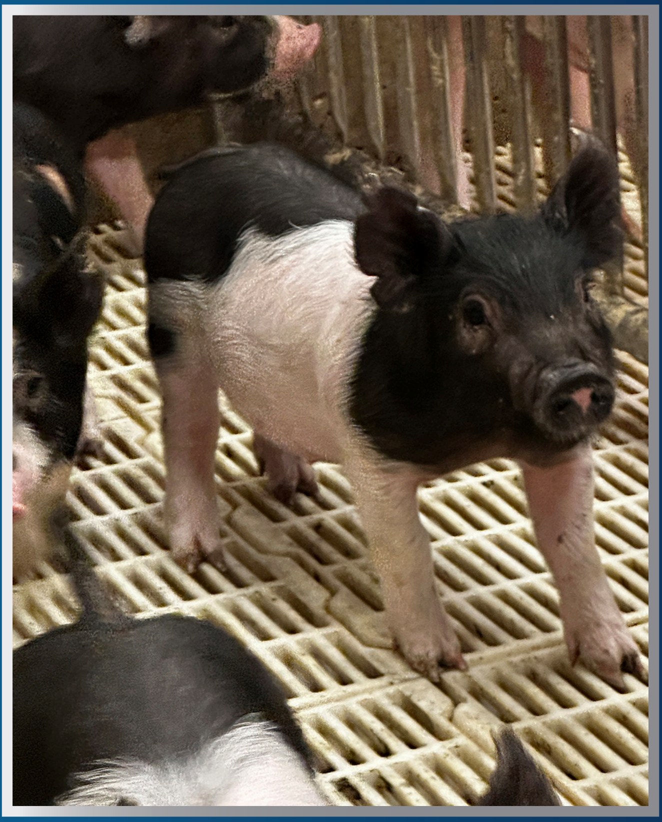
Journal of

SWINE HEALTH & PRODUCTION

November and December 2024 • Volume 32, Number 6



Longitudinal hemoglobin assessment in sows and their offspring

McClellan K, Lindemann M, Levesque C

Characterization of rotaviruses sampled in Canadian suckling piglets, 2019-2023

Malgarin C, de Grau F

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.

Opinions expressed in this publication are those of the individual authors and do not necessarily reflect the endorsement, official attitude, or position of the American Association of Swine Veterinarians, the *Journal of Swine Health and Production*, or any Industry Support Council member.

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

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

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

DISCLAIMER

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

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

JOURNAL OF SWINE HEALTH AND PRODUCTION

(ISSN 1537-209X) Volume 32, Number 6; November and December

TABLE OF CONTENTS

Cover photo is courtesy of Tina Smith

Download this issue at **www.aasv.org/shap/issues/v32n6/v32n6jshap.pdf**

JSHAP SPOTLIGHT

Mallory Wilhelm

2024 AASV Board of Directors Alternate Student Delegate
Iowa State University

Mallory Wilhelm earned her BS ('22) in Animal Science and is currently a third-year veterinary student at Iowa State University (ISU). After graduation, Mallory plans to work in the swine industry and continue her involvement with the AASV organization. Through AASV, Mallory has participated in a wide variety of activities at both the chapter and the national level including coordinating various ISU AASV Chapter wet labs and participating in the student seminar and scholarship competition at the 2023 and 2024 AASV Annual Meetings. "I have learned the importance of communication, networking, and leadership through these experiences. I am so thankful for the opportunities and support that the AASV organization has provided to students and look forward to participating in more events in the future." said Mallory.

Be a champion for all pigs, everywhere

You have probably noticed by now that the AASV executive officer team is sharing the responsibility to pen the President's Messages in Dr Angela Baysinger's absence. Dr Hollis called on us to be advocates, and Dr Robbins carried this theme further to discuss many of the rewarding formal and informal opportunities that arise to advocate within our practice and AASV activities. The objectives of advocacy and teaching are similar in that each seeks to provide knowledge that will change behavior. To achieve this behavioral change, the knowledge must be meaningful and compelling to the person you hope to influence or teach. As an organization, we have focused on evidence-based practice principles since our inception. Many of our membership fit the description of the "clinician-scientist" working to better understand animal health and welfare in real-time while managing cases. I remember my first AASV Annual Meeting and being impressed at the emphasis placed on systematic inquiry and the development and sharing of new knowledge with an evidence basis. Tangible examples of true, life-long learners were walking the halls and standing at the podiums of that meeting, and it was motivating. Certainly Dr Baysinger was an example of someone who worked to generate reliable new knowledge to improve the health and welfare of the pigs in our care using quality evidence-based approaches.

When building evidence, we begin with quality, systematic data that have as much bias removed as possible. These data are analyzed and summarized into information and then join the available body of information that becomes the evidence that supports a particular treatment or intervention. However, providing this evidence alone is not sufficient for teaching or advocacy. Additional components are required, especially when we are summarizing evidence as part of our message.

Trust is a critical component of teaching and advocacy. Merriam-Webster defines trust as "a firm belief in the character, ability, strength, or truth of someone or something." If effective advocacy and teaching require evidence plus trust, then we are constantly advocating and teaching even when that is not the focus of the day's activities. We must earn the trust of those we hope to influence by demonstrating our character, ability, strength, and truth consistently and constantly in our interactions with our peers and clients. As part of AASV executive committee meetings with organizations like the National Pork Board, the American Association of Veterinary Medical Colleges, and the American Veterinary Medical Association over the past year, it is clear that we are the trusted experts on swine health and welfare, especially in pork production settings. These groups also understand evidence-based approaches to medicine and can engage in discussions about topics of mutual interest at a very technical level.

Most of the targets of our teaching and advocacy efforts are not prepared to engage at a highly technical level. Things that strengthen trust are the effort to meet others at their level of understanding and listening to what is important to them. Common ground is a great position from which to advocate. Dr Baysinger understood these things and lived them.

"We must earn the trust of those we hope to influence by demonstrating our character, ability, strength, and truth consistently and constantly in our interactions with our peers and clients."

She earned trust as an advocate because she was engaged in what she was talking about every day.

While we are talking about teaching and advocacy, it is important to reflect on whom we, as an organization, represent. When you review historical meeting agendas, the practice activities of our membership, and the statements that we make as an organization, we are clearly focused on production medicine practiced on animals that are destined for the human food supply. When you consider that the overwhelming majority of pigs in the world are raised for this purpose, and their health has a very direct impact on most of the human population, this makes sense and should continue.

I would argue that the relatively recent increase in pigs being used for other purposes such as biomedical research, pets, and competitive show animals means there are some additional areas that we need to include if we expect to be the exclusive advocates for swine medicine. Estimates vary significantly but suggest that there are at least 1,000,000 households with a pet pig and about 100,000 sows producing show pigs. If you consider that most of the show pig producers are more like each other, in terms of production characteristics and health challenges, than they are to any other system, they would have been the 11th or 12th largest production system in the United States in 2023.

As current chair of the Program Planning Committee preparing for the next AASV Annual Meeting, I have spent a lot of time seeking out and talking to veterinarians that practice swine medicine,

Officer's message continued on page 243

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

6.56 LBS
IMPROVEMENT AT WEAN TO MARKET

4%
INCREASE IN AVERAGE DAILY GAIN

2.5%
IMPROVEMENT IN HOT AND COLD CARCASS WEIGHTS

1.5 LBS
ADDITIONAL TRIMMED LOIN

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

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

PHARMACOSMOS

PM-070-00

Officer's message continued from page 241

but are not members of our organization, to better understand how we as an association might meet their needs. You will see the results of these conversations reflected in the agenda of the 2025 Annual Meeting in San Fransisco. Why dedicate part of our valuable meeting time to topics pertinent to biomedical, show, and pet pigs? Because AASV should be the trusted advocates for all pigs, everywhere. Trust is critical in effective advocacy and trust develops from demonstrating our character, ability, strength, and truth consistently and constantly. This means we need to engage these areas of practice and groups of clients. There is nothing about a pig's role or use in society that should interfere with providing the highest quality of health and welfare while they are alive and in our care.

See you in San Fransisco when we remind folks that we are the pig's champion – all pigs, everywhere.

Locke Karriker, DVM, MSc, DACVPM
AASV President-Elect

High Path AI, it's not just for poultry anymore

Influenza is a respiratory disease. Except when it's not. Highly pathogenic avian influenza (HPAI) has reminded us once again that viruses find a way to adapt, and influenza is a master at adapting. I can accept that an influenza virus occasionally finds its way from the respiratory tract of a migratory bird into a chicken, or even pig. But a bovine mammary gland?? Come on. Really.

As everyone knows, the influenza virus made exactly that leap earlier this year. At the time of this writing, the virus continues to circulate at will, putting much of the US dairy herd at risk. Fortunately, it is not killing cows, but infection does result in significant, hopefully temporary, illness and losses in milk production. Continued virus circulation, however, poses an increased risk for infection in poultry flocks where exposure results in high rates of mortality and depopulation of entire flocks. To date, we have been fortunate to have avoided swine infections – as far as we know.

Researchers are beginning to explore what the implications might be for an H5N1 infection in swine. We need to understand what clinical signs to expect, how the disease might manifest in swine, how it might be transmitted, any risks to exposure in meat, etc. There are early indications that it might be a relatively mild clinical disease in swine but with possible central nervous system signs raising concerns that the disease might go undiagnosed (or misdiagnosed) for a time.

This is why continued surveillance and sample submissions are critically important. The US Department of Agriculture Swine Influenza Surveillance Program is still accepting submissions from the veterinary diagnostic laboratories and conducting next-generation sequencing to monitor for the emergence of new strains or potential recombination. We have heard, however, that sample submissions are declining due to reluctance to have samples tested because of limited detail regarding the regulatory response.

In response to these concerns, the National Pork Producers Council is leading an effort involving AASV, National Pork Board, Swine Health Information Center, and others to develop an H5N1-specific response plan that can then be shared with state and federal animal health officials. The goal of this effort is

"The US Department of Agriculture Swine Influenza Surveillance Program is still accepting submissions from the veterinary diagnostic laboratories and conducting next-generation sequencing to monitor for the emergence of new strains or potential recombination."

to have an agreed-upon response plan ahead of an H5N1 outbreak in swine so everyone understands what will happen when the first, and subsequent, positive herds are detected.

Our only hope of detecting this influenza variant early in an outbreak will likely rely on robust surveillance. The earlier we can detect it, the more options we have of addressing it, controlling it, monitoring it, and ultimately eliminating it. Please encourage your producers to continue to submit suspect samples to the diagnostic laboratory and be vigilant for any production abnormalities. In addition, encourage farm employees to get vaccinated for seasonal flu and avoid contact with pigs if they are not feeling well. While it may not prevent an H5N1 introduction, it will help decrease the number of strains to which pigs are exposed.

Harry Snelson, DVM
Executive Director

Online Ahead of Print

I am thrilled to share some exciting news! The journal office, the editorial board, and I are delighted to introduce a new feature designed to enhance the timeliness and impact of the peer-reviewed manuscripts published in JSHAP.

Starting with this issue, we will implement the new Online Ahead of Print (OAOP) feature, marking a significant step forward in the journal's contribution to the timely dissemination of peer-reviewed literature focused on swine health and production.

Accelerating access to knowledge

I am sure most of you would agree that the pace of advancements in swine practice, and swine health and production, continues to rapidly accelerate. The dissemination of peer-reviewed literature must keep up! Our new OAOP feature will bridge the gap between manuscript acceptance and the publication of the final, paginated, online and print issues. With OAOP, accepted JSHAP manuscripts will be published online immediately after completing the peer-review process and editorial processing. This will provide researchers and veterinary practitioners with prompt access to the latest findings, without waiting for the full issue to be compiled and printed.

Enhancing visibility and impact

Another key advantage of OAOP is the increased visibility that early online publication enables. Articles published online ahead of print can be indexed in scientific databases, ensuring that they are discoverable by the global swine and research community. Furthermore, these OAOP manuscripts can be cited just like fully published manuscripts. This enhanced visibility often translates into earlier citations, which can be crucial for authors seeking to establish or advance their careers. Moreover, the extended period during which an article remains in the spotlight—first as an OAOP and later as part of a paginated issue—can boost its impact and overall readership.

Improving the author and reader experience

For authors, OAOP represents a significant improvement in the publication process. The time between acceptance and reader availability is greatly reduced, offering authors the benefit of having their work disseminated more quickly. This can be particularly beneficial for early-career researchers or for those working on time-sensitive topics such as novel disease outbreaks or swine production tools.

"Starting with this issue, we will implement the new Online Ahead of Print (OAOP) feature, marking a significant step forward in the journal's contribution to the timely dissemination of peer-reviewed literature focused on swine health and production."

For readers, OAOP provides a more up-to-date reading experience. You will be able to access the latest JSHAP peer-reviewed publications without waiting for the full issue release. Keep an eye on the AASV e-Letter for announcements when manuscripts are available online ahead of print.

As we roll out the "Online Ahead of Print" feature with our November/December issue, the editorial board and journal staff remain committed to maintaining the rigorous standards of peer review and editorial quality that JSHAP readers expect. The OAOP feature is not about speed; it is about timely, accessible, and impactful science.

I invite all of you: JSHAP readers, authors, and reviewers, to explore this new feature on the AASV website and see what is available online ahead of print.

I hope you enjoy this issue.

Terri O'Sullivan, DVM, PhD
Executive Editor

Peer reviewed **ORIGINAL RESEARCH**

Assessment of hemoglobin concentration in sows and their offspring over consecutive reproductive cycles

Katlyn A. McClellan, MSc; Merlin D. Lindemann, PhD; Crystal L. Levesque, PhD

Summary

Objective: Evaluate hemoglobin concentration (HbC) in sows and their offspring over consecutive parities.

Materials and methods: Twenty-three females were monitored for HbC during parities 1, 2, and 3 at 7 timepoints (30 [± 2], 60 [± 2], 90 [± 2], and 112 days of gestation, 2 and 16 [± 1] days of lactation, and 5 [± 1] days post weaning). Piglet HbC was measured within 18 hours after birth and at 16 (± 1) days of age. Pigs were classified as anemic (HbC < 10 g/dL) or nonanemic (HbC ≥ 10 g/dL) at each timepoint.

Results: On gestation day 90, 71.1% of sows were anemic across parities. In parity 1, HbC was less on lactation day 16 than all gestational timepoints ($P < .001$). In parity 2, HbC on lactation days 2 and 16 was less than all gestational timepoints ($P < .001$). In parity 3, HbC on lactation days 2 and 16 was less than gestation days 30 and 60 ($P = .015$). Piglet anemia prevalence at 1 day of age was 55.8%, 36.3%, and 46.1% for parity 1, 2, and 3, respectively ($X^2 < .001$). Piglet anemia prevalence at 16 days of age was 35.6%, 18.7%, and 15.9% for parity 1, 2, and 3, respectively ($X^2 < .001$).

Implications: Decreasing sow HbC over the reproductive cycle and lack of post-weaning recovery in parity 3 indicates iron declines with advancing parity and may impact long-term health. Piglet anemia prevalence declined with advancing parity, suggesting a need to reevaluate piglet iron supplementation in litters from younger females.

Keywords: swine, anemia, hemoglobin, sow

Received: March 14, 2024
Accepted: July 1, 2024
Published online: October 8, 2024

Resumen - Evaluación de la concentración de hemoglobina en cerdas y sus lechones durante ciclos reproductivos consecutivos

Objetivo: Evaluar la concentración de hemoglobina (HbC) en cerdas y sus lechones en partos consecutivos.

Materiales y métodos: Veintitrés hembras fueron monitoreadas para la HbC durante los partos 1, 2 y, 3 en 7 ocasiones (30 [± 2], 60 [± 2], 90 [± 2], y 112 días de gestación, 2 y 16 [± 1] días de lactancia, y 5 [± 1] días después del destete). La HbC de los lechones se midió dentro de las 18 horas posteriores al nacimiento y a los 16 (± 1) días de edad. Los cerdos se clasificaron como anémicos (HbC < 10 g/dL) o no anémicos (HbC ≥ 10 g/dL) en cada punto de muestreo.

Resultados: En el día 90 de gestación, el 71.1% de las cerdas presentaban anemia en todas las paridades. En el parto 1, la HbC fue menor el día 16 de lactancia comparada con todos los puntos de muestreo durante la gestación ($P < .001$). En la paridad 2, la HbC en los días 2 y 16 de lactancia fue menor que en todos los momentos de muestreo durante la gestación ($P < .001$). En la paridad 3, la HbC en los días de lactancia 2 y 16 fue menor que en los días 30 y 60 de gestación ($P = .015$). La prevalencia de anemia de lechones al día 1 de edad fue de 55.8%, 36.3%, y 46.1% para las paridades 1, 2, y 3, respectivamente ($X^2 < .001$). La prevalencia de anemia de los lechones a los 16 días de edad fue de 35.6%, 18.7%, y 15.9% para el parto 1, 2, y 3, respectivamente ($X^2 < .001$).

Implicaciones: La disminución de la HbC en las cerdas a lo largo del ciclo reproductivo, y la falta de recuperación post-destete en el parto 3 indica que el hierro disminuye con el aumento de paridad y puede afectar la salud a largo plazo. La prevalencia de la anemia de los lechones disminuyó con el aumento en paridad, lo que sugiere la necesidad de reevaluar la suplementación

KAM, CLL: Department of Animal Sciences, South Dakota State University, Brookings, South Dakota.

MDL: Department of Animal and Food Sciences, University of Kentucky, Lexington, Kentucky.

Corresponding author: Dr Crystal L. Levesque, 1097 N. Campus Dr, Brookings, SD 57006; Tel: 605-688-5011; Email: **crystal.levesque@sdstate.edu**

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

McClellan K, Lindemann M, Levesque C. Assessment of hemoglobin concentration in sows and their offspring over consecutive reproductive cycles. *J Swine Health Prod*. 2024;32(6):248-257. **https://doi.org/10.54846/jshap/1399**

Résumé - Évaluation de la concentration d'hémoglobine chez les truies et leur progéniture au cours de cycles de reproduction consécutifs

Objectif: Évaluer la concentration d'hémoglobine (HbC) chez les truies et leur progéniture au cours de parités consécutives.

Matériel et méthodes: Vingt-trois femelles ont été surveillées pour l'HbC pendant les parités 1, 2, et 3 à 7 moments (30 [± 2], 60 [± 2], 90 [± 2], et 112 jours de gestation, 2 et 16 [± 1] jours de lactation, et 5 [± 1] jours après le sevrage). L'HbC des porcelets a été mesurée dans les 18 heures suivant la naissance et à 16 (± 1) jours d'âge. Les porcelets ont été classés comme anémiques (HbC < 10 g/dL) ou non anémiques (HbC ≥ 10 g/dL) à chaque moment.

Résultats: Au jour 90 de la gestation, 71.1 % des truies étaient anémiques toutes parités confondues. À la parité 1, l'HbC était inférieure au jour 16 de la lactation qu'à tous les points de gestation ($P < .001$). À la parité 2, l'HbC aux jours 2 et 16 de la lactation était inférieure à tous les points de gestation ($P < .001$). À la parité 3, l'HbC aux jours 2 et 16 de la lactation était inférieure à celle aux jours 30 et 60 de la gestation ($P = .015$). La prévalence de l'anémie des porcelets à 1 jour d'âge était de 55.8%, 36.3%, et 46.1% pour les parités 1, 2, et 3, respectivement ($X^2 < .001$). La prévalence de l'anémie des porcelets à 16 jours d'âge était de 35.6%, 18.7%, et 15.9% pour les parités 1, 2, et 3, respectivement ($X^2 < .001$).

Implications: La diminution de l'HbC des truies au cours du cycle de reproduction et l'absence de récupération après le sevrage à la parité 3 indiquent une diminution du fer à mesure que la parité progresse et peuvent avoir un impact sur la santé à long terme. La prévalence de l'anémie des porcelets a diminué avec l'avancement de la parité, ce qui suggère la nécessité de réévaluer la supplémentation en fer des porcelets dans les portées de femelles plus jeunes.

Trace mineral nutrition has received considerably less attention than other areas (ie, amino acids and energy) of pig nutrition, and most studies to establish trace mineral requirements were conducted prior to 1980.[1] Additionally, trace mineral requirements are based on a per kg of feed basis and do not take into account the body weight of the animal, its production level (including metrics such as total piglets born), changing metabolic needs during gestation and lactation, or parity. Industry levels of iron inclusion within mineral premixes into sow diets are several times higher than the published recommendations. In a recent survey of vitamin and trace mineral levels in US swine diets, average dietary iron content (mg/kg) was 1.37-fold higher than NRC requirement estimates[1] with the 25th and 75th percentile at 1.2- and 1.48-fold higher, respectively.[1,2] The authors suggest the increased inclusion of trace minerals may be attributed, in part, to an evolving understanding that the nutritional demands of modern hyperprolific sows may differ from current recommendations. However, despite the common fortification of iron in sow diets that are above recommended levels, deficiencies may still emerge due to escalating iron demands associated with increased litter size resulting from prolific breeding.

Recent data suggests that approximately 50% of sows exhibit low hemoglobin (Hb) concentration (HbC), with a greater prevalence of anemia observed in older parity sows and during lactation[3]; however, this data is based on single point of time assessment across individuals rather than serial observations in the same females. Mahan and Newton[4] reported that with advancing parity and greater levels of productivity, sows had a greater degree of depletion of micro-mineral status. Further the relationship of sow Hb status with parity and the impact on piglet Hb with parity is not well established. This prompts the question whether the greater prevalence of anemia in older parity sows also results in a decline in iron status of the offspring and whether the decline can be attributed to an escalation in the sow's iron requirements and a subsequent deficiency over time.

In response to these observations and the expected increase in reproductive capacity of sows, our study employed a longitudinal approach to track blood HbC, an indicator of anemia, across consecutive reproductive cycles in female pigs. We assessed sow HbC at 4 gestational, 2 lactational, and 1 post-weaning timepoints. This study aimed to address the current knowledge gap concerning the timeline of anemia onset in sows. Additionally, we explored the impact of parity and sow HbC on the Hb status and anemia prevalence of suckling piglets.

Animal care and use

All procedures used in this study were approved 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). Animals used in this experiment were raised and managed in the sow barn at SDSU Swine Education and Research Facility, located in Brookings, South Dakota. This study was conducted between September 2022 and October 2023.

Materials and methods

Animals, experimental design, and feeding

A total of 23 female pigs (PIC Camborough 42) with a mean (SD) age of 250 (21) days at first breeding were monitored across reproductive parities 1 to 3. The mean (SD) wean-to-estrus interval among the sows across parities was 5 (1) days. Blood HbC measurements were conducted at seven timepoints (30 [± 2], 60 [± 2], 90 [± 2], and 112 days of gestation, 2 and 16 [± 1] days of lactation, and 5 [± 1] days post weaning). Females were housed in gestation stalls from breeding until pregnancy confirmation at 28 to 30 days after breeding, after which they were moved to group housing. Around day 110 of gestation, females were relocated to farrowing crates until weaning. The study spanned 3 complete reproductive cycles, with 12 females monitored in parities 1, 2, and 3; 7 females monitored in parities 1 and 2; and 4 females monitored in parities 2 and 3.

Diets were formulated to meet or exceed NRC nutrient requirement estimates for pregnant and lactating gilts[1] based on an expected litter size of 14 piglets (Table 1). Females were provided the standard SDSU gestation diet to maintain body condition score 2.5 to 3 in each parity. Electronic sow feeders (Gestal 3G, Jyga Technologies Inc) were used to provide daily feed allotment in gestation group housing. Daily feed allotment in lactation followed a step-up program according to the standard SDSU feed curve using an electronic feeding system (Gestal Solo, Jyga Technologies Inc) starting with a target of 2.7 kg on day 1 post farrowing and to achieve *ad libitum* intake

Table 1: Composition of gestation and lactation diets (as-fed basis)

Item	Gestation	Lactation
Ingredient, %		
Ground corn	81.33	66.19
Soybean meal	14.62	29.85
Calcium carbonate	1.36	1.22
Monocalcium phosphate, 21%	1.84	1.76
Salt	0.50	0.50
Swine trace mineral premix*	0.15	0.15
Swine sow vitamin premix†	0.05	0.05
Swine toxin binder‡	0.15	0.15
Larvicide§	0.13	0.13
Calculated composition		
Dry matter, %	89.5	89.6
Metabolizable energy, kcal/kg	3403.4	3269.2
Crude protein, %	13.5	19.4
Calcium, %	0.91	0.89
Phosphorus-total, %	0.75	0.76
Phosphorus-dig, %	0.41	0.42
Standardized ileal digestibility of amino acid, %		
Lysine	0.55	0.97
Threonine	0.42	0.62
Methionine	0.21	0.28
Tryptophan	0.12	0.20
Isoleucine	0.47	0.72
Valine	0.56	0.80
Arginine	0.73	1.17
Histidine	0.33	0.47
Leucine	1.2	1.55
Phenylalanine	0.59	0.85
Analyzed composition		
Crude protein, %	14.90	18.53
Crude fat, %	3.11	1.94
Crude fiber, %	3.19	2.44
Ash, %	5.52	4.60
Iron, mean (SD), ppm¶	283.8 (28.8)	318.4 (29.8)

* Minimum provided the following per kg of diet: Copper 20 mg, Iodine 0.36 mg, Iron (ferrous sulfate) 165 mg, Manganese 40 mg, Selenium 0.3 mg, Zinc 170 mg (J & R Distributing Inc).

† Minimum supplied the following per kg of diets: Calcium 55 mg, Vitamin A 11,000 IU, Vitamin D3 1650 IU, Vitamin E 55 IU; Vitamin B12 0.044 mg, Menadione 4.4 mg, Biotin 0.165 mg, Folic Acid 1.1 mg, Niacin 55 mg, d-Pantothenic Acid 60.5 mg, Vitamin B16 3.3 mg, Riboflavin 9.9 mg, Thiamin 3.3 mg (J & R Distributing Inc).

‡ Algonite; blend of dried yeast cells, diatomaceous earth, and algae (Olmix NA Inc).

§ Minimum supplied the following per kg of diets: Active Ingredient: Tetrachlorovinphos 75.9 mg (Elanco US Inc).

¶ Analyzed iron represents the mean of five subsamples within a given diet.

within 5 days after parturition. Daily iron intake was determined based on daily feed intake and dietary iron content. Dietary iron content was based on the mean (SD) of 5 analyzed samples collected across the 3 gestation periods (283.8 [28.8] ppm of iron) and 5 analyzed samples across the 3 lactation periods (318.4 [29.8] ppm of iron).

Reproductive performance and body weight

Throughout each reproductive cycle, females were weighed on days 2 (± 1) and 109 (± 1) of gestation and on days 2 and 19 (± 3) of lactation. After completion of farrowing, comprehensive reproductive performance data for sows were recorded including litter size and number of mummified and stillborn piglets. Stillborn piglets were recorded based upon visual assessment (ie, no visible signs of crushing, lying near the rear of the sow or crate). Piglets born alive were weighed within 18 hours after birth and at weaning. Weaning (mean [SD]) occurred on days 18.1 (2.4), 18.5 (1.5), and 19.6 (1.8) of lactation for parity 1, 2, and 3, respectively.

Blood HbC

Blood samples were collected from an ear vein of sows and piglets by pricking with a 20-gauge, 2.5-cm needle and collecting a blood droplet into disposable microcuvettes via capillary action. Microcuvettes were analyzed using the HemoCue Hb 201+ device (HemoCue America) with the resulting HbC displayed and recorded within 60 seconds. The HemoCue is a suitable indicator of blood HbC and was determined to be within 1% of laboratory analysis of HbC when comparing blood collected at the same anatomical location (ie, arterial vein),[5] and within 4% when comparing laboratory analysis of blood collected at a different anatomical location (ie, ear vein vs jugular).[6] A total of 364 samples (52 samples per timepoint) were collected from sows over the duration of this experiment (n = 19, 17, and 16 at each timepoint in parity 1, 2, and 3, respectively). All piglets born alive for each respective parity (n = 294 for parity 1; n = 262 for parity 2; and n = 234 for parity 3) were monitored for HbC by collecting blood samples as previously described within 18 hours after birth, post colostrum intake, to allow for potential dehydration correction. Piglets received a 200 mg dose of iron (Gleptoferron, CEVA Animal Health) administered intramuscularly at 3 (1) days of age. Blood HbC was assessed in all piglets at 16 (1) days of age (n = 261 for parity 1; n = 219 for parity 2; and n = 201 for parity 3) to maintain consistency with the day of age each piglet was tested regardless of their actual weaning age.

Statistical analysis

To ensure the validity of our statistical approach, we performed checks for the assumptions of analysis of variance, including homogeneity of variances and normal distribution. Blood HbC of sows and piglets across time within each parity was analyzed as repeated measures analysis of variance using the GLIMMIX procedures of SAS 9.4 (SAS Institute Inc) where day was the repeated measure. The Proc Mixed procedure of SAS was used to compare blood HbC of sows and piglets across parity at a given timepoint and to compare sow body weight and reproductive performance across parity. Differences between parity were tested using Tukey's honest significant difference test. Sows and piglets were categorized as anemic using an HbC threshold of < 10 g/dL[1,7] and the percentage of anemic and nonanemic animals in those categories within each parity was compared using a Chi-square test. Given the decline in HbC over time and parity, the interaction between parity and reproductive day on sow HbC was evaluated using a multiple regression model and the slope-ratio analysis.[8] The statistical model used in the analysis is expressed as: $y = a + b_s x_s + e$ where y is the response criterion (sow HbC at a given timepoint); a is intercept; b_s is the slope; x_s is day (independent variable); and e is random error. An individual sow served as the experimental unit. An alpha ≤ .05 was considered significant and an alpha of .06 to .10 was considered a tendency.

Results

Reproductive performance

At breeding, females had less body weight in parity 1 than parity 2 and 3 ($P < .001$; Table 2). On day 109 of gestation, sows were heavier in parity 3 than in parity 1 ($P = .02$), with parity 2 being intermediate. Sow body weight on day 2 of lactation did not differ between parities; however, on day 19, sows were heavier in parity 3 than in parity 1 and parity 2 ($P < .001$). Sows in parity 3 had greater ($P = .007$) total piglets born than in parity 1 and 2; however, piglets born alive did not differ between parities (Table 2). Stillborn rates in parity 3 were greater ($P < .001$) than in both parity 1 and 2. In the first two parities, percentage of stillborn piglets was 4% for both anemic and nonanemic sows. In parity 3, the percentage of stillborn piglets was 11% among anemic sows compared to 7% among nonanemic sows. Individual birth weights of piglets born alive were greater in parity 2 ($P < .001$) followed by parity 3, with parity 1 born alive birth weights being the lowest. Piglet wean weights did not differ between parities. Piglet age at weaning tended to be greater ($P = .061$) in parity 3 than in parity 1 and 2. The total number of piglets weaned was greater in parity 3 ($P = .031$) than in parity 1, with parity 2 being intermediate.

Sow feed and iron intake

Daily sow feed intake during gestation did not differ by parity (Table 2). However, daily feed intake varied during lactation, with parity 3 sows having greater ($P = .002$) daily feed intake than both parity 1 and 2 sows. There was no difference in estimated daily iron intake between parities in gestation, however in lactation, parity 3 sows consumed greater ($P < .001$) iron than in parity 1 and 2.

Sow HbC within and across parity

In parity 1, HbC was less ($P = .015$) on day 16 than on day 2 of lactation, and day 16 was less than all gestational timepoints ($P < .001$). Parity 1 sows had greater HbC on day 5 post weaning than on day 16 of lactation ($P = .012$). In parity 2, both day 2 and 16 of lactation had less HbC than all gestational timepoints ($P < .001$), with greater HbC observed on day 5 postweaning than on day 16 of lactation ($P < .001$). In parity 3, sows had less HbC on days 2 and 16 of lactation than on days 30 and 60 of gestation ($P = .015$). No differences were observed between days 90 and 112 of gestation, days 2 and 16 of lactation, and day 5 post weaning in parity 3.

Comparing across parities, HbC was greater ($P = .04$) in parity 1 and 2 than in parity 3 on day 30 of gestation (Table 3). On day 60 of gestation, HbC was less ($P = .03$) in parity 2 and 3 than in parity 1. There was no difference in sow HbC on days 90 and 112 of gestation across parities.

On day 2 of lactation, parity 1 had greater ($P < .001$) HbC than both parity 2 and 3. On day 16 of lactation, mean HbC fell below the threshold considered anemic irrespective of parity, and parity 1 was greater ($P = .05$) than parity 2 and 3. At day 5 post weaning, sow HbC did not differ between parity 1 and 2, however, parity 3 was less ($P < .001$) than both parity 1 and 2.

Sow anemia prevalence by parity

During gestation, the prevalence of anemia peaked at day 112 for parity 1, 2, and 3, reaching rates of 26.3%, 29.4%, and 37.5%, respectively ($X^2 < .001$). The prevalence of anemia on day 2 of lactation for parity 1, 2, and 3 was 20%, 94.1%, and 87.5%, respectively ($X^2 < .001$). On day 16 of lactation, the prevalence of anemia for parity 1, 2, and 3 was 57.9% and 82.3%, 75.0%, respectively ($X^2 < .001$). The cumulative prevalence of anemia across all timepoints was 24.0% for parity 1, 37.0% for parity 2, and 47.3% for parity 3 ($X^2 < .001$).

Changes in sow HbC over time

Slope ratio analysis revealed a negative linear effect ($P < .001$) within each parity (Figure 1), indicating a decline in HbC over time where parity 2 slope tended ($P = 0.105$) to be greater than the slope of both parity 1 and 3.

Parity 1:
sow HbC = 12.4 + (-0.016 × d),
$R^2 = 0.17$
Parity 2:
sow HbC = 12.2 + (-0.023 × d),
$R^2 = 0.37$
Parity 3:
sow HbC = 11.3 + (-0.015 × d),
$R^2 = 0.37$

Piglet HbC within and across parity

In parity 1, piglets had greater ($P = .01$) HbC at 16 days of age than at 1 day of age. In parity 2, there was no difference in piglet HbC between 16 and 1 days of age. In parity 3, piglets tended to have greater ($P = .07$) HbC at 16 than at 1 days of age. Piglet HbC was greater ($P = .04$) at 1 day of age in parity 3 than at 1 day of age in parity 1 only (Table 3). Additionally, HbC at 16 days of age was greater ($P = .001$) in parity 3 than at 16 days of age in parity 1.

Piglet anemia prevalence by parity

The prevalence of piglet anemia at 1 day of age was 55.8%, 36.3%, and 46.1%, for parity 1, 2 and 3, respectively ($X^2 < .001$; Table 4). The prevalence of piglet anemia at 16 days of age was 35.6%, 18.7%, and 15.9% for parity 1, 2 and 3, respectively ($X^2 < .001$).

Discussion

By exploring the relationship between sow HbC, reproductive stage, parity, and piglet outcomes, we gain a deeper understanding of these interrelationships

Table 2: Sow body weight, reproductive performance, feed intake, and iron intake over 3 consecutive reproductive cycles

Variable	Parity 1	Parity 2	Parity 3	SEM	P*
Total females, No.	19	17	16		
Sow body weight, kg					
Gestation d 0	161.9[a]	201.5[b]	214.4[b]	4.1	< .001
Gestation d 110	229.6[a]	238.9[ab]	245.1[b]	3.8	. 02
Lactation d 2	216.3	225.3	225.1	3.6	.12
Weaning*	201.7[a]	215.1[a]	233.8[b]	4.5	< .001
Total born, No.	16.6[a]	16.8[a]	17.5[b]	0.5	. 02
Born alive, No.	15.7	16.0	15.7	0.64	.94
Stillborn rate†, %	4.0[a]	4.0[a]	8.0[b]	0.3	< .001
Piglet birth weight, kg	1.42[a]	1.68[b]	1.58[c]	0.02	< .001
Piglet wean weight‡, kg	5.6	5.6	5.9	0.2	.49
Piglet wean age, d	17.9[x]	18.3[x]	19.6[y]	0.5	.06
Total weaned, No.	14.5[a]	14.7[ab]	15.2[b]	0.4	.03
Gestation feed intake, kg/d	2.18	2.20	2.20	0.01	.47
Gestation iron intake§, mg/d	619.1	624.6	624.1	0.09	.50
Lactation feed intake, kg/d	5.3[a]	5.5[a]	6.9[b]	1.20	.002
Lactation iron intake§, mg/d	1698.9[a]	1755.8[a]	2226.9[b]	0.1	< .001

* Weaning (mean [SD]) occurred on day 18.1 (2.4), 18.5 (1.5), and 19.6 (1.8) of lactation for parity 1, 2, and 3, respectively.
† The stillborn rate is expressed as a percentage of stillborn piglets relative to the total number of piglets born.
‡ Wean weights adjusted for lactation day as a covariate.
§ Calculated as individual feed intake × analyzed diet iron content. Analyzed iron represents the mean of five subsamples within a given phase.
a,b,c Different superscripts within the same row indicate differences at $P < .05$.
x,y Different superscripts within the same row indicate tendences at $P > .06$ to $P < .10$.

Table 3: Blood concentration of hemoglobin (g/dL) in sows and piglets in 3 consecutive reproductive cycles

Reproductive cycle	Parity 1	Parity 2	Parity 3	SEM	*P*
Females, No.	19	17	16	NA	NA
Gestation					
d 30	11.8^{aD}	11.3^{aD}	10.6^{bD}	0.28	.004
d 60	11.9^{aD}	10.9^{bD}	10.5^{bD}	0.29	.01
d 90	10.7^{DE}	10.4^{D}	10.2^{DE}	0.26	.57
d 112	11.0^{DE}	10.3^{D}	10.1^{DE}	0.34	.16
Lactation					
d 2	11.3^{aDE}	8.7^{bF}	9.0^{bE}	0.29	< .001
d 16*	9.8^{cV}	9.0^{yF}	9.1^{yE}	0.26	.08
Post wean†					
d 5	11.5^{aD}	11.5^{aD}	9.8^{bDE}	0.27	< .001
P	< .001	< .001	< .001	NA	NA
SEM	0.26	0.28	0.28	NA	NA
Piglets, No.	261	219	201	NA	NA
d 1	9.5^{aD}	9.8 ^{ab}	10.2^{bV}	0.26	.05
d 16	10.2^{aE}	10.2 ^{ab}	10.8^{bW}	0.29	.001
P	0.01	.94	.07	NA	NA
SEM	0.16	0.35	0.18	NA	NA

* Blood hemoglobin determined on 16 days of age for each piglet.

† Blood hemoglobin determined at 4 to 6 days after weaning.

a,b,c,x,y Superscripts a, b, and c represent *P* < .05 and x and y represent *P* < .10 across parity within day (within row).

D,E,F,V,W Superscripts D, E, and F represent *P* < .05 and V and W represent *P* < .10 across day within a specific parity (within the same column).

NA = not applicable.

in reproduction. Our findings highlight variations in both sow and piglet HbC and the prevalence of anemia, underscoring the influence of reproductive stage and consecutive reproductive cycles. This insight not only contributes to our understanding of sow and piglet health but also draws attention to potential heightened demands for iron that prolific sows and their piglets may encounter.

Sow anemia rates peaked on day 90 of gestation, with a high prevalence persisting during lactation for all parities, aligning with earlier research finding low HbC in sows during late gestation and lactation compared to earlier timepoints (ie, mid gestation).[9] Similar to humans, some degree of anemia may be expected in sows during critical reproductive phases such as late gestation and lactation. Physiologically, significant changes occur in blood serum volume and packed red blood cell volume in gestating and lactating sows.[10] An early study demonstrated a 25% increase in serum volume as a percentage of body weight and a 22% decrease in packed red blood cell volume during late gestation compared to early gestation, with a 9% continued decrease in serum volume during lactation.[11] The changes observed in serum and red blood cell volume are driven by natural processes as sows in late gestation prioritize the allocation of more nutrients to their developing fetuses and mammary glands for colostrum production, which is derived from circulating plasma.[12]

While a decline in HbC during a sow's reproductive cycle could be interpreted as a dilution effect of the overall Hb molecules due to decreased red blood cells and increased serum, often referred to as physiological anemia, the ramifications of this dilution effect have not been extensively evaluated in the sow. Considering the sow spends most of her life either gestating or lactating, the implications of her enduring a continual dilution of Hb remain uncertain. Additionally, the increased prevalence of anemia with advancing parity is challenging to justify solely by this potential dilution effect. While there is an increase in sow body weight as sows increase in parity, and there is likely a corresponding increase in blood volume, potentially exacerbating the dilution effect caused by pregnancy-related changes, it is important to distinguish this alteration from iron deficiency anemia.

The occurrence of anemia near farrowing may be attributed to increased iron requirements associated with enhanced fetal iron storage and the nutritional needs of newborn piglets.[13] The rise in sow anemia prevalence with greater parity is consistent with previous studies

Figure 1: Slope-ratio comparison of sow HbC values across gestation and lactation time points based on sow parity. Parity 1: sow HbC = 12.4 + (-0.016 × d), R^2 = 0.17; Parity 2: sow HbC = 12.2 + (-0.023 × d), R^2 = 0.37; Parity 3: sow HbC = 11.3 + (-0.015 × d), R^2 = 0.37.

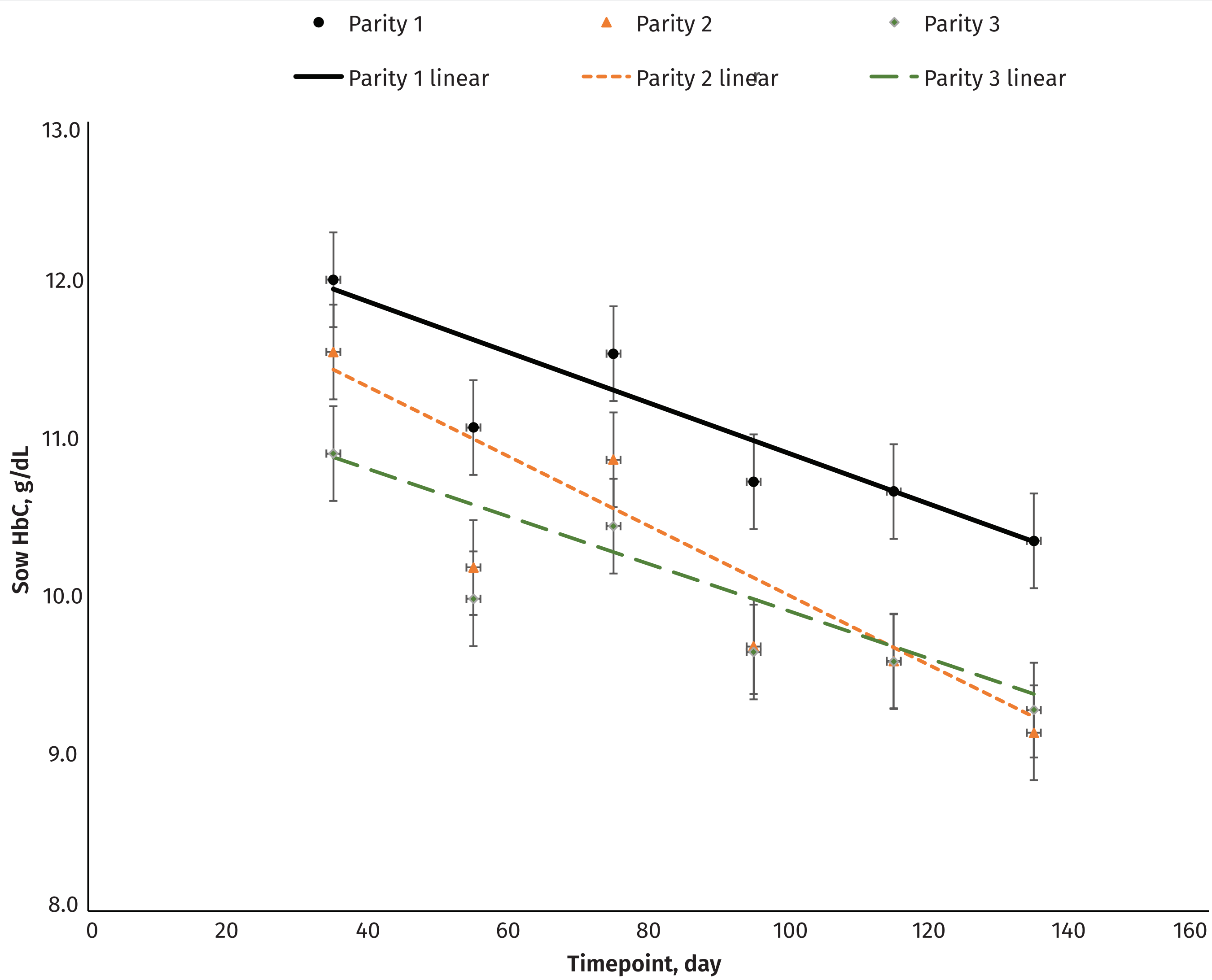


Table 4: Percent of piglets in blood hemoglobin concentration categories for each parity

	Piglet day of age					
	1			16*		
Parity	No.	HbC ≥ 10 g/dL, %	HbC < 10 g/dL, %	No.	HbC ≥ 10 g/dL, %	HbC < 10 g/dL, %
1	294	44.2	55.8	261	64.4	35.6
2	262	63.7	36.4	219	81.3	18.7
3	234	53.8	46.2	201	84.1	15.9

* Weaning occurred between 15 and 22 days of age.

that reported that sows of advanced parity have a greater prevalence of anemia.[3,14] This suggests that the decline in HbC during late gestation and lactation, potentially due to heightened iron demands, may pose challenges for sows in replenishing their iron stores after each lactation. It is speculated that the lack of recovery in HbC as sows advance in parity could be attributed to blood loss during farrowing where excessive bleeding and the loss of red blood cells exceeds the production of new red blood cells.[15] Research on blood loss during farrowing and its consequences is limited. Hemorrhaging, which is bleeding from damaged blood vessels, is a common occurrence in humans during labor often leading to exacerbated blood loss.[16] Excessive blood loss in humans can be attributed to various other factors such as prolonged, abnormal, or rapid labor, vaginal or cervical tears, or retained placental tissue.[17] The diffused nature of the sow's placenta, known as epitheliochorial placentation,[18] may potentially increase the risk of blood loss, although extensive investigation into this aspect in sows is necessary to draw definitive conclusions. Excessive blood loss in sows however may lead to difficulty in replenishing blood Hb and the potential increased iron demands post farrowing could further contribute to a decline in sow HbC over time, potentially increasing the prevalence of anemia as the sow's parity advances. If the sow enters farrowing relatively low in HbC already, experiencing blood loss could potentially worsen the degree of anemia.

Despite dietary iron at 3-fold greater than requirement estimates, iron absorbed from the diet may fall short of meeting the escalating demands across consecutive pregnancies. However, attempts to increase maternal iron supplies through oral supplementation have not shown a significant effect on hematologic variables, as indicated by previous studies.[19-21] Providing the sow with additional dietary iron (inorganic or organic sources) may not necessarily improve HbC or eliminate anemia which may suggest that the cause of low HbC is related to iron metabolism rather than dietary iron supply.

Moreover, intramuscular injection of iron to sows during gestation did not result in changes to hematologic variables in sows.[22,23] This complexity may be attributed to the intricate nature of dietary iron absorption. Additionally, the size of the sow may present challenges in providing adequate injectable iron. For piglets, the standard injectable iron dosage of 200 mg was established based on piglet iron status (circulating and stored iron) at birth and daily body weight gain.[24,25] When considering the dose of 200 mg administered to a 1.5 kg piglet near birth, the piglet receives over 130 times its body weight in iron. Applying this ratio to a 200 kg sow would result in over 26,000 mg of iron injection for a single sow. It is plausible that the sow may require a supplementation of greater injectable iron dosage in addition to dietary iron than what has been evaluated in previous research. Tailoring sow iron dosages to sow weight and daily iron needs during lactation and other critical phases, such as late gestation when iron demand is high, may be necessary. However, determining the appropriate iron dosage for the sow presents practical and economic challenges.

It is crucial to also consider the potential influence of other dietary components and the overall nutritional status of the sows. The effectiveness of iron absorption can be influenced by certain dietary factors, such as other minerals or compounds that may enhance or inhibit iron uptake. A more comprehensive evaluation of sow iron status involving measurements such as serum ferritin, serum iron, transferrin saturation, total iron-binding capacity, soluble transferrin receptor, as well as other red blood cell indices may need to be considered. This approach may offer a detailed understanding of sow iron status and absorption and help to develop strategies to address declining HbC in older parity sows. However, it must be noted that the practical implication of declining sow HbC with parity is not known. Further, the diets in this study did not include phytase. Phytases are known to enhance the release of phosphate and other minerals, including iron, from phytates,[26] potentially increasing iron absorption from cereal meals by up to 42%.[27] Considering the potential influence of phytase on iron absorption in sow diets, its inclusion could potentially enhance iron absorption, thus impacting sow HbC and overall iron status.

A potential limitation in this study is the timing of assessing piglets' initial HbC status. Colostrum intake is expected to cause a drastic increase in plasma volume during the first 12 hours of nursing without significant change to red blood cell volume.[28] This effect results in physiological anemia, similar to what was previously discussed regarding sow blood volume expansion in gestation. However, testing HbC prior to colostrum intake carries the risk to testing dehydrated piglets possibly causing HbC to appear falsely elevated due to a concentration effect. Additionally, the negative effects of HbC blood dilution due to increased plasma volume are not fully understood, particularly in conjunction with limited iron stores of approximately 50 mg mostly in the form of Hb in piglets at birth.[24]

The relationship of sow HbC to piglet HbC, which also varied across parities, indicated potential maternal influences. In contrast to sow HbC patterns, piglet HbC increased with sow parity, leading to a decrease in anemia prevalence. This observation aligns with prior research where younger parity sows were associated with a greater percentage of anemic piglets at weaning.[29] It can be speculated that there is a potential enhancement in iron transfer from sows to fetuses in utero with greater parity.[30] This speculation may contribute to understanding why sows exhibited a greater prevalence of anemia with advancing parity, suggesting a potential link to an increased iron supply to their offspring and thereby a decreased sow iron status.

Despite the reduced prevalence of anemia in piglets with increasing sow parity, the occurrence of piglet anemia near weaning raises concerns about the effectiveness of current industry standard practices for iron supplementation. Our findings correspond with previous studies suggesting an inadequacy of a standard iron injection (200 mg of Fe) administered shortly after birth to sustain optimal iron levels throughout the lactation period.[31-33] However, Chevalier et al[34] examined the effects of a second iron injection administered to suckling piglets before weaning across seven experimental stations. While additional iron injections showed some positive effects on growth and hematological measures in piglets, the response varied among different stations indicating the influence of various factors beyond iron supplementation alone. Based on the findings of this current study, sow parity could be a contributing factor causing varied response of iron supplementation in piglets. To better understand the optimal timing and dosage of iron supplementation in piglets, tailored investigations into iron dosages specific to sow parity are warranted. Addressing potential variations in iron requirements among piglets from different parity sows could optimize iron supplementation strategies and promote overall piglet health outcomes.

A potential negative consequence of the decline in sow HbC with parity may be an impact on stillborn rates. While a definitive relationship between sow HbC and stillborn piglets could not be made in this study due to limitations in sample size and the multifactorial nature of stillborn incidence,[35] low sow HbC in late gestation may have led to inadequate oxygen supply to fetuses, compromising fetal viability and resulting in elevated stillborn incidence in parity 3 sows vs parity 1 or 2. This observation aligns with findings from prior studies where the stillborn rate was greater in sows with less HbC (< 10 g/dL).[36,37] This may suggest that maternal anemia could potentially have a greater impact on fetal outcomes in later parities. However, further research is needed to elucidate the specific factors contributing to this parity-related variation in the impact of maternal anemia on fetal outcome. Additionally, while the threshold of anemia for sows is often defined as HbC < 10 g/dL, the impact of declining HbC as sows age and advance in parity requires further assessment and the current anemia threshold may need to be reevaluated based on other potential implications of anemia in older sows.

Implications

Under the conditions of this study:

- Sow HbC declines over the reproductive cycle and recovery declines with parity.
- Anemia in sows may contribute to stillborn incidence.
- Piglets from younger parity sows have greater anemia prevalence.

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.

References

1. National Research Council. *Nutrient Requirements of Swine*. 11th ed. National Academies Press; 2012.

2. Faccin JEG, Tokach MD, Goodband RD, DeRouchey JM, Woodworth JC, Gebhardt JT. Industry survey of added vitamins and trace minerals in US swine diets. *Transl Anim Sci.* 2023;7(1):txad035. **https://doi.org/10.1093/tas/txad035**

3. Castevens K, Ferreira JB, Gillespie T, Olsen C, Nielsen J-P, Almond G. Assessment of hemoglobin concentration in relation to sow reproductive stage and parity. *J Swine Health Prod.* 2020;28:254-257. **https://doi.org/10.54846/jshap/1182**

4. Mahan DC, Newton EA. Effect of initial breeding weight on macro- and micromineral composition over a three-parity period using a high-producing sow genotype. *J Anim Sci.* 1995;73(1):151-158. **https://doi.org/10.2527/1995.731151x**

5. Kutter AP, Mauch JY, Riond B, Martin-Jurado O, Spielmann N, Weiss M, Bettschart-Wolfensberger R. Evaluation of two devices for point-of-care testing of haemoglobin in neonatal pigs. *Lab Anim.* 2012;46(1):65-70. **https://doi.org.10.1258/la.2011.011086**

6. Maes D, Steyaert M, Vanderhaeghe C, López Rodríguez A, de Jong E, Del Pozo Sacristán R, Vangroenweghe F, Dewulf J. Comparison of oral versus parenteral iron supplementation on the health and productivity of piglets. *Vet Rec.* 2011;168(7):188. **https://doi.org/10.1136/vr.c7033**

7. Bhattarai S, Framstad T, Nielsen JP. Hematologic reference intervals of Danish sows at mid-gestation. *Acta Vet Scand*. 2019;61:16. **https://doi.org/10.1186/s13028-019-0451-7**

8. Littell RC, Henry PR, Lewis AJ, Ammerman CB. Estimation of relative bioavailability of nutrients using SAS procedures. *J Anim Sci.* 1997;75(10):2672-2683. **https://doi.org/10.2527/1997.75102672x**

9. Normand V, Perrin H, Auvigne V, Robert N, Laval A. Anaemia in the sow: A cohort study to assess factors with an impact on haemoglobin concentration, and the influence of haemoglobin concentration on the reproductive performance. *Vet Rec.* 2012;171:350. **https://doi.org/10.1136/vr.100404**

10. Anderson DM, Elsley FW, McDonald I. Blood volume changes during pregnancy and lactation of sows. *Q J Exp Physiol Cogn Med Sci*. 1970;55:293-300. **https://doi.org/10.1113/expphysiol. 1970.sp002081**

11. Matte JJ, Girard CL. Changes of serum and blood volumes during gestation and lactation in multiparous sows. *Can J Anim Sci*. 1996;76:263-266. **https://doi.org/10.4141/cjas96-039**

12. Shen Y, Crenshaw J. Physiological changes in sows that may contribute to higher risk for mortality and prolapse. *Res Rev: J Vet Sci.* 2022;6:1. **https://doi.org/10.4172/2581-3897.6.S3.001**

13. Mahan DC, Watts MR, St-Pierre N. Macro- and micromineral composition of fetal pigs and their accretion rates during fetal development. *J Anim Sci*. 2009;87:2823-2832. **https://doi.org/10.2527/jas.2008-1266**

14. Noblett E, Ferriera JB, Bhattarai S, Nielsen JP, Almond G. Late gestation hemoglobin concentrations in sows: Predictor for stillborn piglets. *J Swine Health Prod*. 2021;29:200-203. **https://doi.org/10.54846/jshap/1249**

15. Braunstein EM. Anemia due to excessive bleeding. In: *Merck Manual*. Consumer Version. Published July 2022. Accessed February 15, 2024. **https://www.merckmanuals.com/hom/blood-disorders/anemia/anemia-due-to-excessive-bleeding**

16. Wormer KC, Jamil RT, Bryant SB. Acute postpartum hemorrhage. In: *StatPearls* [Internet]. StatPearls; 2024. **https://www.ncbi.nlm.nih.gov/books/NBK499988**

17. Moldenhauer JS. Excessive uterine bleeding at delivery. In: *Merck Manual*. January 2024, Accessed May 29, 2024. **https://www.merckmanuals.com/home/women-s-health-issues/complications-of-labor-and-delivery/excessive-uterine-bleeding-at-delivery**

18. Johnson GA, Bazer FW, Seo H. The early stages of implantation and placentation in the pig. *Adv Anat Embryol Cell Biol*. 2021;234:61-89. **https://doi.rg/10.1007/978-3-030-77360-1_5**

19. Egeli A, Framstad T, Grønningen D. The effect of peroral administration of amino acid-chelated iron to pregnant sows in preventing sow and piglet anaemia. *Acta Vet Scand.* 1998;39:77-87. **https://doi.org/10.1186/BF03547809**

20. Petrichev M, Bambova M. The effects of oral administration of iron methionate to pregnant sows and their litters. *Folia Vet.* 2005;49:125-128.

21. Buffler M, Becker C, Windisch WM. Effects of different iron supply to pregnant sows (*Sus scrofa domestica* L.) on reproductive performance as well as iron status of newborn piglets. *Arch Anim Nutr.* 2017;71:219-230. **https://doi.org/10.1080/1745039X.2017.1301059**

22. Oldenhage D. Influence of a prepartal iron injection on the red blood cell count of sows, the course of parturition and the reproductive performance. *Prakt Tierarz.* 2009;90:977-981.

23. Bhattarai S, Framstad T, Nielsen JP. Iron treatment of pregnant sows in a Danish herd without iron deficiency anemia did not improve sow and piglet hematology or stillbirth rate. *Acta Vet Scand*, 2019;61:60. **https://doi.org/10.1186/s13028-019-0497-6**

24. Venn JA, McCance RA, Widdowson EM. Iron metabolism in piglet anaemia. *J Comp Pathol Ther*. 1947;57:314-325. **https://doi.org/10.1016/s0368-1742(47)80037-2**

25. Braude R, Chamberlain AG, Kotarbińska M, Mitchell KG. The metabolism of iron in piglets given labelled iron either orally or by injection. *Br J Nutr*. 1962;16:427-449. **https://doi.org/10.1079/bjn19620043**

26. Vashishth A, Ram S, Beniwal V. Cereal phytases and their importance in improvement of micronutrients bioavailability. *3 Biotech*. 2017;7:42-49. **https://doi.org/10.1007/s13205-017-0698-5**

27. Nielsen AVF, Inge T, Meyer AS. Potential of phytase-mediated iron release from cereal-based foods: A quantitative view. *Nutrients*. 2013;5:3074-3098. **https://doi.org/10.3390/nu5083074**

28. Underwood EJ, Suttle NF. Iron. In: *The mineral nutrition of livestock*. 3rd ed. CAB International; 1999:383. **https://doi.org/10.1079/9780851991283.0000**

29. Sperling D, Guerra N, Dimitrov S. Iron deficiency anemia (IDA) in sows – an emerging problem? *Bulg J Anim Husbandry*. 2021;58:47-52.

30. Guo L, Zhang D, Tang W, Dong Z, Zhang Y, Wang S, Yin Y, Wan D. Correlations of gestational hemoglobin level, placental trace elements content, and reproductive performances in pregnant sows. *J Anim Sci*. 2022;100:skac010. **https://doi.org/10.1093/jas/skac010**

31. Jolliff JS, Mahan DC. Effect of injected and dietary iron in young pigs on blood hematology and postnatal pig growth performance. *J Anim Sci*. 2011;89:4068-4080. **https://doi.org/10.2527/jas.2010-3736**

32. Bhattarai S, Nielsen JP. Early indicators of iron deficiency in large piglets at weaning. *J Swine Health Prod*. 2015;23:10-17. **https://doi.org/10.54846/jshap/871**

33. Perri AM, Friendship RM, Harding JSC, O'Sullivan TL. An investigation of iron deficiency and anemia in piglets and the effect of iron status at weaning on post-weaning performance. *J Swine Health Prod*. 2016;24:10-20. **https://doi.org/10.54846/jshap/922**

34. Chevalier TB, Adeola O, Carter SD, Dove CR, Estienne MJ, Levesque CL, Maxwell CV, Tsai TCC, Lindemann MD. PSIV-9 A multistate evaluation of an additional iron injection administered to piglets before weaning. *J Anim Sci*. 2021;99(Suppl 1):184-185. **https://doi.org/10.1093/jas/skab054.308**

35. Vanderhaeghe C, Dewulf J, de Kruif A, Maes D. Non-infectious factors associated with stillbirth in pigs: A review. *Anim Reprod Sci*. 2013;139(1-4):76-88. **https://doi.org/10.1016/j.anireprosci.2013.03.007**

36. Bhattarai S, Framstad T, Nielsen JP. Stillbirths in relation to sow hematological parameters at farrowing: A cohort study. *J Swine Health Prod*. 2018; 26:215-222. **https://doi.org/10.54846/jshap/1052**

37. Bhattarai S, Framstad T, Nielsen JP. Association between sow and piglet blood hemoglobin concentrations and stillbirth risk. *Acta Vet Scand*. 2019;61:61. **https://doi.org/10.1186/s13028-019-0496-7**

An investigation of group and subtype diversity and distribution of porcine rotaviruses in Canadian suckling piglets with diarrhea, 2019-2023

Carol Malgarin, MV, PhD; Francisco de Grau, MVZ, EPA, DVM, DVSc

Summary

Objective: To determine the frequency of detection and group diversity of rotavirus (RV) A, B, and C, and G (glycoprotein antigen) serotype (based on viral protein 7 [VP7] gene analysis) infecting suckling piglets with diarrhea in Canadian farms.

Materials and methods: Canadian swine veterinarians submitted 1117 enteric samples from suckling piglets between July 2019 and December 2023 to the University of Guelph Animal Health Laboratory for RV group identification and VP7 sequencing for subtyping. Analysis of the VP7 sequence from 837 samples was performed using the Animal Health Sequivity Dashboard (Merck & Co, Inc) and descriptive statistics.

Results: Rotavirus A, B, and C were present in 40.7%, 12.5%, and 46.8% of samples, respectively. The most common RV identified was RVC G6, present in 296 samples, followed by RVA G9 in 205 samples. A single RV group was involved in 444 cases (72.3%), while in 170 cases (27.7%), more than one RV group/subtype was detected. Eighteen subtypes were identified by sequencing the VP7 protein (5 RVA, 9 RVB, and 4 RVC).

Implications: Rotavirus protection for suckling piglets comes from colostrum and milk. Knowing which RV group is causing diarrhea is important since vaccination does not generate cross-protection among groups. Using molecular diagnostic testing, it is possible to identify the specific group and subtype of RV circulating on the premises and decide the best treatment strategy for the disease.

Keywords: swine, rotavirus, diarrhea, VP7, vaccine.

Received: March 18, 2024
Accepted: July 1, 2024
Published online: October 8, 2024

Resumen - Una investigación sobre la diversidad de grupos y subtipos y la distribución de rotavirus porcinos en lechones lactantes canadienses con diarrea, 2019-2023

Objetivo: Determinar la frecuencia de detección y la diversidad de grupos del serotipo A, B, y C de rotavirus (RV) y serotipo G (antígeno glicoprotéico) (basado en el análisis del gen de la proteína viral 7 [VP7]) que infectan lechones lactantes con diarrea en granjas canadienses.

Materiales y métodos: Los veterinarios porcinos canadienses enviaron 1117 muestras entéricas de lechones lactantes entre julio de 2019 y diciembre de 2023 al Laboratorio de Salud Animal de la Universidad de Guelph para la identificación del grupo de RV y la secuenciación de VP7 para su subtipificación. El análisis de la secuencia VP7 de 837 muestras se realizó utilizando el Tablero Sequivity de Salud Animal (Merck & Co, Inc) y estadística descriptiva.

Resultados: Los rotavirus A, B, y C estuvieron presentes en el 40.7%, 12.5%, y 46.8% de las muestras, respectivamente. El RV más común identificado fue el RVC G6, presente en 296 muestras, seguido del RVA G9 en 205 muestras. En 444 casos (72.3%) se detectó un solo grupo de RV (72.3%), mientras que en 170 casos (27.7%) se detectó más de un grupo/subtipo de RV. Se identificaron dieciocho subtipos mediante la secuenciación de la proteína VP7 (5 RVA, 9 RVB, y 4 RVC).

Implicaciones: La protección contra el rotavirus para los lechones lactantes proviene del calostro y la leche. Es importante saber qué grupo de RV está causando diarrea, ya que la vacunación no genera protección cruzada entre los grupos. Mediante el uso de pruebas de diagnóstico molecular, es posible identificar el grupo específico y el subtipo de RV que circula en las instalaciones y decidir la mejor estrategia de tratamiento para la enfermedad.

Merck Animal Health, Kirkland, Quebec, Canada.

Corresponding author: Dr Carol Malgarin, 16750 Trans-Canada Hwy, Kirkland, QC H9H 4M7, Canada; Tel: +1 3064915117; Email: **carolina.malgarin@merck.com**

Malgarin C, de Grau F. An investigation of group and subtype diversity and distribution of porcine rotaviruses in Canadian suckling piglets with diarrhea, 2019-2023. *J Swine Health Prod*. 2024;32(6):258-262. **https://doi.org/10.54846/jshap/1400**

Résumé - Étude sur la diversité des groupes et des sous-types et la distribution des rotavirus porcins chez des porcelets allaités canadiens atteints de diarrhée, 2019-2023

Objectif: Déterminer la fréquence de détection et la diversité des groupes de rotavirus (RV) A, B, et C et le sérotype G (antigène glycoprotéique) (sur la base de l'analyse du gène de la protéine virale 7 [VP7]) infectant les porcelets allaités atteints de diarrhée dans des fermes canadiennes.

Matériel et méthodes: Des vétérinaires porcins canadiens ont soumis 1117 échantillons entériques de porcelets allaités entre juillet 2019 et décembre 2023 au Laboratoire de santé animale de l'Université de Guelph pour l'identification du groupe RV et le séquençage VP7 pour le sous-typage. L'analyse de la séquence VP7 de 837 échantillons a été réalisée à l'aide de la plateforme Sequivity (Merck & Co, Inc) et de statistiques descriptives.

Résultats: Les rotavirus A, B, et C étaient présents dans 40.7%, 12.5%, et 46.8% des échantillons, respectivement. Le RV le plus fréquemment identifié était le RVC G6, présent dans 296 échantillons, suivi du RVA G9 dans 205 échantillons. Un seul groupe de RV était impliqué dans 444 cas (72.3%), tandis que dans 170 cas (27.7%), plusieurs groupes/sous-types de RV ont été détectés. Dix-huit sous-types ont été identifiés par séquençage de la protéine VP7 (5 RVA, 9 RVB, et 4 RVC).

Implications: La protection contre le rotavirus pour les porcelets allaités provient du colostrum et du lait. Il est important de savoir quel groupe de RV est à l'origine de la diarrhée, car la vaccination ne génère pas de protection croisée entre les groupes. À l'aide de tests de diagnostic moléculaire, il est possible d'identifier le groupe et le sous-type spécifiques de RV circulant dans les bâtiments et de décider de la meilleure stratégie de traitement pour la maladie.

Rotavirus (RV) is a ubiquitous pathogen able to cause diarrhea in pigs of all ages, although suckling piglets are the most susceptible.[1-4] As animals age, most become protected from the disease by developing post-exposure immunity to RV coupled with maturation of the gut physiology and overall immunity.[1,5] Rotavirus groups A, B, and C are the most common in pigs, although E and H have also been demonstrated to cause disease in swine.[1] The RV groups are identified by the antigenicity of viral protein (VP) 6.[1] Sequencing of other structural viral proteins, such as VP7 and VP4, are employed to further type the virus into G (glycoprotein antigen) or P (protease-sensitive antigen) serotypes based on their antibody neutralization properties.[1,2,6]

Group A was the first RV to be identified in pig production and has been considered the most critical and prevalent RV causing diarrhea in suckling piglets.[6] Although RV groups B and C have been detected since the 1980s, the difficulty in growing these in cell culture did not allow for extensive investigation and analyses until recently.[2] Rotavirus C relevance as a diarrhea-causing pathogen in the pork industry was first thought sporadic. However, it has recently been recognized as endemic in most pig herds causing both subclinical disease and severe gastroenteritis in young piglets (78%, < 3 days of age).[2] Group B appears as a less prevalent RV and is sporadically found in pig herds and has been shown to have the ability to cause disease in piglets.[6,7] Due to the difficulty in culturing groups B and C, the only commercial vaccine available in Canada is based on the RV A G5 and A G9 subtypes. The prescription RNA particle vaccines are available for all three RV groups.

We aimed to understand the genetic diversity and geographical distribution of RV groups A, B, C, and G subtypes (VP7) infecting suckling piglets in Canadian farms. The determination of RV as cause of disease is not within the scope of this study, as not enough diagnostic data was collected, and the detection of RV does not imply infection and disease.

Animal care and use

This study used laboratory submission data from diagnostic veterinary submissions. Institutional animal use approval was not required.

Materials and methods

The animals were adequately housed and cared for in 290 commercial swine herds located in Alberta (AB), British Columbia (BC), Manitoba (MB), New Brunswick (NB), Ontario (ON), Quebec (QC), and Saskatchewan (SK). Fifty-eight swine veterinarians from 30 clinics submitted targeted (not random) enteric samples (fecal swab, intestinal content, or intestinal tissue) from suckling piglets presenting with rotaviral diarrhea between July 1, 2019 and December 31, 2023. Each sample collection was a result of the veterinarian investigating the cause of diarrhea in suckling piglets on their client's farms. As they had previously eliminated other sources of pathogen-induced diarrhea, they submitted samples for RV sequencing to produce a prescription RV vaccine for each farm under the Sequivity RNA particle vaccine program (Merck & Co, Inc). Thus, samples, number of samples, and sample collection methods were not standardized among veterinarians and farms.

Samples received by the Animal Health Lab (AHL) at the University of Guelph were tested upon arrival for the RV group by polymerase chain reaction (qPCR), as previously described,[8] followed by Sanger sequencing of the G type (VP7). If multiple samples within the same submission (case) were positive, only the sample with the lowest cycle threshold (Ct) on qPCR for each group (if more than one detected) was sequenced. Results were recorded matching the sequence to the clinic, farm, and veterinarian name (which remained confidential), province, date of collection, and age of pigs presenting clinical signs (only samples identified as suckling piglets were included). Sequencing results were analyzed using the Animal Health Sequivity Dashboard (Merck & Co, Inc), an RNA vaccine platform database and tool for sequence storage and analysis, as previously described by Sebo[9] and followed by descriptive analysis.

Results

A total of 1117 samples from 614 cases of diarrhea were submitted to the AHL, where the samples with the lowest Cts (837 samples) were identified by sequencing the VP7 gene. Ontario had the highest representation in sequenced samples, with 22.6% (189 of 837) of the total samples, followed by AB with 21.8% (183 of 837), MB with 21.3% (178 of 837), SK with 17.7% (148 of 837), QC with 14.6% (122 of 837), BC with 1.2% (10 of 837), and

NB with 0.8% (7 of 837). From all samples sequenced, RVA was present in 40.7% (341 of 837) of samples, RVB in 12.5% (105 of 837), and RVC in 46.8% (391 of 837) (Table 1). In most provinces (AB, BC, MB, NB, QC, and SK), RVC was the most detected group followed by RVA and RVB, while ON observed a higher presence of RVA followed by RVC and RVB. The number of farms and cases from each province are detailed in Table 1.

Single RV detections (only one group or subtype involved) represented 72.3% (444 of 614) of the cases, while 170 of the 614 cases (27.7%) had more than one RV group and subtype detected. The 170 RV codetection cases were represented by 393 sequences, from which RVC was present in 40.5% (159 of 393), followed by RVA in 38.4% (151 of 393), and RVB in 21.1% (83 of 393). Thirty-two cases had all three groups (RV A, B, and C) detected, while 90 codetection cases had groups A and C present; other combinations of groups or subtypes were also identified (Table 2).

Eighteen RV subtypes were identified within all cases and included 5 RVA, 9 RVB, and 4 RVC (Figure 1). The most common RV was RVC G6 detected in 296 samples, with a mean homology of 90.8% (range: 69.06%-100%) among samples. Rotavirus A G9 was found in 205 samples with a mean homology of 94.5% (range: 86.76%-100%). Similar mean homology was found within provinces (Table 3). Some less common RV sequences were present only in a specific region or province, for example, RVB G8 was only detected in SK.

Discussion

Rotavirus-related diarrhea in suckling piglets is a concern for the pork industry due to its high prevalence and impact on preweaning mortality and piglet performance.[10] Like other studies, we found that suckling piglet samples were mainly positive with only one RV, although multigroup/subtype RV codetections were present.[2,5,11] In this study, RVC was

Table 1: Number of sequenced rotavirus (RV) groups, number of farms, and number of cases by Canadian provinces

	Canadian province							
	Alberta	British Columbia	Manitoba	New Brunswick	Ontario	Quebec	Saskatchewan	Total
No. of farms	43	2	66	1	81	59	38	290
No. of cases	121	9	126	6	145	112	95	614
RVA sequences	73	1	74	2	106	29	56	341
RVB sequences	32	1	27	0	7	3	35	105
RVC sequences	78	8	77	5	76	90	57	391
Total RV Sequences	183	10	178	7	189	122	148	837

Table 2: Number of cases with rotavirus (RV) group or subtype codetection by combinations

	RV group/subtype combinations						
	A + B	A + C	C + B	B + B*	C + C†	A + B + C	Total
No. of cases	20	90	26	1	1	32	170

* B G8 and B G14.

† C G1 and C G6.

Figure 1: Distribution of rotavirus groups and types by Canadian province.

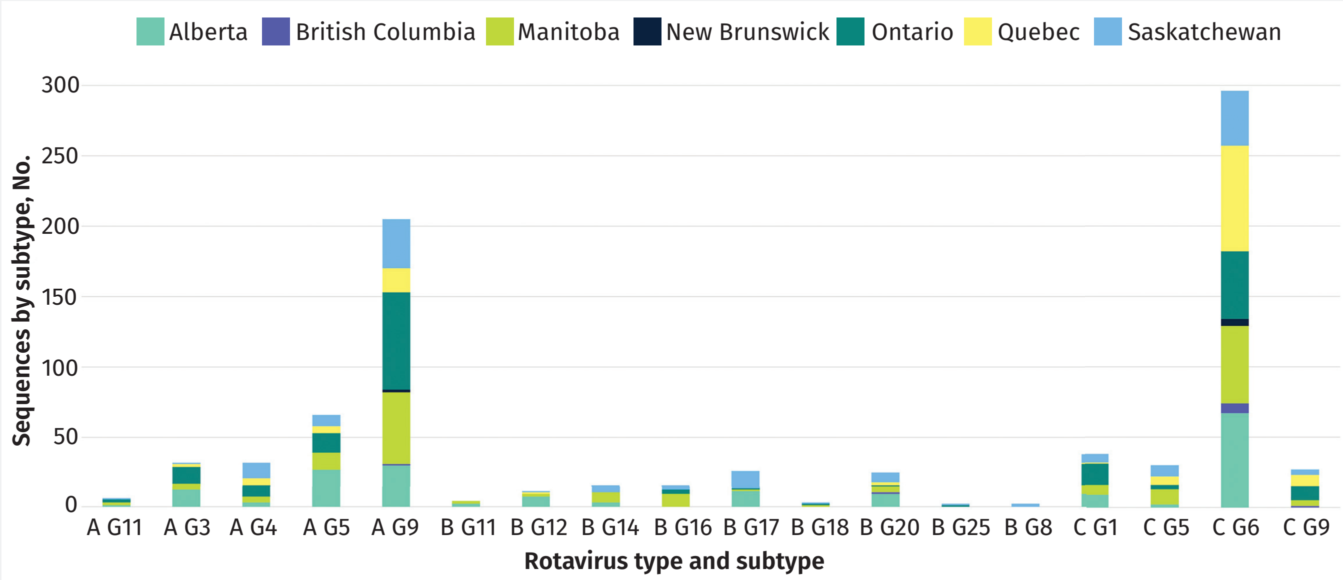


Table 3: Number and homology percentage of rotavirus (RV) sub-type detections by province

	Canadian province						
	Alberta	**British Columbia**	**Manitoba**	**New Brunswick**	**Ontario**	**Quebec**	**Saskatchewan**
RVA G9							
No. of detections	31	1	54	2	71	16	31
% homology	94.17	NA	94.76	99.23	95.26	95.27	95.38
RVC G6							
No. of detections	73	7	61	5	50	61	39
% homology	91.33	97.60	92.85	99.35	90.46	92.22	92.49

NA = not applicable.

the most detected RV in Canadian provinces (except in ON), followed by RVA, which was similar to previous results from the United States where RVC has been detected in 76% of suckling piglets. As previously observed, RVB was the least detected yet most diverse group.[6] Our results indicated that RVA was the most detected RV in ON, which is similar to past studies conducted in this province.[11,8] Buchan and colleagues[11] summarized three years of diagnostic reports involving diarrhea presentations in ON during the lactation and nursery phases. Rotavirus A was detected in 69% of diarrhea cases in suckling piglets, RVC in 37%, and RVB in 13%. Similarly, Tran et al[8] found RVA in 56.4% of samples from suckling pigs, 10% of RVB, and 34.4% of RVC (93% of all samples were from Ontario and Quebec).

Marthaler et al[12] tested 7508 samples from pigs with diarrhea in Canada, the United States, and Mexico. They found that 83% of samples were qPCR positive for RVA, RVB, or RVC. Group A was detected at the highest percentage (62%). While RVB and RVC were seen at a lower frequency (33% and 53%, respectively), both were considered epidemiologically relevant. The study also reported that RV detection can be related to the age of the pig sampled. Rotavirus C was more frequently detected in pigs within the first 21 days of age, while RVA and RVB were suggested as the cause of diarrhea in pigs over 21 days of age,[12] which may explain the higher detection of RVC observed in our study which targeted samples from suckling piglets.

The reason why the prominent group detected differed in ON from other provinces is not apparent. However, RV group detection has been shown to vary geographically.[1] Furthermore, sow vaccination programs, age, diet, genetics, and farrowing room management can vary from province to province, potentially influencing RV distribution. A diversity of subtypes within groups were observed demonstrating the diversity of RV. The VP7 sequences can vary within the same group as was shown in the homology analyses within the two most detected RV subtypes (A G9 and C G6). It is unknown what percentage of homology of VP7 would offer cross-protective immunity within the same subtype, although different subtypes within the same group are known to have small to no cross-protection.[13,14] Higher mean homology was observed among the A G9 sequences than the C G6, which had lower mean homology both within the country as well as within provinces.

The results presented here were not paired and analyzed with qPCR Ct results, clinical signs, or specific diagnostic tests to confirm RV-related disease. However, samples were collected from farms presenting with diarrhea in suckling piglets, where the veterinarian had previously tested for other pathogens and eliminated them as the cause of disease. Our observations suggest two different primary RV groups in Canada, RVA in ON and RVC in the western provinces and QC, indicating the relevance of RVC and the classic RVA in the Canadian swine industry.

Implications

Under the conditions of this study:

- Rotavirus C was the most detected RV in Canadian suckling piglets.
- Most cases were single RV detections, although RV codetections were common.
- Knowledge of RV subtypes inform veterinarians on prevention programs.

Acknowledgments

The authors thank all the veterinarians and staff cooperating in this study.

Conflict of interest

Malgarin and de Grau are both employed by Merck Animal Health, which provided the funding for all diagnostic tests used in this study. All diagnostic tests were conducted by the AHL at the University of Guelph.

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

References

1. Vlasova AN, Amimo JO, Saif LJ. Porcine rotaviruses: Epidemiology, immune responses and control strategies. *Viruses*. 2017;9(3):1-27. **https://doi.org/10.3390/v9030048**

2. Marthaler D, Rossow K, Culhane M, Collins J, Goyal S, Ciarlet M, Matthijnssens J. Identification, phylogenetic analysis, and classification of porcine group C rotavirus VP7 sequences from the United States and Canada. *Virology*. 2013;446(1-2):189-198. **https://doi.org/10.1016/j.virol.2013.08.001**

3. Naseer O, Jarvis MC, Ciarlet M, Marthaler DG. Genotypic and epitope characteristics of group A porcine rotavirus strains circulating in Canada. *Virology*. 2017;507:53-63. **https://doi.org/10.1016/j.virol.2017.03.008**

4. Chepngeno J, Diaz A, Paim FC, Saif LJ, Vlasova AN. Rotavirus C: Prevalence in suckling piglets and development of virus-like particles to assess the influence of maternal immunity on the disease development. *Vet Res*. 2019;50(1):84. **https://doi.org/10.1186/s13567-019-0705-4**

5. Almeida PR, Lorenzetti E, Cruz RS, Watanabe T, Zlotowski P, Alfieri A, Driemeier D. Diarrhea caused by rotavirus A, B, and C in suckling piglets from southern Brazil: Molecular detection and histologic and immunohistochemical characterization. *J Vet Diagn Invest*. 2018;30(3):370-376. **https://doi.org/10.1177/1040638718756050**

6. Marthaler D, Rossow K, Gramer M, Collins J, Goyal S, Tsunemitsu H, Kuga K, Suzuki T, Ciarlet M, Matthijnssens J. Detection of substantial porcine group B rotavirus genetic diversity in the United States, resulting in a modified classification proposal for G genotypes. *Virology*. 2012;433(1):85-96. **https://doi.org/10.1016/j.virol.2012.07.006**

7. Miyabe FM, Dall Agnol AM, Leme RA, Oliveira TES, Headley SA, Fernandes T, Gonçalves de Oliveira A, Alfieri AF, Alfieri AA. Porcine rotavirus B as primary causative agent of diarrhea outbreaks in newborn piglets. *Sci Rep*. 2020;10:22002. **https://doi.org/10.1038/s41598-020-78797-y**

8. Tran H, Friendship R, Ojkic D, Poljak Z. Assessment of seasonality of rotavirus PCR detection in swine from Ontario and Quebec between 2016-2020 using submissions to a diagnostic laboratory. *Can J Vet Res*. 2022;86(4):241-253.

*9. Sebo C, Kitikoon P, Donovan T, Morgan C, Knetter S, Dempsey H, Crawford K, Mogler M, Thacker B, Strait E. Updates on influenza A vaccination using the SEQUIVITY technology. In: *Proceedings of the 51st AASV Annual Meeting*. American Association of Swine Veterinarians; 2020:112-115.

*10. Groth D. Clinical management of rotavirus. In: *Proceedings of the 45th AASV Annual Meeting*. American Association of Swine Veterinarians; 2014:561-562.

*11. Buchan J, Jansen H, Surmak A, Vilaca K, Moser G, Marenger K, Moser L. Evaluation of porcine rotavirus prevalence and distribution within southwestern Ontario. In: *Proceedings of the 52nd AASV Annual Meeting*. American Association of Swine Veterinarians; 2021:248.

12. Marthaler D, Homwong N, Rossow K, Culhane M, Goyal S, Collins J, Matthijnssens J, Ciarlet M. Rapid detection and high occurrence of porcine rotavirus A, B, and C by RT-qPCR in diagnostic samples. *J Virol Methods*. 2014;209:30-34. **https://doi.org/10.1016/j.jviromet.2014.08.018**

13. Anderson AV, Shepherd F, Dominguez F, Pittman JS, Marthaler D, Karriker LA. Evaluating natural planned exposure protocols on rotavirus shedding patterns in gilts and the impact on their suckling pigs. *J Swine Health Prod*. 2023;30(1):10-19. **https://doi.org/10.54846/jshap/1294**

14. Chattha KS, Roth JA, Saif LJ. Strategies for design and application of enteric viral vaccines. *Annu Rev Anim Biosci*. 2015;3:375-395. **https://doi.org/10.1146/annurev-animal-022114-111038**

* Non-refereed references.

Conversion tables

Weights and measures conversions

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

Temperature equivalents (approx)

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

°F = (°C × 9/5) + 32

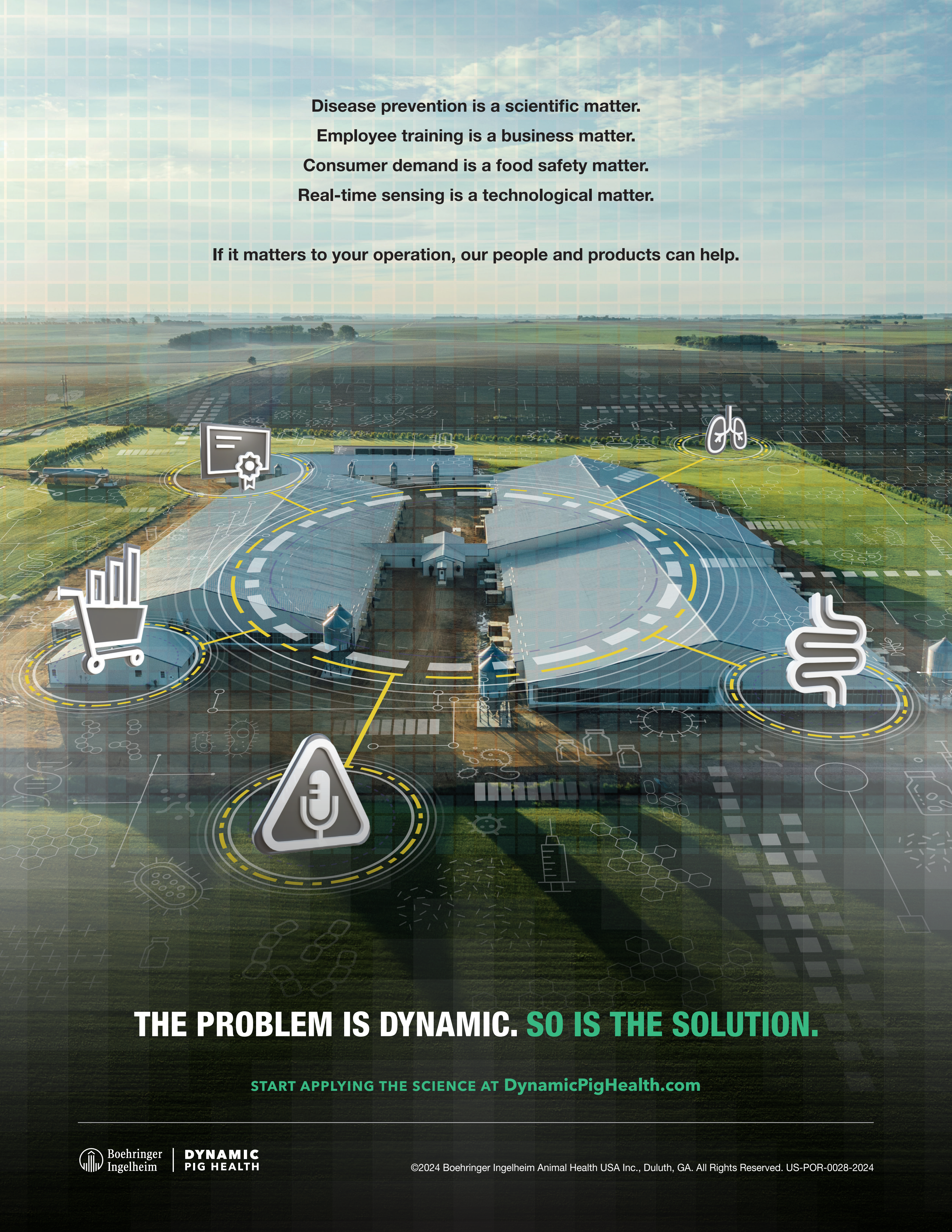
°C = (°F - 32) × 5/9

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

Conversion chart, kg to lb (approx)

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

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


Disease prevention is a scientific matter.
Employee training is a business matter.
Consumer demand is a food safety matter.
Real-time sensing is a technological matter.
If it matters to your operation, our people and products can help.
THE PROBLEM IS DYNAMIC. SO IS THE SOLUTION.
START APPLYING THE SCIENCE AT DynamicPigHealth.com
Boehringer Ingelheim
DYNAMIC PIG HEALTH
©2024 Boehringer Ingelheim Animal Health USA Inc., Duluth, GA. All Rights Reserved. US-POR-0028-2024

Producer input drives Pork Board research priorities

The National Pork Board established the Swine Disease Research Task Force to focus on addressing knowledge gaps related to pathogen management and prevention, biosecurity, and foreign animal disease (FAD) response. Task force membership is made up of producers, veterinarians, and subject matter experts. National Pork Board heard producer requests to incorporate endemic disease research along with FAD work and this is reflected in the task force priorities. Dr Marisa Rotolo, director, swine health, said the task force has a dual focus on these swine disease challenges.

The task force is responsible for identifying and prioritizing research and activities related to foreign animal and endemic diseases to enhance overall preparedness. It aims to leverage insights and address gaps identified through member discussions, along with learnings from functional and tabletop exercises. Additionally, the task force supports and collaborates with the American Association of Swine Veterinarians' Porcine Epidemic Diarrhea Elimination Task Force.

The task force issued requests for proposals due May 15, 2024, and subsequently funded four projects using the new criteria. The total amount funded for the Pork Checkoff-supported research is approximately $400,000 and will provide quality, immediately usable information for the investment. "We developed the request for proposals by meeting with the task force and really drilling down to what challenges our producers face every day." Dr Rotolo said. "The task force selected the projects from the field of applicants using a robust scientific review process in which they carefully weighed proposed research against the priorities identified," said Dr Rotolo. "We are excited to see the results of these funded projects, which should provide practical outcomes and guidance for producers and veterinarians on control of endemic disease through biosecurity, vaccination practices, and a deeper epidemiological understanding of several pathogens."

Projects funded as a result of the request for proposals are:

- A modeling approach to estimate the effect of weather conditions on cleaning and disinfection strategies to reduce the risk of *Escherichia coli*, porcine epidemic diarrhea virus, and rotavirus contamination in trucks and trailers for swine transportation – *Principal investigator: Dr Valentina Trinetta*
- Determine the significance of PRRSV NGS genome fragments – *Principal investigator: Dr Giovani Trevisan*
- Evaluation of maternally derived immunity to improve PRRSV vaccination and control programs – *Principal investigator: Dr Pablo Pineyro*
- Modified field truck wash procedure analysis – winter conditions – *Principal investigator: Dr Megan Hood*

When completed, funded projects should identify and develop key messages and resources. Results from the funded projects are anticipated in 2025-2026. The four projects now underway will provide valuable information for the industry. "If you have research ideas or see knowledge gaps, contact me," Dr Rotolo said. Call 800-456-7675 or email Dr Rotolo at **mrotolo@pork.org**.

FASTER. STRONGER. CLEANER.

Easy to apply

Excellent foaming capabilities

Quick disinfection

5-minute contact time

Efficacious

Superior kill performance against ASFv, PRRSv, PEDv, FMDv, TGE, SARS-CoV-2, and more.

5 Gallon Pail

1 Gallon Bottle

55 Gallon Drum

Intervention® Concentrate Disinfectants cleans while it disinfects, and disinfects while it cleans. It provides the right balance between strength and responsibility: the power to kill pathogens while being gentle to humans, animals and equipment.

Make Intervention® Concentrate part of your disinfection routine.

InterventionDisinfectants.com

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

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

*See labels and reference sheets for a complete list of efficacy claims, contact times, additional features and directions for use.

DISCLAIMER: You must read and follow the instructions on the label for our product and use the product for the particular applications specified on the product label. To the full extent permitted under applicable law, Virox Technologies Inc. shall not be liable for any damages whatsoever, arising out of or otherwise in connection with any failure to follow those instructions or any use of its products which is not specified on the product's label. The instructions on the product label are not a warranty, express or implied, and Virox Technologies, Inc. expressly disclaims any implied warranties, including any warranty of fitness for a particular purpose. Under applicable law, some of the above waivers or disclaimers of warranty, or exclusions of liability for certain types of damages may not apply to you. In such cases, our liability will be limited to the fullest extent permitted by applicable law.

AHP® and Design and Accelerated Hydrogen Peroxide® and Design are trademarks of Diversey, Inc.

Early-career swine vets explore economics, nutrition, NBAF, and more

Participants in the AASV Participant-Led, Early-Career Swine Veterinarian Development Program met in Nashville, Tennessee Friday, February 23, 2024, immediately before the AASV Annual Meeting. As selected by the program participants, the topic was "Economic problem-solving tools for business and personal financial decisions" presented by Dr Derald Holtkamp.

In September, participants had a unique opportunity to visit the National Bio and Agro-Defense Facility (NBAF) in Manhattan, Kansas. The $1.25 billion, 574,000-ft^2 facility will safely and securely support the US Department of Agriculture's (USDA) mission to protect livestock from foreign, emerging, and zoonotic diseases. After learning about research priorities, foreign animal disease diagnostic services, and completion progress, participants toured biosafety level (BSL)-2, -3, and -4 livestock containment spaces, the Biologics Development Module, and supporting infrastructure.

One participant said, "Getting to see inside the NBAF facility was likely a once-in-a-lifetime opportunity, so I greatly appreciate being able to see behind the scenes into what USDA works on when we talk about foreign animal diseases," while others were impressed with the extraordinary level of biosecurity. The AASV Board of Directors toured NBAF in August 2023 and shared their impressions in a previous issue of JSHAP (**aasv.org/shap/issues/v31n6/v31n6advocacy.html**).

The following day, early career participants were joined by Kansas State University swine nutrition experts Drs Jordan Gebhardt, Robert Goodband, Mike Tokach, and Katelyn Gaffield. Participants enjoyed an interactive discussion about nutrition and non-infectious disease management.

The sixth and final individual module will be held this winter. The program will end with an early-career preconference seminar, "Be the Pig's Champion with Effective Herd Visits," at the 2025 AASV Annual Meeting in San Francisco on Sunday, March 2. All annual meeting attendees are eligible to register for the preconference seminar.

Participants of the AASV Participant-Led, Early-Career Swine Veterinarian Development Program toured the National Bio and Agro-Defense Facility in Manhattan, Kansas.

The goal of the AASV Participant-Led Early-Career Swine Veterinarian Development Program, funded by the USDA National Institute of Food and Agriculture Veterinary Services Grant Program, is to create a practitioner-led, early-career swine veterinarian development program to provide participants with resources needed to encourage and ensure successful, lifelong careers as swine veterinarians and to cultivate new leaders in swine veterinary medicine. This program is free to selected participants. Participants attending modules in person receive a $500 stipend per module to offset travel, lodging, and any other costs associated with participation in this program. The current program runs through July 2025. AASV hopes to to offer this program to another cohort of early-career swine veterinarians in the future. Learn more about the program at **aasv.org/earlycareerdevelopmentprogram**.

AASV Board of Directors conducted business in August

The AASV Board of Directors met in Ames, Iowa August 21-22. After a tour of the new Iowa State University Veterinary Diagnostic Laboratory, they met to conduct association business. Highlights of action taken include:

Gene editing position statement: The board approved a new position on gene editing. See **aasv.org/position-statements**.

MentorVet scholarships: The board approved funding for 5 additional AASV member scholarships for the spring 2025 cohort of the program. Application instructions will be announced in the AASV e-Letter.

Member directory: The board directed staff to increase the number of membership directory queries allowed per day from 8 to 15.

Muscular injury survey: The board approved a request from Texas A&M University to invite AASV members to participate in a survey on veterinarian muscular injury research.

Porcine epidemic diarrhea virus (PEDV) elimination resolution: The board approved a resolution on PEDV elimination to be presented at the upcoming US Animal Health Association meeting.

Complete Board of Directors and Executive Committee meeting minutes are available to AASV members at **aasv.org/board-meeting-minutes**.

Students: Apply for Alternate Student Delegate position by November 15

The AASV Student Engagement Committee is accepting applications from veterinary students interested in serving as the Alternate Student Delegate on the AASV Board of Directors. This student will represent student interests and serve as a non-voting member of the AASV board. This experience will provide the student with a unique perspective of the inner workings of the AASV. The term of service is 2 years: the first year as alternate student delegate, and the second year as the student delegate.

The alternate student delegate and student delegate are required to attend the AASV board's fall and spring meetings each year, as well as the two AASV Annual Meetings held during their term. The spring board meeting is usually held in April and the fall board meeting is generally held in September. Recent board meetings have been held in central Iowa, but the date and location can vary as determined by the board. The two delegates work with AASV staff to prepare for student activities (Vet Hunt, Speed Networking) conducted during the AASV Annual Meeting. During the student breakfast at the Annual Meeting, the student delegate is encouraged to present a summary of board activities and describe student opportunities in AASV to the students in attendance. In addition, the delegate and alternate delegate serve as voting members of the AASV Student Engagement Committee and are invited to participate in committee conference calls and meetings.

Both delegates receive reimbursement of their travel and lodging expenses to attend board meetings as well as both AASV Annual Meetings during their term of office.

Interested students must be members of AASV in their freshman or sophomore year. The Student Engagement Committee does take notice of repeat applicants in the selection process. Applicants are required to submit the following documentation to the AASV (**aasv@aasv.org**):

1. An introductory letter, not to exceed one page, describing why they want to serve as the alternate student delegate for AASV, their level of interest/background in swine medicine, and their future career goals.
2. A one- or two-page resume featuring the student's interest and experience in production medicine, particularly swine medicine.
3. A statement of recommendation from a faculty member.

The deadline for submission of necessary documentation is Friday, November 15, 2024. The delegate will be chosen by members of the AASV Student Engagement Committee following review of the submitted materials.

The term of service is two years, beginning at the AASV Annual Meeting. During the first year, the student will serve as the alternate student delegate. The alternate delegate will automatically succeed as student delegate, beginning at the Annual Meeting the following year. The alternate delegate will serve in the capacity of delegate if the student delegate is unable to carry out their duties. Each year, a new alternate delegate is selected by the AASV Student Engagement Committee.

Questions may be directed to the chair of the AASV Student Engagement Committee, Dr Jamie Madigan, by email at **jamiemm@pillenfamilyfarms.com**.

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

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

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

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

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

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

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

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

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

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

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

Announcing AASV's new website

We are pleased to announce the launch of AASV's new website! All of AASV's content and information will continue to be available to you at **aasv.org**.

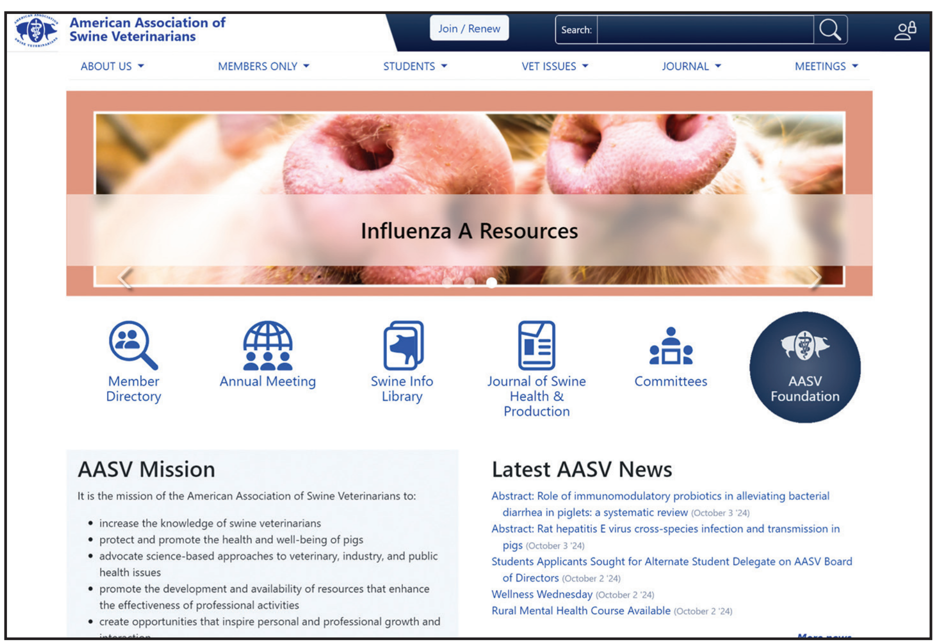
However, the login process has changed. You will need to use the email address you have on file with AASV to set up a new password for accessing the site's members-only content.

To set your new password:

1. Go to **aasv.org** and click on the lock icon in the upper right of the screen.
2. Look for "Need your password?" and click the button to "Reset Password."
3. Enter your email address on file with AASV and click the button to "Get New Password."
4. Open the email message you should have just received from AASV (remember to check your spam folder) and click on the URL it contains.
5. Create and enter your new password, then click "Save Password".

To log in, click the lock icon and enter your email address and your new password.

We think you will love the site's fresh look and mobile-friendly functionality! The AASV staff has worked hard to update and migrate content, but we realize there may be a few glitches during this transition. Thank you in advance for your patience and understanding. Please contact **aasv@aasv.org** if you are unable to find what you are looking for, or if you see something amiss. We will do our best to assist as quickly as possible.



AASV student member contributes to AASV theme image

Cora Schau, a third-year veterinary student at Iowa State University (ISU) and AASV student member, was happy to lend her artistic talent to support AASV in response to a request from 2025 AASV Annual Meeting Program Chair Dr Locke Karriker.

While working for the ISU Swine Medicine Education Center (SMEC) directed by Dr Karriker, Cora had the opportunity to use her artistic skills in a variety of projects. Recognizing her abilities, Karriker invited her to design a sticker to promote the 2025 AASV Annual Meeting. Cora prepared several designs for consideration, and AASV officers and staff selected their favorite for the sticker.

The stickers proved popular at the 2024 IPVS Congress, ISU James D. McKean Swine Disease Conference, Allen D. Leman Conference, and other gatherings of swine veterinarians, so elements from Cora's original design were incorporated into the 2025 AASV Annual Meeting theme image that accompanies the meeting program in this issue.

Cora grew up raising and showing many different livestock species and plans to return to Michigan to work in rural mixed-animal practice. However, she has always had an interest in art. When not working with her animals, she spent a lot of time painting and drawing. She owns a photography company and paints commission pieces when she's not busy with third-year studies.

Cora encourages other student members to attend the Annual Meeting in San Francisco March 1-4, 2025. "It is a great opportunity for students to get out and talk with members of the industry and get involved. It connects individuals from all over and provides a place to learn and grow."

Check AASV out on social media

Join us on Facebook @AASwineVets

Read AASV e-Letter news headlines by following AASV on X @AASwineVets

Follow us on Instagram @AASwineVets

Video resources for AASV members

Many video resources are available to AASV members in the Video Library at **aasv.org/video**.

Annual Meeting videos. AASV members can view keynote addresses, special 50th anniversary videos, and other selected presentations from 2005-2024 Annual Meetings.

SHIC/AASV webinars. Webinars sponsored by the Swine Health Information Center and AASV bring together subject matter experts to discuss current issues facing US pork producers and practitioners. Conducted by the Iowa State University Swine Medicine Education Center, webinar participants include practitioners with first-hand experience with the topic being discussed, diagnosticians, and other experts. Recorded webinars from 2019-2024 are available in the video library.

Do you have a recommendation for a topic to be addressed in this format? SHIC and AASV would like your input! Reach out to SHIC Executive Director Dr Megan Niederwerder at **mniederwerder@swinehealth.org** or AASV Director of Public Health and Communications Dr Abbey Canon at **canon@aasv.org** with your webinar recommendations.

The Swine Medicine Talks. Free video recordings from the 2015-2024 Swine Medicine Talks seminar series are available to AASV members. Recent topics include tractor-trailer rollovers and emergency response, the path to success for new graduates and gaining trust on a farm, and what practitioners need to know about applied swine genetics.

Early career webinars. Recorded presentations from the 2021 Early Career Swine Veterinarian Conference are available to AASV members. Topics include financial literacy, ventilation, and case studies in reproductive failure and nursery and finishing disease.

Heritage videos. To preserve some of the personal histories and capture the human element of swine veterinary medicine, distinguished AASV members recollect their experiences in the Heritage video series. The latest Heritage videos feature Drs Conrad Schmidt, Lisa Tokach, and Angela Baysinger. A video produced in 2023 recounts the history of the AASV Foundation from its humble beginnings.

Worth 1000 words – AASV Photo Library

Did you know the AASV has more than 10,000 images available in its photo library? Members can access photos at **aasv.org/photo-library.**

AASV members are encouraged to use the contributed images for their own reference and for extending their own knowledge. Brief scholarly use — such as inclusion in a classroom lecture or when speaking at a conference — is generally permissible. Commercial use or publication is not covered by the informal understanding we have with our contributors. Additional guidelines for use are described in the photo library.

Need something to listen to? Download from AASV's Audio Library

During the AASV Annual Meeting, veterinary students research a presenter's topic, prepare questions, and interview conference speakers to gain additional information about their presentation topics. Each 5- to 15-minute audio interview is produced as an MP3 audio file.

Did you miss this year's meeting? Do you wish you could listen to a talk from a past meeting? More than 300 AASV podcasts are available at no cost to AASV members on the website at **aasv.org/aasv-podcasts**. Login to hear conference speaker interviews from the 2007-2024 AASV Annual Meetings.

Also available to AASV members as MP3 audio files are recordings produced by the Early Career Committee. These recordings feature interviews with subject matter experts on topics particularly useful for early career swine veterinarians. Find the free podcasts on the AASV website at **aasv.org/aasv-podcasts**.


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

2025 Annual Meeting Program
BE THE PIG'S CHAMPION

SATURDAY, MARCH 1
Preconference seminars

1:00 PM – 5:00 PM

Seminar #1 — Max Rodibaugh Memorial Practice Tips
Jessica Risser and Melissa Billing, co-chairs

Seminar #2 — Boar Stud Issues
Kayla Blake and Megan Hood, co-chairs

Seminar #3 — Transforming the Pork Industry: Optimizing the Pork Chain from Farm to Fork
Jessica Seate and Rebecca Robbins, co-chairs

Seminar #4 — Being the Pig's Champion: Assessing, Addressing, and Reflecting on Current Issues in Swine Welfare
Monique Pairis-Garcia, chair

Seminar #5 — ChatPIG
Brent Sexton and Brandi Burton, co-chairs

SUNDAY, MARCH 2
Preconference seminars

8:00 AM – 12:00 PM

Seminar #6 — Biosecurity
Derald Holtkamp and Kate Dion, co-chairs

Seminar #7 — Swine Lameness
Meghann Pierdon and Jamee Eggers, co-chairs

Seminar #8 — Be the Pig's Champion with Effective Herd Visits
Clayton Johnson, chair

Seminar #9 — NPPC Public Policy and Advocacy Update
Anna Forseth, chair

Seminar #10 — Swine Medicine for Students
Kimberlee Baker and Brandi Burton, co-chairs

Research Topics

8:00 AM – 12:00 PM

Session chair: Chris Rademacher

8:00 AM — Establishing best practices for oral fluid collection
Grzegorz Tarasiuk

8:15 AM — Assessing the effect of pooling commonly used samples in breeding herds on the probability of influenza A virus sequencing
Daniel Moraes

8:30 AM — How many samples do you need for influenza A monitoring in farrowing rooms?
Daniel Moraes

8:45 AM — Effect of oral meloxicam administration to sows on piglet colostrum intake based on immunocrit, birth weights, and infrared thermography
Kendra Blaschko

9:00 AM — Evaluation of meloxicam residues in commercial sows/pigs utilizing a sensitive diagnostic assay
Brian Payne

9:15 AM — Prevention of *Streptococcus suis* disease using avirulent strain inoculation
Samantha Hau

9:30 AM — Mitigating economic losses from *Streptococcus suis* through data-driven decision making
László Gombos

9:45 AM — REFRESHMENT BREAK

10:15 AM — Effect of stocking density on F1 gilt grow-finish and reproductive performance
Brady McNeil

10:30 AM — PRRSV-2 variant classification: A dynamic nomenclature for enhanced monitoring and surveillance
Kimberly VanderWaal

10:45 AM — Can air filtration systems truly reduce PRRS outbreaks? Estimating the effects of negative and positive pressure systems on PRRS occurrence
Xiaomei Yue

11:00 AM — Impact of production and health management strategies on PRRSV outbreak recovery in breeding herds
Ana Paula Poeta Silva

11:15 AM — Productivity losses due to PRRSV, PEDV, and *Mycoplasma hyopneumoniae* in US breed-to-wean herds from 2016 to 2020
Onyekachukwu Henry Osemeke

11:30 AM — The impact of the timing of PRRSV and swine enteric coronaviruses introduction on wean-to-market productivity
Kate Dion

11:45 AM — Evaluating the efficacy of alternative livestock trailer wash methods on reducing the risk of PEDV introduction to farm site areas when loading market pigs
Edison Magalhaes

12:00 PM — Session concludes

Poster session: Veterinary Students, Research Topics, and Industrial Partners

12:00 PM – 5:00 PM

Poster authors present from 12:00 PM to 1:00 PM
Poster display continues on Monday, 8:00 AM to 5:00 PM

Concurrent sessions

1:00 PM – 5:15 PM

Session #1 — **Student Seminar**
Justin Brown and Jordan Gebhardt, co-chairs

Session #2 — **Industrial Partners**
Katie Beckman and Deborah Murray, co-chairs

Session #3 — **Industrial Partners**
Brent Pepin and Marisa Rotolo, co-chairs

Session #4 — **Industrial Partners**
Keith Erlandson, chair

MONDAY, MARCH 3
GENERAL SESSION
Be the Pig's Champion

8:00 AM – 12:30 PM

Program and session chair: Locke Karriker

8:00 AM — **Howard Dunne Memorial Lecture**
The challenges and opportunities of becoming the pig's champion
Clayton Johnson

9:00 AM — **Alex Hogg Memorial Lecture**
Who gets to be the pig's champion?
Cara Haden

10:00 AM — REFRESHMENT BREAK

10:30 AM — Earning the role of the pig's champion
Daryl Olsen

11:30 AM — **Angela Baysinger Memorial Lecture**
Advancing pig welfare together: Standing on the shoulders of Angela
Anna Johnson

12:30 PM — AASV-AASV FOUNDATION LUNCHEON

Concurrent Session #1: PEDV Elimination

2:00 PM – 5:30 PM

Session co-chairs: Marisa Rotolo and Paul Yeske

2:00 PM	Introduction
2:15 PM	PED elimination in Manitoba *Jenelle Hamblin*
2:45 PM	Estimating prevalence *Giovani Trevisan and Cesar Corzo*
3:15 PM	Comparison of elimination protocols for PED, PRRS, and *Mycoplasma hyopneumoniae* *Paul Yeske*
3:30 PM	REFRESHMENT BREAK
4:00 PM	Transport survey and study *Edison Magalhaes*
4:20 PM	Transport case study *Pete Thomas*
4:40 PM	PEDV elimination question and answer panel *Mary Battrell, Darin Madson, Jon Tangen, and Pete Thomas*
5:20 PM	Conclusion: PEDV classification and future of elimination
5:30 PM	Session concludes

Concurrent Session #2: Pig 101 on Pig One-on-One

2:00 PM – 5:30 PM

Session chair: Megan Hindman

2:00 PM	Swine pharmacology update: New tools and techniques for the individual pig *Joe Smith*
3:00 PM	Basic husbandry for Wilbur, and how to navigate through individual pig advice *Joe Smith*
3:30 PM	REFRESHMENT BREAK
4:00 PM	We sent Wilbur to medical school: Describing the use of swine in biomedical research *Caitlin Vonderohe*
4:30 PM	Niche production: It's not for everyone *Pete Schneider and Trevor Schwartz*
5:00 PM	Facebook: Question and answer panel *Joe Smith, Caitlin Vonderohe, Pete Schneider, and Trevor Schwartz*
5:30 PM	Session concludes

Concurrent Session #3: Global Hot Topics

2:00 PM – 5:30 PM

Session chair: Perle Zhitnitskiy

2:00 PM	African swine fever control and management challenges in the Philippines *Angel Manabat*
2:30 PM	The problem of ASF in pig production and the impact of the pig and meat trade *Rafał Niemyjski*
3:00 PM	African swine fever in Germany: Lessons learned *Tim Snider*
3:30 PM	REFRESHMENT BREAK
4:00 PM	Hot topics in European swine production *Vincent ter Beek*
4:30 PM	Unlocking the secrets of *Streptococcus zooepidemicus* *LeeAnn Peters*
5:00 PM	Brazilian swine industry: An update on actual strategies and future perspectives *Glauber Machado*
5:30 PM	Session concludes

TUESDAY, MARCH 4

General Session Influenza Insights

8:00 AM – 12:00 PM

Chair: Rebecca Robbins

8:00 AM	Human spillover cases in swine and significance to influenza A virus ecology *Phil Gauger*
8:30 AM	Don't be a fomite: The role of personal protective equipment (PPE) in preventing influenza A virus *Montse Torremorell*
9:00 AM	Influenza A virus in non-commercial swine and best practices for control and prevention *Andrew Bowman*
9:30 AM	Expect the unexpected: Are swine veterinarians ready for H5N1? *Scanlon Daniels*
10:00 AM	REFRESHMENT BREAK
10:30 AM	Where to begin: Selecting influenza A virus strains for a system-specific vaccine *Marie Culhane and Emily Mahan-Riggs*
11:15 AM	Ask the experts: How is a herd-specific vaccine produced? *Erin Strait, Ben Hause, and Mark Mogler*
12:00 PM	Session and meeting conclude

Members and colleagues invited to support Baysinger Memorial

The AASV and the veterinary profession lost a valued member, leader, and advocate for animal welfare when Dr Angela Baysinger passed away on March 8 of this year.

To honor Angela's memory and further her commitment to improve the welfare of production animals, the Baysinger family made a generous contribution to the AASV Foundation to establish the Angela K. Baysinger Memorial Fund.

In accordance with the Baysinger family's wishes, a working group of AASV members and Angela's colleagues proposed – and the AASV Foundation board approved – that the foundation establish the following three initiatives to be supported by the proceeds of the memorial fund:

Angela Baysinger Memorial Scholarship

One or more annual scholarships focused on providing educational and mentoring support for students interested in production animal welfare. Up to $10,000 may be disbursed annually, with a maximum award of $5000 per student.

Angela Baysinger Memorial Lecture

A general session lecture ($3000 speaker honorarium) to be given annually during the AASV Annual Meeting to address production animal welfare. The 2025 AASV Annual Meeting will feature Dr Anna Johnson presenting the first Angela Baysinger Memorial Lecture: *Advancing pig welfare together: Standing on the shoulders of Angela.*

Support for the AVMA Animal Welfare Assessment Contest

Contributions of $7500 will be made in 2024 and 2025 to support the AVMA's Animal Welfare Assessment Contest in honor of Angela.

The AASV Foundation invites AASV members and Angela's friends and colleagues to make additional donations to the Angela Baysinger Memorial Fund to ensure the long-term viability of these initiatives.

Already, Merck Animal Health has added its support to the memorial fund. In making the contribution, Justin Welsh, DVM, executive director of Merck's Livestock Technical Services, said "Merck Animal Health is proud to support the efforts of the AASV to honor Dr Angela Baysinger through this memorial fund. Angela was part of the Merck Animal Health family, and her legacy and contributions will live on through this effort."

Donate in Angela's honor

For more information about the activities to be supported by the memorial, and to honor Angela's memory with your own support for production animal welfare, visit **aasv.org/foundation/contribute/memorials**.

A life dedicated to animal welfare:

Dr Angela Baysinger's interest and involvement in animal welfare issues knew no boundaries. Throughout her career, she worked tirelessly to understand, improve, and promote animal welfare. In addition to her DVM degree, Angela held a master's degree in Animal Welfare, Ethics, and Law from the University of Edinburgh. For the past several years, she was the North American Lead for Animal Well-being at Merck Animal Health, where she coordinated the annual symposium "Advancing Animal Welfare Together."

Although pigs were her passion, Angela's efforts encompassed all species of production animals. Besides serving for many years on the AASV Pig Welfare Committee and the National Pork Board's Animal Welfare Committee, she also served on the AVMA Animal Welfare Committee from 2013 to 2024 and was chair of the committee at the time of her passing. She served on the Professional Animal Auditor Certification Organization (PAACO) Board of Directors from 2004 to 2007 and again from 2011 to 2024. She was involved in the International Poultry Welfare Alliance, the Global Roundtable for Sustainable Beef, and the North American Meat Institute.

Angela's many contributions were recognized with the AASV Meritorious Service Award in 2021, the Feather in Her Cap Award in 2021, and the PAACO Service Award in 2022.

AASV Foundation news continued on page 279

AASV Foundation news continued from page 277

Prospecting for the foundation

As AASV heads to the Golden State in 2025, the AASV Foundation Auction Committee is staking its claim on holding another successful fundraising auction. Committee members are already prospecting for auction items and cash donations, and they are banking on their partners (AASV members and sponsors) to lend a hand.

Good news – there is no hard labor involved! Just submit the donation form with a photo of your item (or a check). Your contribution will be recognized in the auction catalog as well as on the auction website, and your name will appear in the full-page JSHAP spread recognizing our auction donors.

Nuggets of gold

Every donation is a nugget of gold that helps the foundation fulfill its mission through its many programs. The foundation's travel stipends, externship grants, and scholarships help attract veterinary students to the profession, while its research grants, debt-relief awards, and support for advanced certification programs provide opportunities for graduate veterinarians.

The rush is on!

Join the wagon train of foundation supporters: **Submit your donation by December 1** using the form available at **aasv.org/foundation/auctioninfo.**

Researchers, submit your proposals for funding

The AASV Foundation announces the availability of up to $100,000 in funding for 2025 to support research with direct application to the swine veterinary profession.

Research proposals are due by **12:00 PM Central Time on December 13, 2024**. Proposals are limited to a maximum request of $30,000 per project. Detailed submission instructions are available at **aasv.org/foundation/research/call-for-proposals**.

The projects selected for funding will be announced during the AASV-AASV Foundation Luncheon at the AASV Annual Meeting on Monday, March 3, 2025.

A panel of AASV members will review and select proposals based on the following criteria:

- Potential benefit to swine veterinarians and the swine industry (40 points)
- Likelihood of success within the proposed timeline (35 points)
- Scientific and investigative quality (15 points)
- Justification of the budget (5 points)
- Originality of the research (5 points)

A summary of previously funded research can be viewed at **aasv.org/foundation/research/funded/**.

Early-career swine veterinarians: Twelve $7500 debt-relief grants to be awarded

The AASV Foundation is pleased to announce two opportunities for AASV members to apply for debt relief. Applications are due December 1 for a total of twelve $7500 grants awarded at the 2025 AASV Annual Meeting. While the application process is the same for both opportunities, the eligibility requirements are different as described below and at **aasv.org/foundation/swine-veterinarians/debt-relief-grants**.

Dr Conrad and Judy Schmidt Family Student Debt-Relief Scholarships

The Foundation will award two $7500 scholarships to AASV members 2 to 5 years post-graduation from veterinary school (2020, 2021, or 2022 graduates) who are engaged **in private veterinary practice** devoted 50% or more to swine, providing on-farm service directly to independent pork producers. The recipient must have maintained AASV membership since joining as a student and must also have attended the AASV Annual Meeting while in veterinary school.

AASVF/Zoetis Foundation Student Debt-Relief Grant Program

For the second year, the AASV Foundation has partnered with the Zoetis Foundation to award ten $7500 grants to swine veterinarians to help relieve their student debt burden. In addition to private practitioners, AASV members who work for production companies, universities, or pharmaceutical companies are encouraged to apply. Any member who graduated from an AVMA-accredited college of veterinary medicine in the years 2015 through 2022, joined AASV as a student member, and whose career since graduation has been 50% or more devoted to swine is eligible to apply.

Those who meet eligibility requirements for the Schmidt scholarship also qualify for the AASVF/Zoetis Foundation grant and will automatically be considered for both opportunities from the same application. Previous recipients are recognized at **aasv.org/foundation/swine-veterinarians/debt-relief-grants/#recipients**, and are not eligible to reapply for either award.

To apply, complete and submit the application available at **aasv.org/foundation/swine-veterinarians/debt-relief-grants by December 1**. The scholarship recipients will be announced during the 2025 AASV Annual Meeting in San Francisco, California.

Hogg Scholarship available to practitioners seeking MS or PhD

The American Association of Swine Veterinarians Foundation is accepting applications for the prestigious Hogg Scholarship. Established in 2008, the intent of the $10,000 Hogg Scholarship is to assist a swine veterinarian in their efforts to return to school for graduate education (resulting in a master's degree or higher) in an academic field of study related to swine health and production. To date, 21 swine practitioners have been awarded the scholarship and are recognized at **aasv.org/foundation/swine-veterinarians/hogg-scholarship**.

Dr Alex Hogg's career serves as the ideal model for successful applicants. After 20 years in mixed animal practice, Dr Hogg pursued a master's degree in veterinary pathology. He subsequently became the Nebraska swine extension veterinarian and professor at the University of Nebraska. Upon "retirement," Dr Hogg capped off his career with his work for MVP Laboratories. Always an enthusiastic learner, at age 75 he graduated from the Executive Veterinary Program offered at the University of Illinois.

The scholarship application requirements are outlined here, and on the AASV website at **aasv.org/foundation/swine-veterinarians/hogg-scholarship/**.

Hogg Scholarship Requirements

Applicants for the Hogg Scholarship shall have:

1. Three or more years of experience as a swine veterinarian, either in a private practice or in an integrated production setting.
2. Five or more years of continuous membership in the American Association of Swine Veterinarians.

Applicants are required to submit the following for consideration as a Hogg Scholar:

1. Current curriculum vitae
2. Letter of intent detailing his or her plans for graduate education and future plans for participation and employment within the swine industry
3. Two letters of reference from AASV members attesting to the applicant's qualifications to be a Hogg Scholar

Selection of Hogg Scholars is made by a three-person panel composed of previous recipients of the Hogg Scholarship. Panel members each serve a 3-year term, with one member rotating off as a new member added each year.

To apply for the Hogg Scholarship, application materials previously outlined must be **received by December 1** via email, **foundation@aasv.org**, or mail to:

AASV Foundation
830 26th Street
Perry, IA, 50220

The scholarship recipient(s) will be announced during the AASV-AASVF Luncheon at the AASV Annual Meeting on Monday, March 3.

Sophomore and junior veterinary students: Apply for $10,000 by December 31

The AASV Foundation, in collaboration with Merck Animal Health, is pleased to once again offer the AASVF-Merck Animal Health Veterinary Student Scholarships to assist with the educational expenses of aspiring swine veterinarians. Merck has generously contributed $50,000, allowing the AASV Foundation to award five scholarships of $10,000 each in 2025.

Veterinary students in their second or third year, enrolled in AVMA-accredited or recognized veterinary colleges in the United States, Canada, Mexico, South America, and the Caribbean Islands, are eligible to apply. Applicants must be current student members of the AASV for the 2024-2025 academic year. The application process requires submission of a resume, the name of a faculty member or AASV member for reference, and responses to four essay questions. Detailed application instructions are available at **aasv.org/foundation/veterinary-students/aasvf-merck-scholarship**. The deadline for applications is December 31.

Please note that students who have previously received this scholarship from the AASV or the American Association of Bovine Practitioners (AABP) are not eligible to reapply.

A committee comprising two AASV Foundation Board members and two AASV members-at-large will review and score the applications. Each essay question response will be evaluated on a scale from 1 to 10, with a total possible score ranging from 0 to 40 points.

The scholarship winners will be announced on Monday, March 3, during the AASV-AASV Foundation Luncheon at the 2025 AASV Annual Meeting in San Francisco (attendance not required).

The AASVF-Merck Animal Health Veterinary Student Scholarship Program reflects Merck Animal Health's and the AASV Foundation's commitment to support the development and scholarship of students and veterinarians interested in the swine industry. For additional information about scholarships and other AASV Foundation initiatives, visit **aasv.org/foundation**.

Golfers tee off for the foundation

Forty-six golfers on twelve teams enjoyed comfortable weather and collegial camaraderie as they played their way around Veenker Memorial Golf Course to support the AASV Foundation on September 10.

The golfers hosted by Pharmgate Animal Health (Dakota Fiene, Daniel Fedders, Jeffery OKones, and Jason Hengeveld) topped the field with a score of 60, winning in a tiebreaker over the team from Iowa State University composed of Justin Brown, Scott Radke, Shawn Steverson, and Brian Yarborough. Golfers hosted by VRI, including Ryan Saltzman, Joe Thomas, Rick Sibbel, and Ben Crawford, made up the third-place team finishing with a score of 66.

The liberal use of mulligans, which were sold to provide additional support to the foundation, contributed to many of the low scores recorded in the 18-hole best ball team contest. However, golfers were forced to rely on pure talent – or good luck – to prevail in the individual contests hosted by several of the golf hole sponsors, which included **Agri-King**, **Aurora Pharmaceutical**, **Huvepharma**, **Insight Wealth Group**, **Kemin Animal Nutrition and Health**, **Metafarms**, **National Pork Producers Council**, and **Veterinary Pharmaceutical Solutions**.

Sponsors also helped keep the golfers well fed and hydrated throughout the day. Lunch was sponsored by **Merck Animal Health**, beverages were provided by **Zoetis**, and **Boehringer Ingelheim Animal Health** generously supported the concluding pork dinner.

Thanks to the enthusiastic participation of golfers and sponsors, the event raised support for the foundation's many programs, including scholarships for students and graduate veterinarians, research grants, student debt relief, swine externship grants, travel stipends for students attending the AASV Annual Meeting, Heritage videos, and more.

From left to right, the Pharmgate Animal Health team of Daniel Fedders, Jeffrey OKones, Jason Hengeveld, and Dakota Fiene took first place honors in the best-ball team contest. Photo by Martina Valline, courtesy of Andrew Kleis, Insight Wealth Group.

As he has done for the past several years, Dr Josh Ellingson coordinated the event for the foundation and announced the following team and individual contest winners:

First flight

First place, hosted by Pharmgate Animal Health: Dakota Fiene, Daniel Fedders, Jeffery OKones, and Jason Hengeveld

Second place, hosted by Iowa State University: Justin Brown, Scott Radke, Shawn Steverson, and Brian Yarborough

Third place, hosted by VRI: Ryan Saltzman, Joe Thomas, Rick Sibbel, and Ben Crawford

Second flight

First place, hosted by Merck Animal Health: Jack Creel, Michelle Sprague, Steve Sprague, and Mike Bauer

Second place, hosted by Zoetis: Brian Roggow, Deb Roggow, James Kloeckner, and Javen Holm

Third place, hosted by Pharmacosmos: Chris Olsen, Wesley Lyons, Chelsea Hamilton, and Jacob Stratton

Third flight

First place, Wayne Freese and Dan Rosener

Second place, hosted by Zoetis: Josh Ellingson, Dave Pyburn, Darran Miller, and Ben Schmaling

Third place, hosted by Topigs Norsvin: Tyler Dick, Amber Stricker, Mitch Christensen, and Brent Sexton

Individual Contests

Hole #2, **Chipping contest**, sponsored by Kemin Animal Nutrition and Health: Shelby Ramirez, Jason Hengeveld, and Michelle Sprague

Hole #4, **Longest Putt**: Dan Fedders

Hole #10, **Longest Drive**: Chris Olsen

Hole #11, **Closest to the pin, tee shot**, sponsored by Huvepharma: Shelby Ramirez

Hole #17, **Closest to the pin**: Javen Holm

Hole #18, **Longest putt**, sponsored by Aurora Pharmaceutical: Jason Hocker

Thank you, reviewers

for working together and creating a journal to be proud of!

The editorial staff of the *Journal of Swine Health and Production* acknowledge the invaluable assistance of the following individuals for their service as referees for the manuscripts that were reviewed between September 20, 2023, and August 29, 2024.

Marcelo Almeida
Glen Almond
Raghavendra Amachawadi
Andreia Arruda
Brittany Backus
Meggan Bandrick
Sheeva Bhattarai
Justin Brown
Alexandra Buckley
Rodrigo Chaves De Paiva
Jane Christopher-Hennings
Sherri Clark-Deener
Dyneah Classen
Cesar Corzo
Marie Culhane
Laura Dalquist
Russ Daly
John Deen
Susan Detmer
Mark Estienne
Héctor Puente Fernández
Robert Friendship
Phillip Gauger
Connie Gebhardt
JordanGebhardt
Marika Genzow
Luca Guardabassi
John Harding
Jeff Harker
Mariana Kikuti
Daniel Linhares
Jim Lowe
Wesley Lyons
Franco Matias-Ferreyra
Daniel Moraes
Chris Olsen
Tanja Opriessnig
Onyekachukwu Osemeke
Fernando Osorio
Thomas Petznick
Meghann Pierdon
Mike Pierdon
Pablo Pineyro-Pineiro
Zvonimir Poljak
Sergei Raev
Michael Rahe
Alex Ramirez
Gaurav Rawal
David Rosero
Marisa Rotolo
Kent Schwartz
Christopher Siepker
Brad Thacker
Montserrat Torremorell
Pablo Valdes-Donoso
Nathan Winkelman
Beth Young
Jianqiang Zhang

We apologize if we have inadvertently left a reviewer's name off the list.

Cumulative index

The *Journal of Swine Health and Production* cumulative index is updated online throughout the year as issues go to press. Articles can be accessed via the "Search" function and from the Abstracts page, **aasv.org/shap/abstracts/.**

Index by Title 2024

Index by Author 2024

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

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

1

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

7+

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

100+

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

2.6 Million

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

There’s only one Hy•D

Follow us on:

dsm-firmenich

UPCOMING MEETINGS

AVMA Diversity, Equity, Inclusion, and Wellbeing Summit

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

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

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

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

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

Pig Research Summit 2024

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

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

Passion for Pigs Seminar & Trade Show

December 3, 2024 (Tue)
Isle of Capri
Boonville, Missouri

For more information:
Web: **passionforpigs.com**
Email: **julie@passionforpigs.com**
Tel: 660-651-0570

North American PRRS Symposium

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

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

2025 AVMA Veterinary Leadership Conference

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

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

Pig Ski Conference

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

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

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**

World Pork Expo

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

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

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

JSHAP Resources

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