Journal of
SWINE HEALTH & PRODUCTION
January and February 2025 • Volume 33, Number 1

Influenza virus affects feed efficiency differently between two pig breeds
Er J

Assessing point-of-care anemia testing in pigs
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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:

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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 33, Number 1; January and February

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JSHAP SPOTLIGHT

New JSHAP features

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The *Journal of Swine Health and Production* is excited to announce two new features. Scientific articles are now published online ahead of print at **aasv.org/jshap-online-ahead-of-print** giving readers earlier access to the latest findings, without the wait for the full JSHAP issue to be compiled and printed. Newly available articles will be announced in the weekly AASV e-Letter. The second new JSHAP feature is the implementation of a new license. While the copyright for manuscripts published in JSHAP is still held by the AASV, published articles will be licensed using Creative Commons CC BY-NC 4.0 International (**creativecommons.org/licenses/by-nc/4.0**). This license allows users to share, copy, and redistribute the material in any medium or format and remix, transform, and build upon the material as long as proper attribution is given and the material is used for noncommercial purposes.

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Are you going to San Francisco?

"If you're going to San Francisco, be sure to..." I am going to stop here and let you keep humming the tune to this catchy 1967 counter-culture ballad and suggest a few things you might be sure to do:

- Register for the 56th AASV Annual Meeting and a preconference seminar or two.
- Reserve a room in the conference hotel's AASV room block by February 4, 2025.
- Make your travel arrangements, scheduling your departure time after 12 PM PST on March 4 so you don't miss any of the Tuesday general session.
- Update your AASV directory and LinkedIn profiles. Add a current picture so your colleagues recognize you.

Are you already tired? You still must pack, set your out-of-office notifications, and fill in your social calendar, which should include the AASV/AASVF Monday Luncheon and AASV Awards Reception where we recognize our outstanding students and colleagues. A professional meeting "done right" always feels like a whirlwind to me. One colleague gives his account:

> Wake up early to have breakfast, then attend most of the scientific program, chatting along with other pig professionals about swine health and production plus any other swine emerging topic, plus doing this, plus doing that...busy eh...successful meeting I would say!

In 2023, I had the privilege to attend the 55th Annual Meeting as well as the 27th International Pig Veterinary Society Congress, held in conjunction with the 15th European Symposium of Porcine Health Management, and Association of Mexican Veterinary Specialists in Swine (AMVEC). As I reflect on those meetings, I realized that swine veterinarians worldwide are alike in a lot of ways. The most striking to me, which Dr Karriker described in his November/December 2024 JSHAP Officer Message, is the number of swine clinicians and scientists worldwide and the constant desire of swine veterinarian's for evidence as a foundation. Each of these meetings recorded over 1000 registrants and as many as 2700 attendees; a clear indication that the experiences and research delivered at these meetings stand to be very impactful for the pigs, their owners and caretakers, and the consumer.

Another similarity of swine veterinarians is our appreciation for preparedness, whether the emergence of African swine fever or changes to pig rearing standards. The AASV Annual Meeting requires preparation on the part of the Program Planning Committee, the AASV staff, session chairs, speakers, and attendees. With that in mind, I asked some of our AASV members who regularly attend the AASV Annual Meeting and other professional conferences to share what they do before, during, and after.*

* Thank you to the following AASV members that provided input for this message: Drs Daniel Moraes, Enrique Corona, and Jessica Seate.

"Although virtual training events and webinars are increasing in popularity, they do not replace the in-person experience."

Before the meeting

- Seek out sessions or discussions on topics outside your direct expertise. This year it might be the ChatPIG seminar on Saturday or the Pig 101 on Pig One-on-One session on Monday.
- Read the proceedings papers in advance, jot down a few questions you might have after reading the paper to enhance your engagement and get the most out of the session. This will be especially helpful during the "Ask the experts: How is a herd-specific vaccine produced?" panel discussion being held on Tuesday.

During the meeting

- Get involved in the conference! Attend and join a committee meeting on Saturday morning or volunteer for the Vet Hunt or Speed Networking event.
- Attend the research talks and view the posters. Research Topics and Student Seminar presentations and posters are juried and guaranteed to focus on applied swine health.
- Do not be afraid to ask and answer questions candidly. It builds trust amongst students and colleagues that we can be life-long learners. A graduate student shared that "it is great to hear from veterinarians about what is, and what is not, working. Learning from somebody that already has exposure to the topic can make you think about how you can approach it differently or replicate it in your reality."
- Visit the technical tables, a great place to learn about new technologies and potentially arrange a trial for or give feedback on a product.
- Set a personal goal to meet and interact with several new people. Contact them beforehand and ask to schedule a time to talk and learn

Officer's message continued on page 7

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Officer's message continued from page 5

more about what they do and their routine. Some suggestions would be our global attendees that include speakers in the Global Hot Topics session and our AASV Board or Director members from Districts 10 (Mexico) and 11 (Canada).

After the meeting

- Make sure to thank staff, members of the Program Planning Committee, chairpersons, speakers, sponsors, and yourselves for taking the time to come, listen, learn, and "Be the Pig's Champion."
- Arrange time with your peers, associates, or even form a journal club to review the key takeaways and list any action items. For one colleague, these are crucial steps to reinforce connections, share insights, and create collaborations.

Although virtual training events and webinars are increasing in popularity, they do not replace the in-person experience. To close, I hope you are coming to the 56th AASV Annual Meeting in San Francisco; I will be sure to find you there. Safe travels!

Rebecca Robbins, DVM, PhD
AASV Vice President

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Aspirin use in animals is illegal

Only US Food and Drug Administration (FDA)-approved drugs may be administered to animals. Aspirin (acetylsalicylic acid) is not FDA approved for use in animals or humans. Thus, it cannot be legally used to treat animals. Sodium salicylate is also not FDA approved and likewise cannot be used.

In early October 2024, the FDA published a Dear Veterinarian Letter (**fda.gov/animal-veterinary/product-safety-information/dear-veterinarian-letter-regarding-use-aspirin-products-lactating-dairy-cattle**) informing veterinarians that the use of aspirin products in dairy cattle was illegal because aspirin is not an FDA-approved drug. The FDA has confirmed that while this letter specifically addresses the use of aspirin in dairy cattle, the same use restriction applies to all animals including swine. Since this announcement, AASV staff have fielded several questions from AASV members asking about the extra-label use of these products under the Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA). Under AMDUCA, only the use of FDA-approved drugs is allowed, thus negating the use of aspirin and sodium salicylate in animals.

So, what is an FDA-approved drug? It is a drug that has gone through the FDA approval process meaning the drug is safe and effective when it is used according to the label. An FDA approval also ensures that the drug's strength, quality, and purity are consistent from batch to batch, and that the drug's labeling is truthful, complete, and not misleading. Any FDA-approved drug will have either a New Animal Drug Application (NADA) number, or for an approved generic animal drug, the Abbreviated New Animal Drug Application (ANADA) number. In most cases, FDA-approved brand name drugs will have the statement, "Approved by FDA under NADA # XXX-XXX" printed on the label. In the case of an FDA-approved generic animal drug, the statement, "Approved by FDA under ANADA # XXX-XXX" will appear on the label.

In 1996, the FDA issued a final rule implementing AMDUCA. This rule delineates the guidelines governing the extra-label use of animal and human drugs. It applies to both prescription and over-the-counter drugs. Prior to the enactment of AMDUCA, the use of any drug except in a manner specifically outlined on the label rendered the drug "unsafe" in the eyes of the law, making its use illegal.[1]

Under AMDUCA, extra-label drug treatment modalities are only allowed when the health of an animal is threatened or suffering or death may result from failure to treat. Extra-label drug use for production uses is prohibited. According to the FDA, the extra-label use of drugs for reproductive purposes would, in most cases, not be considered treatment and is thus not allowed under AMDUCA. Additionally, AMDUCA does not allow for extra-label use if an FDA-approved food-animal drug that contains the needed ingredient, in the proper dosage form, and is labeled for and effective against the condition being treated exists. Extra-label use of a drug is permitted if the existing labeled drug is clinically ineffective provided that the veterinarian has a basis for determining that the approved drug is ineffective in the animals being treated. Drug cost is not an acceptable reason for

"Under AMDUCA, only the use of FDA-approved drugs is allowed, thus negating the use of aspirin and sodium salicylate in animals."

extra-label use. Preventive extra-label use is allowed if the veterinarian can substantiate that the health of the animals is threatened. However, AMDUCA does not allow for the extra-label use of any drugs administered through the feed. Extra-label administration of feed-grade antibiotics is illegal in all circumstances.[2]

Drugs may be used in an extra-label manner as prescribed under AMDUCA only if all the following conditions are met[2]:

1. There is a valid veterinarian/client/patient relationship
   a. The veterinarian has assumed responsibility for making clinical judgments regarding the health of the animals and the need for medical treatment, and the client has agreed to follow the veterinarian's instructions.
   b. The veterinarian has sufficient knowledge of the animals to initiate at least a general or preliminary diagnosis of the medical condition of the animals. This means that the veterinarian has recently seen and is personally acquainted with the keeping and care of the animals by virtue of an examination of the animals or by medically appropriate and timely visits to the premises where the animals are kept.
   c. The veterinarian is readily available for follow-up evaluation, or has arranged for emergency coverage, in the event of adverse reactions or failure of the treatment regimen.
2. Use is permitted only by or under the supervision of a veterinarian. It is illegal for a layperson to use drugs in an extra-label manner without the approval of a veterinarian.
3. Only FDA-approved animal and human drugs may be used in an extra-label manner.

4. The AMDUCA applies only to dosage form drugs and drugs administered in the water. The Act does not allow for extra-label use through the feed.
5. The veterinarian is responsible for establishing prolonged withdrawal times to ensure no violative residues or any residues which may cause public harm. Additional information on specific drugs may be found at **farad.org**.
6. FDA may specifically disallow the use of certain drugs or classes of drugs. The following drugs are currently prohibited for use in food animals: chloramphenicol, clenbuterol, diethylstilbestrol, dimetridazole, ipronidazole, other nitroimidazoles, dipyrone, furazolidone, nitrofurazone, sulfonamide drugs in lactating dairy cattle (except approved use of sulfadimethoxine, sulfabromomethazine, and sulfaethoxypyridazine), fluoroquinolones, glycopeptides, phenylbutazone use in female dairy cattle 20 months of age or older, and cephalosporins (not including cephapirin) in cattle, swine, chickens, or turkeys for disease prevention purposes, at unapproved doses, frequencies, durations, or routes of administration, or if the drug is not approved for that species and production class.
7. The AMDUCA only allows for the therapeutic extra-label use of drugs. Use for production reasons is not allowed. Drug cost is not a factor in determining extra-label drug use.
8. Records must be maintained indicating the drug used (name and active ingredient), route of administration, dosage, number of animals treated, species treated, condition being treated, duration of treatment, and withdrawal time. These records must be kept for 2 years and are subject to FDA inspection.
9. Drugs dispensed for extra-label use must be labeled individually and the label must contain the name and address of the prescribing veterinarian (or the name of the veterinarian and the name and address of the dispensing pharmacy), the established name of the drug, directions for use (including species; identification of the animal or herd, flock, pen, lot, or other group; dosage frequency; route of administration; and duration of therapy), any cautionary statements, and withdrawal time. The FDA states that case-labeling is appropriate when large numbers of animals need to be treated in an extra-label manner for a short period.

The AASV has designed a flow chart to aid veterinarians with decision-making regarding the appropriate use of drugs in an extra-label manner. This and other reference materials can be accessed under the "Vet Issues" tab on the AASV homepage (**aasv.org/antimicrobial-use**). In addition, veterinarians who have questions about AMDUCA or the extra-label use of drugs may contact FDA Center for Veterinary Medicine at **AskCVM@fda.hhs.gov** or 1-888-INFO-FDA (1-888-463-6332).

Harry Snelson, DVM
Executive Director

References

1. Waddell, John T. A practical look at AMDUCA and the risks for swine veterinarians. In: *Proceedings of the AASV Annual Meeting*. American Association of Swine Veterinarians; 2001:321-329.

2. Extralabel Drug Use in Animals. 21 CFR §530 (2024). **https://www.ecfr.gov/current/title-21/chapter-I/subchapter-E/part-530**

Exploring a city full of expectations

During most travel, especially business travel, you should have expectations. At the AASV Annual Meeting, for example, you should expect events to facilitate networking among veterinarians and students. You should expect celebrations to recognize the achievements of colleagues. You should expect to learn about tried, true, and new products and technologies advancing swine health. And you should certainly expect excellent, science-based continuing education delivered by experienced speakers.

The AASV Annual Meeting Program Planning Committee met in June to develop the scientific program. This committee had many first-time participants, with only a few individuals having previously served on an AASV Annual Meeting Program Planning Committee. This group recognized what is important to the health of all pigs and what is important to any veterinarian who sees swine, and they were willing to embrace an opportunity to create a program for every size and shape of swine veterinarian.

With a fresh look, this committee designed an incredible program with something for everyone that will exceed your educational expectations.

At the AASV Annual Meeting, however, you should also expect the unexpected. An unexpected question during a seminar or session could lead to a new research priority. An unplanned visit to a committee meeting could lead to a new leadership opportunity. An emergent issue discussed during another committee meeting could lead to a new passion. A new connection made with a person sitting across from you at the AASV and AASV Foundation Luncheon could lead to a new mentor/mentee relationship. A friendly hallway conversation during a refreshment break could lead to a new job opportunity. A conveniently shared Uber could lead to a life-long friendship. The unexpected connections you make could leave you feeling like part of a family.

Business travel, including traveling to the AASV Annual Meeting, is an investment. It should be about the educational content, is rarely about hassle-free travel, is only sometimes about the location, and is almost always about the people.

But if you need more convincing about the 2025 AASV Annual Meeting location, San Francisco has much to offer anyone looking to tack on a traditional tourist stop or explore hidden gems. Consider inviting one of those new connections for a quick outing or extended stay!

Not to miss – Explore Iconic San Francisco[1] (distance from San Francisco Marriott Marquis)

1. The Golden Gate Bridge – one of the seven wonders of the modern world (7 miles)
2. Alcatraz – a famous island prison turned national park (2 miles)
3. Cable Cars – a way to travel San Fran through time on cable cars first put into place in 1873 (.5 mile)
4. Painted Ladies – a frequently photographed row of pastel-colored Victorian homes on the sloping Steiner Street (2.5 miles)

"Business travel, including traveling to the AASV Annual Meeting, is an investment. It should be about the educational content, is rarely about hassle-free travel, is only sometimes about the location, and is almost always about the people."

5. Fisherman's Wharf and Pier 39 – a high-activity area showcasing food, fun, and sea lions (2.5 miles)
6. Coit Tower – a defining tower on San Francisco's highline (2.5 miles)
7. Lombard Street – the beautifully manicured "crookedest street in the world" (2 miles)
8. Chinatown – North America's first and largest outside of Asia (1 mile)

Is mainstream not your idea of a great side activity? Are you looking for something off the beaten path?

If you enjoyed… don't miss[1]

- Alcatraz…Angel Island
- Cabel Cars…F Line Streetcar
- Lombard Street…Twine Peaks
- Golden Gate Bridge…Fog Bridge at the Exploratorium
- Coit Tower…Palace of Fine Arts
- Fisherman's Warf…The Embarcadero
- Painted Ladies…Haight-Ashbury

There is something for everyone at the AASV Annual Meeting, and there is something for everyone in San Francisco, too! The following are unique, obscure, and some downright weird attractions or experiences you will only find in San Francsico.[2]

1. The Wave Organ – an acoustic sculpture made from reclaimed stone and concrete pipes that amplifies the sounds of the sea; the best time to visit is high-tide (4.6 miles)
2. Presidio Pet Cemetery – a resting place for pets, military dogs, and possibly cavalry horses (5.5 miles)
3. Aquatic Park Tombstones – a breakwater made of Gold-Rush-era tombstones, best visible in low-tide (2.5 miles)

Advocacy continued on page 13

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Advocacy continued from page 11

4. Ruins of the Sutro Baths – the remains of 1894 glass-enclosed public baths that burned in 1966 (6.5 miles)
5. The Shipwrecks at Land's End – a graveyard of more than 300 ships, including the SS *City of Rio de Janeiro* and three still visible wrecks (6.5 miles)
6. Magowan's Infinite Mirror Maze – a psychedelic and disorienting dungeon of mirrored columns (2.6 miles)

Is adventuring through San Francisco to a teahouse in Chinatown overwhelming? Is introverting more your cup of tea? You can experience all the benefits of the AASV Annual Meeting without ever leaving the hotel. Hop in a driverless taxi at the airport and avoid strangers until you find your people at the San Francisco Marriott Marquis! We look forward to welcoming you there!

Abbey Canon, DVM, MPH, DACVPM
Director of Public Health and Communications

References

1. Welcome to San Francisco. San Francisco Travel Association. Accessed November 19, 2024. **https://www.sftravel.com**

2. Unusual Attractions in San Francisco. Atlas Obscura. Accessed November 19, 2024. **https://www.atlasobscura.com/things-to-do/san-francisco-california**

Peer reviewed **Original Research**

A Norwegian observational study of feed conversion efficiency in Duroc and Landrace grower pigs seropositive for influenza A (H1N1) pdm09 virus

Jwee Chiek Er

Abstract

Objective: Investigate the influence of influenza A(H1N1)pdm09 virus (pH1N1v) on feed conversion efficiency (FCE) in Norwegian Landrace and Duroc pigs.

Materials and methods: This observational study analyzed the growth and serological data of 1954 grower pigs collected from 43 nucleus breeding herds in eastern Norway between 2009 and 2012. Serial serological tests, enzyme-linked immunosorbent assay, and hemagglutination inhibition were used to detect pH1N1v antibodies in pigs weighing 100 kg. Statistical analyses included mixed-effects regression modelling, Cox regression, and Kaplan-Meier Failure analysis to assess the effects of breed on pH1N1v influence on growth performance.

Results: Duroc pigs experienced a greater reduction in FCE (5.6%; 95% CI, 5.5%-5.7%) compared to Landrace pigs (3.5%; 95% CI, 1.3%-5.6%) when exposed to pH1N1v. Seropositive pigs of both breeds maintained normal growth rates under *ad libitum* feeding conditions. To reach 100 kg body weight, seropositive Landrace pigs consumed 2.4 kg (95% CI, 0.9-3.9 kg) more feed, while Duroc pigs consumed 3.8 kg (95% CI, 3.7-4.0 kg) more feed than their seronegative counterparts.

Implications: Results suggest breed-specific differences in resilience to influenza even though the overall appetite of seropositive pigs was unimpaired during the growth phase (approximately 33-100 kg body weight). Study findings highlight the economic implications of selecting appropriate breeds for specific environmental challenges. However, the study's observational nature limits the ability to infer causality and may not be generalized to other breeds or crossbreeds. By understanding breed-specific responses to influenza, producers can optimize breed selection strategies to enhance overall herd resilience and efficiency, contributing to more sustainable pork production.

Keywords: swine, influenza, feed conversion efficiency, breed, mixed-effects linear regression

Received: January 28, 2024
Accepted: July 17, 2024
Published online: December 9, 2024

Un estudio observacional Noruego de la eficiencia de conversión alimenticia en cerdos de engorde Duroc y Landrace seropositivos para el virus de la influenza A (H1N1)pdm09

Objetivo: Investigar la influencia del virus de la influenza A(H1N1)pdm09 (pH1N1v) en la eficiencia de conversión alimenticia (FCA) en cerdos Landrace y Duroc Noruegos.

Materiales y métodos: Este estudio observacional analizó el crecimiento y los datos serológicos de 1954 cerdos de engorde recolectados de 43 granjas núcleo en el este de Noruega entre 2009 y 2012. Se utilizaron pruebas serológicas seriadas, ensayo de inmunoadsorción enzimática e inhibición de la hemaglutinación para detectar anticuerpos pH1N1v en cerdos de 100 kg de peso. Los análisis estadísticos incluyeron modelos de regresión de efectos mixtos, regresión de Cox y análisis de falla de Kaplan-Meier para evaluar los efectos de la raza en la influencia del pH1N1v en el rendimiento del crecimiento.

Resultados: Los cerdos Duroc experimentaron una mayor reducción en FCE (5.6%; IC 95%, 5.5%-5.7%) en comparación con los cerdos Landrace (3.5%; IC 95%, 1.3%-5.6%) cuando se expusieron a pH1N1v. Los cerdos seropositivos de ambas razas mantuvieron tasas de crecimiento normales en condiciones de alimentación *ad libitum*. Para alcanzar los 100 kg de peso corporal, los cerdos Landrace seropositivos consumieron 2.4 kg (IC 95%, 0.9-3.9 kg) más de alimento, mientras que los cerdos Duroc consumieron 3.8 kg (IC 95%, 3.7-4.0 kg) más de alimento que sus contrapartes seronegativas.

Implicaciones: Los resultados sugieren diferencias específicas de cada raza en la resistencia a la gripe, a pesar de que el apetito general de los cerdos seropositivos no se vio afectado durante la fase de crecimiento (aproximadamente

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Er J. A Norwegian observational study of feed conversion efficiency in Duroc and Landrace grower pigs seropositive for influenza A (H1N1) pdm09 virus. *J Swine Health Prod*. 2025;33(1):14-21. **https://doi.org/10.54846/jshap/1395**

33-100 kg de peso corporal). Los hallazgos del estudio resaltan las implicaciones económicas de seleccionar razas apropiadas para desafíos ambientales específicos. Sin embargo, la naturaleza observacional del estudio limita la capacidad de inferir causalidad y no puede generalizarse a otras razas o cruzas. Al comprender las respuestas específicas de las razas a la influenza, los productores pueden optimizar las estrategias de selección de razas para mejorar la resistencia y la eficiencia general del rebaño, lo que contribuye a una producción de carne de cerdo más sostenible.

Étude observationnelle Norvégienne sur l'efficacité de la conversion alimentaire chez des porcs Duroc et Landrace en croissance séropositifs pour le virus de l'influenza A (H1N1)pdm09

Objectif: Étudier l'influence du virus de l'influenza A (H1N1)pdm09 (pH1Niv) sur l'efficacité de la conversion alimentaire (FCE) chez des porcs Landrace et Duroc Norvégiens.

Matériels et méthodes: Cette étude observationnelle a analysé les données de croissance et de sérologie de 1954 porcs en croissance obtenues de 43 noyaux de troupeaux de reproduction dans l'est de la Norvège entre 2009 et 2012. Des tests sérologiques en série, un essai immuno-enzymatique et l'inhibition de l'hémagglutination, ont été utilisés afin de détecter des anticorps contre pH1N1v chez des porcs pesant 100 kg. Les analyses statistiques incluaient une modélisation de régression avec effets mixtes, une régression de Cox et l'analyse de survie de Kaplan-Meier afin d'évaluer les effets de la race sur l'influence du pH1N1v sur la performance de croissance.

Résultats: Les porcs de race Duroc ont montré une plus grande réduction de FCE (5.6%; IC 95%, 5.5%-5.7%) comparativement aux porcs Landrace (3.5%, IC 95%, 1.3-5.6%) lorsqu'exposés à pH1N1v. Les porcs séropositifs des deux races ont maintenu des taux de croissance normaux dans des conditions d'alimentation *ad libitum*. Afin d'atteindre le poids corporel de 100 kg, les porcs Landrace séropositifs ont consommés 2.4 kg plus de nourriture (IC 95%, 0.9-3.9 kg), alors que les porcs Duroc ont consommé 3.8 kg de plus (IC 95%, 3.7-4.0 kg) que leur contrepartie séronégative.

Implications: Les résultats suggèrent des différences spécifiques aux races quant à la résilience à l'influenza, bien que de manière générale l'appétit des porcs séropositifs n'était pas affecté durant la période de croissance (approximativement de 33-100 kg de poids corporel). Les résultats de l'analyse mettent en évidence les conséquences économiques de sélectionner les races appropriées pour des défis environnementaux spécifiques. Toutefois, la nature observationnelle de l'étude limite la capacité à supposer une causalité et ne peut être généralisée à d'autres races ou croisements. En comprenant les réponses spécifiques à la race à l'influenza, les producteurs peuvent optimiser les stratégies de sélection de la race pour augmenter la résilience et l'efficacité globale du troupeau, contribuant ainsi à une production porcine plus durable.

Swine genetics significantly influence key agricultural performance metrics, including disease resistance and growth performance. Such genetic factors are crucial for enhancing pork production efficiency and animal welfare, but also in responding to increasing global demands and environmental sustainability pressures. In Norway, a leader in pork self-sufficiency, the strategic use of crossbreeding among predominant breeds, like Landrace, Duroc, Yorkshire, and Hampshire, optimizes heterosis to balance traits, meet market demands, and bolster disease resistance cost effectively.

Building on previous research by Rowland et al[1] and Lunney et al[2] that highlight the role of breed genetics in disease resistance, our study examines the different effects of influenza A(H1N1) pdm09 virus (pH1N1v) on feed conversion efficiency (FCE) among seropositive Norwegian Landrace and Duroc pigs. Norwegian Landrace pigs exhibit superior growth performance compared to Duroc, which deviates from trends observed in other countries. This study seeks to deepen the understanding of how genetic predispositions influence resilience to influenza, aiming to enhance both the profitability and environmental sustainability of pork production.

Research into optimizing FCE focuses not just on profitability in pork production,[3] but also promotes responsible environmental stewardship by using less agricultural resources. To achieve this, considerable research has been dedicated to dietary influences, such as nutrition, appetite, and feed composition,[4] and nondietary factors including housing conditions, genetics, and overall health.[5-9] Respiratory diseases caused by various pathogens are severe health and production challenges for pig producing countries.[10-13] Among these, the influenza A virus (IAV) stands out due to its ubiquity, multispecies hosts including humans, and impact.[14,15] The coexistence of multiple porcine respiratory pathogens in the same pig host, known as the porcine respiratory disease complex (PRDC), further complicates this issue, significantly impacting growth and feed efficiency by diverting energy towards immune responses.[11,12,15-17] The PRDC also includes other major pig respiratory pathogens such as porcine reproductive and respiratory syndrome virus (PRRSV), *Actinobacillus pleuropneumonia*, porcine circovirus-associated disease, and *Mycoplasma hyopneumonia*, which can dramatically affect pig health and pork production.[18,19]

The emergence of pH1N1v in 2009 was the first IAV detected in the Norwegian pig population through active serological screening of notifiable diseases absent in Norwegian pigs.[20,21] The virus spread quickly and became endemic in the human population first and later in Norwegian pigs, reaching approximately 800 pig herds (40% herd prevalence) in a short time.[21-25] Previous research by Er et al[26] demonstrated that pH1N1v can depress FCE in pigs even when they did not show overt clinical signs.[26-28] The objective of the current study is to investigate the role of breed genetics in modulating the effects of pH1N1v on FCE among Norwegian Landrace and Duroc pig breeds. These breeds represent the pinnacle of Norway's pig breeding in 46 nucleus herds in terms of biosecurity, health profile, and genetic quality, making them ideal subjects for our research on genetic modulations in response to pH1N1v.

Animal care and use

This comparative field study was observational and conducted from 2009 to 2012 at Norsvin's commercial boar testing station in Hamar, Norway. All husbandry and housing conditions remained unchanged during the observation period. Norway has a long standing comprehensive animal welfare act that covers aquatic and terrestrial animals.[29]

Materials and methods

Study design

In this comparative study, longitudinal growth data and serological results were collected from Landrace (n = 1084) and Duroc boars (n = 870) from Norsvin's boar testing station in the Hamar municipality of eastern Norway. The indoor boar testing facility, capable of testing 1152 pigs concurrently, features 16 separate rooms housing cohorts of 72 pigs (Landrace or Duroc) divided into six pens. Batches of pigs from specific herds (n = 43 nucleus herds) arrived at the station with a mean weight of 33 kg were monitored individually using electronic feeding stations equipped with Feed Intake Recording Equipment (FIRE, Osborne Ltd). This automated system tracked individual pig feed consumption and body weight until pigs reached 100 kg. Before departure from the facility, each pig's exposure status to pH1N1v was determined by serological testing for the presence of antibodies.[30] Additionally, each departing pig was screened for select mandatory notifiable diseases not found in Norway including pseudorabies virus, transmissible gastroenteritis virus, porcine respiratory corona virus, PRRSV, porcine epidemic diarrhea virus, and other swine influenza viruses including pH1N1v since 2009. Influenza A specific NP antibodies were detected by enzyme-linked immunosorbent assay (ID Screen IAV Antibody Competition test, IDVET) according to manufacturer's instructions. Samples positive for IAV antibodies were tested using the hemagglutination-inhibition assay according to the method described in the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.[31] All serological tests were performed by the Norwegian Veterinary Institute. Yearly surveillance to date (2023) has confirmed pH1N1v as the sole IAV circulating among Norwegian pigs since 2009. In our study sample, 60% of Landrace pigs and 49% of Duroc pigs were seropositive from exposure to pH1N1v (Table 1).

Statistical analysis

Statistical tools include mixed-effects regression modelling, Cox regression with the Breslow method (CRB), and Kaplan-Meier Failure function (KMF). Comparative box plots visualized the fitted values from the regression models. The three outcome variables included FCE, overall feed intake (OFI), and age at 100 kg body weight (Age100kg), the latter being a proxy for growth rate. Key predictors (fixed effects) were breed, infection status, and each pig's birth date. Initially structured longitudinally, the data was converted into a panel format to aggregate daily growth data into the study outcomes. Mixed-effects regression techniques acknowledged the hierarchical data structure, with pig (n = 1954) nested within herd (n = 43). Data handling and analysis were conducted using SAS Enterprise Guide 4.3 (SAS Institute Inc) and STATA version 17.0 (StataCorp LP).

Model selection and statistical approach

The selection of mixed-effects regression models was guided by causal-diagrams and principles of parsimony and the Akaike Information Criterion (AIC).[32] The study sample of 1954 pigs originated from 43 nucleus herds. By including the herd ID as a random effects variable, we accounted for potential confounding factors such as sanitary conditions and genetic variants unique to the herd. As the data spanned four years, pig birth date was incorporated as a fixed effect covariate in the regression model to mitigate chronological bias eg, pig genetics, feed technology, and all-time variant variables.

Mixed-effects linear regression model formula with pig as the unit of analysis

$$Y[i,j] = \beta 0 + \beta_1 X_1[i,j] + \beta_2 X_2\,[i,j,] + u[i,j] + v[j] + \varepsilon[i,j]$$

Where Y is one of the three outcomes in this study (OFI, FCE, Age100kg). Y_i is the value of the response for ith pig (n = 1954) nested within the jth (n = 43) herd. β is a vector of the 3 coefficients, constant, main predictor (breed and infection or Inf#Br), and the continuous covariate (birth date). $X_{[i,j]}$ is the vector of 2 explanatory variables (main predictor and the covariate) for the ith pig observed value in the jth herd. $u_{[i,j]}$ is a vector of random intercepts unique to each pig in each herd, where $u_{ij} \sim N(0, \sigma^2_{\text{pig}})$. v_j is a vector of random intercepts unique to each herd, where $v_j \sim N(0, \sigma^2_{\text{herd}})$. $\varepsilon_{[i,j]}$ is the vector of error terms where $\varepsilon_{ij} \sim N(\mu, \sigma^2)$. The creation of the interaction term Inf#Br simplifies the comparison of pH1N1v's marginal effects on the four categories of pigs.

Results

Feed conversion efficiency

Seropositive Landrace pigs exhibited a decrease in FCE (kg feed/kg weight gain) by 3.5% (95% CI, 1.3%-5.6%; $P = .002$), whereas seropositive Duroc pigs showed

Table 1: Sample size and influenza A(H1N1)pdm09 serial serology results of Landrace and Duroc pigs tested for growth performance from 2009 to 2012 at Norsvin's commercial boar testing station

	Influenza A(H1N1)pdm09 serology*						
	Landrace			Duroc			
Year	Negative	Positive	Subtotal	Negative	Positive	Subtotal	Total pigs
2009†	140	74	214	151	30	181	395
2010	83	6	89	63	12	75	164
2011	133	524	657	148	352	500	1157
2012	82	42	124	86	28	114	238
Total	438	646	1084	448	422	870	1954

* Serial serology was by enzyme-linked immunosorbent assay and hemagglutination-inhibition assay.

† Year of introduction of influenza A(H1N1)pdm09, the first influenza A virus, in the Norwegian pig population.

a more pronounced decrease of 5.6% (95% CI, 5.5%-5.7%; $P < .001$). The continuous variable birth date indicated an improvement in FCE by 0.003% ($P < .001$) for each subsequent day a pig was born. Detailed results are presented in Table 2 and Figure 1.

Overall feed intake

The study demonstrated a clear inverse correlation between OFI and FCE, where a decrease in FCE led to increased feed consumption necessary for weight gain. Our data indicated that compared to their uninfected counterparts at 100 kg, seropositive Landrace pigs consumed more than 2.4 kg (95% CI, 0.9-3.9 kg; $P = .002$) of compensatory feed while Duroc pigs consumed 3.8 kg (95% CI, 3.7-4.0kg; $P < .001$). Furthermore, the birth date coefficient revealed a daily decrease in OFI of 17 g starting from the earliest born pig (Table 3). Figure 2 is a visual presentation of predicted OFI values differentiated by pig breed, infection status, and chronology.

Growth rate and compensatory feeding

Despite the observed decline in FCE, infected pigs maintained normal growth rates, a phenomenon attributed to compensatory feeding under *ad libitum* conditions. The CRB, boxplots and KMF curves, shown in Table 4 and Figures 3 and 4, respectively, indicated minimal differences in growth rates between infected and uninfected pigs across both breeds. Even with depressed FCE in seropositive pigs, their growth rates were comparable to seronegative pigs, facilitated by unimpaired appetite and an *ad libitum* feeding system. Some seropositive pigs, because of greater appetite, had slightly faster growth rates than their seronegative counterparts.

Discussion

Our comprehensive observational study of 1954 pigs uncovered breed-specific responses to pH1N1v infection by regression analysis focusing on infection status and the breed. Landrace pigs exhibited a smaller decline in FCE compared to Duroc pigs, underscoring inherent differences in disease resilience and growth efficiency between breeds. In seropositive pigs, the FCE reduction was 6% for Duroc and 3% for Landrace, highlighting Landrace's superior resilience. At 100 kg, the seropositive Landrace pigs consumed an additional 2.4 kg (95% CI, 0.9-3.9 kg) of feed, while seropositive Duroc pigs consumed 3.8 kg (95% CI, 3.7-4.0 kg). Compensatory feed consumption that occurred from unrestricted feeding allowed seropositive pigs to achieve similar growth rates as their seronegative counterparts. In comparison, Duroc pigs exhibited greater compensatory feeding, which carries economic implications in terms of feed cost to the farmer.

Despite its observational nature, the controlled environment provided by the boar testing station ensured uniform conditions for husbandry, housing, ventilation, and feeding for every cohort of pigs. This consistency allowed for a simplified analysis of variance components, enabling the mixed-regression techniques to effectively concentrate on the interactions between breed genetics and pH1N1v infection, thereby enhancing the study's validity. Additionally, the inclusion of birth date as the continuous

Table 2: Mixed-effects linear regression* comparing the feed conversion efficiency (FCE) between Landrace and Duroc pigs (n = 1954) serologically positive for influenza A(H1N1)pdm09 virus

Feed conversion efficiency of a pig growing from 33-100 kg				
Predictors	**Coefficient†**	**SE**	***P***	**95% CI**
Breed#Infection status				
Landrace#negative	0	-	-	-
Landrace#positive	0.035	0.0111	.002	0.013 to 0.056
Duroc#negative	0.058	0.0225	.01	0.014 to 0.102
Duroc#positive	0.113	0.0227	< .001	0.068 to 0.157
Birth date	-0.0003	0.00001	< .001	-0.00032 to -0.00028
Constant (β0)‡	6.527	0.239	< .001	6.059 to 6.996
Breed	**Margins§**			
Landrace	1.95	0.0106	< .001	1.93 to 1.97
Duroc	2.02	0.0178	< .001	1.99 to 2.06
Infection status				
Negative	1.96	0.0109	< .001	1.94 to 1.98
Positive	2.00	0.0106	< .001	1.98 to 2.02

* Data is hierarchical with 1954 pigs nested in 43 breeding herds where the 43 unique herd IDs represented the random effects in the regression model (values not shown).

† The coefficients and standard errors of predictors were the parameters for Gaussian curves describing the variability between pigs.

‡ Constant represents the FCE of a seronegative Landrace pig born on October 3, 2008.

§ Least squares means.

Figure 1: Box plots for the predicted FCE of pigs growing from 33 to 100 kg categorized by breed, infection status, and testing cohort. The differences in 2009 were less obvious because of the smaller positive pig sample size given the introduction of influenza A(H1N1)pdm09 to Norwegian pigs occurred in September 2009. Boxes indicate the 25th percentile, median, and 75th percentile. Whiskers show the 10th and 90th percentiles. FCE = feed conversion efficiency; BW = body weight.

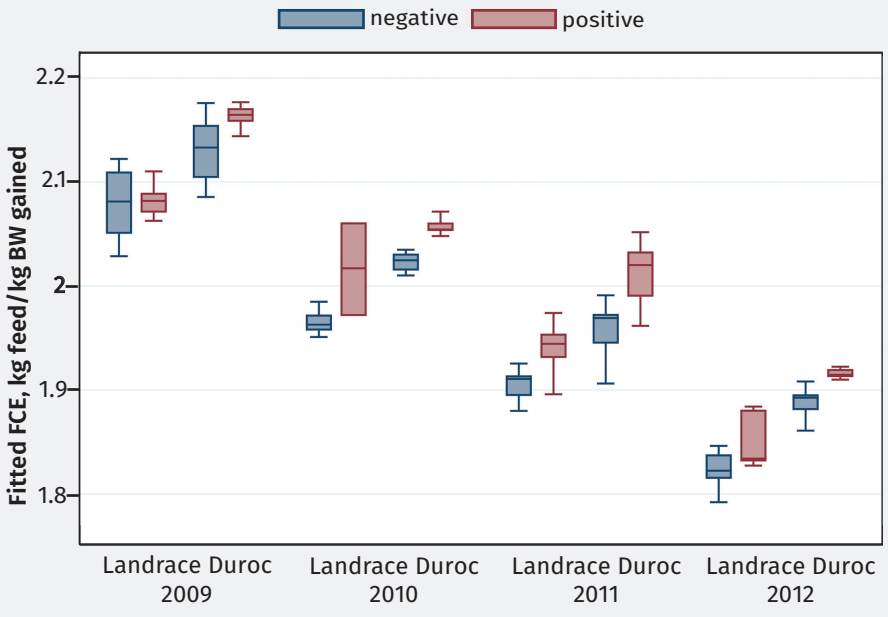


Table 3: Mixed-effects linear regression comparing overall feed intake (OFI) of Duroc and Landrace grower pigs (n = 1954) when infected with influenza A(H1N1)pdm09 virus*

Overall feed intake of a pig growing from 33-100 kg				
Predictors	**Coefficient**	**SE**	***P* > z**	**95% CI**
Breed#Infection status				
Landrace#negative	0	-	-	-
Landrace#positive	2.42	0.775	.002	0.9 to 3.93
Duroc#negative	4.05	1.572	.01	0.97 to 7.13
Duroc#positive	7.9	1.592	< .001	4.78 to 11.02
Birth date	-0.02	0.001	< .001	-0.019 to -0.016
Constant (β0)†	456.91	16.74	< .001	424.1 to 489.72
Breed	**Margin‡**			
Landrace	136.57	0.745	< .001	135.11 to 138.03
Duroc	141.40	1.248	< .001	138.96 to 143.85
Infection status				
Negative	137.05	0.762	< .001	135.56 to 138.55
Positve	140.10	0.741	< .001	138.66 to 141.56

* Data is hierarchical with 1954 pigs nested in 43 breeding herds where the 43 unique herd IDs represented the random effects in the regression model (values not shown). The coefficients and standard errors of predictors were the parameters for Gaussian curves describing the variability between pigs.

† Constant represents the OFI of a seronegative Landrace pig born on October 3, 2008.

‡ Least squares means.

variable served as a proxy to account for time-variant biases among the pigs studied over the four years.

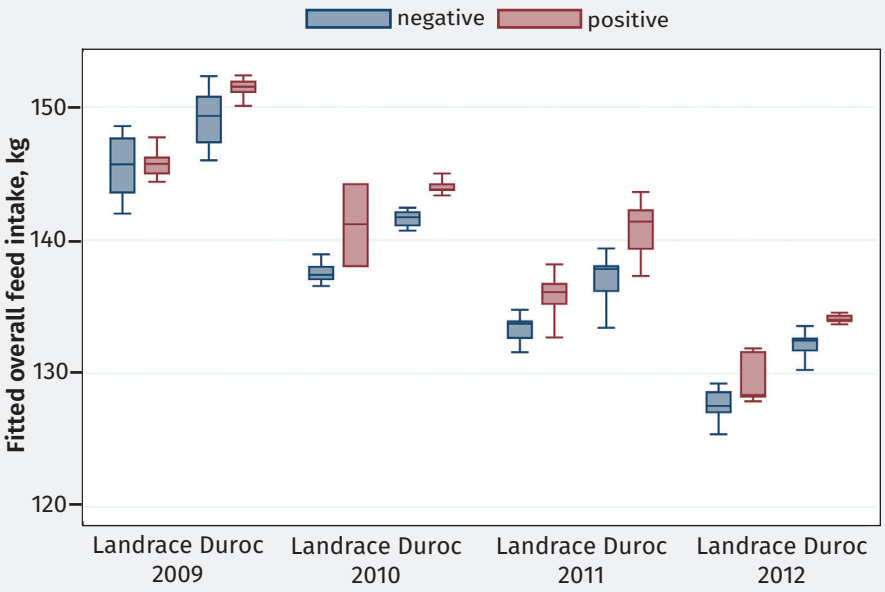
Although this study demonstrates that Landrace pigs possess genetic advantages over Duroc pigs in reducing pH1N1v impact on growth performance, the majority of growing pigs raised for slaughter in Norway are derived from the crossbreeding of Landrace, Duroc, Yorkshire, and Hampshire. Consequently, the impact of pH1N1v on these crossbreeds, as well as on the other 300 pig breeds and their resulting crossbreeds raised in other countries, is likely to vary. While our findings affirm that breed genetics can influence the effects of pH1N1v on growth performance, the ability to quantify the external validity of these negative effects remains limited both in Norway and internationally.

The parallel patterns in pH1N1v pig herd prevalence and human pH1N1v variant persistent trends in Norway hint at ongoing human-to-pig transmission, affecting pork production efficiency under the current nonintervention policy.[33,34] This interspecies transmission underlines a crucial one health perspective, necessitating a holistic approach to managing public and animal health.

The global diversity of over 300 pig breeds, each with distinct growth and disease resilience traits, presents opportunities to optimize farm economics and national strategies by capitalizing on breed-specific characteristics. The global persistence of pH1N1v in both humans and pigs, along with the prevalence of other porcine respiratory diseases, necessitates a broader consideration of the compounded effects of concurrent infections on growth performance and their economic impact.

The impact of pH1N1v on growth performance could be exacerbated by concurrent infections with other respiratory pathogens,[16,35-37] potentially amplifying the economic losses beyond those caused by uncomplicated pH1N1v. This consideration is crucial for understanding the full scope of economic and health implications in pig farming, both in Norway and globally.

Figure 2: Fitted (predicted) values of overall feed intake from the fitted regression models. Boxplots are categorized on three levels by breed, infection status, and testing cohort by year. Boxes indicate the 25th percentile, median, and 75th percentile. Whiskers show the 10th and 90th percentiles.



Implications

Under the Norwegian conditions of this observational study:

- Breed-specific influenza resilience can guide breeding strategies for improved FCE.
- Breed predisposition affects economics by modulating OFI during influenza outbreaks.
- Genetic selection can mitigate the economic impacts of respiratory diseases.

Acknowledgments

Thanks go to Norsvin for the use of their boar testing facility in Hamar, and for providing the longitudinal growth and diagnostic data for the 1954 sample pigs. This study was conducted with the generous funding from the Norwegian research council (NFR207836). Thanks to the co-authors of a precursor paper, "Adverse effects of Influenza A(H1N1)pdm09 virus infection on growth performance of Norwegian pigs – a longitudinal study at the boar testing station," which was obligatory to the new scientific findings in this study.

Conflict of interest

None reported.

Table 4: Cox Regression Analysis Breslow for growth rate comparative analysis at 100 kg body weight

Predictors	Hazards ratio	SE	*P*	95% CI
Breed#Infection status				
Landrace#negative	1	-	-	-
Landrace#positive	1.136	0.072	.04	1.003 - 1.286
Duroc#negative	0.490	0.033	< .001	0.429 - 0.560
Duroc#positive	0.523	0.037	< .001	0.455 - 0.601
Birth date	1.0004	0.0001	< .001	1.0002 - 1.0005

Figure 3: Boxplots of predicted pig age at 100 kg body weight (BW) categorized by breed, infection status, and testing cohort by year. Boxes indicate the 25th percentile, median, and 75th percentile. Whiskers show the 10th and 90th percentiles.

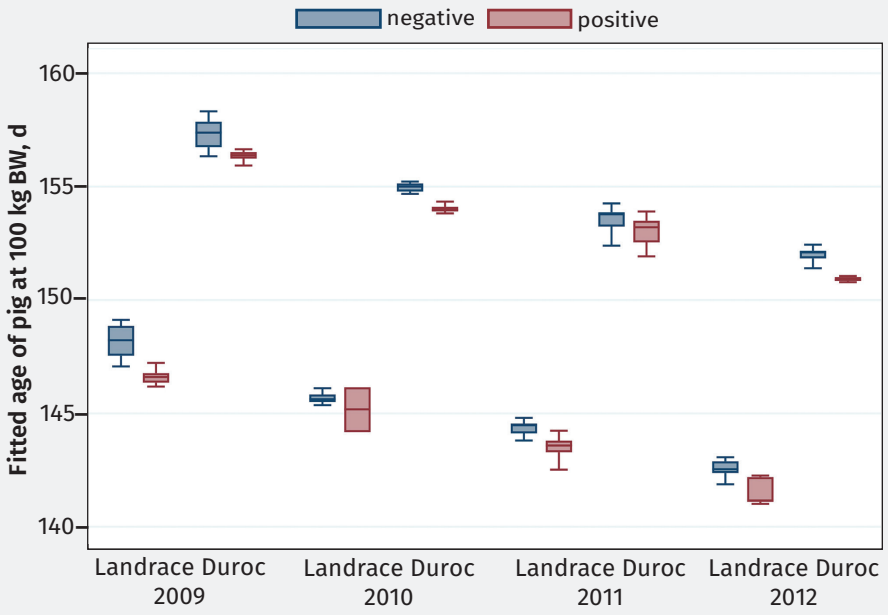
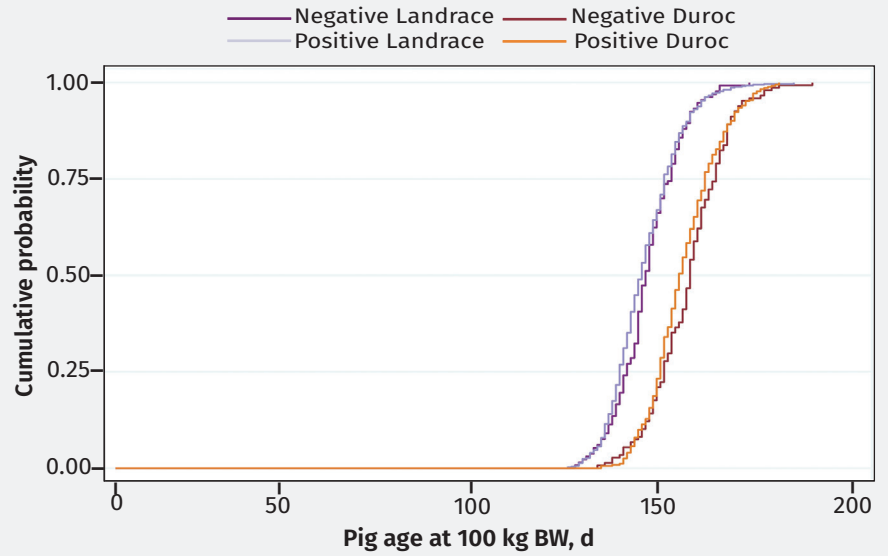


Figure 4: Four distinct Kaplan-Meier Failure Curves for pig age at 100 kg body weight (BW) categorized by breed and infection status.



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PEER REVIEWED **BRIEF COMMUNICATION**

Evaluating point-of-care testing for anemia diagnosis in pigs: Blood collection location disparities, repeatability, and validity

Katlyn A. McClellan, Crystal L. Levesque, Eric M. Weaver

Abstract

The HemoCue 201 was used to compare hemoglobin (HbC) across blood sampling sites. Tail docking samples had lower HbC than both ear and mammary vein samples ($P = .001$). Both point-of-care and laboratory HbC testing methods showed agreement, with biases of 0.2 g/dL (ear) and -0.45 g/dL (jugular).

Keywords: swine, anemia, hemoglobin, point-of-care

Received: April 15, 2024
Accepted: July 17, 2024
Published online: November 27, 2024

Evaluación de las pruebas en el punto de atención para el diagnóstico de anemia en cerdos: Disparidades en la ubicación de la extracción de sangre, repetibilidad, y validez

El HemoCue 201 se utilizó para comparar la hemoglobina (HbC) en los sitios de muestreo de sangre. Las muestras de corte de cola tuvieron HbC más baja que las muestras de oreja y vena mamaria ($P = .001$). Tanto los métodos de prueba de HbC en el punto de atención como los de laboratorio mostraron concordancia, con sesgos de 0.2 g/dL (oreja) y -0.45 g/dL (yugular).

Évaluation au point de soin pour le diagnostic de l'anémie chez les porcs: Disparités, répétabilité, et validité du site de collecte du sang

Le système HemoCue 201 a été utilisé pour comparer les taux d'hémoglobine (HbC) entre des sites de prélèvement d'échantillons de sang. Des échantillons obtenus à la suite de la caudectomie avaient un taux de HbC inférieur aux échantillons provenant de la veine de l'oreille et de la veine mammaire ($P = .001$). Les résultats de la méthode utilisée au point de soin et la méthode utilisée en laboratoire étaient en accords, avec un biais de 0.2 g/dL (oreille) et de -0.45 g/dL (jugulaire).

In veterinary medicine, point-of-care testing (POCT) has become increasingly common due to its rapid results and minimal blood requirement, especially in field settings. Blood hemoglobin concentration (HbC) serves as a crucial indicator of iron status in pigs, essential for growth and health. The HemoCue device has gained popularity for POCT in pig anemia investigations[1,2] despite the traditional use of laboratory hematology analyzers as the gold standard, which can be costly and impractical. Handling challenges, such as sample transport and storage, all while trying to avoid issues such as hemolysis and clotting, underscore the practical benefits of POCT in providing immediate and reliable results.

Studies evaluating the HemoCue device in pigs show conflicting results. Kutter et al[3] found agreement between HemoCue and laboratory results when testing arteriole blood, with a difference of -0.1 g/dL across measured values of 3.2 to 10.8 g/dL. Conversely, Maes et al[4] reported a slight overestimation of 0.49 g/dL by the HemoCue device compared to laboratory results when sampling from the jugular vein for laboratory testing and the ear vein for the HemoCue device. Variations in blood sampling location may have contributed to these inconsistencies. Discrepancies have been identified in human studies that employed varying anatomical locations for HbC measurement according to a review article of HemoCue validation studies.[5] Consideration of anatomical variation in swine HbC testing may be crucial for determining suitable sampling sites when using the HemoCue for HbC testing.

The ear vein is commonly used for HbC POCT in swine due to convenience and minimal invasiveness compared to the jugular vein. However, concerns exist regarding reliability of the ear vein and potential differences in HbC levels across anatomical sites, impacting critical measurement accuracy for clinical decisions. Our study compared HbC values across samples collected from ear vein, mammary vein, and tail sampling sites using a POCT device (HemoCue 201+ Hb system). Additionally, we compared POCT results with laboratory testing (Siemens Advia 2120/21201 hematology system analyzer) of samples from both ear and jugular venous sites. We also assessed the device's reliability through repeat measurements. The study aimed to determine site influence on HbC values and validate the POCT device for diagnosing pig anemia.

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This article was derived from Katlyn McClellan's MS thesis, University of South Dakota, Brookings, South Dakota.

McClellan K, Levesque C, Weaver E. Evaluating point-of-care testing for anemia diagnosis in pigs: Blood collection location disparities, repeatability, and validity. *J Swine Health Prod*. 2025;33(1):22-25. **https://doi.org/10.54846/jshap/1402**

Animal care and use

All procedures conducted in this study were subject to approval by the South Dakota State University (SDSU) Institutional Animal Care and Use Committee (IACUC No. 2209-051) and adhered to the Guide for the Care and Use of Agricultural Animals in Research and Teaching (4th edition, 2020). The animals involved in this experiment were raised and managed within the sow barn at the SDSU Swine Education and Research Facility. The study took place between February 2024 and March 2024.

Materials and methods

Hemoglobin sampling and analysis

In this experiment, the single POCT device used to assess HbC was a HemoCue 201+ Hb analyzer (HemoCue America). This portable device used microcuvettes into which a small quantity (< 10 µL) of blood was loaded for analysis. The microcuvettes were analyzed with the POCT system using a photometric method at a wavelength of 570 nm. The resulting HbC was displayed and recorded within 60 seconds. The laboratory testing measurements in this study were conducted by the SDSU Animal Research and Diagnostic Laboratory using a Siemens Advia 2120/21201 hematology system (Siemens Healthcare Diagnostics), which employed the standard hemiglobincyanide test method.

Experiment 1: POCT repeatability

Repeatability of HbC measured in samples from the ear vein was determined using a total of 10 lactating sows, ranging from parity 1 to 4, and in two randomly selected 1-day-old piglets from each sow (n = 20 suckling piglets). For each subject, the ear vein was pricked once and HbC was measured three times using three separate microcuvettes from the same ear vein prick followed by immediate analysis using the POCT device.

Experiment 2: POCT location comparison testing

Thirty-eight piglets from three litters were selected for HbC testing at three different collection locations: ear vein, mammary vein, and tail. Blood samples were collected from each piglet at 1 day of age at the time of processing (ie, tail docking and iron supplementation). Ear and mammary vein blood collections were performed by pricking the respective vein using a 20-gauge needle. Blood from the tail was collected following the tail docking procedure. All samples from each location were immediately analyzed using the POCT device as previously described.

Experiment 3: POCT vs laboratory testing

Twenty-one sows, ranging from parity 1 to 4, were selected for this experiment. On day 7 of lactation, HbC measurements were taken from both the ear vein and jugular vein. Ear vein samples were collected using a 20-gauge, 2.5-cm needle and analyzed via POCT. Whole blood samples were also collected from the ear vein using s-monovette 1.3-mL, low-volume blood collection tubes containing EDTA as an anticoagulant (Thermo Fisher Scientific). Jugular vein blood was collected into 6-mL tubes containing EDTA (Becton, Dickinson and Company). Approximately 500 µL was immediately removed using a sterile syringe, with approximately 10 µL of blood placed into a microcuvette for POCT analysis. All blood tubes were transported to the SDSU Animal Research and Diagnostic Laboratory at room temperature (25°C) for HbC analysis. The mean (SD) time from collection to analysis was 3.9 (2.6) hours, and no specimens were analyzed after 12 hours.

Statistical analyses

To validate our statistical approach, we confirmed non-violation of the analysis of variance assumptions, including homogeneity of variances and normal distribution. Data are presented as mean (SD) or frequency when appropriate. An analysis of variance using Proc MIXED in SAS (version 9.4, SAS Institute Inc) was conducted to compare HbC in blood obtained from different locations (ear vein, mammary vein, and tail) and differences between the two testing methods (POCT vs laboratory testing). Bland-Altman analysis was conducted to calculate bias and limits of agreement (LOA) to assess agreement between methods. Anemia, defined as < 10 g/dL, was determined for each sample.[6,7] The prevalence of anemic and nonanemic animals was compared using a Chi-square test for frequency. Differences with $P < .05$ were considered statistically significant.

Results

POCT repeatability

Hemoglobin concentration from the three consecutive samples taken from the ear vein among the 38 pigs resulted in mean HbC values of 9.31 (1.4), 9.30 (1.2), and 9.33 (1.2) g/dL for samples 1, 2, and 3 across all animals, respectively. The average coefficient of variation determined between means within animals was 3.65%. When classifying each animal as anemic (< 10 g/dL) or nonanemic (≥ 10 g/dL) using each of the three samples taken, 3 of 38 pigs did not have the same classification across the 3 samples taken.

POCT location comparison

Ear and mammary vein HbC values were not different from one another ($P = .64$), while the ear and mammary vein HbC values were both higher compared to the tail HbC ($P < .001$; Table 1). Anemia prevalence varied between locations, with the highest prevalence occurring when using HbC values from the tail (92.1%) followed by the ear vein (55.3%), and the lowest prevalence occurring when using the mammary vein (39.5%) ($X^2 = .001$).

POCT vs laboratory testing

There was no difference ($P = .99$) observed in HbC values between ear vein samples analyzed with POCT and those analyzed with laboratory testing (Table 2). Similarly, no difference ($P = .91$) was observed in HbC values between jugular vein samples analyzed with the POCT and laboratory testing. When comparing HbC values between ear vein samples analyzed with POCT and jugular vein samples analyzed using laboratory testing, no difference was observed ($P = .98$). Similarly, there was no difference ($P = .89$) between jugular vein samples analyzed with POCT and ear vein samples analyzed with laboratory testing. Ear vein samples analyzed with POCT exhibited a bias of 0.2 g/dL with LOA of -1.1 to 1.5 compared to laboratory testing HbC values. For jugular blood, HbC values using POCT showed a bias of -0.45 g/dL with LOA of -1.4 to 0.53 compared to laboratory testing.

Table 1: Comparative analysis of hemoglobin measurement using a point-of-care testing method* to assess different blood draw sites in 1-day-old piglets

Blood draw site	Samples, No.	Anemia, %†	Mean HbC, g/dL
Ear vein	38	55.3[a]	9.8[a]
Mammary vein	38	39.5[b]	10.1[a]
Tail dock	38	92.1[c]	7.2[b]
SEM	NA	NA	2.5
P	NA	NA	< .001
X^2	NA	< .001	NA

* HemoCue 201 Hb analyzer.

† Anemia was defined as < 10 g/dL blood hemoglobin concentration.

[a,b,c] Different superscripts with the same column indicate differences at $P < .05$.

HbC = hemoglobin concentration; NA = not applicable.

Table 2: Comparison between POCT* and laboratory testing† in sows using blood samples taken from two different sites

		Mean HbC, g/dL			
Location	No. of samples	POCT	Laboratory testing	SEM, g/dL	*P*
Ear	21	10.8	10.7	0.3	.99
Jugular	21	10.4	10.7	0.3	.91
SEM		0.3	0.3	NA	NA
P		.73	.99	NA	NA

* HemoCue 201 Hb analyzer.

† Siemens Advia 2120/21201 hematology system.

POCT = point-of-care testing; HbC = hemoglobin concentration; NA = not applicable.

Discussion

The POCT method used in this study provides a rapid and cost-effective solution for on-farm HbC assessment. Consistent mean HbC values were observed with acceptable repeatability from consecutive ear vein samples, supported by low variability within each animal. It is worth noting that a few pigs near the 10 g/dL HbC cutoff showed variability across repeat samples, impacting diagnostic consistency for anemia.

Differences between tail sampling and ear and mammary vein sampling may be due to tail docking blood being a mix of venous and arteriolar blood, possibly diluted by tissue damage as well. Reference HbC values in pigs have been established based on venous blood. Therefore, venous blood is recommended for diagnosing anemia using HbC cutoff values that have been previously defined. Additionally, it was frequently observed during sample collections that some piglets yielded insufficient blood from the tail docking site, posing challenges if duplicate samples were needed. While sampling at the time of tail docking is convenient and can be performed while handling the pig, its limitations in terms of blood volume were evident. Consequently, the ear and mammary veins were considered more reliable for testing HbC in newborn piglets using the POCT device.

Differences among blood collection sites highlight the importance of considering anatomical location when interpreting HbC measurements, which can influence the determination of anemia prevalence. While no significant differences in HbC levels were found between ear and mammary vein samples, anemia prevalence was higher when using ear vein samples versus mammary vein samples. This raises concerns about accuracy and the potential need for site-specific adjustments, particularly when using an anemia cutoff < 10 g/dL. Pigs categorized differently for anemia based on location were those pigs that were very close to the anemic HbC cutoff value, similar to observations with repeat samples. Based on these findings, consistency in blood collection site is crucial for monitoring HbC over time and tracking recovery post treatment in pig herds.

Diagnosis of clinical anemia should consider additional symptoms such as pale skin, labored breathing, lethargy, and inactivity. These signs may provide crucial supplementary information to confirm or challenge anemia diagnosis, particularly when HbC values are near the anemia cutoff point. Nonetheless, site-specific variations in HbC affected a small percentage of pigs for anemia diagnosis across ear, mammary, and jugular vein sampling sites in this study. Based on these findings, these are suitable blood sampling sites for HbC analysis using POCT.

When comparing these findings to previous research, human studies have indicated the HemoCue device's accuracy compared to standard laboratory tests. Differences in blood sampling location have been investigated, revealing that the site from which blood is drawn can have a small but statistically significant impact on both the mean and variability of HbC measurements. Specifically, higher HbC in capillary samples have been noted compared to venous samples.[8,9] Other studies have found acceptable accuracy when arterial and venous blood samples were assessed POCT compared to laboratory testing.[10,11] The current study found consistent measurements regardless of the specific venous site used. However, HbC from blood obtained during tail docking, which may have included venous blood, arterial blood, and tissue fluids, differed in HbC from the venous samples.

Overall, this study demonstrates that the HemoCue is a promising POCT device for measuring HbC in swine, suitable for research and field settings. Hemoglobin concentration measurement in pigs is currently infrequent, likely due to the time required for submission and cost, potentially resulting in a lack of pig anemia diagnosis. The HemoCue offers rapid and reliable results, potentially improving on-farm HbC assessment in pigs, benefiting both commercial and research applications.

Implications

Under the conditions of this study:

- Collection site HbC variations affect anemia (< 10 g/dL) diagnosis.
- Use of blood collected during tail docking is not recommended for HbC analysis.
- HemoCue reliably measures ear, jugular, and mammary vein HbC for anemia screening.

Acknowledgments

This study was supported by SDSU Agricultural Experiment Station Hatch funds (Hatch project: SDH00066). The authors also want to thank Pharmacosmos, Inc for their contributions and support for this research.

Conflict of interest

None reported.

Disclaimer

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

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Secure Pork Supply Plan revisions planned for 2026

The Secure Pork Supply (SPS) Plan, funded by the US Department of Agriculture (USDA) and Pork Checkoff, facilitates timely recovery and business continuity in case of a foreign animal disease (FAD) outbreak in the United States. National Pork Board Director of Swine Health Dr Meredith Petersen says they have assembled an SPS advisory group to assist with updating the plan to reflect current industry programs and anticipated mandatory traceability standards.

"The group is going to review research findings, risk assessments, and field reports," Petersen says. "They will bring all of that together and make updates to the Secure Pork Supply Plan to make it consistent with current scientific knowledge and industry practices."

The SPS advisory group consists of pork producers, veterinarians, state animal health officials, USDA representatives, academicians, and industry representatives. "Secure Pork Supply is a great program to increase industry FAD preparedness," Dr Petersen says. "But it needs to be reviewed, as there are some new things in the industry, such as the US Swine Health Improvement Plan, to incorporate. We want to make sure we're really being collaborative across the industry and not duplicating any efforts."

The SPS advisory group's first meeting took place in November 2024, and its work will continue through 2025. This schedule means the advisory group anticipates rolling out updates to the SPS in 2026.

Dr Petersen welcomes input during the update process. "If you have experience with the Secure Pork Supply Plan, if you have feedback or updates, now is the time to make your voice heard. You can always reach out to me at the National Pork Board. I will bring your feedback to the advisory group, and they can discuss where it may fit in the update," she states.

SPS Plan includes biosecurity element

The SPS Plan is designed for farms in the United States that might be affected by movement restrictions but not infected with an FAD. These farms might be near an infected farm and consequently have some restrictions on what can move on and off their premises despite not being infected.

Within the SPS exists an enhanced biosecurity plan with a map of the farm and defined practices. "Secure Pork Supply is a comprehensive business continuity plan, including elements such as traceability, movement records, and disease monitoring. It ensures that pigs are observed daily to detect any changes or clinical signs of foreign animal diseases and prepares a pork premises for response if one was detected," Dr Petersen says.

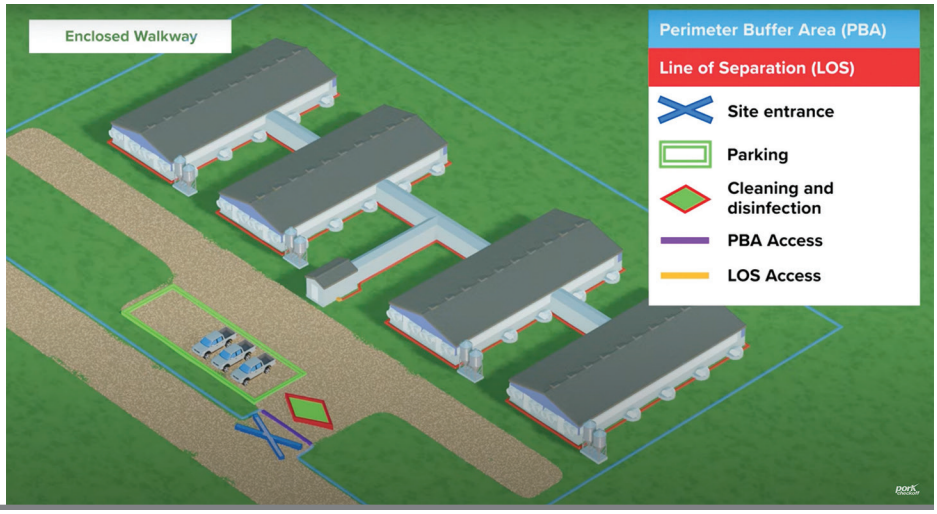
To begin, producers and their herd veterinarians should visit **securepork.org** to find everything needed to create a site-specific SPS Plan. "The first step is to make sure you have your farm Premises Identification Number," Dr Petersen says. "That's a specific number associated with your farm where pigs are raised. After that, you can start on your enhanced biosecurity plan." Plan templates for various production types can be found on the website.

The SPS Plan template includes designating a biosecurity manager for the farm. "This is the person responsible for ensuring the biosecurity plan is more than just a piece of paper, that it is being implemented during an FAD outbreak," Dr Petersen says.

The enhanced biosecurity plan includes a perimeter buffer area (PBA). The PBA designates limited access points, so everything that enters needs to be cleaned and disinfected. This keeps anything in the outside world that could be potentially contaminated from entering the farm. This includes vehicles, supplies, and anything from outside the farm.

"The second thing the enhanced biosecurity plan should include is a defined line of separation," Dr Petersen says. "This is the final threshold from outside of the pig spaces, or the barns, to the inside." Establishing limited access points with biosecurity procedures for farm entry may look like a shower-in facility, with the shower serving as the line of separation. Other farms might have a bench entry to delineate the line of separation.

Finally, the enhanced biosecurity plan includes an aerial map of the farm, where the pork producer and their herd veterinarian can work together to draw the line of separation, a PBA with access points, as well as cleaning and disinfection stations.



Working together on the SPS's site-specific enhanced biosecurity plan is a great way to strengthen the relationship between the pork producer and herd veterinarian, who can provide valuable input on biosecurity and what practices are needed.

SPS Plans require periodic review and farm-level updates

Once created, Dr Petersen recommends farmers review their SPS plans annually and update them as needed. Updates may include personnel turnover, including the biosecurity manager, and infrastructure changes on the farm.

While intended to facilitate response to an FAD outbreak, many of the biosecurity practices included in a farm's SPS Plan should be done every day. "Many parts of the enhanced biosecurity plans are things we can do every day to mitigate the risk of endemic diseases entering the farm," Dr Petersen says. "This is an important part of FAD preparedness, but also should be practiced day-to-day on the farm."

Beyond biosecurity, an SPS Plan also includes movement records. Pig movements, supply movements on and off the farm, and farm visitors all should be recorded and kept. In the event of an FAD discovery on a US swine farm, the producer can share these movement records with their state animal health official. In the event of an FAD outbreak, state animal health officials will need to know where disease is, and where it is not. The more information they have, the quicker they can trace potential links between infected farms. This rapid response is critical in minimizing the production and economic impact of an FAD on the pork industry. Dr Petersen recommends recording movements on a platform like AgView.

Created by the Pork Checkoff, AgView is a way for pork producers to store movement records and have their data available digitally, eliminating paper copies. Farmers can securely house their movement data in AgView and share it with state animal health officials with the click of a button in an outbreak situation.

The SPS Plan update will look at ensuring movement records are consistent with the US Swine Health Improvement Plan (US SHIP) traceability standards as well as the potential mandatory traceability standards the National Pork Producers Council has presented to the USDA. Pig farms need to have their SPS Plan completed and shared with their official state agency to be certified in the US SHIP program. "Another reason we want to bring Secure Pork Supply to the forefront is because as producers are enrolling in US SHIP, it's one of the things they'll need to complete for certification," Dr Petersen says.

Send feedback or input on SPS updates to **mpetersen@pork.org** for review by the advisory group.

Your vote is important!

If you are a veterinarian member of AASV residing in Canada, Mexico, or the United States, it is time to exercise your right to vote for your association leaders. Voting opens on **January 6** for the following leadership positions:

Vice president and president-elect

Dr Melissa Billing of Defiance, Ohio and Dr Chris Rademacher of Ames, Iowa are this year's candidates for vice president. Their candidate messages appear in this JSHAP issue. Dr Rebecca Robbins is the current vice president and is unopposed on the ballot to ascend to the president-elect position.

District directors

Members in 2 districts may vote for their district representative on the AASV Board of Directors. Elections are being conducted in District 3 (AR, KY, and MO) and District 7 (western US: AK, AZ, CA, CO, HI, KS, ID, MT, NM, NV, OK, OR, TX, UT, WA, and WY).

All balloting is conducted electronically. Voting members may access their ballot by logging into their AASV member account at **aasv.org/members**. The last day to submit or change a vote is **Friday, February 21**.

The election results will be announced during the AASV Annual Meeting in San Francisco, California.

AASV committees to meet virtually before Annual Meeting

Once again this year, AASV's membership and issue-based committees will meet virtually before the Annual Meeting, in addition to meeting in person in San Francisco, California. Meeting times are posted on the AASV committee webpage at **aasv.org/committees**. Agendas will be posted on each committee page as they become available.

Learn about each committee, read their reports and workplans, and review committee guidelines on the AASV committee webpage. All AASV members and student members are welcome to attend any committee meeting, but only committee members are eligible to vote. If you are interested in joining a committee, please contact the committee chair or Dr Abbey Canon. Not sure which to join? The AASV staff can help you fill an open seat!

The AASV Board of Directors relies on the committees as topic experts and seeks their input regarding issues of importance to swine veterinarians. Committees are called upon to examine an issue and advise the board on official positions the association should take or to develop additional resources to educate membership.

AVMA Committee and Council positions open

The AASV designates representatives for several committees of the American Veterinary Medical Association. Current representatives are listed at **aasv.org/contacts/avma-reps**. Visit **avma.org/membership/volunteering-avma/avma-volunteer-opportunities-vacancies** for more details and descriptions of each committee. Some committees have openings; please contact the AASV office if you are interested in representing AASV.

AASV news continued on page 31

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AASV news continued from page 29

Scholarships available for MentorVet Leap; apply by February 7

The American Association of Swine Veterinarians and MentorVet continue their partnership to offer scholarships to swine veterinarians early in their careers. The AASV has approved funding of 5 additional scholarships for early-career swine vets to participate in the spring 2025 MentorVet Leap program.

The MentorVet Leap program is a 6-month, entirely virtual, evidence-based mentorship and professional development program that aims to promote well-being and decrease burnout in the transition into veterinary practice. The mentorship program has been adapted to meet the needs of early-career swine veterinarians including swine-specific case examples and paired mentorship with a more experienced swine veterinarian.

In addition to paired mentorship, the program provides holistic support to veterinarians through a combination of professional skills training, financial and mental health coaching, and peer mentorship. Mentees engage in a self-paced online curriculum and then meet monthly with other early-career veterinarians to discuss shared challenges and share perspectives on how to create a sustainable career path.

Dr Monica Strawn, a 2024 AASV MentorVet Leap scholarship recipient said, "MentorVet helped me grow as a person and a doctor in all the areas vet school doesn't prepare you for. The soft skills I have learned over the last 6 months have helped me navigate as a new veterinarian and will benefit me for the rest of my career."

Jenna Scott, DVM, a 2023 AASV MentorVet Leap scholarship recipient, shared, "MentorVet Leap is a great way to gain knowledge and learn skills to better navigate early-career veterinary practice. Through the MentorVet Leap program, I have also been paired with an excellent mentor whom I plan to stay in communication with after the program ends. I have found it very helpful to have a supportive person to talk to about goals and stresses associated with work."

During the 2023 pilot, small-group discussions were facilitated by a MentorVet team member allowing early-career swine veterinarians to connect with one another and share experiences. After participating in the program in spring 2023, swine veterinarian Jordan Buchan shared, "Being able to discuss topics such as self-care, professional boundary setting, and conflict resolution, amongst many others, with colleagues in the same discipline of veterinary medicine, was life changing. In addition, being assigned an external professional mentor in the industry continues to be a great asset. I actively use the lessons learned during my participation in MentorVet every day in my career. I am very grateful to AASV for funding my enrollment in the program and know it will continue to be transformative for many young swine veterinarians in the future."

The spring 2025 MentorVet Leap program will take place from February 21, 2025 - July 31, 2025. **The deadline to apply for the spring scholarship is February 7, 2025.** Those AASV members who have received their veterinary degree in the past 5 years (classes of 2020-2024) can apply for a scholarship to participate in the MentorVet Leap Program by visiting **mentorvet.net/scholarships**.


BE THE PIG'S
AMERICAN ASSOCIATION
SWINE VETERINARIANS
56th AASV ANNUAL MEETING
MARCH 1-4, 2025
SAN FRANCISCO, CALIFORNIA
aasv.org/annmtg
CHAMPION

Get ready to stake your claim

Psst … have you heard? There are some mighty fine items in this year's AASV Foundation fundraising auction! As soon as the bidding opens on February 1, folks will be rushing to stake their claims. Do not be left in the dust – head over to **aasv.org/foundation/2025-auction** now and start digging into the many gems waiting to be discovered!

The word is that there are all sorts and sizes of "golden nuggets" to be had, if you are willing to place a bid or two. You could come away with anything from pig collectibles and household items to quality pork and beef to a football tailgating event – or even a fabulous vacation!

Don't be stingy! Every auction bid is paydirt for swine veterinarians, making it possible for the foundation to continue to dole out cartloads of research grants, scholarships, travel stipends, externship grants, and debt-relief awards to deserving individuals.

Start "prospecting" February 1, when the silent auction opens for bidding on ClickBid at **aasvf.cbo.io**. Anyone can stake their claim on an item until the auction closes at 7:00 PM PST on Monday, March 3. After the auction, donors will ship or deliver items to the winning bidders.

The "golden state" of California will host the live auction the evening of Monday, March 3, immediately after the AASV Awards Reception at the San Francisco Marriott Marquis. If you are not able to bid in person, submit bids or make arrangements to bid remotely by contacting **foundation@aasv.org**.

Let's get mining and strike it rich for the AASV Foundation!

Dr Melissa Billing

I am extremely honored to have been nominated for vice president of the American Association of Swine Veterinarians. I would like to thank the AASV Board of Directors for their confidence in me.

I believe that values, shared purpose, communication, and strategic planning are things that build a strong organization. I have been privileged to represent interests of AASV members on the Board of Directors for the past 6 years.

The AASV mission statement (**aasv.org/about**) contains six pillars of value and purpose that are the basis for the direction of the organization:

- increase the knowledge of swine veterinarians
- protect and promote the health and well-being of pigs
- advocate science-based approaches to veterinary, industry, and public health issues
- promote the development and availability of resources that enhance the effectiveness of professional activities
- create opportunities that inspire personal and professional growth and interaction
- mentor students, encouraging lifelong careers as swine veterinarians

I, along with many of you, have been a part of our mission statement in action. I served the organization as the chair of the Annual Meeting Practice Tips session for the past 4 years and assisted as a member of the Annual Meeting Program Planning Committee during that time. In addition, I was the chair of the AASV Operation Main Street Committee for 4 years. In fact, I first became interested in serving as a board member and officer of AASV through my role as a committee member and chair. So, get yourself involved and do not be afraid to try new things, because you never know where it will lead!

Early in my career, I was told to "be the voice of the pig" meaning to advocate for the health and well-being of the animals. Soon, I found that being an advocate meant so much more. I also became a voice for swine veterinarians and now find myself as a representative of pig farmers and the pork industry as well. I continue to speak to civic and professional groups as a volunteer speaker for the Ohio Pork Council in a manner very similar to the former Operation Main Street program. In addition, I have presented to veterinary and pre-veterinary students from all over the world on a variety of topics in swine medicine over the past 20 years. I am now a member of the AASV Communications Committee, where we facilitate communication internally to members and externally to the broader pork industry and the public.

Like many swine veterinarians, I strive to be a life-long learner. I received my DVM from The Ohio State University, College of Veterinary Medicine in 2005. I completed the Executive Veterinary Program in Swine Health Management at the University of Illinois in 2016 and, with the help of the AASV Foundation's Alex Hogg Scholarship, I received a Master of Veterinary Science degree with a concentration in Livestock Systems Health from the University of Illinois in 2022. I am currently a senior key account veterinarian in the swine division at Boehringer Ingelheim Animal Health USA Inc, where I collaborate with veterinarians and swine producers throughout the United States on matters including vaccines, disease challenges, disease prevention, biosecurity, food safety, and swine production. Prior to joining Boehringer Ingelheim, I was a veterinarian at Smithfield Foods in Rose Hill, North Carolina for nearly ten years.

Outside of my career and the AASV, my husband and I have two teenage daughters. I am involved with my church, recently serving as a member of the Parish Council for 2 years and the treasurer of our Parents of Religious Education organization for 6 years. I have been a member of the Parent Teacher Organization at my daughters' school for 5 years and have served as the organization's secretary for 2 years. Furthermore, I coached bitty volleyball and basketball for the youth of our community.

My time on the Board of Directors has shown me that the AASV is a strong organization. I have the knowledge, experience, and desire to lead the AASV into the future. Thank you for considering me for AASV vice president.

Melissa Billing, DVM

Dr Chris Rademacher

I am humbled and honored to be considered a nominee for vice president of the greatest association I have ever had the privilege to serve. I have benefited immensely from the many opportunities provided by our association and firmly believe in giving back, just as our predecessors have done for us. From participating in the inaugural AASV student competition in 1995 (the prizes were much smaller then), to chairing the Annual Meeting Research Topics session for the past 15 years, to serving as Chair of the Pharmaceutical Issues Committee, to currently representing District 6 (Iowa) on the AASV Board of Directors, I have gained a deep appreciation for the issues and concerns of our members and our association.

I was born and raised on a 50-sow, 300-acre diversified crop and livestock farm in southwestern Minnesota and attended a small school with a strong FFA program. There, I learned the value of hard work and developed a love for agriculture. Although I initially pursued a premedicine track in college, I realized I needed to stay in agriculture while working with a litter of pigs. After spending time with the Worthington Veterinary Medical Center, I knew a career as a swine veterinarian was my path. After graduating from the University of Minnesota in 1998, I joined my neighbor, Dr Brad Freking, as he was starting up New Fashion Pork. This experience gave me insight into all facets of swine production and how to integrate sound business decisions into veterinary practice. Starting in 2009, I spent five years with Smithfield Foods where I had the opportunity to collaborate with a team of veterinarians before moving to Iowa State University in 2014, where I now share my practical experiences with the next generation of swine industry leaders.

The strength of our association lies in our membership and collective commitment to address the challenges our colleagues and clients face. Some of the challenges that will require our collective talent and collaboration include:

1. **Swine veterinarian retention**
   I was fortunate to work with the Early Career Committee to develop and execute a survey of veterinarians who have left veterinary practice or our industry altogether (**aasv.org/video/annual-meeting/2024-annual-meeting-video/2024-rademacher**). We have opportunities to improve practice efficiency to compete within the veterinary space and a duty to ensure everyone in our profession feels valued and welcomed.

2. **Foreign animal disease preparedness**
   While we have made significant progress in this area, there is still work to be done. We need to continue guiding our clients toward better preparedness. The codification of the US Swine Health Improvement Plan certification program and its possible application with an endemic disease, like porcine epidemic diarrhea virus, as well as increasing the number of Certified Swine Sample Collectors are examples where our association can lead the way.

3. **Innovation**
   We must be at the forefront of using technological advancements to improve our practice and enhance swine health and well-being. Integrating telemedicine and other technology to enable veterinarians to use their time more efficiently is one example.

4. **Mentorship**
   The AASV has sponsored wonderful opportunities for young veterinarians to receive mentorship. One of the unique strengths of our association is that we are a relatively small, close-knit group of veterinarians willing to invest their time and expertise in helping the next generation, as was done for us when we began our careers.

5. **Education for present and future veterinarians**
   We must continue advocating and exploring opportunities to recruit and educate the future leaders of our association while providing valuable educational experiences for our current members. It is crucial that we monitor the decline in swine medicine programs in US veterinary colleges and vigorously advocate against this trend.

The American Association of Swine Veterinarians is the finest organization I have ever been a part of. We face many challenges moving forward, but as we have in the past, we will confront them head-on and evolve to meet the needs of our clients and the pigs we care for. I am grateful for the opportunity to run for vice president, and I thank you for your time and consideration.

Chris Rademacher, DVM

Author guidelines

Updated December 2024

Journal description

The *Journal of Swine Health and Production* (JSHAP) is published bi-monthly by the American Association of Swine Veterinarians (AASV) and is freely available online. The journal accepts manuscripts for peer review that encompass the many domains of applied swine health and production, ie, the diagnosis, treatment, management, prevention, and eradication of swine diseases, swine welfare and behavior, nutrition, public health, epidemiology, food safety, biosecurity, pharmaceuticals, antimicrobial use and resistance, reproduction, growth, systems flow, economics, and facility design.

Types of papers

The *Journal of Swine Health and Production* currently accepts manuscripts that meet the descriptions and formatting requirements defined in Table 1.

Policies and procedures

Animal care and welfare

For all research studies involving animal or human subjects, the manuscript must include a statement attesting that the study protocol was reviewed and approved by an appropriate oversight entity (eg, institutional animal care and use committee [IACUC], institutional review board [IRB], or country-specific equivalent) and the study performed in accordance with relevant institutional and national guidelines and regulations. The statement must include the name of the approving oversight entity and approval reference number. For example, "The study was conducted according to the Guide for the Care and Use of Agricultural Animals in Research and Teaching and was approved by the NAME OF INSTITUTE (IACUC No. 12345)."

For Case Studies and Case Reports performed under field conditions in which animals are not manipulated beyond what would be required for diagnostic purposes, the manuscript must include a statement attesting that the animals were adequately housed and humanely cared for in accordance with relevant industry and country guidelines and regulations. For example, "The animals in this case study were housed and cared for in accordance with the Pork Quality Assurance Plus program under the supervision of the herd veterinarian."

For studies that do not include animal or human subjects, the manuscript must include a statement providing justification for why the study is exempt from animal care and use approval. For example, "This study was a retrospective analysis of farm production records and therefore, no animal care and use approval was required."

The Animal care and use section should immediately follow the Introduction section of the manuscript. Literature review and peer-reviewed commentary manuscripts are exempt from providing an animal care and use statement.

Authorship

According to the International Committee of Medical Journal Editors, all listed authors must have participated sufficiently to take public responsibility for the work. Individuals should only be listed as authors if contributions have been made in each of the following areas[1]:

1. Conception and design, acquisition of data, or analysis and interpretation of the data,
2. Drafting the manuscript or revising it critically for important intellectual content,
3. Approval of the version of the manuscript to be published, and
4. Agreement to be accountable for all aspects of the work, ensuring questions related to accuracy and integrity are investigated and resolved.

Authors who use generative or assistive artificial intelligence (AI) technologies are responsible for the originality, validity, and integrity of the content of their submission and for ensuring there is no plagiarism. Use of AI tools should be disclosed in the Acknowledgment section of the manuscript and include the full name of the tool used (with version number) and how it was used.

Ethics

Authors are expected to observe high standards with respect to research and publication ethics. Fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results is considered research misconduct.[2] All cases of research misconduct will be investigated and addressed accordingly.

Conflict of interest

Authors are required to declare the presence of any personal, professional, or financial relationships that could potentially be construed as a conflict of interest for the submitted manuscript, regardless of genre. This declaration is placed just before the reference section and provides information concerning authors who profit in some way from publication of the paper. For example, one or more of the authors may be employed by a pharmaceutical company that manufactures a drug or vaccine tested in the study reported. Other examples include consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. If there is no conflict of interest to declare, the statement under the "Conflict of interest" heading is "None reported."

Copyright transfer

The copyright for manuscripts published in the *Journal of Swine Health and Production* is held by the AASV. Published articles will be licensed using Creative Commons CC BY-NC 4.0 International (**creativecommons.org/licenses/by-nc/4.0**). When a manuscript is submitted to the JSHAP, all authors must electronically sign a pre-review copyright agreement and disclosure statement. This electronic form will be sent by the JSHAP publications manager to all listed co-authors upon submission. When the manuscript is accepted for publication, the corresponding author will be required to transfer copyright to the AASV, except for US government employees whose work is in the public domain, and portions of manuscripts used by permission of another copyright holder. Anyone acknowledged by name in the manuscript or acknowledgment section will need to sign an acknowledgment permission form.

Prior publication

We do not republish materials previously published in refereed journals. Sections of theses and extension publications that may be of value to our readership will be considered. Prior publication of an abstract only (eg, in a proceedings book) is generally acceptable.

Table 1: Manuscript genres and formatting requirements currently accepted by the *Journal of Swine Health and Production*

Genre	Description	Maximum words		Maximum No.		Other requirements*
		Abstract	Manuscript body	Figures and Tables	References	
Original Research	Reports the results of original research on topics that are within journal scope.	250	4000	As needed	35	–
Brief Communication	Documents observations made in a narrowly defined research area or a mini-review of a subject area.	50	2000	2	15	–
Case Report	Describes an unusual or interesting case.	100	3000	As needed	As needed	Manuscript should not exceed 20 pages including figures, tables, and references.
Case Study	Describes unusual or interesting cases occurring on two or more farms.	100	3000	As needed	As needed	Manuscript should not exceed 20 pages including figures, tables, and references.
Literature Review	Review of the published scientific literature about a specific topic area in which important advances have been made in the past five years and is of current interest.	200	5000	As needed	As needed but most references should be recent (within 5 yrs) and avoid use of non-refereed references and personal communications.	Manuscript should not exceed 30 pages including figures, tables, and references.
Production Tool	Describes a practical, state-of-the-art technique for improving an individual swine enterprise or the swine industry at large.	100	3000	As needed	As needed	Manuscript should not exceed 20 pages including figures, tables, and references.
Diagnostic Note	Describes methods of diagnosis for swine diseases. A brief literature review may be included and use of non-refereed references and personal communications is not restricted.	100	3000	As needed	As needed	Manuscript should not exceed 20 pages including figures, tables, and references.
Practice Tip	Describes new technological methods likely to be of use to swine practitioners.	100	3000	As needed	As needed	Manuscript should not exceed 20 pages including figures, tables, and references.
Peer-reviewed Commentary	Commentary on diagnostic, research, or production techniques used in the field of swine health and production.	100	3000	As needed	As needed	Manuscript should not exceed 20 pages including figures, tables, and references.

Table 1: Continued

Genre	Description	Maximum words		Maximum No.		Other requirements*
		Abstract	Manuscript body	Figures and Tables	References	
Letter to the Editor (LTE)	Offers comment or useful critique on materials published in the journal.	-	500	0	5	The decision to publish an LTE rests solely with the executive editor. Letters referring to a published article will be forwarded to the author of the article, and both the original letter and the response will be published in the same issue if possible. Letters to the Editor are not peer-reviewed but are subject to editorial changes.

* Page limits are for Microsoft Word documents using 1-inch margins, Times New Roman, 12-point font (unless otherwise specified), and left justification with double-spacing throughout.

Permissions

If copyrighted material is used, advise the editors of this at the time of manuscript submission. Authors are responsible for securing permission to use copyrighted art or text, including the payment of fees.

Publication fees

There is no fee for publication of manuscripts in the JSHAP.

Manuscript preparation

File types

All manuscripts must be submitted as a Microsoft Word document using 1-inch margins, Times New Roman, 12-point font (unless otherwise specified), and left justification with double-spacing throughout. Include continuous page and line numbers. Do not use numbered or bulleted lists in the abstract or the text. Do not include tables or figures in this file, but do include table and figure references, such as (Table 1) or (Figure 1), within the text. Software programs that automatically create endnotes, footnotes, and references should be avoided in the final submitted version of the manuscript as the embedded formatting cannot be read by the publication software.

If the manuscript includes tables, each table must be created and submitted in a separate Microsoft Word document titled as the respective table number.

If the manuscript includes figures (graphs or images), submit each figure in a separate file titled as the respective figure number. Graphs created in Microsoft Excel should be submitted in the original .xls file(s). A graph created in statistics software can be submitted as a .pdf file. Photographs and images need to be high resolution .jpg files.

Sample templates have been created for each genre to assist authors in formatting their manuscript and can be accessed at **aasv.org/author-guidelines**.

Supplementary materials

Supplementary materials are additional materials that are not essential to the understanding of the manuscript but provide important context to the manuscript and may be submitted for only online publication. Examples of materials accepted include extended descriptions of experimental methods or statistical analysis, extended bibliographies, additional supporting tables and figures, reporting checklists, copies of surveys or questionnaires, handouts, and forms.

For supplementary materials that are too large or in a format not consistent with JSHAP publication (eg, data sheets, presentations, audio, or video), authors are encouraged to upload and publish these files to a repository, such as FigShare, and reference the DOI within the manuscript.

Supplementary materials must be formatted according to the JSHAP Author Guidelines. There is no word or page limit for supplementary materials, but they should be succinctly presented to facilitate peer review. Acceptance of supplementary materials for publication is at the discretion of the editor. All JSHAP published supplementary materials are subject to copyright.

General style

Manuscripts must be written in English and use American spelling and usage. The JSHAP uses the AMA Manual of Style for guidance on general style and form.[3] Please review the complete author guidelines and author checklist at **aasv.org/author-guidelines** for full details on journal formatting requirements for submitted manuscripts.

Manuscript submission and review

Submission instructions

All submissions must be accompanied by a cover letter. The cover letter should be on official letterhead, not exceed 1 page, and include the following information:

- a statement acknowledging that the manuscript is not currently under consideration for publication elsewhere,
- a statement that all co-authors have reviewed and approve the manuscript submission,
- the intended genre of the submitted manuscript,

- a brief description of how the manuscript relates to the scope of JSHAP (optional),
- suggestions for potential reviewers of the submitted manuscript (optional), and
- signature of the corresponding author.

All manuscripts and supporting documents will be submitted through the JSHAP ScholarOne Manuscripts platform.

Questions about manuscript submission or status can be directed to JSHAP Publications Manager, Rhea Schirm at **jshap@aasv.org**.

Review of manuscripts

The executive editor will initially assess all manuscript submissions to ensure suitability for the journal. Papers deemed suitable are sent to a minimum of 3 independent, expert reviewers for assessment of the scientific quality of the paper. The executive editor makes the final decision regarding acceptance or rejection of manuscripts. Accepted manuscripts are subject to further revision from the associate editor. The abstract of accepted manuscripts will be professionally translated to French and Spanish for publication.

Contact information

Executive Editor, Terri O'Sullivan, DVM, PhD; Email: **jshap@aasv.org**

Associate Editor, Sherrie Webb, MSc; Email: **webb@aasv.org**

Publications Manager and Advertising Coordinator, Rhea Schirm; Email: **jshap@aasv.org**

References

1. International Committee of Medical Journal Editors. Recommendations for the conduct, reporting, editing, and publication of scholarly work in medical journals. Updated January 2024. Accessed October 9, 2024. **http://www.icmje.org/icmje-recommendations.pdf**.

2. Office of Science and Technology Policy. Federal policy on research misconduct. *Fed Regist*. 2000;65(6):76260-76264.

3. Christiansen SL, Iverson C, Flanagin A, Livingston EH, Fischer L, Manno C, Gregoline B, Frey T, Fontanarosa PB, Young RK, eds. *AMA Manual of Style: A Guide for Authors and Editors*. 11th ed. Oxford University Press; 2020.

JSHAP Author Guideline Checklist

Updated December 2024

Title page

- ☐ I have created my manuscript in a Word document with double spacing, footer page numbers, continuous line numbers, and Times New Roman, 12-point font.
- ☐ I have provided a short title of 90 characters or less (including spaces).
- ☐ I have included the genre of publication.
- ☐ I have created a title that is concise, specific, and informative without using abbreviations.
- ☐ I have properly formatted the author byline.
  - Alpha B. Charlie, Juliett K. Lima, Mike N. Oscar
- ☐ I have properly formatted the author affiliations.
  - ABC, MNO: department, college, institution, City, State or Country. (State only if in the United States)
  - JKL: company, City, State or Country. (State only if in the United States)
- ☐ I have properly formatted the corresponding author information.
  - Corresponding author: Dr Alpha B. Charlie, street address, City, State Zip; Tel: 555-555-5555; Email: **email@email.com**.

Abstract

- ☐ I have included an Abstract not exceeding the word limit for the genre:
  - 250 words for original research including these subheadings – Objective(s), Materials and methods, Results, and Implication(s).
  - 200 words for literature review. No subheadings needed.
  - 100 words for case report, case study, production tool, diagnostic note, practice tip, or peer-reviewed commentary. No subheadings needed.
  - 50 words for brief communication. No subheadings needed.
- ☐ I have only introduced abbreviations if they are used again in the abstract; defined abbreviations at the first mention of the term; and used the abbreviation whenever the term is mentioned except at the beginning of a sentence.
- ☐ I have included "swine" as the first keyword with up to 4 additional words or phrases for a total of 5 keywords.

Manuscript body

- ☐ I have included the required sections for the genre of manuscript.
- ☐ I have included an animal care and use statement prior to the Materials and methods section that either attests that the study protocol was reviewed and approved by an appropriate oversight entity and the study performed in accordance with relevant institutional and national guidelines and regulations or is exempt for this review.
- ☐ I have only introduced abbreviations if they are used again in the manuscript body; defined abbreviations at the first mention of the term except in titles, headings, and subheadings; and used the abbreviation whenever the term is mentioned except at the beginning of a sentence or as the sole term in headings and subheadings.
- ☐ I have provided the manufacturer's name for all equipment and reagents used in my study.
- ☐ When *P* values are reported, I have capitalized and italicized the *P* and have not included a zero to the left of the decimal point. The numerical value is rounded to 2 or 3 digits to the right of the decimal point with the smallest being $P < .001$.
- ☐ I have included spaces around signs of operation (+, <, >, =, etc).
- ☐ I have used commas to separate all parts of a series (eg, green, red, and yellow).
- ☐ I have spelled out all units of measure unless they are accompanied by a numerical value.
- ☐ I have not used numbered or bulleted lists in the manuscript.
- ☐ I have used brackets to indicate a parenthetical expression within a parenthetical expression: ([ ]).

Implications

- ☐ I have included up to 3 bulleted implications, each with a maximum of 80 characters or less (including spaces). This section is exempt only for literature review and practice tip manuscripts.

Acknowledgments

- ☐ I have mentioned any individuals, companies, or funding sources that I would like to acknowledge.
- ☐ I have disclosed all conflicts of interest for this paper. If none exist, I have included the statement "None reported."
- ☐ I have included the JSHAP disclaimer.

References

- □ I have checked that all reference numbers in the manuscript are listed in sequential order.
- □ I have formatted reference numbers in the manuscript as superscripts placed after periods and commas and before colons and semicolons.
- □ I have properly formatted references according to the table in the author guidelines.
- □ I have italicized and abbreviated all journal titles according to the US National Library of Medicine catalog (**ncbi.nlm.nih.gov/nlmcatalog/journals**).
- □ I have provided complete page numbers in all references (eg, 120-128, not 120-8).
- □ I have used a hyphen to separate page numbers in all references.
- □ I have included the DOI, if one exists, for all references.

Tables

- □ I have created tables that stand alone from the manuscript (ie, they do not rely on explanatory materials from the manuscript) and are numbered in the order they are referenced in the text.
- □ My table titles are brief, in sentence case with only the first word capitalized, and do not end with a period.
- □ I have created my tables using Microsoft Word and saved them in individual files separate from the manuscript titled with the respective table number.
- □ I have included the appropriate unit of measure for each row and column.
- □ I have no missing data in my tables (eg, empty cell, hyphen, period) and used the numeral "0" to indicate the value of the data is zero or "NA" to denote not available, not analyzed, or not applicable and have defined the abbreviation accordingly in the abbreviations footnote.
- □ I have used parentheses instead of the ± symbol throughout my table (eg, "1 (3.5)" rather than 1 ± 3.5").
- □ I have used footnotes to explain data in the table using symbols in the designated order (*†‡§¶) and doubled the symbols in that order if more were needed.
- □ When appropriate, I have provided a footnote to describe the level of significance and the statistical method of analysis used.
- □ When appropriate, I have used lower case letters as superscripts to designate significant differences and have created a footnote to explain the level of significance and the statistical method used.
- □ I have defined all abbreviations used in the table in the last footnote, which does not use a footnote symbol.
- □ I have ensured the abbreviations used in the table are consistent with any abbreviations used in the manuscript.

Figures

- □ I have included all figure legends at the end of the manuscript and have not included the figures.
- □ I have created figures that stand alone from the manuscript (ie, they can be understood without referencing information from the manuscript) and are numbered in the order they are referenced in the text.
- □ My figure title is descriptive, brief, and followed by the legend and abbreviations. The legend includes a brief description of treatments, level of significance, *P* values, and the statistical method used. All abbreviations used in the figure are defined.
- □ I have created a separate file for each figure in the acceptable file types (ie, .xls, .pdf, or .jpg).
- □ All axes are labeled with a description followed by the unit of measure, when needed, separated by a comma.

Manuscript submission

- □ I have included a cover letter that does not exceed 1 page and includes the requested information.

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Pharmgate ANIMAL HEALTH

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UPCOMING MEETINGS

Banff Pork Seminar
January 7 - 9, 2025 (Tue-Thu)
Fairmont Banff Springs Hotel
Banff, Alberta, Canada

For more information:
Web: **banffpork.ca**

2025 AVMA Veterinary Leadership Conference
January 9 - 11, 2025 (Thu-Sat)
Chicago, Illinois

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

Pig Ski Conference
February 5 - 7, 2025 (Wed-Fri)
Copper Mountain, Colorado

For more information:
Tel: 507-381-1647
Email: **pyeske@swinevetcenter.com**
Web: **pigski.com**

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**

Animal Ag Alliance Stakeholders Summit
April 30 - May 2, 2025 (Wed-Fri)
Arlington, Virginia

For more information:
Web: **animalagalliance.org/initiatives/stakeholders-summit**

World Pork Expo
June 4 - 5, 2025 (Wed-Thu)
Iowa State Fairgrounds
Des Moines, Iowa

For more information:
Web: **worldpork.org**

15th SAFEPORK
October 6 - 8, 2025 (Mon-Wed)
Rennes, France

For more information:
Tel: +33 07 62 53 33 96
Email: **safepork@ifip.asso.fr**
Web: **safepork.ifip.asso.fr**

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

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