection from the samples. This is specifically true for the ES samples, which were diluted in a larger volume of media and could explain the lower detection rate for that sample type. Additionally, even though we utilized a relatively large number of samples (over 100), it is important to note that there were only two farms enrolled in this study. This complicated further analysis of potential farm-level confounders such as farm size, facility-specific characteristics, and detailed management. We attempted to address this by building a robust model that partially accounted for clustering effects, but the effect of vaccination versus other farm-level characteristics cannot be disentangled. Interestingly, farm 2 (vaccinated) had increased odds for PRRSV detection in TS when compared to farm 1 (unvaccinated). This was unexpected since viral shedding of vaccine virus strains has been shown to be shorter compared to wild types.[25,26] However, we hypothesize that this increase could be due to the presence of the vaccine strain in the lymphoid tissue as farm 2 was vaccinated with an MLV three weeks prior to arrival at the grower facility. These pigs were at least 84 days post inoculation with the MLV, which can show varying shedding results as time increases. For example, Linhares et al[26] showed that the viral shedding from TS and OF can vary in both a control and vaccinated group. This team demonstrated that for both the vaccinated and control groups OF PCR was only detected up to 36 days post inoculation, while TS PCR was detected until the end of the study (118 days).[26] Furthermore, it could also be the case that the farm still had field viruses in the facility; which were being detected by the assay.

Another limitation of our study was that the study design did not allow for calculations of sensitivity or specificity for TS sampling, since samples were not collected from the same animal for head to head comparison. However, the aim of

this paper was to describe the use and limitations of TS, OF, NS, and ES to detect PRRSV; and not to validate TS as a gold standard compared to other methods. Furthermore, this study was conducted from May to August, therefore, we do not know whether these results would differ during cooler months. Nevertheless, we would not anticipate major deviations in our conclusions considering that PRRSV has been shown to survive and infect animals throughout the year[27] and that modern swine farms are commonly able to provide a well-controlled climate inside the barns year round.

Lastly, under the conditions of this study, we were not able to obtain an open reading frame (ORF) 5 sequences from the samples we had collected to differentiate whether the PRRSV being detected via PCR corresponded to vaccine-like or wild-type viruses. This information would have been important to differentiate between potential lateral PRRSV introduction and vaccine or previous outbreak strains.

To continue to understand the potential benefits of TS sampling for PRRSV detection, we recommend that future research focus on comparing OF and TS sampling from individual, known positive swine herds. This will allow for additional discussion surrounding the effectiveness of TS vs OF testing. Furthermore, performing ORF5 or whole genome sequencing and virus isolation would likewise be of value as they would provide further information on which viruses are being detected and whether they could cause infection in other pigs. These were not successfully conducted in this study, likely due to high overall Ct values.

Implications

Under the conditions of this study:

- Tonsil scrapings yielded more positive PRRSV results overall.
- Tonsil scrapings tested positive for PRRSV up to 168 days post exposure.
- In this study, OF, NS, and ES showed lower PRRSV detection than TS.

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Conflict of interest

None reported.

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PEER REVIEWED ORIGINAL RESEARCH

Drinker to nursery pig ratio: Drinking behavior, aggression, and drinker location preference over 2 days

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Summary

Objective: Determine the effect of drinker number (1, 2, or 3 drinkers/pen) on the frequency and duration for drinker visits, aggressive interactions in the drinker vicinity, drinker location preference, and water disappearance for 7-week-old nursery pigs.

Materials and methods: Two hundred twenty-five, 7-week-old gilts identified with unique numbers were commercially housed (25 gilts/pen). Three treatments were compared with 3 pens/treatment: 1 drinker (treatment 1), 2 drinkers (treatment 2), and 3 drinkers (treatment 3). One camera was positioned over each drinker to record behavior between 7:00 AM and 12:59 PM over 2 consecutive days. In addition, 1 water meter was installed on each water line to record water disappearance.

Results: Pigs in treatment 3 visited and spent more time at the drinkers compared to the other 2 treatments ($P = .02$). Pigs in treatment 1 had more and longer duration of aggressive interactions in the drinker vicinity compared to the other 2 treatments between 7:00 AM to 7:59 AM ($P = .02$). When offered 3 drinkers, pigs spent the least amount of time at the drinker across from the feeder near the alleyway ($P < .001$). Total water disappearance was greatest for treatment 1 and least for treatment 2.

Implications: Under study conditions, 3 drinkers increased visits and time at drinkers without increasing aggressive interactions. Pigs exhibited location preference when offered 3 drinkers. Results can inform producers on water placement in pens.

Keywords: swine, drinking pattern , water, welfare

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Resumen - Proporción de bebederos a lechones en el destete: Comportamiento durante 2 días, de bebida, agresión y preferencia de la ubicación del bebedero

Objetivo: Determinar el efecto del número de bebederos (1, 2, o 3 bebederos/corral) sobre la frecuencia y duración de las visitas a los bebederos, interacciones agresivas en las cercanías de los bebederos, preferencia de ubicación de los bebederos y desaparición de agua en lechones de 7 semanas de edad en el destete.

Materiales y métodos: Doscientas veinticinco primerizas de 7 semanas de edad identificadas con números únicos se alojaron comercialmente (25 primerizas/corral). Se compararon tres tratamientos con 3 corrales/tratamiento: 1 bebedero (tratamiento 1), 2 bebederos (tratamiento 2), y 3 bebederos (tratamiento 3). Se colocó una cámara sobre cada bebedero para registrar el comportamiento entre las 7:00 AM y las 12:59 PM durante 2 días consecutivos. Además, se instaló 1 medidor de agua en cada línea de agua para registrar la desaparición del agua.

Resultados: Los cerdos del tratamiento 3 visitaron y pasaron más tiempo en los bebederos en comparación con los otros 2 tratamientos ($P = .02$). Los cerdos en el tratamiento 1 tuvieron más interacciones agresivas y más duraderas alrededor del bebedero en comparación con los otros 2 tratamientos entre las 7:00 AM y las 7:59 AM ($P = .02$). Cuando se les ofrecieron 3 bebederos, los cerdos pasaron menor cantidad de tiempo en el bebedero frente al comedero cerca del pasillo ($P < .001$). La desaparición total de agua fue mayor para el tratamiento 1 y menor para el tratamiento 2.

Implicaciones: En las condiciones de este estudio, 3 bebederos aumentaron las visitas y el tiempo en los bebederos sin aumentar las interacciones agresivas. Los cerdos mostraron una preferencia de ubicación cuando se les ofrecieron 3 bebederos. Los resultados pueden dar información a los productores sobre la colocación del agua en los corrales.

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Jackson CJ, Johnson AK, Stalder KJ, Edler RA, Holck JT, DuBois PR, Karriker LA, Sadler LJ, Stambuk CR. Drinker to nursery pig ratio: Drinking behavior, aggression, and drinker location preference over 2 days. *J Swine Health Prod*. 2021;29(2):81-89.

Résumé - Ratio abreuvoirs/porcelets en pouponnière: Comportement d'abreuvement, agression et préférence de la localisation des abreuvoirs pendant une période de 2 jours

Objectif: Déterminer l'effet du nombre d'abreuvoirs (1, 2, ou 3 abreuvoirs/enclos) sur la fréquence et la durée des visites aux abreuvoirs, les interactions agressives dans la proximité des abreuvoirs, les préférences dans la localisation des abreuvoirs et la disparition de l'eau chez des porcelets en pouponnière âgés de 7 semaines.

Matériels et méthodes: Deux cent vingt-cinq cochettes âgées de 7 semaines, identifiées avec un numéro unique, furent logées commercialement (25 cochettes/enclos). Trois traitements furent comparés avec 3 enclos/traitement : un abreuvoir (traitement 1), deux abreuvoirs (traitement 2), et trois abreuvoirs (traitement 3). Une caméra était positionnée au-dessus de chaque abreuvoir afin d'enregistrer le comportement entre 7:00 AM et 12:59 PM pendant 2 jours consécutifs. De plus, un compteur d'eau a été installé sur chaque ligne d'alimentation en eau afin d'enregistrer la disparition d'eau.

Résultats: Les porcs du groupe de traitement 3 ont visité et passé plus de temps aux abreuvoirs comparativement aux deux autres groupes de traitement (P = .02). Les porcs du groupe de traitement 1avaient plus et pour plus longtemps des interactions d'agressivité à la proximité de l'abreuvoir comparativement aux deux autres traitements entre 7:00 AM M et 7:59 AM (P = .02). Lorsqu'on offrait trois abreuvoirs, les porcs ont passé le moins de temps à l'abreuvoir de l'autre côté de la mangeoire près de l'allée (P < .001). La disparition totale d'eau était plus grande pour le traitement 1 et la plus petite pour le traitement 2.

Implication: Dans les conditions de la présente étude, la présence de trois abreuvoirs augmentait les visites et le temps passé aux abreuvoirs sans augmenter les interactions d'agressivité. Les porcs ont démontré des préférences de localisation lorsque trois abreuvoirs étaient offerts. Les résultats peuvent renseigner les producteurs sur le positionnement de l'eau dans les enclos.

Water function, quality,[1] and quantity are essential to the individual pig's health and welfare.[2] Water is essential for a variety of biochemical reactions to function correctly, it supplies a protective cushioning to the nervous system (ie, cerebral-spinal fluid), and is required for the lubrication of joints.[3] In addition, nutrients are transported to tissues via water and waste products from cell metabolism are removed.

Water accounts for approximately 80% of body weight at birth and declines to 50% in a finished market pig.[4] Nursery pigs require 2.65 L/pig/day at a flow rate of 0.24 to 0.47 L/min.[5] If 10% or more of body water is lost, it can result in devastating consequences, such as severe dehydration, salt poisoning, and, in extreme cases, death.[6,7] Drinking is defined as voluntary oral ingestion of liquids[8] and refers to total water consumption. Drinking behavior develops over the first few days post weaning,[2,9] with pigs engaging in 60 drinking visits per day (≤ 10 s/bout).[9] Water intake follows a stable diurnal pattern at a group level[10] and can be influenced by drinker design,[11,12] diet,[13,14] environmental conditions,[15] health status,[16] social competition,[17] drinker maintenance, and location.[2]

Although water quantity is critical for nursery pig health and overall welfare, limited scientific research has been published that evaluates optimal pig-to-water resource ratios (ie, pig to drinker) and where it is best to place water resources within a pen.[2] A current recommendation is 1:10 drinker to pig ratio,[18] however these ratios of pig to drinker are often higher on farm (Paul DuBois, DVM, email communication, 2006).

Andersen et al[10] considered individual pig drinking patterns as a potential tool for disease monitoring. Pigs were housed as either 3 or 10 pigs/pen with 1 water nipple. The authors reported that overall, pigs spent 594 seconds at the nipple during 24 hours distributed among 44 visits. During this period, 5 L of water were used, of which > 30% was wasted. With 3 pigs/water nipple, pigs visited the drinker less often and drank less. This study was useful in comparing different group sizes and the effects on water consumption, but a limitation was that it did not offer more drinking options in the pen, thus decreasing the number of nursery pigs per drinker.

Therefore, the objectives of this study were to determine the effect of 1, 2, or 3 drinkers/pen on the frequency and duration of drinker visits, aggressive interactions in the drinker vicinity, drinker location preference, and water disappearance for 7-week-old nursery pigs.

Materials and methods

Animals and location

This project was approved by the Iowa State University Animal Care and Use Committee and conducted at a commercial nursery facility in central Missouri. A total of 225 PIC crossbred (mean [SD] 21 [4] days of age) gilts weighing 5.38 (2.65) kg were assigned to pens by body weight (all piglets were weighed individually on an electronic scale accurate to 0.1 kg; PS250 Platform Scale; Salter Brecknell). Gilts originated from a single, high-health status sow herd that was negative by serological testing for pseudorabies, porcine reproductive and respiratory syndrome virus, and *Mycoplasma hyopneumoniae*; and where suckling piglets had access to a stainless steel nipple water drinker until they were weaned.

Gilts were housed in nursery pens that measured 1.83 m × 3.05 m, providing 0.22 m^2/pig meeting space recommendations for pigs at this production stage.[19] Steel penning was used for dividers and were 3.1 m long × 0.91 m high. Tenderfoot (Tandem Products, Inc) flooring was utilized in all pens and pigs had ad libitum access to a corn-soy diet formulated to meet or exceed NRC requirements.[20] Diets were provided through a 5-hole stainless steel feeder 68.6 cm high × 91.4 cm long. The building was curtain sided and pigs received natural light. Farm personnel observed all pigs at 7:30 AM and 3:30 PM. Environmental temperature was electronically recorded using data loggers (Hobo Pro series; Forestry Supplies, Inc). A data logger was suspended over each pen from the feed auger at a height of 92 cm from the ground. Ambient temperature (°C) and relative humidity (%) were recorded at 10-minute intervals for the duration of the trial. Mean environmental measurements were 24.8°C and 51.0% relative humidity for the duration of the trial.

Treatments and experimental design

A total of 9 pens were used (n = 3/treatment) with twenty-five, 7-week-old nursery pigs/pen. Each pen contained 1, 2, or 3 stainless steel nipple cup drinkers that measured 12.7 cm deep × 28.6 cm high × 17.8 cm wide (Farmweld DRIK-O-MAT Wean-to-Finish Cup; Farmweld, Inc). Treatment 1 was defined as 1 drinker/pen (1:25 drinker to pig ratio) and the

drinker was positioned on the same side as the feeder and near the back gate (F; Figure 1). Treatment 2 was defined as 2 drinkers/pen (1:12 drinker to pig ratio) and the drinkers were positioned at F and close to the back gate opposite the feeder (O; Figure 1). Treatment 3 was defined as 3 drinkers/pen (1:8 drinker to pig ratio). Drinker positions were F, O, and across from the feeder next to the alleyway gate (A; Figure 1).

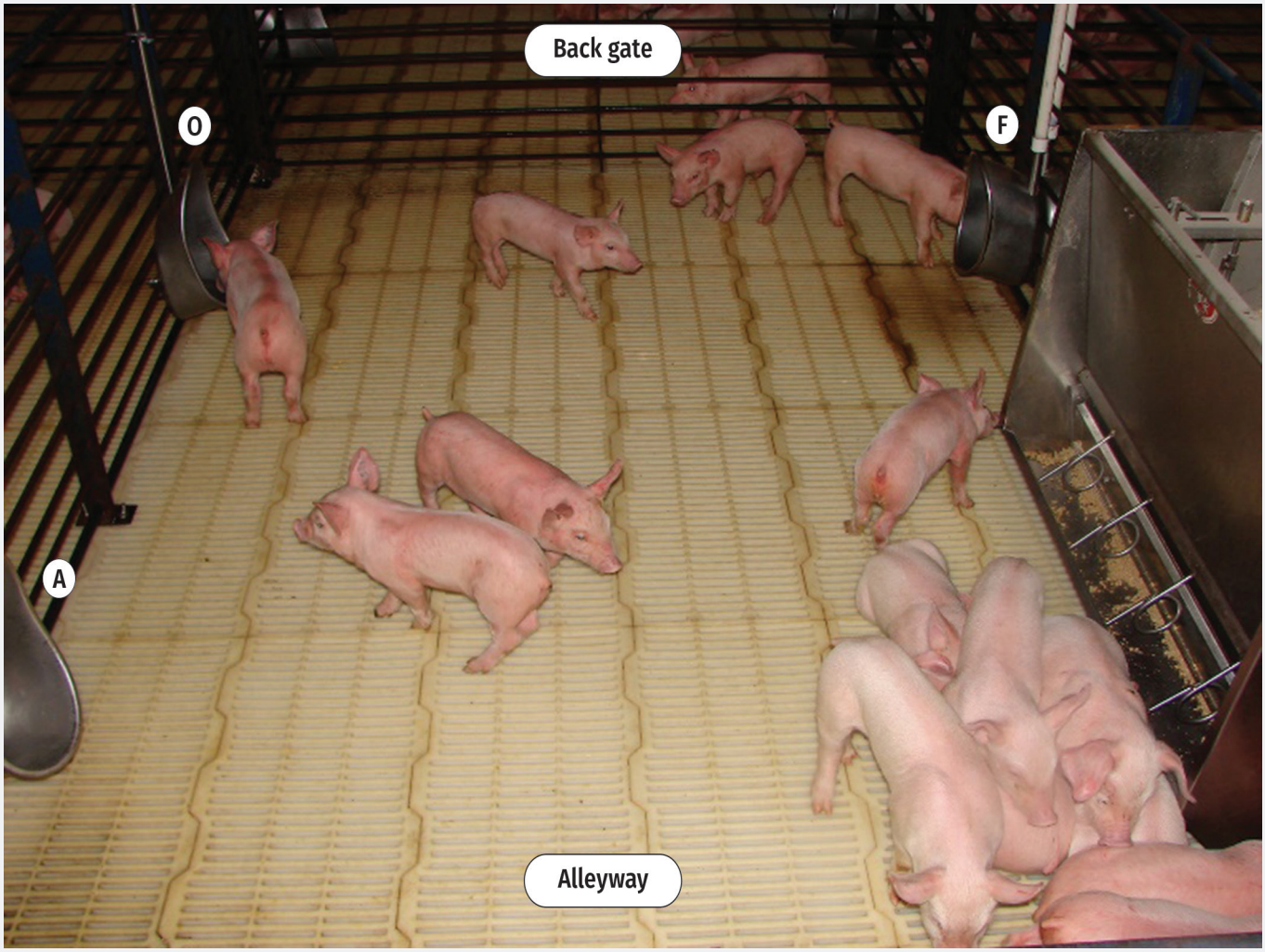
Behavior equipment and collection

One day prior to behavior recording, each gilt was identified with a unique number placed on its back between the scapula using an animal safe crayon (Laco Twist-Stick Livestock Marker; LA-CO). One 12 V black and white close circuit television camera (Model WV-CP484, Panasonic Matsushita Co Ltd) was positioned over each drinker. Behavior was recorded between 7:00 AM and 12:59 PM over the 2 consecutive trial days (2700 hours of data recorded; RECO-204; Darim Vision Corp) at 1 frame/s. Behavioral video acquisition was collected in real time using the Observer software by 1 trained observer (The Observer Version 5.0.25; Noldus Information Technology). The observer was trained to the ethogram (Table 1) prior to data collection. A total of 18 (6/treatment), 5-minute video clips were selected using the Excel random number generator software. The trainer and the student scored the same video clips until 90% inter-reliability was achieved.

Water flow rates and disappearance

Water flow rates met industry flow standards (mean 0.47 L/min).[5] A water meter (DLJ-hose Bibb; Daniel L. Jerman Co) was installed on each water line to each nursery pen so that water disappearance for each treatment could be recorded. Water disappearance (water consumed and wasted) from all pens was recorded on both trial days for each hour between 7:00 AM and 12:59 PM. Water disappearance occurred when a pig depressed the nipple located inside the drinker during a visit, and water was drawn down through the pipe passing through the water meter which then read the amount of water drawn. For behavior observations, only visits ≥ 5 seconds in duration were assessed, as Turner et al[17] determined that it is not possible to conclude if water is drawn during shorter visits.

Figure 1: Placement of drinkers within the nursery pen. Treatment 1 was defined as 1 drinker/pen (1:25 drinker to pig ratio) and the drinker was positioned on the same side as the feeder and close to the back gate (F). Treatment 2 was defined as 2 drinkers/pen (1:12 drinker to pig ratio), and the drinkers were positioned as close to the back gate opposite the feeder (O) and F. Treatment 3 was defined as 3 drinkers/pen (1:8 drinker to pig ratio). Drinker positions were F, O, and the third drinker was positioned across from the feeder next to the alleyway gate (A).



Statistical analysis

The frequency and duration of visits to the drinker and frequency and duration of aggressive interactions around the drinker made by each pig were acquired through Observer and entered into Microsoft Excel Software. Any visit < 5 seconds in duration was not included in the final analysis. The data was sorted by day, pen, pig, and hour. The total frequency visits to the drinker and the total time spent at the drinker for each observed hour were calculated. The total frequency of visits and visit duration on an hourly basis were analyzed by ANOVA for parametric data using the PROC MIXED procedure of SAS (SAS Institute, Inc) with pen as the experimental unit. Treatment (1, 2, and 3), pen (1-9), and pig number (1-25) being discrete variables were considered fixed effects and were included in the model (PROC MIXED, class statement). Day was initially included in the model, but due to being nonsignificant, was removed. The statistical model included the parameter of interest (treatment). Body weight (kg) of gilts at day 42 was used as a linear covariate. Pen nested within both treatment and day was included as a random effect in the model. A value of $P < .05$ was considered significant. Descriptive results for the water disappearance data were calculated. Total water disappearance was presented by treatment over the 2-day trial.

Results

Frequency and duration of visits to the drinker

Total drinker visit frequencies during the 6-hour observation period were different between treatments. Pigs in treatment 1 and 2 made fewer total visits compared to treatment 3 ($P = .02$; Table 2). Pigs assigned to treatment 3 visited the drinker more times when compared to pigs from treatment 2 during the first hour from 7:00 AM to 7:59 AM ($P = .03$). Between 8:00 AM to 8:59 AM and 12:00 PM to 12:59 PM, treatment 3 pigs visited the drinkers more than pigs from the other 2 treatments ($P = .01$). For all other hours there were no treatment differences in the frequency of visits to the drinkers ($P > .05$; Table 2). Total drinker visits during the 6-hour observation period differed between treatments ($P = .02$; Table 3) with treatment 3 pigs spending a greater amount of time at the drinkers when compared to pigs assigned to the other 2 treatments. Pigs in treatment 2 spent more time at the drinker than pigs in treatment 1. Drinker visit duration differed between 8:00 AM to 8:59 AM, where pigs assigned to treatment 1 spent less time at the drinkers when compared to pigs assigned to treatment 3 ($P = .05$). Between 12:00 PM and 12:59 PM, treatment 1 pigs spent less time per visit at the drinker compared to pigs assigned to the other 2 treatments ($P = .02$). For all other hours, there were no treatment differences for the duration of a visit at the drinkers ($P > .05$; Table 3).

Frequency and duration of aggressive interactions around the drinker

Total aggressive interaction frequencies in the drinker vicinity were not different between treatments ($P = .28$; Table 4). When comparing the frequency of aggressive interactions hourly across treatments, more aggressive interactions occurred around the drinker within treatment 1 compared to the other treatments between 7:00 AM to 7:59 AM ($P = .02$). However, for all other hours, aggressive interactions in the drinker vicinity did not differ ($P > .05$; Table 4). Total duration of time engaged in aggressive interactions around the drinker were not different between treatments ($P = .80$; Table 5). When comparing aggressive interaction duration hourly across treatments, pigs

Table 1: Ethogram used to analyze the frequency and duration of drinking visits and the frequency and duration of aggressive interactions when 7-week-old nursery pigs were given 1, 2, or 3 stainless steel nipple cup drinkers during a 6-hour observational period* over 2 consecutive days in a commercial nursery

Measure	Description
Visits	
Frequency	Began each time the individual nursery pig's head was in the drinker and terminated when the pig's head moved out of the drinker for ≥ 5 s.
Duration	Total time per visit ≥ 5 s at the drinker.†
Aggressive interactions	Aggression in the vicinity of the drinker was defined as any fight, bully, head-knock, or chase which occurred in a radius of 0.6 m‡ or less from the edge of the drinker.
Frequency	Frequency of aggressive interactions were calculated as totals for the 6-hour observation period of each day and for each hour of each day.
Duration	The duration (seconds) of aggressive interactions were calculated as totals for the 6-hour observation period of each day and for each hour of each day.
Drinker location preference	Location preference for the drinker was defined as the duration (seconds) spent in the drinker vicinity (0.6 m or less from the edge of the drinker‡). Drinker location preference was determined for treatment 2 and 3 separately.

* Behavior was recorded between 7:00 AM and 12:59 PM over the 2 consecutive trial days at 1 frame/s.

† Turner et al[17] used alternate 5-hour blocks over 24 hours to analyze growing pig drinking behavior. This work defined drinking behavior as when a pig has its head in the drinker for ≥ 5 seconds.

‡ The 0.6 m was rationalized as an average two-third lengths of a 7-week-old nursery pig (beginning at the snout). The drinker proximity was measured using the ruler tool in Adobe Photoshop CS5 (Adobe Systems Inc). The ruler tool was calibrated using the ratio of the length and the pixel length of a nursery pen gate divider. A conversion ratio was determined and a semi-circle was drawn out onto a clear transparency sheet taped to the computer screen from the edge of the drinker. Any aggressive interactions that occurred within the semi-circle were considered "aggressive interactions around the water source."

Table 2: Least square means (SE) of the effect of drinker number (1, 2, or 3 drinkers*) on the frequency of drinker visits ≥ 5 seconds performed by 7-week-old nursery pigs during a 6-hour observational period over 2 consecutive days

	Treatment†				
Hour	**1**	**2**	**3**	**SE**	***P*‡**
7:00 – 7:59 AM	1.2[ab]	0.9[a]	1.3[b]	0.1	.03
8:00 – 8:59 AM	2.3[a]	2.6[a]	3.7[b]	0.3	.01
9:00 – 9:59 AM	1.6	1.8	2.1	0.4	.60
10:00 – 10:59 AM	1.2	1.0	1.1	0.3	.66
11:00 – 11:59 AM	1.9	1.9	2.5	0.2	.08
12:00 – 12:59 PM	2.2[a]	2.4[a]	3.2[b]	0.2	.01
Total frequency of visits	10.4[a]	10.6[a]	13.9[b]	0.8	.02

* Trial conducted in November 2006 using 9 pens of 25 gilts/pen for each treatment (3 pens/treatment; n = 225 pigs) in a complete random design. Each pen contained 1, 2, or 3 stainless steel nipple cup drinkers (12.7 cm deep × 28.6 cm high × 17.8 cm wide; Farmweld DRIK-O-MAT Wean-to-Finish Cup; Farmweld, Inc).

† Treatment 1 was defined as 1 drinker/pen (1:25 drinker to pig ratio) and the drinker was positioned on the same side as the feeder and close to the back gate. Treatment 2 was defined as 2 drinkers/pen (1:12 drinker to pig ratio), and the drinkers were positioned as close to the back gate opposite the feeder and same side as the feeder. Treatment 3 was defined as 3 drinkers/pen (1:8 drinker to pig ratio). Drinker positions were close to the back gate same side as the feeder, opposite the feeder, and the third drinker was positioned across from the feeder next to the alleyway gate.

‡ ANOVA; pen nested within both treatment and day was included as a random effect in the model with body weight (kg) used as a linear covariate.

[a,b] Different superscripts within an hour indicate significant differences ($P < .05$).

Table 3: Least square means (SE) of the effect of drinker number (1, 2, or 3 drinkers) on the duration of visits ≥ 5 seconds performed by 7-week-old nursery pigs during a 6-hour observation period over 2 consecutive days

	Treatment*, s				
Hour	**1**	**2**	**3**	**SE**	***P*†**
7:00 – 7:59 AM	16.7	11.3	15.7	1.8	.11
8:00 – 8:59 AM	29.6[a]	35.5[ab]	46.7[b]	4.3	.05
9:00 – 9:59 AM	17.2	25.2	29.1	5.7	.38
10:00 – 10:59 AM	15.8	12.5	14.2	2.3	.62
11:00 – 11:59 AM	22.5	27.4	31.7	3.8	.28
12:00 – 12:59 PM	23.5[a]	35.4[b]	41.0[b]	3.6	.02
Total duration of time	125.3[a]	147.3[b]	178.4[c]	16.3	.02

* Trial design and treatments described in Table 2.

† ANOVA; pen nested within both treatment and day was included as a random effect in the model with body weight (kg) used as a linear covariate.

[a,b,c] Different superscripts within an hour indicate significant differences ($P < .05$).

assigned to treatment 1 spent more time engaged in aggressive interactions in the drinker vicinity compared to the other treatments between 7:00 AM to 7:59 AM ($P = .02$). For the other time periods, there were no differences in aggressive interactions duration around the drinker ($P > .05$; Table 5).

Drinker location preference

Total duration of time nursery pigs spent at a specific drinker for treatment 2 were not different (144.7 [16.3] seconds at F vs 158.2 [18.3] seconds at O; $P = .47$). When comparing the duration of time spent at the drinkers during specific hours across locations for treatment 2, there were no differences between F and O ($P > .05$). For pigs in treatment 3, there was a difference between all locations in the total time spent with more time spent at O than the other 2 drinker locations (135.9 [16.2] seconds at F vs 188.3 [16.4] seconds at O vs 61.4 [18.1] seconds at A; $P < .001$). When comparing the duration of time spent at the drinkers hourly, pigs preferred O over A ($P < .05$), but this preference was not observed during the last hour ($P > .05$; Figure 2).

Water disappearance

Cumulative water disappearance for the 12-hour observation period was 512.7 L (treatment 1), 356.9 L (treatment 2), and 482.1 L (treatment 3). When evaluating water disappearance based on location,

Table 4: Least square means (SE) of the effect of drinker number (1, 2, or 3 drinkers) on the frequency of aggressive interactions performed by 7-week-old nursery pigs near a drinker during a 6-hour observation period over 2 consecutive days

	Treatment*				
Hour	**1**	**2**	**3**	**SE**	***P*†**
7:00 – 7:59 AM	0.18[a]	0.08[b]	0.04[b]	0.03	.02
8:00 – 8:59 AM	0.65	0.49	0.77	0.17	.49
9:00 – 9:59 AM	0.26	0.26	0.34	0.08	.74
10:00 – 10:59 AM	0.29	0.08	0.16	0.06	.12
11:00 – 11:59 AM	0.26	0.30	0.41	0.07	.38
12:00 – 12:59 PM	0.40	0.40	0.66	0.12	.18
Total aggressive interactions	2.04	1.61	2.38	0.30	.28

* Trial design and treatments described in Table 2.

† ANOVA; pen nested within both treatment and day was included as a random effect in the model with body weight (kg) used as a linear covariate.

[a,b] Different superscripts within an hour indicate significant differences ($P < .05$).

Table 5: Least square means (SE) of the effect of drinker number (1, 2, or 3 drinkers) on the duration of aggressive interactions performed by 7-week-old nursery pigs near a drinker during a 6-hour observation period over 2 consecutive days

	Treatment*, s				
Hour	**1**	**2**	**3**	**SE**	***P*†**
7:00 – 7:59 AM	1.22[a]	0.49[b]	0.16[b]	0.22	.02
8:00 – 8:59 AM	5.74	3.65	5.56	1.89	.69
9:00 – 9:59 AM	2.48	2.38	1.91	0.74	.84
10:00 – 10:59 AM	2.17	0.76	1.21	0.52	.21
11:00 – 11:59 AM	0.60	2.63	2.94	0.68	.07
12:00 – 12:59 PM	2.57	3.29	4.37	1.23	.61
Total duration of time	14.78	13.20	16.15	3.23	.80

* Trial design and treatments described in Table 2.

† ANOVA; pen nested within both treatment and day was included as a random effect in the model with body weight (kg) used as a linear covariate.

[a,b] Different superscripts within an hour indicate significant differences ($P < .05$).

water only disappeared from F for treatment 1 as expected because treatment 1 pigs only had access to this 1 drinker. In treatment 2 and 3 when pigs were given a choice, more water disappeared from the drinker positioned opposite the feeder close to the back gate (O). Similar amounts of water disappeared from F and A locations in treatment 3 (Figure 3).

Discussion

Healthy pigs kept at thermal-neutral conditions display a distinct drinking pattern over a 24-hour period. Pigs begin drinking between 5:00 AM to 6:00 AM, with a peak in water disappearance around 1:00 PM followed by a gradual decline at 4:00 PM, and drinking leveled off around 10:00 PM.[21] Drinking is an ingestive, cyclic, and sequential behavior event that is often performed with feeding.[22] It can be difficult to precisely ascertain if a pig is drinking, or just in the drinker vicinity. Turner et al[17] used alternate 5-hour blocks over 24 hours to analyze growing pig drinking behavior using video recording. This work defined drinking behavior as when a pig has its head in the drinker for ≥ 5 seconds. Based on these previous bodies of work, drinking patterns and water disappearance in the current study were recorded over the morning to early afternoon hours using video recording, and only considered a drinking event as being ≥ 5 seconds. Pig drinker accessibility was also considered when deciding upon drinker location within the nursery pen. Previous work has suggested that drinkers placed too close to each other, a wall, or too close to the feeder can cause 1 or more pigs to dominate the drinker. Spacing between waterers when using > 1 waterer/pen has been suggested at 31 cm and located in an area free of incoming air to prevent freezing of pipes.[1]

Figure 2: Least square means (LSM) and SE for nipple cup drinker location preference based on the duration of time spent at the drinker location when nursery aged pigs were offered a drinker next to the feeder (F), opposite F (O), and next to the alleyway across from the feeder (A). Different superscripts within an hour indicate a significant difference ($P < .05$).

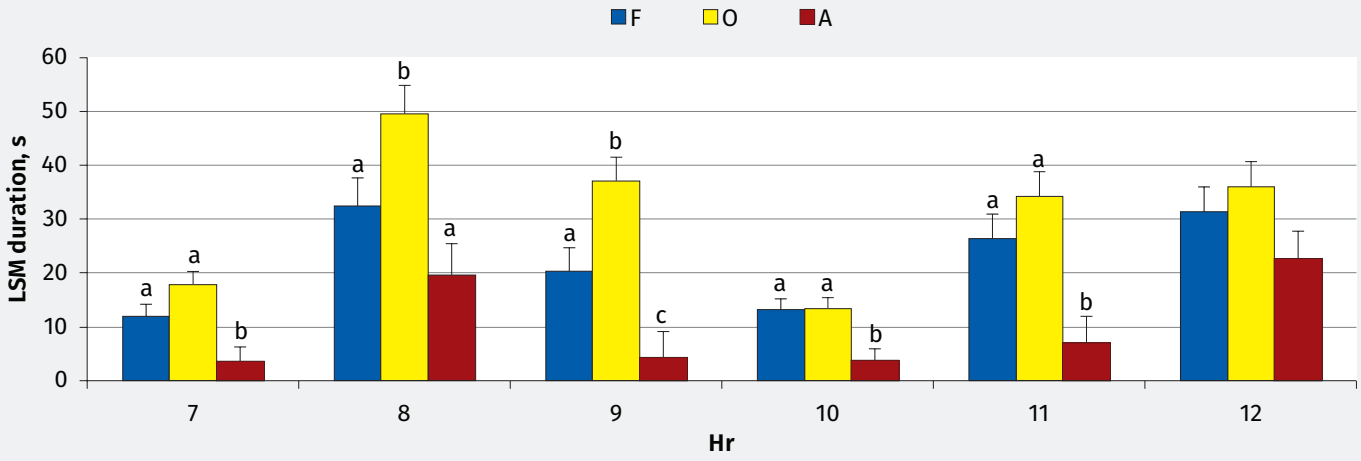
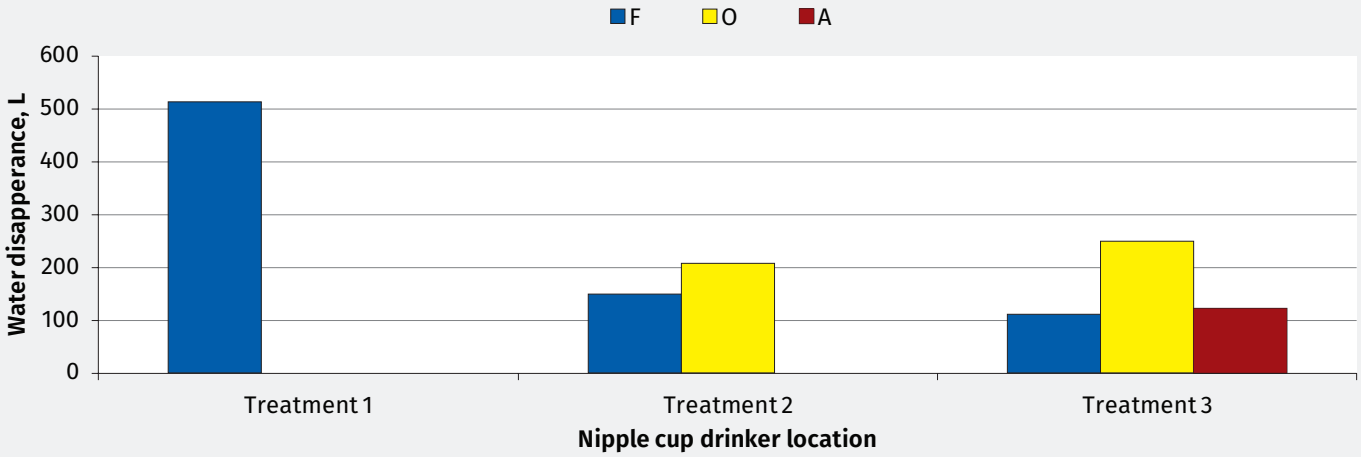


Figure 3: Water disappearance for nursery aged pigs offered a drinker next to the feeder (F), F and opposite F (O), or F, O, and next to the alleyway across from the feeder (A) by treatment. Treatment 1 had 1 drinker/pen (1:25 drinker to pig ratio), treatment 2 had 2 drinkers/pen (1:12 drinker to pig ratio), and treatment 3 had 3 drinkers/pen (1:8 drinker to pig ratio).



The results of this study, although important, need to be interpreted within context by producers and veterinarians. Water intake can be influenced by drinker design,[11,12] diet,[13,14] environmental conditions,[15] health status,[16] social competition,[17] drinker maintenance, and location.[2] Weanling pigs consume approximately 20 kg of water per 100 kg of body weight daily, while those near market weight consume much less, approximately 7 kg of water per 100 kg of body weight daily.[23] These differences are due to younger pigs having proportionally greater pulmonary and peripheral losses.[24] To meet these increased water needs, younger pigs engage in more drinking related activities over 24 hours.[25]

In a review by Weary et al,[26] the link between behavior and illness is discussed. The authors note that abnormal drinking behavior, decreased activity, and isolation behaviors are indicative of general malaise. To compliment these behavioral changes, pigs will also display key clinical signs of inadequate water consumption, such as dry feces, hollow eyes, and dehydrated skin. Therefore, understanding drinking patterns (defined as water disappearance, water consumption, and water wastage) and combining this with behavioral measures and clinical signs (frequency visits, visit duration, and water intake per unit of time[10]) are useful to help pork producers and swine veterinarians predict potential or actual health issues.[27] Brumm[21] reported that if daily water usage drops more than 30% or if water usage is severely decreased for 3 continuous days, this provides evidence of an occurring health challenge. Producers and veterinarians need to understand nursery pig drinking patterns and water availability if administering a water-based pharmaceutical product, electrolyte supply, acidifiers, or probiotics in conjunction with antibiotics to maximize health.[28,29]

Exogenous environmental factors can also influence drinking. The recommended thermal conditions for a US nursery pig are between 18.3 and 32.2°C.[19] Brumm[21] noted that the daily drinking needs in warm conditions for pigs range between 1.89 L/pig/day for newly weaned piglets to greater than 5.68 L/pig/day for grow-finish pigs

using nipple waterers. Several different types of drinkers are used in the United States, such as cup waterers, bite drinkers, nipple drinkers, nose drinkers, troughs, and wet feed systems.[30] Brumm[31] reported that wet/dry feeders and bowl drinkers had lower water to feed ratios (2.11:1 kg of water per kg of feed disappearance) when compared to gate-mounted nipple drinkers which had higher water to feed ratios (3.35:1 kg of water per kg of feed disappearance) in nursery pigs. Regardless of drinker type implemented on-farm, producers and veterinarians must ensure that it is suitable for the pigs' age and size, that it can provide water at an appropriate flow rate and pressure, and that it is positioned correctly.[32] Finally, group size and space has been shown to affect pig drinking behavior. Turner et al[17] compared 20 versus 60 pigs at 0.51 m^2 and reported that although water usage was higher when pigs were housed in larger groups, total drinking time per pig decreased.

In this study, healthy nursery pigs kept at thermal-neutral conditions and provided a nipple cup waterer were compared. Offering 3 drinking resources resulted in pigs visiting the drinkers 4 times more and for longer (53 seconds longer than 1 drinker, or 31 seconds longer than 2 drinkers) over the studied hours. Our results are slightly lower than work published by Andersen et al[10] who reported that barrows visited the nipple drinker 21 times between 6:00 AM and 2:00 PM and spent 274 seconds drinking. However, differences could be attributed to the different drinker systems (stainless steel nipple cup drinker versus nipple), group sizes (25 pigs/pen versus 3 or 10, respectively), sex (gilts versus barrows), age (7 weeks versus 8-9 weeks), average water flow rate (0.47 L/min versus 0.82 L/min) and the additional hour that was observed.

When breaking down visits, duration, and water disappearance by drinker location, nursery pigs preferred the drinker location opposite the feeder, followed by the feeder location. These findings agree with Turner et al[17] who compared 4 treatments that varied both pig and drinker number. The authors concluded that a 1:10 drinker to pig ratio resulted in more visits than a 1:20 drinker to pig ratio. Although feeder visits and feeding behavior were not collected in the current work, it has been documented that there is a clear relationship between feeding and drinking[33] along with preferred times when pigs will drink.[21,34] Haugse et al[35] found that 35% of pigs would begin drinking immediately after they were finished eating, and pigs engaged in drinking behavior would subsequently initiate feeding 50% of the time. Thus, this drinker location opposite the feeder along the back gate may have given pigs more space to move away from other pigs that were trying to get to or were already at the feeder.

When considering the study length of 12 hours and breaking water disappearance down onto a per pig level, treatment 1 pigs used 6.84 L/pig/12 hours, treatment 2 used 4.76 L/pig/12 hours, and treatment 3 used 6.43 L/pig/12 hours. Water disappearance in this study for nursery pigs given 1 water source was higher than reported by Andersen et al.[10] In that study the researchers monitored growing barrows over 24 hours that had access to 1 water nipple/pen and reported overall water disappearance at 4.99 L/pig/24 hours. We cannot conclude that increased drinker time equates to higher water consumption as the consumed versus waste was not recorded. The researchers anecdotally noted that the alley was used as the preferred dunging area. Dunging is typically done away from feed and water resources. In the case of placing 3 waterers, we may have limited the nursery pig's ability to dung away from 1 of the waterers. Therefore, if producers or veterinarians were considering increasing water access, then it would be advisable for placement decisions to be based on avoiding areas where pigs traditionally dung.

Finally, aggression over all treatments was low in frequency and short in duration. These low aggression levels could be attributed to several factors, such as pigs had adequate space between waterers, pigs had an established hierarchy, and barn personnel inspected waterers daily for correct height and working abilities. Therefore, in conclusion, determining where to place drinkers and the number of drinkers per pen may improve a nursery pig's ability to access a drinker.

Implications

Under the conditions of this study:

- Providing 3 drinkers increased visits and time spent at the drinker.
- Pigs exhibited a location preference for a drinker opposite the feeder.

Acknowledgments

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Conflict of interest

Dr Holck and Mr Edler worked for Boehringer Ingelheim and the company partially funded this project. The roles of Dr Holck and Mr Edler were in experimental design and final manuscript approval. These co-authors were not involved in data collection, data analysis, or interpretation of the study findings.

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Enzootic pneumonia-like lesions: Ultrasound vs pathological findings under field conditions

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Summary

Thoracic ultrasonography has been increasingly utilized as a diagnostic tool in human and veterinary medicine. However, limited data are currently available about its field application in pigs. The present study aimed to evaluate the feasibility of thoracic ultrasonography in pigs affected by enzootic pneumonia-like lesions. Following technique verification on cadavers, ultrasound investigations were performed on the thorax of healthy and diseased live pigs to assess lungs. Overall, results indicated that ultrasonography was effective to discriminate between healthy and diseased lungs, with enzootic pneumonia-like lesions showing an easily recognizable ultrasonographic pattern. Thoracic ultrasonography could contribute to better manage porcine respiratory diseases.

Keywords: swine, pneumonia, thoracic ultrasonography, pathology

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Resumen - Lesiones similares a la neumonía enzoótica: Ecografía versus hallazgos patológicos en condiciones de campo

La ecografía torácica se ha utilizado cada vez más como herramienta diagnóstica en medicina humana y veterinaria. Sin embargo, actualmente se dispone de información limitada sobre su aplicación de campo en cerdos. El presente estudio tuvo como objetivo evaluar la viabilidad de la ecografía torácica en cerdos afectados con lesiones similares a la neumonía enzoótica. Tras la verificación de la técnica en cadáveres, se realizaron investigaciones de ultrasonido en el tórax de cerdos vivos sanos y enfermos para evaluar los pulmones. En general, los resultados indicaron que la ecografía fue eficaz para discriminar entre pulmones sanos y enfermos, con lesiones similares a las de neumonía enzoótica que muestran un patrón ecográfico fácilmente reconocible. La ecografía torácica podría contribuir a un mejor manejo de las enfermedades respiratorias porcinas.

Résumé - Lésions apparentées à la pneumonie enzootique: Trouvailles échographiques vs pathologiques en conditions de terrain

L'échographie thoracique est utilisée de plus en plus couramment comme outil diagnostique en médecine humaine et vétérinaire. Toutefois, des données limitées sont actuellement disponibles concernant son utilisation sur le terrain chez les porcs. La présente étude visait à évaluer la faisabilité de l'échographie thoracique chez les porcs ayant des lésions apparentées à la pneumonie enzootique. À la suite d'une vérification de la technique sur des cadavres, des examens échographiques ont été effectués sur le thorax de porcs vivants sains et malades pour évaluer les poumons. De manière générale, les résultats indiquaient que l'échographie était efficace pour discriminer entre les poumons sains et malades, avec les lésions apparentées à la pneumonie enzootique montant un patron échographique facilement reconnaissable. L'échographie thoracique pourrait contribuer à mieux gérer les maladies respiratoires porcines.

Respiratory disorders are widely recognized as the leading cause of financial losses to the pig industry due to veterinary care costs, decreased performance, and increased mortality. The etiology of porcine respiratory disorders is usually complex, with several pathogens acting together to determine the clinical and pathological outcomes. As a consequence, the term porcine respiratory disease complex (PRDC) has been introduced to indicate a multifactorial respiratory disease in growing and finishing pigs.[1,2]

Mycoplasma hyopneumoniae is among the most important causative agents of PRDC and is recognized as the primary pathogen of the so-called enzootic pneumonia (EP), a chronic and worldwide diffuse respiratory disease usually showing high morbidity and low mortality rates. Dry cough is the main clinical sign, which is greatly exacerbated by physical activity and may last for weeks to months. In EP-affected pigs, pulmonary lesions are bilateral consisting of slightly red or grey areas of bronchopneumonia, which affect the cranio-ventral parts of both lungs. Such gross findings are not pathognomonic for *M hyopneumoniae* as other pathogens (eg, swine influenza

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virus) may induce similar lesions. Microscopically, bronchointerstitial pneumonia and hyperplasia of the bronchial associated lymphoid tissue are the most relevant lesions.[3,4]

The present study aimed to assess the strengths and weaknesses of thoracic ultrasonography in pigs to provide suitable information to diagnose respiratory diseases, a special emphasis being placed upon EP-like lung lesions.

Materials and methods

This investigation was conducted in a farrow-to-finish pig herd (about 200 sows) with a recent history of severe respiratory disease. Pigs were not vaccinated for *M hyopneumoniae* and cases of EP complicated by *Pasteurella multocida* had been repeatedly diagnosed during the previous weeks.

Ultrasonography was performed using a linear multifrequency ultrasound transducer (probe Chison L7V-A, 5.3-10 MHz; Chison Medical Technologies Eco 3 Expert). A pregnancy-check ultrasound machine (3.5 MHz convex probe; manufacturer unknown) was also used.

Lung ultrasonography

Pigs (n = 8; 12-16 weeks of age) that spontaneously died after showing respiratory distress were necropsied. Lungs were removed from the chest and carefully examined. Thereafter, ultrasonography was performed by applying the transducer on the lung surface in both healthy and diseased areas. This step confirmed the ultrasound pattern of normal and diseased lungs. In this case, the linear multifrequency ultrasound transducer was used at 10 MHz.

Ultrasonography on pig cadavers and lungs

Transcutaneous ultrasonography was conducted along the left and right thoracic walls of pig carcasses (n = 8; 12-16 weeks of age) using some anatomic sites (ie, the elbow, the heart, and the intercostal spaces) as landmarks (Figure 1). Subsequently, the pigs were necropsied, and the ultrasound findings compared with the pathological findings. Once again, lungs were removed from the chest, carefully inspected, and further examined by ultrasonography. The linear multifrequency ultrasound transducer was used at 5.3 MHz on carcasses and at 10 MHz on lungs.

Ultrasonography on clinically healthy and diseased live pigs

Ultrasonography was carried out on live, clinically healthy pigs aged 4 (n = 8), 8 (n = 8), and 12 (n = 8) weeks, randomly selected from two batches. Likewise, ultrasonography was performed on live pigs (n = 8; 12-16 weeks of age) showing prominent respiratory clinical signs (dry coughing) and, therefore, confined in the recovery pen. To this aim, pigs were placed in the lateral decubitus position with no sedation or hair clipping required. Specifically, the pig was placed with its back facing an operator, who restrained the pig by holding the two forelimbs with one hand, and the two hindlimbs with the other hand. The linear multifrequency ultrasound transducer was used at 5.3 MHz.

Results

Lung ultrasonography

All lungs under study showed gross lesions compatible with EP (Figure 2). Ultrasonography of diseased areas showed a homogeneous, "liver-like" appearance, with hyperechogenic spots and lines of variable size and shape (Figure 3). The healthy lung parenchyma could not be shown by ultrasonography. Its air content induced the appearance of the so-called A-lines, ie, reverberation artefacts running parallel to the pleural surface. The images obtained by the pregnancy-check ultrasound machine were of lower quality because they were photographs of the device screen (this tool was unable to store and download images; Figure 3).

Ultrasonography on pig cadavers and lungs

The aforementioned ultrasonographic patterns were easily recognized also on pig carcasses. The intercostal spaces corresponding to disease ultrasonograms were recorded before necropsy. Gross findings consisted of bilateral foci of EP-like bronchopneumonia and were consistent with ultrasonograms.

Ultrasonography on clinically healthy and diseased live pigs

Thoracic ultrasonography took about 5 min/pig. No disease ultrasonogram was observed in clinically healthy pigs at 4, 8, and 12 weeks of age. On the contrary, ultrasonograms compatible with bronchopneumonia were always detected in pigs with respiratory syndrome at 12 to 16 weeks of age (Figure 4). Although providing images of different quality, ultrasonograms obtained using the linear multifrequency ultrasound transducer provided similar ultrasonographic pattern at the same anatomical site when compared with the 3.5 MHz sector transducer.

Discussion

In modern and intensive pig farming, it is always important to assess the impact (ie, the prevalence and severity) of pneumonia, as well as monitor the effectiveness of strategies implemented to treat and prevent such disease conditions.[5] The Madec's grid is the most common method used to score lung lesions and is usually performed on slaughtered pigs.[6] However, EP lesions can be missed when the animals recover, this being more probable in heavy pigs slaughtered at 9 to 10 months of age. Accordingly, some studies indicate that losses are associated with a clinical history of pneumonia rather than with lung lesions at slaughter. This is not surprising when the impact of complex and multifactorial disorders is investigated.[7,8]

Clinical assessment and laboratory tests (eg, serological test) can be complementary to scoring lesions at slaughter providing useful information about the timing of infection and the prevalence and severity of the disease to plan effective control strategies.[1,7] Investigative methods on live animals should be easy, fast, reliable, and cost-effective, yet such requisites often remain disregarded. As an example, systems for cough recording could be of value for early EP detection, but they are still unavailable in practice.[7] Likewise, radiography is a highly informative tool, but not feasible under field conditions.[9]

In human[10,11] and veterinary medicine, thoracic ultrasonography has been increasingly used as a diagnostic tool, as well as to monitor clinical outcomes on individual patients. In particular, a number of scientific papers have been published regarding the application of thoracic ultrasonography in pets, ruminants, and horses.[12-17] To the best of our knowledge, limited data are currently available about thoracic ultrasonography in pigs under field conditions, with only a few reports dealing with experimental investigations.[18-20] Overall, the present study indicates that ultrasonography is effective to discriminate between healthy and diseased lungs with

Figure 1: Topography of thoracic and abdominal organs of a pig carcass A) before and B) during necropsy. This picture provides a practical tool to investigate the lung, which is bordered by a yellow line. As landmarks, the ribs (blue circles), the heart (H) and the liver (L) are also indicated. The transducer was placed and moved along the intercostal spaces, from the axillary region to the 10^{th} and 11^{th} rib.

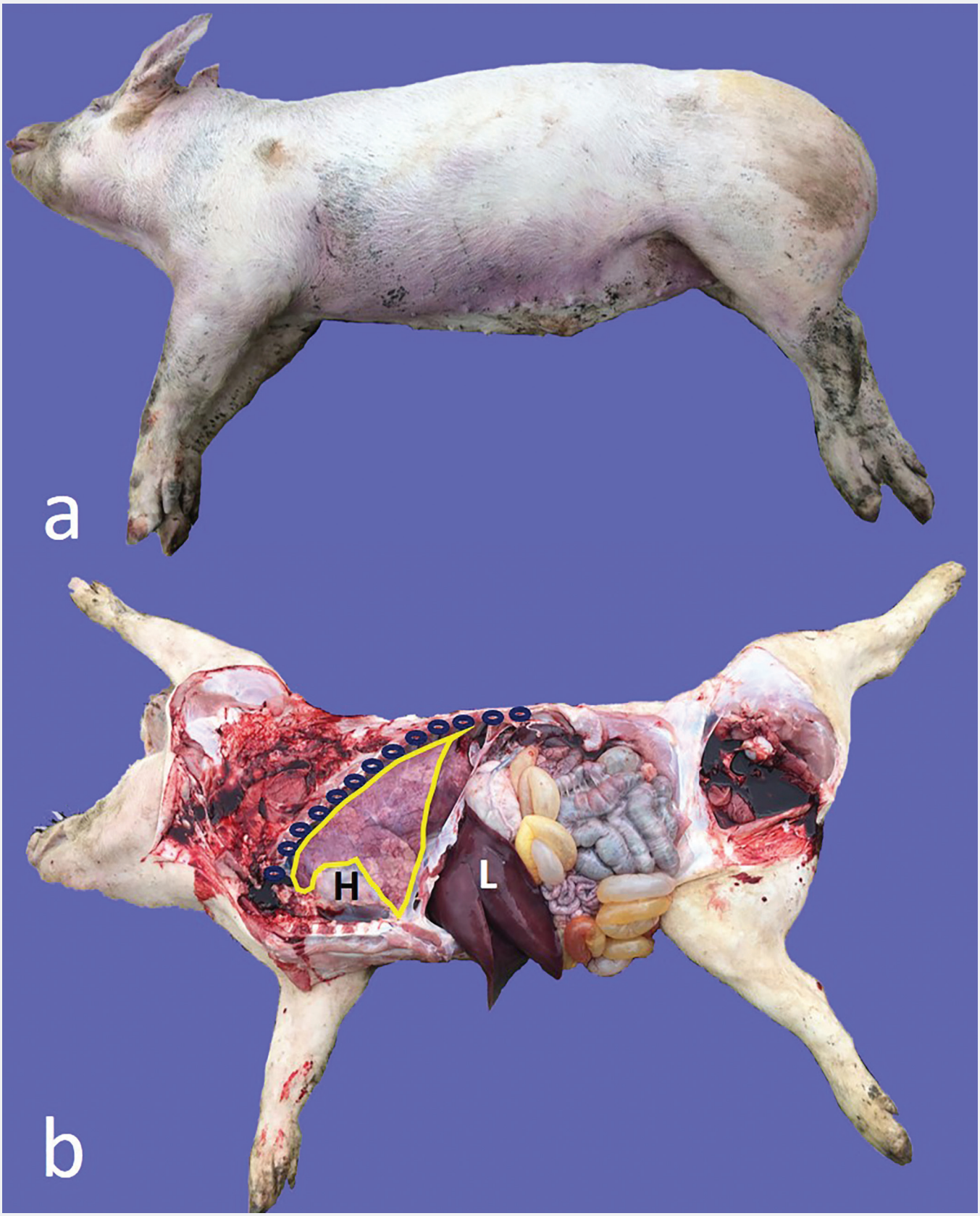
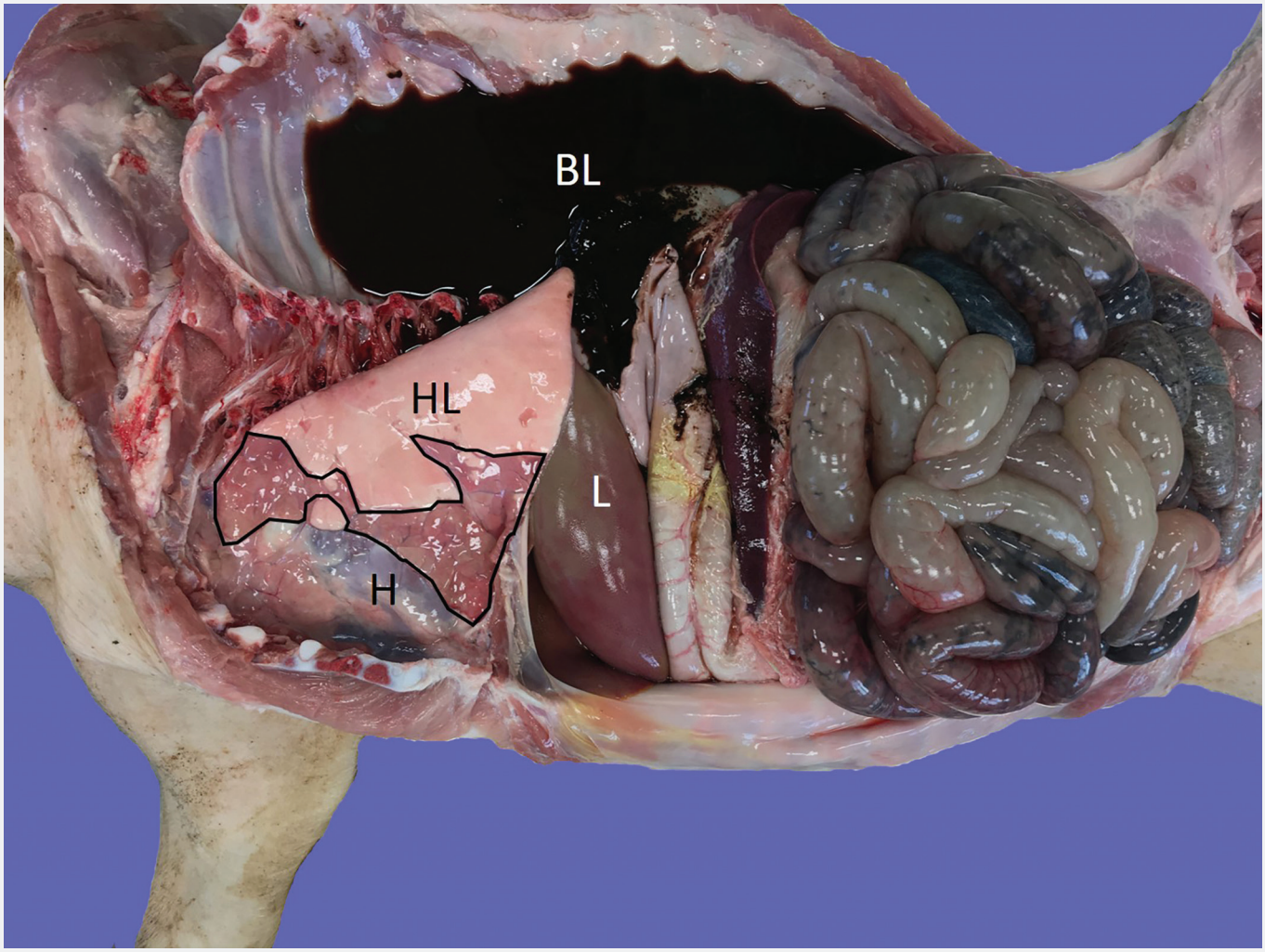


Figure 2: Pig necropsy. Typical slightly red or grey EP-like lesions affect the cranio-ventral portions of the left lung (black outline). The heart (H), the healthy lung (HL) and the liver (L) are also indicated. This pig died because of a severe gastric ulceration and a large amount of blood (BL) was released after opening the stomach.



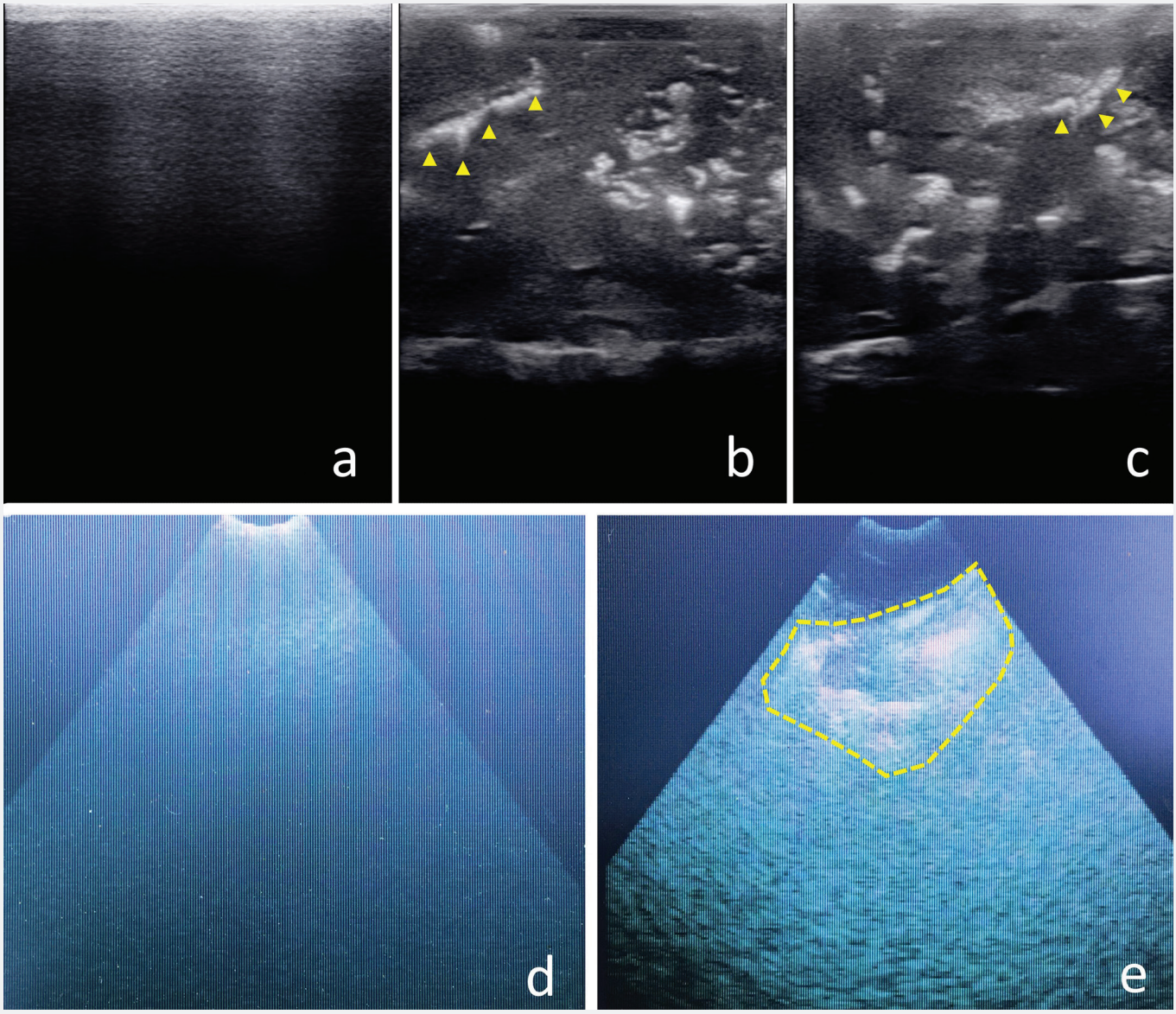
EP-like lesions showing an easily recognizable appearance. In our opinion, the main strengths of thoracic ultrasonography include:

- Ultrasonography is considered safe both for investigators and for pigs.
- It is inexpensive, as ultrasound transducers are commonly available on pig farms where they are routinely used to detect pregnancy. When the same ultrasound equipment is used at different herd sites, it is essential to comply with biosecurity measures to avoid the spread of pathogens.
- Thoracic ultrasonography could be useful to evaluate the main features of lung lesions (ie, extent, involvement of cranio-ventral vs dorsal-caudal areas, unilateral vs bilateral distribution, absence vs presence of pleuritis), which are needed to better address the diagnostic approach and a rational and effective treatment.

The main weaknesses of thoracic ultrasonography that should be considered include:

- Accurate interpretation of the ultrasonographic patterns requires targeted professional training even though image acquisition is relatively easy. For example, severe pleuritis and pericarditis, as observed in Glasser's disease affected pigs, can be very easily identified by ultrasonography, while the detection of virus-induced interstitial pneumonia, although possible, requires more focused skills.
- Because of the reverberation artefacts, thoracic ultrasonography can only detect disease conditions reaching the pleural surface, thus overlooking deeper lesions (eg, abscesses fully embedded within the lung parenchyma).
- Thoracic ultrasonography could be time-consuming in large pig farms where a high number of animals should be investigated to have a suitable sample size. As a consequence, this tool may not be routinely used to determine EP prevalence.
- Thoracic ultrasonography often provides a presumptive diagnosis, which should be confirmed by further laboratory investigations. This is crucial for proper management of PRDC through vaccination strategy or to select the most effective antimicrobial.
- Thoracic ultrasonography is less accurate and should not replace post-mortem investigations, even under the best conditions. Moreover, post-mortem changes (eg, reduction of pulmonary air content) make the

Figure 3: Direct ultrasound examination of lungs. A) Ultrasonogram of a healthy lung showing echogenic bands which represent reverberation artefacts. B) and C) Pneumonic foci were characterized by a homogeneous, hypoechoic, liver-like texture and by small, irregular, and scattered hyperechoic structures. Linear or branched-shaped hyperechoic areas (bronchograms; yellow arrows) were also observed. Images A, B, and C were obtained using a linear, multifrequency ultrasound transducer (Chison Medical Technologies Eco 3 Expert) at 10 MHz of frequency. Ultrasonogram images obtained by means of a pregnancy-check ultrasound machine (3.5 MHz convex probe), directly applied to D) healthy or E) diseased lungs, where pneumonic areas could be easily identified (yellow outline).



interpretation of ultrasonograms more challenging and could provide false positive results, especially when ultrasonography occurs several hours after death.

To conclude, thoracic ultrasonography could be a useful tool for the clinical appraisal of pig herds to assess the kinetics of respiratory infections/diseases, as well as the severity and the main features of pneumonia. Data resulting from thoracic ultrasonography should integrate with, not replace, other diagnostic tools, including necropsy, with the aim to manage PRDC in a more precise and rational manner.

Acknowledgments

The present study has been carried out in the framework of the Project Demetra (Dipartimenti di Eccellenza 2018-2022, CUP_C46C18000530001) funded by the Italian Ministry for Education, University, and Research.

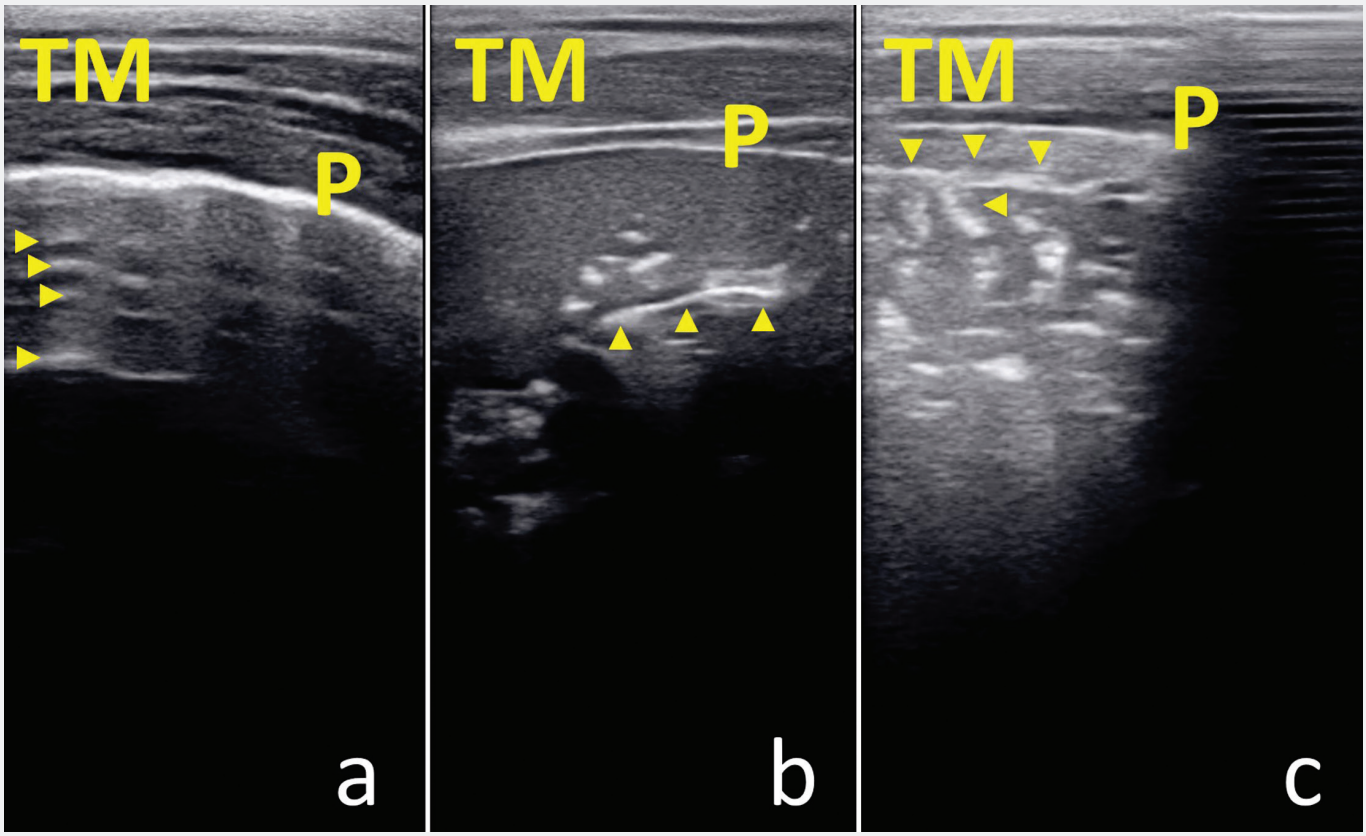
Conflict of interest

None reported.

Disclaimer

Scientific manuscripts published in the *Journal of Swine Health and Production* are peer reviewed. However, information on medications, feed, and management techniques may be specific to the research or commercial situation presented in the manuscript. It is the responsibility of the reader to use information responsibly and in accordance

Figure 4: Ultrasound examination of live pigs. In A) healthy pigs, the thoracic wall (TM), the pleural layers (P), and the reverberation artefacts (arrows) are seen. Ultrasonograms of B) and C) diseased pigs are dominated by dot, round, irregular, or linear/branched-shaped hyperechoic texture (yellow arrows). The thoracic ultrasonography was obtained using a linear, multifrequency ultrasound transducer (Chison Medical Technologies Eco 3 Expert) at 5.3 MHz of frequency.



with the rules and regulations governing research or the practice of veterinary medicine in their country or region.

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Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.35
1 lb (16 oz)	0.45 kg	lb to kg	0.45
2.2 lb	1 kg	kg to lb	2.2
1 in	2.54 cm	in to cm	2.54
0.39 in	1 cm	cm to in	0.39
1 ft (12 in)	0.3 m	ft to m	0.3
3.28 ft	1 m	m to ft	3.28
1 mi	1.6 km	mi to km	1.6
0.62 mi	1 km	km to mi	0.62
1 in^2	6.45 cm^2	in^2 to cm^2	6.45
0.16 in^2	1 cm^2	cm^2 to in^2	0.16
1 ft^2	0.09 m^2	ft^2 to m^2	0.09
10.76 ft^2	1 m^2	m^2 to ft^2	10.8
1 ft^3	0.03 m^3	ft^3 to m^3	0.03
35.3 ft^3	1 m^3	m^3 to ft^3	35.3
1 gal (128 fl oz)	3.8 L	gal to L	3.8
0.26 gal	1 L	L to gal	0.26
1 qt (32 fl oz)	0.95 L	qt to L	0.95
1.06 qt	1 L	L to qt	1.06

Temperature equivalents (approx)

°F	°C
32	0
50	10.0
60	15.5
61	16.1
65	18.3
70	21.1
75	23.8
80	26.6
82	27.7
85	29.4
90	32.2
102	38.8
103	39.4
104	40.0
105	40.5
106	41.1
212	100.0

°F = (°C × 9/5) + 32
°C = (°F - 32) × 5/9

Conversion calculator available at: amamanualofstyle.com/page/si-conversion-calculator

Conversion chart, kg to lb (approx)

Pig size	Lb	Kg
Birth	3.3-4.4	1.5-2.0
Weaning	7.7	3.5
	11	5
	22	10
Nursery	33	15
	44	20
	55	25
	66	30
Grower	99	45
	110	50
	132	60
Finisher	198	90
	220	100
	231	105
	242	110
	253	115
Sow	300	136
	661	300
Boar	794	360
	800	363

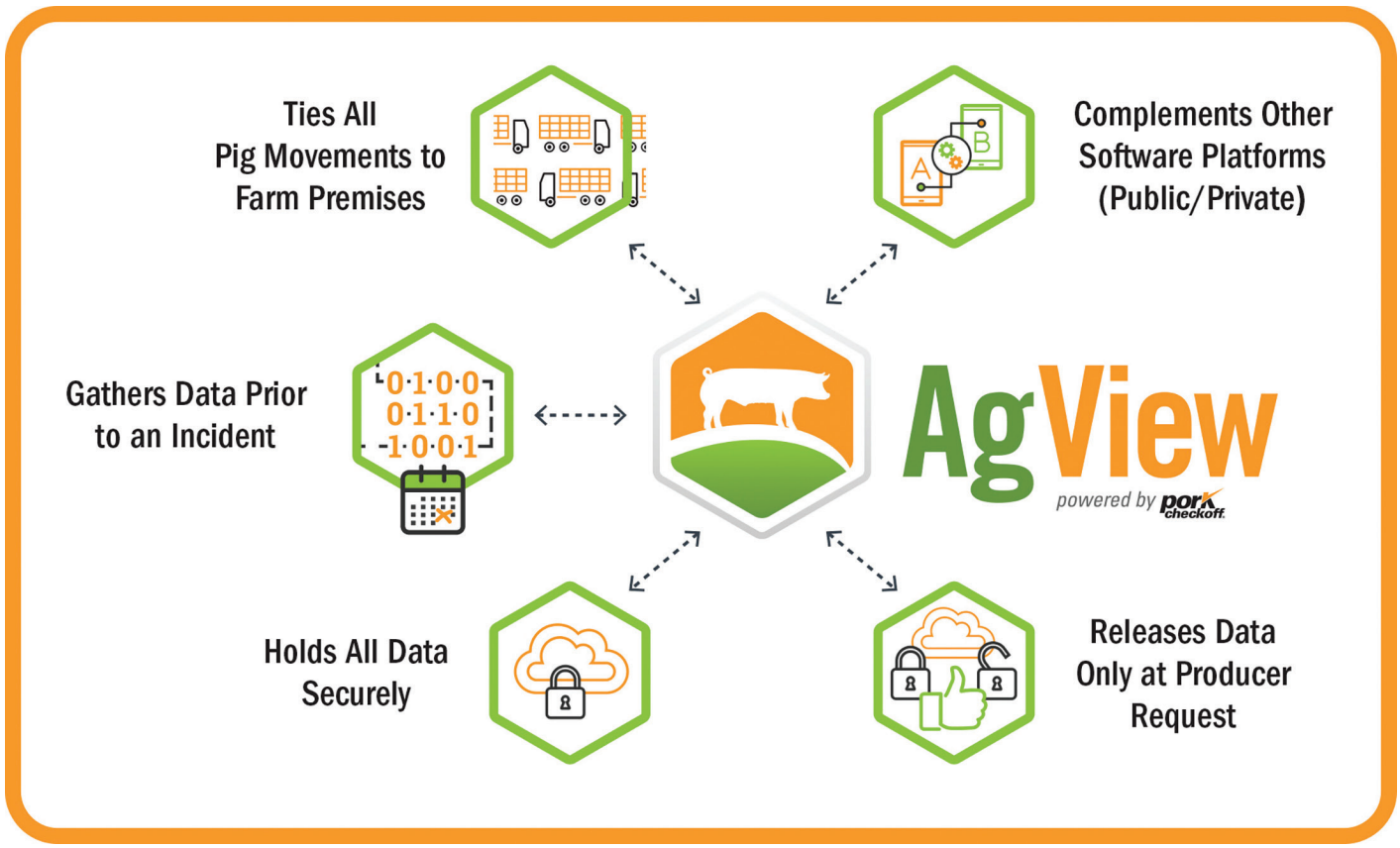
1 tonne = 1000 kg
1 ppm = 0.0001% = 1 mg/kg = 1 g/tonne
1 ppm = 1 mg/L

AgView gains momentum with more adoption

As more state animal health officials give AgView the greenlight to help augment their state's ability to respond to a foreign animal disease (FAD) emergency, the Checkoff-funded software platform is gaining traction in the pork industry. "We're pleased with how producers and animal health officials are responding to the introduction of AgView," says Dr Dave Pyburn, chief veterinarian with the National Pork Board. "We are always happy to do demonstrations of the software's capabilities for producers and veterinarians who want to learn how AgView can help mitigate a swine health emergency, such as African swine fever."

Pyburn points to AgView's core strengths as shown in the infographic below, which highlights the platform's top five features.

For more information, contact Dr Dave Pyburn at **DPyburn@pork.org** or visit **agview.com**.



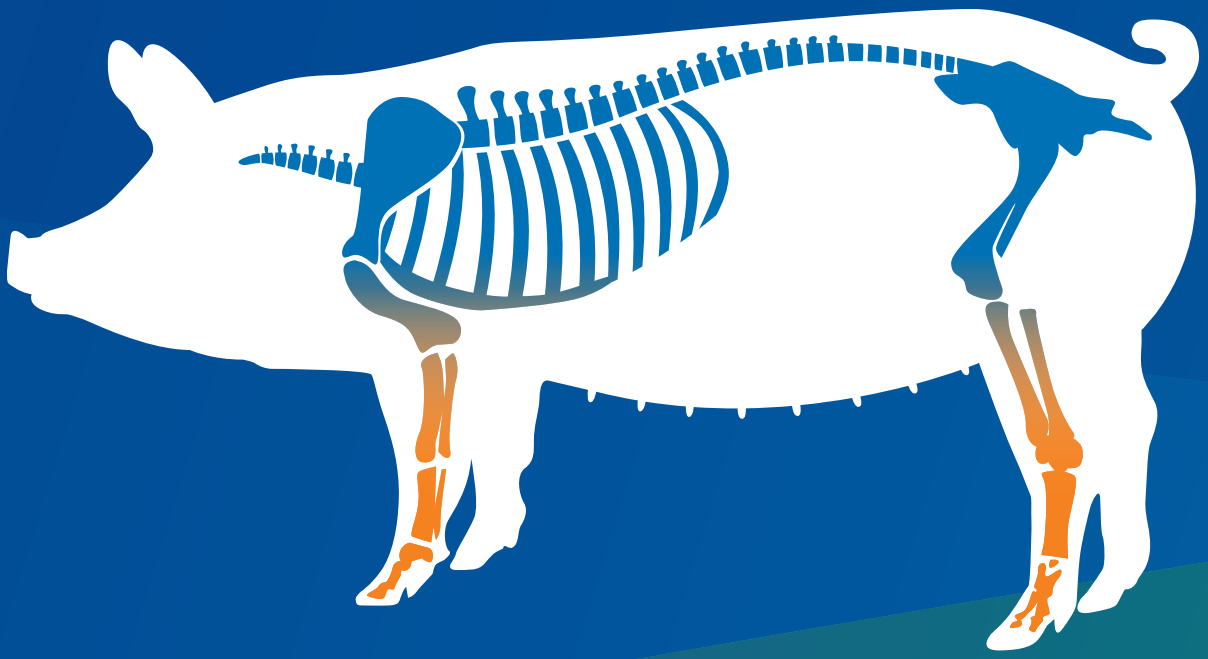
Humane Animal Handling modules available in Spanish

The Checkoff-funded Humane Animal Handling online training series is now available in Spanish. The four, 15-minute modules cover Pig Movement, Environment, Animal Handling, and Electric Prod Use. They are designed to easily fit with established training schedules for onboarding new employees or as part of an annual training refresher for experienced handlers. If you are interested in implementing this training contact Stephanie Wisdom at **SWisdom@pork.org** or **info@pork.org**.

NPB news continued on page 99

Hy•D®

STAND STRONG
FOR A LIFETIME OF PRODUCTIVITY



Is your sow herd's vitamin D status high enough to ensure strong skeletal development, bone health and mobility? Hy•D®, a pure and proprietary vitamin D metabolite called 25-OH D3, works better than supplementing with vitamin D alone. Its unique mode of action eliminates the need for the conversion of D3 in the liver, allowing 25-OH D3 to be absorbed more quickly and consistently. Help your sows Stand Strong with Hy•D, your vitamin D solution for improving lifetime productivity.

See your DSM representative or visit dsm.com/hyd-swine

- Reduced bone lesions
- Improved gilt selection rates
- Reduced farrowing difficulties due to mobility issues
- Heavier birth and weaning weights

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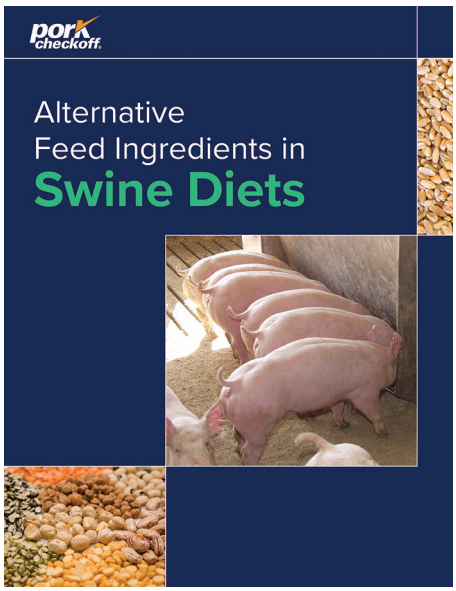
DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

NPB news continued from page 97

Managing increased feed costs

Historically, feed costs have represented 65% to 75% of the variable costs of swine production, but for many producers this figure is testing the upper limit of that range because of the recent surge in corn and soybean prices. The Pork Checkoff's newly edited *Alternative Feed Ingredients* resource outlines considerations when selecting alternative feed ingredients for swine diets and is available at **pork.to/feed.** The Pork Checkoff is also working on updating and developing several other resources to help producers manage increased feed costs and control costs in other areas of their farms.

For more information, contact Dr Chris Hostetler at **CHostetler@pork.org** or 515-223-2600.



Russ Nugent to represent NPB on SHIC Board of Directors

Russ Nugent, PhD, from Arkansas, has joined the Swine Health Information Center (SHIC) Board of Directors, representing the National Pork Board. Nugent was appointed to fill the SHIC board seat previously held by National Pork Board member Bill Luckey of Nebraska.

Build a productive herd with a healthy gut.

Lawsonia and *Salmonella* work together to destroy the microbiome of a pig's gut, which can slow ADG. If you only protect from one, profit may be left on the table. Vaccinate against *Lawsonia* with Porcilis® Ileitis and *Salmonella* with Argus® SC/ST to complete your herd's gut protection and help establish operation efficiency.

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AASV's virtual meeting brings new – and continuing – opportunities

The 2021 AASV Annual Meeting is sure to go down in the history books, if for no other reason than it is the association's first-ever virtual conference. While the virtual format doesn't provide the opportunity to greet one other face-to-face in the hallway or share a meal together in the hotel restaurant, it DOES offer some new benefits that aren't possible when meeting in person.

CE online until April 30th

For starters, even though the meeting dates may have come and gone by the time you read this, the meeting is not over – and it will not be over until April 30th. Veterinarians can continue to register after March 2nd to access ALL the conference presentations, posters, and proceedings: up to 40 hours of continuing education, and even more if you add the preconference seminars.

While some features, such as live chat with speakers and live meetings with exhibitors, will not be available after the conference dates, the meeting site content will remain online for all registered attendees to access until April 30th. Register at **http://ecom.aasv.org/annmtg**.

Seminar deals

Do you often have trouble deciding which preconference seminars to attend? No problem! Since the presentations stay online until April 30th, you don't have to choose one seminar and miss out on another. Plus, as a benefit of this year's virtual conference, registrants gain access to five seminars (20 hours of continuing education) for the price of one – or, if you register for both Saturday and Sunday, ten seminars for the price of two. Your only decision is which talks to watch during the scheduled presentation time when the speakers are available for live Q&A chat, and which to watch later.

Live Q&A

If you ARE able to participate in the conference on the scheduled dates (February 27 – March 2), you will appreciate the opportunity to ask questions of the speakers while you're watching their prerecorded presentations. The speakers will answer questions in the live chat box during their scheduled presentation time. No need to wait until the talk is over to ask your question and get the answer.

Who is attending?

Want to find out if someone you know is at the meeting? It only takes a few moments to do a quick search of the attendee directory to find the answer. Click the "Connect" button next to their name to request a meeting and supply your Zoom meeting info.

Tech Tables

The virtual Tech Tables exhibit offers the perfect no-pressure opportunity to explore the products and services offered by industry partners. Download product information or watch the company's video overview. If you want to learn more, pop into the live Zoom meeting room to visit with a sales rep, or just click a button to have information emailed to you. Easy peasy!

Of course, you do not have to be reminded that there are no travel expenses or hotel bills associated with a virtual meeting. No worries about bad weather, flight delays, what to pack, or what to wear. And no masks required. Regardless of what anyone says, the 2021 AASV Annual Meeting promises to be the best virtual meeting we have ever had!

SHIC and AASV host recurring webinars

The Swine Health Information Center (SHIC) and American Association of Swine Veterinarians (AASV) have been jointly sponsoring a webinar series on swine health «industry chatter» topics. These webinars bring together subject matter experts to discuss current issues facing US pork producers and practitioners. Past topics have included viral myelitis, tracheitis, coccidiosis, and lameness/arthritis. Conducted by the Iowa State University Swine Medicine Education Center (SMEC), webinar participants include practitioners with first-hand experience with the topic being discussed, diagnosticians, and other experts. Completed webinars are posted online for convenient access at **aasv.org/members/only/video/webinars/**.

Your input is needed to guide SHIC and AASV on what topics to address next. Are you seeing new occurrences of "old" diseases that are difficult to manage? Are you facing challenging diagnoses or syndromes? Do you need more information and points of view related to ongoing health issues in your barns? Reach out to SHIC Executive Director Dr Paul Sundberg at **psundberg@swinehealth.org** or AASV Director of Public Health and Communications Dr Abbey Canon at **canon@aasv.org** with your webinar recommendations.

AASV news continued on page 103

Drying agent options that you and baby pigs can be comfortable with.

DUAL DRY® by TechMix

The dual-purpose drying agent and scours support product for newborn and pre-weaned pigs.

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Ready-to-use moisture absorbent with essential oils for livestock.

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Cold, shivering baby pigs quickly lose energy and are prone to excessive heat loss due to their limited energy reserves. Establishing a comfortable environment that is dry and warm is Step 1 in our 3E platform for nurturing and developing weaned pigs.

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TechMix **Redefining hydration** to keep animals **drinking, eating & producing.**

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AASV news continued from page 101

Alternate Student Delegate selected for AASV Board

The AASV Student Recruitment Committee is pleased to announce the selection of Sydney Simmons, a second-year veterinary student at North Carolina State University (NCSU), as the incoming Alternate Student Delegate to the AASV Board of Directors.

A native of North Carolina, Sydney recognized her excitement for swine production and animal agriculture early on. Her very first summer job as a sow farm employee encouraged her to seek more opportunities in swine production. She spent another summer in a rotating internship touring feed mills, visiting diagnostic laboratories, and spending time at a boar stud. During that internship, Sydney worked directly under swine veterinarians and alongside a first-year veterinary student intern.

Sydney's previous experiences, including the time she spent with swine veterinarian mentors, convinced her to pursue a career in swine veterinary medicine. After her first year of veterinary school, Sydney participated in the Swine Veterinary Internship Program as an intern at the Swine Vet Center in St. Peter, Minnesota. She will present her research in electrostatic fogging methods in the AASV Student Poster Competition at the 2021 AASV Annual Meeting.

No stranger to AASV leadership, Sydney has served as the NCSU Student Chapter of the AASV first-year representative and the swine wet-lab coordinator. She anticipates career-long participation in the AASV.

Sydney is driven by a passion to educate consumers and colleagues and a life-long dedication to animal agriculture. She is eager to engage with AASV member students and veterinarians as Alternate Student Delegate.

Enthusiastically, Sydney said, "I am very excited for the opportunity to work with the AASV for the next two years. I am eager to meet and work alongside so many other students, veterinarians, and future colleagues!"

Simmons will assume her duties as Alternate Student Delegate during the 2021 AASV Annual Meeting. The current alternate delegate, Amanda Anderson (Iowa State, 2022), will assume the delegate position currently held by Jamie Madigan (NCSU, 2021), who will rotate off the board. Amanda and Sydney will represent student interests within AASV as non-voting members of the Board of Directors and the Student Recruitment Committee. Please join us in welcoming Sydney to the AASV Board of Directors and thanking Jamie for her service!

AASV proceedings online

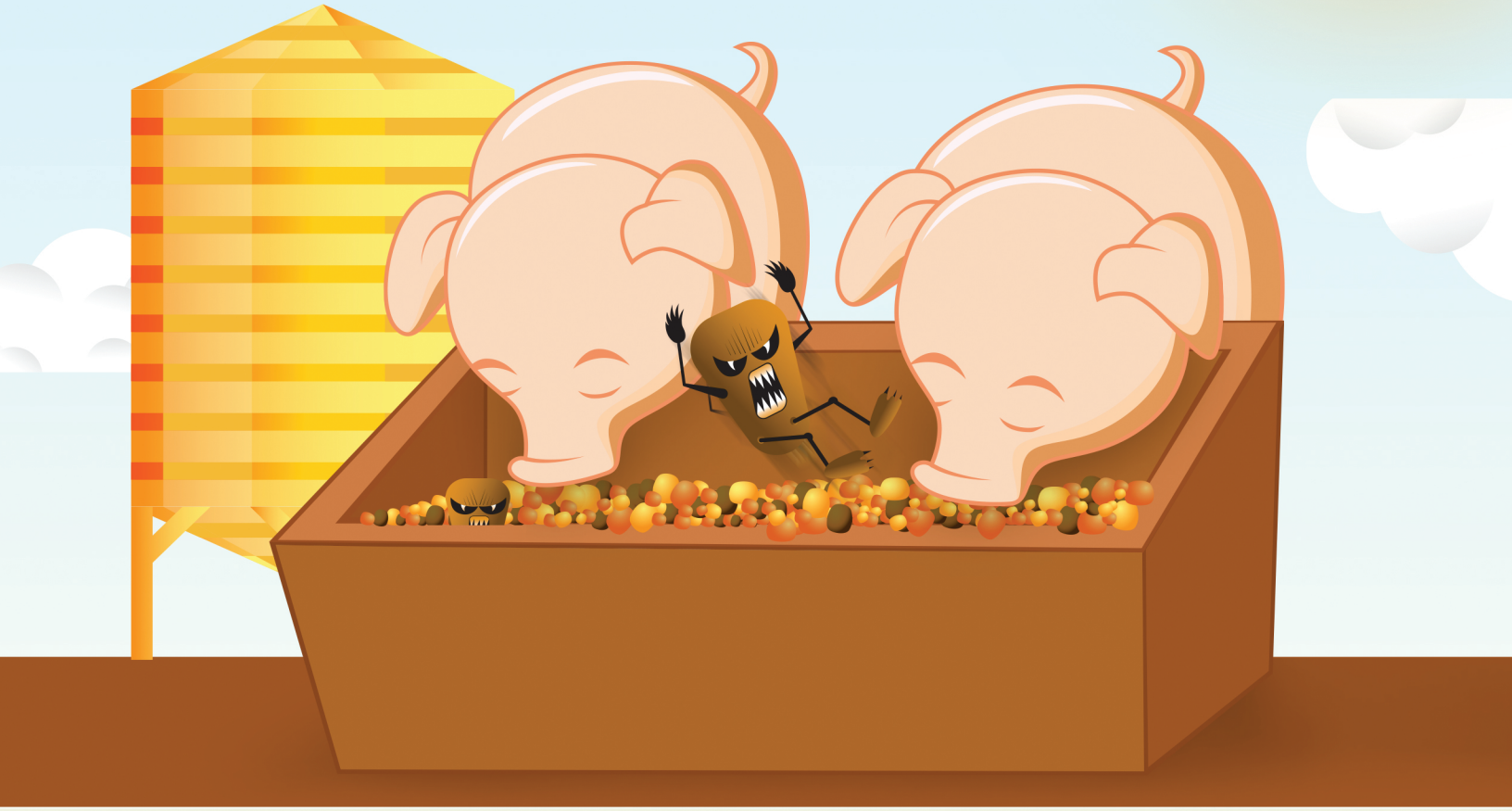
The proceedings of the 2021 AASV Annual Meeting are available for members to download at **aasv.org/annmtg/proceedings**. Current 2021 dues-paid status is required to access the files.

As in the past, the proceedings are available in the following formats:

- The "big book" of all the regular session papers in a single PDF file with a linked table of contents
- Seminar booklets: a PDF collection of the papers for each seminar
- An individual paper for each presentation is available in the Swine Information Library: **aasv.org/library/swineinfo/**

You will be prompted for your AASV website username and password to access the files. If you have forgotten your password, use the "Reset Password" link in the upper right of the AASV website (**www.aasv.org**) or contact the AASV office for assistance.

UNITED
ANIMAL HEALTH



Contaminated Feeds Contaminate Profit

Mycotoxins produced during grain storage contribute to an increased pathogen load for your animals. The symptoms from eating contaminated feed can be varied and sub-clinical. Even low mycotoxin levels in feed can reduce performance and profits.

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Reduces feed intake and absorption of nutrients

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You don't have to lose performance because of mycotoxins.

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One good thing leads to another … Leman Fellow

When Drs Tom Gillespie and David Reeves purchased the "Iowa pheasant hunt for four" offered by Fast Genetics in the 2016 AASV Foundation Auction, their intention was to enjoy a good hunting trip and support the foundation at the same time.

Five years later, they – and the other half of their hunting foursome, Drs Bob Evelsizer and John Waddell – are still enjoying some good pheasant hunting, and they are still supporting the foundation, but they are doing so in an entirely new way.

The four men – Leman Fellows, all – enjoyed that first hunting trip so much that they made it an annual tradition to get together for a fall hunt. This past November, they took advantage of an offer from fellow (and younger) AASV member Dr Shamus Brown to guide and host their 2020 hunt on his family's farm. If you have attended the AASV Annual Meeting lately, you know that Shamus has donated his auctioneer talents to call the AASV Foundation's live fundraising auction for the past several years.

When the four senior hunting buddies tried to compensate Shamus for the excellent guided hunting and hospitality they enjoyed, he refused to accept their payment. So they changed their approach and made him an offer he couldn't refuse: they would make him a Leman Fellow by contributing to the AASV Foundation.

It all started five years ago with the purchase of a pheasant hunting trip at the AASV Foundation Auction. The 2020 hunting party of AASV Foundation supporters and Leman Fellows: (L to R) Drs David Reeves, John Waddell, Shamus Brown, Bob Evelsizer, and Tom Gillespie.

The Leman Fellow designation is awarded for a contribution of $1000 to the AASV Foundation endowment.

True to their word, each hunter sent a check for $250 to the AASV Foundation. As a result, the foundation is pleased to welcome its newest Leman Fellow, Dr W. Shamus Brown, to this distinguished group of donors, recognized at **aasv.org/foundation/leman.htm**.

Think about it: is there a young (or not-so-young) colleague you can thank or recognize by making a contribution to the foundation in their honor? For more information about the foundation and its giving programs, see **aasv.org/foundation**.

American Association of Swine Veterinarians Foundation Auction

FEATURED ITEMS

Bidding on Featured Items (#1–15) closes TUESDAY, March 2 at 12:30 PM CST.

Winners of the Featured Items will be announced LIVE during AASV Annual Meeting Grand Finale

Get your bidding number at aasvf.cbo.io and pre-enter your bids!

1. **Nebraska Upland Game Hunt for Eight**
   Donated by: DNA Genetics
2. **Trip for 4 to October 2021 Talladega NASCAR Race**
   Donated by: Suidae Health & Production

3. **Peloton "Bike Works" Package with Online Class Subscription**
   Donated by: Four Star Veterinary Service, LLC
4. **Pheasant Hunt and Gift Cards for 4**
   Donated by: Fast Genetics

5. **Guided Colorado Fly Fishing Adventure for Three**
   Donated by: Boehringer Ingelheim
6. **Beretta A400 Xplor 20-Gauge Shotgun**
   Donated by: Pharmgate Animal Health

7. **Browning Sporter Gun Safe**
   Donated by: Phibro Animal Health

8. **Diagnostic Laboratory Training Workshop and/or Diagnostic Credit**
   Donated by: Iowa State University Veterinary Diagnostic Lab

9. **Blaz'n Grill Grid Iron Red Pellet Smoker Grill with Accessories**
   Donated by: Boehringer Ingelheim

10. **Grilla Wood Pellet Smoker Grill, Pellets, Rubs**
    Donated by: Huvepharma
11. **Traeger Lil Pig Wood Pellet Grill - Pink**
    Donated by: Swine Vet Center
12. **Illinois Football Tickets and Tailgate for Eight**
    Donated by: Drs. Clayton Johnson and Aaron Lower
13. **Green Bay Packers: Tickets and Tailgate for Four**
    Donated by: The Packer Backers: Drs. Butch Baker, Paul Mleziva, Steve Sornsen, and Warren Wilson

14. **Two Lifetime Memberships to FrontSight Firearms Institute**
    Donated by: Struve Labs International
15. **Custom-Fitted Golf Clubs from Golf Galaxy**
    Donated by: Zoetis

American Association of Swine Veterinarians Foundation Auction

SILENT AUCTION ITEMS

The traditional Silent Auction for Items #16-67 will close at the usual time: 7:00 PM CST on MONDAY, March 1.

ITEMS WILL BE SHIPPED DIRECTLY TO THE WINNING BIDDER BY THE DONOR.

Cash Donations

We're grateful to the following individuals and companies who made monetary contributions totaling more than $50,000 to support the 2021 AASV Foundation Auction:

$5000 and above

AMVC and PIC
Paul Armbrecht
Four Star Veterinary Service LLC

$2000 - $4999

AVMA PLIT Trust
East Fork Swine Veterinary Services, PC
Andrew Kleis (Insight Wealth Group)
Larry Rueff

$1000 - $1999

Butch and Emma Baker
Mary Lou Chapek-Hogg
Jack and Carla Coleman
Larry L. Coleman
Fairmont Veterinary Clinic
Jack Feldman and Hans Koehnk
Wayne and Karen Freese
Jerome Geiger
Peggy Anne Hawkins

$1000 - $1999 (cont.)

Steve Henry
J. Tyler Holck
Kerry and Betsy Keffaber
James and Erin Lowe
Sarah Probst Miller (AgCreate Solutions)
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Christa Goodell
Jeff Harker and Family
Perry Harms
Phil Hayes
Megan Hood
Jeff Husa
Huvepharma
Indiana Packers Corporation
Megan Inskeep
Iowa State University
Kuster Research and Consulting
Claire LeFevre
Karen Menz
Michelle Michalak
National Pork Producers Council
David Nolan
Pharmacosmos
Reid Philips
Dale Polson
Karen Richardson
Rebecca Robbins
Max and Carol Rodibaugh
Brian Roggow
Gail Rueff
Larry Rueff
Lee Schulteis
Smithfield Foods
Swine Medicine Education Center
Swine Vet Center
Matthew Turner
Virox Animal Health
John Waddell
Sherrie Webb
Boguslaw Zakrezewski
Zoetis

Sharing your experience

In October 2019, AASV partnered with National Pork Board to bring together a working group of veterinarians, producers, state pork associations, and state and federal animal health officials to identify industry needs related to depopulation of swine in the face of an emergency. At that time, the US Department of Agriculture (USDA) had just completed their industry-wide Swine Fever Exercise for Agriculture Response and much of the working group's discussion and industry needs identified were based on assumptions around an African swine fever or other foreign animal disease (FAD) response. Little did we know then how soon the industry would be tested, and not by an FAD outbreak, but by the COVID-19 market disruption.

Fast forward 17 months later and portions of the swine industry have had very real, hands-on experience with stop movement situations and mass depopulation. Many state pork associations partnered with their state animal health officials to initiate programs and provide support to their producers faced with depopulation. Additionally, the National Pork Board invested just over $1 million to fund depopulation experimental research and field trials and the USDA provided support to the industry through their Veterinary Stockpile equipment and cooperative agreement projects for depopulation field trials.

The final step of any emergency response is to debrief with the response team and reflect on what went well and what needs to be improved to be better prepared for the next emergency. During their Fall 2020 meeting, the AASV Pig Welfare Committee discussed how best to capture the first-hand experiences gained by veterinarians and farmers faced with depopulation and improve our resources or build new tools to meet the needs of the AASV membership. A subcommittee was formed to review and update the *AASV Recommendations for the Depopulation of Swine* to incorporate the results from the research studies and field trials and the first-hand knowledge gained through the COVID-19 market disruption.

To complete this work, the AASV has received funding from the USDA Animal and Plant Health Inspection Service through their National Animal Disease Preparedness and Response Program (NADPRP). The 3 project objectives are:

- Conduct interviews with veterinarians, farmers, and animal health officials who have depopulated swine to gather and compile experiential, field trial, and research data on setup, implementation, and efficacy of swine depopulation methods.
- Building from the AVMA Guidelines for the Depopulation of Animals and using information gathered from Objective 1, develop detailed swine-specific recommendations for practical on-farm implementation of depopulation methods.
- Develop supplemental education resources, including depopulation method decision making tools, equipment lists, recordkeeping forms, and team debriefing tools, to assist swine veterinarians and farmers before and after the depopulation event occurs.

"To complete this work, the AASV has received funding from the USDA Animal and Plant Health Inspection Service through their National Animal Disease Preparedness and Response Program (NADPRP)."

This project is 1 of 46 NADPRP funded projects aimed to individually and collectively address critical livestock biosecurity and large-scale depopulation and carcass disposal concerns across all regions of the United States.

Interviews to systematically gather information from the swine industry's recent experience with depopulation will occur in March and April. The subcommittee will then use this information to revise and update the swine-specific recommendations and develop the supplemental education resources. If you are asked to participate in an interview, I encourage you to share your experiences and help improve our industry preparedness and response for the next emergency, whatever that may be.

Sherrie Webb, MSc
Director of Swine Welfare

The American Association of Swine Veterinarians is committed to providing members with resources to promote and enhance well-being - the state of being comfortable, healthy, and happy.

The nine dimensions

Well-being isn't a single measure of health.

It is composed of nine unique dimensions that touch upon every aspect of our lives: occupational, intellectual, spiritual, social, emotional, physical, financial, creative and environmental. These dimensions work together, and collaboratively contribute to our overall well-being.

Intellectual
Learning new things; participating in activities that foster critical thinking and expand your worldviews.

Environmental
Taking an active role in preserving, protecting, and improving the environment.

Social
Surrounding yourself with a network of support built on mutual trust, respect, and compassion.

Emotional
Being able to identify and manage your full range of emotions, and seeking help when necessary.

Physical
Taking care of your body (e.g., getting enough sleep, eating a well-balanced diet, exercising regularly).

Financial
Being aware of your personal finances and adhering to a budget that enables you to meet your financial goals.

Creative
Participating in diverse cultural and artistic experiences.

Occupational
Being engaged in work that gives you personal satisfaction, and aligns with your values, goals, and lifestyle.

Spiritual
Having a sense of inner harmony and balance.

UPCOMING MEETINGS

American Association of Swine Veterinarians 52nd Annual Meeting

February 27 - March 2, 2021 (Sat-Tue)
AASV's first-ever virtual meeting!

Registrations for the conference will continue to be accepted after March 2. Registrants will have access to all conference presentation recordings and proceedings until April 30.

For more information:
American Association of Swine Veterinarians
830 26th Street
Perry, IA 50220
Tel: 515-465-5255
Email: **aasv@aasv.org**
Web: **aasv.org/annmtg**

2021 World Pork Expo

June 9 - 11, 2021 (Wed-Fri)
Iowa State Fairgrounds
Des Moines, Iowa

For more information:
Lauren Swanson
National Pork Producers Council
Tel: 515-864-7985
Email: **swansonl@nppc.org**
Web: **worldpork.org**

Allen D. Leman Swine Conference

September 18 - 21, 2021 (Sat-Tue)
Hosted by the University of Minnesota

For more information:
Email: **vetmedccaps@umn.edu**
Web: **ccaps.umn.edu/allen-d-leman-swine-conference**

US Animal Health Association 125th Annual Meeting

October 21 - 27, 2021 (Thu-Wed)
Gaylord Rockies Hotel
Denver, Colorado

For more information:
United States Animal Health Association
4221 Mitchell Ave
Saint Joseph, MO 64507
Tel: 816-671-1144
Web: **usaha.org/meetings**

International Conference on Pig Survivability

October 27 - 28, 2021 (Wed-Thu)
Hosted by: Iowa State University, Kansas State University, and Purdue University
Omaha, Nebraska

For more information:
Dr Joel DeRouchey
Email: **jderouch@ksu.edu**
Web: **piglivability.org/conference**

26th International Pig Veterinary Society Congress

June 2022 - Date to be determined
Rio de Janeiro, Brazil

For more information:
Tel: +55 31 3360 3663
Email: **ipvs2020@ipvs2020.com**
Web: **ipvs2020.com**

For additional information on upcoming meetings: aasv.org/meetings

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