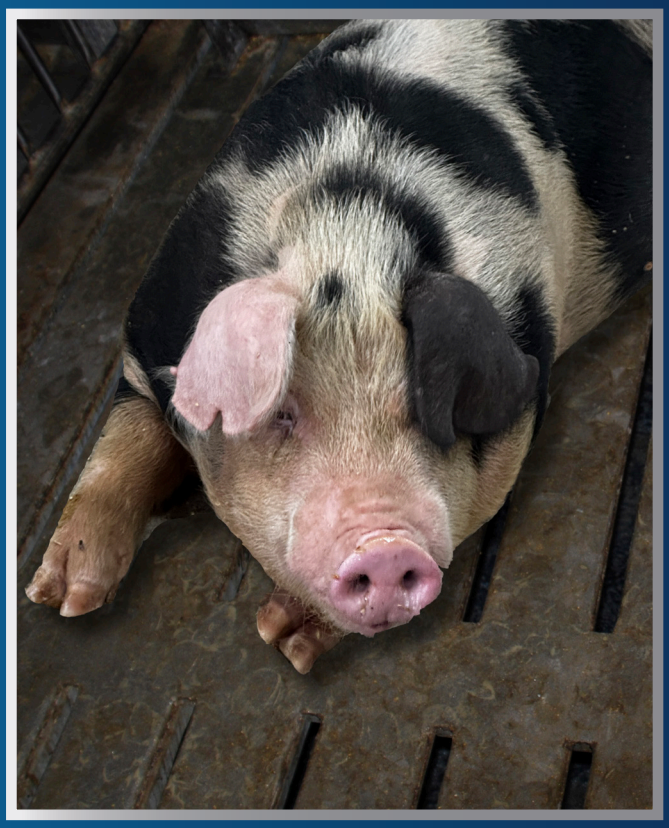
Journal of
SWINE HEALTH & PRODUCTION
September and October 2024 • Volume 32, Number 5



Practices adopted in response to PRRS outbreaks among breeding herds
Paiva R, Rademacher C, Peterson T, et al

Ethanol preservation of pig samples for PCR
Gerszon J, Genz B, Moser R, et al

The Journal of the American Association of Swine Veterinarians

The *Journal of Swine Health and Production* is published by the American Association of Swine Veterinarians.

The *Journal of Swine Health and Production* is a refereed publication and is a benefit of membership in the American Association of Swine Veterinarians. For inquiries regarding membership or subscriptions, please contact:

AASV
830 26th Street, Perry, IA 50220-2328
Tel: 515-465-5255
Email: aasv@aasv.org

Editorial questions, comments, and inquiries should be addressed to Rhea Schirm, Publications Manager:
Email: jshap@aasv.org.

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

Journal of Swine Health and Production is indexed in CAB Abstracts, Google Scholar, Web of Science SCIE, and CrossRef

JOURNAL OF SWINE HEALTH AND PRODUCTION

(ISSN 1537-209X) Volume 32, Number 5; September and October

AASV STAFF

AASV OFFICERS

JSHAP STAFF

EDITORIAL BOARD

TABLE OF CONTENTS

Cover photo is courtesy of Tina Smith

Download this issue at **www.aasv.org/shap/issues/v32n5/v32n5jshap.pdf**

JSHAP SPOTLIGHT

Alexis Berte

2024 AASV Board of Directors Student Delegate
Iowa State University

Alexis Berte earned her BS ('21) in Animal Science and is currently a fourth-year veterinary student at Iowa State University (ISU). After graduation, Alexis plans to practice production-animal medicine, specifically as a swine veterinarian who works closely with pork producers to provide high quality, healthy pork products to consumers. Her passion for swine medicine stems from helping on her family's 4800-head, wean-to-finish swine farm. As an active student member of AASV and the ISU AASV chapter, Alexis has gained experience and valuable skills through presenting her summer internship research, networking with current swine practitioners and students who will become future colleagues, and serving in numerous leadership roles, including as the 2024 AASV Board of Directors Student Delegate. "The connections that I have made through AASV are invaluable to my future career as a swine practitioner," said Alexis.

Boehringer Ingelheim

The right solution protects more than just your herd.

BOTTLE OF PROOF

A lot rides on the health of your herd. Few jobs carry as much weight as the responsibility to feed the world. From ensuring food safety to promoting sustainability and animal welfare, producers shoulder a hefty mantle. Taking chances on protection is simply not an option. Drawing on 30 years of investing in PRRS protection, we're able to provide a holistic approach to disease control. **And it starts by protecting your herd with Ingelvac PRRS® MLV, backed by the support of the Boehringer Ingelheim team.** Because protecting your herd from PRRS is just one part of the interconnected puzzle of pig health.

Talk to your Boehringer Ingelheim representative to learn more.

Together, we get it right

Advocacy of the swine veterinarian

The AASV executive officer team is sharing the responsibility to pen the President's messages in Dr Angela Baysinger's absence. I hope to honor her legacy by writing about topics she might have believed to be pertinent to the organization, inspirational, or thought provoking. In the previous President's message (JSHAP July/August issue), Dr Hollis called upon us to be advocates. I would like to continue that theme and take us outside the barn to discuss advocacy to our peers.

I believe the advocacy we do as practicing veterinarians is different from paid lobbyists or those individuals in technical staff positions in organizations like the National Pork Board, National Pork Producers Council, or American Association of Swine Veterinarians (AASV) that do advocacy in fulfillment of their job description. The swine veterinarian is donating their professional time to serve as a subject matter expert, giving their voice to an issue or topic that impacts practitioners. I make a distinction here not to say one is better than the other or deserves more accolades, rather to emphasize that we earnestly need all swine veterinarians seeing themselves as a worthy advocate for swine veterinary issues.

Hopefully you are now interested enough that your wheels are turning and you are thinking of subjects and issues you would like to advocate on and where you can start to represent us in your advocacy.

To get off the starting line, if you have not been an AASV committee member, become one today. It is the best way to get connected with member issues. Be active on that committee by attending the meetings, sharing resources and experiences, and making sure the group is doing all it can to address the issue(s) it specializes in.

Next, being one of the American Veterinary Medical Association's (AVMA) allied associations, the AASV has a primary seat and alternate on 7 committee rosters: Animal Agriculture Liaison, Animal Welfare, Clinical Practitioner Advisory, Committee on Antimicrobials, Environmental Issues, Food Safety, and Legislative Advisory. In addition, we have a representative and alternate seat in the House of Delegates and a district representative to the Executive Board. This is only possible because at least 350 US voting members of AASV are also members of AVMA. The AVMA is our profession's strongest voice. From my own experience on the AVMA Committee on Antimicrobials, I know how vital the AASV representatives have been in educating peers, commenting on legislation, and co-authoring documents to inform the entire profession. I would ask you to just trust me that advocacy is rewarding and representing AASV by serving on AVMA committees is something everyone should try, but I will share testimonials from others who also serve in this capacity.

I sent a 3-question survey to AASV members currently serving on AVMA committees about their experience and here is what they had to say...

"...we earnestly need all swine veterinarians seeing themselves as a worthy advocate for swine veterinary issues."

Question 1: Why did you agree to serve on behalf of AASV in an advocacy role to the AVMA?

- "My respect for the AASV veterinarians that had held the role prior."
- "Our peers and our clients expect us to advocate for the profession."
- "To network with people who also have an interest or passion in the subject matter area."
- "Be part of an important conversation about that subject matter area."
- "Gain a better understanding of broader issues in the veterinary world beyond pigs."

Question 2: What have you valued about representing AASV to the AVMA?

- "Mutual respect and support other professional groups have for each other."
- "Other species/allied groups truly value and appreciate our perspective on swine health and swine veterinary medicine. Just as it is difficult for AASV membership to understand the challenges in other facets of veterinary medicine, our peers intently listen to the barnyard group for insight and input."
- "Even though AASV membership in AVMA is small, the other organizations and representatives are intent to hear the perspectives of the AASV."
- "Networking with other veterinarians and subject matter experts and through them, found other organizations which a swine veterinarian can represent the pig, the producer, and the profession."
- "Having the opportunity to influence discussions and helping shape regulations that our profession will uphold."
- "I've grown to appreciate the efforts of AVMA."

Officer's message continued on page 195

When SRD-complex has less impact on your cost of gain

THAT'S THE SOY EFFECT

Higher levels of soybean meal can help reduce swine respiratory disease (SRD) losses

Soybean meal (SBM) contains essential amino acids and functional bioactive molecules — not found in alternative least-cost ingredients. By strategically feeding higher levels of soybean meal in health-challenged pig flows, you can help reduce mortality, increase gain and improve feed efficiency.[1] Optimize performance and profitability by formulating for the full value of SBM in your swine diets.

LEARN MORE AT SOYEFFECT.USSOY.ORG

[1]Boyd, R. D. Soybean Meal: Growth and Health Promoting Effects Under High Health and Immune Stress. 2021 International Conference on Swine Nutrition. https://www.youtube.com/watch?v=Z13ssHwUb2s

ussoy.org

US SOY

Officer's message continued from page 193

Question 3: What advice would you give others about serving in an advocacy role to the AVMA?

- "Reminds you of the diversity of roles veterinarians need to fill."
- "You never regret getting involved, so just do it!"
- "The AASV leadership team is extremely supportive and willing to help as questions and needs arise, so recognize it's a team effort and that you will not be all on your own."
- "Even when life is crazy, there is usually a phase where you could carve out some time to help AASV and our profession."
- "Recognize the value you bring as a swine veterinarian with population medicine experience."

As you can see, we have all had a rewarding experience! Our veterinary professional colleagues outside of swine medicine are always interested in getting our perspective on issues, hear our unique client and practice concerns, and support us in the advancement of veterinary health issues. In my AASV vice-president candidacy statement, the first bullet I promised to ask members to focus on was advocacy by "[p]romoting committee membership, encouraging members to actively participate, and ensuring that our staff have the necessary resources, both financial and technical, to effectively represent the interests of practitioners."

I see the influence each of us as swine veterinarians can have when we are willing to bring our voice, our practical experience, and our passion to issues (and you do not need a bunch of extra letters aside from VDM/DVM to have that influence). Thank you to all our past and present representatives to AVMA and especially those who shared their thoughts on their advocacy experience (Drs Aaron Lower, Carissa Odland, Jason Kelly, Jessica Seate, and Kimberly Crawford). I saw Dr Baysinger as a tireless advocate for the pig; she served as AASV's representative to the AVMA Animal Welfare Committee until her passing. I respected her immensely and I hope you will consider honoring her by advocating on behalf of AASV.

If you are interested in serving on an AASV committee or representing AASV in other leadership opportunities, please contact me, a member currently serving on a committee or in a representative role, or the AASV office.

Rebecca Robbins, DVM, PhD
AASV Vice President

There's only one Hy•D®
for lifetime productivity

When it comes to purity, performance and immunity, Hy•D® has been helping pigs and producers stand strong for years. As the proven source of pure 25-OH D3 for diet fortification, Hy•D is the fastest and most efficient way to provide pigs with essential vitamin D.

1

As the original pure source of 25-OH D3, Hy•D is a proven, safe and effective metabolite for improving vitamin D status in poultry

7+

Years on the market for swine in North America, with demonstrated safety and research for increasing vitamin D status

100+

Research trials demonstrating the safety and benefits of Hy•D in diets for poultry, swine, and ruminants globally

2.6 Million

Pigs fed Hy•D per year in North America, based on dsm-firmenich actual sales, recommended feeding rates and survey data

There's only one Hy•D

Follow us on:

dsm-firmenich

AASV receives grant to train stakeholders in the Certified Swine Sample Collector training program

The AASV has received a grant from the US Department of Agriculture to facilitate Certified Swine Sample Collector (CSSC) training of swine producers and increase the number of CSSCs. This grant will support approved training sessions completed before October 1, 2025. To achieve this goal, AASV has contracted with Dr Pam Zaabel to lead this project. I have asked Pam to provide the following summary of the CSSC training program and grant.

Harry Snelson, DVM
Executive Director

Along with federal, state, and local agencies, the swine industry had the opportunity to exercise their response to an African swine fever outbreak during the Swine Fever Exercise for Agriculture Response in 2019. Throughout the exercise, it became apparent that the number of samples required to confirm the health status of premises within a given zone would be a significant bottleneck during a response. The number of samples required quickly outpaced the number of people authorized to collect and submit these samples. During a foreign animal disease (FAD) outbreak, not only do sample collection requirements increase, but biosecurity and downtime requirements also increase. These increased requirements would be difficult for Foreign Animal Disease Diagnosticians and swine-focused veterinarians to perform the necessary diagnostic investigations and sample collections for the large number of swine farms involved. It will also be impossible for veterinarians to perform the necessary surveillance and other regulatory tasks during an FAD response while also maintaining ongoing herd health and animal welfare programs on their farms.

To address this sample collection bottleneck, the AASV collaborated with the Center for Food Security and Public Health and Swine Medicine Education Center at Iowa State University, the National Pork Board, and the Multi-State Partnership for Security in Agriculture to develop the CSSC training program with funding from the US Department of Agriculture's National Animal Disease Preparedness and Response Program (NADPRP). The CSSC training program, a national sample collection training program, was developed to increase capacity by allowing the current on-farm labor force to assist in sample collection and submission. Through CSSC, producers, caretakers, and others on-farm become a critical asset during an FAD response. Providing a standardized process for category II accredited veterinarians to train producers, caretakers, and other on-farm employees to correctly collect, handle, and submit samples helps assure state and federal animal health officials of the CSSC's knowledge and aptitude. Program standards and other CSSC resources are available at **securepork.org/cssc**.

During 2021, several states conducted pilot projects to implement and evaluate the CSSC training program. Training continues to be introduced on a state-by-state basis. In states which have begun the CSSC program, category II accredited veterinarians train producers or caretakers, or they may train individuals identified by the state animal health official (SAHO) to help build state-level resources. Many of AASV's members have been active in providing feedback during program development as well as training their clients. However, veterinarians, SAHOs, state pork associations, and university extension personnel have identified lack of funding as one of the main barriers to implementing the CSSC program.

In July 2024, AASV received a new NADPRP grant to provide funding to stakeholders who facilitate CSSC training. Having individuals trained to assist with sample collection on farms of all sizes is essential to facilitate a faster FAD response. Collecting high quality samples on the farm and sending them to the laboratory in a timely fashion will speed up response efforts, assist with FAD diagnosis, and help facilitate business continuity for farms free of infection. Funds from this grant will help build sample collection capacity through distribution of multiple subawards to provide training to producers, caretakers, veterinary staff, extension personnel, and animal health officials. While category II accredited veterinarians are required to perform the actual training according to the CSSC program standards, other veterinarians, SAHOS, state pork associations, and university extension personnel can help organize or facilitate CSSC training to help producers of all sizes prepare for an FAD outbreak and response. Different approaches can be used to offer CSSC training, whether a group approach or on a farm-by-farm basis, and this NADPRP grant and subaward process will support that flexibility.

"Veterinarians, SAHOs, state pork associations, and extension personnel are eligible to apply for a CSSC training program subaward by submitting an application before ***October 15, 2024.****"*

Veterinarians, SAHOs, state pork associations, and extension personnel are eligible to apply for a CSSC training program subaward by submitting an application before **October 15, 2024**. All applications will be reviewed and evaluated based on the training description, training compliance with the program standards, the training evaluation process, and cost effectiveness of the training. Those stakeholders selected to receive subawards will have until October 1, 2025, to complete their CSSC training sessions. Once the CSSC training is complete, subaward recipients are required to submit a final report to receive reimbursement. For additional information on the CSSC training program funding subawards or to submit an application, visit **aasv.org** or contact Dr Pam Zaabel at **zaabel@aasv.org**.

Pam Zaabel, DVM

SEQUIVITY®
IAV-S NA

YOUR NEW WEAPON AGAINST FLU

NEW SEQUIVITY IAV-S NA vaccine works differently than past influenza A vaccines. Because it was built differently.

This one-of-a-kind influenza A vaccine for growing pigs utilizes revolutionary RNA particle technology to cut down flu with serious power. It's safe and effective – and the proven Microsol Diluvac Forte® adjuvant provides optimal immune response to help keep pigs on track.

Scan the QR code to learn more, or visit *SEQUIVITY.COM/IAVS-NA*.

TALK TO YOUR VETERINARIAN TODAY.

DRIVEN BY PREVENTION®

MERCK Animal Health

Swine industry organizations respond to H5N1 outbreak in dairy cattle

A multistate outbreak of highly pathogenic avian influenza (HPAI) Type A (H5N1) in dairy cows began on March 25, 2024, in Texas. The cross-species outbreak immediately drew the attention of pork industry organizations whose representatives began collaborating for a cohesive, coordinated - not duplicative - effort to be informed, engaged, and responsive on behalf of the pig farmers and practitioners they represent and serve.

"Since H5N1 was identified in dairy cattle, there's been constant collaboration and communication between partners in the pork industry. The National Pork Board has been meeting at least weekly with stakeholders from the Swine Health Information Center, the American Association of Swine Veterinarians, The Meat Institute, the National Pork Producers Council, the US Department of Agriculture, and others to closely monitor H5N1 updates and response within the dairy industry. These meetings give us the opportunity to discuss the potential implications and possible response," remarked Marisa Rotolo, DVM, PhD, director of swine health with the National Pork Board.

As of August 2, 2024, H5N1 has been confirmed in dairy cattle in 13 states. This includes 30 herds in Idaho, 27 in Michigan, 52 in Colorado, 23 in Texas, 13 in Iowa, 8 in New Mexico, 9 in Minnesota, 7 in South Dakota, 4 in Kansas, 2 in Oklahoma, and 1 each in North Carolina, Ohio, and Wyoming, per US Department of Agriculture Animal and Plant Health Inspection Service. To date, H5N1 has not been found in pigs.

In an opinion piece by US Secretary of Agriculture Tom Vilsack titled, Good Biosecurity Is the Key to Mitigating the Spread of H5N1, released on June 26, 2024, he wrote, "The more we learn about H5N1, the more we understand that good biosecurity is a critically important path to containing the virus. Containing, and eliminating, the virus in our dairy cattle is essential - to protect the health of our herds and flocks, our farmers, our farmworkers, our families, and the rural economy they make possible." Pork industry representatives support efforts being made by the dairy and poultry sectors, while looking for lessons in their experience to apply in the event it is needed for pigs.

Collaboration is critical

Collaboration is critical for preparedness and response, not only with other pork organizations, but within the barnyard and beyond. "We have those relationships in place and communicate almost daily with our colleagues in other pork organizations, and frequently with those working in animal health, human health, and the regulatory space," said Abbey Canon, DVM, MPH, DACVPM, director of public health and communications with the American Association of Swine Veterinarians.

Part of AASV's mission is to increase the knowledge of swine veterinarians, protect and promote the health and well-being of pigs, and advocate science-based approaches to veterinary, industry, and public health issues. Dr Canon says the organization strives to disseminate the most up-to-date information that swine veterinarians need and can use or distribute to their clients.

Leveraging lessons learned

Preparing for and responding to livelihood-damaging endemic and emerging swine disease, including influenza, is nothing new for the pork industry. "The pork industry is not a stranger to managing new and novel influenza strains. We learned a lot from H1N1 in 2009, which resulted in a lot of good planning between industry stakeholders and federal and state government agencies which can serve as the foundation for a measured and appropriate response to the introduction of different strains in the future," remarked Dr Patrick Webb, assistant chief veterinarian with the National Pork Board.

Existing preparedness programs developed for the swine industry serve multiple purposes. "While the swine industry has had a particular focus on African swine fever and other foreign diseases, much of this work and preparation benefits current conversations about H5N1. Examples include enhanced biosecurity protocols as part of the Secure Pork Supply plan, development of the Certified Swine Sample Collector program to improve our surveillance capacity, and improvements to live swine traceability with the swine traceability standards supported by producers at National Pork Forum. The industry recognizes that there are multiple threats to swine health and in response, has invested time, money and resources into improving our readiness,» explained Anna Forseth, DVM, MS, director of animal health with the National Pork Producers Council.

"The swine industry has been monitoring the evolving H5N1 situation closely. We know that new or novel strains of a virus can raise questions and activity beyond how it impacts the animals themselves, including regulatory action and impacts to trade. As we watch the dairy industry's experience, we are engaging in conversations with state and federal regulators, public health officials, diagnostic laboratories, and trading partners to educate decision makers about the swine industry," Dr Forseth said.

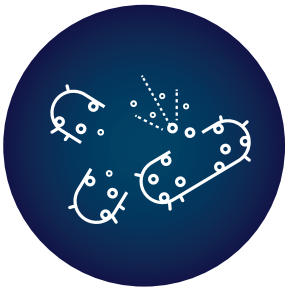
Informing the pork industry's preparedness and response

The Swine Health Information Center (SHIC) was founded in 2015, after the porcine epidemic diarrhea virus outbreak of 2013 when resources and response were determined to be inadequate. Resulting work of the Center has informed the industry's response, preparation, and preparedness efforts surrounding emerging disease issues, including H5N1.

Advocacy continued on page 201

Pradalex works by simultaneously binding and inactivating both **DNA gyrase** and **topoisomerase IV**, inhibiting bacterial replication.

This causes the chromosome to fragment and results in rapid cell death.



INTRODUCING PRADALEX™

THE NOVEL MOA

- **Equal affinity for DNA gyrase and topoisomerase IV**
- **Equal affinity for gram positive and gram negative bacteria**
- **High C_{max} + fast T_{max} = short $T_{½}$**
- **Only minutes in the Mutant Selection Window**

A NEW SRD POWERHOUSE

Learn more at: *farmanimal.elanco.com/us/campaign/pradalex-about*

The label contains complete use information, including cautions and warnings. Always read, understand and follow the label and use directions.

IMPORTANT SAFETY INFORMATION: CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian. Not for use in humans. Keep out of reach of children. Avoid contact with eyes and skin. Individuals with a history of hypersensitivity to quinolones should avoid this product. Not for use in animals intended for breeding because the effects of Pradalex on swine reproductive performance, pregnancy and lactation have not been determined. Not for use in nursing piglets because safety and effectiveness have not been demonstrated. Quinolones should be used with caution in animals with known or suspected central nervous system (CNS) disorders. Mild to moderate inflammatory changes of the injection site may be seen in swine treated with Pradalex. See package insert for additional safety information.

Advocacy continued from page 199

"The recent detection of HPAI in domestic livestock raised questions regarding the emerging threat and potential risks for swine herds. The Swine Health Information Center, along with the American Association of Swine Veterinarians, hosted a webinar April 19, 2024, on influenza A viruses, with the goal of informing producers about influenza A virus pathogenesis, distribution, surveillance and research including the H5N1 outbreak. The webinar highlighted practical steps producers could take to reduce the risk of avian influenza on their farms, with a focus on biosecurity considerations to decrease wild bird access, and outlined the outbreak investigation tools available through SHIC for use during suspected health challenges," explained Megan Niederwerder, DVM, PhD, executive director of SHIC.

The Center provides additional tools for practitioners and producers to employ in preparedness efforts as well. "Swine producers and their veterinarians are very familiar with surveillance and management of influenza A viruses in their herds and the detection of H5N1 in dairy cattle highlights the continued importance for IAV surveillance. The Swine Disease Reporting System, funded by SHIC, provides information and tools that can be applied for use in decision making on farms. Monthly domestic disease monitoring reports detail the detection of influenza A virus across six veterinary diagnostic laboratories and represent > 96% of US swine sample submissions, enabling producers to rapidly detect new viruses, track changes over time and by region, and inform decisions for management strategies," stated Lisa Becton, DVM, MS, DACVPM, associate director of SHIC.

One Health perspective incorporated in collaboration

Influenza has indeed been present in the US swine industry for decades with multiple strains impacting herds. "AASV recommends pork producers, swine veterinarians and diagnostic laboratories actively participate in IAV surveillance programs that provide information regarding influenza A virus evolution and epidemiology. Participation in these surveillance programs can help identify and quickly respond to emerging threats with early detection," stated Dr Canon. "Further, AASV supports the recommendation that people working with swine take all available precautions, including vaccination (with their human health professional's approval), biosecurity, and personal protection measures to work towards prevention of bidirectional influenza transmission. It is important to consider cross-species transmission of influenza viruses as part of a One Health approach."

Following the discovery of H5N1 in dairy herds, four human cases of the influenza strain have been detected in people, per the US Centers for Disease Control and Prevention. "This is a great reminder for the industry of how important our seasonal flu shots are. Since pigs can contract influenza strains from humans, keeping workers healthy also keeps pigs healthy. Everyone who works with pigs should be getting their annual flu shot," commented Dr Heather Fowler, public health veterinarian, director of producer and public health with the National Pork Board.

Preparing for outbreak together

"The current influenza outbreak is a great example of how important a One Health approach is when dealing with illnesses that affect both humans and animals in a shared environment. Since the identification of the H5N1 virus in dairy cattle, the National Pork Board has been working collaboratively with partners across the barnyard to help us prepare if we were to have an introduction of H5N1 into the swine herd," said Dr Fowler.

"The swine industry already has extensive knowledge and experience when it comes to flu management and monitoring. We have multiple programs that can be quickly deployed should H5N1 be detected in swine," Dr Rotolo observed. Existing programs combined with intentional preparedness efforts equip the pork industry to deploy an effective response to H5N1 in the US swine herd if needed.

Peer reviewed **ORIGINAL RESEARCH**

Description of practices adopted in response to porcine reproductive and respiratory syndrome outbreaks among breeding herds in the United States from 2019-2021

Rodrigo C. Paiva, DVM, MBA, MS; Christopher Rademacher, DVM; Tina Peterson, BS; Ana Paula S. P. Silva, DVM, MS, PhD; Gustavo S. Silva, DVM, MS, PhD; Daniel C. L. Linhares, DVM, MBA, PhD; Giovani Trevisan, DVM, MBA, PhD

Summary

Objectives: Describe and benchmark strategies and practices used in the field across the United States to control and eliminate porcine reproductive and respiratory syndrome (PRRS) virus in response to PRRS outbreaks from 2019 to 2021.

Materials and methods: A voluntary survey was used to collect information on practices implemented in response to PRRS outbreaks in different herds from 2019 to 2021. Information about herd demographic characteristics, biomanagement practices, diagnostic test and testing results, and production data were collected, collated, standardized, and described according to the herd's outbreak characteristics.

Results: A diversity of biomanagement practices were observed among 86 herd outbreaks. The median time to stability (TTS) was 38.0 weeks (interquartile range (IQR), 32.0-49.0 weeks), and time to baseline productivity (TTBP) was 22.0 weeks (IQR, 15.0-26.0 weeks). The median total production losses (TL) was 3675 pigs per 1000 sows (IQR, 2356-6845 pigs per 1000 sows); TTS and TTBP were longer and TL higher than a study reported ten years ago (26.6 weeks, 16.5 weeks, and 2217 pigs/1000 sows, respectively). Herd closure strategy, herd interventions such as live virus inoculation and modified-live virus vaccine, and biomanagement strategies to reduce virus transmission among sows and pigs were inconsistent among the studied herds.

Implications: Under the conditions of this study, management practices used during PRRS outbreaks were highly diverse among herds. In addition, herd closure, interventions, and biomanagement strategies were inconsistent. The TTS and TTBP were longer, and TL was higher than reported 10 years ago.

Keywords: swine, porcine reproductive and respiratory syndrome virus, benchmarking, time to stability, total loss

Received: August 29, 2023
Accepted: February 19, 2024

Resumen - Descripción de las prácticas adoptadas en respuesta a los brotes de síndrome reproductivo y respiratorio porcino en las piaras de cría en los Estados Unidos entre 2019 y 2021

Objetivos: Describir y comparar las estrategias y prácticas utilizadas en el campo en los Estados Unidos para controlar y eliminar el virus del síndrome reproductivo y respiratorio porcino (PRRS) en respuesta a los brotes de PRRS de 2019 a 2021.

Materiales y métodos: Se utilizó una encuesta voluntaria para recopilar información sobre las prácticas implementadas en respuesta a los brotes de PRRS en diferentes piaras entre 2019 y 2021. Se recopiló, cotejó, estandarizó y describió la información sobre las características demográficas de la piara, las prácticas de biomanejo, las pruebas diagnósticas y los resultados de las pruebas, y los datos de producción de acuerdo con las características del brote de la piara.

Resultados: Se observó una diversidad de prácticas de biomanejo entre 86 brotes en las piaras. La mediana del tiempo hasta la estabilidad (TTS) fue de 38.0 semanas (rango intercuartílico [RIC], 32.0-49.0 semanas) y el tiempo hasta la productividad basal (TTBP) fue de 22.0 semanas (RIC, 15.0-26.0 semanas). La mediana de las pérdidas totales de producción (LT) fue de 3675 cerdos por cada 1000 cerdas (RIC, 2356-6845 cerdos por cada 1000 cerdas); la TTS y la TTBP fueron más largas y la LT más alta que un estudio reportado hace diez años (26.6 semanas, 16.5 semanas, y 2217 cerdos/1000 cerdas, respectivamente). La estrategia de cierre de granja, las intervenciones en la piara, como la inoculación con virus vivo y la vacunación con virus vivo modificado, y las estrategias de biomanejo para reducir la transmisión del virus entre hembras y lechones fueron inconsistentes entre las piaras estudiadas.

Implicaciones: En las condiciones de este estudio, las prácticas de manejo utilizadas durante los brotes de PRRS fueron muy diversas entre las piaras. Además, el cierre de la granja, las intervenciones y las estrategias de biomanejo fueron inconsistentes. El TTS y el TTBP fueron más largos, y el TL fue más alto que el reportado hace 10 años.

Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, Iowa.

Corresponding author: Dr Daniel C. L. Linhares, 2203 Lloyd Veterinary Medical Center, Ames, IA, 50011; Tel: 515-294-9358; Email: **linhares@iastate.edu**

Paiva R, Rademacher C, Peterson T, Silva A, Silva G, Linhares D, Trevisan G. Description of practices adopted in response to porcine reproductive and respiratory syndrome outbreaks among breeding herds in the United States from 2019-2021. *J Swine Health Prod*. 2024;32(5):202-212. **https://doi.org/10.54846/jshap/1384**

Résumé – Descriptions des procédures adoptées en réponse à des poussées de cas du syndrome reproducteur et respiratoire porcin dans des troupeaux de reproducteurs aux États-Unis pour la période 2019-2021

Objectifs: Décrire et comparer les stratégies et pratiques utilisées sur le terrain aux États-Unis pour limiter et éliminer le virus du syndrome reproducteur et respiratoire porcin (SRRP) en réponse aux épidémies de SDRP de 2019 à 2021.

Matériels et méthodes: Une enquête volontaire a été utilisée pour collecter des informations sur les pratiques mises en œuvre en réponse aux épidémies de SRRP dans différents troupeaux de 2019 à 2021. Des informations sur les caractéristiques démographiques des troupeaux, les pratiques de biogestion, les tests de diagnostic et les résultats des tests, ainsi que les données de production ont été collectées, rassemblées, standardisées et décrits selon les caractéristiques épidémiques du troupeau.

Résultats: Une diversité de pratiques de biogestion a été observée parmi 86 troupeaux avec épidémie. Le délai médian jusqu'à la stabilité (TTS) était de 38.0 semaines (intervalle interquartile (IQR), 32.0-49.0 semaines) et le délai jusqu'à la productivité de base (TTBP) était de 22.0 semaines (IQR, 15.0-26.0 semaines). Les pertes de production totales médianes (TL) étaient de 3675 porcs pour 1000 truies (IQR, 2356 à 6845 porcs pour 1000 truies); le TTS et le TTBP étaient plus longs et le TL plus élevé qu'une étude rapportait il y a dix ans (26.6 semaines, 16.5 semaines, et 2217 porcs/1000 truies, respectivement). La stratégie de fermeture des troupeaux, les interventions dans les troupeaux telles que l'inoculation de virus vivants et le vaccin à virus vivant modifié, ainsi que les stratégies de biogestion visant à réduire la transmission du virus entre les truies et les porcs variaient parmi les troupeaux étudiés.

Implications: Dans les conditions de cette étude, les pratiques de gestion utilisées lors des épidémies de SRRP étaient très diverses selon les troupeaux. De plus, la fermeture des troupeaux, les interventions et les stratégies de biogestion n'étaient pas constante. Le TTS et le TTBP étaient plus longs et le TL était plus élevé que celui signalé il y a 10 ans.

Porcine reproductive and respiratory syndrome (PRRS) is an endemic and devastating disease in most swine-producing regions worldwide.[1] The PRRS virus (PRRSV) can persist in individuals and pig populations for several months.[2] Acute disease outbreaks are common and associated with new virus introduction and lack of appropriate herd immunity.[3] Porcine reproductive and respiratory syndrome is among the diseases with the highest economic impact in modern pig production,[4] with generalized estimated annual production losses of $664 million in the United States and $150 million in Canada.[5,6] Different immunologic solutions, including live virus inoculation (LVI) and modified-live virus (MLV) vaccines, or a combination of both, have been used to reduce the impact of PRRSV on production in breeding herds.[7,8]

The time to stability (TTS), defined as the number of weeks to produce negative pigs at weaning, and the total production losses (TL), defined as number of pigs weaned below the herd-specific baseline, normalized by 1000 sows, may be correlated with different PRRS management practices and virus characteristics.[7-9] The use of LVI as part of a whole-herd exposure program to control and eliminate PRRSV contributed to shortening TTS compared to using an MLV vaccine.[8] Intervention with MLV vaccine has been demonstrated to reduce the duration of viral shedding.[10] In addition, breeding herds detected with three or more PRRSV strains or the presence of recombinant variants were associated with increased TTS and TL.[9] Although different interventions have been reported in response to PRRS outbreaks, the results of management practices vary and have been inconsistent across studies.[7,10-12]

Among different biosecurity and management strategies, herd closure, with or without whole-herd exposure (eg, MLV or LVI), is a common practice in North America to manage PRRSV infection in breeding herds.[13] Herd closure is the interruption of animal introduction (eg, replacement gilts) for a determined period (usually until the herd achieves stability); the combined implementation of herd closure and whole-herd exposure using MLV vaccination or LVI is often referred to as load-close-expose.[8,11,14] The concept of load-close-expose is that pig introduction into a breeding herd is interrupted until the pathogen's infection cycle ends; most often when PRRSV is no longer detected in pigs at weaning age,[8,15] The principle is to prevent the introduction of susceptible pigs that, when in contact with PRRSV, become infected and disseminate the virus within the herd, thus perpetuating the within-farm infection.[15]

Despite significant progress in understanding interventions to manage PRRSV infection, achieving consistent results in endemically infected herds varies with no unique or completely effective intervention identified.[1,16] An understanding of practices implemented in the field may help veterinarians and producers standardize PRRS management and control strategies. This study aimed to describe and benchmark strategies and practices used in the field across the United States to control and eliminate PRRSV in response to a PRRS outbreak.

Animal care and use

This study was approved by the Iowa State University Institutional Animal Care and Use Committee under protocol number 19-118. The data was shared anonymously, and disclosure of responses outside the research will not place participants at risk of harm.

Materials and methods

Overview

A voluntary survey was used to collect information on practices implemented in response to a PRRS outbreak in different herds. Herd veterinarians were contacted between 2019 and 2021 and were asked to voluntarily share herd demographic characteristics, biomanagement practices, diagnostic test and testing results, and production data. All collected, collated, and standardized data were described according to the herd's outbreak characteristics.

Eligibility and exclusion criteria

The eligibility criteria included swine breeding herds reporting a PRRS outbreak, working on a plan to manage the infection, and tracking the recovery

from the outbreak using diagnostic testing and productivity data monitoring. A PRRS outbreak was characterized by RNA detection using reverse transcription-quantitative polymerase chain reaction (RT-PCR) and clinical signs of PRRS observed by the veterinarian (eg, increase in abortions, increase in sow mortality, increase in the number of stillborn piglets). The respective herd veterinarians were asked to complete a survey with information on herd demographic characteristics and the interventions implemented in response to the PRRS outbreak. The veterinarians were encouraged to revise the survey quarterly until the herd achieved the desired status according to the American Association of Swine Veterinarians' (AASV) recommendations for PRRSV herd classification.[17,18]

The exclusion criteria included events that would impact the study's outcomes, such as outbreaks of other diseases (eg, porcine epidemic diarrhea), a second PRRS outbreak before achieving stability, or a ≥ 20% change in sow inventory due to factors unrelated to the PRRS outbreak.

Survey and data collection

An Excel-based survey was developed to collect data on the practices implemented in response to PRRS outbreaks (Table 1). Herd demographic characteristics, veterinarians' contact information, and immunologic solutions for gilts and sows were collected. Biomanagement practices adopted, eg, management changes to reduce exposure to bacteria to eliminate losses (McREBEL) like practices,[19] were collected from the herds seeking PRRSV stability. Veterinarians received the survey via email, and follow-up emails and phone calls were used to keep in touch about the initial information provided and interventions applied in the herds until the desired AASV classification status was achieved. All herd-specific information regarding the survey and interventions applied was confirmed after achieving the desired status. An Iowa State University consent form of participation, data handling, and confidentiality was signed to assure agreement and data protection for all parties. Data were collected from farms located in Iowa, Nebraska, Oklahoma, Minnesota, Illinois, Indiana, Texas, Ohio, Colorado, and Kansas.

Monitoring, PRRSV classification, and diagnostic data

Herds were monitored for PRRSV weekly using PRRSV RNA detection by RT-PCR from processing fluid (PF) samples. Processing fluids are obtained from the serosanguinous fluid recovered from piglet castration and tail docking.[20] The veterinarian submitted one pool of PF per week to Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) or the University of Minnesota Veterinary Diagnostic Laboratory (UMN VDL) until the desired AASV herd classification status was achieved. The herds were classified following recommendations from the AASV PRRS classification[17,18]: positive unstable (I), positive stable (II-A), positive stable (II-B [undergoing elimination]), provisional negative (III), and negative (IV). Diagnostic data were shared through the ISU VDL or UMN VDL client web interface applications, and combined data was accessed through the Animal Health Monitoring and Evaluation System (**www.vdl.iastate.edu**) using a standardized and consistent methodology.

TTS, TL, and time to baseline productivity analysis

Three recovery metrics were used in this study: TTS, time to baseline productivity (TTBP), and TL. For each PRRS outbreak, TTS was declared when the herd reached 8 consecutive weeks without PRRSV RNA detection by RT-PCR in weekly PF samples. Time to baseline productivity was defined as the number of weeks the herd took to recover to the number of pigs weaned per week prior to the PRRS outbreak and was calculated using an exponentially weighted moving average with 3 sigmas, 0.4 lambda, and a baseline of 21 weeks prior to the outbreak following a previously reported methodology.[8] The severity of the PRRS outbreak was defined by TL and calculated as the number of pigs weaned below the herd-specific baseline, normalized by 1000 sows from the initial PRRS outbreak to when the herd returned to TTBP.

At 1 to 4 weeks after the PRRS outbreak, the virus was classified according to restriction fragment length polymorphisms and lineages, both based on the open reading frame-5 gene as previously described.[21-23]

Table 1: Survey blocks and requested information about each porcine reproductive and respiratory syndrome (PRRS) outbreak

Survey blocks	Survey information requested	Type of data
Herd demographics information	Herd size (inventory of mated sows)	Farm and veterinarian information captured to follow up until the herd achieved the desired status
	Sow genetics	
	Farm address, state	
	Name of the herd veterinarian	
	Email of the herd veterinarian	
	Phone number of the herd veterinarian	
Information about the PRRS outbreak	Date of previous outbreak	PRRS virus information collected according to current outbreak
	Date of current outbreak	
	Plan for the current outbreak (control or control and eliminate)	
	Accession ID information from the PRRS virus sequencing test	
	Restriction fragment length polymorphisms	
	Open reading frame-5	
	PRRS herd status (AASV classification)	

Table 1: Continued

Immunologic solutions for gilts and sows	Type of whole herd exposure Date of whole herd exposure Age of groups exposed Route of exposure Dose of exposure Number of doses	Information about the type of immunologic solution (live virus inoculation or modified-live virus) used in the current outbreak
Breeding herd flow and herd closure	Implementation of herd closure Date of herd closure Age of youngest gilt at time of herd closure Source of gilts	Gilt flow-related question about implementation or not of herd closure (Yes or No)
Biomanagement strategies	Nurse sows allowed from within a farrowing room. Strict all-in/all-out practice with sows and piglets in farrowing Needle changed between every sow/gilt in the breeding herd when giving injections (vaccines or treatment) Discontinuation of prefarrowing tissue/scour feedback practices Discontinuation of prebreeding tissue/scour feedback practices Cross fostering allowed before 24 hours Poor-doing piglets are euthanized when clinically unresponsive to a repeated treatment (2nd treatment and no response) Pigs that are very thin, lethargic, gaunt, moribund or lightweight, and depressed are euthanized immediately Pigs are worked from youngest to oldest Use of warming tubs/split suckle boxes individually per litter Use of processing carts not allowed Personnel should not step into the farrowing crates to perform anymanagement procedures Change/disinfection of needles and blades between litters when processing Farrowing crates washed and with dry time between litters Alleys in farrowing rooms are cleaned and disinfected Hallways and alleys between rooms are cleaned and disinfected daily Personnel caring for youngest room(s) of pigs are dedicated to those room(s) and are not allowed to enter other rooms Personnel are required to change boots upon entry into each farrowing room Personnel are required to change coveralls upon entry into each farrowing room Personnel are required to wash hands upon entry into each farrowing room Boot baths with fresh disinfectant are used at the entry of farrowing rooms	Biomanagement strategies captured from herds seeking stability from scale 1 to 5, where 1 is not implemented at all and 5 is fully implemented.

Results

Overview

Eighty-six herds experiencing a PRRS outbreak were enrolled in this study, with each herd followed until the desired PRRS herd status was achieved. All the herds provided information about intervention characteristics (Table 2), and 35 herds (40.7%) reported biomanagement practices (Figures 1, 2, and 3). The mean herd size was 3902 sows (range, 765-12,694 sows). Different interventions used to control and reduce losses were identified and described in the survey responses. There was great variation in the interquartile ranges for TTS, TTBP, and TL (Table 3) among herds. No herds met the exclusion criteria defined for this study.

Descriptive results

The states represented by participating herds are presented in Figure 4. Descriptive results of herd characteristics, response levels, and the number of herds in each of the categories are presented in Table 2.

Biomanagement strategies

Forty percent of the respondents (35 of 86) reported recommending and implementing biomanagement strategies to minimize PRRSV transmission among sows and piglets. Figures 1, 2, and 3 demonstrate the level of biomanagement practice implementation within each herd according to the veterinarian respondents, with none being considered as no practice implemented at all, 25%, 50%, and 75% as a percentage of practice implemented over the period of the outbreak, and fully implemented as implemented until achieving PRRSV stability.

Discussion

The median TTS (38.0 weeks), TTBP (22.0 weeks), and TL (3675 pigs/1000 sows) were higher than previously reported in 2014 (26.6 weeks, 16.5 weeks, and 2217 pigs/1000 sows, respectively).[8] The longer TTS may be related to more representation of sampling methods used for PRRSV monitoring (eg, PF) within the herd population in this study compared to ten years ago, where serum from a finite number of animals was used.[20,24,25] In addition, the longer TTS and TTBP and higher TL in this study might be associated with changes in herd size, production flow, PRRSV variants, and other variables not assessed in this study. The number of PRRSV strains and recombination events have been reported to be associated with longer TTS and higher TL.[9] The numerical range of TTS, TTBP, and TL and the variability of practices implemented in the field to control or control and eliminate PRRSV reported in this study emphasize the need to better understand best practices to minimize the PRRSV impact in breeding herds.

Responders who reported seeking elimination and herd closure implementation as part of the PRRSV control and elimination plan varied among the herds. The implementation of herd closure has been reported to control and eliminate PRRSV at the farm level.[14] Beyond herd closure implementation, the PRRSV control and elimination program has been associated with closed-herd internal multiplication, negative gilts introduced into a negative herd, focus on biosecurity methods, use of PRRSV-negative semen, and single-source pig flow.[26] Despite reported rules of success for PRRSV control and elimination, this descriptive study has shown that PRRS management is complex, including desired AASV herd PRRSV classification status and strategies to achieve TTS.

One participant reported using a two-week batch flow, and 3 participants reported using a four-week batch flow as part of a strategy to improve biocontainment and reduce PRRSV transmission through better all-in/all-out management and farrowing room disinfection between batches. Batch farrowing management allows fixed-interval mating groups of sows of equal size, leading to all-in/all-out pig management in which animals in different batches have no contact,[27] and may help to control herd health status.[28-30] The reported median TTS of herds operating in a four-week batch system was 27 weeks.[31] The use of a batch system may be an opportunity to shorten TTS and reduce TL in breeding herds facing a PRRS outbreak.

The interventions used with sows and gilts reported in this study were inconsistent across different herd outbreaks. The use of LVI, MLV, or a combination of LVI and MLV in sows was similarly reported. Different management procedures for PRRSV control at the farm level have been previously reported,[7,8,10,14,15,26] and the use of PRRS MLV vaccines has been predominant in the US breeding herd.[11,32,33] The use of LVI, preparation and administration of LVI, the timing of interventions, and timing of MLV use are practices and interventions that might change according to the control and elimination strategy adopted by the veterinarian. Still, there are limitations regarding intervention assessment and a better understanding of all these factor combinations is needed.

The survey used in this study included various questions regarding biomanagement strategies to reduce virus transmission between sows and piglets. The results were inconsistent among participants. Studies have highlighted the importance of biomanagement practices to avoid PRRSV transmission[1,14,34] and practices, such as limiting cross fostering and avoiding mixing animals from different litters, on PRRSV-positive farms to optimize production have been reported.[35] Biomanagement protocols based on the McREBEL pig flow management implementation system have been reported as an important piece of PRRSV control and elimination.[19,36]

The reported biomanagement strategies adopted following PRRS outbreaks were variable. Biomanagement refers to management practices to mitigate the transmission of pathogens between animals within the same population.[25] In addition, identifying a farm's weak points, prioritizing the items to be improved first, and constantly revising and auditing the implemented biosecurity and biomanagement strategies were essential to prevent and control virus transmission within and among large herds.[32] The variety of biomanagement practices reported in this study demonstrated the need for more consistency among the herds after a PRRS outbreak.

Implications

Under the conditions of this descriptive study:

- Management practices used during PRRS outbreaks were highly diverse among herds.
- Herd closure, interventions, and biomanagement strategies were inconsistent.
- The TTS and TTBP were longer and TL higher than reported 10 years ago.

Table 2: Intervention characteristics used in herds experiencing a porcine reproductive and respiratory syndrome (PRRS) outbreak in this study

Characteristic	Response levels	Number of herds
Targeted management plan	PRRSV control	30
	PRRSV elimination	56
Herd closure	Yes	52
	No	34
Management flow	Weekly batch	82
	Bi-weekly batch	1
	Four-weekly batch	3
AASV classification status at the PRRS outbreak	Positive unstable (I)	21
	Positive stable II-A	15
	Positive stable II-B	24
	Provisional negative	10
	Negative	16
Interventions following the outbreak implemented in gilts	LVI	25
	MLV	24
	LVI + MLV	23
	None	14
Route of gilts exposure	Intramuscular	72
	Intranasal	0
Dose of exposure in gilts	Full dose	72
	Half dose	0
Number of exposure doses in gilts	One intervention	5
	Two interventions	67
	Three interventions	0
Interventions following the outbreak implemented in sows	LVI	27
	MLV	28
	LVI + MLV	24
	None	7
Groups of exposure	All animals in the herd	1
	All breeding females	77
	Group gestation	1
Route of exposure in sows	Intramuscular	79
	Nasal	0
Dose of exposure in sows	Full dose	79
	Half dose	0
Number of exposure doses in sows	One intervention	45
	Two interventions	31
	Three interventions	3

Table 2 continued on page 208

Table 2: Continued

PRRSV Lineage and RFLP	L1A of RFLPs 1-10-4, 1-1-2, 1-1-4, 1-3-4, 1-4-3, 1-6-4, 1-7-2, or 1-7-4	40
	L1H of RFLPs 1-4-4, 1-7-4, 1-8-3, or 1-8-4	17
	L1C.5 (L1C variant) of RFLP 1-4-4	15
	L1C of RFLP 1-2-4, 1-3-2, or 1-4-4	9
	L1E of RFLP 1-3-2 or 1-4-2	2
	L1G of RFLP 1-18-2	1
	L5 of RFLP 2-5-2	1
	Inconclusive	1

PRRSV = porcine reproductive and respiratory syndrome virus; AASV = American Association of Swine Veterinarians; LVI = live virus inoculation; MLV = modified-live virus; RFLP = restriction fragment length polymorphisms.

Figure 1: Level of biomanagement practices implemented within each herd after the outbreak to avoid porcine reproductive and respiratory syndrome virus transmission among sows.

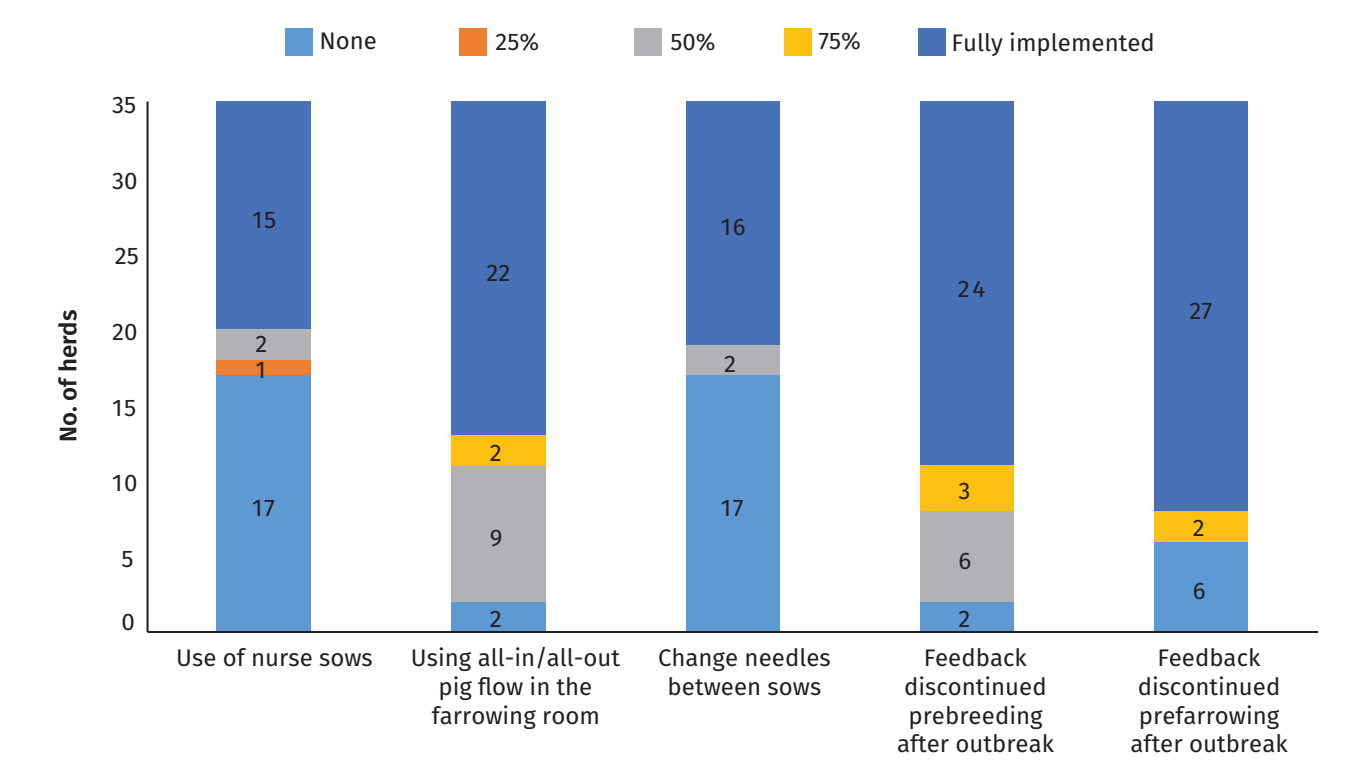
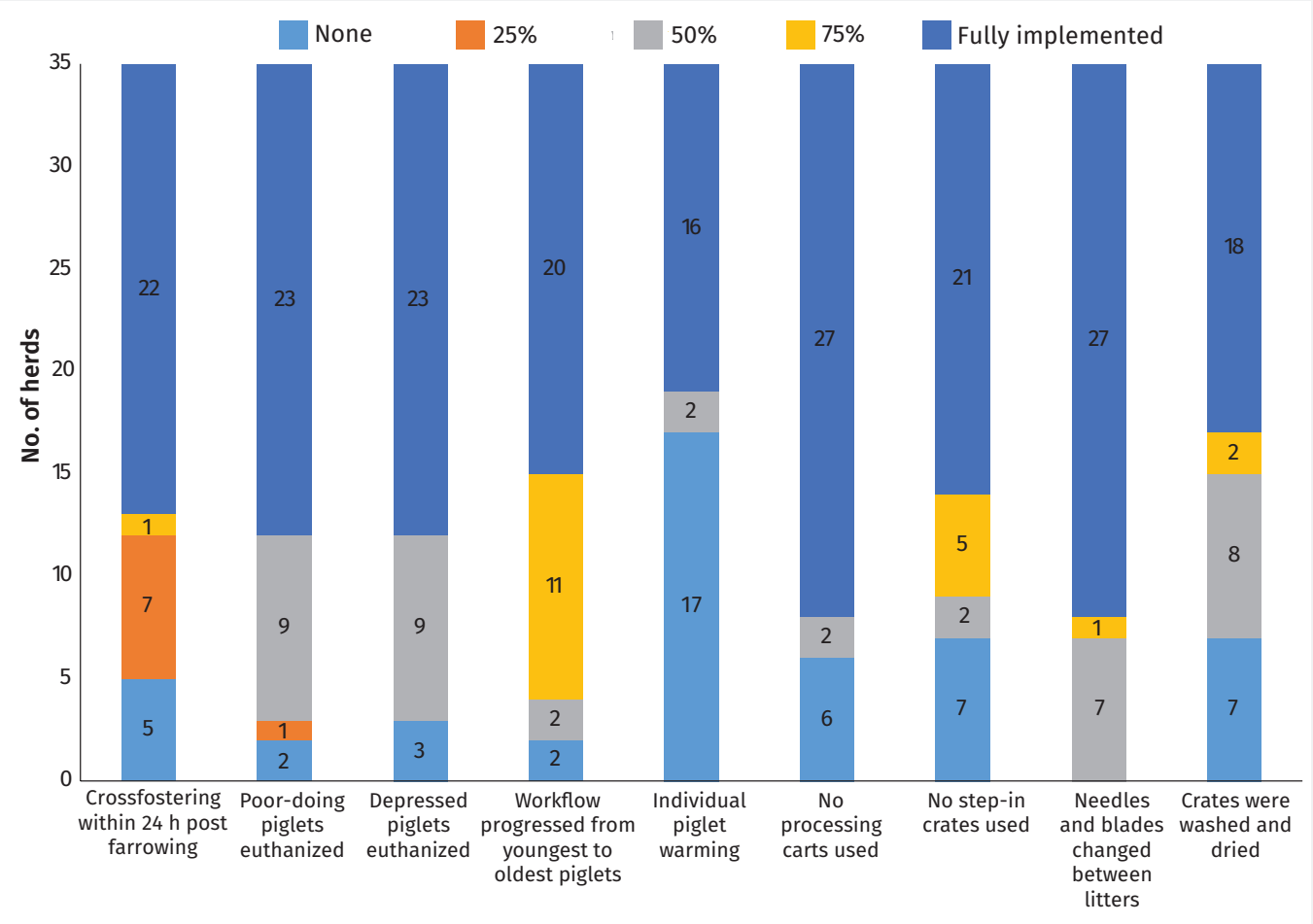


Figure 2: Level of biomanagement practices implemented within each herd after the outbreak to mitigate porcine reproductive and respiratory syndrome virus transmission among piglets.



Acknowledgments

The authors acknowledge the veterinarians and producers for their support and cooperative data provided for this study. This study was supported by the Iowa Pork Producers Association grant No. 20-109 IPPA and by Boehringer Ingelheim Animal Health.

Conflict of interest

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Disclaimer

Dr Linhares, a member of this journal's editorial board, was not involved in the editorial review of or decision to publish this article.

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

References

1. Zimmerman JJ, Dee SA, Holtkamp DJ, Murtaugh MP, Stadejek T, Stevenson GW, Torremorell M, Yang H, Zhang J. Porcine reproductive and respiratory syndrome viruses (Porcine Arteriviruses). In: Zimmerman JJ, Karriker LA, Ramirez A, Schwartz KJ, Stevenson GW, Zhang J, eds. *Diseases of Swine*. 11th ed. Wiley & Sons; 2019:685-708. **https://doi.org/10.1002/9781119350927.ch41**

2. Arruda AG, Friendship R, Carpenter J, Hand K, Ojkic D, Poljak Z. Investigation of the occurrence of porcine reproductive and respiratory virus in swine herds participating in an area regional control and elimination project in Ontario, Canada. *Transbound Emerg Dis*. 2017;64:89-100. **https://doi.org/10.1111/tbed.12343**

3. Rowland RRR, Morrison RB. Challenges and opportunities for the control and elimination of porcine reproductive and respiratory syndrome virus. *Transbound Emerg Dis*. 2012;59:55-59. **https://doi.org/10.1111/j.1865-1682.2011.01306.x**

4. Lunney JK, Benfield DA, Rowland RRR. Porcine reproductive and respiratory syndrome virus: An update on an emerging and re-emerging viral disease of swine. *Virus Res*. 2010;154:1-6. **https://doi.org/10.1016/j.virusres.2010.10.009**

5. Holtkamp DJ, Kliebenstein JB, Neumann E, Zimmerman JJ, Rotto H, Yoder TK, Wang C, Yeske P, Mowrer CL, Haley C. Assessment of the economic impact of porcine reproductive and respiratory syndrome virus on United States pork producers. *J Swine Health Prod*. 2013;21:72-84. **https://doi.org/10.54846/jshap/754**

*6. Mussell A, Oginskyy A, Grier K, Morin M, Lachance M, Whittington L, Friendship R. A risk, benefit, strength, weakness, opportunity and threat analysis for the control and possible eradication of porcine reproductive and respiratory syndrome (PRRS) virus within the Canadian swine herd. *Canadian Swine Health Board Report*. 2011:1–122.

Figure 3: Level of biomanagement practices implemented within each herd after the outbreak to avoid porcine reproductive and respiratory syndrome virus transmission among rooms.

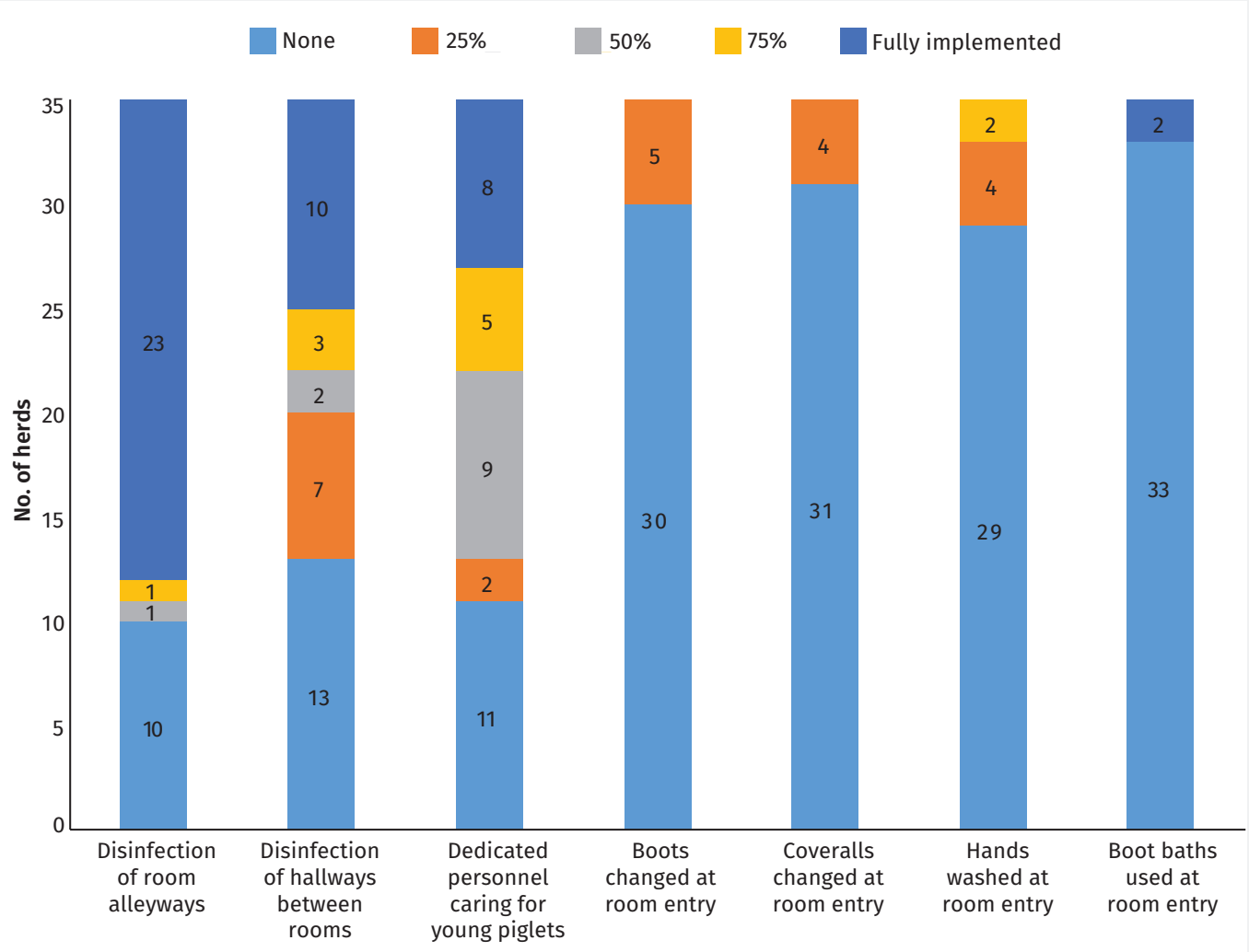
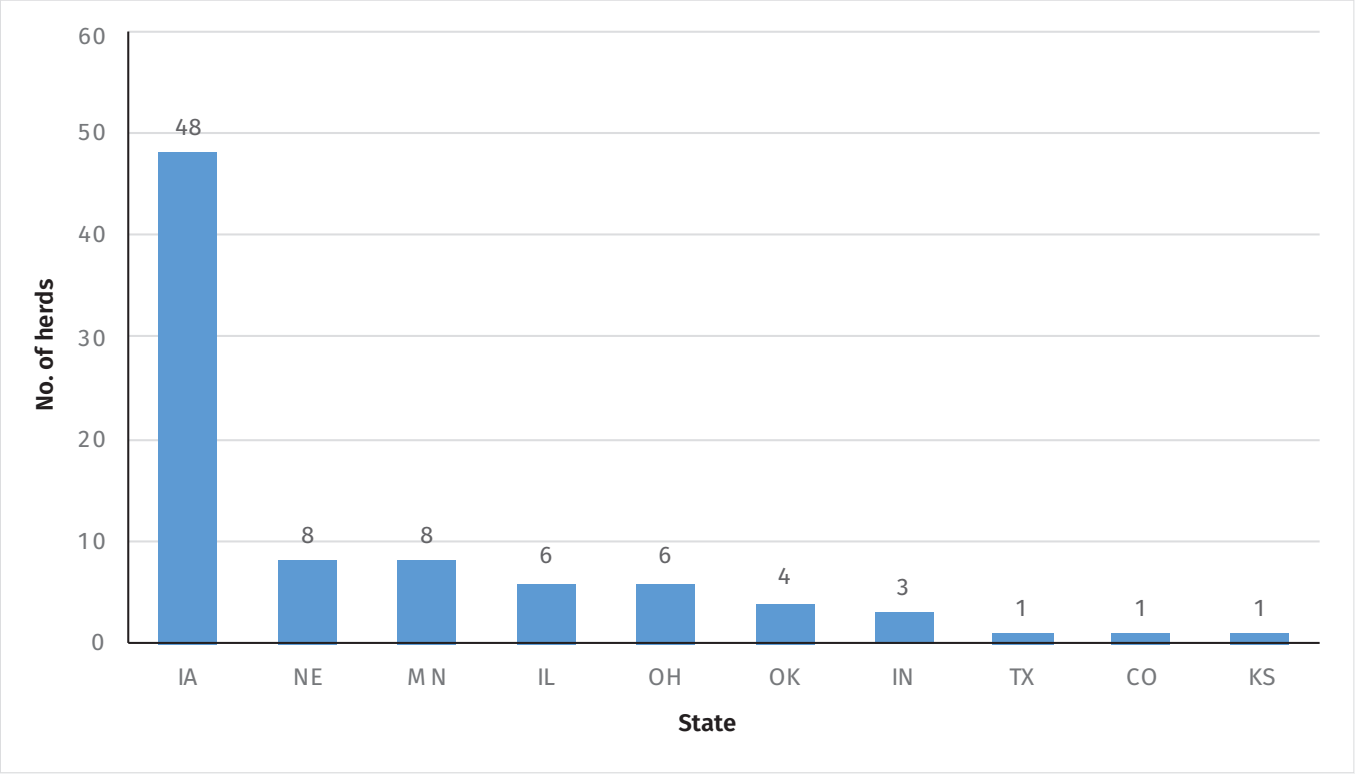


Table 3: The median and interquartile for TTS, TTBP, and TL of herds experiencing a PRRS outbreak, 2019 to 2021

Categories	TTS, wk	TTBP, wk	TL, pigs/1000 sows
First quartile	32.0	15.0	2356
Median	38.0	22.0	3675
Third quartile	49.0	26.0	6845

TTS = time to stability; TTBP = time to baseline productivity; TL = total losses; PRRSV = porcine reproductive and respiratory syndrome virus.

Figure 4: States represented in this study by participating herds



7. Linhares DCL, Betlach C, Morrison RB. Effect of immunologic solutions on sows and gilts on time to stability, and production losses in breeding herds infected with 1-7-4 PRRSV. *Prev Vet Med*. 2017;144:112-116. **https://doi.org/10.1016/j.prevetmed.2017.05.024**

8. Linhares DCL, Cano JP, Torremorell M, Morrison RB. Comparison of time to PRRSV-stability and production losses between two exposure programs to control PRRSV in sow herds. *Prev Vet Med*. 2014;116:111-119. **https://doi.org/10.1016/j.prevetmed.2014.05.010**

9. Trevisan G, Zeller M, Li G, Zhang J, Gauger P, Linhares DCL. Implementing a user-friendly format to analyze PRRSV next-generation sequencing results and associating breeding herd production performance with number of PRRSV strains and recombination events. *Transbound Emerg Dis*. 2022;69:e2214-e2229. **https://doi.org/10.1111/tbed.14560**

10. Cano JP, Dee SA, Murtaugh MP, Pijoan C. Impact of a modified-live porcine reproductive and respiratory syndrome virus vaccine intervention on a population of pigs infected with a heterologous isolate. *Vaccine*. 2007;25:4382-4391. **https://doi.org/10.1016/j.vaccine.2007.03.031**

11. Arruda AG, Friendship R, Carpenter J, Greer A, Poljak Z. Evaluation of control strategies for porcine reproductive and respiratory syndrome (PRRS) in swine breeding herds using a discrete event agent-based model. *PLoS One*. 2016;11:e0166596. **https://doi.org/10.1371/journal.pone.0166596**

12. Sanhueza JM, Vilalta C, Corzo C, Arruda AG. Factors affecting porcine reproductive and respiratory syndrome virus time-to-stability in breeding herds in the Midwestern United States. *Transbound Emerg Dis*. 2019;66:823-830. **https://doi.org/10.1111/tbed.13091**

*13. Yeske P. Winter of 2007-2008: A practitioner's experience with PRRS. In: *Proceedings of the 40th AASV Annual Meeting*. American Association of Swine Veterinarians; 2009:455-458.

14. Corzo CA, Mondaca E, Wayne S, Torremorell M, Dee S, Davies P, Morrison RB. Control and elimination of porcine reproductive and respiratory syndrome virus. *Virus Res*. 2010;154:185-192. **https://doi.org/10.1016/j.virusres.2010.08.016**

*15. Torremorell M, Henry S, Christianson WT. Eradication using herd closure. *PRRS Compendium*. National Pork Board; 2003:157-162.

16. Morrison RB. Control and elimination of PRRS virus. *Adv Pork Prod*. 2011;22:137-145. **https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=01731b1c7147f821c5f91e7094f6c15213af4beb**

17. Holtkamp DJ, Torremorell M, Corzo CA, Linhares DCL, Almeida MN, Yeske P, Polson DD, Becton L, Snelson H, Donovan T, Pittman J, Johnson C, Vilalta C, Silva GS, Sanhueza J. Proposed modifications to porcine reproductive and respiratory syndrome virus herd classification. *J Swine Health Prod*. 2021;29:261-270. **https://doi.org/10.54846/jshap/1218**

18. Holtkamp DJ, Polson DD, Torremorell M, Morrison B, Classen DM, Becton L, Henry S, Rodibaugh MT, Rowland RR, Snelson H, Straw B, Yeske P, Zimmerman JJ. Terminology for classifying swine herds by porcine reproductive and respiratory syndrome virus status. *J Swine Health Prod*. 2011;19:44-56. **https://doi.org/10.54846/jshap/669**

*19. Alonso C. Internal Biosecurity: McREBEL and beyond!! Pig 333. Published September 29, 2020. Accessed November 28, 2023. **https://www.pig333.com/articles/internal-biosecurity-mcrebel-and-beyond_15979/**

20. Lopez W, Angulo J, Zimmerman J, Linhares D. Porcine reproductive and respiratory syndrome monitoring in breeding herds using processing fluids. *J Swine Health Prod*. 2018;26:146-150. **https://doi.org/10.54846/jshap/1055**

21. Paploski IAD, Pamornchainavakul N, Makau DN, Rovira A, Corzo CA, Schroeder DC, Cheeran MC-J, Doeschl-Wilson A, Kao RR, Lycett S, VanderWaal K. Phylogenetic structure and sequential dominance of sub-lineages of PRRSV Type-2 Lineage 1 in the United States. *Vaccines (Basel)*. 2021;9:608. **https://doi.org/10.3390/vaccines9060608**

22. Shi M, Lam TT-Y, Hon C-C, Murtaugh MP, Davies PR, Hui RK-H, Li J, Wong LT-W, Yip C-W, Jiang J-W, Leung FC-C. Phylogeny-based evolutionary, demographical, and geographical dissection of North American type 2 porcine reproductive and respiratory syndrome viruses. *J Virol*. 2010;84:8700-8711. **https://doi.org/10.1128/jvi.02551-09**

23. Wesley RD, Mengeling WL, Lager KM, Clouser DF, Landgraf JG, Frey ML. Differentiation of a porcine reproductive and respiratory syndrome virus vaccine strain from North American field strains by restriction fragment length polymorphism analysis of ORF 5. *J Vet Diagn Invest*. 1998;10:140-144. **https://doi.org/10.1177/104063879801000204**

24. Almeida MN, Zhang M, Lopez WAL, Vilalta C, Sanhueza J, Corzo CA, Zimmerman JJ, Linhares DCL. A comparison of three sampling approaches for detecting PRRSV in suckling piglets. *Prev Vet Med*. 2021;194:105427. **https://doi.org/10.1016/j.prevetmed.2021.105427**

25. Trevisan G, Linhares LCM, Crim B, Dubey P, Schwartz KJ, Burrough ER, Main RG, Sundberg P, Thurn M, Lages PTF, Corzo CA, Torrison J, Henningson J, Herrman E, Hanzlicek GA, Raghavan R, Marthaler D, Greseth J, Clement T, Christopher-Hennings J, Linhares DCL. Macroepidemiological aspects of porcine reproductive and respiratory syndrome virus detection by major United States veterinary diagnostic laboratories over time, age group, and specimen. *PLoS One*. 2019;14:e0223544. **https://doi.org/10.1371/journal.pone.0223544**

*26. Donovan T. PRRS control and eradication in a production system. In: *Proceedings of the Allen D. Leman Swine Conference*. University of Minnesota; 2011:151-155.

27. Lurette A, Belloc C, Touzeau S, Hoch T, Seegers H, Fourichon C. Modelling batch farrowing management within a farrow-to-finish pig herd: Influence of management on contact structure and pig delivery to the slaughterhouse. *Animal*. 2008;2:105-116. **https://doi.org/10.1017/S1751731107000997**

28. Berends BR, Urlings HA, Snijders JM, Van Knapen F. Identification and quantification of risk factors in animal management and transport regarding *Salmonella* spp. in pigs. *Int J Food Microbiol*. 1996;30:37-53. **https://doi.org/10.1016/0168-1605(96)00990-7**

29. Madec F, Bridoux N, Bounaix S, Jestin A. Measurement of digestive disorders in the piglet at weaning and related risk factors. *Prev Vet Med*. 1998;35:53-72. **https://doi.org/10.1016/S0167-5877(97)00057-3**

30. Rose N, Larour G, Le Diguerher G, Eveno E, Jolly JP, Blanchard P, Oger A, Le Dimna M, Jestin A, Madec F. Risk factors for porcine post-weaning multisystemic wasting syndrome (PMWS) in 149 French farrow-to-finish herds. *Prev Vet Med*. 2003;61:209-225. **https://doi.org/10.1016/j.prevetmed.2003.07.003**

31. Trevisan G, Jablonski E, Angulo J, Lopez WA, Linhares DCL. Use of processing fluid samples for longitudinal monitoring of PRRS virus in herds undergoing virus elimination. *Porcine Health Manag*. 2019;5:18. **https://doi.org/10.1186/s40813-019-0125-x**

32. Murtaugh MP, Genzow M. Immunological solutions for treatment and prevention of porcine reproductive and respiratory syndrome (PRRS). *Vaccine*. 2011;29:8192-8204. **https://doi.org/10.1016/j.vaccine.2011.09.013**

33. Tousignant SJP, Perez AM, Lowe JF, Yeske PE, Morrison RB. Temporal and spatial dynamics of porcine reproductive and respiratory syndrome virus infection in the United States. *Am J Vet Res*. 2015;76:70-76. **https://doi.org/10.2460/ajvr.76.1.70**

*34. Pitkin A, Otake S, Dee S. Biosecurity protocols for the prevention of spread of porcine reproductive and respiratory syndrome virus. University of Minnesota College of Veterinary Medicine Swine Disease Eradication Center; 2009. Accessed November 28, 2023. **http://www.biosecureairinc.com/files/protocols.pdf**

35. Colomer MÀ, Margalida A, Fraile L. Improving the management procedures in farms infected with the porcine reproductive and respiratory syndrome virus using PDP models. *Sci Rep*. 2019;9:9959. **https://doi.org/10.1038/s41598-019-46339-w**

36. Rathkjen PH, Dall J. Control and eradication of porcine reproductive and respiratory syndrome virus type 2 using a modified-live type 2 vaccine in combination with a load, close, homogenise model: An area elimination study. *Acta Vet Scand*. 2017;59:4. **https://doi.org/10.1186/s13028-016-0270-z**

* Non-refereed references.

Suitability of undenatured ethanol for DNA and RNA preservation in pig oral fluid and fecal samples used for PCR-based pathogen detection

Joanna Gerszon, PhD; Berit Genz, PhD; Ralf J. Moser, PhD; Yvette Pollock, BVSc, PhD; Melony J. Sellars, PhD

Summary

Nucleic acid integrity in pig oral fluid and fecal samples is important for polymerase chain reaction-based pathogen detection and appropriate preservation during shipping is required. A final concentration of 70% undenatured ethanol was sufficient to maintain DNA and RNA quality for up to 7 days.

Keywords: swine, oral fluids, feces, ethanol

Received: August 23, 2023
Accepted: March 7, 2024

Resumen - Eficacia del etanol sin desnaturalizar para la conservación de ADN y ARN en muestras fecales y de fluidos orales de cerdos utilizados para la detección de patógenos basada en la PCR

La integridad de los ácidos nucleicos en el fluido oral y las muestras fecales de cerdos es importante para la detección de patógenos basada en la reacción en cadena de la polimerasa, y se requiere una conservación adecuada durante el envío. Una concentración final de 70% de etanol sin desnaturalizar fue suficiente para mantener la calidad del ADN y el ARN hasta por 7 días.

Résumé - Pertinence de l'éthanol non dénaturé pour la préservation de l'ADN et de l'ARN dans les échantillons de salive et de selles de porc utilisés pour la détection d'agents pathogènes par PCR

L'intégrité de l'acide nucléique dans les échantillons de salive et de selles de porc est importante pour la détection des agents pathogènes par réaction d'amplification en chaîne par la polymérase et une conservation appropriée pendant le transport est requise. Une concentration finale de 70% d'éthanol non dénaturé était suffisante pour maintenir la qualité de l'ADN et de l'ARN jusqu'à 7 jours.

Respiratory and enteric diseases in pigs remain major health concerns for pork producers.[1] One of the evolving strategies for monitoring and surveillance of pig respiratory and enteric diseases are oral fluid (rope) sampling as well as pooled fecal (sock) sampling, methods proven to be suitable for detecting multiple pathogens of concern.[2,3] Resulting sample types are complex matrices, which means that their mixed composition of water, proteins and enzymes, microorganisms, host cell components, and other environmental additives such as soil[2,4] pose a major challenge for preserving the integrity (eg, molecular weight and size) of target pathogen analytes in the DNA and RNA compartment prior to nucleic acid extraction and downstream molecular analysis. Enzymatic-driven nucleic acid degradation, dilution of target pathogen analytes by continued pathogen overgrowth, or overwhelming presence of nontarget species exacerbate inaccurate and nonsensitive pathogen diagnostics in both sample types. To overcome these challenges, various storage and preservation methods have been tested.[5,6]

Undenatured ethanol is one of the most common, least toxic, and least expensive preservation methods used for animal tissues.[7] Ethanol easily replaces water molecules in biological tissues and cells and leads to major alterations of cellular and membranous proteins by disrupting hydrophobic bonds within the tertiary structure. This inactivates nucleic acid-degrading enzymes, such as DNases, when used in concentrations of 95% to 99%.[8] Undenatured ethanol does not contain other chemicals, such as methanol, which are often added during the denaturing process making the substance unsuitable for different end uses. Furthermore, this preservation method complies with biosecurity import regulations of many countries. The objective of this study was to test a final concentration of 70% undenatured ethanol as a method to preserve the integrity of total nucleic acids in pig oral fluid and fecal samples held for at least 7 days at ambient temperature before use in downstream polymerase chain reaction (PCR)-based molecular applications.

Animal care and use

Oral fluid and fecal samples were collected by a veterinarian between April and May 2022 from farms with previously

JG, BG, RJM, MJS: Genics Pty Ltd, St Lucia, Queensland, Australia.

YP: SunPork Fresh Foods, CGM Alliance Pty Ltd, Eagle Farm, Queensland, Australia.

Corresponding author: Dr Joanna Gerszon; Genics Pty Ltd, Level 5, Gehrman Building, 60 Research Road, St Lucia, Qld 4067, Australia; Email: **joanna.gerszon@genics.com.au**

Supplementary material available at **https://doi.org/10.54846/jshap/1383suppl**

Gerszon J, Genz B, Moser R, Pollock Y, Sellars M. Suitability of undenatured ethanol for DNA and RNA preservation in pig oral fluid and fecal samples used for PCR-based pathogen detection. *J Swine Health Prod*. 2024;32(5):213-219. **https://doi.org/10.54846/jshap/1383**

detected *Streptococcus suis* and rotavirus infections. Samples were sent to Genics Laboratories for diagnostic purposes and transferred to the study with the permission of the farm owners and veterinarian. No specific animal ethics approval was required.

Materials and methods

Oral fluids were collected using 3 cotton ropes hung in the pig pen for 30 minutes. The chewed-on ropes were drained into one tube, mixed, and divided into 2 aliquots. One aliquot was immediately preserved with ethanol as described herein. Three fecal droppings were collected from the pen floor and pooled into one container. After shipping to the laboratory, both sample types were further aliquoted, and feces were diluted with > 99.5% undenatured ethanol using a 1:2.5 ratio to obtain a final concentration of approximately 70%. Ethanol-preserved samples were stored at ambient temperature whereas undiluted samples were stored at 4°C and -80°C (n = 5-6 aliquots per group and time point). The extraction of total nucleic acids (TNA = DNA + RNA) was carried out on day 1, 4, and 7 of storage using the MagMAX CORE Nucleic Acid Purification Kit (Thermo Fisher Scientific) following the manufacturer's instruction with some modifications (see Supplementary Material). Concentration of DNA was determined using a Qubit 4 fluorometer and Qubit dsDNA high sensitivity assay (Thermo Fisher Scientific). Additionally, DNA quality was estimated by spectrophotometric analysis at 260 and 280 nm using a ClarioSTAR microplate reader (BMG LABTECH).

In a follow-up study, 405 oral fluids and 405 pooled fecal samples were collected from three different Australian pig farms over a period of three months using the previously described sampling methods. Due to varying transit times during shipping, individual samples were assigned to different storage durations ranging from 1 to 6 days.

Extracted TNA from oral fluid and fecal samples were tested on the high-throughput PCR-based Pork MultiPath respiratory (PMP1) and enteric (PMP2) panels (Genics Pty Ltd) which were inclusive of a reverse transcription and PCR step. The PMP1 panel contained assay targets for *Actinobacillus pleuropneumoniae* serotypes 1, 5, 7, and 15, *S suis*, *S suis* serotypes 2 and 3, *Pasteurella multocida*, *Glaesserella parasuis*, *Mycoplasma hyorhinis*, *Mycoplasma hyopneumoniae*, and porcine circovirus 2 (PCV-2). The PMP2 panel contained assay targets for *Lawsonia intracellularis*, *Brachyspira pilosicoli, Brachyspira hyodysenteriae*, *Salmonella enterica, S enterica* serovar Typhimurium, *Escherichia coli* virulence genes (F4, F5, F6, F18, F41, LT1, ST1, ST2, STX2e, and eaeA), Porcine rotavirus A, B, and C, and PCV-2. Both panels included two assays that targeted the housekeeping gene beta-2-microglobulin (B2M), which serve as an internal control for detection of pig genomic DNA (gDNA) and messenger RNA (mRNA). Each assay also included a synthetic positive control, an extraction control, and a no-template control. The presence of target genes was determined by copy number per reaction.

All assays of both PMP panels were previously assessed for analytical specificity (ASp; inclusive and exclusive), analytical sensitivity (ASe) or limit of detection (LOD), and dynamic range or limit of quantitation (LOQ) of each assay (Tables 1 and 2). Data analysis was performed using the MedCalc Statistical Software version 20.111 (MedCalc Software Ltd). Statistical significance was tested using a two-way analysis of variance with Bonferroni corrected pairwise comparisons (dependent variable was concentration; independent variables were time and storage conditions). All data was presented as the mean (SD) and $P < .05$ was deemed statistically significant.

Table 1: Summary of LOD and upper and lower LOQ for each respiratory pathogen assay

Assay*	Upper LOQ†, No. copies	Lower LOQ†, No. copies	LOD†
Actinobacillus pleuropneumoniae serovar 1	1800	10	2
A pleuropneumoniae serovar 5	1800	5	3
A pleuropneumoniae serovar 7	2000	1	2
A pleuropneumoniae serovar 15	1800	10	2
Streptococcus suis	2000	10	4
S suis serotype 2	1800	25	2
S suis serotype 3	1000	1	13
Glaesserella parasuis	1800	0.1	6
Pasteurella multocida	2000	2.5	2
Mycoplasma hyorhinis	1800	10	3
Mycoplasma hyopneumoniae	1800	5	4
Porcine circovirus 2	1800	25	3

* Extracted total nucleic acids from orthogonal samples were tested on the high-throughput PCR-based Pork MultiPath respiratory panel (Genics Pty Ltd).

† Above Upper LOQ assay called HIGH, between Upper and Lower LOQ assay gives the numerical value, between Lower LOQ and LOD assay called LOW, below LOD assay called negative.

LOD = limit of detection; LOQ = limit of quantification.

Table 2: Summary of LOD and upper and lower LOQ for each enteric pathogen assay

Assay*	Upper LOQ†, No. copies	Lower LOQ†, No. copies	LOD†
Lawsonia intracellularis	2000	10	3
Brachyspira pilosicoli	2000	50	3
B hyodysenteriae	1800	50	4
Salmonella enterica	1500	25	4
S enterica serovar Typhimurium	1500	50	6
Escherichia coli F4	2000	10	6
E coli F5	1250	2.5	3
E coli F6	1800	0.1	3
E coli F18	1000	50	7
E coli F41	1800	2.5	5
E coli LT	1800	25	4
E coli ST1	1000	50	10
E coli ST2	1500	50	7
E coli STX2E	1000	50	3
E coli EAE	2000	50	4
Porcine rotavirus A	2000	250	6
Porcine rotavirus B	1800	25	4
Porcine rotavirus C	1000	10	4
Porcine circovirus 2	1800	25	4

* Extracted total nucleic acids from orthogonal samples were tested on the high-throughput PCR-based Pork MultiPath enteric panel (Genics Pty Ltd).

† Above Upper LOQ assay called HIGH, between Upper and Lower LOQ assay gives the numerical value, between Lower LOQ and LOD assay called LOW, below LOD assay called negative.

LOD = limit of detection; LOQ = limit of quantification.

Results

Statistical analysis revealed that both time and storage condition had a substantial impact on the yield of DNA extracted from oral fluid samples. Amongst 3 different storage methods, freezing samples at -80°C yielded the lowest oral fluid DNA ($P < .001$) across all time points (Figure 1A). Oral fluids were not stored at -80°C before day 1 because samples were shipped during the first 24 hours. In fecal samples, no difference in DNA yield was observed between the different storage methods ($P = .16$; Figure 1A). The greatest impact on DNA yield for both sample types was time of storage with a decrease in fecal samples in all storage groups after day 1 ($P < .001$; Figure 1A).

Further, the A260/280 ratio was used as a quality indicator of extracted TNA (Table 3). The mean A260/280 ratio for oral fluids stored at 4°C and preserved with ethanol across all time points was closest to the acceptable threshold of 1.8 to 2.0, while the mean ratio for oral fluids stored at -80°C substantially deviated below 1.7 (Table 3). The quality of TNA extracted from feces was not influenced by time or method of storage (Table 3).

Additionally, the effect of different storage methods on the performance of the multiplex PCR-based assay in extracted TNA from oral fluid and feces was investigated. For PMP1, this study focused on the housekeeping gene B2M_gDNA, an internal control for detection of pig gDNA, and *S suis* glutamate dehydrogenase (SS_gdh, a generic *S suis* assay), used as a proxy for the putative performance of DNA pathogen targets. The results showed that the copy number of B2M_gDNA gradually decreased in all three storage groups over time. Statistical analysis also confirmed that for both B2M_gDNA and SS_gdh, a considerably higher detection rate occurred in undenatured ethanol samples compared to other storage methods (Table 3 and Figure 1B). Even though the concentration of total dsDNA extracted from oral fluid samples was equal or even slightly higher ($P = .14$) in samples stored at 4°C compared to the 70% undenatured ethanol preserved samples, the degradation rate of DNA was much more pronounced over time in samples stored at 4°C as seen by copy number decrease of DNA targets.

Similar but less distinct effects were observed in fecal samples when running the PMP2 panel. This panel contained several DNA and RNA pathogen targets as well as two quality control assays for pig gDNA (B2M_gDNA) and mRNA (B2M_RNA). Analysis of DNA assays targeting B2M_gDNA and the *E coli* F4 antigen showed the highest detection rate in 70% undenatured ethanol for up to 7 days of preservation (Table 3 and Figure 1C).

Figure 1: Quantity and quality assessment of DNA and RNA extracted from pooled pig oral fluid and fecal samples stored at 4°C, -80°C, or in a final concentration of 70% undenatured ethanol (EtOH) at room temperature after 1, 4 and 7 days of storage. Due to nucleic acid instability, oral fluids were divided into EtOH-preserved and 4°C directly after sampling prior to shipping. Shipping at -80°C was not feasible, so this storage method could not be assessed on day 1. **A)** Concentration of DNA extracted from pooled pig oral fluid (left) and fecal samples (right). Molecular DNA and RNA quality was assessed using the multiplex polymerase chain reaction-based Pork MultiPath respiratory and enteric panels (Genics Pty Ltd) to quantify **B)** *Streptococcus suis* glutamate dehydrogenase gene, **C)** *Escherichia coli* F4 fimbrial antigen, and **D)** porcine rotavirus B viral protein 6. Quality of pig beta-2-microglobulin (B2M) genomic DNA in samples extracted from **E)** oral fluids and **F)** fecal samples stored in a final concentration of 70% EtOH at ambient temperature at different time periods. Quality of pig B2M mRNA in samples extracted from **G)** oral fluids and **H)** fecal samples stored in a final concentration of 70% EtOH at ambient temperature at different time periods. For each boxplot, boxes indicate the 25th percentile, median, and 75th percentile. Whiskers show the 10th and 90th percentiles. Dots (E-H) represent each sample. Asterisks indicate a significance level of $P < .05$ between storage conditions. Hashtags indicate a significance level of $P < .05$ between time points.

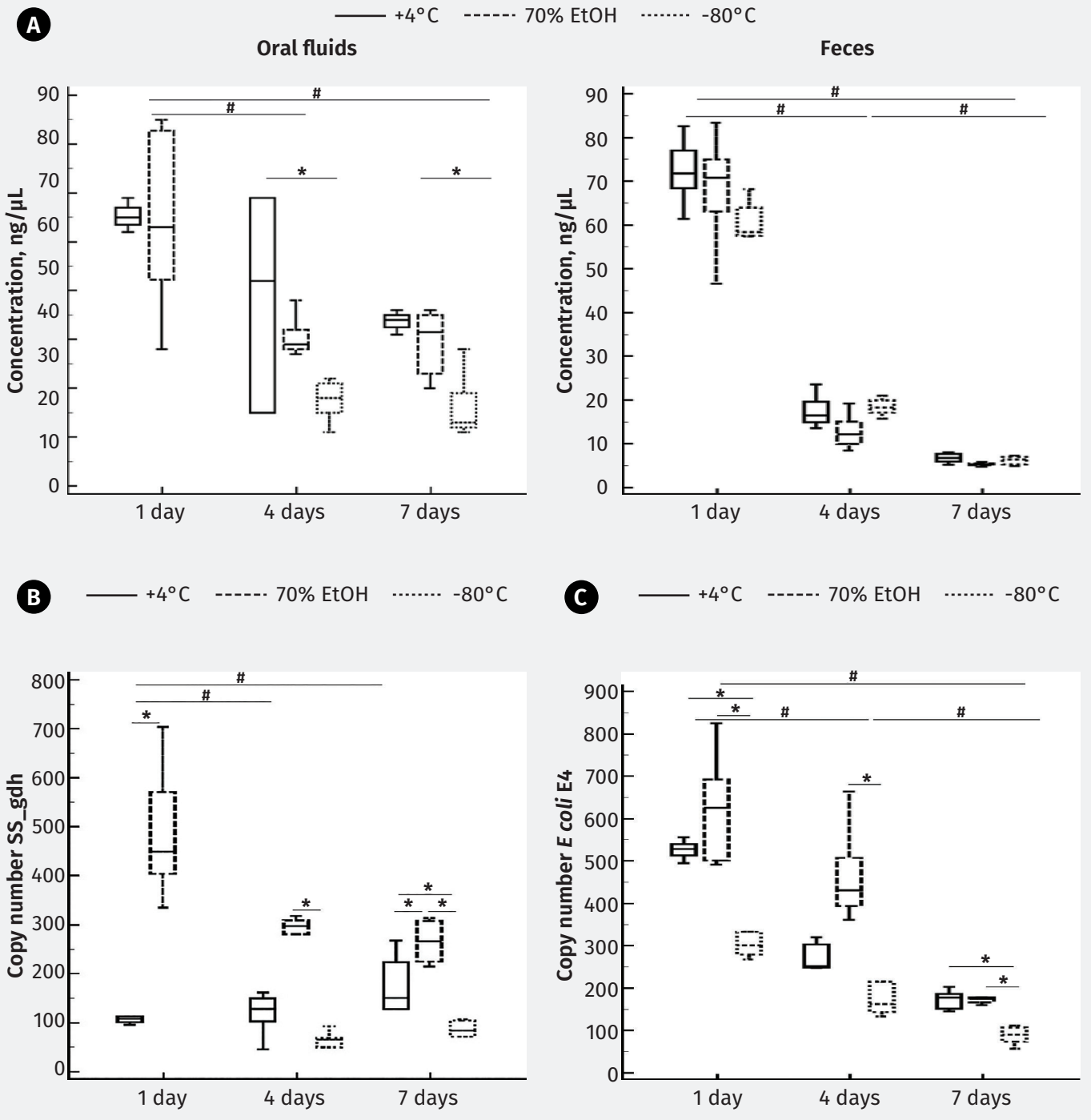


Figure 1: Continued

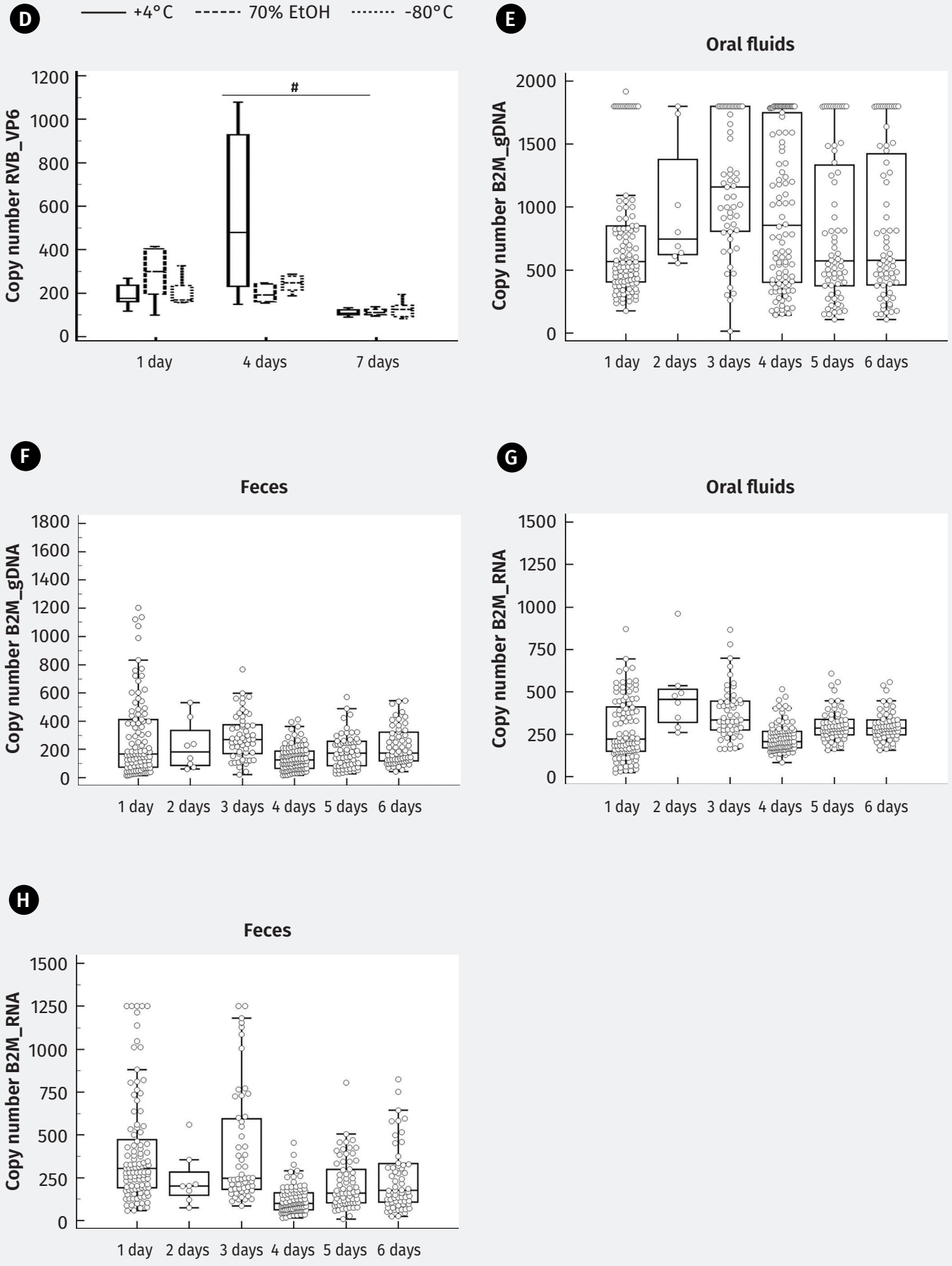


Table 3: Quality assessment of TNA isolated from oral fluid and fecal samples stored under different conditions

TNA quality assessment, mean (SD)	Sample storage conditions								
	1 day			4 days			7 days		
	4°C	-80°C	EtOH	4°C	-80°C	EtOH	4°C	-80°C	EtOH
Oral fluids									
A260/280*	1.75 (0.03)	NA	1.95 (0.02)	1.69 (0.18)	1.58 (0.07)	1.93 (0.05)	1.86 (0.08)	1.70 (0.08)	1.80 (0.03)
B2M_gDNA†	14 (2)‡	NA	127 (90)	3 (3)‡	3 (1)‡	43 (12)	1 (1)‡	3 (2)	43 (10)
Feces									
A260/280*	1.93 (0.07)	1.91 (0.01)	1.92 (0.05)	1.82 (0.03)	1.90 (0.03)	1.84 (0.02)	1.90 (0.08)	1.91 (0.02)	1.86 (0.03)
B2M_gDNA†	119 (30)	98 (23)	154 (59)	42 (14)	50 (14)	55 (22)	13 (6)	20 (7)	24 (12)
B2M_RNA†	HIGH 1359 (844)	HIGH 1502 (260)	HIGH 1728 (557)	1151 (672)‡	1122 (132)‡	528 (194)	849 (317)‡	731 (145)‡	318 (101)

* Absorption at 260 and 280 nm indicates general TNA quality and purity.

† Pork MultiPath control DNA (B2M_gDNA) and RNA (B2M_RNA) assay copy number detection as reported by PMP indicates TNA integrity. All samples passed quality control assessment. HIGH score represents samples with copy number higher than limit of quantitation.

‡ Denotes means that are statistically different from EtOH means, $P < .05$. Statistical significance was tested using a two-way analysis of variance with Bonferroni corrected pairwise comparisons.

TNA = total nucleic acids; EtOH = ethanol; NA = not assessed.

The gold standard of freezing samples at -80°C was not as efficient in DNA preservation as expected. With respect to undenatured ethanol preservation on RNA in feces, PMP2 results revealed that the rotavirus B VP6 RNA target was more stable over time than the endogenous B2M_RNA control (Table 3 and Figure 1D).

In a follow-up study, pooled oral fluids and fecal samples (n = 405 each) preserved in a final concentration of 70% undenatured ethanol at ambient temperature were assessed on PMP1 and PMP2 panels at different time points after sampling (1 to 6 days). Comparison of the copy number of housekeeping genes B2M_gDNA and B2M_RNA between samples at different time points confirmed that retaining both specimen types in ethanol sufficiently preserved DNA and RNA to perform PMP analysis (Figures 1E, F, G, and H). Furthermore, screening with PMP demonstrated that detection of different bacterial and viral pathogen targets at high, medium, and low level is attainable even after 6 days of storage in a final concentration of 70% undenatured ethanol at ambient temperature (data not shown).

Discussion

Preservation of biological diagnostic samples is vital before shipment. Especially when extracting nucleic acids for molecular biological analysis, temperature fluctuations and transit times can have a major impact on nucleic acid yield and quality due to nuclease activity, oxidative degradation, or both.[9] Immediate freezing or short-term storage at 4°C is regarded as best practice despite the challenges of maintaining a cold chain during shipment. For international shipments, freezing or sending samples on ice or preserved in special DNA/RNA stabilizers is often not permitted due to biosecurity import restrictions and can be very cost intensive. In an Australian context, the government's biosecurity import conditions allow the import of most animal and invertebrate samples that are preserved in 70% alcohol (ethanol for example) without requirement of an import permit. Due to the relatively low cost, nontoxicity, global availability, and proven efficiency in preservation of many sample types, undenatured ethanol is widely used and tested as an alternative storage medium for microbial community stabilization.

The presented study demonstrates that a final concentration of 70% undenatured ethanol is a suitable preservative for both pig oral fluids and fecal samples for downstream analysis with the PCR-based PMP panels when stored at ambient temperature for at least up to 7 days. In oral fluid samples, extracted DNA yield was comparable in samples preserved in 70% undenatured ethanol and stored at 4°C over 7 days, whereas storage at -80°C yielded the lowest DNA concentration presumably due to the freezing-thawing process.[10,11] Furthermore, DNA yield was greatly affected by storage time, especially in fecal samples. Degradation of DNA in feces over time has been shown in other studies and may be caused by remaining nuclease activity.[12,13]

When focusing on the impact of the different preservation methods for oral fluids and feces on the performance of the PMP panels, DNA target-based assays (B2M_gDNA, SS_gdh, *E coli*_F4)

detected the highest copy numbers in samples treated with undenatured ethanol across all time points. Even though dsDNA concentration in oral fluid samples was equal or even slightly higher in samples stored at 4°C, the rate of DNA degradation as reflected by copy number decrease of PMP DNA targets was much more pronounced over time compared to the ethanol preserved samples. With DNA input being approximately the same for all PMP1 tests conducted, these results suggest that undenatured ethanol has an immediate fixative effect on DNA and the preservation of respective target analytes. Additionally, it shows that the relatively high concentration of DNA extracted from samples stored at 4°C is likely a consequence of storage without any stabilizers allowing microbiome overgrowth which can vastly misrepresent the sample composition. Similar conclusions were reported by Marotz et al[6] where microbial communities in oral fluid and fecal samples were identified in the presence of different preservatives. The greatest changes of specific taxa were recognized in both types of samples when stored at room temperature without any stabilizers. Additionally, it was demonstrated that microbial blooming was efficiently prevented by using 95% ethanol at ambient temperature.[6] Further, the gold standard of freezing fecal samples at -80°C was not as efficient in DNA preservation as expected. A study examining the effect of storage conditions on genomic DNA in human fecal samples demonstrated that DNA degrades when samples are allowed to defrost.[14] With respect to the effect of undenatured ethanol preservation on RNA in feces, PMP2 results revealed that the rotavirus B VP6 RNA target was more stable over time than the endogenous B2M_RNA control. This distinct difference is likely a result of protective strategies of RNA viruses and their developed defense mechanisms against exonuclease degradation.[15]

This study confirms the suitability of a final concentration of 70% undenatured ethanol for the preservation of pig oral fluid and fecal samples when used at ambient temperature for up to seven days. Further studies are recommended to determine the suitability of this preservation technique on other complex sample types (eg, blood) and different applications such as next-generation sequencing.

Implications

Under the conditions of this study:

- Multiple pathogens were detected in pig oral fluids and feces using PCR-based panels.
- Undenatured ethanol (70%) preserved nucleic acid integrity for at least 7 days.
- Both PCR-based panels can be combined with ethanol preserved samples.

Acknowledgments

We would like to thank the team at Sun-Pork Farms for helping with sampling, preservation, and shipping. Thank you also to the Genics Board for funding this work.

Conflict of interest

Gerszon, Genz, Moser, and Sellars are affiliated with Genics Pty Ltd, which provides the Pork MultiPath as a commercial service.

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

References

1. VanderWaal K, Deen J. Global trends in infectious diseases of swine. *Proc Natl Acad Sci U S A*. 2018;115(45):11495-11500. **https://doi.org/10.1073/pnas.1806068115**

2. Henao-Diaz A, Giménez-Lirola L, Baum DH, Zimmerman J. Guidelines for oral fluid-based surveillance of viral pathogens in swine. *Porcine Health Manag*. 2020;6:28. **https://doi.org/10.1186/s40813-020-00168-w**

3. Pedersen KS, Okholm E, Johansen M, Angen Ø, Jorsal SE, Nielsen JP, Bækbo P. Clinical utility and performance of sock sampling in weaner pig diarrhoea. *Prev Vet Med*. 2015;120(3-4):313-320. **https://doi.org/10.1016/j.prevetmed.2015.04.015**

4. Kumar J, Kumar M, Gupta S, Ahmed V, Bhambi M, Pandey R, Chauhan NS. An improved methodology to overcome key issues in human fecal metagenomic DNA extraction. *Genomics Proteomics Bioinformatics*. 2016;14(6):371-378. **https://doi.org/10.1016/j.gpb.2016.06.002**

5. Kim Y-W, Kim Y-K. The effects of storage of human saliva on DNA isolation and stability. *J Oral Med Pain*. 2006;31(1):1-16.

6. Marotz C, Cavagnero KJ, Song SJ, McDonald D, Wandro S, Humphrey G, Bryant M, Ackermann G, Diaz E, Knight R. Evaluation of the effect of storage methods on fecal, saliva, and skin microbiome composition. *mSystems*. 2021;6(2):e01329-20. **https://doi.org/10.1128/msystems.01329-20**

7. Nagy ZT. A hands-on overview of tissue preservation methods for molecular genetic analyses. *Org Divers Evol*. 2010;10:91-105. **https://doi.org/10.1007/s13127-010-0012-4**

8. King JR, Porter SD. Recommendations on the use of alcohols for preservation of ant specimens (Hymenoptera *Formicidae*). *Insectes Soc*. 2004;51:197-202. **https://doi.org/10.1007/s00040-003-0709-x**

9. Prendini L, Hanner RH, DeSalle R. Obtaining, storing and archiving specimens and tissue samples for use in molecular studies. In: DeSalle R, Giribet G, Wheeler W, eds. *Techniques in Molecular Systematics and Evolution*. Birkhäuser Basel; 2002:176-248. **https://doi.org/10.1007/978-3-0348-8125-8_11**

10. Weiser AC, Poonsuk K, Bade SA, Gauger PC, Rotolo M, Harmon K, Gonzalez WM, Wang C, Main R, Zimmerman JJ. Effects of sample handling on the detection of porcine reproductive and respiratory syndrome virus in oral fluids by reverse-transcription real-time PCR. *J Vet Diagn Invest*. 2018;30(6):807-812. **https://doi.org/10.1177/1040638718805534**

11. Straube D, Juen A. Storage and shipping of tissue samples for DNA analyses: A case study on earthworms. *Eur J Soil Biol*. 2013;57:13-18. **https://doi.org/10.1016/j.ejsobi.2013.04.001**

12. Murphy MA, Waits LP, Kendall KC, Wasser SK, Higbee JA, Bogden R. An evaluation of long-term preservation methods for brown bear (*Ursus arctos*) faecal DNA samples. *Conserv Genet*. 2002;3:435-440. **https://doi.org/10.1023/A:1020503330767**

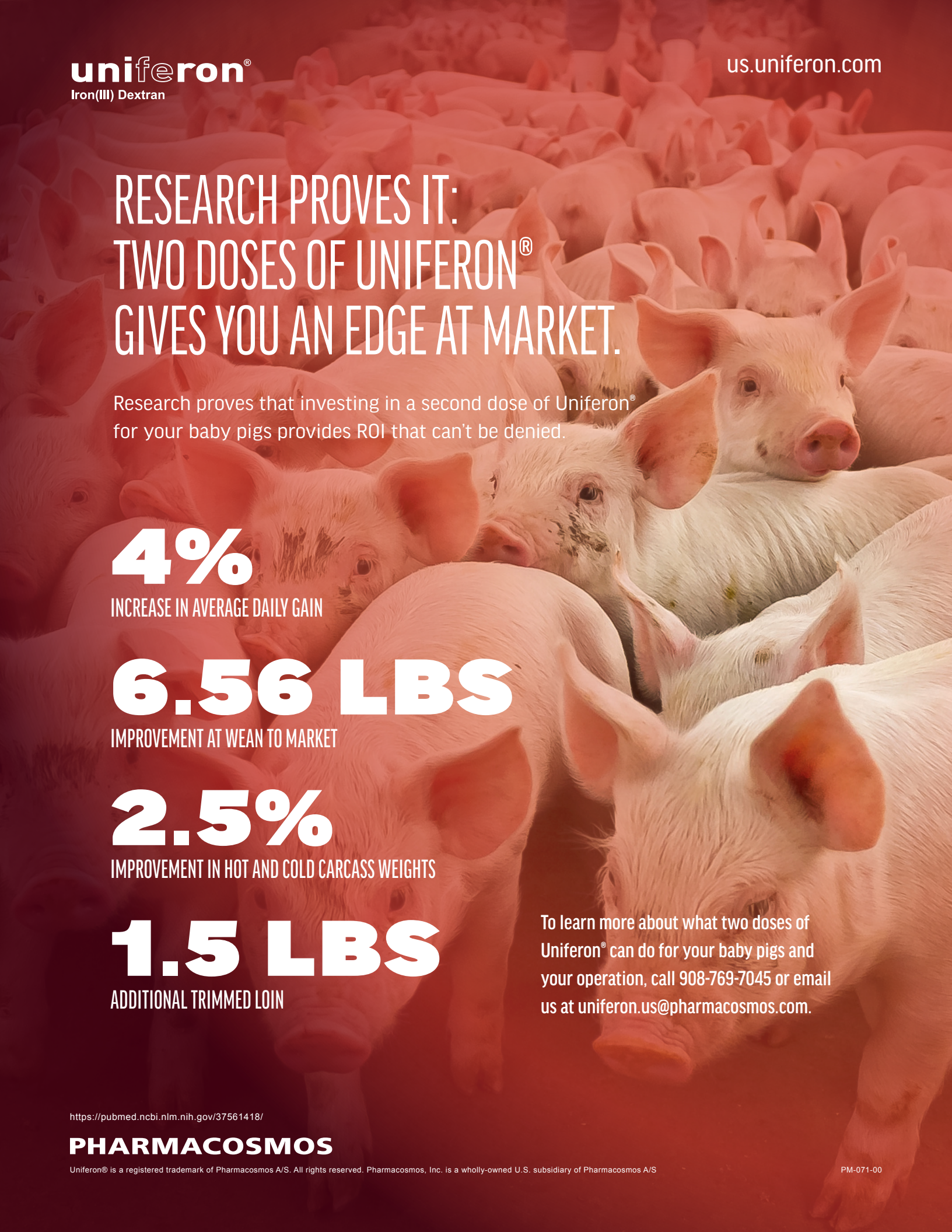
13. Panasci M, Ballard WB, Breck S, Rodriguez D, Densmore III LD, Wester DB, Baker RJ. Evaluation of fecal DNA preservation techniques and effects of sample age and diet on genotyping success. *J Wildl Manage*. 2011;75(7):1616-1624. **https://doi.org/10.1002/jwmg.221**

14. Cardona S, Eck A, Cassellas M, Gallart M, Alastrue C, Dore J, Azpiroz F, Roca J, Guarner F, Manichanh C. Storage conditions of intestinal microbiota matter in metagenomic analysis. *BMC Microbiol*. 2012;12:158. **https://doi.org/10.1186/1471-2180-12-158**

15. Dickson AM, Wilusz J. Strategies for viral RNA stability: Live long and prosper. *Trends Genet*. 2011;27(7):286-293. **https://doi.org/10.1016/j.tig.2011.04.003**

uniferon®
Iron(III) Dextran

us.uniferon.com



RESEARCH PROVES IT: TWO DOSES OF UNIFERON® GIVES YOU AN EDGE AT MARKET.

Research proves that investing in a second dose of Uniferon® for your baby pigs provides ROI that can't be denied.

4%
INCREASE IN AVERAGE DAILY GAIN

6.56 LBS
IMPROVEMENT AT WEAN TO MARKET

2.5%
IMPROVEMENT IN HOT AND COLD CARCASS WEIGHTS

1.5 LBS
ADDITIONAL TRIMMED LOIN

To learn more about what two doses of Uniferon® can do for your baby pigs and your operation, call 908-769-7045 or email us at uniferon.us@pharmacosmos.com.

https://pubmed.ncbi.nlm.nih.gov/37561418/

PHARMACOSMOS

PM-071-00

Growing the benefits of AgView's robust preharvest traceability platform

The drive to improve preharvest traceability for the US swine industry led to the creation of AgView (**agview.com**). This commercial-grade software system, developed using Pork Checkoff dollars along with funds from US Department of Agriculture (USDA) Foreign Agricultural Service, functions as a database of record for a preharvest traceability program. It enables the tracking and sharing of all live pig and semen movements with state animal health officials, aiding in the rapid response and control of suspected or confirmed foreign animal disease outbreaks. Continual upgrades also address pain-points for swine veterinarians, including making it easier to set up Swine Production Health Plans (SPHP), also known as commuter agreements.

Swine veterinarians and animal health officials know SPHP creation and approvals, which may include at least eight signatures, require significant time and effort for compliance with 9 CFR 71.19, the portion of the US Code of Federal Regulations outlining the steps for SPHPs. Recognizing this challenge, an AgView update was implemented in late 2023, with a successful field test conducted in Ohio and Indiana. This update significantly streamlines the SPHP process making it easier and more efficient. Once the SPHPs are approved, the movements are automatically provided to the state animal health officials through the producer's AgView account, eliminating an administrative burden of reporting movements manually.

"If the herd veterinarian for a swine production system wants to set up a commuter agreement, it requires approval by the state veterinarian, USDA Area Veterinarian in Charge, attending veterinarian, and site or barn manager from the sending state. Then those same persons in the receiving state must also sign off," explained Dr Patrick Webb, assistant chief veterinarian at National Pork Board. "To create, review, revise, and share the plan among all eight people for their approval could take up to two months. With AgView, the process is easier and will save a lot of valuable time."

Dr Webb said state animal health officials and production companies were eager for a solution to the time-intensive systems in place today. "Using the Account Manager, Partner Account feature in AgView, the herd veterinarian or assigned staff person can create the needed SPHP documentation for companies moving pigs within their production systems, inviting all required signatories to the process," he explained.

Similar to cloud-based systems, stakeholders engaged in the SPHP process will login to AgView, review the documentation prepared by the production company's herd veterinarian or assigned staff person, and request revisions as needed. The details of the SPHP, including revisions and resolutions, will be visible to all eight people required to approve the agreement. Approval signatures occur in AgView, which then files the documentation and provides the movements in real-time as they are uploaded into the producer's AgView account. This collaborative process within AgView replaces email chains, tracking of eight stakeholders' input, review of revisions, and emailing spreadsheets of documented movements to the appropriate agencies every month.

"Because this process is all contained as a capsule within AgView, state animal health officials and USDA Area Veterinarians in Charge can visualize swine movements in real time, rather than delayed by up to 30 days through monthly spreadsheets. This greatly improves their situational awareness," Dr Webb explained. "There is no additional cost to pork producers for AgView which allows for sharing of traceability data prior to, or during, a swine disease outbreak. AgView also communicates with software platforms that state animal health officials use in the event of a foreign animal disease outbreak. Producers own their data in AgView, which is secure and confidential."

Traceability has a role in swine disease management and response, provides for business continuity which can help decrease the economic impacts of an outbreak, informs trading partners of product safety, unifies response nationally, and safeguards the pork industry's future. During the 2024 National Pork Industry Forum, producer delegates approved a resolution seeking to make traceability a mandatory process. The resolution was submitted to USDA and the anticipated implementation will occur in 2027.

An opt-in software program with no cost to the pork producer, AgView promotes business continuity for America's pig farmers by making disease traceback and pig movement data available to state animal health officials at the producer's discretion in the event of a foreign animal disease outbreak. AgView has been designed to support voluntary participation in US Swine Health Improvement Plan (US SHIP). Implementation of SPHPs may be one way that producers can demonstrate compliance with the voluntary US SHIP traceability standard.

To learn more about AgView, request a product demonstration, or learn more about creating commuter agreements, call 800-767-5675 or email **help@agview.com**.

Kills deadly pathogens*

African Swine Fever Virus (ASFv),
Porcine Reproductive and Respiratory Syndrome virus (PRRSv),
Porcine Epidemic Diarrhea virus (PEDv)

All-in-one cleaner and disinfectant

Excellent foaming ability allows you to easily see surface coverage

Tackle the toughest pathogens

There are few diseases that have the devastating impact to the swine industry compared to African Swine Fever. Intervention™ Disinfectants, powered by Accelerated Hydrogen Peroxide®, is formulated to kill deadly pathogens that threaten your animals. Its powerful formulation is designed to clean, disinfect and protect, while delivering the confidence and peace of mind you deserve.

InterventionDisinfectants.com

VIROX® TECHNOLOGIES INC. | Creators of ACCELERATED HYDROGEN PEROXIDE® Patented | INTERvention®

Intervention® is a member of the Virox family of brands.

*Refer to product label and reference sheet for full list of claims, contact times and use-directions.

Student abstracts due September 11 for AASV presentation and scholarship opportunity

The American Association of Swine Veterinarians announces an opportunity for veterinary students to make a scientific presentation at the AASV Annual Meeting in San Francisco, California on Sunday, March 2, 2025. Interested students are invited to submit a one-page abstract of a research paper, clinical case study, or literature review for consideration. The submitting student must be a current (2024-2025) student member of the AASV at the time of submission and must not have graduated from veterinary school prior to March 2, 2025.

Submissions are limited to one abstract per student. Abstracts and supporting information must be submitted online at **cmt3.research.microsoft.com/AASV2025**.

Submissions must be completed before 11:59 PM Central Daylight Time on Wednesday, September 11, 2024 (firm deadline). Late submissions will not be considered. Students will receive an email confirmation of their submission. If they do not receive the confirmation email, they must contact Dr Justin Brown (**brownjt@iastate.edu**) by Friday, September 13 with supporting evidence that the submission was made in time; otherwise the abstract will not be considered for judging. The abstracts will be reviewed by an unbiased, professional panel consisting of private practitioners, academicians, and industry veterinarians. Fifteen abstracts will be selected for oral presentation in the Student Seminar at the AASV Annual Meeting. Students will be notified of the review results by October 15, 2024, and those selected to participate will be expected to provide the complete paper or abstract reformatted for publication in the conference proceedings by November 15, 2024.

Student Seminar

Student participants will receive presentation awards and compete for scholarships awarded through the AASV Foundation. The oral presentations will be judged to determine the scholarship amount.

The Zoetis Foundation has provided a $26,250 grant to the AASV Foundation to support awards and the top student presenter scholarship. This includes a $750 award for the student presenter of each paper selected for oral presentation at the meeting. Through the Zoetis Foundation's grant, the AASV Foundation will also award a $5000 scholarship to the student whose project and oral presentation are judged best overall.

Elanco Animal Health has provided $20,000 in additional funding enabling the AASV Foundation to award scholarships of $2500 each for 2nd through 5th place, $1500 each for 6th through 10th place, and $500 each for 11th through 15th place.

Student Poster Session

Abstracts that are not selected for oral presentation in the Student Seminar will be considered for presentation in a poster session at the Annual Meeting. Those who participate in the poster session will receive a $500 presentation stipend funded by the AASV Foundation through a grant from the Zoetis Foundation. All students selected to make a poster presentation will be expected to supply a brief paper formatted for publication in the conference proceedings by November 15. The guidelines for preparing posters for the display are available at **aasv.org/annmtg/presenters/posters**.

Veterinary Student Poster Competition

The presenters of the top fifteen poster abstracts compete for scholarship awards ranging from $200 to $500 in the Veterinary Student Poster Competition, sponsored by United Animal Health. See **aasv.org/foundation/veterinary-students/scholarship-competition/poster-competition** for poster judging details.

In all cases, the student presenter is required to attend the meeting in person to make the presentation. Recorded/virtual presentations will not be accepted unless the meeting converts to an entirely virtual event.

Complete information for preparing and submitting abstracts is available at **aasv.org/foundation/veterinary-students/scholarship-competition/abstract-submission**. The rules for submission should be followed carefully. For more information, contact the AASV office by phone, 515-465-5255, or email, **aasv@aasv.org**.

AASV news continued on page 225

Funding Available for Certified Swine Sample Collector (CSSC) Training

Who can apply for funds?

- Veterinarians
- State Animal Health Officials
- State Pork Associations
- University Extension Personnel

For additional information on how to apply for funding, visit www.aasv.org, www.securepork.org/cssc, or contact Dr. Pam Zaabel at zaabel@aasv.org.

Funding process:

1. Complete and submit an application September 1 – October 15, 2024.
2. Await panel review of the applications based on the training descriptions, adherence to program standards, training evaluation process, and cost effectiveness of the training.
3. Implement training December 1, 2024 – October 1, 2025.
4. Submit a final report once the training is complete to receive reimbursement.

CSSC

For more information on the training program

If you are ready to start training, contact the state animal health officials in the state in which you wish to train individuals

AASV news continued from page 223

Industrial Partners submissions due October 1

The American Association of Swine Veterinarians invites submissions for the Industrial Partners oral and poster sessions at the 56th AASV Annual Meeting. This is an opportunity for commercial companies to make brief presentations of a technical, educational nature to members of the AASV. The conference will be held March 1-4, 2025, in San Francisco, California.

The oral sessions consist of a series of 15-minute presentations scheduled from 1:00 to 5:00 PM on Sunday, March 2. A poster session takes place the same day. Poster authors will be required to be stationed with their poster from noon to 1:00 PM, and the posters will remain on display throughout the afternoon and the following day for viewing.

SUBMISSION PREREQUISITE: All companies submitting topics for presentation during the Industrial Partners sessions must register to participate in the AASV Technical Tables Exhibit before October 1.

SUBMISSION LIMIT: Restricted program space necessitates a limit on the number of presentations per company. Companies that are a member of the *Journal of Swine Health and Production* Industry Support Council and sponsor the AASV e-Letter may submit three topics for oral presentation. Companies that are either a member of the JSHAP Industry Support Council or sponsor the AASV e-Letter may submit up to two topics. All other companies may submit one topic for oral presentation. In addition, every company may submit one topic for poster presentation, but the topic must not duplicate the oral presentation. All topics must represent information not previously presented at the AASV Annual Meeting or published in the meeting proceedings.

To participate, send the following information to **aasv@aasv.org** by October 1, 2024:

1. Company name
2. Presentation title
3. Brief description of the presentation content
4. Presenter name (one only) and contact details (mailing address, telephone number, and email address)
5. Whether the submission is intended for oral or poster presentation

Receipt of submissions will be confirmed by email. Presenters will be notified of their acceptance by October 15 and must submit a paper by November 15 for publication in the meeting proceedings. Failure to submit the paper in a timely manner will jeopardize the company's future participation in these sessions.

The presenting author is required to register* for and attend the meeting in person to make the presentation. Recorded/virtual presentations will not be accepted unless the meeting converts to an entirely virtual event.

*Presenters may register for the meeting either as a Tech Table representative or as an individual registrant (nonmember oral and poster presenters are eligible to register at the AASV regular member rate). The AASV does not provide a speaking stipend or travel reimbursement to Industrial Partners presenters.

Financial assistance available to conduct CSSC trainings – Apply today!

During July 2024, AASV was awarded a grant from the US Department of Agriculture's National Animal Disease Response and Preparedness program to provide funding to stakeholders who facilitate Certified Swine Sample Collector (CSSC) training. Having individuals trained to assist with sample collection on farms of all sizes is essential to facilitate a faster foreign animal disease (FAD) response. Collecting high quality samples on the farm and sending them to the laboratory in a timely fashion will speed up response efforts, assist with FAD diagnosis, and help facilitate business continuity for farms free of infection. Funds from this grant will help build sample collection capacity through training of producers, caretakers, veterinary staff, extension personnel, and animal health officials. While category II accredited veterinarians are required to perform the actual training according to the CSSC program standards, other veterinarians, state animal health officials (SAHOs), state pork associations, and university extension personnel can help organize or facilitate CSSC trainings to help producers of all sizes prepare for an FAD outbreak and response.

Veterinarians, SAHOs, state pork associations, and extension personnel are eligible to apply for CSSC training program funds by submitting an application before October 15, 2024. All applications will be reviewed and evaluated based on the training description, training compliance with the program standards, the training evaluation process, and cost effectiveness of the training. Various types of approaches, including a group approach or on a farm-by-farm basis, are eligible for funding support. Stakeholders selected to receive funds will have until October 1, 2025, to complete their CSSC training sessions and submit a final report to receive reimbursement. For additional information on the CSSC training program funds or to submit an application, visit **aasv.org** or contact Dr Pam Zaabel at **zaabel@aasv.org**.

AASV news continued on page 227

ENDOVAC-Porci®
with Immune Plus

MORE Than *Just* a Vaccine

Studies have determined that ENDOVAC-Porci, a core antigen vaccine with an immunostimulant, provides pigs broad-spectrum protection against the enteric & respiratory effects of gram-negative bacterial diseases.

Lawsonia Intracellularis Challenge:
ENDOVAC-Porci vs. Porcilis® Ileitis vs. Controls

- **29.0%** (7.7 lb) higher weight gain over controls
- **No** statistical difference in weight gain compared to Porcilis Ileitis
- **40.9%** better clinical scores than controls
- **8.2%** better clinical scores than Porcilis Ileitis
- **37.6%** better fecal scores to controls
- **18.2%** better fecal scores than Porcilis Ileitis

Clinical & Fecal Scores

Study days 58-70:
Clinical Scores: 0 Normal, 1 Mild, 2 Moderate, 3 Severe
Fecal Scores: 0 Normal, 1 Soft, 2 Loose, 3 Watery

Scoring	Saline	ENDOVAC-Porci®	Porcilis® Ileitis
Clinical	24.7^{a}	14.6^{b}	15.9^{ab}
Fecal	27.4^{a}	17.1^{b}	20.9^{ab}

Treatment means with different superscripts differ from each other ($P < 0.05$)

E. coli and Pasteurella Challenge:
ENDOVAC-Porci vs. Controls

- **11.1%** pre-wean survivability advantage
- **7.9%** (1.05 lbs) higher average weaning weight
- **13.6%** (3.3 lbs) higher final 42-day weight
- **61.9%** less mortality over the entire study
- **75.6%** better clinical scores
- **50.8%** better fecal scores

Clinical & Fecal Scores

Study days 22-35:
Clinical Scores: 0 Normal, 1 Mild, 2 Moderate, 3 Severe
Fecal Scores: 0 Normal, 1 Soft, 2 Loose, 3 Watery

Treatment	Saline	ENDOVAC-Porci®	P-value
Clinical	1.19	0.29	.05
Fecal	1.95	0.96	.05

Effect of treatment ($P < 0.01$)

To review the studies that back up the science, scan the QR Code.

AASV news continued from page 225

Who are the "champions" of AASV? Nominate them for an award!

The 2025 AASV Annual Meeting theme exhorts each of us to "be the pig's champion." As nominations open for the awards to be presented at the meeting, it seems fitting to ask, "Who are the champions of AASV?" That is, who are the members that elevate the profession by striving for excellence in their role within it?

Who comes to your mind as a champion industry leader? A first-rate teacher or researcher? An exemplary tech services veterinarian? Someone who says "yes" and does a great job when asked to serve the association? An outstanding practitioner or young swine vet? It is time to give them the recognition they deserve! Nominate them for one of the following six awards to be presented in San Francisco, California.

Howard Dunne Memorial Award – Given annually to an AASV member who has made a significant contribution and rendered outstanding service to the AASV and the swine industry.

Meritorious Service Award – Given annually to an individual who has consistently given time and effort to the association in service to the AASV members, AASV officers, and the AASV staff.

Swine Practitioner of the Year – Given annually to the swine practitioner (AASV member) who has demonstrated an unusual degree of proficiency in the delivery of veterinary service to his or her clients.

Technical Services/Allied Industry Veterinarian of the Year – Given annually to the technical services or allied industry veterinarian (AASV member) who has demonstrated an unusual degree of proficiency and effectiveness in the delivery of veterinary service to his or her company and its clients as well as given tirelessly in service to the AASV and the swine industry.

Outstanding Swine Academic of the Year - Given annually to an AASV member employed in academia who has demonstrated excellence in teaching, research, and service to the swine veterinary profession. Faculty members, graduate students, and researchers are eligible to receive this award.

Young Swine Veterinarian of the Year – Given annually to a swine veterinarian who is an AASV member, 5 years or less post graduation, who has demonstrated the ideals of exemplary service and proficiency early in his or her career. AASV members who received their veterinary degree in 2019 through 2023 are eligible to be considered for the 2025 award.

Are you wondering who has been recognized in the past? See **aasv.org/awards/** for a list of the previous recipients of each award.

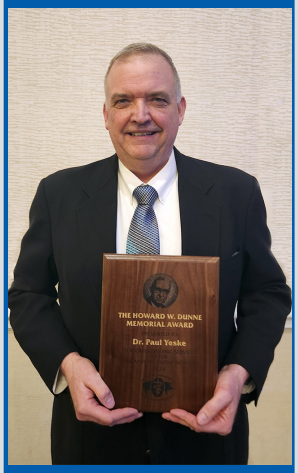
Nominations are due December 11. The nomination letter should specify the award and cite the qualifications of the candidate for the award. Submit nominations by email, **aasv@aasv.org**, or mail to 830 26th Street, Perry, Iowa 50220.

2024 AASV Award Recipients

Swine Practitioner of the Year

Dr Matt Allerson

Howard Dunne Memorial Award



Dr Paul Yeske

Meritorious Service Award

Dr Nathan Winkelman

Outstanding Swine Academic

Dr Rodger Main

Technical Services/ Allied Industry Veterinarian

Dr Melissa Billing

Young Swine Veterinarian of the Year

Dr Dylan Lape

YOUR HEALTHY PIG PARTNER

Cambridge Technologies combines innovative diagnostics and surveillance with proven autogenous vaccines to bring Precision Vaccinology® to today's leading veterinarians.

- Complete diagnostic menu
- Total vaccine customization
- Innovative manufacturing techniques
- Legendary customer support

Visit our website today to learn more about putting our tradition of innovation to work for you.

VISIT WITH US AT THE LEMAN CONFERENCE TO LEARN MORE!

877-298-1321

INFO@CAMBRIDGETECHNOLOGIES.COM
WWW.CAMBRIDGETECHNOLOGIES.COM
1525 BIOSCIENCE DRIVE,
WORTHINGTON, MN 56187

SCAN QR

56th AASV Annual Meeting

March 1-4, 2025

San Francisco, California

AMERICAN ASSOCIATION OF SWINE VETERINARIANS

RESERVE LODGING NOW:

San Francisco Marriott Marquis

aasv.org/annmtg/attendees/lodging/

ALL HAIL *the Queen*

With the right honor and care, sows will drive profitability for your system. Keep her healthy to reign for three parities and more with the right products and partner at your side.

Pharmgate Animal Health offers a consultative approach to combat sow mortality by finding solutions to your sow farm's health challenges.

Let us show you how we can help.

pharmgate.com/usa/sows

Pharmgate
ANIMAL HEALTH

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Federal law restricts medicated feed containing this veterinary feed directive (VFD) drug to use by or on the order of a licensed veterinarian.

Pursuing board certification in Swine Health Management? The AASV Foundation can help!

For the second year, the AASV Foundation is offering a scholarship to support an AASV member pursuing certification in Swine Health Management (SHM) through the American Board of Veterinary Practitioners (ABVP). As part of its mission to support the development and scholarship of students and veterinarians interested in the swine industry, the foundation seeks to relieve some of the financial burden associated with achieving board certification.

The scholarship provides reimbursement for SHM certification-related expenses incurred within the first 3 years following the scholarship award date. Eligible expenses include such things as travel, course fees, and textbooks. Reimbursement will not cover lost income. The maximum amount of reimbursement is $10,000. An additional incentive payment of $10,000 will be paid upon successful and timely achievement of ABVP-SHM certification.

Scholarship applications may be submitted by candidates who have successfully passed the ABVP-SHM entry examination administered during the AASV Annual Meeting. Applicants must have a DVM or VMD degree and at least 5 years of continuous membership in the AASV prior to sitting the exam.

The applicant must provide a letter of application that includes the date of passing the exam, a brief description of the applicant's background, financial needs, interest in swine health, reasons for pursuing board certification in Swine Health Management, and how the applicant anticipates serving the swine industry and AASV after becoming board certified. The application must also include a curriculum vitae and contact information for three references. At least one (1) reference must be a board-certified diplomate of a recognized veterinary specialty organization.

Applications are due October 1. A selection committee designated by the foundation will review the applications and select one awardee. The successful applicant will be notified in early January.

For more information, visit **aasv.org/foundation/swine-veterinarians/abvp-scholarship.** Submit applications by email, **foundation@aasv.org**, or mail to:

AASV Foundation
830 26th Street
Perry, IA 50220

Swine externship grant program expanded to include SMEC courses

Veterinary students, are you planning a swine-based externship experience? The AASV Foundation provides grants of up to $500 to students who complete an externship of at least 2 weeks in a swine practice or mixed-animal practice with a considerable swine component. This grant opportunity now includes courses offered by the Swine Medicine Education Center (SMEC).

Any AASV student member in veterinary school who fulfills the requirements is eligible to apply. There is a limit of one grant per student. More information can be found at: **aasv.org/foundation/veterinary-students/externship-grants**.

To help locate the perfect opportunity, check out the roster of practices and companies willing to mentor students at **aasv.org/career-services/externships-internships**.

AASV members, does your practice or company host students? Please contact Alternate Student Delegate Mallory Wilhelm (**studentdelegate@aasv.org**) to have your internship and externship opportunities included in AASV's online listing. Make sure students who visit your practice are aware of the opportunity to join AASV and apply for the grant!

Thank you, sponsors!

AASV FOUNDATION GOLF OUTING

Veenker Memorial
Golf Course - Ames, Iowa
Tuesday, September 10
11:00 AM - 6:00 PM

Awards Dinner
Boehringer Ingelheim Animal Health USA

Lunch
Merck Animal Health

Beverages
Zoetis

Golf Holes
Agri-King | Aurora Pharmaceutical
Huvepharma | Insight Wealth Group
Kemin Animal Nutrition & Health | MetaFarms
National Pork Producers Council
Veterinary Pharmaceutical Solutions

The generous support provided by these industry partners not only enhances the enjoyment of the event for participants, it also helps fund the foundation's many grants and scholarships that "ensure the future and create a legacy" for current and future swine veterinarians. See aasv.org/foundation.

AMERICAN ASSOCIATION OF SWINE VETERINARIANS FOUNDATION

aasv.org/foundation/golf

Support available for pursuit of board certification in animal welfare

The AASV Foundation Board of Directors continues to accept scholarship applications from AASV members seeking board certification in the American College of Animal Welfare (ACAW).

The scholarship provides annual reimbursements for expenses related to the ACAW certification program, including travel, course fees, and textbooks, with a maximum reimbursement amount of $20,000. Reimbursement will not cover lost income. An incentive payment of $10,000 will be issued upon successful and timely completion of ACAW board certification.

The applicant must have a DVM or VMD degree and at least 5 years of continuous membership in the AASV.

To apply, the applicant must submit a curriculum vitae, an ACAW-approved program plan, and three letters of reference (one of which must come from the applicant's mentor). Accompanying these materials, the applicant's letter of application should provide a brief description of the applicant's background and interest in animal welfare and reasons for pursuing board certification in ACAW, how the scholarship funds will be used if awarded, and how the applicant anticipates serving the swine industry and AASV as a result of becoming ACAW board certified.

A selection committee will review and select awardees as applications are received. There is no submission due date, but there is a limit to the amount of funding available each year.

For more information, contact the AASV Foundation by phone, 515-465-5255, or email, **foundation@aasv.org** or visit **aasv.org/foundation/swine-veterinarians/acaw-scholarship**.

UNITED®
ANIMAL HEALTH

WE ♡ MOMS

Systemwide performance starts with the sow.

Strong sow research can change your system.

UnitedAnH.com/Mother

UPCOMING MEETINGS

Four Star Veterinary Service Pork Industry Conference

September 10 - 11, 2024 (Tue-Wed)
Horizon Convention Center
Muncie, Indiana

For more information:
Web: **web.cvent.com/event/838b06a0-bd52-4076-8afe-01f17428b6d2/summary**

Allen D. Leman Swine Conference

September 21 - 24, 2024 (Sat-Tue)
St Paul River Center
Saint Paul, Minnesota

For more information:
Web: **lemanconference.umn.edu**

US Animal Health Association 128th Annual Meeting

October 10 - 16, 2024 (Thu-Wed)
Gaylord Opryland Hotel
Nashville, Tennessee

For more information:
Web: **usaha.org/meetings**

13th Leman China Swine Conference & World Swine Industry Expo

October 25 - 27, 2024 (Fri-Sun)
Western China International Expo City
Chengdu city, Sichuan province, China

For more information:
Tel: +86 010 60600195
Email: **andyzhang@shixin-expo.com**
Web: **lemanchina.com**

AVMA Diversity, Equity, Inclusion, and Wellbeing Summit

November 7 - 9, 2024 (Thu-Sat)
Atlanta, Georgia

For more information:
Web: **avma.org/events**

National Institute for Animal Agriculture's 14th Annual Antibiotics Symposium

November 19 - 21, 2024 (Tue-Thu)
Colorado State University SPUR Campus
4777 National Western Dr
Denver, Colorado

For more information:
Web: **animalagriculture.org/events/14th-annual-antibiotics-symposium/**

Pig Research Summit 2024

November 20 - 21, 2024 (Wed-Thu)
Crowne Plaza Copenhagen Towers
Copenhagen, Denmark

For more information:
Web: **pigresearchsummit.com**

North American PRRS Symposium

December 8 - 9, 2024 (Sun-Mon)
InterContinental: Chicago Magnificent Mile
505 N. Michigan Ave
Chicago, Illinois

For more information:
Web: **vetmed.illinois.edu/about-the-college/pathobiology/north-american-prrs-symposium/**

2025 AVMA Veterinary Leadership Conference

January 9 - 11, 2025 (Thu-Sat)
Chicago, Illinois

For more information:
Web: **avma.org/events/veterinary-leadership-conference**

56th Annual Meeting of the American Association of Swine Veterinarians

March 1 - 4, 2025 (Sat-Tue)
San Francisco Marriott Marquis
San Francisco, California

For more information:
Tel: 515-465-5255
Email: **aasv@aasv.org**
Web: **aasv.org/annmtg**

28th Congress of the International Pig Veterinary Society

June 16 – 19, 2026 (Tue-Fri)
Nong Lam University HCMC
Ho Chi Minh City, Vietnam

For more information:
Web: **ipvs2026.vn**

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

AASV Industry Support Council

The Journal of Swine Health and Production **is made possible by the generous support of these Industry Support Council members:**

JSHAP Resources

AASV resources	aasv.org
Author guidelines	aasv.org/author-guidelines
Journal of Swine Health and Production	aasv.org/jshap
Membership information	aasv.org/membership
Subscription information	ecom.aasv.org/journal
Upcoming meetings	aasv.org/meetings
Industry Support Council member info	aasv.org/advertising