May and June 2018 • Volume 26, Number 3

Journal of Swine Health & Production

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The Journal of the American Association of Swine Veterinarians

Journal of Swine Health and Production

(**ISSN 1537-209X**) Volume 26, Number 3; May and June 2018

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

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The *Journal of Swine Health and Production* is a refereed publication and is a benefit of membership in the American Association of Swine Veterinarians. Subscriptions ($US) are available to nonmembers at $145.00 per year (six issues) for United States, Canada, and Mexico. The cost is $180.00 for all countries outside North America. For inquiries regarding membership or subscriptions, please contact

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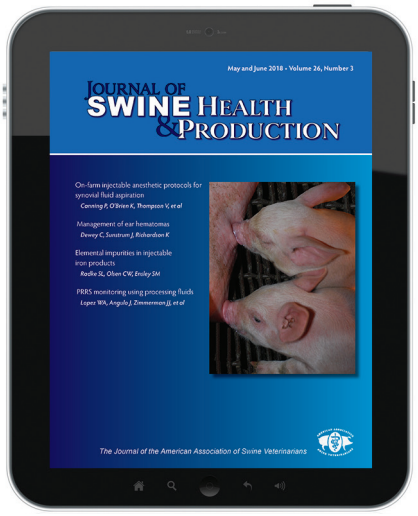

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Nursing pigs in North-Central Missouri

Photo courtesy of Tina Smith

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"It has been an exciting time at the journal."

quoted from the Executive editor's message, page 129

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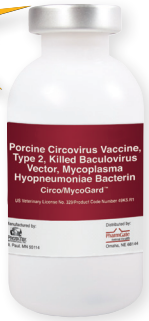

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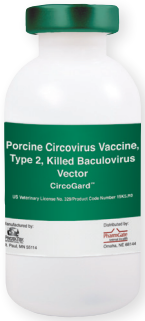

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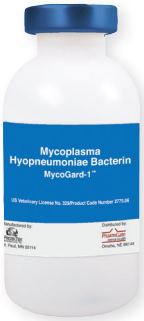

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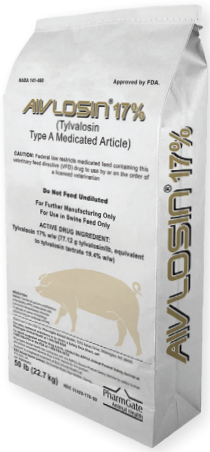

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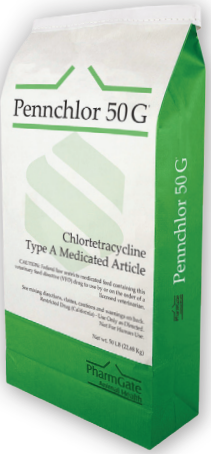

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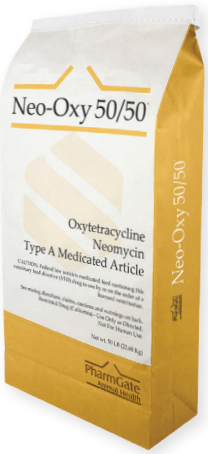

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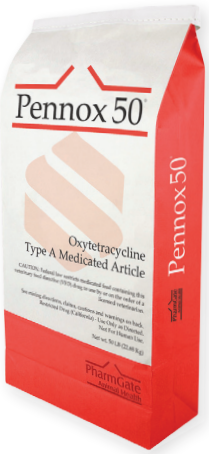

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Global Knowledge: Individual Application, #AASV2018 was one for the record books!

The 2018 Annual Meeting of the American Association of Swine Veterinarians in San Diego, California was a record-setting event. With your support, we achieved record overall and international attendance. I want to thank the program planning committee for a job well done. Your great ideas and willingness to individually chair sessions made the meeting a success. I also want to thank Sue Schulteis, Tom Burkgren, and Harry Snelson for all your behind-the-scenes work. There is a lot you do to make the meeting run smoothly.

I'm thankful for the opportunity to be president of this wonderful organization for the next year. I've given some thought to goals and objectives. Our mission to educate swine veterinarians continues to be relevant and worthy. That said, our position as the "go-to" source of knowledge about swine health, production and welfare can continue to be strengthened. How do we utilize the knowledge and relationships we have to be more effective?

I believe the answer is in communication and collaboration.

This year at the annual meeting, we started a social media initiative where we encouraged participants to communicate on various social media platforms using #AASV2018. I think it was a great success! I hope that we build on this for #AASV2019! Our next meeting in Orlando, Florida will be the 50th anniversary of the organization so there will be lots to share! Erin Brenneman's presentation on how she uses social media was wonderful in sharing how we can communicate what we do in an effective way. I encourage you to use her example and others to increase our visibility and influence as swine veterinarians. Thank you to Dr Lisa Tokach for leading the social media efforts at the annual meeting.

In the Howard Dunne and Alec Hogg Memorial Lectures, we also heard some thought-provoking ideas for our organization from Drs Bill DuBois and Rodger Main. Dr DuBois shared his ideas on how we can be of service to food production systems throughout the world and challenged us to increase our international membership. I appreciate the thought and work that went into his presentation. The goodwill that can be generated and the relationships that can be forged through international collaboration are imperative in the current environment of global trade and health.

Dr Main shared his vision for how we can better influence the health of the North American swine herd and presented a model for the US Swine Health Improvement Plan. This system of collaboration would offer practical benefits for endemic disease control and allow us to better respond to new or emerging disease threats in the United States.

"Our mission to educate swine veterinarians continues to be relevant and worthy."

And finally, the work of our AASV Foundation is so important to furthering our mission. Thank you to Dr Butch Baker and all those who have championed this worthy organization's efforts. Without your contributions of time and finances, we would not be able to support research and education for our membership. The AASV Foundation has lofty goals for the next year and I encourage all of you to support these causes.

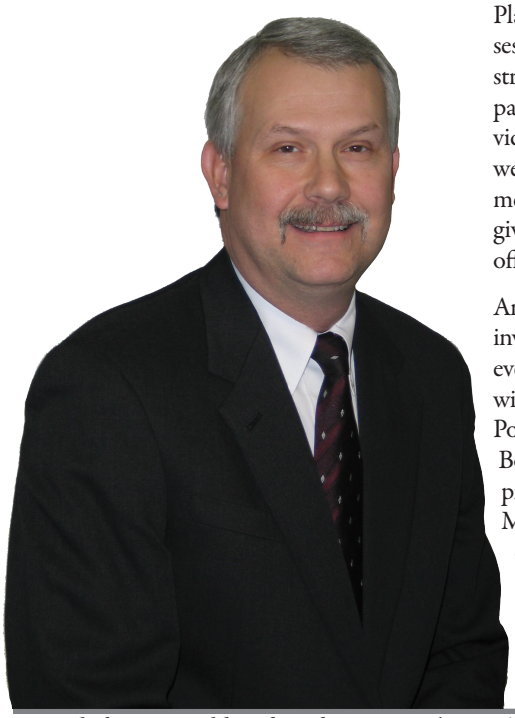
Let's look forward to celebrating our 50th anniversary and continuing our legacy! Thank you so much for all you do.

C. Scanlon Daniels, DVM
AASV President

Where's your shovel?

Recently, John Waddell told me the story about a friend of his who was in the US Army. He had told John that he learned early on that if he carried a shovel with him wherever he went, everyone would leave him alone because they thought he had an assignment requiring that shovel. The AASV differs from this example of the army in that we have many members carrying their proverbial "shovels," but they are quite busy in tangible service to the AASV. They are actively working for the betterment of the AASV, the veterinary profession, and the pork industry.

The AASV Annual Meeting is always a whirlwind affair due to the many meetings, events, and responsibilities associated with hosting 1,200 attendees. I don't get to visit with each and every person at the meeting but I do see a lot of AASV members carrying their shovels around. I see many volunteers who lend their time, talents, and resources to the AASV. One reminder of the shovels I constantly see are the ribbons hanging from name badges of so many members. These ribbons include committee members, officers, AASV board members, speakers, session chairs, AASV Foundation board members, and program committee members to name a few. Each ribbon represents many hours of work and commitment to our organization.



All the AASV committees met during our time in San Diego. These committee meetings are often where action initially takes place before going to the board of directors for approval. The committees also serve the board in that issues can be referred to the committees for consideration and possible action. The committee chairs meet twice a year to hear what other committees are working on as well as look for areas of synergy. If an issue spans more than one committee, then consideration may well be placed among more than one committee or addressed by a working group with representatives from each involved committee. Every committee also has the opportunity to meet outside of the annual meeting, either face-to-face or by conference call. Additional meetings are based on the needs of the association and the respective committee.

The planning process for the annual meeting starts during the prior annual meeting as the incoming AASV president-elect begins looking for volunteers to serve on the program planning committee. This committee typically meets in May or June to begin deciding on the program for the next year's meeting. Planning includes the workshops, the general sessions, and the concurrent sessions. The strength of the meeting is based on member participation and input. Members can provide input through the meeting survey, as well as through any officer, director, or staff member. You can always drop me an email or give me a call. Each year many good ideas are offered for speakers and topics.

Another shovel carried by AASV members involves representation to organizations and events outside of the AASV. This may be within the pork industry such as the National Pork Producers Council and the National Pork Board. It may be within the veterinary medical profession such as the American Veterinary Medical Association, American Association of Bovine Practitioners, and American Association of Avian Pathologists. Other areas in need of representation by swine veterinarians include public health, animal agriculture, One Health, and regulatory agencies (state and federal). There is a constant need for volunteers to represent the AASV in a number of settings.

"As the executive director of a successful not-for-profit organization, I can't overemphasize the role of the volunteer leadership of the AASV."

As the executive director of a successful not-for-profit organization, I can't overemphasize the role of the volunteer leadership of the AASV. Over the last 24 years I have had the distinct pleasure to consistently work with outstanding officers and directors. It is their considerable talents and aptitude as well as unswerving dedication that have brought the AASV to its current status. The shovels they carry around are noticeable because of the firm and steady hand they have used to guide the mission and vision of the organization.

The engagement of members is the lifeblood that sustains and improves an organization. The AASV can only thrive if our members volunteer on a regular basis. An apt description of a membership-driven association is "people-powered." Lisa Sullivan was a well-known and respected organizer working on development in inner cities. Her volunteers were consistently overworked and under-resourced. Once when they were complaining that there just didn't seem to be more people coming forth to help, Ms Sullivan's response was "We are the people we have been waiting for!" I believe that this statement applies to the AASV. Our success is not based on the concept of waiting for someone else to do the work. It is the result of members picking up their shovels and doing the work that needs to be done.

If you are looking for opportunities to find your own shovel, then there are several ways to get involved. Please contact an officer, director, committee chair, committee member, or staff member to express your interest. All AASV officers, directors, and committee chairs and members are listed on the website.

Tom Burkgren, DVM
Executive Director

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The evolution of the journal

I am writing this on my way home from the AASV Annual meeting held in San Diego, California. I always find "air time" to be so rewarding and productive as there are no distractions because my smartphone is in airplane mode. As always, the meeting this year was superb and motivational. It is a valuable time for me because it allows me to connect with other AASV members, the members of the editorial board, and is a welcomed break from Canadian winter weather!

It has been an exciting time at the journal. In my November 2017 message, I mentioned the retirement of our Associate Editor, Dr Judi Bell. It was nice to have Judi attend the AASV Annual meeting this year so that we could celebrate and thank her for her 17 years of outstanding work for the journal. Congratulations Judi!

As many of you know, the journal has also welcomed our incoming Associate Editor, Sherrie Webb. Sherrie visited Judi, Karen, and me in Guelph, Ontario in January 2018. True to form our Canadian winter did not disappoint, it wasn't the best weather that week; sorry Sherrie! Sherrie spent the week here learning the ropes and shadowing Judi. This was a valuable training opportunity and Sherrie has already brought new ideas to the editing process. Sherrie also visited with Tina Smith, our graphic designer and advertising coordinator, and our publisher (Walsworth in Marceline, Missouri) in February 2018 to round out her training. Welcome to the journal Sherrie!

I also hope you were able to visit the "Evolution of JSHAP" display at the annual meeting. This was a lovely display of how the journal has changed and improved over the years. Some comments were received and the journal staff will review these suggestions at upcoming staff meetings. Thank you to those who took the time to submit suggestions and comments.

The journal's editorial board met at the AASV annual meeting. The journal continues to see a healthy line-up of submissions covering a broad range of relevant swine health and production related topics. The hard work and dedication of the editorial board members are vital to the success of the journal, and I would like to thank the entire editorial board for their dedication and individual contributions. At the editorial board meeting, we discussed important journal-related issues. One topic was the journal's 2016 impact factor, which has dropped since our last published rating in 2015. While disappointing to see this drop, it was unanimous amongst those editorial board members in attendance that most journals, in general, do not hold the impact factor metric in high regard anymore. This is predominately because the impact factor metric doesn't take into consideration the impact of a specific article but rather citation rate of articles from the whole journal.

As a reminder to JSHAP readers, I invite you to revisit my editorials from the September-October 2013[1] and the May-June 2016[2] issues where I discuss impact factors in a little more detail. An important take-home message I would like to highlight from my past editorials is that a journal's impact factor does not reflect how well a journal is read or how influential the journal may be in a certain area. Rather, the impact factor is a metric of citation rate and journals with an applied focus typically have lower impact factor ratings when compared to non-applied focused journals.

My message is brief this issue because I wanted to share this lovely photo of journal staff taken while in San Diego.

Left to right: Sherrie Webb, Associate Editor; Karen Richardson, Publications Manager; Dr Terri O'Sullivan, Executive Editor; Dr Judi Bell, Associate Editor (retired); and Tina Smith, Graphic Designer and Advertising Co-ordinator.

Photo credit: Barbara Molnár Smith

All the best,

Terri O'Sullivan, DVM, PhD
Executive Editor

References:

1. O'Sullivan T. Impact! [editorial]. *J Swine Health Prod*. 2013;21(5):239.

2. O'Sullivan T. Shout-out! [editorial]. *J Swine Health Prod*. 2016;24(3):129.

Original research

Peer reviewed

Suitability of four injectable anesthetic protocols for percutaneous synovial fluid aspiration in healthy swine under field conditions and assessment of lameness seven days post procedure

Paisley Canning, DVM, PhD; Katie O'Brien; Victoria Thompson; Darin Madson, DVM, PhD, Diplomate ACVP; Kristin Skoland; Alejandro Ramirez, DVM, MPH, PhD, Diplomate ACVPM; Daniel Linhares, DVM, MBA, PhD; Phillip Gauger, DVM, PhD; Locke Karriker, DVM, MS, Diplomate ACVPM

Summary

Objective: To compare the suitability of four anesthetic protocols for ante-mortem percutaneous synovial fluid aspiration from healthy swine in field conditions. A supplemental objective was to assess the iatrogenic impact of ante-mortem joint sampling by monitoring lameness and joint swelling after the procedure and assessing synovium histology at day seven post treatment.

Materials and methods: Twenty-four finisher pigs (mean weight 86.1 kg ± 10.6) were each randomly allocated to receive one of four intramuscularly administered anesthetic protocols: telazol-ketamine-xylazine (TKX); telazol-ketamine-acepromazine (TKA); ketamine-acepromazine with lidocaine epidural (KAL); or telazol-acepromazine with lidocaine epidural (TAL). Synovial fluid was collected aseptically from one carpus and tarsus joint per anesthetized pig. The anesthetic protocols were evaluated in terms of successful general anesthesia, time to sternal recumbency and time to standing recovery, and protocol cost. Joint swelling and lameness assessments were completed on days two, four, and seven post sampling. On day seven, pigs were euthanized and synovium was collected from each sampled joint for histologic evaluation.

Results: The TKX and TAL treatments were the only anesthetic combinations that provided an adequate anesthesia depth for fluid collection to occur. Mean (SD) time to sternal recumbency for TKX was 125 (26) minutes and for TAL was 198 (28) minutes. There was no evidence of post-aspiration infection in any sampled joints.

Implications: The TKX treatment was the most effective anesthetic protocol for ante-mortem joint fluid collection. Ante-mortem joint fluid collection was not associated with significant joint tissue damage and can be a useful diagnostic tool for infectious arthritis.

Keywords: swine, synovial fluid, telazol, ketamine, xylazine

Received: June 26, 2017
Accepted: November 11, 2017

Resumen – Evaluación de la aptitud de cuatro protocolos de anestesia inyectable para la aspiración percutánea de fluido sinovial en cerdos sanos bajo condiciones de campo y valoración de la cojera siete días después del procedimiento

Objetivo: Comparar la aptitud de cuatro protocolos de anestesia para la aspiración percutánea ante-mortem de fluido sinovial de cerdos saludables en condiciones de campo. Un objetivo suplementario fue valorar el impacto iatrogénico del muestreo ante-mortem de la articulación mediante el monitoreo de la cojera, y la inflamación de la articulación después del procedimiento, así como valorar la histología sinovial en el día siete post tratamiento.

Materiales y métodos: Se repartieron al azar, veinticuatro cerdos de finalización (peso promedio 86.1 kg ± 10.6) para recibir uno de cuatro protocolos de anestesia administrada intramuscularmente: zelazol-ketamina-xilazina (TKX por sus siglas en inglés); zelazol-ketamina-acepromazina (TKA por sus siglas en inglés); ketamina-acepromazina con epidural de lidocaína (KAL por sus siglas en inglés); o zelazol-aceproma¬zina con lidocaína epidural (TAL por sus siglas en inglés). En cada cerdo anestesiado, se recolectó asépticamente fluido sinovial de una articulación del carpo y del tarso. Se evaluaron los protocolos anestésicos en términos de anestesia general exitosa, tiempo de recumbencia esternal, tiempo para recuperación de pie, y costo de protocolo. Se hizo la valoración de la inflamación de la articulación y cojera en los días dos, cuatro, y siete post muestreo. En el día siete, se realizó la eutanasia de los cerdos y se recolectó la sinovia de cada articulación muestreada para la valoración histológica.

Resultados: Los tratamientos TKX y TAL fueron las únicas combinaciones que alcanzaron una anestesia profunda adecuada para que se hiciera la recolección del fluido.

PC, KOB, VT, KS, AR, LK: Swine Medicine Education Center, College of Veterinary Medicine, Iowa State University, Ames, Iowa.

DM, PG: Veterinary Diagnostic Laboratory, Iowa State University, Ames, Iowa.

AR, DL: Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University, Ames, Iowa.

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

Canning P, O'Brien K, Thompson V, et al. Suitability of four injectable anesthetic protocols for percutaneous synovial fluid aspiration in healthy swine under field conditions and assessment of lameness seven days post procedure. *J Swine Health Prod.* 2018;26(3):130-136.

El tiempo promedio (SD por sus siglas en inglés) para la recumbencia esternal con TKX fue de 125 (26) minutos y con TAL de 198 (28) minutos. No hubo evidencia de infección post aspiración en ninguna de las articulaciones muestreadas.

Implicaciones: El tratamiento de TKX resultó ser el protocolo anestésico más efectivo para la recolección ante-mortem de fluido de articulación. La recolección ante-mortem de fluido de la articulación no se asoció con daño significativo en el tejido de la articulación y puede ser una herramienta de diagnóstico útil para la artritis infecciosa.

Résumé – Pertinence de quatre protocoles d'anesthésie par injection pour aspiration de liquide synovial chez des porcs en santé dans des conditions de terrain et évaluation des boiteries sept jours post-procédure

Objectif: Comparer la pertinence de quatre protocoles d'anesthésie pour l'aspiration transcutanée ante-mortem de liquide synovial de porcs en santé dans des conditions de terrain. Un objectif supplémentaire était d'évaluer l'impact iatrogénique de l'échantillonnage ante-mortem d'articulations en surveillant la boiterie et l'enflure des articulations suite à la procédure et en évaluant l'histologie de la synoviale sept jours après le traitement.

Matériels et méthodes: Vingt-quatre porcs en période de finition (poids moyen 86,1 kg ± 10,6) ont été répartis de manière aléatoire afin de recevoir un des quatre protocoles d'anesthésie par voie intra-musculaire: telazol-kétamine-xylazine (TKX); telazol-kétamine-acépromazine (TKA); kétamine-acépromazine avec lidocaïne en épidurale (KAL); ou telazol-acépromazine avec lidocaïne en épidurale (TAL). Du liquide synovial a été prélevé de manière aseptique à partir d'une articulation du carpe et du tarse de chaque porc anesthésié. Le protocole anesthésique était évalué en termes de succès de l'anesthésie générale, délai avant le décubitus sternal et délai pour retour à la station debout et coût du protocole. L'enflure de l'articulation et l'évaluation de la boiterie ont été réalisées au jour 2, 4, et 7 post-échantillonnage. Au jour 7, les porcs ont été euthanasiés et la synoviale prélevée de chaque articulation échantillonnée pour évaluation histologique.

Résultats: Les traitements TKX et TAL étaient les seules combinaisons d'anesthétiques qui fournissaient une profondeur d'anesthésie adéquate pour effectuer les prélèvements de liquide. Le temps moyen ± l'écart-type pour atteindre le décubitus sternal pour TKX était de 125 ± 26 min et pour TAL il était de 198 ± 28 min. Aucune évidence d'infection post-aspiration ne fut notée dans toutes les articulations échantillonnées.

Implication: Le traitement TKX était le protocole d'anesthésie le plus efficace pour le prélèvement ante-mortem de liquide articulaire. Le prélèvement ante-mortem de liquide articulaire n'était pas associé avec du dommage tissulaire significatif dans les articulations et peut être un outil diagnostique utile lors d'arthrite infectieuse.

Infectious arthritis in swine is an important cause of lameness in growing pigs.[1] Infectious lameness diagnosis in pigs can be difficult due to the transient nature of joint pathogens. Diagnostic investigations generally involve post-mortem samples, substantially limiting the specimens that are available to submit for testing. An ante-mortem joint fluid collection technique would offer practitioners additional flexibility to collect diagnostic samples without having to sacrifice animals. A challenge of this technique is achieving a sufficient plane of anesthesia for the procedure in the field. Although there are published recommendations for injectable anesthesia for pigs, these references typically do not state the protocol effectiveness for specific procedures, such as percutaneous joint fluid aspiration.[2-5] Additionally, to the knowledge of the authors, there are no peer-reviewed reports on the impact of ante-mortem joint fluid collection on lameness and synovial damage post-procedure.

The primary objective of this study was to compare four anesthetic protocols for ante-mortem percutaneous synovial fluid aspiration from healthy swine in field conditions. The protocols were evaluated in terms of successful anesthesia, time to recovery, and protocol cost. The secondary objective was to assess the iatrogenic impact of ante-mortem joint fluid collection by monitoring lameness and joint swelling for 7 days post treatment and assessing histology at day seven.

Materials and methods

The trial was approved through the Iowa State University Institutional Animal Care and Use Committee.

Animals, housing, feed, and water

Prior to the initiation of the trial, pigs were housed in pens with partially slatted flooring in groups of 15 to 20 in a feeder-to-finisher barn with a total group size of approximately 200. At selection for the trial, 80- to 90-kg pigs were moved from group housing to individual pens for the procedures described below. Pigs were first assessed while standing and observed while walking to ensure they did not display lameness or swollen joints. Pigs were given a physical exam by a veterinarian, which included joint palpation, and only pigs free of clinical signs of illness, such as coughing, diarrhea, and lameness, were included in the trial.

All pigs were provided ad libitum access to a commercial finisher feed without antibiotics for the duration of the trial and had ad libitum access to water. The diets met the National Research Council requirements for swine.[6] Neither feed nor water was withheld from pigs prior to anesthesia.

Treatment allocation

There were 24 pigs in this trial and the group was a mix of barrows and gilts. After selection, pigs were weighed, ear-tagged, and each was randomly allocated, using a random number table, to one of four anesthetic protocols: telazol-ketamine-xylazine (TKX); telazol-ketamine-acepromazine(TKA); telazol-acepromazine with lidocaine epidural (TAL); or ketamine-acepromazine with lidocaine epidural (KAL). Generally, for each protocol, an initial minimum dose was given and then additional step-dosing was done until anesthesia was sufficient for the procedure or until the a priori maximum dose was achieved within 1.5 hours of the initial dose. If the maximum dose was achieved and an insufficient plane of anesthesia was attained for joint fluid collection, the pig was not given any more anesthetic agents and was monitored until recovery. Pigs receiving the TKX treatment were given an initial intramuscular (IM) injection of 4.4 mg/kg telazol (tiletamine HCl and zolazepam HCl injection; Zoetis, Kalamazoo, Michigan), 2.2 mg/kg ketamine (Zoetis) and 4.4 mg/kg xylazine (VetOne, Boise, Idaho) combined

in the same syringe[3,5] with a maximum cumulative dose of 4.4 mg/kg of ketamine and 8.8 mg/kg each of xylazine and telazol.

Pigs receiving the TKA treatment were given an initial IM injection of 0.03 mg/kg acepromazine (VetOne, Boise, Idaho), 2.2 mg/kg of ketamine, and 4.4 mg/kg telazol combined in the same syringe[3] with a maximum cumulative dose of 10 mg/kg telazol, 0.07 mg/kg acepromazine, and 5 mg/kg of ketamine.

Pigs receiving the TAL treatment were given an initial IM injection of 0.3 mg/kg acepromazine and 4.4 mg/kg telazol in the same syringe[2,3] with a maximum of 0.5 mg/kg acepromazine and 11 mg/kg telazol until the pig was in a suitable anesthetic plane to administer a lumbosacral epidural. The lumbosacral epidural consisted of 2% lidocaine (MWI, Boise, Idaho) dosed at 2.2 mg/kg, up to a maximum of 10 mL/pig.

Pigs receiving the KAL treatment were given an initial IM injection of 0.5 mg/kg acepromazine and 5 mg/kg ketamine mixed in the same syringe[3,4] with a maximum 1.2 mg/kg acepromazine and 33 mg/kg ketamine until a suitable anesthetic plane was achieved to administer epidural anesthesia.[2,7] The lumbosacral epidural consisted of 2% lidocaine dosed at 2.2 mg/kg, up to a maximum of 10 mL/pig.

Between 5 and 10 minutes after the initial IM injection, pigs were assessed for sedation depth, which was based on their behavior and reflex responses. To be considered eligible for the joint fluid collection procedure (sufficient anesthesia), the pig must have been recumbent, with a negative palpebral response and negative toe withdrawal response. If these criteria were not met or the pig reacted to the needle insertion in the joint, then an additional dose of the applicable treatment protocol was administered. At this time, if the pig was recumbent and unconscious, then the second dose of the anesthetic combination given was half of the initial doses described above. However, if the pig was conscious and ambulatory after the initial dose, the full initial dose was repeated. The animal was then left alone with minimal background noise and was reassessed 5 to 15 minutes later. This process was repeated until a suitable depth was attained or the maximum dose was administered. Under these dosing parameters, a pig could be re-dosed without reaching the maximum dose limit.

Placement of epidural

For the TAL and KAL treatment groups, a lumbosacral epidural was placed using an 18G by 8.9-cm spinal needle (BD, Franklin Lakes, New Jersey) as previously described.[3,8,9] Briefly, a 25 cm × 25 cm section on midline at the cranial aspect of the tuber coxae was shaved and aseptically prepared for the epidural. After shaving, the surgical preparation consisted of three steps: a chlorhexidine soap scrub, an alcohol scrub, and a final surgical preparation with tincture of chlorhexidine. Steps one and two were repeated three times. To administer the epidural, a veterinarian wore sterile gloves and inserted the epidural needle into the intervertebral disc space between lumbar vertebra six and sacral vertebra one. Lidocaine was injected into the spinal canal as previously reported.[3,8,9]

Synovial fluid collection

Under anesthesia, pigs were positioned in dorsal recumbency. One tarsus (all groups) and one carpus (TKX and TKA treatment groups only) were selected for sampling. An aseptic preparation, as previously described for epidural injection, was performed on the joints prior to sampling. Sterile 18G by 3.8-cm needles (Monoject BD Bioscience, San Jose, California) with 12-mL syringes (Monoject BD Bioscience) were used for the joint fluid aspirations. Sterile gloves and coveralls were worn.

If a needle was inserted into the joint, whether or not fluid was successfully collected, it was recorded and that joint subsequently monitored.

Anesthesia monitoring

From the initial IM injection onwards, pigs were monitored closely until recovery. Heart rate, respiratory rate, rectal temperature, and depth of sedation were monitored at least every 15 minutes until the joint aspiration was performed, then monitoring changed to every 30 minutes. Heart rate was assessed using thoracic auscultation and respiration rate was counted by observing the rib cage expansion and contraction. Rectal temperature was measured with a digital thermometer. Once the pig was in sternal recumbency, vital parameters were recorded hourly and the pig was assessed visually approximately every 30 minutes until it was ambulatory.

During the anesthesia and recovery process, the following data points were recorded: if sufficient plane was achieved for joint fluid aspiration (yes or no), time to joint sampling from first anesthesia injection, and time to sternal recumbency and ambulation for pigs that reached a sufficient anesthesia plane for sampling. Once pigs were fully recovered from anesthesia, the pigs were returned to their original group pens.

Post-procedure observation procedures

After pigs recovered and were ambulatory, they were scored for lameness and joint swelling. On days two, four, and seven post joint aspiration, pigs were re-assessed for lameness and joint swelling.

Lameness scoring. The gait scoring scale used was from a previously published scoring rubric.[10] Pigs were given a lameness score from zero to 5 and pigs were evaluated while standing and then while ambulating only. The modification in the scoring system used was that pigs were not evaluated with respect to response to human presence, opening of gate, or interactions with pen mates.

Joint enlargement and swelling scoring. Joint swelling scoring was performed as previously described: score 0 was no or slight joint swelling; score 1 was soft, non-warm swelling of the joint; score 2 was marked soft, fluctuating enlargement of the joint and surroundings; and score 3 was a firm and warm periarticular swelling.[11] Pigs were assessed visually and joints were palpated before assigning a score. The same individuals performed the joint and lameness scoring for all days of the trial and these individuals were not blinded to treatment allocation.

Necropsy and sample collection. Seven days after the joint fluid collection all animals were humanely euthanized for necropsy using penetrating captive bolt and exsanguination. At necropsy, all carpus and tarsus joints in which a needle had penetrated were examined. The articular cartilage, synovial fluid, and synovial tissue were assessed grossly, with abnormalities documented. Additional synovial tissue from each joint was collected and placed in 10% buffered formalin for histological evaluation. A systematic evaluation of the internal organs and other appendicular joints was performed.

Synovial tissue scoring. A board-certified veterinary pathologist who was blinded to treatment allocation conducted the synovial tissue sample evaluation using a scoring rubric modified from Hagedorn-Olsen et al[12] and published in Gomes-Neto et al.[13] The score for each category was summed to create a composite score ranging from 0 to 15. The scoring rubric encompassed two categories: first, categories that indicate active infectious processes such as neutrophils, fibrin, and hemorrhage were scored, and second, categories such as synovial proliferation or

alterations, which encompassed noninfectious and chronic joint changes were scored.

Statistical analysis

Descriptive statistics were prepared using SAS Version 9.1 (SAS Institute, Cary, North Carolina).

Results

Anesthesia protocols

In Table 1, an anesthetic protocol comparison is presented in terms of successfully producing anesthesia to allow for joint aspiration, anesthetic protocol costs, and recovery time. All treatment groups contained at least two pigs that required additional dosing beyond the initial dose. All pigs in the TKX and TAL treatment groups reached a sufficient anesthesia plane to allow joint aspiration. The recovery time for all protocols was over 3 hours. For the KAL treatment group, the first three pigs anesthetized received the maximum IM dose without reaching a sufficient anesthetic plane to place an epidural or conduct a joint aspiration. As such, the authors opted to remove the remaining three pigs from the KAL group in lieu of dosing them.

In the TKA treatment group, pig 185 died after reaching sternal recumbency and attempting to stand during the recovery process. Post-mortem evaluation revealed pulmonary congestion affecting both lungs and grossly enlarged heart with ventricular dilation. During the monitoring process, pig 185 had a numerically greater heart rate and respiration rate than its cohorts (Table 2).

The heart rate, respiratory rate, and rectal temperature of the pigs were measured regularly until the pigs were able to stand and the mean and range of each parameter is presented in Table 2. Several pigs required rewarming with blankets as their rectal temperature fell below 37°C.

Lameness and joint swelling

All pigs had a lameness score of 0 on days 0, 2, 4, and 7. One pig from the TKX treatment group had mild joint swelling (score 1) on the right carpus on day 4, which had been sampled on day 0. This swelling decreased to score 0 by day 7. A second pig from the same group had a score 1 on day 2 on the left tarsus, which was sampled previously. The score decreased to 0 on days 4 and 7 during the monitoring period. All other pigs received a joint swelling score of zero on both joints for the duration of the 7-day monitoring period.

Synovial histology

The synovium histology scoring indicated that all joints received a score of zero on all three categories related to acute inflammation: neutrophils, fibrin, and hemorrhage. The synovial fluid and synovium from these joints were grossly within expected values for a normal joint. There were four tarsus joints, two from the TKX and two from the TAL treatment groups, in which there were mild, non-specific changes to the synovium suggestive of a chronic, non-infectious process in the joint. Their cumulative synovium score ranged between 3 to 6 out of a maximum possible score of 15.

Discussion

Telazol, ketamine, and xylazine was the only treatment protocol that was consistently suitable for collection of joint fluid from market-sized pigs. The anesthesia depth produced by the other protocols was insufficient to inhibit the foot withdrawal reflex, facilitate epidural placement, or, in some cases,

Table 1: Comparison of four anesthetic protocols with respect to cost, procedure success, and recovery times in 80- to 90-kg grow-finish swine

Group information for all pigs	TKX	KAL	TAL	TKA
No. of pigs	6	3*	6	6
Mean BW (SD), kg	83.1 (12.7)	92.1 (2.7)	82.2 (6.4)	90.1 (10.7)
No. of animals for which sufficient surgical plane was achieved to allow for joint aspiration (%)	6 (100)	1 (33)†	6 (100)	2 (33)†
No. of pigs requiring at least one additional dose (%)	2 (33)	3 (100)	3 (50)	6 (100)
No. of pigs that reached maximum dosage (%)	0 (0)	3 (100)	0 (0)	2 (33)
Mean cost of anesthesia protocol (SD), USD	24.98 (4.16)	22.37 (0.82)	38.96 (4.65)	50.99 (3.65)
Procedure and recovery time for pigs that reached sufficient surgical plane for joint aspiration				
Mean time to joint aspiration from first injection in minutes (SD)‡	13 (9)	74 (NA§)	40 (7)	82 (2)
Mean time to sternal recumbency in minutes (SD)‡	125 (26)	151 (NA§)	198 (28)	363 (258)
Mean time to ambulatory in minutes (SD)‡	266 (73)	317 (NA§)	378 (79)	267¶

* As the first three pigs anesthetized did not reach a sufficient plane to place an epidural or conduct joint aspiration, the remaining three pigs in the group were not dosed and were removed from the study.
† In one pig, the joint was sampled but fluid was not collected.
‡ For pigs that reached sufficient surgical plane for sampling.
§ In the KAL treatment group, there was only one pig that appeared to reach sufficient anesthetic plane for joint aspiration, thus a standard deviation could not be calculated for the recovery time measurements.
¶ One pig died after achieving sternal recumbency.
TKX= telazol, ketamine, and xylazine; KAL= ketamine and acepromazine with lidocaine epidural; TAL= telazol and acepromazine with lidocaine epidural; TKA= telazol, ketamine, and acepromazine; BW = body weight; SD = standard deviation; NA = not applicable.

Table 2: Mean, minimum, and maximum heart rate, respiratory rate, and rectal temperature of 80- to 90-kg grow-finish pigs each treated with one of four injectable anesthetic protocols*

Pig no.	Heart rate (beats/min)			Respiratory rate (breaths/min)			Rectal temperature (°C)		
	Mean	Low	High	Mean	Low	High	Mean	Low	High
TKX treatment									
178	116	104	140	34	28	44	38.9	38.0	39.9
179	98	88	128	43	24	60	38.7	37.8	39.5
180	111	90	140	39	28	52	39.1	38.5	39.7
181	101	80	120	38	24	52	38.1	37.3	38.9
182	96	84	112	41	20	76	38.2	37.5	39.6
183	82	64	100	50	32	80	37.7	36.7	38.6
KAL treatment									
190	115	68	148	35	24	48	38.2	37.6	39.0
191	117	72	148	45	44	48	37.3	36.6	38.3
192	89	52	128	34	28	44	37.4	36.4	38.4
TAL treatment									
193	121	96	160	40	28	52	36.7	35.9	38.9
194	109	64	140	41	28	64	37.9	36.7	39.6
195	119	104	132	44	24	76	37.3	36.6	39.2
196	108	72	120	34	20	48	36.6	36.0	37.7
197	122	72	160	57	40	80	37.8	36.2	39.4
198	90	72	108	37	28	60	36.7	35.2	38.8
TKA treatment									
184	105	56	128	30	28	40	37.9	36.8	39.0
185†	160	120	200	55	36	84	38.2	37.0	39.3
186	122	60	160	39	24	60	38.2	37.5	39.1
187	96	78	116	53	36	78	38.0	36.6	39.6
188	100	80	140	29	18	44	38.2	37.4	39.5
189	100	80	120	42	36	44	37.3	36.5	38.5

* Each parameter was measured until pigs were able to stand.
† Pig number 185 died before it was observed to have stood.
TKX = telazol, ketamine, and xylazine; KAL = ketamine and acepromazine with lidocaine epidural; TAL= telazol and acepromazine with lidocaine epidural; TKA = telazol, ketamine, and acepromazine; min = minute.

achieve unconsciousness. None of the pigs in this study were lame post procedure, nor was there iatrogenic infectious arthritis evidence identified in any treatment pigs.

There are several resources available to practitioners that recommend drug combinations, drug dosages, and practical tips for in-field anesthesia.[2-5,7,14] These resources provide general descriptions for the duration of effect, contraindications, adverse effects, and pharmacology. Absent from these resources is an evaluation of the utility for a particular protocol and procedure in a specific age of pig. Without this information, there is increased reliance on practical experience in lieu of evidence-based medicine for anesthetic protocol selection for use in field situations and settings.

Additional considerations for field applications of the TKX protocol are that the duration of xylazine is relatively short (10 to 30 minutes) and xylazine's analgesic, sedative, and muscle relaxation effects are critical to balance the muscle spasticity and rigidity associated with ketamine in combination protocols.[3,8,15,16] Thus, there is a short window for optimal joint aspiration procedure using the TKX protocol, and the practitioner needs to monitor the animal closely so as to not inadvertently miss this window and require re-dosing, particularly if sampling more than one pig simultaneously. Performing a foot withdrawal test using a needle is an easy and non-invasive method to assess the withdrawal reflex and suitability for joint aspiration.

During substantial recovery times as observed in this study, the potential exists for physiological complications which neccesitates active monitoring and veterinary management. Recovery time typically decreases in smaller (young) pigs due to different body composition and metabolism rate. For ex-

ample, in two studies on telazol and xylazine in 37-kg crossbred pigs using similar parameters to this study, the pigs reached sternal recumbency in 76 to 98 minutes and were standing at 100 to 130 minutes post initial injection.[14,17] However, these studies did not use ketamine with telazol and xylazine, thus direct recovery time comparisons cannot be made to the recovery times published in the present study.

Epidural placement was successful in the pigs in the TAL treatment group but required additional equipment and technical skill beyond the joint aspiration. Compared to the TKX treatment group, there was a great delay between initial IM injection and joint fluid collection and ultimately, recovery. Despite this, epidurals in swine may be useful for other procedures such as scrotal and inguinal hernia repair.[18]

From the post-mortem findings and elevated vital parameters while under anesthesia, it is believed that pig 185 experienced cardiac or respiratory complications that lead to its death. In this study and in the field setting, it would be difficult to screen pigs for pre-existing conditions beyond a visual examination and thoracic auscultation. Since pigs have a relatively small lung capacity compared to horses and companion animals, knowledge of pre-existing conditions, such as previous bouts of pneumonia, would be important when selecting good candidates for anesthesia and subsequent ante-mortem joint aspirations.[8] Additionally, pig 185 was in the TKA treatment group which received a larger dose of acepromazine than other groups. Acepromazine is known for its hypotensive effects that may have negatively affected cardiac output in this pig.[19] For this reason, in addition to recovery time, it is not advised that practitioners use TKA in the field for market weight hogs.

The mean values for individual pig heart rate, respiratory rate, and temperature were generally elevated compared to normal values for finisher pigs reported in Anderson and St Jean.[3] As well, within each of the treatment groups, there was variability in vital parameters between individual pigs, at least under the conditions presented in the current study. For example, mean heart rate in the TKX treatment group ranged between 82 and 116. Information about normal vital parameters for commercial pigs in field conditions is limited. Published values for vital parameter information under specific anesthetic regimes in the field are not available. Thus, Table 2 provides information for practitioners on the vital parameter values and variability they may encounter while performing field anesthesia in finisher pigs.

This report emphasizes the use of tools readily available to practitioners in the field to monitor vital parameters. This is unique from other anesthetic evaluation and comparison studies in which there is additional monitoring performed including blood pressure, arterial blood gases, and blood biochemistry.[14,17,20] In those studies, expanded monitoring was critical to collect the data required to compare the physiological effects when different protocols are utilized which served as the primary objective of the research. The present study focused on the ability of anesthetic protocols to provide appropriate conditions for efficacious completion of a diagnostic task.

The TKX protocol performed well during this ante-mortem procedure and allowed for successful joint fluid collection and prompt recovery post procedure. An anesthetic protocol for ante-mortem joint aspiration that is applicable to commercial settings and cost effective is a valuable tool to practitioners for diagnostic lameness investigations. The ante-mortem technique allows practitioners to increase their diagnostic sample size, and monitor treatment success in sampled pigs, and can complement post-mortem examinations in affected herds. Veterinary practitioners must carefully consider the local, state, and federal regulatory consequences and current rules or guidance before utilizing any anesthetic protocol in the field. Guidelines for extra-label use of medications in animals and guidance specific to the use of anesthetic agents in food animals are available from the Federal Drug Administration (United States) and Health Canada (Canada). Additionally there are online food animal database avoidance services in the United States (`http://www.farad.org`) and Canada (`https://cgfarad.usask.ca/`) which fulfill withdrawal time requests from practitioners for individual cases and specific drug regimens.

Implications

- The TKX treatment was the best overall anesthetic protocol for ante-mortem joint fluid collection in this trial. Based on the findings from this trial, with a limited sample size, these dosing guidelines worked well to facilitate successful joint fluid collection: an initial IM injection of 4.4 mg/kg telazol (tiletamine HCl and zolazepam HCl injection), 2.2 mg/kg ketamine, and 4.4 mg/kg xylazine combined in the same syringe with a maximum cumulative dose of 4.4 mg/kg of ketamine and 8.8 mg/kg each of xylazine and telazol. If the pig is recumbent and unconscious after the initial dose of TKX but still has a palpebral or toe withdrawal response, an additional dose of half of the initial dose worked well in this trial to attain the sufficient depth.
- Veterinary practitioners must consider the local, state and federal regulatory consequences and current rules or guidance before utilizing any anesthetic protocol in the field.
- Ante-mortem joint fluid collection was not associated with significant joint tissue damage and is therefore potentially a useful diagnostic tool for infectious arthritis in pigs.

Acknowledgments

Thank you to Iowa State University Swine Nutrition Farm staff for their assistance, especially Trey Faaborg and Tim Hicks. Thank you to the Swine Medicine Education Center (SMEC) summer interns, Megan Nickel and Rochelle Warner, for their help with the live animal work. We sincerely appreciate the efforts of SMEC veterinarians Justin Brown and Anna Forseth who were instrumental in monitoring the animals. National Pork Board, Iowa Pork Producers Association and PIC provided funding for this project.

Conflict of interest

None reported.

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References

1. Gomes Neto JC, Gauger PC, Strait EL, Boyes N, Madson DM, Schwartz KJ. Mycoplasma-associated arthritis: Critical points for diagnosis. *J Swine Health Prod*. 2012;20(2):82-86.

2. Swindle MM, Sistino JJ. Anesthesia, analgesia, and perioperative care. In: Swindle MM, Smith AC, eds. *Swine in the Laboratory*. 3rd ed. Boca Raton, Florida: CRC Press; 2015:39-88.

3. Anderson DE, St Jean G. Anesthesia and surgical procedures in swine. In: Zimmerman J, Karriker L, Ramirez A, Schwartz K, Stevensen G, eds. *Diseases of Swine*. 10th ed. Ames, IA: Wiley-Blackwell, 2012;119-126.

4. Hodgkinson O. Practical sedation and anaesthesia in pigs. *In Prac.* 2007;29:34-39.

5. Thomas JA, Lerche P. *Anesthesia and Analgesia for Veterinary Technicians*. 5th ed. Missouri: Elsevier; 2017.

6. Nutrient requirements of swine: 11th revised ed. Washington, DC: The National Academies Press; 2012:420.

*7. Moon PF, Smith LJ. General Anesthetic Techniques in Swine. *Vet Clin North Am Food Anim Pract.* 1996;12:663-691.

8. Ames NK. *Noordsy's Food Animal Surgery*. 5th ed. Ames, Iowa: Wiley Blackwell; 2014.

9. Swindle MM. Head and Neck Surgery/Central Nervous System. In: Swindle MM, Smith AC, eds. *Swine in the Laboratory*. 3rd ed. Boca Raton, Florida: CRC Press; 2015:283-316.

10. Main D, Clegg J, Spatz A, Green L. Repeatability of a lameness scoring system for finishing pigs. *Vet Rec.* 2000;147:574-576.

11. Nieslen E. *Lameness in swine: a field study of etiology and epidemiology of lameness in swine – with special reference to* Mycoplasma hyosynoviae *infections in growing-finishing pigs* [dissertation]. Copenhagen, Denmark: Royal Veterinary and Agricultural University, University of Copenhagen; 2000;173.

12. Hagedorn-Olsen T, Basse A, Jensen TK, Nielsen, N. Gross and histopathological findings in synovial membranes of pigs with experimentally induced *Mycoplasma hyosynoviae* arthritis. *APMIS*. 1999;107:201-210.

13. Gomes-Neto JC, Raymond M, Bower L, Ramirez A, Madson DM, Strait EL, Rosey EL, Rapp-Gabrielson VJ. Two clinical isolates of *Mycoplasma hyosynoviae* show differing pattern of lameness and pathogen detection in experimentally challenged pigs. *J Vet Sci.* 2016;17:489-496.

14. Lee JY, Jee HC, Jeong SM, Park C, Kim M. Comparison of anaesthetic and cardiorespiratory effects of xylazine or medetomidine in combination with tiletamine/zolazepam in pigs. *Vet Rec.* 2010;167:245-249.

15. Papich MG. Xylazine Hydrochloride. In: Papich MG. *Saunders Handbook of Veterinary Drugs*. 4th ed. St Louis: W.B. Saunders. 2016;850-852.

16. Papich MG. Ketamine Hydrochloride. In: Papich MG. *Saunders Handbook of Veterinary Drugs*. 4th ed. St Louis: W. B. Saunders, 2016;427-430.

17. Kim MJ, Park CS, Jun MH, Kim M. Antagonistic effects of yohimbine in pigs anaesthetised with tiletamine/zolazepam and xylazine. *Vet Rec.* 2007;161:620-624.

18. Ekstrand C, Sterning M, Bohman L, Edner A. Lumbo-sacral epidural anaesthesia as a complement to dissociative anaesthesia during scrotal herniorrhaphy of livestock pigs in the field. *Acta Vet Scand.* 2015;57:33.

19. Papich MG. Acepromazine Maleate. In: Papich MG. *Saunders Handbook of Veterinary Drugs* 4th ed. St Louis: W. B. Saunders. 2016;13.

20. Lu DZ, Fan HG, Wang HB, Hu K, Zhang J, Yu S. Effect of the addition of tramadol to a combination of tiletamine-zolazepam and xylazine for anaesthesia of miniature pigs. *Vet Rec.* 2010;167:489-492.

*Non-refereed reference.

Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.4
1 lb (16 oz)	453.59 g	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)	0.31 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
1 gal (128 fl oz)	3.8 L	gal to L	3.8
0.264 gal	1 L	L to gal	0.26
1 qt (32 fl oz)	946.36 mL	qt to L	0.95
33.815 fl oz	1 L	L to qt	1.1

Temperature equivalents (approx)

°F	°C
32	0
50	10
60	15.5
61	16
65	18.3
70	21.1
75	23.8
80	26.6
82	28
85	29.4
90	32.2
102	38.8
103	39.4
104	40.0
105	40.5
106	41.1
212	100

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

Conversion chart, kg to lb (approx)

Pig size	Lb	Kg
Birth	3.3-4.4	1.5-2.0
Weaning	7.7	3.5
	11	5
	22	10
Nursery	33	15
	44	20
	55	25
	66	30
Grower	99	45
	110	50
	132	60
Finisher	198	90
	220	100
	231	105
	242	110
	253	115
Sow	300	135
	661	300
Boar	794	360
	800	363

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

Peer reviewed

Brief communication

Management of ear hematomas in pigs

Cate Dewey, DVM, MSc, PhD; Janet Sunstrum, DVM; Karen Richardson

Summary

This study compared two treatment options to manage ear hematomas and measured impact of hematomas on growth rate. Incised ears were more likely to become infected than those not incised but did not differ in time to resolution of the hematoma. Pigs with hematomas grew slower than those without hematomas.

Keywords: swine, ear, aural, hematoma, treatment

Received: February 15, 2017
Accepted: December 5, 2017

Resumen – Tratamiento de hematomas de oreja en cerdos

Este estudio comparó dos opciones de tratamiento para manejar hematomas de oreja y medir el impacto de los hematomas en el índice de crecimiento. Las orejas cortadas fueron más propensas a infectarse que las nos cortadas pero no difirieron en el tiempo de resolución del hematoma. Los cerdos con hematomas crecieron más lento que los que no tuvieron hematomas.

Résumé – Gestion des hématomes d'oreille chez les porcs

La présente étude visait à comparer deux options de traitement pour la gestion des hématomes d'oreille et à mesurer l'impact des hématomes sur le taux de croissance. Des oreilles incisées étaient plus susceptibles de s'infecter que celles non-incisées mais il n'y avait pas de différence dans le temps pour la résolution des hématomes. Les porcs avec des hématomes avaient une croissance ralentie comparativement à ceux sans hématome.

Aural (ear) hematomas occur due to the rupture of blood vessels resulting in a collection of blood predominantly in the subperichondral region of the cartilage within the pinna.[1] Rupture of the blood vessels within the cartilage is typically due to physical trauma from violent shaking of the ear in response to sarcoptic mange or pediculosis, bites on the ears from other pigs, necrotic ear syndrome, from handling the pig by the ear, or injuries on barn equipment.[2] If left untreated, a hematoma will resolve without any intervention; however, this can take several weeks and the hematoma may be of sufficient size as to reduce feed intake.[1] To the authors' knowledge, no research has been published that describes the best methods to treat hematomas as a means to optimize resolution of the hematoma and the growth rate of the pig.

In pot-bellied pigs, treatment options include leaving the hematoma alone to spontaneously open and drain, inserting an indwelling plastic teat tube, or surgical incision into the most fluctuant area of the hematoma.[3] Similar to pot-bellied pigs, dogs can also develop ear hematomas and several treatment options are available. In dogs, treatment involves either medical management with corticosteroids, with or without concurrent draining of the hematoma, or surgical intervention.[4] Surgical intervention most commonly involves either placement of a teat cannula, a closed suction drain, or an incision into the pinna to drain the hematoma and full thickness mattress sutures to compress the cavity.[5] At least one source recommends that hematomas in commercial pigs be surgically repaired in a similar manner.[2] The objectives of this study were to evaluate the impact of surgical intervention of the ear hematoma on resolution time; infection rate and severity; and growth rate 3 weeks post intervention.

Materials and methods

The protocol for this study was approved by the University of Guelph Animal Care Committee.

A convenience sample of four swine farms was selected to participate in this study. Farms were visited on a weekly basis for 7 to 18 weeks. During this time, all nursery pigs with ear hematomas were enrolled in the study and matched to negative-control pigs with similar weights. Pigs with hematomas were randomly assigned to one of two treatments: surgical incision or no intervention (positive control). On each farm, systematic random sampling was used such that the first three pigs identified with hematomas were randomly assigned to the surgical-incision group or positive-control group so that within each block of three pigs there were two in the surgically-incised group and one in the positive-control group. More pigs (66%) were assigned to the surgical-incision group because that was identified as the optimal treatment according to reference textbooks.[2,6] Subsequent blocks of three pigs were assigned to groups in the same pattern as that of the first block. Pigs in the surgically-incised group had the skin of the ear incised to release the blood, but in the positive-control group the pig's ear was left untreated. A uniquely numbered ear tag was put in the healthy ear. Upon enrollment, pigs were weighed and assigned swelling and infection scores. They were re-weighed and re-examined weekly for 3 weeks post identification. Swelling was scored on a scale of 0 to 4 where 0 indicated little to no swelling, 1 indicated slight swelling, 2 indicated moderate swelling, 3 indicated severe swelling, and 4 indicated swelling extended as much as the skin would accommodate (Figure 1). The hematoma was considered resolved if the swelling score was < 1 following the first, second, or third week after the pig entered the

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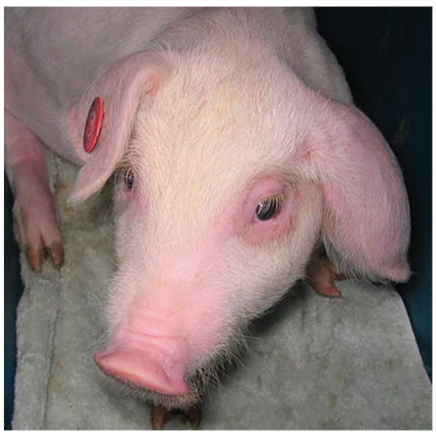
This article is available online at http://www.aasv.org/shap.html.

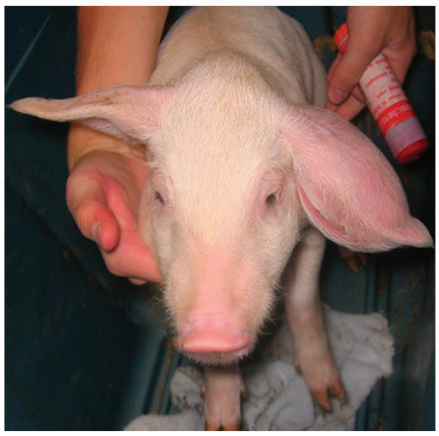
Dewey C, Sunstrum J, Richardson K. Management of ear hematomas in pigs. *J Swine Health Prod.* 2018;26(3):137-141.

Figure 1: Examples of swelling scores from 1-4 and a pig with a resolved hematoma.

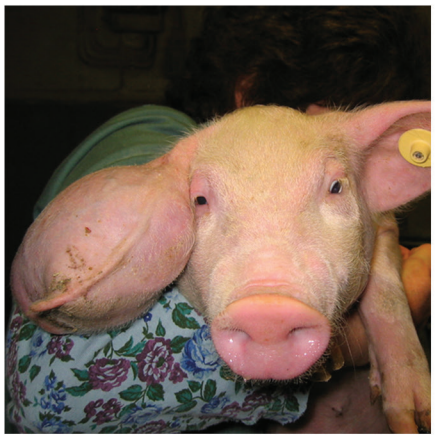
1: Slight swelling



2: Moderate swelling



3: Severe swelling



4: Expanded to fullest capacity

Resolved hematoma, ear is flat with scarring

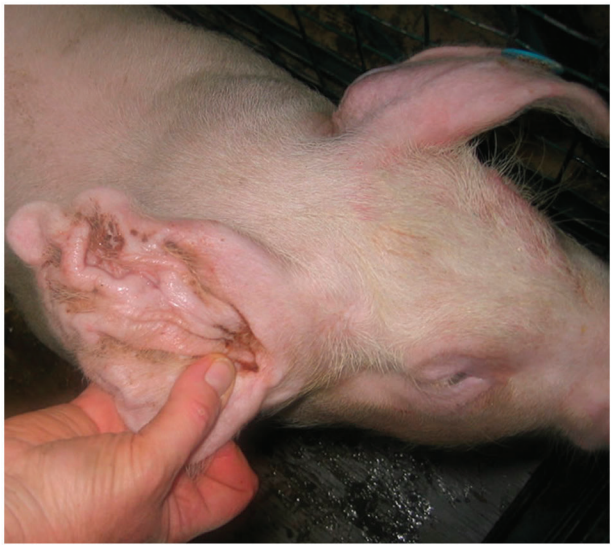
study. Infection was scored on a scale of 0 to 4 where 0 indicated no exudate, 1 indicated clear exudate, 2 indicated redness with clear or white exudate, 3 indicated a small amount of purulent exudate, and 4 indicated copious amounts of purulent exudate, redness, and swelling (Figure 2). On each farm, two pigs with approximately the same weight and in the same pen as the pig with the hematoma were selected for the negative-control group. These pigs were ear tagged and weighed upon enrollment and then weekly for 3 subsequent weeks. All pigs remained in their home pen as was the management practice of the farms included in the study.

Pigs in the negative-control group were removed prior to the analyses of the study if the weight upon enrollment differed from that of the matched pig (with the hematoma) by more than 1 kg. Pigs in the surgically-incised and positive-control groups were removed prior to the analyses if they did not have at least one weight-matched negative-control pig or if they died prior to being weighed 3 weeks after enrollment. There were 77, 47, and 213 pigs in the surgically-incised, positive-control, and negative-control groups respectively. A Wilcoxin rank sum test was used to compare the proportion of pigs whose hematomas were resolved by week between surgically-incised and positive-control groups. A Wilcoxin rank sum test was also used to compare the proportion of pigs with ear infections and the extent of the ear infection by week between surgically-incised and positive-control groups. The weight of the pig at each week was compared among treatment groups using an ANOVA after controlling for the farm of origin. The average daily gain (ADG) was calculated for the first-, second-, and third-week weights after the pigs were enrolled in the study. An ANOVA was used to determine the association between weekly ADG, the presence of a hematoma, and the treatment group after controlling for the weight of the pig at the start of the time period and the farm of origin. All weights and ADG were presented as least squares means after controlling for farm of origin. These statistics were calculated using Statistix version 9 software (Analytical Software, Tallahassee, Florida).

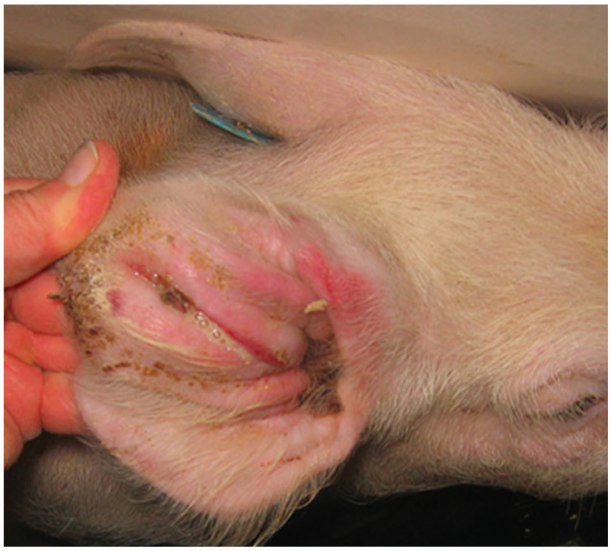
Results

The average weight of the pigs enrolled in the study did not differ by group ($P > .05$). At enrollment, pigs in the surgically-incised, positive- and negative-control groups weighed 11.58, 11.04, and 11.21 kg respectively (Table 1). Pigs in the surgically-incised group had a lower ADG in the first and

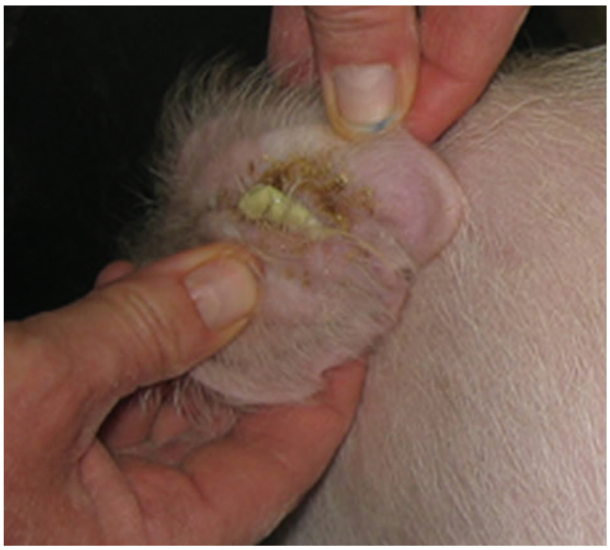
Figure 2: Examples of infection scores from 1-4 with 4 being the most infected.



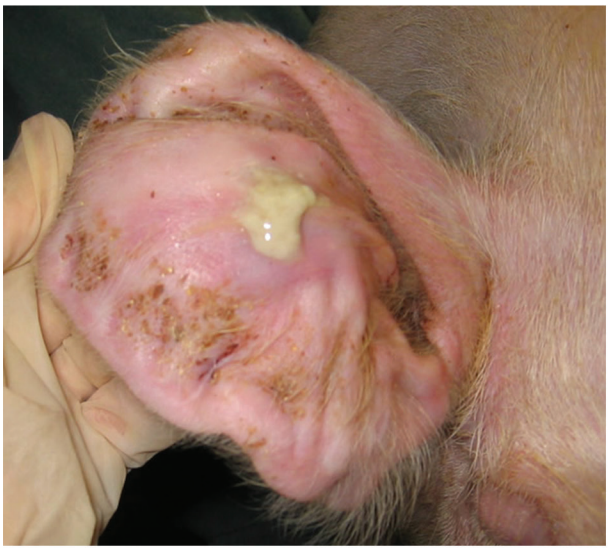
1: Clear exudate



2: Red, inflamed ear with clear-to-white exudate



3: Small amount of purulent exudate with little to no swelling



4: Copious amounts of purulent exudate, red and swollen ear

second week after incising the hematoma than did pigs in the negative-control group ($P < .01$). Pigs in the surgically-incised group had a lower ADG in the first and second week after treatment than did the pigs in the positive-control group ($P = .01$). The ADG of pigs with hematomas did not differ from that of pigs without hematomas in the third week after enrollment. The ADG of pigs from enrollment until week 3 in the surgically-incised group was lower than that of the positive- and negative-control groups ($P < .01$). However, the increase in the ADG from the first week of the study to the last week of the study was larger in the surgically-incised group than in the other two groups, indicating that there was compensatory gain in the pigs in the treatment group ($P = .001$) (Table 1).

Pigs in the surgically-incised group were more likely to have infections and were more likely to have more severe infections in weeks 1, 2, and 3 after incising the ear than pigs in the positive-control group ($P < .01$) (Table 2). There were 47 pigs (61%) in the surgically-incised group whose ears became infected following treatment, whereas only three pigs (1.5%) in the positive-control group had infected ears. In the surgically-incised group, 14, seven, and three pigs had maximum infection scores with a severity of 2, 3, and 4, respectively, whereas only one pig

Table 1: Weight and average daily gain of pigs enrolled in a clinical trial to compare treatment options for hematomas

	No hematoma (Negative control)		Hematoma not incised (Positive control)		Surgically incised		
	Mean	SE	Mean	SE	Mean	SE	*P*
Weight (kg)*							
Week 0	11.58[a]	.261	11.04[a]	.469	11.21[a]	.386	.47
Week 1	14.20[a]	.291	13.53[ab]	.532	13.17[b]	.438	.10
Week 2	17.45[a]	.336	16.25[ab]	.604	16.02[b]	.497	.02
Week 3	21.98[a]	.385	19.46[b]	.691	19.45[b]	.569	.02
ADG (kg)†							
Week 1	.42[a]	.014	.40[a]	.012	.32[b]	.019	< .001
Week 2	.51[a]	.017	.49[ab]	.026	.46[b]	.023	.018
Week 3	.51[a]	.021	.51[a]	.031	.52[a]	.027	.91
Weeks 1 to 3	.48[a]	.009	.45[ab]	.018	.43[b]	.017	.01
Increase week 1 to week 3	.13[a]	.018	.124[a]	.033	.226[b]	.027	.001

* ANOVA presenting least squares means after controlling for farm of origin.
† ANOVA presenting least squares means after controlling for farm of origin and weight of the pig at the start of the week.
[ab] Different superscripts within rows indicates significantly different mean values.
SE = standard error; ADG = average daily gain.

Table 2: Number of pigs in each swelling* and infection† score category, which was based on the ear affected by a hematoma and the week post enrollment in a clinical trial to compare treatment options for hematomas

	Hematoma not incised (Positive control)					Surgically incised				
Swelling score	0	1	2	3	4	0	1	2	3	4
Week 0	0	13	24	9	1	0	13	35	25	4
Week 1	5	20	17	2	3	14	34	26	2	1
Week 2	25	11	7	4	0	42	16	16	3	0
Week 3	34	10	3	0	0	53	19	5	0	0
Infection score	0	1	2	3	4	0	1	2	3	4
Week 0	47	0	0	0	0	77	0	0	0	0
Week 1	47	0	0	0	0	34	28	12	2	1
Week 2	44	2	1	0	0	49	18	4	4	2
Week 3	45	1	1	0	0	65	6	5	1	0

* Swelling was scored on a scale of 0 to 4: 0 = little to no swelling; 1 = slight swelling; 2 = moderate swelling; 3 = severe swelling; and 4 = extended as much as the skin would accommodate.
† Infection was scored on a scale of 0 to 4: 0 = no exudate; 1 = clear exudate; 2 = redness with clear or white exudate; 3 = small amount of purulent exudate; and 4 = copious amounts of purulent exudate with redness and swelling.

in the positive-control group reached a maximum severity score of 2 and none reached infection scores of 3 or 4. No pigs in the negative-control group had ear infections.

The proportion of pigs whose hematomas had resolved after week 1, 2, and 3 following inclusion in the study did not differ between the surgically-incised and positive-control groups. In the surgically-incised group, 18%, 55%, and 69% of pigs had resolved hematomas after weeks 1, 2, and 3, respectively. For the pigs in the positive-control group, 11%, 53%, and 72% had resolved hematomas after weeks 1, 2, and 3, respectively.

Discussion

Hematomas are a result of trauma to the ear caused by pigs being handled by the ear, injuries on barn equipment such as broken feeders, violent shaking of the head, or ear biting. Ear biting in pigs is typically a response to environmental stressors[7] such as poor ventilation, overcrowding, mixing and moving pigs, insufficient access or intermittent lack of access to feed or water.[7,8] Pigs will shake their heads in response to mange or lice infections or an ear bite that then can result in a hematoma.[9] Management practices to decrease ear biting should be implemented to decrease the prevalence of hematomas. Studies have shown a lower incidence of ear biting and aggression when pigs are provided with enrichment materials,[10] and a lower prevalence of ear lesions is associated with improved ventilation and solid flooring.[11]

The current study found that pigs with hematomas gain less weight than pigs without hematomas. Previous studies have shown that ear-bitten pigs have higher cortisol concentrations and growth rate significantly drops as cortisol levels rise.[7] Therefore, management changes to prevent ear hematomas are expected to improve ADG and subsequently improve economic returns for swine producers. Producers may consider increasing feed and water availability, reducing stocking density, reducing the number of times pigs are mixed, providing enrichment materials, such as chains to chew on, and improving air quality within the barn as potential solutions to decrease the prevalence of hematomas. These management changes are expected to decrease stress levels in pigs that will decrease ear-biting behavior and may also reduce the incidence of hematomas.

The results of this study indicate that it is preferable to leave hematomas untreated rather than incising them to release the accumulated blood. Untreated hematomas resolved at the same rate as those that were incised. However, ears that were incised were more likely to develop infections and the infections were more severe than in ears that were left untreated. Further, pigs whose ears were incised had a lower ADG in the first and second week after being enrolled than those whose ears were left untreated. Therefore, the expectation that incised ears would reduce the pain of the hematoma and therefore result in the pig eating more was not substantiated.

Implications

- Management practices to prevent hematomas should be implemented to improve swine growth rates.
- According to the results of this study, it is preferable to leave hematomas untreated rather than incising the ear, regardless of the size of the hematoma.

Acknowledgements

The authors greatly appreciate the contributions of the cooperating producers and Ontario Pork for the financial support.

Conflict of interest

None reported

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References

1. Drolet R, Hélie P, D'Allaire S. Pathology of ear hematomas in swine. *J Diag Vet Invest*. 2016;28:244-248.

2. Torres SMF. Auricular hematomas. *Merck Veterinary Manual*. 9th ed. 2005:420.

*3. Tobias K. Surgery of the Ear. *Proc Western Vet Conf*. Las Vegas, Nevada. 2012. http://www.vin.com/members/cms/project/defaultadvl.aspx?id=5603817&pid=11348. Accessed January, 27 2017.

*4. MacPhail C. Current treatment options for auricular hematomas. *Vet Clin North Am Small Anim Pract*. 2016;46:635-641.

5. George L, Van Metre D, Smith B, Angelos J, Fecteau G, Angelos S. The new pot bellied pig manual. 2012. Available at http://www.vin.com/members/cms/project/defaultadvl.aspx?id=5260945&pid=5260. Accessed January 27, 2017.

6. Straw BE. Skin. In: Leman AD, Straw BE, Mengeling WL, D'Allaire S, Taylor DJ, eds. *Diseases of Swine*. Ames, Iowa: Iowa State University Press; 1994:210.

7. Busch ME, Nielsen EO, Wachmann H, Petersen HH. Production conditions of significance for the welfare of slaughter pigs: An investigation of lameness, tail biting and ear lesions on 98 farms. *Dansk Veterinaertidsskrift*. 2003;86:32-39.

8. Smulders D, Verbeke G, Mormede P, Geers R. Validation of a behavioral observation tool to assess pig welfare. *Physiol Behav*. 2006;89:438-447.

9. Bracke MBM, Zonderland JJ, Lenskens P, Schouten WGP, Vermeer H, Spoolder HAM, Hendriks HJM, Hopster H. Formalised review of environmental enrichment for pigs in relation to political decision making. *Appl Anim Behav Sci*. 2006;98:165-182.

10. Fraser D, Broom DM. Farm animal behaviour and welfare. 3rd ed. London: Bailliére Tindall; 1990;7, 32, 96, 274.

*11. Jungbluth T, Stubbe A. A new technique for the ethological improvement of intensive housing systems for pigs. *ASAE/CSAE-SCGR Annual International Meeting*. 1999:18-21.

* Non-refereed references.

Brief communication

Peer reviewed

Elemental impurities in injectable iron products for swine

Scott L. Radke, DVM; Chris W. Olsen, DVM, MS; Steve M. Ensley, DVM, MS, PhD

Summary

Elevated levels of arsenic, chromium and lead were detected in multiple injectable iron products following concurrent analysis by two laboratories. Only one product possessed concentrations of all three elements of concern that were undetectable or below the parenteral daily exposure limit for humans for each heavy metal, respectively.

Keywords: swine, elemental impurities, iron deficiency anemia

Received: June 17, 2017
Accepted: November 21, 2017

Resumen – Impurezas elementales en los productos de hierro inyectable en cerdos

Se detectaron elevados niveles de arsénico, cromo y plomo en múltiples productos de hierro inyectables después análisis concurrentes en dos laboratorios. Solo un producto contenía concentraciones de los tres productos valorados que no fueron detectables o bajo los límites de exposición parenteral para humanos, para cada uno de los metales pesados, respectivamente.

Résumé – Éléments d'impuretés dans des produits de fer injectable pour les porcs

Des quantités élevées d'arsenic, de chrome et de plomb ont été détectées dans de multiples produits de fer injectable à la suite d'analyses simultanées effectuées dans deux laboratoires. Un seul produit possédait des concentrations de ces trois produits dans des quantités non-détectables ou sous la limite d'exposition quotidienne parentérale pour les humains pour chaque métal lourd, respectivement.

The use of injectable iron for the prevention of iron deficiency anemia is nearly an industry standard in swine production throughout the world. Since initial reports in the mid-twentieth century detailed a piglet's need for supplemental iron, 200-mg doses of injectable iron have routinely been given to every pig as per product label directions.[1-3] More recently, it has been shown that genetic improvements leading to larger litter sizes and rapid growth rates are resulting in piglets outgrowing their available iron stores prior to weaning, even when given an iron injection at birth.[4] Therefore, an additional 200-mg dose of iron prior to weaning has been shown to provide improved post-weaning growth performance.[5-7]

With an ever-increasing desire to produce a safe food supply, it is important to ensure that the products used in all phases of swine production are safe for use in food-producing animals. Though each of the iron products reported in this publication are approved for use in swine by the regulatory authorities in their respective countries, no inclusion limits for elemental impurities have been established for parenteral veterinary products. Guidelines are available, however, for human pharmaceutical products through guidance documents USP <232>[8] and ICH Q3D[9] which are being adopted as required standards for human drugs by many authorities including the United States and the European Union.[9]

The nature of the manufacturing process of pharmaceutical-grade iron dextran and gleptoferron requires one or more sources of raw materials, including elemental iron. Without appropriate quality control, it is reasonable that other elemental impurities may accompany iron in the raw material used during formulation. The purity of the final product will then depend on the steps employed to remove any such impurities. Additional quality and consistency challenges are presented by the fact that parenteral veterinary iron products are classified as non-biological complex drugs. Non-biological complex drugs are unique in that their structures cannot be fully characterized by physiochemical analysis and replication of the final active pharmaceutical product relies on specific and highly controlled manufacturing processes.[10] Altogether, this information indicates that adherence to high standards of manufacturing is paramount to creating a parenteral veterinary iron product that is safe, efficacious, and consistent. Therefore, the aim of the present project was to evaluate parenteral veterinary iron products for the presence of impurities that would be undesirable for intramuscular injection in food-producing animals.

Materials and methods

Sample submission

In total, 16 iron products from eight countries, each approved for the treatment of iron deficiency anemia in swine, were evaluated by the Toxicology and Nutrition Laboratory at the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL). Fifteen of the 16 samples were also evaluated for the same analytes at an independent laboratory. Samples were submitted to each laboratory in their original unopened containers with the exception of the two products from China, which had been inspected by US customs during the shipping process, and the bottle stopper had been punctured. Prior to submission for testing, a random number was assigned to each vial using a random

SLR, SME: Veterinary Diagnostic Laboratory, Iowa State University, Ames, Iowa.

CWO: Pharmacosmos Inc, Watchung, New Jersey.

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

Radke SL, Olsen CW, Ensley SM. Elemental impurities in injectable iron products for swine. *J Swine Health Prod.* 2018;26(3):142-145.

number sequence generator (**www.random.org**). The original product label was removed and a label with the assigned random identification number was adhered to each vial. All product-specific information was withheld from the laboratories until testing was complete.

Analysis of samples

Samples were analyzed for arsenic, cadmium, chromium, cobalt, lead and mercury using inductively coupled plasma mass spectrometry (ICP/MS; Analytik Jena Inc, Woburn, Massachusetts) at the ISU VDL. Analysis was performed with the ICP/MS in collisional reaction interface mode with hydrogen as the skimmer gas and the autosampler rinse solutions consisting of 1% nitric acid, 2% hydrochloric acid, and 4 ppm gold. Standards for elemental analyses were obtained from Inorganic Ventures (Christiansburg, Virginia) while digestion tubes, syringe filters, trace mineral grade nitric acid, and trace mineral grade hydrochloric acid were obtained from Fisher Scientific (Pittsburgh, Pennsylvania). Each sample was processed and analyzed following the established standard operating procedure for the fluid heavy metal panel.

To begin the analysis, samples were first digested in 70% nitric acid at 60°C for ≥ 1 hour. To do so, a 0.25-mL portion of each sample was transferred to a 15-mL centrifuge tube, and 0.25 mL of 70% nitric acid was added. All samples were digested for a minimum of 1 hour at 60°C. After digestion, all samples were diluted to 5 mL using 18MΩ water and vortexed to mix. Sample digests were then centrifuged for 5 minutes at 1900*g* and forced through 0.45-µm filter discs. Filtered samples were then diluted 1:500, 1:50, and 1:10 to accommodate the varying concentrations of the elements. To avoid carryover, the dilutions and the original digest were analyzed by ICP/MS from highest dilution to no dilution. Additionally, a blank sample of 1% nitric acid was analyzed between dilutions and 1% and 10% nitric acid was analyzed after each injectable solution sample. For quality control, certified reference materials were analyzed with each batch, additionally bismuth, indium, lithium, scandium, terbium and yttrium were used as internal standards for the ICP/MS.

Utilizing ICP/MS, a secondary analysis was performed by an independent laboratory following analysis at the ISU VDL. The limit of detection for arsenic, chromium and lead for both laboratories was 0.1 ppm.

Results

Results from the present study showed that a 200-mg injection of many of the iron products tested contained a concentration of one or more elemental impurities that exceed the permitted daily exposure (PDE) limit established for humans via parenteral exposure (Table 1). Only one injectable product, Uniferon (Pharmacosmos Inc, Watchung, New Jersey), was found to have non-detectable levels of both arsenic and lead, and was also the only product with chromium levels that would not exceed human PDE limits. The remaining elements included in the testing (cadmium, cobalt, and mercury), were either not detected, or were detected at levels well below PDE limits for humans and are therefore not reported. Briefly, the presence of chromium was detected in all the injectable iron products tested with eight (ISU VDL) and 11 (independent laboratory) products containing concentrations exceeding the human PDE by greater than 25%. Of the products with arsenic concentrations greater than 0.1 ppm, nine (ISU VDL) and eight (independent laboratory) samples exhibited concentrations exceeding the human PDE by greater than 25%. Likewise, of the products found to have detectable levels of lead, 10 (ISU VDL) and eight (independent laboratory) exhibited concentrations exceeding the human PDE by greater than 25%. Both laboratories agreed analytically on one iron product that possessed concentrations of arsenic, chromium and lead greater than the allowable PDE established for humans. In contrast, only one iron product was found to have concentrations of all three elements of concern that were undetectable or below the human PDE for each heavy metal, respectively.

Discussion

While injecting animals with products containing elemental impurities is potentially contrary to a practitioner's responsibility to "first, do no harm," there is currently no published data supporting the level of risk associated with injection of such impurities in swine. As a result, acceptable concentrations of elemental impurities such as arsenic, chromium and lead in animal drugs have not been established by the US Food and Drug Administration Center for Veterinary Medicine (CVM). It is therefore necessary for sponsors of veterinary drug products to apply risk-based control strategies for these impurities and to establish appropriate acceptance criteria. Thus, it is recommended that the USP <232>[8] and ICH Q3D[9] limits for elemental impurities, which are for humans, be used as a starting point for establishing a suitable limit for animal drug impurities. Adjustment of these limits may be justified following consideration of species and dosage; however, it remains the responsibility of the sponsor of a veterinary drug product to ensure that elemental impurities in the final drug are controlled within safe limits (AskCVM, oral communication; May 9, 2017).

For these reasons, the PDEs referenced and used as basis for comparison in this article are based on the ICH Q3D guidelines for maximum allowable levels of metal impurities when administering a drug to treat disease in humans.[9] Although these guidelines specify that exposures higher than the PDE may be acceptable in certain cases, such as intermittent treatment, the burden is on the manufacturer to demonstrate that it is acceptable in a given case. In this context, arsenic and lead merit particular scrutiny as they belong to the highest risk group as specified in the guidelines (Class 1 – highest degree of toxicity combined with reasonable risk of being found in pharmaceuticals).[9] Furthermore, the guidelines deal primarily with exposure in adult humans, whereas the use of injectable iron in piglets would correspond to use in infants. For these reasons, the human PDEs appear a reasonable starting point for evaluating whether certain levels of heavy metal impurities may be problematic for piglet health.

Generally speaking, the degrees of toxicity of arsenic and chromium are dependent on their respective valences. Arsenic(III) is more toxic than either As+5 or organic arsenic.[11] However, potential toxicological effects of arsenic can result in ataxia, paresis, and blindness following demyelination of nerves. The lethal oral dose of sodium arsenite, an inorganic arsenic, is approximately 200 mg/kg.[12] The more toxic and orally absorbable form of chromium is Cr+6, while Cr+3 is poorly absorbed orally and is considered less toxic. The maximum tolerable oral dose for Cr+3 in mammals, since Cr+6 is rarely ingested, is 100 mg/kg of more soluble forms of Cr+3.[13] Sperm motility of boars may potentially decrease with excess Cr+6 resulting in inhibited fertility.[14] Speciation of either arsenic or chromium contaminants within the injectable products to determine their potential toxicity could not be determined at the time of analysis. Swine are relatively resistant to lead toxicosis, but affected animals may exhibit tremors, seizures, and inappetance.[15]

Table 1: Detected content of arsenic, chromium and lead in parenteral iron products for swine, tested at two laboratories*

Brand name	Manufacturer†	Country	Molecule	Concentration (mg/mL)	Arsenic‡			Chromium			Lead‡		
					ISU	Lab 2	PDE¶	ISU	Lab 2	PDE¶	ISU	Lab 2	PDE¶
					µg/200mg dose§		µg/kg	µg/200mg dose§		µg/kg	µg/200mg dose§		µg/kg
Aspen Anem-X 100	Sparhawk	United States (USA)	ID	100	3.4	2.0		30.2	27.0		<0.1	<0.1	
Durvet Iron-100	Sparhawk	USA	ID	100	4.0	1.9		36.2	32.9		<0.1	<0.1	
Ecotin 200	Iven Laboratories	Spain	ID	200	0.2	0.4		36.0	49.5		4.9	5.8	
FerroForte	Bimeda	Canada	ID	200	1.7	1.6		12.0	35.0		0.3	<0.1	
Ferrohipra 200	Hipra	Belgium	Glep	200	<0.1	<0.1		25.0	24.1		2.0	1.1	
GleptoForte	Ceva	USA	Glep	200	0.9	<0.1		32.4	29.6		0.6	0.5	
Gleptosil	Ceva	Germany	Glep	200	2.2	1.2		21.0	28.9		<0.1	<0.1	
Gleptosil	Sogeval	United Kingdom	Glep	200	1.4	0.5		18.0	27.0		<0.1	<0.1	
Prolongal	Bayer	Belgium	Glep	200	<0.1	<0.1	0.3	33.2	28.9	22.0	2.6	0.6	0.1
Uniferon 200	Pharmacosmos	USA	ID	200	<0.1	<0.1		0.4	0.7		<0.1	<0.1	
Ursoferran	Serumwerk	Germany	Glep	200	<0.1	<0.1		25.0	36.0		0.4	0.4	
Ursoferran	Serumwerk	Russia	Glep	200	0.1	<0.1		19.0	21.9		1.1	1.2	
VetOne	Sparhawk	USA	ID	100	2.0	2.2		19.4	36.7		1.2	1.5	
Viloferron	iron4u	Denmark	Glep	200	<0.1	<0.1		29.0	29.0		3.1	0.3	
Xue Duo Bang	Guangxi Research Institute of Chemical Industry	China	ID	100	1.4	1.8		65.4	39.8		0.6	<0.1	
Xue Wei Bao**	Guangdong Wens Dahunong Biotechnology	China	ID	100	1.8	NA		28.6	NA		<0.1	NA	

* All values are rounded to the nearest one significant figure. Yellow highlighted cells indicate the element was present at ≤ 25% higher than the daily limits established for humans. Blue highlighted cells exceed the human daily exposure limit by > 25%.

† Marketing Authorization holder/NADA owner.

‡ Values reported as < 0.1 µg/200 mg dose were below the limit of detection for the assay.

§ For all 200 mg/mL products the reported elemental concentrations in µg/200 mg dose are equivalent to parts per million. For 100 mg/mL products, detected concentrations in parts per million were doubled to represent a typical 200 mg dose.

¶ Permitted daily exposure is the published daily exposure limit for an adult human. Values were converted to µg/kg assuming 50 kg as a conservative adult human body weight and using inclusion limits reported in USP < 232 >[8] and ICH Q3D[9] for human pharmaceutical products.

** Sample was not available for testing at both laboratories.

ISU = Iowa State University Veterinary Diagnostic Laboratory; Lab 2 = independent laboratory; PDE = permitted daily exposure; ID = Iron Dextran; Glep = Gleptoferron; NA = not applicable.

Although swine may be more resistant to arsenic and lead toxicity relative to other species, and diagnosed toxicities are uncommon, food safety must be taken into account and was not considered in establishing human PDE limits for these elements. Though we do not fully understand the potential risk(s) in swine associated with parenteral exposure to these impurities, the United States Department of Agriculture's Food Safety and Inspection Service currently does not allow for a detectable level of lead in any meat, while arsenic must be below 0.5 ppm in uncooked skeletal muscle tissue from swine.[12,16] Chromium, however, has a high volume of distribution with low accumulation in tissue, and therefore is not likely a toxicological concern for humans.[13] The combination of limited information and potential risk warrants that further research be done to determine the pharmacokinetics and tissue levels of heavy metal impurities subsequent to parenteral injection, or to expect that drug sponsors take steps to reduce or eliminate the level of impurities in parenteral products used for food-producing animals.

The present data shows that arsenic, chromium and lead can inadvertently be administered with iron injections to pigs depending on the product used. Because there is little information on the subject; in the absence of further investigation, practitioners and producers should consider taking steps to minimize the risk of any potential food safety, toxicological, or clinical impact(s) of parenteral administration of unintended heavy metals prior to the use of products containing such impurities.

Implications

- Under the conditions of this study, most of the 16 injectable iron products tested contain levels of arsenic, chromium or lead exceeding the human PDE for each respective impurity.
- Uniferon was the only product tested with undetectable levels of arsenic and lead while having a level of chromium lower than the human PDE.
- Given the limited knowledge of the properties of arsenic, chromium and lead when injected parenterally in swine, further research is warranted to fully characterize the consequences of exposure.
- Any potential risk associated with parenteral exposure of arsenic, chromium or lead to piglets can be avoided by using an injectable iron product with levels of these impurities below known human PDE limits.
- Manufacturers of injectable iron products for swine should take all steps necessary to ensure their product is void of any potentially harmful impurities, including heavy metals.

Acknowledgments

We would like to thank Dwayne Schrunk, Olha Ivanytska, and Angela Willems for their contributions in processing samples and performing the analytic testing at the ISU VDL.

Conflict of interest

Funding for analytical testing of iron injectable products was provided by Pharmacosmos. Pharmacosmos is the manufacturer and sponsor of Uniferon and co-author Chris Olsen is employed by Pharmacosmos.

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References

1. Kernkamp HCH, Clawson AJ, Ferneyhough RH. Preventing iron-deficiency anemia in baby pigs. *J Anim Sci*. 1962;21:527-532.

2. Ullrey DE, Miller ER, West DR, Schmidt DA, Seerley RW, Hoefer JA, Luecke RW. Oral and parenteral administration of iron in the prevention and treatment of baby pig anemia. *J Anim Sci*. 1959;18:256-263.

3. Zimmerman DR, Speer VC, Hays VW, Catron DV. Injectable iron-dextran and several oral iron treatments for the prevention of iron-deficiency anemia in baby pigs. *J Anim Sci*. 1959;18:1409-1415.

*4. Van Gorp S, Segers H, von der Recke C. Preventing iron deficiency by avoiding an iron gap in modern pig production. *Proc AASV*. San Diego, California. 2012;407-408.

5. Bhattarai S, Nielsen JP. Association between hematological status at weaning and weight gain post-weaning in piglets. *Livest Sci*. 2015;182:64-68.

*6. Dunnigan S, Jones R, Almond G, Gillespie T. The effects of hemoglobin levels on growth rates in pigs. *Proc AASV*. Orlando, Florida. 2015;305-306.

7. Perri AM, Friendship RM, Harding JCS, 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*. 2015;24(1):10-20.

*8. USP. General Chapter <232>. Elemental Impurities – Limits. In: *U.S. Pharmacopoeia (USP 39)-National Formulary (NF 34)*. Rockville, Maryland. United States Pharmacopeial Convention, Inc; 2015:1-3.

*9. US Food and Drug Administration. Q3D Elemental Impurities Guidance for Industry. **https://www.fda.gov/downloads/drugs/guidances/ucm371025.pdf**. Published 2015. Accessed January 9, 2017.

10. Crommelin DJA, Shah VP, Klebovich I, McNeil SE, Weinstein V, Flühmann B, Mühlebach S, de Vlieger JSB. The similarity question for biologicals and non-biological complex drugs. *Eur J Pharm Sci*. 2015;76:10-17.

*11. National Research Council. Arsenic. In: *Mineral Tolerance of Animals*. 2nd rev ed. Washington, DC: The National Academic Press; 2005;31-45.

*12. Ensley S, Osweiler G. Toxic minerals, chemicals, plants, and gases. In: Zimmerman J, Karriker L, Ramirez A, Schwartz K, Stevenson G, eds. *Diseases of Swine*. 10th ed. Ames, Iowa: Blackwell Publishing; 2012:953-967.

*13. National Research Council. Chromium. In: *Mineral Tolerance of Animals*. 2nd rev ed. Washington, DC: The National Academic Press; 2005;115-123.

14. Zhen L, Wang L, Fu J, Li Y, Zhao N, Li X. Hexavalent chromium affects sperm motility by influencing protein tyrosine phosphorylation in the midpiece of boar spermatozoa. *Reprod Toxicol*. 2016;59:66-79.

*15. Puls R. Lead. In: Puls R, eds. *Mineral Levels in Animal Health*. 2nd ed. Clearbrook, BC: Sherpa International; 1988:154.

*16. National Research Council. Lead. In: *Mineral Tolerance of Animals*. 2nd rev ed. Washington, DC: The National Academic Press; 2005;210-223.

* Non-refereed references.

Brief communication

Peer reviewed

Porcine reproductive and respiratory syndrome monitoring in breeding herds using processing fluids

Will A. Lopez, DVM; Jose Angulo, DVM; Jeffrey J. Zimmerman, DVM, PhD, ACVPM; Daniel C. L. Linhares, DVM, MBA, PhD

Summary

Processing fluids (PF), the serosanguinous fluid recovered from piglet castration and tail docking, were used for porcine reproductive and respiratory syndrome virus (PRRSV) infection assessment. Processing fluid samples from four breed-to-wean herds were compared with standard sampling protocols, demonstrating PRRSV RNA detection in PF at greater frequency than standard schemes.

Keywords: swine, porcine reproductive and respiratory syndrome virus, monitoring, surveillance, processing fluids

Received: July 14, 2017
Accepted: November 3, 2017

Resumen – Monitoreo del síndrome reproductivo y respiratorio porcino en hatos de cría utilizando fluidos de procesamiento

Los fluidos de procesamiento (PF por sus siglas en inglés), el fluido serosanguíneo recuperado de la castración de lechones y corte de cola, fueron utilizados para monitorear la infección del virus del síndrome reproductivo y respiratorio porcino (PRRSV). Se compararon muestras de fluidos de procesamiento de cuatro hatos de cría a destete con protocolos de muestreo estándar, demostrando la detección del RNA del PRRSV en PF a una frecuencia mayor que en los esquemas estándar.

Résumé – Surveillance du syndrome reproducteur et respiratoire porcin dans des troupeaux reproducteurs en utilisant les fluides de traitement

Les fluides de traitement (FT), le fluide sérosanguignolant récupéré lors de la castration et de la taille de la queue des porcelets, ont été utilisés pour évaluer l'infection par le virus du syndrome reproducteur et respiratoire porcin (VSRRP). Des échantillons de FT de quatre troupeaux de type reproducteur-sevrage ont été comparés avec les protocoles standards d'échantillonnage, démontrant la détection d'ARN du VSRRP dans les FT à une fréquence plus élevée que les façons standards.

Swine producers face ongoing challenges related to the detection and management of infectious diseases. In particular, porcine reproductive and respiratory syndrome (PRRS) is an economically significant problem, costing US producers more than 1 billion USD per year.[1] A milestone in the control and elimination of PRRS virus (PRRSV) in production systems is the interruption of the transmission cycle in breeding herds and the production of PRRSV-free piglets at weaning.[2] Tracking progress towards this goal can only be accomplished through routine diagnostic monitoring.

The current industry standard for monitoring PRRSV in breeding herds consists of testing serum samples monthly from 30 randomly-selected weaning-age piglets (pooled by five) for PRRSV RNA. Breeding herds are defined as "stable" after four consecutive negative monthly tests.[3] This monitoring plan assumes that PRRSV cannot remain in breeding herds at a prevalence < 10% over a period of 90 days, and that the true PRRSV status of the breeding herd can be accurately inferred by testing suckling pigs. However, cases of breeding herds detecting PRRSV shortly after achieving stability have been reported.[4] Likewise, near-zero PRRSV prevalence has been documented in endemically-infected breeding herds.[4-7]

These observations are evidence that the assumptions upon which the current monitoring plan is based are not sufficiently robust to provide reliable results. Thus, there is a clear need for improved PRRSV monitoring systems. The current monitoring scheme could be improved upon by testing higher numbers of individual piglets at a higher testing frequency. However, collecting blood samples from piglets is time consuming, requires two trained persons, and causes additional piglet stress. These practical and economic constraints render this option unsatisfactory for most commercial production systems.

Aggregate (population) samples, eg, oral fluids, are practical options for infectious disease monitoring of swine populations. Oral-fluid testing was introduced into the swine industry in 2010 and has been widely implemented in monitoring and surveillance systems.[5-11] However, the collection of oral fluids from suckling piglets has not been proven to be practical. Alternatively, a largely unexplored option for PRRSV surveillance in the breeding herd and suckling piglet populations is the use of "processing fluids." An aggregate sample easily collected by farm staff, processing fluid samples are defined as the serosanguinous fluid recovered at the time of castration and tail docking, ie, piglet processing. The purpose of this pilot study was to describe the collection of processing

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

Lopez WA, Angulo J, Zimmerman JJ, et al. Porcine reproductive and respiratory syndrome monitoring in breeding herds using processing fluids. *J Swine Health Prod.* 2018;26(3):146-150.

fluids in commercial herds and evaluate their use in PRRSV monitoring.

Materials and methods

This study was approved by the Iowa State University Institutional Animal Care and Use Committee under protocol No. 6-17-8547-S.

Study design

Twelve samplings were performed in four breed-to-wean herds at different time points within 27 weeks of their most recent clinical PRRS episode. Each sampling consisted of one aggregate processing fluid sample, composed of the fluids from all piglets processed that day, and serum samples from 30 piglets conveniently selected from the same population of processed piglets, targeting the weak and fall behind animals and including males and females. All processing fluid samples and serum samples were tested for PRRSV RNA (serum samples were tested in pools of five). Selected processing fluid samples (n = 5) were submitted for PRRSV ORF-5 sequencing and for detection of PRRSV antibody. Testing was performed at the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) using routine test methods. Two farms (matching sets 1, 2, 4, 6, and 10) were vaccinating piglets with Fostera PRRS (Zoetis, Parsippany, New Jersey) immediately after processing.

Sample collection and matching

Processing fluids were collected by placing a disposable plastic bag in a clean plastic bucket and then covering the top of the bucket with disposable gauze, ie, cheese cloth. A rubber band around the mouth of the bucket held the plastic bag and gauze firmly in place, but the gauze was placed with sufficient slack so as to create a concave cavity in which to hold the tissues (Figure 1). At the end of piglet processing, the gauze and tissues were removed from the bucket, after which the processing fluids were transferred from the plastic bag to a sterile 50 mL conical centrifuge plastic tube. The number of piglets that contributed to the processing fluid sample was recorded for each sampling.

Blood samples were collected from a convenience sample of 30 piglets in the same room at the time processing fluids were obtained. Blood was obtained using single-use serum separation tubes and needles and standard procedures for the restraint of piglets.

Blood samples and processing fluids were refrigerated immediately after collection and submitted for testing within 24 hours. Processing fluids were tested individually; serum samples were tested in pools of five. Thus, each "matched sampling set" consisted of one processing-fluid sample and six pooled-serum samples.

Diagnostic testing

Diagnostic testing was performed at the ISU VDL using assays routinely used for swine serum samples in the case of serum and oral fluids (high volume extraction protocol) for processing fluids. All processing fluids samples (n = 12) and pooled serum samples (n = 72) were tested for PRRSV RNA using the Applied Biosystems TaqMan kit for North American and European PRRS virus RNA detection (Thermo Fisher Scientific, Waltham, Massachusetts). In addition, five matched sampling sets (5, 7, 8, 9, 10) were conveniently selected to be tested for PRRSV antibody testing using the IDEXX PRRS X3 Ab ELISA test (IDEXX Laboratories, Westbrook, Maine), and five matched sampling sets (2, 3, 4, 5, 7) were submitted for PRRS ORF-5 sequencing (Sanger method).[12]

Results

Processing fluids were obtained on all attempts (Table 1), yielding a median volume of 49.0 mL (range 30.0 to 110.0 mL) of fluids. The median number of piglets that contributed to processing fluids was 256 (ranging from 174 to 650) and the average volumes of processing fluid per litter and per pig were 2.17 mL (1.22 to 2.67) and 0.186 mL (0.097 to 0.276), respectively. The age of sampled piglets ranged from 3 to 5 days.

Ten of 12 processing-fluid samples (83.33%) tested positive for PRRSV RNA by real time reverse transcription polymerase chain reaction (rRT-PCR) with cycle threshold (Ct) values ranging from 22 to 35 (Table 2). Eleven of 72 (15.27%) pooled serum samples tested positive. Eight of 12 matching sets (66.66 %) had at least one positive pooled serum sample (of six pools of five samples) test positive for PRRSV PCR (Table 2).

All processing fluids submitted for serology tested positive for PRRSV antibody (n = 5), with sample-to-positive (S:P) ratios of 1.50, 1.01, 2.50, 0.42, and 0.92, respectively. Likewise, it was possible to sequence the PRRSV ORF-5 from processing fluids in all attempts (n = 5). All five cases had a 100% nucleotide sequence homology when comparing processing fluids and blood samples from the same population. In all cases, the ORF-5 sequence was identified as wild-type PRRSV.

Discussion

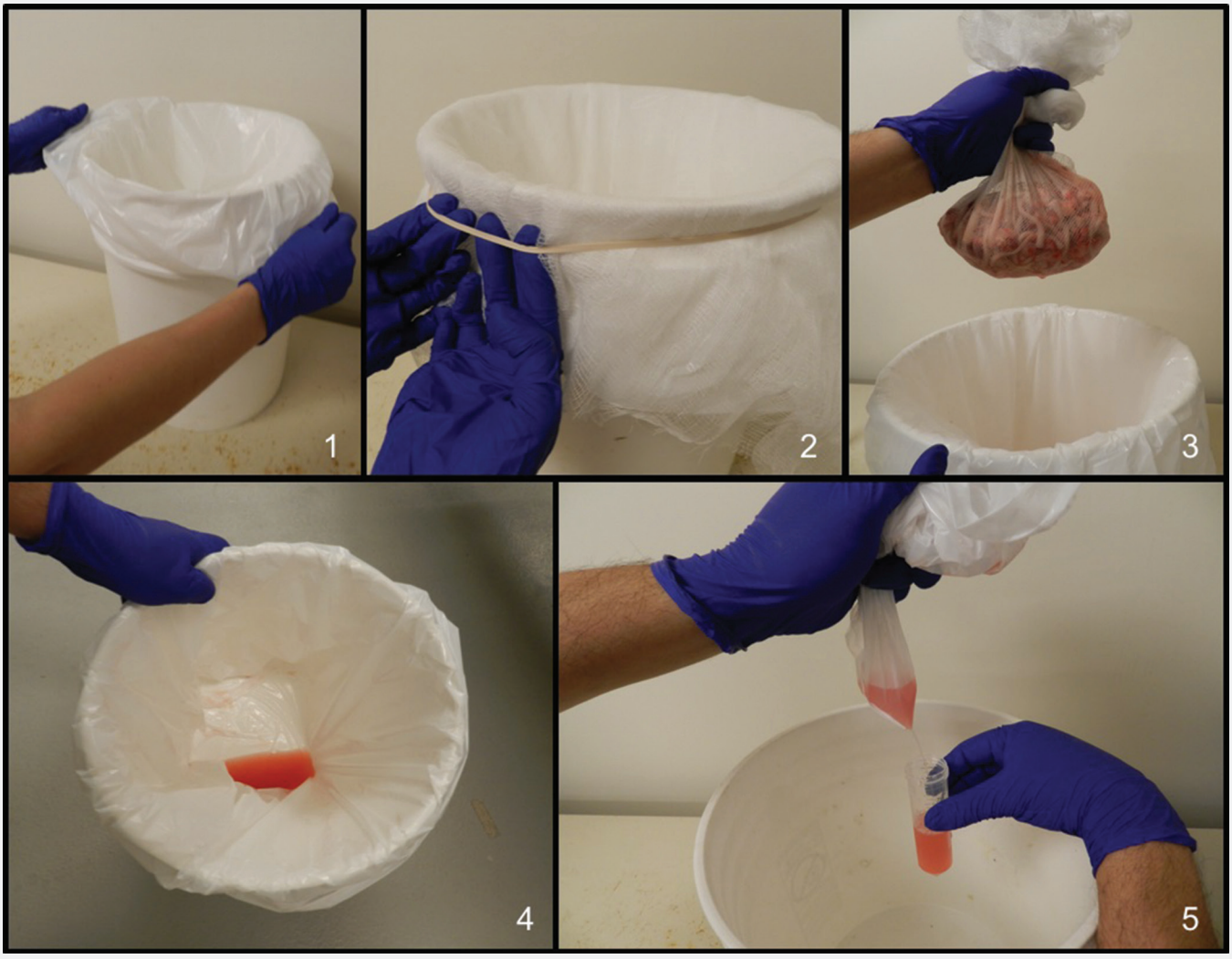
This study described the process of collecting processing fluids from 3- to 5-day-old piglets and provided initial data on the use of processing fluids for PRRSV monitoring. Recovering processing fluids from testicles and tails of 3- to 5-day-old piglets was practical and convenient for farm staff under field conditions. We emphasize the importance of the biosecurity measures that were used (disposable materials described in Figure 1) to avoid contamination of fluids with nucleic acid present in the farm environment.

The current procedures for PRRSV ORF-5 sequencing and antibody detection in serum samples were compatible with processing fluids. This was not unexpected but required verification. Testing results indicated that the likelihood of PRRSV RNA detection in processing fluids was greater than the likelihood of detecting PRRSV RNA in 30 matched serum samples (tested in pools of five) from the same population. Thirty serum samples were used as a comparison because this sample size is commonly used to monitor PRRSV in North American breeding herds.

Aggregate samples used in monitoring infectious agents include bulk-tank milk samples, environmental swabs, air samples, or oral fluid samples.[5-11] Overall, this is a highly cost-effective approach for improved monitoring. For example, the monthly cost of testing 30 piglet serum samples pooled by five is approximately 150 USD. Instead, the same 150 USD could be spent on six processing fluids per month representing hundreds of piglets. Alternatively, a 2500-sow herd producing an average of 1550 weaned piglets per week could test every piglet born in a week (approximately 1650 liveborn) by PRRSV rRT-PCR at a cost of approximately 100 USD (four processing fluids samples per week). The cost of testing the same number of pigs by PRRSV rRT-PCR in serum pooled by five would be approximately 8250 USD (330 PCRs at 25 USD each) per week.

It has been documented that PRRSV replicates in testicular epithelial cells and macrophages.[13] Therefore, it makes biological plausibility that bodily fluids originated from castration and tail docking are suitable samples for PRRSV detection. At the piglet

Figure 1: Steps for collecting processing fluids. Panel 1: Plastic bag in clean bucket. Panel 2: Cheese cloth placed over mouth of bucket to hold tissues and allow fluid to pass through to plastic bag. Panel 3: Tissues are removed after collection. Panel 4: Processing fluid recovered in plastic bag: Panel 5: Fluid decanted from plastic bag into tube.



processing age (3 to 5 days old), PRRSV infection may have taken place in gestation (transplacental infection) or shortly after farrowing. Situations in which processing-fluid-based sampling can be used include monitoring breeding herds undergoing PRRSV elimination to determine whether there is virus circulation at the piglet processing-age group or to establish the optimum timing to intensify internal biosecurity practices (ie, no evidence of virus circulation in piglets being processed). Likewise, processing fluids offer an efficient method for continuous surveillance in breeding herds presumed to be PRRSV-negative. Perhaps most importantly, regional and national PRRSV elimination programs will benefit from this practical, simple, and affordable approach.

Regardless of the application, the design of monitoring and surveillance schemes will become more flexible and easily integrated with the daily routine due to the ease of implementation and lower costs associated with processing fluids. Whatever sampling design is ultimately implemented, testing more pigs more frequently will result in improved herd-level sensitivity for the detection of PRRSV and other pathogens. This may be a great tool for veterinarians to make informed interventions to decrease the time-to-detect PRRS outbreaks and increase the probability of detecting virus at near-zero prevalence. More studies are needed to further evaluate the herd sensitivity of processing fluids for PRRSV and other pathogen monitoring systems. This simple development promises to be a major breakthrough in disease monitoring and surveillance.

Implications

- Processing fluid is an aggregate sample easily obtained by farm staff under field conditions.
- The use of processing fluids makes it possible to test more pigs, more frequently for PRRSV.
- Processing fluids are a major improvement in disease surveillance systems and may increase the strength of PRRSV control and elimination programs.

Acknowledgments

This work was supported by Zoetis Inc. We thank Drs Pete Thomas, Deb Murray, Sara Dillon Hough, and Emily Byers for collaborating with this study by facilitating sample collection in breeding herds.

Table 1: Volume of processing fluids retrieved from piglets at processing time (castration and tail docking) at each sampling point

Sampling set*	Processing fluids retrieved volume (mL)	Litters in sample	Piglets in sample	Average processing fluids volume†	
				Per litter (mL)	Per pig (μL)
1	30	21	262	1.43	115
2	45	21	250	2.14	180
3	48	18	174	2.67	276
4	50	20	226	2.50	221
5	55	25	265	2.20	208
6	45	37	466	1.22	97
7	80	35	438	2.29	183
8	110	50	650	2.20	169
9	90	37	481	2.43	187
10	45	17	221	2.65	204
11	32	17	177	1.88	181
12	50	21	233	2.38	215
Totals	**680**	**319**	**3843**	**2.17**	**186**

* Each 'Sampling set' consists of one processing-fluid sample and 30 serum samples (tested in six pools of five) taken from the same piglet population, on the same day of piglet processing at each sampling point.

† This table shows only the volume of processing fluid retrieved in each sampling set.

Table 2: Qualitative result of PRRSV rRT-PCR tests in processing fluids and matching serum samples and timeline of PRRS outbreak and whole-herd exposure

Sampling set	Time between PRRS outbreak and sampling (weeks)	Time from whole-herd exposure to MLV or FVE (weeks)	Result of PRRSV rRT-PCR			
			Processing fluids		Serum samples	
			Ct value*	Test result	Ct value*	Test result
1	6.0	FVE: 1.0	31.7	Positive	23.0	Positive
2	5.4	MLV: 5.4	28.4	Positive	20.1	Positive
3	7.9	MLV: 6.9	30.1	Positive	27.0†	Positive
4	9.6	MLV: 9.6	25.6	Positive	23.7	Positive
5	11.9	MLV: 10.9	22.7	Positive	27.6	Positive
6	8.0	MLV: 2.0	29.2	Positive	25.0†	Positive
7	20.0	MLV: 9.0	34.1	Positive	40.0	Negative
8	21.1	MLV: 10.1	35.2	Positive	40.0	Negative
9	22.0	MLV: 11.0	26.4	Positive	27.9	Positive
10	11.4	MLV: 5.4	30.2	Positive	31.1†	Positive
11	16	MLV: 15	40.0	Negative	40.0	Negative
12	27.1	MLV: 26.1	40.0	Negative	40.0	Negative

* Samples with Ct values < 37 are considered positive samples and those with Ct values ≥ 37 are considered negative samples.

† These Ct values represent the average Ct values of two positive pools of serum samples out of the six pools tested from the correspondent sampling set.

PRRSV = Porcine reproductive respiratory syndrome virus; rRT-PCR = Real time reverse transcription polymerase chain reaction; PRRS = Porcine reproductive respiratory syndrome; MLV = modified live vaccine (PRRSV); FVE = field virus exposure; Ct = Cycle threshold from the rRT-PCR assay.

Conflict of interest

Dr Jose Angulo is employed by Zoetis Inc, that provided funding for the study.

Disclaimer

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References

1. Holtkamp DJ, Kliebenstein JB, Neumann EJ, Zimmerman JJ, Rotto HF, Yoder TK, Wang C, Yeske PE, Mowrer CL, Haley CA. Assessment of the economic impact of porcine reproductive and respiratory syndrome on United States pork producers. *J Swine Health Prod.* 2013;21(2):72-84.

2. Corzo CA, Mondaca E, Wayne S, Torremorell M, Dee S, Davies P, Morrison RB. Control and elimination of porcine reproductive and respiratory syndrome virus. *Virus Res.* 2010;154(1-2):185-192.

3. Holtkamp D, Polson D, Torremorell M, Morrison R, Classen D, Becton L, Henry S, Rodibaugh MT, Rowland RR, Snelson H, Straw B, Yeske P, Zimmerman J. Terminology for classifying swine herds by porcine reproductive and respiratory syndrome virus status. *J Swine Health Prod*. 2011;19(1):44-56.

4. Linhares D. Evaluation of Immune Management Strategies to Control and Eliminate Porcine Reproductive and Respiratory Syndrome Virus (PRRSv) [dissertation]. Saint Paul: University of Minnesota; 2013.

5. Kittawornrat A, Panyasing Y, Goodell C, Wang C, Gauger P, Harmon K, Rauh R, Dufresne L, Levis I, Zimmerman J. Porcine reproductive and respiratory syndrome virus (PRRSV) surveillance using pre-weaning oral fluid samples detects circulation of wild-type PRRSV. *Vet Microbiol*. 2014;168(2-4):331-339.

6. Ramirez A, Wang C, Prickett JR, Pogranichniy R, Yoon KJ, Main R, Johnson JK, Rademacher C, Hoogland M, Hoffmann P, Kurtz A, Kurtz E, Zimmerman J. Efficient surveillance of pig populations using oral fluids. *Prev Vet Med*. 2012;104(3-4):292-300.

7. Prickett JR, Zimmerman JJ. The development of oral fluid-based diagnostics and applications in veterinary medicine. *Anim Health Res Rev*. 2010;11(2):207-216.

8. Prickett JR, Cutler S, Kinyon JM, Naberhaus N, Stensland WR, Yoon K-J, Zimmerman JJ. Stability of porcine reproductive and respiratory syndrome virus and antibody in swine oral fluid. *J Swine Health Prod*. 2010;18(4):187-195.

9. Prickett JR, Kim W, Simer R, Yoon K-J, Zimmerman J. Oral-fluid samples for surveillance of commercial growing pigs for porcine reproductive and respiratory syndrome virus and porcine circovirus type 2 infections. *J Swine Health Prod*. 2008;16(2):86-91.

10. Prickett J, Simer R, Christopher-Hennings J, Yoon KJ, Evans RB, Zimmerman JJ. Detection of Porcine reproductive and respiratory syndrome virus infection in porcine oral fluid samples: a longitudinal study under experimental conditions. *J Vet Diagn Invest*. 2008;20(2):156-163.

11. Kittawornrat A, Prickett J, Chittick W, Wang C, Engle M, Johnson J, Patnayak D, Schwartz T, Whitney D, Olsen C, Schwartz K, Zimmerman J. Porcine reproductive and respiratory syndrome virus (PRRSV) in serum and oral fluid samples from individual boars: Will oral fluid replace serum for PRRSV surveillance? *Virus Res*. 2010;154(1-2):170-176.

12. Sanger F, Nicklen S, Coulson AR. DNA sequencing with chain-terminating inhibitors. *Proc Natl Acad Sci U S A*. 1977;74(12):5463-5467.

13. Sur JH, Doster AR, Christian JS, Galeota JA, Wills RW, Zimmerman JJ, Osorio FA. Porcine reproductive and respiratory syndrome virus replicates in testicular germ cells, alters spermatogenesis, and induces germ cell death by apoptosis. *J Virol*. 1997;71(12):9170-9179.

Study: Pork Checkoff provides 25:1 return to pork producers

The nation's pork producers receive an overall return of 25:1 on their Checkoff investment, according to a 2017 study conducted and released by Harry Kaiser, the Gellert Family Professor in the Dyson School of Applied Economics and Management, Cornell University.

An economic analysis of Pork Checkoff programs is commissioned every five years by the National Pork Board. The study quantifies the returns generated by Pork Checkoff investments in research, pork promotion and producer education programs. The latest results, published in 2017, cover Checkoff programs conducted from 2011 to 2016.

Specifically, the study documented a growing return on investment through defined benefit-cost ratios across several key program areas. Each dollar invested in:

- Production research to benefit on-farm practices yielded $83.30 in pork producer value.
- International marketing yielded $24.70 in producer benefits.
- Domestic marketing resulted in benefits of $14.20 for advertising and $12.40 for non-advertising promotion.
- Research market drivers to grow demand returned $8.30.

Collectively, the overall return of Checkoff program activities is $25.50 for each dollar invested.

USDA requires that a return on investment analysis be conducted every five years. The 2001 to 2006 study showed an overall return to producers of $13.80 for every $1 invested, and the study released in 2012 for the period of 2006 to 2011 found a return of $17.40.

For more information, contact Dave Pyburn at DPyburn@pork.org or 515-223-2634.

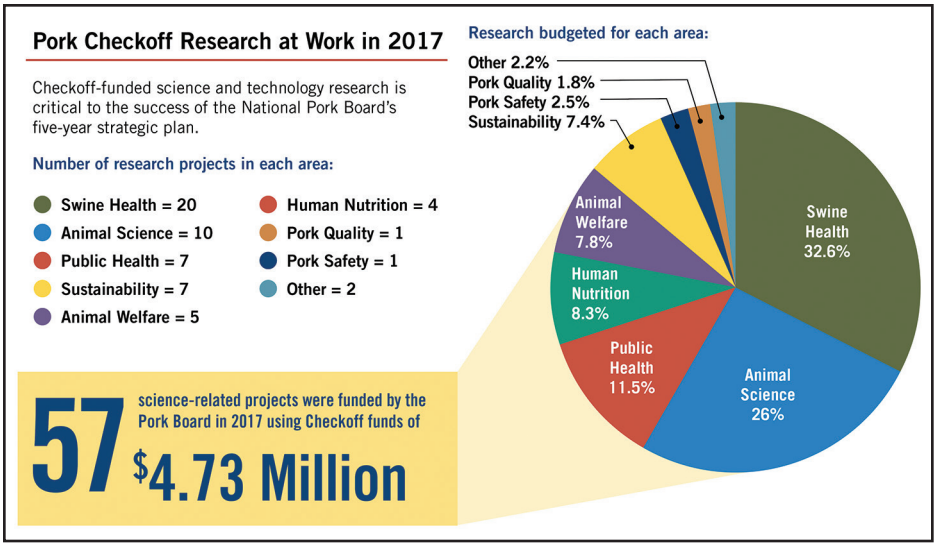
Checkoff's science and technology team delivers more solutions

In the recent Cornell University return on investment study, it's clear that the Pork Checkoff brings value to the table for America's pig farmers on many fronts. This is especially true for research overseen by the Checkoff's producer-led science and technology committees and affiliated staff. The study showed a return of $83.30 to producers for every dollar invested in swine research aimed at improving on-farm practices.

"The results underscore the importance of funding research that has a positive effect on the pork industry," said Dave Pyburn, senior vice president of science and technology for the Checkoff. "America's pork producers deserve a maximum return on their investment and we're pleased to focus our efforts on finding real-world solutions using a science-based approach."

Among the many noteworthy accomplishments in 2017 for Checkoff's science and technology area, several stand out. These include:

- Developing and refining antibiotic stewardship and on-farm solutions
- Making an additional investment in sow productivity research
- Moving ahead on foreign animal disease preparedness tools
- Making progress on sustainability tools and historical benchmarks
- Hosting farm tours for scientific influencers
- Hosting the inaugural Pig Welfare Symposium
- Leading industry-wide efforts in pork safety and quality.



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AASV NEWS

AASV installs 2018 officers

Dr Scanlon Daniels was installed as president of the American Association of Swine Veterinarians on March 6, 2018 during the association's 49th Annual Meeting in San Diego, California. He succeeds Dr Alex Ramirez who is now immediate past president. Dr Nathan Winkelman has ascended to president-elect. The newly elected vice president is Dr Jeff Harker.

AASV officers (left to right) Drs Scanlon Daniels, Nathan Winkelman, Jeffrey Harker and Alex Ramirez.

AASV President Dr C Scanlon Daniels (ISU '98) grew up on a family owned and operated livestock enterprise in central Iowa. He attended Iowa State University where he received a BS degree in Animal Science and DVM degree. He also has a MBA from the University of Guelph. Dr Daniels has been previously employed as a staff veterinarian by Iowa Select Farms and Seaboard Foods. Currently, he operates a diversified food-animal veterinary practice, laboratory, and multi-species contract research organization in Dalhart, Texas. Dr Daniels has been active in multiple AASV committees and has served on the AASV Board of Directors representing District 7 on two occasions.

AASV President-elect Dr Nathan Winkelman (UMN '84) was raised on a diversified crop and livestock farm near St James, Minnesota. Dr Winkelman received a BS degree in Animal Science and DVM from the University of Minnesota. Upon graduation, he joined a swine-exclusive veterinary practice in Morris, MN with Drs Rod Johnson and Tony Scheiber. Currently, he is a partner with Dr Adam Mueller in Swine Services Unlimited, Inc, a swine research and consulting practice in Rice, Minnesota. Dr Winkelman has served on the AASV Board of Directors and currently sits on the AASV Foundation Board where he chairs the Foundation's Research Project Selection Committee. In addition, Dr Winkelman is an active participant in the AASV and National Pork Board Operation Main Street project giving presentations to various groups to raise awareness about modern pork production.

AASV Vice President Dr Jeffrey Harker (Purdue '94) grew up on a diversified livestock and grain farm in south central Indiana. His father built one of the first confinement swine barns in the community in 1980. Interacting with the veterinarians that visited their farm stimulated his interest in population medicine and becoming a veterinarian. Dr Harker was accepted to veterinary school at Purdue University in 1990.

After graduating from veterinary school in 1994, Dr Harker joined Dr Max Rodibaugh at Swine Health Services as an associate veterinarian and then became a partner in 2001. Their practice (now AMVC Swine Health Services) is dedicated to swine and serves a very diverse swine clientele ranging from small show pig herds to contract growers in integrated production. The bulk of their clients have independent family farms.

Dr Harker has been involved in many organizations, starting with 4-H club president and FFA chapter president. He also received the American Farmer Degree from the FFA. He served 7 years on the Indiana Pork Producers Board of Directors and was president in 2008. Dr Harker served as AASV District 4 director at the time of his election. He represented AASV in the American Veterinary Medical Association's House of Delegates until his second term ended in 2017. He has also served on the AASV Annual Meeting Planning Committee and currently chairs the AASV Continuing Education Committee. Dr Harker has been involved with the National Pork Board's Operation Main Street program since it began several years ago.

When asked to comment on what his election meant to him, Harker responded, "I look forward to serving this great association over the next few years as we transition from the first half century to the future. I have been a member and attended the annual meeting for 28 consecutive years and intend to use my historical perspective to guide our future direction."

Dr Harker and his wife, Traci, reside in Frankfort, Indiana. They have four children: Kathleen, Sarah, Matthew, and Amelia, and one granddaughter, Libbi.

AASV news continued on page 155

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AASV news continued from page 153

AASV Past President Dr Alejandro "Alex" Ramirez (ISU '93) grew up in Guadalajara, Mexico. He obtained his doctor of veterinary medicine degree from the Iowa State University (ISU) College of Veterinary Medicine and joined Valley Veterinary Center, a mixed animal practice in Cherokee, Iowa. In 2004, Dr Ramirez left practice and returned to ISU to pursue a teaching career. He obtained a master of public health degree from the University of Iowa and earned a PhD at ISU in 2011. He first served as a substitute judge for the student presentations at the AASV Annual Meeting. Shortly thereafter he was asked to co-chair the student oral competitions. He has also co-chaired the Collegiate Activities Committee for the past few years and has served on the *Journal of Swine Health and Production* Editorial Board since 2010. He represented District 6 on the AASV Board of Directors from 2013 to 2015.

Is your AASV directory listing correct?

Do we have the correct mailing address, phone numbers, and email address on file for you? AASV is preparing to publish the 2018 membership directory, so please take a few moments to verify your listing at **www.aasv.org/members/only/directory.php**.

Once you've logged in, your directory listing will appear, along with a submission box for additions, deletions, or other corrections.

Each directory entry can include the member's name, mailing address (2 lines plus city, state/province, postal code, and country), business phone, fax, mobile phone, home phone, and one email address. The directory does not list multiple email addresses.

Print copies of the directory will be shipped to AASV members in late summer.

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Attendance record set for fifth consecutive year

The American Association of Swine Veterinarians (AASV) held its 49th annual meeting in San Diego, California, March 3-6, 2018. The meeting, held at the Manchester Grand Hyatt, drew record attendance of 1220 total attendees, including 765 paid registrants (also a record) and 102 veterinary students from 22 colleges of veterinary medicine. The conference participants hailed from 30 countries, with 295 attendees (24% of the total) from outside the United States, including 60 from Canada and 79 from Mexico. The total attendance also included a record 305 exhibit representatives from 101 companies and organizations (another all-time high).

The meeting participants enjoyed the opportunity to attend numerous educational sessions, including 10 pre-conference seminars, two general sessions, three break-out sessions, research topics, three industrial partners sessions, a student seminar, and a poster session featuring 89 posters. In addition, 14 AASV committees met during the annual meeting. The Monitoring and Surveillance 2.0 seminar on Saturday afternoon was extremely popular (166 registrants), while the Antibiotic Alternatives seminar garnered the most attention of the seminars on Sunday morning (134 registrants). On Sunday afternoon, the participation by companies in the Industrial Partners sessions was extremely high this year, 3 sessions running every 15 minutes from 1:00 PM through 5:45 PM with no breaks.

Dr Lisa Tokach coordinated a social media competition at this year's meeting to raise awareness of our meeting in a positive way. Fourteen competitors competed across multiple social media platforms. An esteemed panel of judges consisting of Drs Trevor Martin, Brent Pepin, and Katie Woodard judged the contestants based on 5 categories: content of message, professionalism, creativity, interest level, and positive impact on AASV. The winners of the competition were: Rachel Schulte (1st place, $250), Chris Rademacher (2nd place, $100) and Shamus Brown (3rd place, $50). An additional $100 was awarded to Rachel Schulte who was selected as the People's Choice winner.

Dr Bill DuBois opened the Monday general session with the Howard Dunne Memorial Lecture. His presentation, "How geography, culture, and socioeconomic status affect global animal protein consumption: Applications for swine veterinarians," recognized that swine veterinarians are already involved in a global, multi-cultural industry. Dr DuBois explored the global impact veterinarians can have on livestock production and the opportunities this access affords AASV members to better understand the cultural influences of the food choices in those cultures.

Dr Rodger Main presented the Alex Hogg Memorial Lecture, "This is our time, the choices are yours." His presentation explored the changes that have occurred in the United States pork industry and swine veterinary profession over the last 40 years. He discussed the importance of animal health and the impact of disease on production, trade and animal well-being and the role of the veterinarian in modern pork production.

The Monday afternoon concurrent sessions allowed attendees the opportunity to consider advances in technology and management practices, emerging disease issues, and management of endemic diseases. The Tuesday general session addressed the issues associated with antibiotic use in swine medicine.

Dr John Waddell presented the Heritage Award to Dr Conrad Schmidt during the luncheon on Monday. This is only the fourth time the Heritage Award has been presented. The AASV Awards Reception was held Monday night, followed by the AASV Foundation's annual fund-raising auction. Dr Michelle Sprague, 2014 AASV president and chair of the 2018 Awards Selection Committee, introduced the recipients of the Swine Practitioner of the Year Award (Dr Mary Battrell), the Howard Dunne Memorial Award (Dr Dick Hesse), the Meritorious Service Award (Dr Liz Wagstrom), the Young Swine Veterinarian of the Year Award (Dr Adam Schelkopf), and the Technical Services/Allied Industry Veterinarian of the Year Award (Dr Gene Nemechek).

Swine Practitioner of the Year

Dr Mary Battrell was named 2018 **Swine Practitioner of the Year.** The award is given to the swine practitioner who has demonstrated an unusual degree of proficiency and effectiveness in the delivery of veterinary service to clients.

Dr Battrell was born and raised on a family farm in Albany, Ohio. Her family farmed 600 acres of cropland, had a cow-calf operation, raised 250 feeder steers each year, and had a 100-head farrow-to-finish swine operation. She earned a bachelor's degree in agriculture from The Ohio State University followed by a master's degree in animal science with a focus in ruminant nutrition from the University of Tennessee. Upon graduation, she moved to Iowa and worked as a sales representative for the Upjohn Company.

Battrell earned her doctor of veterinary medicine degree and a master's degree in swine production medicine from Iowa State University in 1995. She began her veterinary

Dr Mary Battrell, recipient of the AASV Swine Practitioner of the Year Award.

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career in North Carolina working for Dr Fred Cunningham. A year later, she accepted a position with Brown's of Carolina in Kenansville, North Carolina, where she worked for three years. Following her time at Brown's, she was employed as a technical services veterinarian for Pharmacia before returning to Smithfield Hog Production at the Murphy Family Farms Rose Hill office in 2000. She is currently the staff veterinarian for Smithfield Hog Production's East Central Region and is responsible for the health and well-being of 140,000 sows farrow-to-finish. She has been actively involved in the development of the Smithfield Animal Care Program and serves as chair for that committee.

Asked to comment about receiving this award, Dr Battrell replied, "Swine practitioners do an excellent job of caring for their animals and providing a safe and wholesome product for the consumer. It is incredibly humbling to be selected among them for this award. God has blessed me with a loving family, outstanding mentors, and co-workers that have guided me throughout my career. I am grateful for my Smithfield team, our care givers, and contract growers that work hard every day to put the pigs' needs first. I am proud to be a part of this industry. Thank you for the opportunities and for this recognition."

Dr Battrell and her husband, Wayne Banks, reside in Garland, North Carolina with their son Don Banks.

Howard Dunne Memorial Award

Dr Dick Hesse received the 2018 **Howard Dunne Memorial Award** which recognizes an AASV member who has made important contributions and provided outstanding service to the association and the swine industry.

Hesse was born in Mitchell, South Dakota. He attended Huron College where he received a bachelor of arts degree in 1975 with a major in biology and minors in chemistry and education. From 1976 to 1979, he served as a biological research assistant in the virology division at the United States Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, Maryland where he received his training in classical virology. Following his time at USAMRIID, Hesse was a research assistant in the South Dakota State University Diagnostic Laboratory's virology section until 1981 and then was a research scientist with Solvay Animal Health.

Hesse received a master's degree in 1982 from South Dakota State University and a doctor of philosophy degree from the University of Nebraska in 1993. Hesse was a scientist and group leader in the virology section at Schering-Plough Animal Health until 1997 and Manager of Virology Biologics, Research and Development at Intervet until 2006. Currently, Hesse is a professor in the Department of Diagnostic Medicine and Pathobiology in the College of Veterinary Medicine at Kansas State University. He is also the Director of Diagnostic Virology at the Kansas State Veterinary Diagnostic Laboratory.

Hesse was awarded the Army's Distinguished Service Medal for Lassa Fever research in 1979 and the Schering-Plough Excellence Award for the development of a PRRS vaccine. Additionally, he has received the Kansas Veterinary Medical Association Distinguished Service Award. Dr Hesse has authored or co-authored more than 50 publications, presentations, and patents. In addition, he has led the development of at least 12 USDA-licensed vaccines. He has been active in several AASV committees and currently serves on the National Pork Board Swine Health Committee.

When asked what it meant to him to receive the Howard Dunne Memorial Award he responded, "I am blessed to be able to work with so many talented and dedicated people across the swine industry. To be recognized by them is the highest honor I have ever received, and it means more to me than anyone will ever know."

In 1974, Dick married Debby Anderson, his high school sweetheart. They lived several places but mostly raised the family in Omaha, Nebraska. They have four children: Chris, Josh, Jacque, and Andrea and 11 grandchildren. Sadly, Debby passed away in 2014.

Meritorious Service Award

Dr Elizabeth Wagstrom was named the 2018 recipient of the **Meritorious Service Award**. The award recognizes individuals who have provided outstanding service to the AASV.

Dr Wagstrom was raised in Montevideo, Minnesota, where she became an avid horse lover. This early interest in horses channeled her interest and education in the agricultural field. Wagstrom attended the University of Minnesota where she obtained bachelor of

Dr Dick Hesse, recipient of the Howard Dunne Memorial Award.

science degrees in agricultural economics and animal science. While living in Faribault, Minnesota, Wagstrom worked at a variety of jobs that revolved around the agricultural and science fields. One of these jobs was with Oxford Labs, a swine vaccine company headquartered in Worthington, Minnesota. Her time spent at Oxford Labs as a marketing manager in swine biologics and diagnostics was a launching point for her work in the swine field. Wagstrom ultimately

Dr Elizabeth Wagstrom, recipient of the AASV Meritorious Service Award.

decided to return to school and obtained a doctor of veterinary medicine degree from Iowa State University (ISU) in 1999. During her time at ISU, she also earned her master's degree in veterinary preventive medicine and was a graduate research assistant at ISU from 1996 to1998.

Wagstrom then went on to be a Production Management Veterinarian at Iowa Select Farms. In 2000, she was employed as a public health veterinarian and senior epidemiologist at the Minnesota Department of Health in Minneapolis. From 2001 to July 2004, she served as the Director of Veterinary Science at the National Pork Board in Des Moines, Iowa. From 2004 to 2010 she was the Assistant Vice President of Science and Technology at the National Pork Board.

In 2010, Wagstrom accepted a position as Associate Professor and Veterinary Public Practice-Residency Director at the University of Minnesota Center for Animal Health and Food Safety. Since 2011, she has been the Chief Veterinarian with the National Pork Producers Council in Washington, DC, and Des Moines, Iowa.

When asked to comment about receiving the award, Wagstrom responded, "I am honored to receive this award from my peers and am so appreciative that the work I do with the National Pork Producers Council allows me to advocate not only on behalf of the pork industry but also the swine veterinary profession."

Dr Wagstrom and her husband, Brian, reside in Faribault, Minnesota. They have two children: Andrew and Emily.

Young Swine Veterinarian of the Year Award

The **Young Swine Veterinarian of the Year Award** was presented to **Dr Adam Schelkopf**. It is given annually to an AASV member five or less years post-graduation who has demonstrated the ideals of exemplary service and proficiency early in his or her career.

Dr Schelkopf received his DVM degree in 2012 from the University of Illinois College of Veterinary Medicine. Following graduation, Dr Schelkopf accepted a position as an associate veterinarian with Pipestone Veterinary Services and is currently a partner in Pipestone Holdings. He serves as the Health Director for the Pipestone System and Director of the East Region, working with independent producers across the Midwest.

In addition to his full-time commitment to practicing swine medicine, Dr Schelkopf is finishing his master's degree at Iowa State University. He has been involved in researching porcine epidemic diarrhea virus immunity in sows and piglets, with special consideration to antibody test interpretation. Schelkopf is a third-generation swine veterinarian.

Upon acceptance of the award, Dr Schelkopf commented, "I am honored and humbled to receive this award, and exceptionally thankful to the AASV. The AASV and the swine veterinary community are wonderful in how they embrace students and young practitioners, provide opportunities to learn and develop professionally, as well as create lifelong friendships. I owe tremendous gratitude to my parents, my mentors, and my Pipestone colleagues. Pipestone instills a sense of passion for the industry, profession, and communities we work in, as well as a sense of family throughout the company which I am grateful to be a part of. Thank you to the AASV for this award and the opportunity to be a part of this organization."

In his spare time, Dr Schelkopf enjoys golfing, water sports, and hunting. He currently resides in Sioux Falls, South Dakota.

Technical Services/Allied Industry Veterinarian of the Year Award

Dr Eugene Nemechek received the **Technical Services/Allied Industry Veterinarian of the Year Award**. Established in 2008, the award recognizes swine industry veterinarians who have demonstrated an unusual degree of proficiency and effectiveness in delivery of veterinary service to their companies and their clients, as well as given tirelessly in service to the AASV and the swine industry.

Nemechek grew up on a family farm in Goodland, Kansas as one of eleven children. His interest in veterinary medicine was sparked at an early age by the veterinary practitioner on his family's farm. He earned his bachelor's in animal science and doctor of veterinary medicine degrees at Kansas State University. Upon graduation in 1976, he practiced in a rural mixed animal practice before stepping into a role specializing in the swine industry.

In 1985, Nemechek left private practice to accept a position as a staff veterinarian at Cargill Pork in Wilson, North Carolina

Dr Adam Schelkopf, recipient of the AASV Young Swine Veterinarian of the Year Award.

where he remained until 2005. Upon leaving Cargill, he was hired by Genetic Improvement Services in North Carolina as Director of Health and Production. Subsequently, he joined Tyson Fresh Meats in Springdale, Arkansas as a Quality Assurance Veterinarian before joining Pfizer (Zoetis) in 2011 where he currently serves as a Pork Technical Services Veterinarian.

Dr Eugene Nemechek, recipient of the AASV Technical Services/Allied Industry Veterinarian of the Year Award.

Dr Nemechek has also served on the AASV Board of Directors, the North Carolina Pork Council board, and the National Pork Board, where he was president from 2010 to 2011. He is also extremely active as a presenter for Operation Main Street at the local and national level.

When asked to comment on what the award meant to him, Dr Nemechek said, "I was truly honored to receive this award from the AASV association and my colleagues. It is amazing to be recognized for doing the things every day that you enjoy doing, especially serving a great industry and swine veterinary profession. It makes life fun and worthwhile."

Dr Nemechek and his wife, Susan, reside in Wilson, North Carolina. They have four children: Sarah, Molly, Megan, and Jeremiah and four grandchildren.

Annual Business Breakfast

American Association of Swine Veterinarians President Dr Alex Ramirez reported on the association's membership and activities during the annual breakfast on Tuesday, March 6th. The 2018 AASV officers were installed: Drs Scanlon Daniels, president; Nathan Winkelman, president-elect; Jeff Harker, vice president; and Alex Ramirez, past president. The board welcomed newly-elected district directors: Drs Melissa Billing (District 1), Darryl Ragland (District 4), and Locke Karriker (re-elected District 6). Dr Ramirez also welcomed Jonathan Tubbs (Auburn University, 2020) as incoming Alternate Student Delegate to the AASV Board of Directors and thanked outgoing Student Delegate Brent Sexton (Iowa State University, 2018). Jordan Gebhardt (Kansas State University, 2019) assumes the role of Student Delegate. Honored guests at the business breakfast included Dr Michael Topper (AVMA President), Dr John Howe (AVMA Liaison and candidate for President), Dr Patrick Webb (NPB) and Dr Liz Wagstrom (NPPC). The audience heard updates from each organization. Approximately 250 people attended the breakfast.

AASV Foundation annouces student scholarships

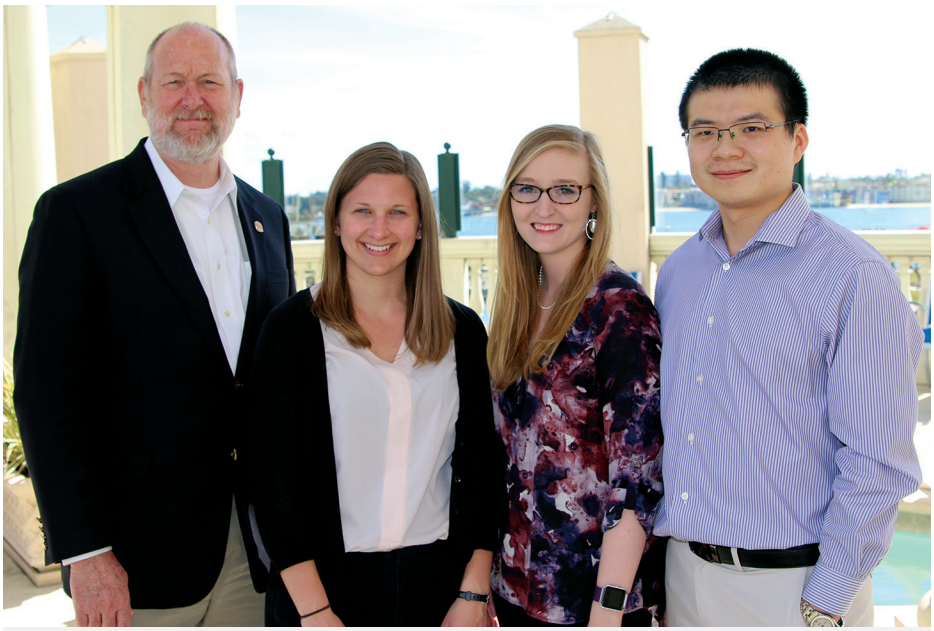
The American Association of Swine Veterinarians Foundation awarded scholarships totaling $25,000 to 15 veterinary students.

Jacob Baker, Iowa State University, received the $5000 scholarship for top student presentation. His presentation was titled "Utilizing piglet processing fluids to detect PRRSV by PCR in a low-prevalence population." Zoetis provided the financial support for the **Top Student Presenter Award**.

Additional scholarships totaling $20,000 were funded by Elanco Animal Health as shown in the accompanying photos.

Article continues on page 162

Recipient of the $5000 scholarship for Best Student Presenter during AASV's Student Seminar: Jacob Baker, Iowa State University. Pictured with Jacob is Dr Gene Nemechek (right) of Zoetis, sponsor of the Best Student Presenter Award.



Dr Mark Hammer (far left) presented scholarships sponsored by Elanco Animal Health. Recipients of the $2500 AASV Foundation scholarships were (from left): Megan Nickel, Iowa State University; Kimberlee Baker, Iowa State University; and Zhen Yang, University of Minnesota. Not pictured: Elizabeth Houston, Iowa State University.

Article continued from page 161

Four veterinary student presenters received $2,500 scholarships: Kimberlee Baker, Iowa State University; Elizabeth Houston, Iowa State University; Megan Nickel, Iowa State University; and Zhen Yang, University of Minnesota.

Five veterinary student presenters received $1,500 scholarships: Bryant Chapman, Virginia-Maryland Regional CVM; Cassandra Fitzgerald, Iowa State University; Megan Hood, North Carolina State University; Evan Koep, Iowa State University; and Mikalah Smith, Iowa State University.

Those student presenters receiving $500 scholarships were: Stephanie Betbeze, Lincoln Memorial University; Rita Anne Neat, Iowa State University; Katie O'Brien, University of Illinois; Joel Steckelberg, Iowa State University; and Whitney Webb, Iowa State University.

Fifty-eight veterinary students from 17 universities submitted abstracts for consideration. From those submissions, 15 students were selected to present during the annual meeting. Zoetis, sponsor of the Student Seminar, provided a $750 travel stipend to each student selected to participate.

Dr Mark Hammer (far left) presented scholarships sponsored by Elanco Animal Health. Recipients of the $1500 AASV Foundation scholarships were (from left): Bryant Chapman, Virginia-Maryland Regional CVM; Evan Koep, Iowa State University; Cassandra Fitzgerald, Iowa State University; and Megan Hood, North Carolina State University. Not pictured: Mikalah Smith, Iowa State University.

Dr Mark Hammer (far left) presented scholarships sponsored by Elanco Animal Health. Recipients of the $500 AASV Foundation scholarships were (from left): Katie O'Brien, University of Illinois; Rita Anne Neat, Iowa State University; Stephanie Betbeze, Lincoln Memorial University; and Joel Steckelberg, Iowa State University. Not pictured: Whitney Webb, Iowa State University.

Save the date

The 2019 Annual Meeting will be held March 9-12
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AASV announces student poster competition awardees

The American Association of Swine Veterinarians (AASV) provided an opportunity for 15 veterinary students to compete for awards in the Veterinary Student Poster Competition. Newport Laboratories sponsored the competition, offering awards totaling $4000.

Using scores received in the original judging of abstracts submitted for the AASV Student Seminar, the top 15 abstracts not selected for oral presentation were eligible to compete in the poster competition. A panel of three AASV practitioners interviewed the competing students and scored their posters to determine the scholarship awards.

Newport Laboratories announced the following awards during the AASV Luncheon on March 5th:

$500 scholarship: Jordan Gebhardt, Kansas State University – Top student poster titled "Medium chain fatty acids improve growth and alter fecal microbial populations in nursery pigs."

$400 scholarships: Jewell Bremer, North Carolina State University; and Taylor Homann, University of Minnesota.

$300 scholarships: Jenna Scott, North Carolina State University; Brent Sexton, Iowa State University; and Rachel Stika, Iowa State University.

$200 scholarships: Kayla Castevens, North Carolina State University; Laura Constance, Kansas State University; Kayla Henness, University of Illinois; Jamie Madigan, North Carolina State University; Elizabeth Noblett, North Carolina State University; Shelby Perkins, University of Missouri; Abigail Ruane, Iowa State University; Rachel Schulte, Iowa State University; and Jonathan Tubbs, Auburn University.

In addition to the poster competition awards, each student poster participant received a $250 travel stipend from Zoetis and the AASV.

Jordan Gebhardt, Kansas State University, winner of the top prize of $500 for best poster.

The $400 poster competition winners (left to right): Jewell Bremer, North Carolina State University; and Taylor Homann, University of Minnesota.

The $300 poster competition winners (left to right): Rachel Stika, Iowa State University; Brent Sexton, Iowa State University; and Jenna Scott, North Carolina State University.

The $200 poster competition winners (left to right): Elizabeth Noblett, North Carolina State University; Laura Constance, Kansas State University; Jamie Madigan, North Carolina State University; Jonathan Tubbs, Auburn University; Abigail Ruane, Iowa State University; Kayla Castevens, North Carolina State University; Kayla Henness, University of Illinois; Shelby Perkins, University of Missouri; and Rachel Schulte, Iowa State University.

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References: 1. BIAH studies #2013200, 2013232, and 2014001 published on http://productdata.aphis.usda.gov. **2.** Genzow M, Goodell C, Kaiser TJ, Johnson W, Eichmeyer M. Live attenuated influenza virus vaccine reduces virus shedding of newborn piglets in the presence of maternal antibody. *Influenza Other Respir Viruses.* 2017;00:1–7. doi:10.1111/irv.12531. **3.** Alvarez J, Sarradell J, Kerkaert B, et al. Association of the presence of influenza A virus and porcine reproductive and respiratory syndrome virus in sow farms with post-weaning mortality. *Prev Vet Med.* 2015;121:240–245. **4.** Vincent AL, Ma W, Lager KM, et al. Efficacy of intranasal administration of a truncated NS1 modified live influenza virus vaccine in swine. *Vaccine.* 2007;25:7999–8009. **5.** Janke BH. Influenza A virus infections in swine: pathogenesis and diagnosis. *Vet Pathol.* 2014;51:410–426.

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AASV Proceedings online

Even if you weren't able to attend the AASV Annual Meeting in San Diego, you can still benefit from the many excellent presentations delivered at the meeting. The conference proceedings (including the pre-conference seminar booklets) are available for all AASV members to download at **www.aasv.org/library/proceedings/** (or look under the "Resources" menu tab on the AASV Web site for "AASV Meeting Proceedings"). All you need is your AASV member username and password with 2018 dues-paid status.

Here's what you'll find:

- The "big book" containing all of the papers for the regular meeting sessions in a single PDF file with a hyperlinked table of contents
- Seminar booklets – a PDF file for each seminar
- Individual papers for each presentation in the Swine Information Library (**www.aasv.org/library/swineinfo/**).

If your AASV username/password isn't handy, click the "Reset Password" link in the upper right of the AASV web site (**www.aasv.org**) to receive them by email. Need to pay your 2018 AASV membership dues? Go to **ecom.aasv.org/membership**. Please allow a few days for your membership record to be updated.

Photos are courtesy of Tina Smith and Barbara Molnár Smith.

Thank you, AASV Annual Meeting sponsors!

Members of AASV attending the annual meeting make a substantial investment in the form of registration fees, travel, lodging, meals, and potential loss of income while away from work. However, the cost of attendance would be even greater – or the quality of the meeting experience reduced – if it were not for the financial support provided by corporate sponsors for refreshments, meals, and social activities, as well as scholarships and travel stipends for veterinary students. The AASV extends its sincere appreciation for the sponsorship of meeting events by the following companies:

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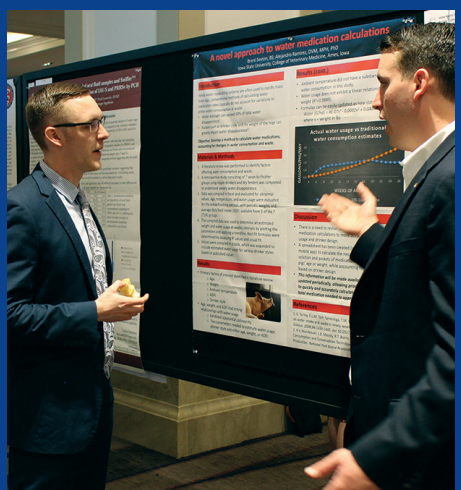
- Stuart Products (Praise Breakfast)
- Zoetis (Welcome Reception, AASV Student Seminar and Student Poster Session, AASV Foundation Top Student Presenter Scholarship)

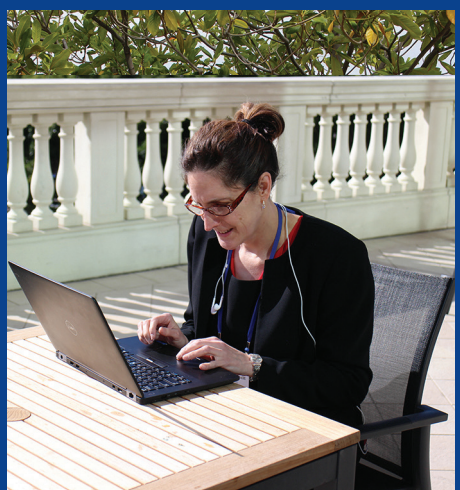
The AASV is also grateful to the 101 companies and organizations that provided support through their participation in the 2018 Technical Tables exhibit.

Thank you all!

GLOBAL KNOWLEDGE:
Individual application


Harry Snelson
AASV Director of Communications
STAFF
Jodi Bell
STAFF


A novel approach to water medication calculations



FOUNDATION NEWS

Four research projects funded in 2018

Dr John Waddell, chairman of the AASV Foundation, announced the selection of four research proposals for funding during the foundation's annual luncheon on March 4th in San Diego, California. The foundation granted a total of $60,000 to support efforts by researchers at Iowa State University and the University of Minnesota.

AASV Foundation Chairman Dr John Waddell (right) with Drs Jianqiang Zhang (left) and Daniel Linhares (center), whose research proposals were selected for funding by the foundation. Not pictured: Dr Perle Boyer.

A $30,000 grant was awarded to fund the project "Refining PRRSV classification system and sequencing reports to better characterize genetic diversity and relatedness of PRRSV," to be carried out by Dr Jianqiang Zhang and co-investigators at Iowa State University (ISU). The study will analyze an ISU Veterinary Diagnostic Laboratory (VDL) dataset of 37,345 PRRSV-2 (North American type) ORF5 sequences spanning 2000 to 2017, in order to refine a previously described lineage classification system. The resulting thorough phylogenetic lineage classification system will 1) help describe genetic diversity and relatedness of PRRSV-2 in the US, 2) improve sequence reports of diagnostic cases, and 3) determine the prevalence and geographic distribution of PRRSV-2 in the US in regards to lineages and RFLP patterns. It is hoped that the classification system will provide a basis for further characterization of the antigenic relationship and cross-protection between different PRRSV-2 lineages in future studies.

Dr Daniel Linhares and various co-investigators at Iowa State University received funding for two separate projects. The foundation awarded $12,582 for Dr Linhares' proposal to study "The effect of attenuated PRRSV mass vaccination on subsequent downstream mortality." The goal of the project is to assess the impact of quarterly modified live virus (MLV) mass vaccination of PRRSV-stable breeding herds on grow-to-finish mortality using natural experiments under field conditions. The results will provide information to help swine veterinarians make better informed decisions regarding the use of PRRSV MLV and other interventions in the sow herd to reduce wean-to-market mortality.

The foundation granted an additional $8,418 to carry out Linhares' second proposal, "Monitoring ISU VDL data for signs of emerging diseases." This project will develop and incorporate analytical tools for the automated detection of significant changes in test results of major swine pathogens, allowing early identification of disease threats affecting swine.

Dr Perle Boyer at the University of Minnesota received a grant of $9000 to fund her proposal to develop day-one competencies for swine veterinary graduates. The project will be carried out by a faculty task force at the University of Minnesota, with input by swine practitioners from across the US and Canada. The resulting prioritized list of skills will be published and shared with other colleges of veterinary medicine and made available to veterinary students at the AASV annual meeting and on the AASV website.

Dr Nathan Winkelman chaired the scientific subcommittee responsible for reviewing and scoring the proposals received for consideration, and he joins the foundation in thanking Drs John Baker, Tim Blackwell, Peggy Anne Hawkins, Martin Mohr, and Jerry Torrison for their service on the subcommittee.

An overview of past and current projects funded by the foundation is available at **www.aasv.org/foundation/research.htm**. The foundation will issue its next call for research proposals in the fall of 2018.

Foundation honors Schmidt with prestigious Heritage Award

Dr Conrad "Connie" Schmidt received the American Association of Swine Veterinarians Foundation's Heritage Award during the AASV's 49th Annual Meeting in San Diego, California. Dr John Waddell, AASV Foundation chair, presented the award to Dr Schmidt on March 4th. He becomes the fourth recipient of the award which recognizes individuals who have lifelong outstanding achievements in swine veterinary medicine. It is only awarded when a deserving individual has been nominated and selected. Awardees have demonstrated their worthiness through their membership in the AASV, service to the AASV, and service to the North American swine industry.

Dr Schmidt graduated from the University of Minnesota College of Veterinary Medicine. For 30 years he was an owner and staff member of a large veterinary practice specializing in production animal medicine. Dr Schmidt has received various honors from the American Association of Swine Veterinarians and state association for his leadership position in the animal production industry.

As a partner in the Veterinary Medical Center PA of Worthington Minnesota, he served as the President of Oxford Veterinary Laboratories as well as senior staff member for the clinic. Dr Schmidt served as a Vice President of UpJohn Animal Health, as well as Pharmacia. In 1987 Dr Schmidt was recognized by the State of Minnesota as the entrepreneur of the year.

Currently Dr Schmidt is President of CB Schmidt and Associates LLC. For more than 12 years, Dr Schmidt has been very active in establishing technologies that will improve and maintain electronic data and health records in the animal production arena. He also has been actively involved with developing and evaluating various pathways to use natural substances as well as various microbial components to improve animal health and wellness.

When asked to reflect on his career as a swine veterinarian and his involvement with AASV, Dr Schmidt replied, "Since the inception of the AASV and the AASVF, I have found that swine veterinarians, as well as our association, are truly committed to our veterinary profession, animal health and wellness, and our animal protein producers. It has been a privilege to see our association grow and succeed in providing the leadership to make our meat supply safe and wholesome. Our accountability to animal health and wellness as well as respected animal care practices is what makes this profession great."

Dr Conrad Schmidt, recipient of the AASV Foundation Heritage Award.

Past Presidents' Challenge spurs endowment growth

Last August, AASV Foundation Chairman Dr John Waddell initiated the Past Presidents' Challenge to reach the foundation's goal of achieving $2 million in restricted funds by the 2019 AASV Annual Meeting. The past presidents have risen to the challenge by generating nearly $250,000 in new contributions and pledges through the addition of 12 Leman Fellows, 8 Heritage Fellows, and 4 Legacy Funds to the endowment. As a result, the current total of endowed contributions plus additional board-restricted funds has risen to approximately $1,260,000.

So far, 12 past presidents have garnered points in the competition to encourage new endowment contributions. The point system is based on the amount of the donation, so the establishment of a Legacy Fund ($50,000) is worth 50 points, a new Heritage Fellow ($5000) generates 5 points, and a new Leman Fellow ($1000) is worth 1 point in the competition.

Dr Tim Loula leads the challenge with 56 points from the addition of a Leman Fellow, a Heritage Fellow, and a Legacy Fund. Dr Bob Morrison follows with 52 points, as one Legacy Fund has been established and two Leman Fellow contributions have been made in his honor. Dr Jim McKean is credited with 50 points and Dr Rodney "Butch" Baker with 45 points.

Although her challenge point total is substantially less, Dr Lisa Tokach is responsible for enlisting the greatest number of new contributors: four new Leman Fellows and one Heritage Fellow. Other past presidents who have recruited one or more donors include Drs George Charbonneau, Joe Connor, Randy Jones, Alex Ramirez, Max Rodibaugh, Larry Rueff, and John Waddell.

The Leman, Heritage, and Legacy contributions provide the basis for a perpetual source of income for foundation programs, including scholarships, swine externship grants, travel stipends for veterinary students, research grants, and more!

If you are ready to lend your support and help build the endowment to ensure future support of the swine veterinary profession, visit **www.aasv.org/foundation** or contact the foundation by phone, 515-465-5255, or email, **aasv@ aasv.org**.

Auction helps build school in India and supports the AASV Foundation

The 2018 American Association of Swine Veterinarians Foundation (AASVF) held its annual fundraising auction on March 5th during the 49th AASV Annual Meeting in San Diego, California. This year's auction raised $120,240!

The funds raised during the auction support foundation programs, including student travel stipends, research projects, scholarships, student externships, awards, support for veterinarians pursuing board certification in the American College of Animal Welfare, and other opportunities to enhance the personal and professional aspects of swine veterinary medicine.

Dr Butch Baker, Foundation Auction Committee chair, once again put together a consortium of 49 individuals and organizations (see sidebar on page 171) to bid on the "Build a School in India" project. The AASVF received the winning bid of $49,000, while Pipestone Veterinary Services made a matching contribution to Indian Evangelical Team (IET) to build an elementary school and bring education to hundreds of India's children. The IET is a network of Christian ministries throughout India, Nepal, and Bhutan that enrolls the poorest of children and empowers them with education and literacy. Pipestone has previously supported IET and missions. The plans are to fund a new school that will enroll 400 to 500 students (Kindergarten through 7th grade) and name it in honor of Dr Bob Morrison, Pam Wetzell, and Deb Spronk.

Auctioneers Drs Tom Burkgren and Shamus Brown called the auction assisted by Wes Johnson, who generously lent his capable clerking services. The spirited live auction raised $98,600 in addition to the $16,890 collected during the silent auction and $4,750 in cash donations. For the second year, bidding on the silent auction was paperless with all bids submitted electronically via ClickBid Mobile Bidding.

The foundation thanks all those who participated in the auction by bidding on or donating items, as well as those who served on the auction committee chaired by Dr Butch Baker.

Visit **www.aasv.org/foundation/2018/auctionlist.php** to view auction results.

Special thanks goes to the bid-takers: Jeff Harker, Howard Hill, Terry Metcalf, Darrell Neuberger, David Reeves, Jess Waddell, and John Waddell, who kept the bids coming. In addition, the following folks' behind-the-scenes and front-end help was invaluable: Miranda Ayers, Joel Burkgren, Sue Kimpston, Kay Kimpston-Burkgren, David and Karen Menz, Barbara Molnár Smith, Karen Richardson, Lee and Sue Schulteis, Tina Smith, and Harry Snelson.

And the winners are…

Thank you to ALL who made a contribution or placed a bid on items in the live and silent auctions.

Thanks to your generosity, the auction raised $120,240 for the AASV Foundation!

We are pleased to recognize the winning bidders who purchased one or more items at the auction:

JoAnn Alumbaugh
Paul Armbrecht
Miranda Ayers
Erin Brenneman
Robin Bretey
Emily Byers
Dean Dau
Todd Distad
Jim Fairles
Cally Fix
Wayne Freese
Jerome Geiger
Christa Goodell
Dwain Guggenbiller
Jennifer Hasty
Peggy Anne Hawkins
Sheryl Heirigs
Daniel Hendrickson
Clayton Johnson
Kerry Keffaber
Barry Kerkaert
Ian Levis
Duane Long
Erin Lowe
James Lowe
Wesley Lyons
Rodger Main
David Scott McVey
Karen Menz
Michelle Michalak
Eric Moore
Jana Morgan
Bryan Myers
Mandi Neujahr
David Nolan
Daryl Olsen
Thomas Petznick
Meghann Pierdon
Mike Pierdon
Doug Powers
Ben Pratte
Alejandro Ramirez
Rebecca Robbins
Gary Robertson
Max Rodibaugh
Brian Roggow
Dan Rosener
Cameron Schmitt
Jeff Schoening
Sue Schulteis
Randy Simonson
Chase Stahl
William Starke
Amber Stricker
Debra Thompson
Elise Toohill
Dennis Villani
Mark Wagner
Liz Wagstrom
Warren Wilson
Teddi Wolff
Paul Yeske

We are pleased to recognize the members of the AASVF 2018 Consortium:

Paul Armbrecht
Butch and Emma Baker
John E Baker
Bob Blomme
Jeff Blythe
David C Bomgaars
Mary Lou Chapek Hogg
Dyneah Classen
Larry Coleman
Tom Fangman
Wayne Freese
Phil Gauger
Jer and Becky Geiger
Tom and Denise Gillespie
GlobalVetLINK
Doug Groth
Pat Halbur
Peggy Anne Hawkins
Steve Henry
Tyler and Gayle Holck
Bill Hollis
Clayton Johnson
Jean (Mrs. Rod) Johnson
Randy Jones
Kerry and Betsy Keffaber
Paul Knoernschild
Hans Koehnk
Erin and Jim Lowe
Aaron Lower
Bill Minton
NutriQuest
Daryl and Nancy Olsen
Jodie Pettit
Phibro Animal Health
Sarah Probst Miller
Hans Rotto
Craig Rowles
Alan Scheidt
Steve and Jane Schmitz
Peter Schneider
Randy Simonson
Mike and Lisa Tokach
Rick Tubbs
Dennis Villani
John and Carol Waddell
Keith Wilson
Warren and Marilyn Wilson
Nathan Winkelman
Teddi Wolff

Ten veterinary students receive $5000 scholarships

In partnership with the AASV Foundation (AASVF), Merck Animal Health announced the recipients of the 2018 AASVF - Merck Animal Health Veterinary Student Scholarships during the 49th AASV Annual Meeting in San Diego, California. A panel of AASV and foundation board members selected ten students to receive the scholarships from a pool of 47 applicants.

The recipients, who each received a $5,000 scholarship, were:

- Jacob Baker, Iowa State University
- Kimberlee Baker, Iowa State University
- Rachel Bardot, University of Missouri
- Stephanie Betbeze, Lincoln Memorial University
- Megan Bloemer, University of Illinois
- Kayla Henness, University of Illinois
- Evan Koep, Iowa State University
- Marjorie Schleper, University of Minnesota
- Joel Steckelberg, Iowa State University
- Jonathan Tubbs, Auburn University

The scholarship program, now in its third year, was funded by a generous $50,000 contribution from Merck Animal Health, assisting the foundation's mission to support the development and scholarship of students and veterinarians interested in the swine industry.

Second- and third-year veterinary students enrolled in American Veterinary Medical Association-accredited or recognized colleges of veterinary medicine in the United States, Canada, Mexico, South America and the Caribbean Islands were eligible to apply. Learn more at `https://www.aasv.org/foundation`.

Recipients of the $5000 AASVF-Merck Veterinary Student Scholarship (from left): Joel Steckelberg, Iowa State University; Jonathan Tubbs, Auburn University; Marjorie Schleper, University of Minnesota; Jacob Baker, Iowa State University; Kimberlee Baker, Iowa State University; Evan Koep, Iowa State University; Kayla Henness, University of Illinois; and Stephanie Betbeze, Lincoln Memorial University. Not pictured are scholarship recipients Rachel Bardot, University of Missouri; and Megan Bloemer, University of Illinois.

Three veterinarians receive Hogg Scholarships

Drs Jose Angulo, Angela Baysinger and Amanda Sponheim were named the 2018 recipients of the American Association of Swine Veterinarians Foundation Hogg Scholarship. Mary Lou Hogg presented the scholarships during the American Association of Swine Veterinarian's 49th Annual Meeting in San Diego, CA.

Established in 2008, the scholarship is named for Dr Alex Hogg, who was a leader in swine medicine and pursued a Master's degree in veterinary pathology after 20 years in a mixed-animal practice. The scholarship is awarded to an AASV member who has been accepted into a qualified graduate program to further his or her education after years as a swine practitioner.

Mary Lou Hogg presents the Alex Hogg Memorial Scholarship award to Drs Jose Angulo and Amanda Sponheim. Not pictured: Dr Angela Baysinger.

Dr Jose Angulo earned his doctor of veterinary medicine and zootechnics from the Instituto Tecnologico de Sonora in 2001. Following graduation, he joined Grupo SOLES based in Sonora, Mexico where he served as the Production and Health Planning and Development Coordinator. Since leaving Grupo SOLES in 2004, Angulo has worked in swine technical services for Boehringer Ingelheim, ELANCO Animal Health, and Zoetis, where he is currently the managing veterinarian specializing in Porcine Reproductive and Respiratory Syndrome (PRRS). He plans to apply the Hogg Scholarship to help fund his master's program at the University of Minnesota College of Veterinary Medicine. His research project is under Dr Montserrat Torremorell and focuses on PRRS virus incidence in growing pigs and factors that drive infections in wean-to-finish farms.

Dr Angela Baysinger earned her doctor of veterinary medicine in 1992 from the University of Missouri-Columbia College of Veterinary Medicine where she graduated Summa Cum Laude. Following graduation, Baysinger accepted an associate veterinary position at Sutton Veterinary Clinic in Sutton, Nebraska. She left practice in 1995 to earn a master's degree in epidemiology at the University of Nebraska-Lincoln while serving as the interim state swine extension veterinarian. Baysinger has since worked as a swine technical services veterinarian with ALPHARMA and Boehringer Ingelheim interspersed with a short stint as a self-employed swine consultant and two and one-half years as a Health Assurance Veterinarian with PIC. Her interest in focusing on animal welfare arose during her 7 years (2000 to 2007) as Vice President of On-farm Food Safety and Animal Welfare at Farmland Foods. Her expertise in welfare continues in her current role as Director of Animal Welfare for all species at Merck Animal Health. Baysinger plans to pursue a master's degree in animal welfare, ethics and law at the University of Edinburgh through a distance learning program followed by pursuit of board certification in the American College of Animal Welfare.

After receiving her doctor of veterinary medicine in 2008 from the University of Illinois College of Veterinary Medicine, **Dr Amanda Sponheim** spent two years as a Health Assurance Veterinarian with PIC. In 2010, she joined Boehringer Ingelheim where she now serves as Strategic Account Technical Services Veterinarian. Sponheim began her master's degree program at the University of Minnesota College of Veterinary Medicine in 2016 under the guidance of Dr Maria Pieters. She is focusing on three thesis projects addressing industry knowledge gaps related to diagnostic approaches for detection of *M hyopneumoniae* in low and high prevalence scenarios. She plans to apply the Hogg Scholarship funds to the completion of this program.

Update on committee meetings in San Diego

Fourteen issue-based committees met during the 2018 American Association of Swine Veterinarians' (AASV) 49th Annual Meeting in San Diego, California. The AASV Board of Directors establishes committees to address specific issues associated with swine veterinary medicine and provide recommendations for actions to the AASV leadership. In addition to being an integral part of the leadership structure within AASV, the committees also serve as a great way for members to participate in developing positions for the association, learn about a particular issue, and meet other members. In 2017, over 215 AASV members volunteered to serve on at least one committee. That's a lot of experience focused on the issues of swine health, well-being, and production.

The following are some key highlights from the committee meetings:

- The **Nutrition Committee** discussed the value of keeping all members informed of nutritional information that veterinarians could use on-farm and the need for the continued cooperation of the nutrition and veterinary professions. In addition, the committee discussed the increase in sow mortality and its association with uterine prolapses. The National Pork Board has begun a project to qualify this issue. The committee also began planning for its 2019 nutrition pre-conference workshop.

- The **Student Recruitment Committee** is requesting funding from the AASV Board to continue hosting, along with the Iowa State University College of Veterinary Medicine's (ISU CVM) Swine Medicine Education Center and the ISU CVM AASV Student Chapter, the Swine Medicine Talks series. The Swine Medicine Talks is a three-part live-streamed lecture series with expert speakers representing a wide range of topics. They also considered clarifying the defined responsibilities of the AASV Student and Alternate Student Delegates.
- The **Boar Stud Committee** focused on continuing discussions with the Pig Welfare Committee on the issue of cull boar transport and euthanasia. The committee also discussed the potential impacts of Seneca Valley virus A, porcine circovirus 3, parvovirus, and pestivirus on boar studs. They also considered the need for standards and resources to support show pig studs and began planning for a pre-conference seminar during the 2019 AASV Annual Meeting.
- The **Influenza Committee** proposes to survey the membership to gain a better understanding of AASV member attitudes regarding the US Department of Agriculture's Influenza A Virus-Swine (IAV-S) surveillance program, vaccine usage, and influenza risk at fairs and exhibitions. They expressed support for the IAV-S surveillance program and raising awareness about the zoonotic potential of influenza.
- The focus of the **Communications Committee** during the 2018 Annual Meeting was a proposal to develop an educational training video displaying routine farrowing house practices in Spanish as a tool to assist veterinarians in educating employees. The committee members are interested in further exploring how social media might benefit AASV members.

"In addition to being an integral part of the leadership structure within AASV, the committees also serve as a great way for members to participate in developing positions for the association, learn about a particular issue, and meet other members."

- The **Committee on Transboundary and Emerging Diseases** was asked to consider the use of live virus inoculation and whether AASV needed to provide any insight or develop a position on the issue. The committee felt they did not have enough information to offer an opinion on the issue but did suggest that this would be a good topic for either a closed-door session at World Pork Expo or as part of a pre-conference workshop at the 2019 Annual Meeting. The pre-conference seminar might also consider the issue of how to address the porcine epidemic diarrhea virus – eradication, elimination, or endemic classification. They also developed a working group to provide some feedback to USDA regarding the 2020 National Animal Health Monitoring System swine study.
- The **Human Health and Safety Committee** (HHS) plans to partner with the Influenza Working Group to develop an influenza survey for the AASV membership. The Committee would like to engage the exhibition swine industry to reduce zoonotic influenza A virus transmission. In addition, the HHS committee would like to work with the Pork Safety Committee to produce six short articles (three on zoonotic diseases and three on safety) for the one health corner in AASV e-Letter.

Advocacy in action continued on page 175

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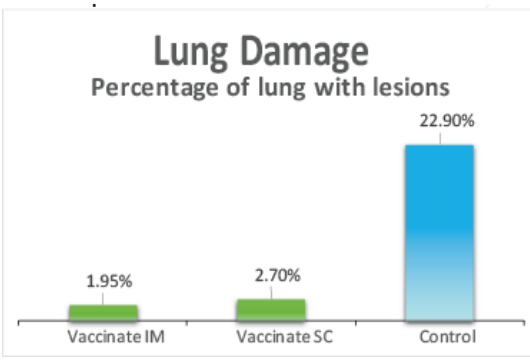

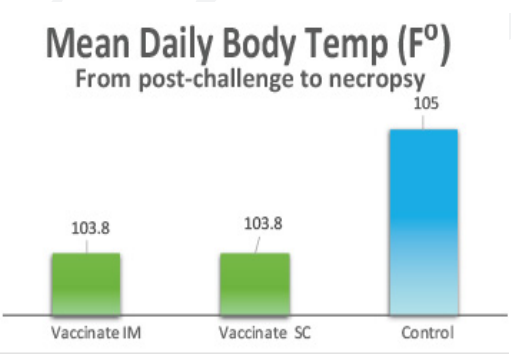

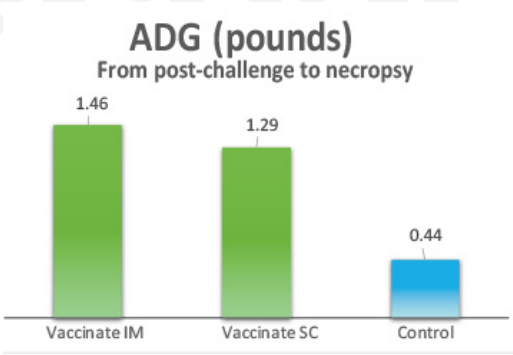

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Advocacy in action continued from page 173

- The **Operation Main Street (OMS) Committee** noted that the demand for veterinarians as OMS speakers is increasing as OMS expands its reach further into high-level influencer audiences such as human health professionals (nurses and schools of medicine), dietitians, food service, and grocer associations. In addition, it is necessary to reach from coast to coast to influence a large percentage of the US population. Key messages for this year will focus on antibiotic use in food-animal agriculture and addressing the labor shortage in agriculture. Furthermore, a virtual farm tour by video or live stream as a way to deliver information and build trust with key audiences will be combined with select OMS presentations. The AASV OMS Committee will encourage veterinarians to become trained OMS speakers to help fill the demand for highly educated presenters. A special emphasis will be placed on inviting veterinarians from the western third of the United States to deliver west coast presentations.
- The **Production Animal Disease Risk Assessment Program (PADRAP) Advisory Committee** discussed the shutdown of the PADRAP web site effective July 1, 2018. Dr Holtkamp will make sure that Iowa State University will maintain the database going forward for AASV. They will also maintain the current tool to be available for any member to access it, but the tool will not be in a web application. Requests to access to the database will be considered similar to any other research project proposal. Since the program will be ending, the committee requests the AASV Board sunset the committee.
- The **Pharmaceutical Issues Committee** continues to work with National Pork Board to update the maximum residue limits for pork exports. The committee is also tracking the progress of Food and Drug Administration-funded projects to establish metrics to measure on-farm antibiotic use. Dr Peter Davies is the principle investigator on a swine project. The committee was also asked to provide input into the development of a preventative use definition for the upcoming G7 Country meeting and a risk assessment on the availability of antibiotics.
- The **Pork Safety Committee** is designing a survey targeting farrowing house employees to establish a baseline of knowledge for swine veterinarians about current training on needle breakage. New technologies at the packing and processing plants have resulted in the increased detection of smaller gauge needles at market hog harvest. The committee hopes this data will allow the development of better injection management and training of employees. The committee is also reviewing existing fact sheets on hepatitis E virus in swine and its potential impact on human health. They plan to offer any necessary revisions or develop a new fact sheet as appropriate. Salmonella was also a topic of discussion as relates to food-borne illness in humans.
- The newly re-populated **Membership Committee** met for the first time. This committee is one of only a couple specifically mandated in the AASV bylaws. A group of AASV Past Presidents agreed to participate as members of the committee to be chaired each year by the current past president. The committee offered input in 2017 on the AASV Salary Survey and the American Veterinary Medical Association's (AVMA) draft Model Practice Act. During their meeting in San Diego, they concentrated on discussing proposed activities for the association's 50th anniversary meeting in 2019.
- The **AASV Porcine Reproductive and Respiratory Syndrome (PRRS) Task Force** is requesting funding to support a sub-committee meeting to revisit the AASV Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) Herd Classification document. It has been seven years since the document was published. The task force felt very strongly about the need to revisit the guidelines given the advances on PRRSV testing strategies and the wide use of PRRSV vaccination in breeding herds. The current guidelines are at risk of becoming obsolete unless they are updated. The committee also expressed interest in promoting outbreak investigations of PRRSV infections and the creation of a system to generate a database to retain and analyze investigation information.
- The **Pig Welfare Committee** congratulated Dr Meghann Pierdon on successfully completing the certification examination for the American College of Animal Welfare. Scholarships are available from the AASV Foundation to help offset the cost of getting credentialed and taking the exam. Dr Pairis-Garcia and Dr Madonna Benjamin are in the process of becoming certified. The AVMA is currently reviewing two welfare policy statements, one of which concerns castration of swine. Dr Michelle Sprague is working with AVMA to ensure their policy mirrors that of AASV. The other involves the use of livestock handling tools. Dr Sprague recommends reaffirming this policy as written. The committee reviewed six AASV position statements and reaffirmed three while suggesting minor edits to two others. The Anti-Abuse position statement was modified to more closely align with the Common Swine Industry Audit. The Board of Directors will consider the committee's recommendations. The committee discussed several topics that may become significant in the future, including space requirements, genetic traits that can impact animal welfare, mortality rates, disposition of runt and blemished pigs, and the use of farrowing crates.

The committees are an integral part of the AASV leadership and we appreciate the efforts of the volunteer members. If you are interested in learning more about the committee activities, visit the committee web pages on the AASV web site (**www.aasv.org/members/only/committee/**). Contact the committee chair or the AASV office to join a committee.

Harry Snelson, DVM
Director of Communications

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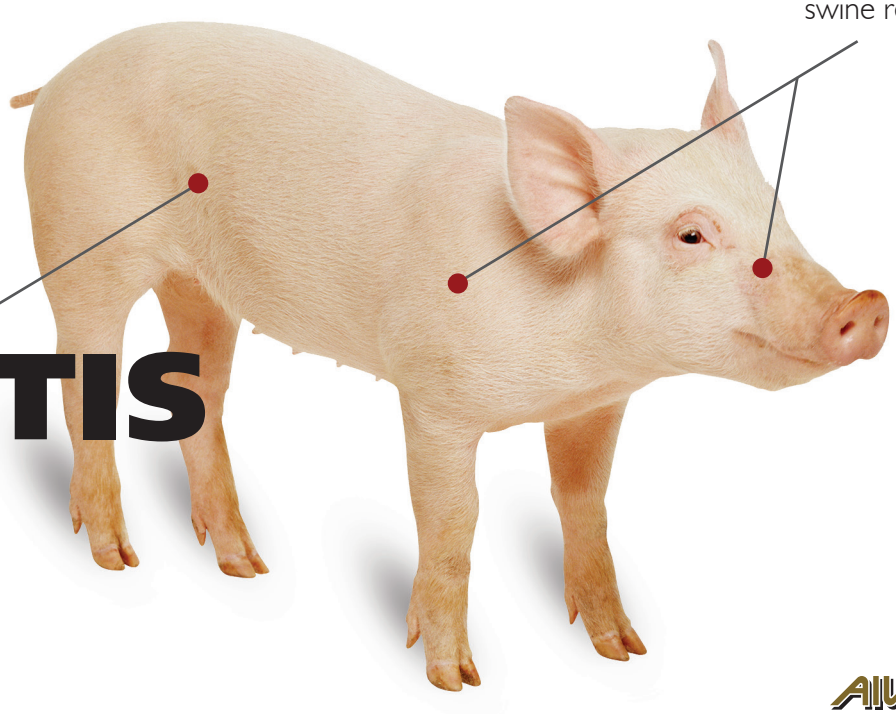

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Water Soluble Granules

AIVLOSIN® is your powerful new tool for cost-effective control of ***both*** SRD and ileitis with ***no*** withdrawal period. Tylvalosin, the active ingredient of AIVLOSIN, is a potent new macrolide antibiotic that provides rapid and effective control of SRD and ileitis. AIVLOSIN can be conveniently administered in drinking water, offering you flexibility and outstanding results when targeting SRD or ileitis in just a single pen or whole-house outbreaks. Ask your veterinarian about trying AIVLOSIN in your herd.

AIVLOSIN®

Important Safety Information: Available under prescription only. AIVLOSIN is indicated for the control of swine respiratory disease (SRD) associated with *Bordetella bronchiseptica, Haemophilus parasuis, Pasteurella multocida,* and *Streptococcus suis*, or PPE caused by *Lawsonia intracellularis*, in groups of swine in a house experiencing an outbreak of either disease. For use only in the drinking water of pigs. Not for use in lactating or pregnant females, or males and females intended for breeding. People with known hypersensitivity to tylvalosin tartrate should avoid contact with this product. When used in accordance with label directions, no withdrawal period is required before slaughter for human consumption.

14040 Industrial Road, Omaha, NE 68144
800.832.8303 www.pharmgateAH.com

PharmGate Animal Health

Classified advertisement

Position Announcement: Asia Regional Health Assurance Director

PIC Asia is seeking a Regional Health Assurance Director to be based in Shanghai, China. This position will lead the implementation and communication of the science-based and comprehensive PIC Health Assurance Program that enables the sustainable delivery of superior healthy genetic merit to customers. The individual will also collaborate with leading organizations in developing and validating innovative health solutions for the swine industry and with the global PIC health team in developing and refining the PIC Health Assurance Program.

The position requirements include:

- Degree of Veterinary Medicine from an accredited veterinary college
- At least 10 years' experience in swine medicine (diagnostics and epidemiology) and production
- Ability to work with all levels of production systems (owners, senior managers, production managers, technicians, nutritionists, veterinarians)
- Experience leading professional teams preferred
- Ability to effectively lead and develop high performing teams in an environment of collaboration and creativity
- Demonstrated ability to influence internal and external stakeholders to achieve high levels of performance improvement
- Excellent communication, planning, and organizational skills
- Proficiency with information technology tools for analysis and communication of health and production related data
- Willing to travel domestically and internationally including extensive travel within PIC wholly owned businesses in China, Philippines, and Russia, and franchises in Japan, South Korea, Vietnam, Australia, New Zealand, and key accounts in Thailand
- Asia region experience an advantage but not a requirement
- Pioneering, resilient, patient, can-do attitude essential.

To apply, interested candidates should submit their resume and cover letter to **careers@pic.com**.

Pigs of #instaham

Share your best pig photos for JSHAP publication.

The *Journal of Swine Health and Production* would like to publish digital photographs submitted by our readers. Images used either on the front cover or in the photo corner on the back page are to represent healthy pigs and modern production facilities. Please ensure that the photos do not include people. Select the largest image size available on your camera (not cell phone) of the quality or compression that allows you to store the fewest images on a given memory card. Do not resize, crop, rotate, or color-correct the image prior to submission to the journal. Please send the images by e-mail attachment to **tina@aasv.org**. Also include your name, affiliation, and the approximate location of the image, or other details that you would like to submit which describe the image.

Upcoming meetings

10th European Symposium of Porcine Health Management

May 9-11, 2018 (Wed-Fri)
Barcelona, Spain

For more information:
Joaquim Segalés
E-mail: joaquim.segales@irta.cat
Maria Sanmiguel
E-mail: msanmiguel@pacifico-meetings.com
Web: www.esphm2018.org

Pork Expo Africa

May 17-19, 2018 (Thu-Sat)
Mandela National Stadium, Namboole - Kampala Uganda.
Hosted by Pig Production and Marketing Uganda Limited

For more information:
Christopher Mulindwa
PO Box 441 Kampala Uganda
Tel: +256773422445
E-mail: chrismulindwa@pigfarmers.co.ug
Web: www.porkexpoafrica.co.ug

6th International Symposium on Animal Mortality Management

June 3-7, 2018 (Sun-Thu)
Embassy Suites, Amarillo, Texas

For more information:
Web: animalmortmgmt.org/

World Pork Expo

June 6-8, 2018 (Wed-Fri)
Iowa State Fairgrounds, Des Moines, Iowa
Hosted by National Pork Producers Council

For more information:
Web: worldpork.org

25th International Pig Veterinary Society Congress

June 11-14, 2018 (Mon-Thu)
Chongqing, China

For more information:
Web: www.ipvs2018.net/

11th Biennial Conference of the Association for Applied Animal Andrology

July 14-16, 2018 (Sat-Mon)
Hilton Riverside, New Orleans, Louisiana

For more information:
Dr Steven P. Lorton
E-mail: splorton04@tds.net
Web: animalandrology.org/futuremeetings.htm

Allen D. Leman Swine Conference

September 15-18, 2018 (Sat-Tue)
Saint Paul River Centre, Saint Paul, Minnesota

For more information:
Tel: 612-624-4754
E-mail: vetmedccaps@umn.edu
Web: ccaps.umn.edu/allen-d-leman-swine-conference

Humane Endings Symposium

November 2-4, 2018 (Fri-Sun)
Westin O'Hare, Rosemont, Illinois
Hosted by American Veterinary Medical Association

For more information:
E-mail: humaneendings@avma.org

American Association of Swine Veterinarians 50th Annual Meeting

March 9-12, 2019 (Sat-Tue)
Hilton Orlando Buena Vista Palace
Lake Buena Vista (Orlando), Florida

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

Asian Pig Veterinary Society Congress 2019

August 26-28, 2019 (Mon-Wed)
BEXCO, Busan 55, APEC-ro, Haeundae-gu, Busan
Republic of Korea
Tel: +82 51-740-7300

For more information:
Amy Chang (Secretariat of APVS 2019):
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E-mail: sue@innon.co.kr
Web: www.apvs2019.com

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

AASV Industry Support Council

The JSHAP is made possible by the generous support of the following Industry Support Council members:

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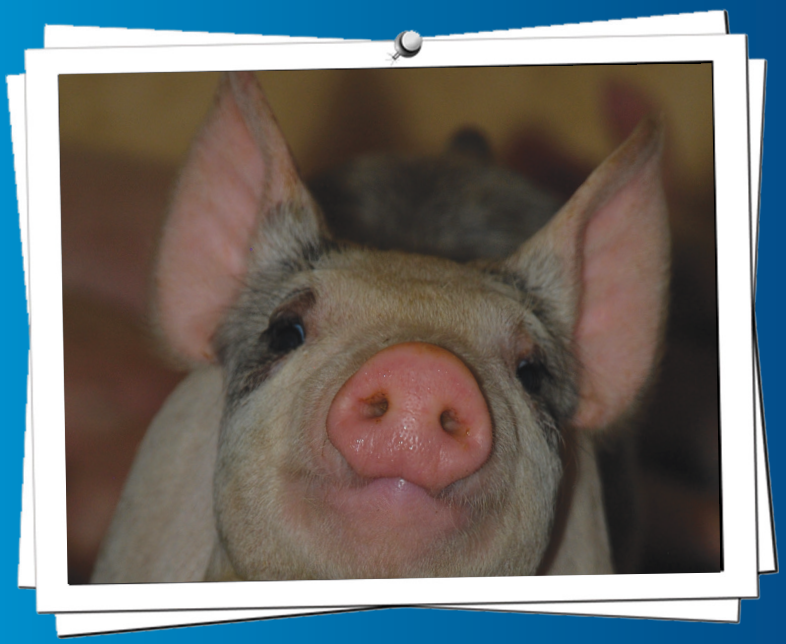

Photo Corner

Piglet in Central Iowa smiles for the camera

Photo courtesy of Tina Smith