November and December 2017 • Volume 25, Number 6

Journal of Swine Health & Production

The Journal of the American Association of Swine Veterinarians

Journal of Swine Health and Production

(**ISSN 1537-209X**) Volume 25, Number 6; November and December 2017

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

The *Journal of Swine Health and Production* is a refereed publication and is a benefit of membership in the American Association of Swine Veterinarians. 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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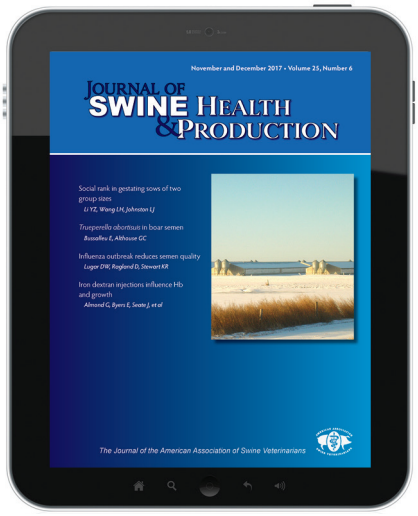

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Wintery morning in a Nebraska finishing site

Photo courtesy of Dr John Waddell

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"...I would like to extend my gratitude to these individuals (reviewers) for their contribution to the peer-reviewed literature as well as the success of the journal. Thank you!"

quoted from the Executive Editor's message, page 289

Outsmart outbreaks.

Flu strains are constantly evolving. So is FluSure XP®. It's the only commercial swine vaccine that helps provide cross-protection against the most prevalent influenza strains impacting hog farms today,[1-3] backed by the ongoing commitment of Zoetis to actively monitor and combat new strains.

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End of science?

It is sad to think of a time when science is no longer believable. As veterinarians we have been well indoctrinated in the value and importance of science. Science focuses on advancing knowledge to make this world a better place. We pride ourselves as a profession and industry that makes decisions based on science. Lifelong learning is part of our culture. Unfortunately, I believe we are approaching a time when too often science no longer plays a role in major decision making.

I am definitely an optimist. I believe most people are good and try to do the right thing. My concern is that the media (regular media as well as social media) are moving away from what I call "true science" and focusing mostly on public perception or "impact," such as number of times something has been viewed, likes, re-tweets, etc. These media are just a reflection of our population worldwide. For many, science today is only believable if it supports a particular viewpoint or bias. Unfortunately, with the existence of the Internet, we can find "science" to support just about any perspective we want. This is being complicated, and I may say threatened, by the large number of "open source" journals that are becoming available for publication. Every week I get e-mails from three to five new journals seeking articles for publication with a promise of quick "peer review" and publication. Many of these journals are predatory journals, meaning they are focused less on content and the peer review process and more on simply collecting fees for publication. What data or results should we trust? Unfortunately, for most of our consumers who are not scientists, their approach is simply to believe "published data" that support their agenda and discredit everything else, regardless of the source. That is a new reality and challenge for us. We are fortunate and grateful, though, for our great JSHAP journal.

"I believe we are approaching a time when too often science no longer plays a role in major decision making."

Company chief executive officers (CEOs) and many government entities are focusing less and less on science and more and more on keeping their "consumer" happy. Decisions are being made on summary statements, and no one is looking back to verify the context or validity of such statements. Even less often are individuals actually taking the time to evaluate the science and rigor of these publications. As true scientists, we must be open minded. We most certainly need to be skeptical, but on the same hand be open minded and fair in making judgements. Both of these points are critical. Regrettably, too often I see the public and sometimes academics and colleagues hold different standards for different data. No study is perfect. There are always things that could be improved. The real question is whether our concerns or objections on the research are truly justified or whether we are manipulating "standards" to fit our agenda.

As we focus on science to continue improving the health and wellbeing of the pigs we help care for, the real questions will be 1) Are we being fair in using science in decision making? and 2) Will our government officials, company executives, and consumers continue to trust good science?

Alex Ramirez, DVM
AASV President

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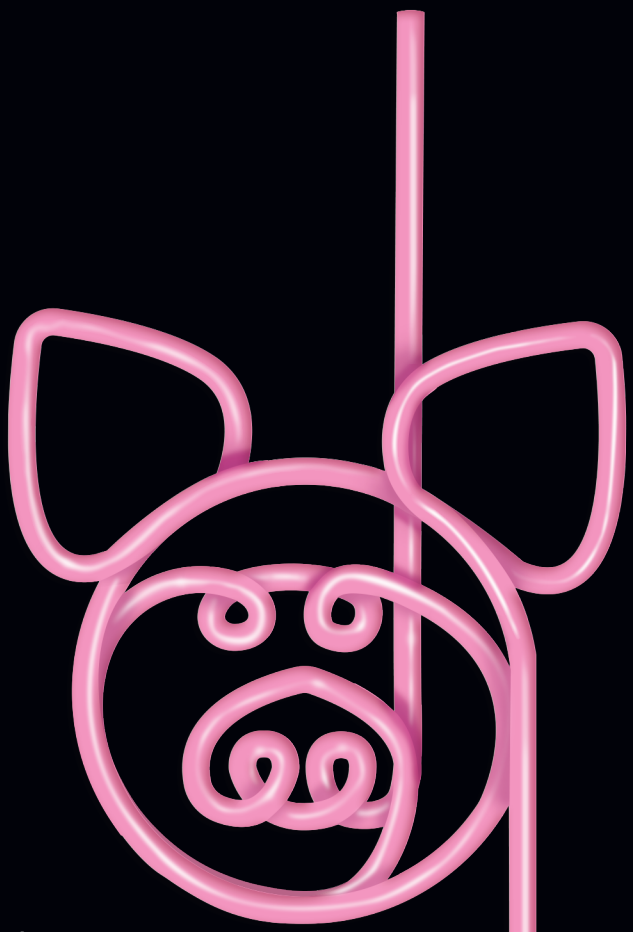

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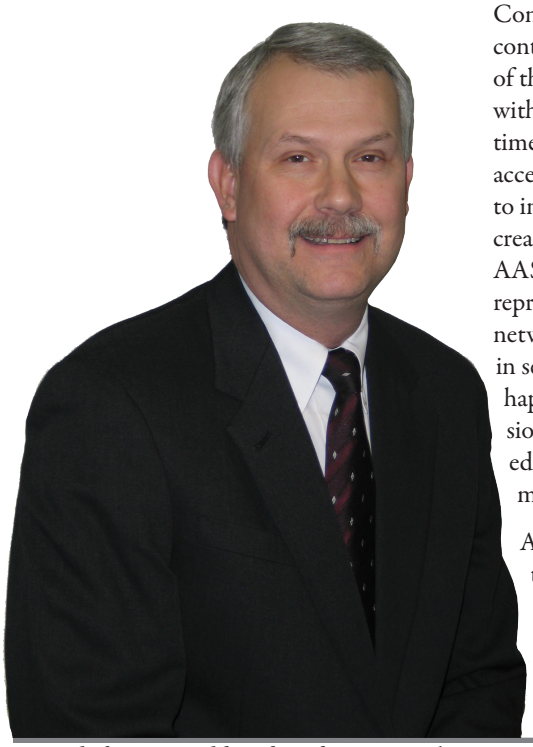
Creating value with gratitude

The American Association of Swine Veterinarians (AASV) has a long history of partnering with commercial companies during the annual meeting as well as in connection with other opportunities, including the *Journal of Swine Health and Production*, the AASV e-Letter, the AASV Membership Directory, and the AASV Foundation. Our goal has always been to create value for both the sponsoring company and our members. The challenge is to do that in a balanced manner that satisfies the needs of both.

Sponsorships directly offset expenses to the AASV and have a direct impact on the association's bottom line. As a result, membership dues and annual meeting registration fees are lower than would otherwise be possible, directly benefitting AASV members. Sponsorships also help support AASV publications and the Web site. The fact that AASV members benefit from sponsorships is undeniable. However, I am not convinced that members always demonstrate their gratitude for these sponsorships. It can be easy to take the companies for granted.

I encourage each and every member of AASV to take the time to say "thank you" to the people who work for the sponsoring companies. Acknowledging the role and the value that sponsorships provide for the association is vital to help companies realize the overall impact on members. I learned a long time ago that taking a benefit for granted is a great way to lose that benefit over time. If our members do not speak up on what the sponsorships mean to them, then companies will look for other ways to spend their marketing dollars.



"I encourage each and every member of AASV to take the time to say 'thank you' to the people who work for the sponsoring companies."

Part of my job is managing AASV's relationships with commercial companies. One of the greatest challenges in that relationship occurs when personnel changes occur within a company. If the new person is not familiar with the AASV, then the process has to begin to inform and educate that person about AASV and our members: AASV members can assist with that process. There is no more credible source than a member when it comes to explaining the role that AASV plays in swine veterinary medicine.

Conversely, it is also essential that the AASV continually strives to understand the needs of the companies. These needs can change with time. However, I have been told many times over the years that companies value access to our members and the opportunity to interact with them. The best example of creating value for companies is during the AASV Annual Meeting, where company representatives have ample opportunities to network with numerous swine veterinarians in several different settings. Networking can happen during the Industrial Partners sessions, at the Technical Tables exhibit, in the educational sessions, or during one of the meal-social events.

A more difficult task is trying to objectively measure the return on investment of a sponsorship. I can't tell a company that any given sponsorship is going to result in an increase in sales. Likewise, it would not be ethical for me to ask members to base their purchases on who does or who does not participate in sponsorships with the AASV. The companies must decide for themselves the value of creating goodwill among swine veterinarians and supporting the mission of the AASV.

The AASV is always willing to consider new marketing and sponsorship ideas from our partnering companies. Over the years I have come to appreciate the creativity shown by many in the area of marketing. I am also humbled by the gracious and respectful approach taken by companies in offering to help the AASV better serve its members. The commercial companies and the people working for them are very much woven into the fabric that makes up the AASV.

We do have some lines we will not cross. One is the sponsorship of specific educational topics and speakers. Another is any sponsorship that would require the endorsement of a commercial product or service by AASV. Ultimately, I depend on the officers and board of directors for guidance on sponsorships and commercial requests of the AASV. The collective wisdom of AASV leadership has so far been proven sound in the decision making over the last 49 years.

Perhaps it is my advancing age, but I find that I have to continually remind myself that we can't be stubborn and rely on what has worked in the past. Going forward with sponsorships, we can use our experiences to help frame and inform our decisions, but we should not rely on them to be the deciding factor. Finding the right combination that provides for the needs of the sponsoring company and benefits AASV members is the ultimate goal.

When both value and gratitude are understood, acknowledged, and expressed, then we have the best opportunity for successful partnerships with sponsors.

Tom Burkgren, DVM
Executive Director

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JSHAP's most wanted!

What is JSHAP's "Most Wanted List" and more importantly, who is on this list?

Ok, so you are thinking that Terri is being really silly with her message this issue. Well, perhaps just a little, but not entirely. I would like to invite all of you to consider being on JSHAP's "Most Wanted List," and this is not just any ordinary list but "the list" of potential peer reviewers for manuscripts that are submitted to the journal. So, to answer the question "who is on JSHAP's Most Wanted List?" – the answer is YOU! The journal has a list of many people who have reviewed in the past or who are potentially available to peer-review a manuscript. And we at the journal office are looking to see this list grow. How do you get on this list? It's simple: you let us know that you are interested in being contacted as a potential peer reviewer and provide your area(s) of expertise and your contact information. But, to be fair, I will explain what is typically involved.

I have written messages about the peer-review process in the past, and in my opinion it is professionally rewarding to contribute to the body of scientific literature by acting as a peer reviewer. It does, however, involve a modest time commitment and comes without financial compensation. Sounds like a great deal doesn't it (sarcasm!) But, please read on...

When a manuscript is submitted to the journal, peer reviewers are approached to inquire about their availability to conduct a review. A peer reviewer is selected on the basis of the topic of the manuscript and the reviewer's complementary area of expertise. If we do not know who you are or your area(s) of expertise, we may never know you are interested or potentially available. Each manuscript is reviewed by a panel of reviewers (usually three people) and the opinions and comments from many reviewers are combined into a review package for the authors. Typically, the reviews strengthen a manuscript, and sometimes very minimal revisions are requested or necessary.

"I would like to invite all of you to consider being on JSHAP's 'Most Wanted List,' and this is not just any ordinary list but 'the list' of potential peer reviewers for manuscripts that are submitted to the journal."

The time commitment required for a review can vary and usually depends on the length and complexity of the manuscript. But typically, the journal requires a reviewer to agree to return a review within 3 weeks of accepting a manuscript. This means, of course, that if you are asked to be a reviewer and the timeline doesn't fit into your current work demands, you can decline the review, eg, you can say "no" to a review request. Once a manuscript has returned from the panel of reviewers then the lead reviewer and executive editor (myself) make recommendation(s) to the author(s) and put together the review package. For example, there may be major revisions requested or minor revisions. As a reviewer, you will likely be asked to look at a manuscript a second time if any substantial revisions have been requested. This would typically be 8 weeks later, and again we would ask if you could do the re-review in an approximate 3-week timeline.

The journal uses a blinded review model in which the authors are blinded to the reviewers. Some journals use an unblinded model, but JSHAP blinds authors to the identity of the reviewers. If you are inexperienced at conducting a peer-review, the journal staff can provide some guidance for first-timers.

This issue of JSHAP also has published a list of recent reviewers and I would like to extend my gratitude to these individuals for their contribution to the peer-reviewed literature as well as the success of the journal. Thank you!

If you would like to be on JSHAP's "Most Wanted List" as a potential/available peer-reviewer, please use the link below and complete the short survey (5-10 minutes). Survey link **https://uoguelph.eu.qualtrics.com/jfe/form/SV_3q6Wc4gJKeg0GGh**.

Terri O'Sullivan, DVM, PhD
Executive Editor

Original research

Peer reviewed

Effects of social rank on welfare and performance of gestating sows housed in two group sizes

Yuzhi Z. Li, MSc, PhD; L. H. Wang, MSc, PhD; L. J. Johnston, MSc, PhD

Summary

Objectives: To compare welfare and performance among low-, middle-, and high-ranking sows in two group sizes of gestation pens.

Materials and methods: Pregnant sows (n = 152) were allocated to four pens of 26 sows (large-group pen) and eight pens of six sows (small-group pen) with floor feeding. Social rank was based on outcomes of aggression during mixing. Skin lesions were assessed for all sows and salivary cortisol concentrations were measured for 32 focal sows. Performance during gestation and lactation was recorded for all sows.

Results: Across the two group sizes, low-ranking sows fought less frequently, but had higher salivary cortisol concentrations and sustained similar skin lesions at mixing compared to high-ranking sows. Low-ranking sows had more skin lesions 5 weeks after mixing, gained less weight during gestation, and had lower body weight before farrowing than high-ranking sows. Social rank did not affect litter size farrowed, litter size weaned, or litter weight at weaning.

Implications: Under the conditions of this study, regardless of the group size adopted, low-ranking sows have poorer welfare than high-ranking sows in a group housing system with floor feeding, demonstrated by their having more skin lesions, higher cortisol levels, and less weight gain during the gestation period than high-ranking sows.

Keywords: swine, gestation housing, social rank, sow, welfare

Received: August 1, 2016
Accepted: April 4, 2017

Resumen - Efectos del rango social en el bienestar y desempeño de las hembras gestantes alojadas en dos tamaños de grupo

Objetivos: Comparar el bienestar y desempeño entre hembras de rango bajo-, medio-, y alto en grupos de dos tamaños de corrales de gestación.

Materiales y métodos: Se alojaron (n = 152) hembras gestantes en cuatro corrales de 26 hembras (corral de grupo grande) y ocho corrales de seis hembras (corral de grupo pequeño) con alimentación al piso. El rango social se basó en resultados de agresión durante la reagrupación. Se valoraron las lesiones de piel de todas las hembras y se midieron las concentraciones de cortisol salival de 32 hembras principales. Se registraron el desempeño durante la gestación, y la lactancia de todas las hembras.

Resultados: En los dos tamaños de grupo, las hembras de bajo rango pelaron con menos frecuencia, pero tuvieron concentraciones de cortisol salivales más altas, y comparadas con las hembras de alto tanto, tuvieron lesiones de piel similares. Las hembras de bajo rango tuvieron más lesiones de piel 5 semanas después de la reagrupación, ganaron menos peso, y tuvieron menos peso corporal antes de parir que las hembras de alto rango. El rango social, no afectó el tamaño de la camada parida, el tamaño de la camada destetada, o el peso de la camada al destete.

Implicaciones: Bajo las condiciones de este estudio, en todos los tamaños de grupos, las hembras de bajo rango tuvieron un menor bienestar que las hembras de alto rango en el sistema de alojamiento en grupos con alimentación al piso; demostrado por el hecho de tener más lesiones de piel, niveles más altos de cortisol, y menor ganancia de peso durante el periodo de gestación que las hembras de alto rango.

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

Li YZ, Wang LH, Johnston LJ. Effects of social rank on welfare and performance of gestating sows housed in two group sizes. *J Swine Health Prod.* 2017;25(6):290–298.

Résumé - Effets du rang social sur le bien-être et les performances de truies en gestation hébergées dans deux groupes de taille différente

Objectifs: Comparer le bien-être et les performances de truies de rang social bas, moyen et haut hébergées en deux groupes de taille différente dans des enclos de gestation.

Matériels et méthodes: Des truies gestantes (n = 152) ont été réparties dans quatre parcs de 26 truies (enclos grand groupe) et huit parcs de six truies (enclos petit groupe) et nourries au sol. Le rang social fut déterminé selon les résultats de l'agressivité au moment du mélange des animaux. Les lésions cutanées ont été évaluées pour toutes les truies et les concentrations de cortisol salivaire ont été mesurées pour 32 truies. Les performances durant la gestation et la lactation ont été enregistrées pour toutes les truies.

Résultats: Entre les groupes des deux tailles, les truies de bas rang social se battaient moins souvent mais avaient des concentrations de cortisol salivaire plus élevées et au moment du mélange ont subi des lésions cutanées similaires à celles de rang social élevé. Les truies de bas rang social avaient plus de lésions cutanées 5 semaines après le mélange, ont pris moins de poids durant la gestation, et avaient un poids corporel plus faible avant la mise-bas que les truies de rang social élevé. Le rang social n'a pas affecté

la taille de la portée mise-bas, le taille de la portée sevrée, ou le poids de la portée au moment du sevrage.

Implications: Dans les conditions expérimentales de la présente étude, indépendamment de la taille du groupe observé, le bien-être des truies de bas rang social était moindre que celui des truies à rang social élevé dans un système d'hébergement en groupe avec distribution de nourriture au sol, tel que démontré par le fait qu'elles avaient plus de lésions cutanées, des concentrations de cortisol plus élevées, et un gain de poids moindre durant la gestation que les truies de rang social élevé.

In response to concerns for animal welfare, the European Union countries and several states in the United States have banned gestation stalls through legislation. Meanwhile, some pork producers have voluntarily committed to replace gestation stalls with group housing systems to meet consumers' demands for improved animal welfare in modern pork production systems. While sow welfare may differ depending on the housing system provided,[1,2] the welfare of individual sows within a given group-housing system can vary greatly.[3] One of the important contributing factors to variation in sow welfare is social rank of the sow within a group of sows. Previous researchers[4,5] have suggested that low-ranking sows usually suffer from poor welfare, compared to sows with higher social rank. O'Connell et al[4] demonstrated that low-ranking sows had more injuries caused by initial fighting at mixing than high-ranking sows. After losing most fights, low-ranking sows may become fearful of further conflicts when attempting to obtain feed, which can lead to inadequate feed intake,[5] less weight gain and poorer body condition,[6] smaller litter size at farrowing[7] and lighter pigs at weaning[6] compared to higher-ranking sows. These problems may become more prominent when floor-feeding systems are used for group-housed sows. Although floor feeding is not an ideal system for group-housed sows due to difficulties of controlling individual feed intake,[1,2] many producers, including some large-scale producers in the United States, still choose to adopt this system because of its low capital investment, no requirement for staff to use computers, and efficient use of floor space.[8,9] The welfare status of individual sows in pens with a floor feeding system has not been evaluated systematically.

The welfare of individual sows, especially of low-ranking sows, may differ when housed in different group sizes.[10,11] When housed in small groups, low-ranking sows are dominated by fewer sows, but have limited space to hide or escape from aggression and threats by high-ranking sows.[12] In contrast, when housed in large groups with the associated larger pens, low-ranking sows have more space to escape from fighting, but also are exposed to a larger number of more dominant sows.[13] To the knowledge of the authors, the welfare and performance of low-ranking sows in different group sizes have not been assessed. The objective of the current study was to evaluate the welfare and performance of gestating sows of different social ranks that were housed in groups of two sizes using a floor feeding system.

Materials and methods

Animals, housing, and management

The Institutional Animal Care and Use Committee of the University of Minnesota reviewed and approved the experimental protocol for this study.

The animal trial was conducted on a commercial 5000-sow breed-to-wean farm between 10 November 2010 and 20 July 2011. Four pens, each housing 26 sows (large-group pen), and eight pens, each housing six sows (small-group pen), were retrofitted from gestation stalls and used for this study.[14] Both large-group pens (5.5 m × 7.3 m) and small-group pens (5.5 m × 1.7 m) had partially slatted floors. The solid areas in each large pen were divided by metal gates (1.8 m) into six smaller areas so that sows could be fed and rest in smaller sections and in smaller subgroups. Each large-group pen was equipped with four bowl drinkers, and each small-group pen had one bowl drinker. Floor space allowance was 1.5 m^2 per sow in both large- and small-group pens. All sows were provided 2.5 kg of a corn-soybean meal-based gestation diet formulated to meet or exceed National Research Council nutritional requirements for gestating sows.[15] The daily ration was delivered in two portions, with two thirds of the ration delivered at 6:00 AM and one third delivered at 12:00 PM. Feed was dropped on the solid portion of the floor from existing feeder lines so that a small pile of feed was dropped for each sow. Temperature in the room was controlled by ventilation fans and heaters to achieve temperature as near as possible to the thermoneutral zone for gestating sows. During the study period, average daily temperature in the gestation barn ranged between 10°C and 22°C. Light period was 9 hours, starting from 6:00 AM, with emergency lights on during the dark period. Room temperature, feeders, drinkers, and animal health were checked daily in the morning and afternoon. When any sow was removed from the study, the reason for removal was recorded.

Sows (parity 1 to 6, Camborough-PIC North America, Hendersonville, Tennessee) had been housed in individual stalls during their previous gestation and lactation. At weaning, sows were moved to and bred in gestation stalls. At approximately 35 days after breeding, sows were tested for pregnancy by ultrasound, and pregnant sows were allocated to gestation pens. Sows from each breeding cohort were assigned to one large-group pen and two small-group pens. Sows remained in their pens until approximately day 109 of gestation, when they were moved to farrowing rooms. Sows farrowed in crates and cross-fostering was conducted within 48 hours after farrowing. Litters were weaned at approximately 21 days after farrowing and sows were bred for the next breeding cycle within a week. This procedure was repeated for four contemporary breeding cohorts at 4- to 6-week intervals. In total, 152 sows were used, with 104 sows assigned to four large-group pens and 48 sows to eight small-group pens.

Sow allocation to gestation pens

At allocation, sows in each breeding cohort were sorted by parity and by body size. Parity was categorized at breeding as parity 1, parity 2, and parity 3 or greater (parity 3+). Body size was classified as large or small by visual appraisal as previously reported.[14] For each breeding cohort, the ratio of large to small sows was calculated. Then, a subset of 26 sows with both the ratio of large to small body size and parity composition similar to those of the breeding cohort were selected and allocated to a large-group pen: the large-group pen housed both large and small sows. In contrast to the large-group pen, the two small-group pens each consisted of a pen with sows of small body size and a pen with sows of large body size. The average ratio of large to small sows was 3.5:1 in the study. The average ratio of parity 1 to parity 2 to parity 3+ was approximately1:3:9 for large sows, and approximately 2:3:1 for small sows.

Data collection

Production performance. The data collection period started when sows were allocated to pens after pregnancy confirmation and continued until they were bred for the next reproductive cycle after weaning their litters. All sows were weighed individually at allocation to pens, at entry to farrowing rooms, and at weaning. Body condition was assessed by visual appraisal using a 1 to 5 scale system.[16] Each sow was scored for body condition at allocation to gestation pens and before being moved to farrowing stalls. All body condition scores were assessed by two trained researchers. Each scored a small-group pen and half of a large-group pen for each breeding cohort. Standard production data were collected for each sow at farrowing and at weaning from the existing on-farm computerized record system. These data included number of sows farrowed, litter size farrowed (total born, number born alive, number stillborn, and number mummified for each litter), and litter size and litter weight at weaning. Farrowing rate was calculated on the basis of the number of sows farrowed as a percentage of sows assigned to the study after pregnancy confirmation. Sows that farrowed and weaned a litter and that were bred for the next breeding cycle within a week were considered to have completed the study. Completion rate was calculated as the number of sows that completed the study as a percentage of sows assigned to the study. Wean-to-estrus intervals were recorded for sows that expressed estrus within a week after weaning.

Social rank and aggression at mixing. All sows were mixed in pens between 9:00 AM and 10:00 AM. Aggressive interactions among sows at mixing and during the first two meals after mixing were recorded by continuous live observations. Aggressive interactions were classified as pushing and biting, according to the methodology used by previous researchers.[4,17] Pushing was defined as sows standing side-by-side and pushing hard with their shoulders against each other, generally performed with frequent bites. Biting was defined as a sow delivering rapid bites or knocks with the snout against the head or body of the receiver. Before observations started, the back of each sow was painted with a unique color and pattern for individual identification. To record aggressive interactions at mixing, the observations started immediately after all sows were moved into a pen and continued for 2 hours. Observations during feeding started from the time when feeder lines were turned on to drop feed until sows in the pen had consumed all feed. The first feeding after mixing started at noon on the mixing day, and the second feeding started at 6:00 AM the next morning. Two researchers were trained to conduct the live observations. Each researcher was assigned to record either two small-group pens or a large-group pen during each recording period. The number and outcomes (wins, losses, and stand-offs) of aggressive interactions, and individual sows that were involved, were registered using a 26 × 26 winner-loser matrix[18] for each large group and a 6 × 6 winner-loser matrix for each small group. On the basis of the number of wins and losses, a rank index (RI) was calculated for each sow using the equation

$$RI = [(S \times P_s) - (N \times P_n)] \div [(S + N) \times (n - 1)]$$

where S = the number of wins, P_s = the number of opponents that the sow had defeated, N = the number of losses, P_n = the number of opponents by which the sow was defeated, and n = the total number of sows in the pen.[19] On the basis of the rank indices (in the range of 1 to -1), each sow in a pen was ranked in order, with rank 1 as the most dominant. For further data analysis, sows in small-group pens with rank 1 to 2 were arbitrarily classified as high-ranking sows, rank 3 to 4 as middle-ranking sows, and rank 5 to 6 as low-ranking sows. Likewise, sows in large-group pens with rank 1 to 8 were classified as high-ranking sows, rank 9 to 18 as middle-ranking sows, and rank 19 to 26 as low-ranking sows. As a result, in each small-group pen, a group of two sows was categorized as high-, middle-, or low-ranking sows, respectively. In each large-group pen, a group of eight sows was categorized as high- or low-ranking, respectively, and a group of 10 sows as middle-ranking.

Skin lesions. To evaluate injuries caused by aggressive interactions, fresh skin lesions were assessed for each sow at 24 hours and 5 weeks after mixing in gestation pens. Skin lesions were assessed using the methodology of Hodgkiss et al,[20] which combines scores of 0 to 3 from 12 surface regions of the body: two ears, snout, two shoulders, two flanks, two hindquarters, top of the back, tail, and vulva. The scoring system was 0 = no injury (skin unmarked: no evidence of injury from agonistic behavior); 1 = slight injury (< 5 superficial wounds); 2 = obvious injury (5-10 superficial wounds and [or] ≤ 3 deep wounds); and 3 = severe injury (> 10 superficial wounds, and [or] > 3 deep wounds).

Salivary cortisol concentrations. Salivary samples were collected between 9:00 AM and 10:00 AM from 16 sows in large-group pens with two high-ranking and two low-ranking sows from each pen, and 16 sows from small-group pens with one high-ranking and one low-ranking sow from each pen. The samples were collected at 24 hours and 5 weeks after mixing using cotton swabs provided with the Salivette tubes (Sarstedt Ltd, Numbrecht, Germany). The cotton swab was secured to 150 cm of dental floss and placed into the mouth of the sow with minimal disturbance to the sow. Sows were allowed to chew on the swab until it was saturated with saliva. To avoid cortisol level being elevated by handling stress, each saliva sample was collected within 3 minutes of approaching the sow. Saliva was removed by centrifugation at 1500*g* for 5 minutes and frozen at -20°C for subsequent analysis. Cortisol concentration was determined by radioimmunoassay using Coat-A-Count Cortisol kits (Siemens Medical Solutions, Malvern, Pennsylvania), according to the methods of Anil et al.[21] All saliva samples were analyzed within the same assay. The intra-assay covariate (coefficient of variance) was less than 10%, and the sensitivity of the assay was 0.04 ng per mL.

Data analyses. Data were analyzed using the SAS package (version 9.4; SAS Institute Inc, Cary, North Carolina.). The Frequency procedure with Chi-square test was used to analyze the number of sows that farrowed and completed the study. The GLIMMIX procedure was used to analyze the remaining data. Within the GLIMMIX procedure, the Poisson regression model was used for analysis of count data, and the Gaussian model was used for analysis of continuous data. Within small-group pens, the effect of sorting by body size was examined initially, and no significant difference for any variable (all $P > .10$) was detected. The effect of sow size was therefore excluded from final statistical models, and the data from small and large sows were combined for small-group pens. To test effects of social rank, the same model was used, but separate analyses were conducted for each group size. The model included social rank as the fixed effect and replicate (breeding cohort) as the random effect. To increase test power, effects of social rank were further examined across

both group sizes using data from the two group-pen sizes. The models included social rank, pen size, and their interactions as fixed effects, with replicate (breeding cohort) serving as the random effect. Since no significant difference (all $P > .34$) was detected in parity among social ranks, parity was not included in any of the final statistical models. Rank group within each pen was the experimental unit for all data analysis, except for cortisol concentration and farrowing performance, where individual sow was the experimental unit. Differences among means were tested by PDIFF with the Tukey adjustment for multiple comparisons. Significant differences among means were identified at $P < .05$ and trends at $P < .10$.

Results

In large-group pens, low-ranking sows tended to have fewer aggressive interactions ($P = .054$; Table 1) than high-ranking sows. Social rank did not affect other variables measured, except that low-ranking sows tended to lose less weight ($P = .051$) during lactation than high-ranking sows.

In small-group pens, social rank affected the number of aggressive interactions during mixing, with low- and middle-ranking sows having fewer aggressive interactions ($P = .04$; Table 2) than high-ranking sows. In addition, low- and middle-ranking sows were lighter before farrowing ($P = .002$) and gained less weight during gestation ($P = .04$), and low-ranking sows tended to lose less weight during lactation ($P = .07$) than high-ranking sows. Social rank did not affect other variables measured in small-group pens.

Across two group sizes, low-ranking sows had fewer aggressive interactions at mixing ($P = .003$; Table 3) and during the initial feedings ($P = .048$) than high-ranking sows. Similar to low-ranking sows, middle-ranking sows experienced fewer aggressive interactions than high-ranking sows. Social rank did not affect skin lesion scores at 24 hours after mixing, but low-ranking sows had more skin lesions than high-ranking sows ($P = .02$) 5 weeks after entering gestation pens, with middle-ranking sows being intermediate.

There were no differences in parity, body weight, or condition score among sows in different social ranks when they entered the gestation pens. However, low- and middle-ranking sows gained less weight during gestation ($P = .01$) and lost less weight during lactation ($P = .01$) than high-ranking sows. As a result, low- and middle-ranking sows were lighter than high-ranking sows before farrowing ($P = .003$), but this difference in body weight between low- and high-ranking sows was not observed when sows weaned their subsequent litters. There was an interaction between group size and social rank for weight change during the lactation period, with middle-ranking sows losing less weight than high-ranking sows when gestated in small-group pens, but not when gestated in large-group pens. There was no interaction between group size and social rank for other variables.

Table 1: Effects of social rank on aggression, skin lesions, and performance of gestating sows housed in four pens of 26 sows with floor feeding*

	Social rank†			
Parameter	**High**	**Middle**	**Low**	***P***
Number of sows per pen	8	10	8	NA
Parity	3.5 ± 0.33	3.0 ± 0.27	3.3 ± 0.32	.49
Aggressive interactions at mixing (no./sow)‡	18.9 ± 3.35^{e}	11.2 ± 1.77^{ef}	9.6 ± 1.70^{f}	.054
Aggressive interactions at feeding (no./sow/meal)§	1.95 ± 0.30	1.76 ± 0.26	1.15 ± 0.22	.14
Skin lesions (average score/sow)				
24 hours after mixing	15.5 ± 1.19	14.5 ± 1.10	13.9 ± 1.09	.63
5 weeks after mixing	7.1 ± 0.85	8.1 ± 0.88	9.8 ± 1.15	.19
Weight (kg)				
Before mixing	228.1 ± 4.9	220.3 ± 4.4	231.9 ± 4.9	.19
Before farrowing	271.4 ± 6.2	252.6 ± 5.4	262.5 ± 6.2	.12
At weaning	240.3 ± 7.4	222.6 ± 6.9	242.5 ± 7.8	.16
Change in weight (kg)				
Between mixing and farrowing	44.9 ± 6.0	35.2 ± 5.6	29.3 ± 6.0	.23
Between farrowing and weaning	-32.3 ± 3.3^{e}	-30.7 ± 2.8^{e}	-19.7 ± 3.5^{f}	.051
Condition score				
Before mixing	2.89 ± 0.06	2.89 ± 0.05	2.81 ± 0.06	.55
Before farrowing	3.02 ± 0.06	2.90 ± 0.06	2.87 ± 0.07	.27

* Each pen provided floor space allowance of 1.5 m^2/sow.
† Sows were categorized as high, middle, or low rank, based on outcomes of aggression at mixing.
‡ Total number of aggressive interactions during the initial 2 hours after mixing. Sows were mixed in gestation pens after pregnancy confirmation 5 weeks after breeding.
§ Aggressive interactions per meal during the first two meals after mixing in group pens. Meals were fed 2 and 18 hours after mixing.
^{ef} Means within a row with no common superscript tend to differ (Tukey test adjusted for multiple comparisons; $P < .10$).
NA = not applicable.

Table 2: Effects of social rank on aggression, skin lesions, and performance of gestating sows housed in eight pens of six sows with floor feeding*

	Social rank†				
Parameter	**High**	**Middle**	**Low**	**SEM**	***P***
No. of sows/pen	2	2	2	NA	NA
Parity	2.3	2.1	1.8	0.3	.56
Aggressive interactions at mixing (no./sow)‡	22.7 ± 5.7[a]	8.9 ± 2.2[b]	9.0 ± 2.3[b]	NA	.04
Aggressive interactions at feeding (no./sow/meal)§	1.9 ± 0.3	1.4 ± 0.3	1.2 ± 0.3	NA	.17
Skin lesions (average score/sow)					
24 hours after mixing	11.0	13.5	11.1	1.3	.41
5 weeks after mixing	4.0	6.4	6.9	1.1	.14
Weight (kg)					
Before mixing	208.6	207.7	204.3	4.75	.80
Before farrowing	264.9[a]	238.4[b]	238.3[b]	5.79	.002
At weaning	225.2	216.4	211.0	7.54	.44
Change in weight (kg)					
Between mixing and farrowing	56.3[a]	30.7[b]	36.9[b]	6.16	.04
Between farrowing and weaning	-41.7[e]	-20.2[f]	-28.8[ef]	5.82	.07
Condition score					
Before mixing	2.72	2.69	2.72	0.12	.97
Before farrowing	3.06	2.91	2.91	0.07	.25

* Each pen provided a floor space allowance of 1.5 m^2/sow.
† Sows were categorized as high, middle, or low rank, based on outcomes of aggression at mixing sows in each rank per pen.
‡ Total number of aggressive interactions during the initial 2 hours after mixing. Sows were mixed in gestation pens after pregnancy confirmation at 5 weeks after breeding.
§ Aggressive interactions per meal during the first two meals after mixing in group pens. Meals were fed at 2 and 18 hours after mixing.
[ab] Means within a row with no common superscript differ (Tukey test adjusted for multiple comparisons; $P < .05$).
[ef] Means within a row with no common superscript tend to differ (Tukey test adjusted for multiple comparisons; $P < .10$).
NA = not applicable; SEM = standard error of the mean.

Compared with high-ranking sows, low-ranking sows had higher salivary cortisol concentrations at 24 hours after mixing ($P = .046$; Table 4), but this difference was not observed 5 weeks later.

Among the 152 sows used for the study, 136 farrowed, with an overall farrowing rate of 89.5% (Table 5). Social rank did not affect farrowing rates or completion rates in either large or small group pens.

Twenty-five sows that did not complete the study were culled, resulting in an overall culling rate of 16% (Table 6). Low- and middle-ranking sows were most likely to be culled for injuries from fighting, while high-ranking sows were most likely to be culled for poor reproduction. Social rank of sows did not affect farrowing performance (Table 7).

Discussion

This study demonstrates that the degree of welfare for individual sows is associated with their social rank in a group. In general, low-ranking sows had poorer welfare than high-ranking sows in the group housing systems studied, as indicated by higher salivary cortisol concentrations at mixing, more skin lesions at 5 weeks after mixing, less weight gain during gestation, and low body weight before farrowing. The degree of welfare of middle-ranking sows was either similar to that of low-ranking sows or intermediate between low- and high-ranking sows.

Skin lesions are indicative of welfare status of sows in a group-housing system. Turner et al[22] noted that skin lesions were correlated with the number of aggressive interactions that sows were involved in either during or after the period of mixing. However, in the current study, we observed that low-ranking sows were less involved in fighting, but sustained the same number of skin lesions as high-ranking sows at 24 hours after mixing. This suggests that the relationship between skin lesions and the number of aggressive interactions may depend on social rank of the sows. Consistent with our results, Mendl et al[23] reported that low-ranking sows fought less frequently than high-ranking sows, but injuries were similar to those of high-ranking sows. Likewise, Hemsworth et al[24] and Borberg and Hoy[25] reported that high-ranking sows initiated more fights and low-ranking sows received more fights in group pens, suggesting that sows that received fights were more likely to be injured. Indeed, in the current study, low-ranking sows had more fresh skin lesions 5 weeks after entering the gestation pens than high-ranking sows, which suggests that low-ranking sows received attacks from high-ranking sows after the establishment of dominance hierarchy.[26] When using a competitive

Table 3: Effects of social rank on aggression, skin lesions, and performance of gestating sows in 12 pens of two group sizes*

	Social rank†			
Parameter	**High**	**Middle**	**Low**	***P***
No. of sows/pen	2 or 8‡	2 or 10	2 or 8	NA
Parity	2.9 ± 0.3	2.5 ± 0.2	2.4 ± 0.3	.34
Aggressive interactions at mixing (no./sow)§	20.7 ± 3.2[a]	10.0 ± 1.5[b]	9.3 ± 1.4[b]	.003
Aggressive interactions at feeding (no./sow/meal)¶	1.9 ± 0.2[a]	1.4 ± 0.2[ab]	1.2 ± 0.2[b]	.048
Skin lesions (average score/sow)				
24 hours after mixing	13.0 ± 0.9	14.0 ± 0.9	12.4 ± 0.9	.47
5 weeks after mixing	5.3 ± 0.6[b]	7.2 ± ± 0.7[ab]	8.3 ± 0.8[a]	.02
Weight (kg)				
Before mixing	218 ± 3.9	214 ± 3.7	218 ± 3.9	.66
Before farrowing	268 ± 4.5[a]	245 ± 4.2[b]	251 ± 4.5[b]	.003
At weaning	233 ± 5.4	220 ± 5.6	227 ± 5.6	.23
Change in weight (kg)				
Between mixing and farrowing	50 ± 4.4[a]	31 ± 4.2[b]	33 ± 4.4[b]	.01
Between farrowing and weaning	-37 ± 3.1[a]	-25 ± 2.9[b]	-24 ± 3.2[b]	.01
Condition score				
Before mixing	2.8 ± 0.06	2.8 ± 0.06	2.8 ±0.06	.89
Before farrowing	3.0 ± 0.05	2.9 ± 0.05	2.9 ± 0.05	.10

* Both pen sizes (four pens of 26 sows/pen and eight pens of six sows/pen) provided equal floor space allowance (1.5 m^2/sow).
† Sows were categorized as high, middle, or low rank, based on outcomes of aggression at mixing.
‡ Two sows per small pen, and eight or 10 sows per large pen.
§ Total number of aggressive interactions during the initial 2 hours after mixing. Sows were mixed in gestation pens after pregnancy confirmation at 5 weeks after breeding.
¶ Aggressive interactions per meal during the first two meals after mixing in group pens. Meals were fed at 2 and 18 hours after mixing.
[ab] Means within a row with no common superscript differ (Tukey test adjusted for multiple comparisons; $P < .05$).
NA = not applicable.

Table 4: Effects of social rank on salivary cortisol concentrations of gestating sows housed in pens of 26 sows or six sows with floor feeding

	Social rank*			
Parameter	**High**	**Low**	**SEM**	***P***
No. of sows†	16	16	NA	NA
Parity	2.8	2.6	0.24	.63
Cortisol (ng/mL)				
24 hours after mixing	14.3[b]	20.1[a]	4.7	.046
5 weeks after mixing	14.0	12.5	1.5	.40

* Sows were categorized as high- or low-ranking, based on outcomes of aggression at mixing.
† Saliva samples were collected from two low-ranking and two high-ranking sows in each pen (n = 4) of 26 sows; and one low-ranking and one high-ranking sow in each pen (n = 8) of six sows. All sows were provided equal floor space allowance (1.5 m^2/sow).
[ab] Means within a row with no common superscript differ (Tukey test adjusted for multiple comparisons; $P < .05$).
NA = not applicable.

feeding system, as in the current study, sows may fight for feed each day during meals. More likely, low-ranking sows were attacked by high-ranking sows when competing for feed. Tonepohl et al[27] reported that even in a group-housing system with electronic sow feeders, low-ranking sows had more skin lesions than high-ranking sows 10 weeks after entering gestation pens.

Fighting is a stressful event for sows that increases cortisol levels.[28] Individual sows may be affected by fights differently, with losers of fights being more affected than winners. In the current study, low-ranking sows had higher salivary cortisol concentrations 24 hours after mixing than high-ranking sows, suggesting that low-ranking sows experienced more stress than high-ranking sows, although they were less involved in fighting during the initial mixing period.

Low-ranking sows were also less involved in fighting during the first two meals after

Table 5: Effects of social rank on the number of sows that gestated in either large or small pens and that farrowed and completed the study

	Large pen*					Small pen*				
Parameter	**HR†**	**MR†**	**LR†**	**Chi-square**	***P***	**HR†**	**MR†**	**LR†**	**Chi-square**	***P***
No. of sows assigned‡	32	40	32	NA	NA	16	16	16	NA	NA
No. of sows farrowed	26	37	26	NA	NA	15	16	16	NA	NA
Farrowing rate (%)§	81	93	81	2.52	0.28	94	100	100	2.04	0.36
No. of sows completed study¶	25	35	23	NA	NA	15	14	15	NA	NA
Retention rate (%)§	78	88	72	2.77	0.25	94	88	94	0.55	0.76

* The large pen housed 26 sows and the small pen housed six sows; both pens provided equal floor space allowance (1.5 m^2/sow).
† Sows were categorized as high (HR), middle (MR), or low ranking (LR) on the basis of outcomes of aggression at mixing.
‡ After confirming pregnancy at 5 weeks after breeding.
§ Percentage of sows assigned to the study.
¶ Farrowed and weaned a litter and started the next breeding cycle.
NA = not applicable.

mixing, which suggests that low-ranking sows may be less competitive at feeding than higher ranking sows. This might contribute to less weight gain for low-ranking sows during gestation compared with high-ranking sows. Hemsworth et al[24] and Kranendonk et al[5] similarly reported that low-ranking sows gained less weight than high-ranking sows in a group housing system with floor feeding. If the feeding system could secure individual sows to consume their feed rations, the compromised welfare of low-ranking sows could be largely alleviated. In a previous study with a non-competitive feeding system, it was observed that social rank of sows did not affect weight gain during gestation.[29]

One of the questions this study attempted to answer was whether group size differentially influenced welfare of sows in different social ranks, especially low-ranking sows. Large group sizes combined with low space allowance may result in more injuries from aggression than small groups, probably due to limited opportunities for defeated sows to escape attacking sows.[30] Gonyou and Lang[31] reported that sows in small groups (up to six to eight sows per group) usually form a stable hierarchy. Once the hierarchy is formed, social positions rarely change and aggression among sows is minimal. In contrast, sows in larger groups (20 or more sows per group) usually form an unstable hierarchy which needs to be maintained by constant threats or attacks, resulting in more aggressive interactions. Furthermore, sows in large groups may take longer to establish dominance hierarchy than sows in small groups, causing more skin lesions to sows.[10,13] Barnett et al[32,33] demonstrated that aggression among gilts following mixing was lower in small-group pens than large-group pens. In the current study, due to differences in pen design and composition of pen mates between the large- and small-group pens, effects of group size could not be separated from these confounding factors. When assigned to the study, sows

Table 6: Reasons for culling sows in different social ranks gestated in either large or small pens

	Large pen*			Small pen*			
	HR†	**MR†**	**LR†**	**HR†**	**MR†**	**LR†**	**Total**
Total no. of sows culled (%)‡	7 (22)	5 (12)	9 (28)	1 (6)	2 (12)	1 (6)	25 (16)
No. of sows culled for each reason							
Injuries from fighting	1	3	2	0	0	1	7
Poor reproduction§	3	1	2	0	0	0	6
Abortion	2	1	1	0	0	0	4
Poor milk production	1	0	3	0	0	0	4
Lameness	0	0	1	0	0	0	1
Poor body condition	0	0	0	0	0	0	0
Sickness	0	0	0	0	1	0	1
Died or euthanized	0	0	0	1	1	0	2

* The large pen housed 26 sows, and the small pen housed six sows. Both pens provided equal floor space allowance (1.5 m^2/sow).
† Sows were categorized as high (HR), middle (MR), or low ranking (LR) on the basis of outcomes of aggression at mixing.
‡ Percent of pregnant sows assigned to the study at 5 weeks after breeding, calculated as [no. of sows culled ÷ no. of pregnant sows assigned] × 100.
§ Included sows that returned to estrus, failed to farrow, and farrowed or weaned small litters.

in small-group pens were younger and had lower body weight than sows in large-group pens. This was because sows were sorted by size in small-group pens, with an equal number of pens housing small sows and large sows, so that the ratio of small to large sows assigned to small-group pens was 1:1. However, in large-group pens, the ratio of small to large size was approximately 1:3.5 due to the sow composition of each breeding cohort. The high percentage of small sows allocated to small-group pens resulted in lower body weight and parity of sows at initiation of the study, and these were confounded with effects of group size. As a result, effects of group size were not examined in the current study. Instead, it focused on effects of social rank on the welfare of sows in each group size. It appears that social rank affects the welfare of sows in both groups in a similar pattern. In other words, the welfare of sows seems dictated by social rank in both groups in the current study.

The competitive feeding system used in the current study may lead to uneven body condition of sows, resulting in an elevated incidence of reproductive failures and culling. One of the management strategies to deal with this issue is to sort sows by size so that sows in a pen have similar nutritional needs and competitive ability.[31] In the current study, sorting was conducted only in small-group pens. Coincidently, farrowing rates of low- and high-ranking sows in small group pens were 100% and 94%, respectively, which were higher than 81% and 81% for their counterparts in large-group pens. The high culling rate of low- and high-ranking sows in large-group pens raises a concern about longevity of sows under the housing conditions of this study.

Implications

- In the group-housing system studied, results suggest that social rank similarly affects the welfare of sows in large-group pens (26 sows per pen) and small-group pens (six sows per pen), with poorer welfare in lower-ranking sows, as indicated by more skin lesions, less weight gain, and higher salivary cortisol concentrations.
- To verify these results, long-term studies that involve several gestation cycles and large number of sows are needed.

Acknowledgements

The authors would like to express appreciation to the National Pork Board and the Minnesota Agricultural Experiment Station's Rapid Agricultural Response Funds for financial support of this study and to staff of the North Dakota Pigs Cooperatives for assistance with data collection.

Conflict of interest

None reported.

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Table 7: Effects of social rank on farrowing performance of sows*

	Social rank†			
	High	**Middle**	**Low**	***P***
Sows farrowed†	41	53	42	NA
Litter size (no. of piglets/litter)				
Total born	13.5 ± 0.6	13.3 ± 0.6	14.5 ± 0.6	.28
Live born	12.4 ± 0.6	12.4 ± 0.5	13.2 ± 0.6	.49
Stillborn	0.8 ± 0.1	0.6 ± 0.1	0.8 ± 0.2	.28
Mummies	0.2 ± 0.1	0.3 ± 0.1	0.5 ± 0.1	.29
Weaned‡	10.9 ± 0.3	11.2 ± 0.3	10.9 ± 0.3	.62
Piglet pre-weaning mortality (%)§	15.1 ± 2.6	12.8 ± 2.0	12.5 ± 2.1	.68
Piglet weight at weaning (kg)				
Litter weight	76.8 ± 2.2	79.9 ± 2.4	76.8 ± 2.3	.52
Piglet weight	7.1 ± 0.1	7.2 ± 0.1	7.2 ± 0.1	.87
Wean-to-estrus interval (days)	4.9 ± 0.7	5.0 ± 0.7	6.0 ± 0.9	.54

* Gestation pens provided equal floor space allowance (1.5 m^2/sow).
† Sows were categorized as high, middle, or low rank on the basis of outcomes of aggression at mixing in gestation pens.
‡ Piglets were weaned at 3 weeks after birth.
§ Calculated as [no. of piglets that died before weaning ÷ no. of piglets born alive] × 100; may differ slightly because of cross-fostering.
NA = not applicable.

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Case report

Identification of *Trueperella abortisuis* contamination in extended boar semen

Eva Bussalleu, MS, PhD; Gary C. Althouse, MS, PhD, DVM, Diplomate ACT

Summary

Trueperella abortisuis is a gram-positive bacterium that has been previously identified in aborted porcine feti and placentae located in Asia and Europe. Routine microbiological screening of extended boar semen from a US mid-Atlantic stud identified delayed growth of very small white colonies on both brain-heart infusion and sheep-blood agars after 48 to 72 hours incubation at 37°C under aerobic conditions. Isolate identification was performed using matrix-assisted laser desorption-ionization time of flight (MALDI-TOF) mass spectrometry, with *T abortisuis* identified (MALDI biotyper score = 2.103). After storage at 16°C and 72 hours post collection, total and progressive motility parameters had decreased in extended semen samples positive for *T abortisuis*. Further work is needed to elucidate the role *T abortisuis* may play in extended boar semen quality, extended semen longevity, and sow reproductive performance.

Keywords: swine, *Trueperella abortisuis*, boar, extended semen

Received: December 5, 2016
Accepted: July 11, 2017

Resumen - Identificación de la contaminación con *Trueperella abortisuis* en semen diluido de cerdo

La *Trueperella abortisuis* es una bacteria gram-positiva que ha sido previamente identificada en fetos porcinos abortados y placentae en Asia y Europa. El monitoreo microbiológico rutinario de semen diluido en un centro de inseminación artificial en el medio del Atlántico de los Estados Unidos identificó el crecimiento retrasado de colonias blancas, muy pequeñas, tanto en agar de infusión de corazón-cerebro, y de sangre de oveja después de 48 a 72 horas de incubación a 37°C, bajo condiciones aeróbicas. Los aislamientos fueron identificados por espectrometría de masa asistida de laser utilizando el tiempo de vuelo desorción-ionización láser asistida por matriz (MALDI-TOF por sus siglas en inglés), identificando *T abortisuis* (MALDI puntaje de biotipo = 2.103). Después de su conservación a 16°C y 72 horas post recolección, los parámetros de motilidad progresiva y total disminuyeron en las muestras de semen diluido, positivas por *T abortisuis*. Es necesario más trabajo para esclarecer el papel que la *T abortisuis* pueda tener en la calidad del semen diluido, sobre la longevidad del semen, y el desempeño reproductivo de la hembra.

Résumé - Identification de *Trueperella abortisuis* dans de la semence de verrat diluée

Trueperella abortisuis est une bactérie à gram-positif qui a été identifiée préalablement en Asie et en Europe dans des fœtus avortés et des placentae de porc. L'examen microbiologique de routine de la semence de verrat diluée provenant d'un mâle reproducteur d'un état américain situé au milieu de la côte Atlantique a permis de mettre en évidence la croissance tardive de très petites colonies blanches sur des géloses d'infusion de cerveau et de cœur et des géloses supplémentées de sang de mouton après 48 à 72 heures d'incubation à 37°C dans des conditions aérobiques. Les isolats ont été identifiés par spectrométrie de masse du temps de vol suite à la désorption-ionisation par laser assistée d'une matrice (MALDI-TOF), et *T abortisuis* identifié (pointage du MALDI biotype = 2,103). Après entreposage à 16°C pendant 72 heures post collecte, les paramètres de mobilité totale et progressive avaient diminué dans les semences diluées positives pour *T abortisuis*. Des travaux additionnels sont requis afin d'élucider le rôle que pourrait jouer *T abortisuis* dans la qualité de la semence de porc diluée, sur la longévité de la semence diluée, et les performances de reproduction des truies.

Bacteriosemina, the presence of bacteria in semen, is a common issue that needs to be controlled at artificial insemination centers in order to optimize extended semen quality and herd reproductive performance.[1] Sources of bacterial contamination of semen are varied and can be generally categorized as those originating from the animal (eg, feces, urogenital tract, preputial fluids, skin, hair, or respiratory secretions, or from personnel) and those of non-animal origin (eg, water sources, plant matter, ventilation systems, sinks and (or) drains, or laboratory material).[1] In the boar, bacteria belonging to the *Enterobacteriaceae*[1,2] and *Pseudomonaceae*[3] families appear to be the isolated contaminants that are most commonly identified in extended semen. To the knowledge of the authors, this report describes for the first time the presence in extended boar semen of *Trueperella abortisuis*, a bacterium that has been isolated from placentae of aborted sows and that has been suggested as an emerging pathogen in swine.

Isolation and identification of *T abortisuis*

A small mid-Atlantic US stud housing purebred adult boars (greater than 1 year of age) submitted extended cooled doses (Beltsville thawing solution [BTS] with gentamicin; IMV International, Maple Grove, Minnesota) to the Reference Andrology Laboratory of the University of Pennsylvania (Kennett Square, Pennsylvania) for routine spermiogram and microbiological analyses. Upon arrival (within 24 hours post collection and processing), subsamples were obtained and screened at 24, 48, and 72 hours using brain-heart infusion (BHI)

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

Bussalleu E, Althouse GC. Identification of *Trueperella abortisuis* contamination in extended boar semen. *J Swine Health Prod.* 2017;25(6):299–302.

agar (BD Biosciences, Baltimore, Maryland) and sheep-blood agar (SBA; Remel, Kansas) to determine bacterial load and time-kill kinetics. All plates were incubated at 37°C in an aerobic atmosphere supplemented with 5% CO_2, with quantification of colony forming units (CFUs) performed using an illuminated plate reader after 24, 48, and 72 hours of incubation.

In an initial single-sire dose submission (Male 1), mixed growth was observed on both BHI and SBA plates from samples plated 24 and 48 hours post collection, with pure growth of a tiny pale colony observed after 72 hours of incubation. The remaining pure growth was re-plated on SBA and submitted to the Pennsylvania Animal Diagnostic Laboratory System (Kennett Square, Pennsylvania) for bacterial identification by matrix assisted laser desorption-ionization time of flight (MALDI-TOF) mass spectrometry using the MALDI Biotyper (Bruker Daltonics; Billerica, Massachusetts). Results identified the contaminant as *T abortisuis* (MALDI biotyper score = 2.103). A score cut-off ≥ 2.000 is recomended by the manufacturers for species-level detection.

Concurrent spermiogram results from the extended semen of Male 1 showed substantial decreases over time in total and progressive motilities, as determined using computer-assisted sperm analysis (HTM-IVOS; Beverly, Massachusetts). Sample total and progressive motilities at arrival were 90% and 67%, respectively. After the extended semen had been stored for 72 hours at 16°C, total and progressive motilities had dropped to 4% and 0%, respectively. *Trueperella abortisuis* was the only contaminant isolated from the low-motility samples.

Subsequently, BTS-extended semen from an additional four males (Male 2, Male 3, Male 4, and Male 5) standing at the same stud were purposely collected, processed, and submitted to the University of Pennsylvania Reference Andrology Laboratory for microbiological screening. After 48 hours post collection and processing, samples were plated on BHI and SBA with daily assessment of growth for up to 72 hours. Selected colonies were re-isolated on SBA, incubated under both aerobic and anaerobic conditions, and then identified using a Microflex LT MALDI-TOF Biotyper (Bruker Daltronics, Inc, Billerica, Massachusetts). Growth was observed under both culture conditions, with higher counts observed when cultures were incubated anaerobically (10^2 CFU per mL under aerobic conditions versus 10^3 to 10^4 CFU under anaerobic conditions) (Table 1). MALDI-TOF analysis demonstrated that *T abortisuis* was present in the extended semen of three of the four boars. The minimum inhibitory concentrations (MICs) (ARIS Sensititre; ThermoFisher Scientific, Waltham, Massachusetts) for selected antimicrobials were determined for the *T abortisuis* isolate (Table 2). Although this isolate was resistant to gentamicin, it was sensitive to the common beta-lactam antibiotics used in commercial porcine semen extenders.

Spermiogram analysis revealed similar changes in total and progressive motility scores over time. Average (± standard error of the mean [SEM]) total and progressive motilities of samples contaminated with *T abortisuis* (N = 3) at arrival were 86.3% ± 2.3% and 50.3% ± 14.4%, respectively. After the extended semen had been stored at 16°C for 72 hours, average (± SEM) total and progressive motilities had decreased to 6.3% ± 0.3% and 1.0% ± 0%, respectively.

Discussion

To the authors' knowledge, this is the first time that *T abortisuis* has been isolated from and identified in extended boar semen. Currently, literature concerning this bacterium is sparse. *Trueperella abortisuis*, previously known as *Arcanobacterium abortisuis* and reclassified to its current name in 2011,[4] is a gram-positive, diphtheroid-shaped organism that was first reported when isolated from a sow's aborted placenta in Japan by Azuma et al.[5] This first report led Ülbegi-Mohyla et al[6] to re-analyze strains suspected to be *Arcanobacterium abortisuis* isolated from the vagina, cervix, kidney, and urine of nine pigs between 1999 and 2007 by phenotypic properties and by sequencing the 16S-23S rDNA intergenic spacer region. Their results demonstrated that the strains were *Trueperella (Arcanobacterium) abortisuis*. Ülbegi-Mohyla et al[6] also reported that the bacterium was normally isolated with other microorganisms such as *Acinetobacter* species, *Branhamella* species, *Corynebacterium* species, *Enterococcus* species, *Escherichia coli*, *Flavobacterium* species, *Staphylococcus* species, or *Streptococcus* species. Similarly, in the current study, *T abortisuis* was present in an extended semen sample (Male 1) with mixed contaminants that included *Bacillus* species, *Corynebacterium* species, *Klebsiella* species, *Pseudomonas* species, *Staphylococcus* species, and *Streptococcus* species. More recently, European work (Metzner et al)[7] has suggested that *T abortisuis* may be an emerging pathogen, with the report describing the presence of the bacterium in umbilical and anal swabs from aborted feti and aborted placentae of swine. Of added interest is that *T abortisuis* does not appear to be swine specific, as it has also been identified in other livestock species.[8]

In this case, decreases in total and progressive motility parameters were observed in extended-cooled samples by 72 hours post collection. Typically, in non-contaminated extended semen samples, motility parameters

Table 1: Total bacterial counts and *Trueperella abortisuis* counts in extended boar ejaculates submitted for testing to the University of Pennsylvania Reference Andrology Laboratory (Kennett Square, Pennsylvania) after storage at 16°C for 0 and 72 hours

	Total bacterial counts (CFU/mL)		*T abortisuis* counts (CFU/mL)	
	0 hours	72 hours post collection	0 hours	72 hours post collection
Male 1	4.2×10^3	1.0×10^2	2×10^1	1.0×10^2
Male 2	2.9×10^3	2.0×10^2	1×10^2	1×10^2
Male 3	3.0×10^2	0	0	0
Male 4	2.9×10^3	1.1×10^3	6×10^2	1.4×10^3
Male 5	3.1×10^3	1.4×10^3	1.8×10^3	1.4×10^3

CFU = colony forming units.

Table 2: Antimicrobial sensitivity of a *Trueperella abortisuis* isolate from extended boar semen*

Antimicrobial	MIC (μg/mL)
Amikacin	8
Ampicillin	1
Azithromycin	> 4
Ceftazidime	16
Ceftiofur	≤ 0.25
Chloramphenicol	≤ 4
Chlortetracycline	> 8
Clindamycin	> 16
Danofloxacin	1
Doxycycline	4
Enrofloxacin	≤ 0.25
Erythromycin	> 8
Gentamicin	> 8
Imipenem	2
Neomycin	8
Oxacillin + 2% NaCl	4
Oxytetracycline	8
Penicillin	0.12
Ticarcillin	≤ 8
Ticarcillin/clavulanic acid	≤ 8
Trimethoprim/sulphamethoxazole	≤ 5
Tylosin	32

* Minimum inhibitory concentration (MIC) refers to the lowest concentration of drug that inhibited growth (ug/mL).

decrease on average 1% to 4% per day of storage.[9] Follow-up contact with the boar stud found that no subjective decreases in motility in their extended-cooled semen doses had been observed. However, upon further inquiry, it was found that extended semen was not normally held beyond 48 hours post collection and it was recommended to use the product within 1 to 2 days of collection. The stud reported no health or other issues described by farms using the extended semen.

In conclusion, this case supports that *T abortisuis* can be present in a non-clinically affected boar stud and can contaminate extended boar semen. This contaminant may cause disruptions to extended porcine semen (ie, total and progressive motilities) when held at typical storage conditions (16°C) for several days prior to use. Further work needs to be performed to elucidate the role *T abortisuis* may play in extended boar semen quality and sow reproductive performance.

Implications

- *T abortisuis* can be identified in extended semen originating from non-clinically affected boars used in artificial insemination programs.
- Under the conditions of this study, *T abortisuis* exhibits slow growth in extended porcine semen, with isolation best found in sampling older stored semen samples (> 48 hours) followed by a 72-hour incubation under aerobic or anaerobic conditions.
- Under the conditions of this study, decreased total and progressive sperm motilities may be found in extended semen contaminated with *T abortisuis* by 72 hours post processing.
- Identification of the source(s) of *T abortisuis* contamination is necessary in order to better mitigate its presence in extended porcine semen.

Acknowledgments

The authors would like to thank Mrs Betty Osborne for her technical assistance.

Conflict of interest

None reported.

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Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.4
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

$^{\circ}F = (^{\circ}C \times 9/5) + 32$

$^{\circ}C = (^{\circ}F - 32) \times 5/9$

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

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Case report

Influenza outbreak causes reduction in semen quality of boars

Drew W. Lugar, MS; Darryl Ragland, DVM, PhD; Kara R. Stewart, MS, PhD

Summary

An influenza outbreak occurred at Purdue University's swine barn, resulting in infection of 28 boars with influenza A virus (H3N2) and causing the death of two boars. The 28 boars, approximately 35 weeks of age, were enrolled in a study at the time of the outbreak and the case report herein describes the effects of the unintended influenza outbreak on sperm production. Semen was collected from the boars once a week and evaluated for total sperm production and concentration, semen volume, and relative motility. Compared to previous collections, total sperm production was substantially decreased (26% reduction) approximately 4 weeks after the first observed clinical signs and remained low for 6 subsequent weeks. Semen production then returned to pre-outbreak levels and was maintained for the duration of the observation period. Sperm motility and percent normal sperm production were also slightly reduced 2 weeks after infection.

Keywords: swine, influenza A virus, boar, semen quality

Received: December 20, 2016
Accepted: April 25, 2017

Resumen - Brote de influenza causa reducción en la calidad de semen en machos

Un brote de influenza sucedió en una sala de la granja porcina de la Universidad de Purdue, resultando en la infección de 28 machos con el virus de la influenza tipo A (H3N2 por sus siglas en inglés), y causando la muerte de dos machos. Los 28 machos de aproximadamente 35 semanas de edad, se incluyeron en un estudio al momento del brote, y el reporte descrito en este caso, así como los efectos de un brote de influenza no intencionado sobre la producción de semen. Una vez a la semana, se recolectó semen de los machos, y se evaluó la concentración y la producción total, el volumen, y la motilidad relativa del semen. Comparándolo con las colecciones previas, la producción total de semen este disminuyó sustancialmente (26% de reducción) aproximadamente 4 semanas después del los primeros signos clínicos observados, este permaneció bajo por las siguientes 6 semanas. La producción de semen regresó a los niveles previos al brote, y se mantuvo durante del periodo de observación. La motilidad del semen y el porcentaje de producción normal también disminuyeron ligeramente 2 semanas después de la infección.

Résumé - Une épidémie d'influenza cause une réduction de la qualité de la semence de verrats

Une épidémie d'influenza est survenue à la porcherie de l'université Purdue, entrainant l'infection de 28 verrats avec le virus de l'influenza A (H3N2) et causant la mort de deux verrats. Les 28 verrats, âgés d'environ 35 semaines, faisaient partie d'une étude au moment de l'épidémie et le présent rapport de cas décrit les effets de cette épidémie inattendue d'influenza sur la production de sperme. De la semence était prélevée des verrats une fois par semaine et évaluée pour la production totale de sperme et la concentration, le volume de semence, et la mobilité relative. Comparativement aux collectes antérieures, la production totale de sperme était diminuée de manière substantielle (26% de réduction) environ 4 semaines après l'observation des premiers signes cliniques et est demeurée faible pour les 6 semaines subséquentes. La production de semence retourna ensuite aux niveaux pré-épidémie et fut maintenue pour la durée de la période d'observation. La mobilité du sperme et le pourcentage de production de sperme normal étaient également réduits 2 semaines après l'infection.

Intensive farming strategies create opportunities for pathogens to enter and rapidly spread throughout herds, causing reduced growth rates, overall performance, and health compared to unchallenged herds. These reductions in growth and performance also have a consequential economic impact on producers. In addition to nutrition-related measures of performance, reproductive performance and efficiency are also keys to producer profitability and are susceptible to reductions caused by physiological stressors like heat stress and diseases. However, there is a lack of literature on the effects of disease on semen quality in boars. Porcine reproductive and respiratory syndrome virus is thought to impair motility and morphology of sperm without a major change in sperm production, though most research is focused on its transmission through semen.[1,2] The Torque teno virus[3] and porcine circovirus type 2[4] are also transmitted through the semen, but do not appear to alter semen quality in boars.

Influenza A virus is a pathogen that induces clinical signs, resulting in fever, which leads to elevated core body temperature, but there is a lack of published information on the effects of this disease on semen quality in boars. Choi et al[5] reported that 22.8% of pigs in the United States test positive for

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

Lugar DW, Ragland D, Stewart KR. Influenza outbreak causes reduction in semen quality of boars. *J Swine Health Prod.* 2017;25(6):303–307.

swine influenza virus via hemagglutination inhibition and real time-polymerase chain reaction.[5] Globally, influenza is one of the most widespread respiratory viruses affecting the swine industry and is considered endemic throughout most of the world.[6] One of the main issues with influenza infections in swine is that pigs are susceptible to swine, avian, and human strains of influenza virus.[6] Influenza-infected animals generally display clinical signs shortly after infection, which include, but are not limited to fever, diarrhea, and sneezing and (or) coughing.[7] Influenza is primarily spread via nose-to-nose contact between pigs and via aerosolized, infectious respiratory excretions.[7]

To the authors' knowledge, this is the first report on the effects of influenza A virus infection on the subsequent semen quality of boars. The purpose of this case report is to elucidate the effects of influenza A virus infections on sperm production and semen quality in boars.

Influenza outbreak and treatment timeline

Twenty-eight 35-week-old boars were being evaluated for semen quality parameters at the Purdue University Animal Sciences Research and Education Center when an influenza outbreak occurred. The first observation of mild clinical signs of illness (intermediate coughing and lethargy) in three boars occurred April 22, 2016, three weeks into the evaluation of semen quality. On the morning of April 24, 2016 (start of week 4), one boar was found dead and mild clinical signs were observed in eight to 10 boars. By April 25, 2016, moderate clinical signs (persistent coughing and lethargy) were observed in over 75% of the boars present. At this point, all of the boars were treated with a single injection of tulathromycin at a dosage of 2.5 mg per kg to minimize the potential for secondary infections, and with a single intramuscular injection of flunixin meglumine at a dosage of 2.2 mg per kg to manage pyrexia. On April 26, 2016, a second boar was found dead in the early afternoon and moderate clinical signs were observed in all of the remaining boars. These moderate clinical signs persisted for 2 to 3 days post treatment in a majority of the boars, and mild clinical signs lasted up to 10 days in some boars. By day 11 post treatment, 2 weeks after initial clinical signs were observed (end of week 5), no clinical signs of illness were observed.

The boars that died on April 24 and April 26 were necropsied by a licensed veterinarian and lung samples were collected and submitted for diagnostic testing. The necropsies revealed consolidation of the cranial and ventral lung lobes and accessory lobes, with some fibrinous exudate in the pleural cavity. The lungs had varying degrees of pulmonary edema and congestion and there appeared to be increased fluid in the pericardial sac of the affected boars. Lung tissue was submitted to the Indiana Animal Disease Diagnostic Laboratory (ADDL; West Lafayette, Indiana) and the cause of the influenza outbreak was confirmed. Testing of the diseased lung tissue via polymerase chain reaction revealed the presence of influenza type A nucleic acids belonging to the H3N2 strain of influenza virus. Blood was collected and serum was harvested from all of the boars during week 5 and samples were submitted to the Indiana ADDL. The serum was tested for influenza type A virus antibodies via enzyme-linked immunosorbent assay (ELISA), and the results showed that all boars tested positive for influenza A virus antibodies.

Effects on reproductive performance

The influenza outbreak had a major impact on the semen quality parameters measured on freshly collected semen in this incident. Prior to the influenza outbreak, the boars were housed in individual stalls and semen was routinely collected one time per week via the double-gloved hand technique and an artificial sow. Semen was evaluated on site immediately after each collection for sperm concentration, semen volume, relative motility, and total sperm production (concentration × volume). Semen was evaluated on site starting at week 1 (April 4, 2016) through week 17 (July 29, 2016). At weeks 5 through 11, semen was diluted with a commercial semen extender on site and also evaluated by computer-assisted sperm assessment (CASA; CEROS II, IMV Technologies USA; Maple Grove, Minnesota) for sperm total motility and progressive motility, as well as by microscopic examination for percent normal sperm morphology, once weekly for each boar. Total motility refers to any movement of the sperm, whereas progressive motility, a subset of total motility, refers to sperm movement in a mostly straight manner. To determine percent normal morphology, a phase contrast microscope was used to count a minimum of 200 sperm.

Statistical analysis was performed using the PROC MIXED function of SAS (version 9.4; SAS Institute Inc, Cary, North Carolina). Statistical analysis of semen parameters utilized repeated measures criteria of boar by week. Different covariance structures (compound symmetry, heterogeneous autoregressive, and unstructured) were tested in order to minimize Akaike information criterion. Where appropriate, collection and laboratory technician were utilized as potential random effects. A P value < .05 was considered statistically significant and a P value < .10 was considered a tendency.

The influenza outbreak occurred at the end of week 3 of the study and lasted through the end of week 5. Normal semen production was seen in weeks 1 through 6 (70.74, 65.14, 70.89, 65.31, 63.98, and 71.53 ± 3.72 × 10^9 sperm per ejaculate, respectively). Sperm production was significantly reduced during weeks 7 through 12 (54.22, 49.45, 49.45, 48.43, 53.41, and 48.94 ± 3.72 × 10^9 sperm per ejaculate, respectively), returning to normal during weeks 13 through 17 (69.23, 67.45, 72.82, 66.79, and 65.95 ± 3.72 × 10^9 sperm per ejaculate). For this reason, total sperm production, total motile sperm production, semen volume, and semen concentration were analyzed in three phases: Phase 1 (weeks 1 to 6), Phase 2 (weeks 7 to 12), and Phase 3 (weeks 13 to 17). Total sperm production data are summarized in Table 1. Total sperm production did not differ in phases 1 and 3 (P > .05). Total sperm production was greater in phases 1 and 3 compared to Phase 2 (67.92 and 68.33 versus 50.52 ± 2.73 × 10^9 sperm; P < .001). Average total sperm production in phases 1 and 3 was 68.13 × 10^9 sperm compared with 50.52 × 10^9 sperm in Phase 2, a difference of 17.61 × 10^9 sperm representing a 26% reduction in sperm production. Total motile sperm production data are summarized in Table 1. Total motile sperm production was lower in Phase 2 than in phases 1 and 3 (P < .001), and did not differ in phases 1 and 3 (P > .05). Semen volume was greater in Phase 3 than in phases 1 and 2 (P < .001 and P < .01, respectively). Semen volume was greater in Phase 2 than in Phase 1 (P < .05). Sperm concentration was lower in Phase 3 than in Phase 1 (P < .001), and lower in Phase 2 than in phases 1 and 3 (P < .001).

Sperm motility and progressive motility data are summarized in Figure 1. Sperm motility was lower in week 7 than in weeks 9 through 11 (P < .05), weeks 5, 6, and 8 through 11 did not differ (P > .05), and

Table 1: Sperm production data by phase from 28 boars unintentionally infected with influenza A virus at a university research farm, with a pre-influenza phase (Phase 1), an influenza-affected phase (Phase 2), and a post-influenza phase (Phase 3)*

	Phase†				
Sperm production	**1**	**2**	**3**	**SE**	***P***
Total sperm production × 10^9	67.92[a]	50.52[b]	68.33[a]	2.730	< .01
Relative motility (%)	89.82[a]	83.30[b]	82.80[b]	0.005	< .01
Total motile sperm × 10^9‡	58.25[a]	40.89[b]	56.03[a]	2.430	< .01

* Clinical signs observed during the influenza outbreak included coughing and lethargy. The outbreak resulted in the deaths of two boars during the observation period. Lung samples from the dead boars were submitted to a diagnostic laboratory, which confirmed by polymerase chain reaction the presence of type A influenza virus (H3N2). Following the laboratory diagnosis, blood was collected and serum harvested and submitted for diagnosis, confirming type A influenza by an enzyme-linked immunosorbent assay.

† Phase 1 (weeks 1-6) where first clinical signs were observed at week 3 and were no longer observed by week 5; Phase 2 (weeks 7-12); Phase 3 (weeks 13-17). Phases were based on the weekly analysis of the data that showed a substantial reduction in total sperm production in weeks 7-12.

‡ Total motile sperm = total sperm production (total sperm production = semen volume × sperm concentration) × relative motility (as assessed by phase contrast microscopy).

[ab] Within a row, values with different superscripts are different ($P < .05$; ANOVA).

SE = standard error.

weeks 5 through 8 did not differ ($P > .05$). Progressive motility did not differ for week 5 compared to other all weeks ($P > .05$). Progressive motility tended to be lower for week 6 than for week 10 ($P < .10$). Week 7 progressive motility was lower than in weeks 8 through 11 ($P < .05$, $P < .01$, $P < .01$, $P < .01$; respectively), and within weeks 8 to 11 progressive motility did not differ ($P > .05$).

Percent normal morphology data are summarized in Figure 2. Percent normal morphology was lower for weeks 5 and 6 than for weeks 10 and 11 ($P < .05$). Week 5 percent normal morphology did not differ from that in weeks 6 to 9 ($P > .05$), and percent normal morphology in week 6 did not differ from that in weeks 5, 7, and 8 ($P > .05$). Week 6 percent normal morphology tended to be lower than week 9 percent normal morphology ($P < .10$).

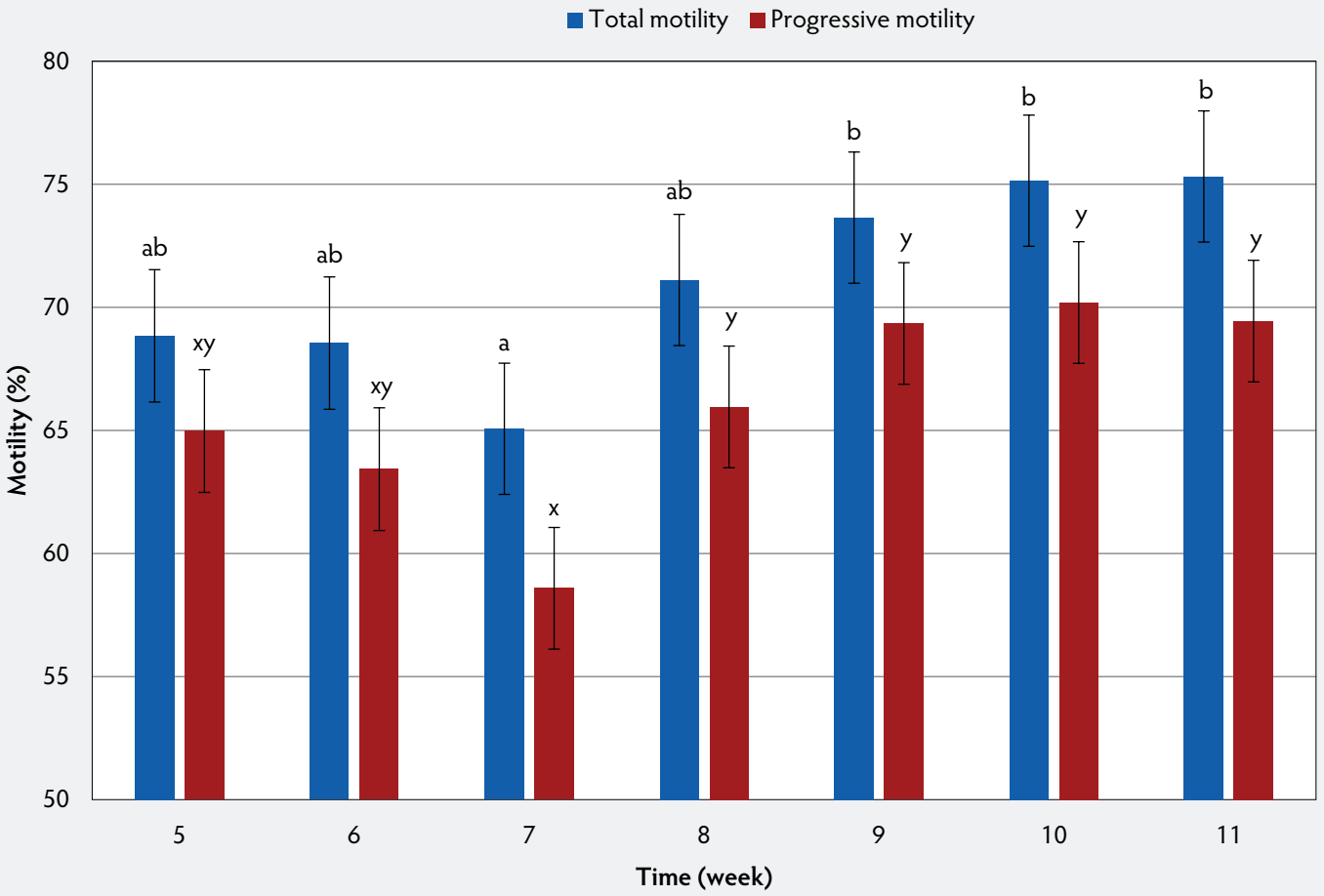
Discussion

The results of this report indicate that influenza A infection had a significant impact on the semen quality of boars, including total sperm production, motility, and morphology. To the authors' knowledge, this is the first reported case of influenza A infection affecting semen quality in boars, although there are reports of influenza's impact on semen quality in humans and mice.[8,9] Research suggests that other diseases can impact semen quality of boars; however, most research on disease in boars is primarily focused on the transmission of pathogens through semen. This report suggests that 4 weeks after the onset of clinical signs of infection, total sperm production is reduced in the boar. This reduction resulted from reduced sperm production within the testes and was confirmed by a reduction in sperm concentration. Semen volume increased during the observation period, as is normally seen in growing, maturing boars. These data suggest that infection with influenza virus causes a physiological response to the extent that there is a reduction in the production of sperm, likely caused by fever and elevated core body temperature. This reduced sperm production has been seen in men infected with febrile (fever causing) diseases.[10,11] It is unlikely that influenza A virus directly impacted semen production in the testes due to its localization in lung tissue; instead, influenza A virus likely had an indirect effect by initiating a fever response which could cause a reduction in sperm production. Further research should investigate the effects of a febrile infection on semen quality parameters in boars to determine the direct cause of the reduced sperm production.

During the 17-week observation period, sperm motility and morphology were analyzed for weeks 5 through 11. Data suggest sperm motility and progressive motility may decline at a minimum of 2 to 4 weeks after the onset of clinical signs of fever or infection with influenza virus and return to normal after 5 to 6 weeks. The percentage of normal spermatozoa was reduced at a minimum of 2 to 3 weeks after the initial onset of clinical signs and steadily returned to normal by 7 to 8 weeks. This case report did not analyze data on CASA parameters and percent normal sperm morphology during the first 4 weeks of the observation period and thus the entire impact on motility and morphology parameters cannot be estimated. However, the results of analysis suggest that these parameters are temporarily decreased a few weeks after influenza A infection, which agrees with results in men infected with febrile diseases.[12]

The semen analysis results presented in this report are common in boars that have undergone a stressful event able to increase core body temperature, such as heat stress. Boars that are heat stressed, for example, typically have reduced sperm motility and increased sperm abnormalities within 2 weeks of the heat stress event.[13] The length of time the stressor impacts the boars also plays a role, as motility and morphology parameters do not return to normal until 4 to 6 weeks after the stressor is removed.[13] Similar results were seen in this case, where there was a clear delay in affected sperm reaching the caudal epididymis and having an effect on spermatogenesis. Influenza and (or) the consequential physiological responses to influenza A virus infection appear to affect spermatogenesis to the extent that an entire spermatogenic cycle (approximately 41 days) is required for sperm production to return to normal.[14] To the authors' knowledge, this is the first reported case of impaired semen quality due to an influenza outbreak in boars. While it is unlikely that influenza virus directly impairs sperm production, the residual effects of

Figure 1: An unintentional outbreak of influenza A (H3N2) occurred at a university research farm, affecting total sperm motility and progressive motility of 28 boars. This outbreak caused clinical signs consisting of coughing and lethargy, as well as the deaths of two boars. Laboratory diagnosis confirmed the presence of this virus in lung tissue samples, as well as in serum samples from the boars. Clinical signs were observed in weeks 3-5 and caused latent effects on semen production and quality. The figure shows the effect of influenza on sperm total motility and progressive motility as assessed by computer assisted sperm assessment weeks 5-11. Blue bars represent total motility where bars with differing letters (a, b) are statistically different ($P < .05$). Red bars represent progressive motility where bars with differing letters (x, y) are statistically different ($P < .05$). Error bars for both total motility and progressive motility represent the standard error. This graph shows that both total motility and progressive motility of sperm were decreased at week 7 and then returned to normal beginning at week 8. Sperm motility parameters were not measured prior to week 5, so the total extent of the effects of influenza on sperm motility parameters cannot be estimated. Statistical analyses on total and progressive motility were performed using repeated measures in the MIXED procedure of SAS (version 9.4) with collection and laboratory technician as random effects. Significant differences were determined at a P value < .05 and a tendency at a P value < .10.



viral infections may be seen in the reproductive function of boars.

Implications

- Influenza and its effects on the body can negatively impact normal sperm production in boars.
- The consequences of influenza on total sperm production are delayed due to the nature of spermatogenesis.

Conflict of interest

None reported.

Disclaimer

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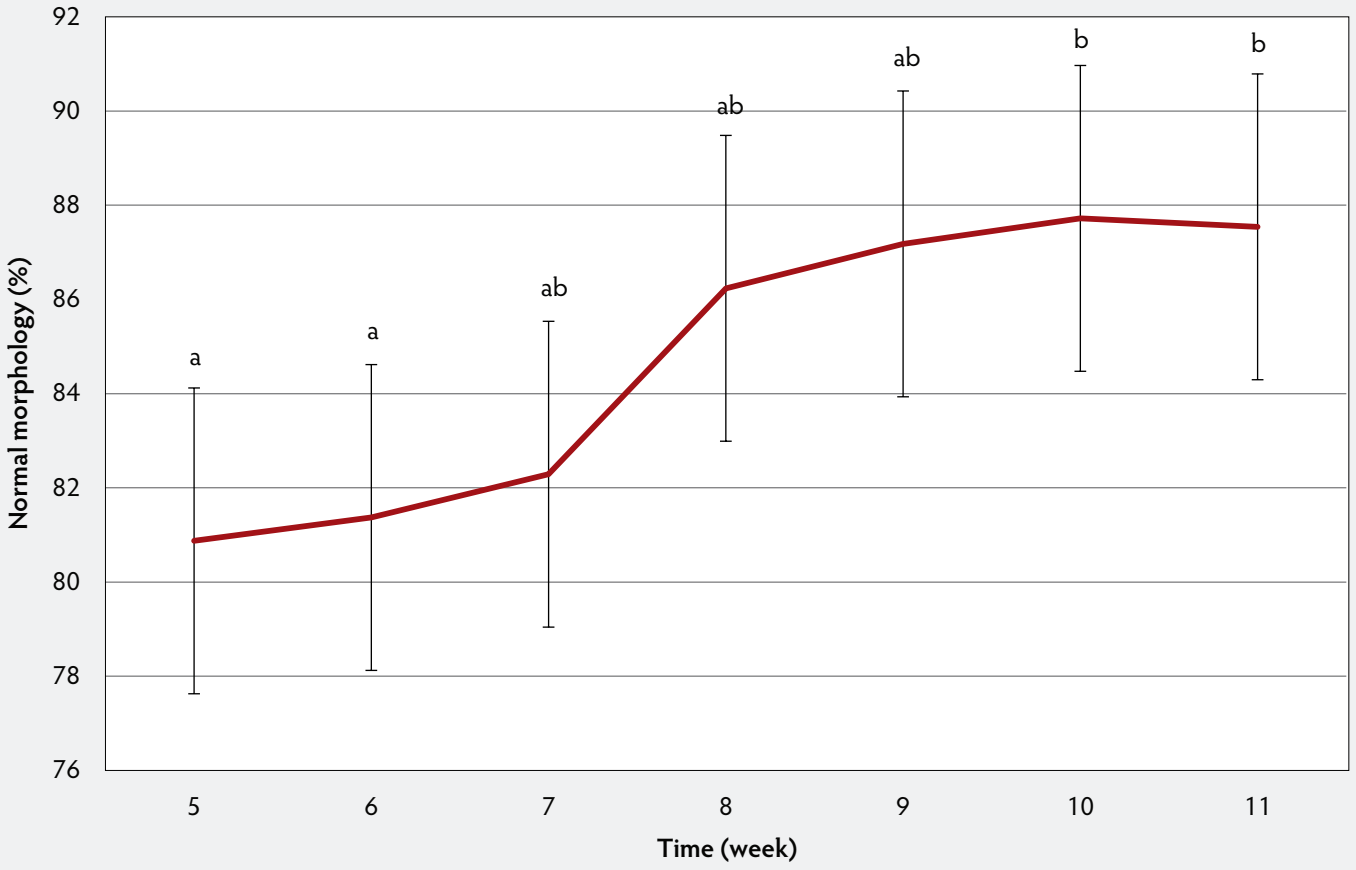
Figure 2: An unintentional outbreak of influenza occurred at a university research farm, affecting the percentage of morphologically normal sperm of 28 boars. This outbreak caused clinical signs which consisted of coughing and lethargy, as well as the deaths of two boars. Laboratory diagnosis confirmed the presence of a type A influenza virus, specifically H3N2, in lung tissue samples from the dead boars, as well as in serum samples from the remaining boars. Clinical signs of the outbreak were observed weeks 3-5 and caused latent effects on semen production and quality. The figure illustrates the effect of influenza virus on the percentage of morphologically normal sperm. Sperm morphology was assessed weeks 5-11 using phase contrast microscopy, where a minimum of 200 sperm were counted and categorized as normal or abnormal. Weeks with differing letters (a, b) are different ($P < .05$) and error bars are represented by the standard error. This figure reveals that the percentage of morphologically normal sperm was low at weeks 5 and 6, and then increased over time. It is likely that percent normal morphology during weeks 1-3 would have been similar to weeks 9-11, where a plateau was observed. Since morphological assessment was not conducted weeks 1-4, the full effect of influenza A virus on sperm morphology cannot be completely estimated. Statistical analysis on sperm morphology was performed using repeated measures in the MIXED procedure of SAS (version 9.4) with collection and laboratory technician as random effects. Significant differences were determined at a P value < .05 and a tendency at a P value < .10.



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Supplemental iron dextran injections: Influence on hemoglobin concentrations and piglet growth

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Summary

This case study assessed effectiveness of protocols for iron dextran administration on hemoglobin (Hb) concentrations in pigs and evaluated the effect of supplemental iron dextran injections prior to weaning on subsequent body weights (BW). Whole blood samples and body weights were collected from piglets at 14 days of age in four farms and at 27 days of age in the fifth farm. For Farms 1 to 3, six piglets per litter were matched by BW to provide a pair of heavy weight (HW) piglets, medium weight (MW) piglets, and light weight (LW) piglets in each litter. For Farms 4 and 5, MW piglets were not included. One piglet from each pair was injected intramuscularly with 200 mg iron dextran immediately after blood collection (treatment pigs). The other piglet in each pair served as the control. At 3 weeks after weaning, pigs were weighed and whole blood samples were collected to determine Hb concentrations. At 14 days of age and after weaning, the results were inconsistent among the farms. Prior to recommending supplemental iron injections for pigs, one must evaluate the existing on-farm protocol for iron administration.

Keywords: swine, pigs, iron dextran, hemoglobin, body weights

Received: August 4, 2016
Accepted: April 11, 2017

Resumen - Inyecciones complementarias de hierro dextrano: Influencia en las concentraciones de hemoglobina y crecimiento del lechón

Este caso valoró la eficacia de los protocolos de administración de hierro dextrano en las concentraciones de hemoglobina (Hb por sus siglas en inglés) en cerdos y evaluó el efecto de las inyecciones complementarias de hierro dextrano antes del destete en subsecuentes pesos corporales (BW por sus siglas en inglés). Se recolectaron muestras completas de sangre y pesos corporales de lechones a los 14 días de edad en cuatro granjas y a los 27 días de edad en una quinta granja. En las granjas 1 a 3, se organizaron seis lechones por camada por BW para tener un par de lechones de peso pesado (HW por sus siglas en inglés), lechones de peso medio (MW peso medio por sus siglas en inglés), y lechones de peso ligero (LW por sus siglas en inglés) en cada camada. De las granjas 4 y 5, no se incluyeron lechones de MW. Se inyecto intramuscularmente (IM por sus siglas en inglés) un lechón de cada par con 200 mg de hierro dextrano inmediatamente después de la recolección de sangre (cerdos de tratamiento). El otro lechón en cada par sirvió como control. A las 3 semanas después del destete, se pesaron los cerdos y se recolectaron muestras completas de sangre para determinar las concentraciones de Hb. A los 14 días de edad y después del destete, los resultados fueron inconsistentes entre las granjas. Antes de recomendar inyecciones complementarias de hierro para los cerdos, se debe evaluar el protocolo existente en cada granja para la administración de hierro.

Résumé - Injections de supplément de fer dextran: Influence sur les concentrations d'hémoglobine et la croissance des porcelets

Cette étude visait à juger l'efficacité des protocoles d'administration de fer dextran sur les concentrations d'hémoglobine (Hb) chez les porcs et à évaluer l'effet d'injections de supplément de fer dextran avant le sevrage sur les poids corporels (PC) subséquents. Des échantillons de sang complet ont été prélevés et les poids corporels notés chez des porcelets âgés de 14 jours dans quatre fermes et à 27 jours d'âge sur une cinquième ferme. Pour les fermes 1 à 3, six porcelets par portée ont été jumelés par PC afin de fournir une paire de porcelets de poids lourds (PLo), de porcelets de poids moyen (PM), et des porcelets de poids léger (PLe) pour chaque portée. Pour les fermes 4 et 5, des porcelets de PM n'ont pas été inclus. Un porcelet de chaque paire fut injecté par voie intramusculaire (IM) avec 200 mg de fer dextran immédiatement après le prélèvement de sang (porcs traités). L'autre porcelet de chaque paire servait de témoin. Trois semaines après le sevrage, les porcs étaient pesés et des échantillons de sang complet prélevés afin de déterminer les concentrations de Hb. Quatorze jours après le sevrage, les résultats étaient inconstants parmi les fermes. Avant de recommander des injections de supplément de fer pour des porcs, une évaluation doit être faite du protocole d'administration de fer actuellement en vigueur sur la ferme.

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

Almond G, Byers E, Seate J, et al. Supplemental iron dextran injections: Influence on hemoglobin concentrations and piglet growth. *J Swine Health Prod.* 2017;25(6):308–312.

Hemoglobin (Hb) contains iron, which is essential for the transfer of oxygen to tissues. Piglets are born with limited iron stores[1] and sow's milk fails to provide sufficient iron to meet the

demands of rapidly growing piglets. Thus, supplemental iron typically is given to piglets within the first 5 days after birth. This iron injection is intended to prevent iron deficiency anemia.

The timing, dosage, and number of injections of iron dextran are highly variable in the pork industry. Some farms use a single injection of 200 mg of iron dextran, while other farms use 100 or 150 mg of iron dextran. Others give 150 mg on the first day after birth and a subsequent 150 mg when pigs are 5 to 7 days of age. Thus, there is little consistency in the administration of iron dextran to the piglets. The rationales for the various iron injection schemes often are based on convenience of administration and cost, with limited consideration for the distinct possibility of anemia. Few veterinarians evaluate Hb concentration in piglets as a routine diagnostic test. Recently, it was shown that Hb status was associated with post-weaning weight gains[2] and that large piglets in a litter are at greater risk of iron deficiency anemia than are smaller piglets.[3] Hence, large piglets may require greater iron dextran supplementation. Moreover, in one investigation,[4] when an additional 100 mg of iron was administered at 10 days of age, Hb concentrations were higher through 14 days post weaning. Therefore, the influence of some protocols for iron dextran administration on Hb concentrations in pigs in commercial farms were evaluated in the cases in this study.

Materials and methods

Farms

All animals were raised and managed on commercial farms in North Carolina. Each farm was Pork Quality Assurance Plus certified and followed the animal care standards of the National Pork Board.[5] An Institutional Animal Care and Use Committee protocol was not required.

The case series involved five commercial sow farms (2000 to 3600 sows per farm) and their respective off-site nursery facilities (Table 1). Two farms (Farm 1 and Farm 2) injected piglets with 200 mg iron dextran at processing (3 to 5 days of age). Farm 3 used 150 mg iron dextran at the time of processing. Farm 4 and Farm 5 used 150 mg iron dextran when pigs were 1 day of age, and then injected a second time with the same dose at processing (approximately at 5 to 7 days of age). The five farms used Uniferon (Pharmacosmos Inc, Watchung, New Jersey) for the iron dextran injections, which were administered intramuscularly (IM). Weaning age was approximately 21 days and 28 days on farms 1 to 3 and farms 4 and 5, respectively.

Iron injection treatments and sampling protocols

For farms 1, 2, and 3, blood samples (5 mL) were collected from the jugular vein or anterior vena cava into EDTA tubes (Becton, Dickinson and Company, Franklin Lakes, New Jersey) from 120, 84, and 72 piglets, respectively, at 14 days of age. All piglets in each litter were weighed, and six piglets per litter were sampled and matched by body weight to provide a pair of heavy weight (HW) piglets, medium weight (MW) piglets, and light weight (LW) piglets in each litter. The first piglet of a pair that approached the investigators received 200 mg iron dextran (Uniferon) IM (treatment pigs; TMT pigs) immediately after the blood collection. The remaining pigs (control pigs; CON pigs), paired by weight with TMT pigs, were not injected with iron. At approximately 3 weeks after weaning, all pigs were weighed and whole blood samples were collected in EDTA tubes.

On the basis of the preliminary results for the first three farms and requests from the farm management to minimize the number of pigs in the cases, the MW piglets were not included in the trials on farms 4 and 5. For Farm 5, the initial blood collection, supplemental iron injection (200 mg), and initial body weight determinations were delayed until the pigs were 27 days of age. Pigs were weaned at 28 days of age on Farm 5 and thus a supplemental iron injection was convenient on the day prior to weaning.

All blood samples were stored in coolers with ice and transported to the research laboratory at the College of Veterinary Medicine, North Carolina State University. The samples were analyzed for Hb concentrations with a HemoCue Hb 201+ instrument (HemoCue America, Brea, California) within 6 hours after collection. The HemoCue Hb 201+ was previously validated as a reliable device to assess Hb in arterial blood of pigs[6] and venous blood of other mammalian species.[7,8] In brief, the samples were allowed to return to room temperature and then

Table 1: Summary of farms and experimental protocols for injection of pigs with iron dextran in five farms

Farm	No. animals	Iron injection protocol	Age at weaning (days)	Age at first blood sample (days)	Age at second blood sample (days)
1	120	200 mg at processing	21	14	44
2	84	200 mg at processing	21	14	44
3	72	150 mg at processing	21	14	44
4	80	150 mg at 1 day of age, 150 mg at processing	28	14	44
5	80	150 mg at 1 day of age, 150 mg at processing	28	27	52

* Whole blood samples and body weights were collected from pigs at 14 days of age in farms 1-4 and at 27 days of age in Farm 5. Additional blood samples and body weights were collected when pigs were 44 or 52 days of age. For farms 1 to 3, six pigs per litter were matched by body weight to provide a pair of heavy weight (HW) pigs, medium weight (MW) pigs, and light weight (LW) pigs in each litter. For farms 4 and 5, MW pigs were not included. One pig from each pair was injected intramuscularly with 200 mg iron dextran immediately after blood collection (treatment pigs) at 14 or 27 days of age. The other pig in each pair served as the control. Piglets were typically processed at 3-5 days of age on farms 1-3 and at 5-7 days of age on farms 4 and 5.

gently rolled to thoroughly mix them. Following the manufacturer's instructions, a drop of blood was placed on a plastic film using a pipette, and the microcuvette was filled with care to avoid air bubbles. Then the microcuvette was placed in the microcuvette holder of the instrument and Hb concentration determined.

Statistical analyses

For the initial analysis, the independent variables included farm, weight class, sex, and treatment. All variables were categorical. To examine the effect of supplemental iron injection on Hb concentrations and body weights, two separate multiple linear regression models initially were used (R Core Team R, Vienna, Austria). To test for multicollinearity, a variance inflation factor was calculated. When all main effects and second-order interaction terms were included, the variables in the model were highly correlated and the model suffered from multicollinearity. Since there were significant ($P < .05$) interactions among farm, treatment, and weight class, the simple effects of treatment were examined for certain combinations of all other factors.[9] Simple effects compare means when there is a statistically significant interaction and the average of the simple effects is the main effect. Because of the interactions, the means across the farms, sexes, and weight classes could not be compared in the statistical analyses; rather, the simple effects of treatment for certain combinations of the factors (sex and weight class within each farm) were examined.

Results

A summary of Hb status and pigs' weights is given in Table 2. It was evident that the

Table 2: Mean body weights (kg) and hemoglobin concentrations (g/L) in pigs from five sow farms*

				Body weight (kg)				Hemoglobin concentrations (g/L)			
Farm	Treatment group	Weight class	N	Day 14 (27)	SE	Day 44 (52)	SE	Day 14 (27)	SE	Day 44 (52)	SE
1	Iron	Light	20	3.8	0.2	9.9	0.5	94.4	2.2	97.2	3.5
		Medium	20	4.6	0.2	12.1	0.5	89.8	2.1	94.0	3.0
		Heavy	20	5.5	0.2	13.8	0.4	88.6	2.2	99.2	3.8
	Control	Light	20	3.7	0.2	9.9	0.4	96.3	1.8	91.6	2.7
		Medium	20	4.6	0.2	11.7	0.4	92.5	1.8	90.4	3.3
		Heavy	20	5.2	0.2	12.3	0.4	88.9	1.8	94.3	3.3
2	Iron	Light	14	3.8	0.2	10.0	0.5	98.4	3.0	101.9	3.8
		Medium	14	4.5	0.2	11.3	0.6	88.5	4.4	111.9	2.9
		Heavy	14	5.1	0.1	12.1	0.3	91.3	3.3	98.5	4.5
	Control	Light	14	3.8	0.2	10.0	0.6	95.3	2.9	102.1	3.7
		Medium	14	4.6	0.2	10.7	0.5	91.7	3.2	100.6	3.0
		Heavy	14	5.2	0.1	11.9	0.7	87.1	2.4	101.8	4.9
3	Iron	Light	12	4.1	0.1	12.6	0.5	84.8	9.8	113.6	4.9
		Medium	12	4.6	0.1	13.7	0.7	89.3	8.7	115.0	4.1
		Heavy	12	5.2	0.1	15.4	0.7	91.3	8.9	118.1	2.4
	Control	Light	12	4.1	0.2	11.2	0.4	95.3	7.7	114.0	5.0
		Medium	12	4.6	0.1	13.8	0.5	97.4	8.4	105.9	4.0
		Heavy	12	5.1	0.1	14.2	0.7	92.1	8.0	107.3	4.4
4	Iron	Light	20	3.7	0.1	13.6	0.5	114.9	3.0	113.6	3.2
		Heavy	20	5.1	0.2	16.2	0.6	115.4	2.5	115.8	2.3
	Control	Light	20	3.7	0.1	13.2	0.8	118.9	2.1	111.5	3.2
		Heavy	20	5.3	0.2	16.1	0.7	119.1	1.9	110.7	2.9
5	Iron	Light	20	6.8	0.2	14.4	0.5	118.9	3.5	107.4	3.7
		Heavy	20	8.7	0.2	16.9	0.5	111.5	3.4	109.7	3.4
	Control	Light	20	6.7	0.2	14.4	0.6	122.5	2.9	106.3	2.1
		Heavy	20	8.7	0.2	17.0	0.5	114.8	3.2	110.3	2.3

* Study described in Table 1. Pigs were assigned at 14 days of age to either the control or iron injection groups. Pigs were matched by body weight (light, medium, heavy) between the control and treatment groups. For farms 4 and 5, the medium weight pigs were not included. For Farm 5, the blood collection days were days 27 and 52. Day numbers represent days when pigs were weighed or had blood samples collected.

SE = standard error.

assignment of pigs to their respective weight classes was consistent for each farm. At 14 days of age, Hb concentrations were numerically lower in the HW pigs than in the LW pigs in farms 1 and 2, but not in the other three farms.

As shown in Table 3, the supplemental iron injection in Farm 1 pigs was associated with greater body weights in most pigs, with the exception of the female MW pigs. There were also higher Hb concentrations in the male pigs, but not necessarily the female pigs. The consistent increase in body weights observed in Farm 1 was not evident in the other farms. In Farm 2, the male MW pigs had greater body weights and Hb concentrations in the TMT pigs than in the CON pigs. These differences were not apparent in the different classes of pigs. Either body weight or Hb was greater following treatment, but not both.

Four of the weight classes (MW male, HW male, LW female, and HW female) had greater weight gains after the iron supplementation than in the CON pigs in Farm 3. In addition, at 44 days of age, four of the weight classes responded to the iron injection with Hb concentrations higher than those of the CON pigs. As evident in Farm 1, greater Hb concentration did not necessarily occur concomitantly with a greater weight gain.

Iron supplementation was associated with greater body weights at 3 weeks after weaning in the male LW pigs in Farm 4, but not in the female pigs. In fact, the treated female LW pigs gained 1.85 kg less than their pair-matched CON pigs. Although the iron injection resulted in 16.2 g per L more Hb in the female HW pigs than in the CON female HW pigs, there was no corresponding increase in body weight. A similar result was apparent in the male HW pigs in Farm 5. In Farm 5, only the female LW pigs benefited with greater body weights from the supplemental iron injection at 27 days of age.

Discussion

The assignments of pigs to weight class (LW, MW, HW) were successful on all farms. Thus, there was an appropriate distribution of pig weights at the onset of the cases. It is important to note that farms 1 to 3 weaned pigs at 21 days of age, while farms 4 and 5 weaned pigs at 28 days of age. Consequently, it was anticipated that body weights would be different among the farms at 3 weeks after weaning.

The HemoCue Hb 201+ provides a convenient method to assess Hb concentrations for on-farm use or within a veterinary clinic. However, this single assessment of Hb concentrations must be viewed with caution. Despite the use of Hb concentration as an indicator of iron status and anemia, other blood parameters, such as serum iron and total iron binding capacity, may be more sensitive in detecting iron deficiency.[3] In addition, this instrument was shown to underestimate the Hb concentrations in pigs at 3 or 25 days of age.[10]

In the current study, Hb concentrations were generally lower at 14 days of age in the HW pigs than in the LW pigs. This should not be surprising, as the HW pigs represent the fastest growing pigs with the greatest demand for iron.[3,11] This inverse relationship, ie, HW pigs with low Hb and LW pigs with high Hb, creates a perplexing issue when one tries to interpret the influence of supplemental iron on subsequent pig growth. Weaning weight is one of the most important factors in pig growth after weaning.[12,13] Consequently, one needs to use caution when interpreting the influence of supplemental iron on subsequent growth. Pre-planned

Table 3: Simple effects for each farm, sex, and weight class*

Farm	Sex	Weight class	N	Body weight (kg)	Hb concentrations
1	Male	Light	15	0.64	7.1
		Medium	20	0.79	13.3
		Heavy	22	0.85	4.4
	Female	Light	25	0.87	-19.1
		Medium	20	0.05	-4.2
		Heavy	18	1.50	5.6
2	Male	Light	14	-0.14	0.3
		Medium	18	2.36	14.0
		Heavy	16	0.65	-7.7
	Female	Light	14	0.22	-13.9
		Medium	10	-0.25	14.8
		Heavy	12	0.14	-7.4
3	Male	Light	13	0.24	-11.4
		Medium	13	1.59	23.6
		Heavy	12	1.06	-1.0
	Female	Light	11	2.58	37.1
		Medium	11	-1.61	9.0
		Heavy	12	1.24	15.2
4	Male	Light	19	1.75	2.1
		Heavy	17	0.14	1.6
	Female	Light	21	-1.85	8.0
		Heavy	23	-0.05	16.2
5	Male	Light	21	-0.75	5.5
		Heavy	31	-0.11	20.2
	Female	Light	19	0.73	3.5
		Heavy	9	-0.08	-1.9

* Study described in Table 1. The simple effects compare the difference due to treatment with specific combinations of the factors (sex and weight class within each farm). It can be concluded, for example, for the Farm 1 male-light situation, the average weight gain (over the 30 days) of TMT pigs was 0.64 kg more than that of the CON pigs, whereas the Hb concentrations were 7.1 g/L greater in TMT pigs than in CON pigs.

TMT = treatment ; CON = control; Hb = hemoglobin.

differences in body weight among the two or three classes at the onset of the study continued into the nursery phase of production. The pigs stayed in the same weight categories throughout the study. The most notable weight gains were in the female HW pigs (Farm 1), male MW pigs (Farm 2), and female LW pigs (Farm 3) treated with supplemental iron. Evidently, greater weights with supplemental iron injections were not consistent among the three farms that weaned piglets at 21 days of age. Furthermore, it would have been beneficial to determine the long-term influence of the iron injections on weight gains into the finishing phase of production. Among the farms, the duration of time in the nursery facilities was variable and it would have been difficult to follow all pigs through to finishing.

In Farm 3, the use of a single injection of 150 mg iron dextran at processing resulted in low Hb concentrations in pigs at 14 days of age. This observation is consistent with the results of recent studies.[2,3,12] In contrast, in Farm 4, the two separate injections of iron resulted in Hb concentrations comparable to previously reported values[3,12] in pigs. Interestingly, the Hb concentrations were similar between the two farms by 44 days of age. Thus, it can be inferred that the additional iron injection in Farm 3 had a beneficial influence on Hb concentrations in MW male pigs and all female pigs.

Farm 5 weaned pigs at 28 days and the supplemental iron injections were given at 27 days of age. Despite the apparent tendency in Hb concentrations at 27 days of age, ie, lower Hb in the HW pigs than in LW pigs, the only notable increase in Hb concentrations was observed in the male HW pigs at 52 days of age. The reason for the influence of sex is speculative, particularly in view of the fact that this observation was not consistent among the farms and weight classes.

Overall, it is evident that the supplemental iron injection failed to consistently increase Hb concentrations and body weights among the five farms. Unfortunately, the composition of the nursery diets was unavailable; however, none of the farms used high concentrations of zinc oxide (ZnO) in the feed. High concentrations of ZnO (> 2000 mg per kg) recently were noted as a potential cause of anemia in pigs after weaning.[3] Hemoglobin concentrations are useful markers for iron status; however, other biomarkers of iron metabolism likely would shed additional light on the usefulness of supplemental iron injections.

Farms 1 and 2 used similar protocols for iron injections, while the protocols for other three farms differed. Farms 4 and 5 used the same routine injections at processing and 5 days later; however, the timing of the supplemental injection differed. In view of these inconsistencies, it should not be surprising that the pigs in each farm responded somewhat differently. Before making a broad, general recommendation on supplemental iron injections to improve post-weaning weight gains or Hb status of pigs, one must evaluate the on-farm protocol for iron injections of piglets. In the on-farm conditions of the present series of cases, it was apparent that increased Hb concentrations are not necessarily associated with greater body weights at 3 weeks after weaning.

Implications

- A two-dose scheme of iron dextran injections in the first week of life appears to meet the iron requirements of piglets.
- Under the conditions of these cases, there was a lack of consistency in dose and number of injections of iron dextran. The influence of pre-weaning supplemental iron injections and (or) Hb concentrations is confounded by the differences in body weights and sex at weaning.
- Practitioners need to evaluate existing protocols, weight gains, and Hb concentrations for each farm prior to recommending a supplemental iron injection prior to weaning.

Acknowledgements

The authors thank the producers and farm personnel for their cooperation, and Patty Routh for technical assistance. Pharmacosmos A/S provided partial funding for the project. The authors also express their gratitude to Dr Emily Griffith for statistical advice.

Conflict of interest

None reported.

Disclaimer

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* Non-refereed references.

Last call for Checkoff's Pig Welfare Symposium

The National Pork Board is holding its first ever Pig Welfare Symposium on November 7-9, 2017, in Des Moines, Iowa. The objectives of the symposium are to improve the wellbeing of pigs by disseminating recent research findings and recommendations, raising awareness of current and emerging issues, and identifying potential solutions. The dynamic program is intended for producers, veterinarians, academia, packers, processors, and allied industry partners. To register for virtual attendance, visit **www.pork.org/pws** or contact Sherrie Webb at **SWebb@pork.org** or 515-223-3533.

Broken Needle Webinar available on demand

The National Pork Board recently held a webinar on preventing broken needles in the administration of medicine to pigs, "How to Prevent Broken Needles: Protecting People, Pigs and Pork." The webinar offers insight into why proper medical care is important to raising healthy pigs and addresses this topic to prevent a broken needle from occurring on the farm.

The webinar includes comments from Laura Bachmeier, National Pork Board director of pork safety; Steven Hoff, Iowa State University professor of Ag and Biosystems Engineering; and Emily Erickson, New Fashion Pork. The replay of the full 60-minute webinar is available by going to **nationalhogfarmer.com** and searching for "needle webinar" to find the link.

Pig Survivability Working Group established

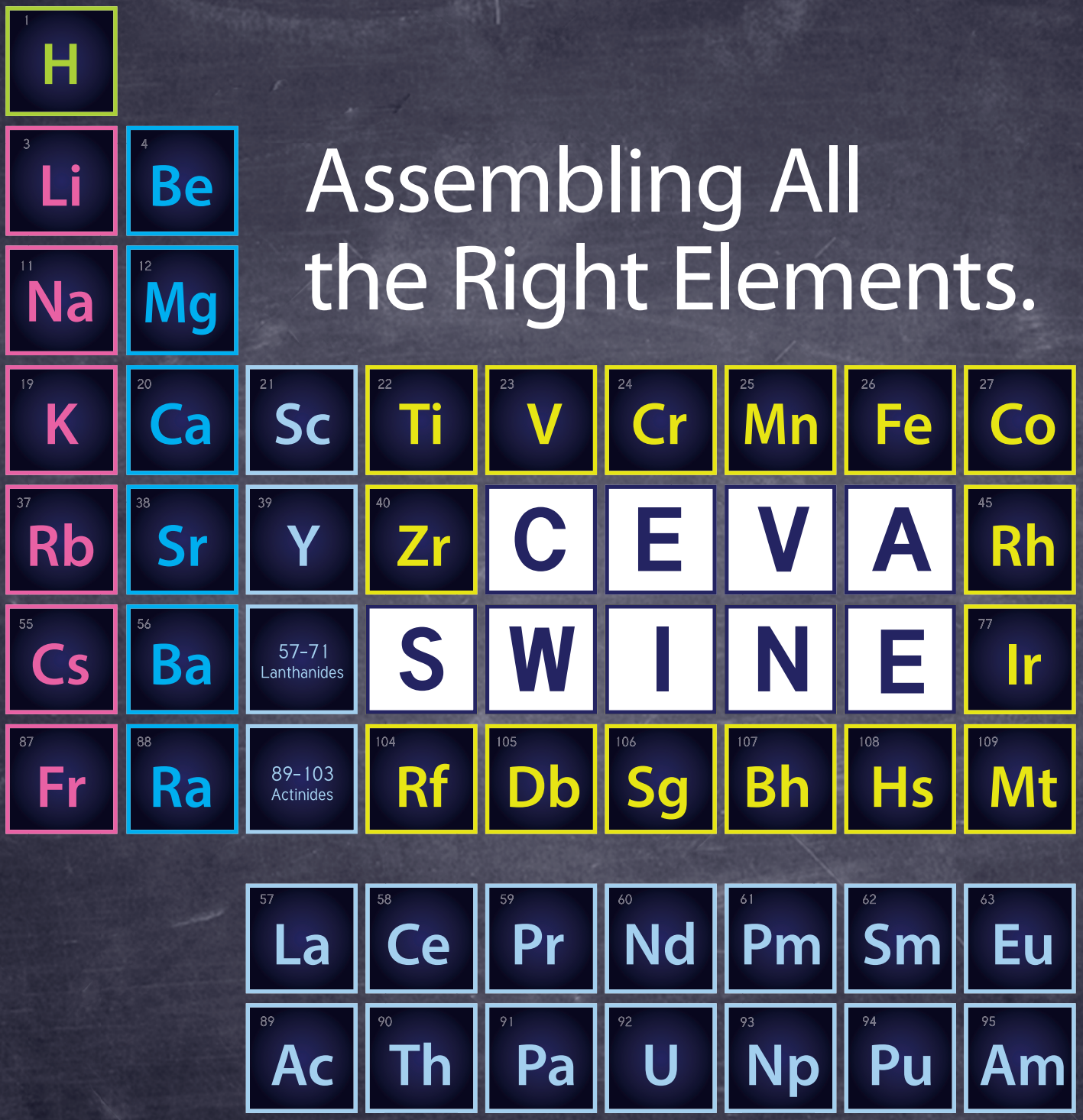
The Checkoff's Animal Science Committee recognizes that one of the biggest drags on productivity, sustainability, and profitability is loss of pigs and sows prior to market. To this end, the group dedicated nearly 80% of its 2018 research budget to mitigating pig death loss. The first step is to identify key areas of research and research priorities under those areas. Last week, the Pig Survivability Working Group, comprising producers, veterinarians, geneticists, and subject matter experts, met and worked on requests for proposals that will guide this area in 2018. This effort also will involve the animal science, animal welfare, and swine health committees. For more information, contact Chris Hostetler at **CHostetler@pork.org** or 515-223-2606.

Producer Services: Bulletin updated to help producers prepare for the Certified Swine Manager (CSM) exam

The Certified Swine Manager Bulletin (Guide) has been updated to better reflect how candidates can become CSMs. The document provides details on how to apply for the exam and share their work experience. There is also information to help candidates better understand how to prepare and gain additional knowledge prior to taking the exam. The National Pork Board will reach out to producers this fall to encourage them to consider having their production managers certified. For more information, contact Karen Hoare at **KHoare@pork.org** or 515-309-6131.

Domestic Marketing: Yummly Partnership

The NPB Digital Strategy Team has worked to define the appropriate recipe partnership. Yummly, the Netflix of Food, will house our 2100-plus recipes and put them in front of Yummly's 22 million users. Nothing will change for state associations and pork consumers. The partnership means we have access to many more recipe searchers who can find our recipes via pork-branded landing page, thereby better connecting users with our recipes. When **porkbeinspired.com** merges into **pork.org**, all recipes will be redirected to a page on **yummly.com**. This partnership also will provide more co-promotion opportunities in the future. For more information, contact Jarrod Sutton at **JSutton@pork.org** or 515-223-2766.



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AASV NEWS

AASV awards nominations due December 15

Do you know an AASV member whose dedication to the association and the swine industry is worthy of recognition? The AASV Awards Committee requests nominations for the following five awards to be presented at the upcoming AASV Annual Meeting in San Diego.

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

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

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

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

Young Swine Veterinarian of the Year – Given annually to a swine veterinarian who is an AASV member, 5 years or less post graduation, who has demonstrated the ideals of exemplary service and proficiency early in his or her career.

Nominations are due December 15. The nomination letter should specify the award and cite the qualifications of the candidate for the award. Submit to AASV, 830 26th Street, Perry, IA 50220-2328; Fax: 515-465-3832; E-mail: **aasv@aasv.org**.

New information shared in 2017 salary survey

The AASV recently completed its sixth salary survey of veterinary members in the United States and Canada, and the results are in! The AASV mailed printed copies of the survey results to US and Canadian members and posted the pdf version on the AASV Web site for all members to access at **https://www.aasv.org/members/only/SalarySurvey2017.pdf**.

Beginning in 2002, AASV has surveyed member salaries every 3 years. The 2017 survey gathered salary and employment details for the year 2016. Of the 955 US and Canadian members who were eligible to participate in the survey, 371 (39%) responded.

As in previous surveys, the AASV membership was classified into two categories: 1) Practitioners: veterinarians who work in private practice or within production systems, and 2) Public/Corporate Veterinarians: veterinarians who work in the allied pork industry or academia. Members in each category received a slightly different version of the survey.

For comparison purposes, the 2017 survey summary presents the same information shared in previous survey reports. Tables and figures compare salary levels with other surveyed parameters, including age, gender, hours worked, number of employees supervised, employer/practice type, and position. The survey also includes a comprehensive list of fringe benefits, noting the percentage of respondents who reported receiving each benefit.

In addition to the usual information, AASV expanded the 2017 summary to include details not shared in the past. A new report displays the income levels of those engaged primarily (90% or more) in swine-related activities separately from the salaries of those who have a lesser percentage of swine involvement. New tables provide average salary, age, gender, and hours worked for several sub-categories of employment activity within each of the Practitioner and Public/Corporate groups. Finally, in addition to breaking down income by age group as has been done in the past, the report now includes a review of income by years since graduation from veterinary school.

The AASV is indebted to IT Specialist David Brown for his management of the online survey instrument, as well as his expertise in compiling the survey results and preparing them for publication. The AASV also extends sincere appreciation to the members of the AASV Membership, Student Recruitment, and Communications Committees who provided suggestions for improving the survey report.

AASV news is continued on page 317

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AASV news is continued from page 315

Swine veterinarians represented in AVMA House of Delegates

During the 2017 AVMA Convention in Indianapolis, Dr Jeffrey Harker completed his term of service as AASV's representative to the AVMA House of Delegates (HOD). Within the HOD, Dr Harker carried the torch for swine veterinarians for nearly 6 years, beginning in 2012 as AASV's alternate delegate, and advancing to the delegate position in 2014. At the same time, he also served on AASV's Board of Directors representing members in District 4 (Indiana and Michigan). The AASV presented Dr Harker with the Meritorious Service Award during the 2017 AASV Annual Meeting in recognition of his commitment to the association.

As AASV's delegate to the HOD, Dr Harker worked to build coalitions with other allied groups within AVMA and chaired the Allied Caucus meeting held during the Indianapolis convention. The AVMA recognized and thanked him for his service at the conclusion of the HOD meeting on July 21.

Dr Jeffrey Harker receives recognition from AVMA for his years of service representing AASV in the House of Delegates.
Photo courtesy of Dr Tara Donovan

Given the small percentage of swine veterinarians within the AVMA, AASV relies on the voices of experienced, respected, and articulate members to inform veterinary colleagues about swine practice and to represent the interests of swine veterinarians within AVMA. As Dr Harker steps down from this role, he passes the torch to Dr Tara Donovan, who becomes AASV's delegate in the HOD after serving as alternate for the past 3 years.

Dr Donovan's experience in the swine industry speaks for itself. She is currently vice president of veterinary management for The Hanor Company, where she has been employed for 18 years. She is accustomed to representing swine veterinarians in a variety of settings, having served on numerous AASV and industry committees and working groups. She led AASV as president in 2012.

Dr Donovan is joined in representing AASV members in the AVMA HOD by Dr Deborah Murray, who will serve a 3-year term as AASV's alternate delegate. Dr Murray received her DVM degree from the University of Minnesota in 2006, and has been employed as a veterinarian at New Fashion Pork for the past 10 years. She has made numerous presentations at swine veterinary conferences. She was named AASV's Young Swine Veterinarian of the Year in 2012, and received the Science in Practice Award at the 2016 Allen D. Leman Swine Conference.

The AASV is fortunate to have well-qualified, dedicated members willing to represent the interests of the swine veterinary profession within AVMA.

Dr Tara Donovan, AVMA Delegate

Dr Deborah Murray, AVMA Alternate Delegate
Photo courtesy of Nicole Schwalbe

Position announcement: Associate Editor, *Journal of Swine Health and Production* (JSHAP)

The AASV seeks a scientific editor to fill the position being vacated by retiring JSHAP Associate Editor Dr Judi Bell. The associate editor will work closely with and have the support of an experienced publication team including the JSHAP Executive Editor, who directs the peer-review process and coordinates activities of the JSHAP staff and editorial board; the JSHAP Publications Manager, who handles internal staff communications as well as external communications with authors and manuscript submitters; and the JSHAP Graphic Designer and AASV Webmaster, who each prepare the copy-edited files for publication in print and electronic formats.

General qualifications

- Experience in scientific editing
- Experience in swine health and production preferred
- Excellent organizational, interpersonal, and communication skills
- Advanced degree (MS, DVM, PhD or equivalent) preferred

Duties

- Work with authors of scientific articles
- Convert scientific articles to JSHAP style (currently AMA style)
- Edit scientific articles
  - Scientific grammar and style
  - Summary
  - Headings and subheadings
  - Conflict of interest and disclaimer sections
  - Reference list format
  - Comments by reviewers and executive editor
  - Expository summary
  - Tables to grid format
  - Copy edit manuscript
  - Legends and footnotes of figures/tables
  - Implications section
  - Summary for translation to Spanish and French
- Accurately proofread final manuscripts and "all page final" of the journal
- Copy edit ancillary manuscripts
  - Style
  - Grammar and spelling
  - Proofreading
- Work unsupervised (geographic location negotiable)
- Set and adhere to strict deadlines for self and others

Time commitment

- It is expected that this position will be at least a 0.75 FTE

To apply

Applications will be accepted until the position is filled. Applicants are requested to send a resume, two references, and a brief statement (no more than one page) why you are applying for this position to AASV, 830 26th St, Perry, IA 50220-2328, Tel: 515-465-5255, E-mail: **aasv@aasv.org**.

Thank you, reviewers

Working together and creating a journal to be proud of!

The editorial staff of the Journal of Swine Health and Production *would like to acknowledge the invaluable assistance of the following individuals for their service as referees for the manuscripts that were reviewed between between September 23, 2016 and September 22, 2017.*

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AASV Annual Meeting Program

SATURDAY, MARCH 3

8:00 AM
Entrance examination: American Board of Veterinary Practitioners, Swine Health Management

Pre-conference seminars

12:30 PM – 5:30 PM

Seminar #1	AASV's Got Talent *Jeff Harker, chair*
Seminar #2	Veterinary Practice Succession *Chase Stahl, chair*
Seminar #3	Monitoring and Surveillance 2.0: Newer and simpler methods for you and your clients *Daniel Linhares, chair*
Seminar #4	Biosecurity *Brad Leuwerke, chair*
Seminar #5	Operation Main Street Training *Al Eidson, chair*

SUNDAY, MARCH 4

Canadian Association of Swine Veterinarians

Annual business meeting
8:00 AM – 12:00 noon

Pre-conference seminars

8:00 AM – 12:00 noon

Seminar #6	Antibiotic Alternatives *Nathan Winkelman, chair*
Seminar #7	Leading People: Leadership styles training for developing more effective and productive working relationships *Emily Byers, chair*
Seminar #8	The 4-Dimensional Revolution in Food Animal Health and Production: The synthesis of diagnostics, devices, digital platforms, and data analytics *Marie Culhane and Dale Polson, co-chairs*
Seminar #9	Diagnostics *Jon Van Blarcom, chair*
Seminar #10	Swine Medicine for Students *Jeremy Pittman and Angela Supple, co-chairs*

Research Topics

8:00 AM – 12:00 noon
Session chair: Chris Rademacher

8:00 AM	Effects of perinatal antibiotic administration in piglets on gut microbiota composition and antibiotic resistance gene prevalence *James Lowe*
8:15 AM	Microbial killing capacity of aqueous and gaseous ozone on different surfaces contaminated with manure *James Lowe*
8:30 AM	Evaluation of the survival of viral pathogens in contaminated feed ingredients using transboundary shipment models *Scott Dee*
8:45 AM	Spatial autocorrelation and what it means for swine surveillance *Marisa Rotolo*

Current program information is online at https://www.aasv.org/annmtg

9:00 AM	Pathogenesis and transmission of a novel porcine parainfluenza virus type 1 isolate (MN25890NS/2016) in weaned pigs *Michael Welch*
9:15 AM	Breeding herd factors associated with influenza in piglets at weaning *Fabian Chamba Pardo*
9:30 AM	Is influenza vaccination a key driver of influenza genetic diversity in piglets? *Jayaveeramuthu Nirmala*
9:45 AM	Novel approaches for influenza surveillance in swine breeding herds *Jorge Garrido Mantilla*
10:00 AM	BREAK
10:15 AM	Case report: Identification of *Mycoplasma hyopneumoniae* infection in a breeding herd through tracheobronchial swab monitoring *Frédéric Vangroenweghe*
10:30 AM	Genotypic differences between LA-MRSA ST5 and MRSA ST5 from humans with no swine contact *Samantha Hau*
10:45 AM	Processing fluids for PRRSV monitoring and surveillance systems *Will López*
11:00 AM	PRRS outbreak investigation pilot program: Lessons learned *Derald Holtkamp*
11:15 AM	Evaluating natural planned exposure protocols on rotavirus shedding patterns in gilts and the impact on their suckling pigs *Amanda Anderson*
11:30 AM	Evaluation of the persistence of Senecavirus A during an elimination program in a sow farm *Deborah Murray*
11:45 AM	Shedding and persistence of Senecavirus A in boars: Natural exposure and experimental infection with an historical and a contemporary strain *Matthew Sturos*
12:00 noon	Session concludes

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

12:00 noon – 5:00 PM

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

Concurrent sessions

1:00 PM – 5:15 PM

Session #1	**Student Seminar** *Andrew Bowman and Maria Pieters, co-chairs*
Session #2	**Industrial Partners** *George Charbonneau, chair*
Session #3	**Industrial Partners** *Attila Farkas and Joseph Fent, co-chairs*
Session #4	**Industrial Partners** *Peggy Brinkman and Abby Patterson, co-chairs*

MONDAY, MARCH 5

General session: Global Knowledge: Individual Application

8:00 AM – 12:15 PM

Program and session chair: C. Scanlon Daniels

8:00 AM	**Howard Dunne Memorial Lecture** How geography, culture, and socioeconomic status affect global animal protein consumption: Applications for swine veterinarians *Bill DuBois*
9:00 AM	**Alex Hogg Memorial Lecture** This is our time, the choices are yours *Rodger Main*
10:00 AM	BREAK
10:30 AM	Evaluating data: What do we really know? *Eric Burrough*
11:00 AM	Portraying the industry in a positive light *Erin Churan Brenneman*
11:30 AM	Agriculture 2025: Global, local, and high tech *Lowell Catlett*
12:15 PM	LUNCHEON

Concurrent session #1: Not Your Father's Sow Farm: Advances in technology and management practices

2:00 PM – 5:30 PM

Session chair: Steve Sornsen

2:00 PM	Experiences with new sow farm technologies *Noel Williams*
2:30 PM	Developing and maintaining highly prolific sows *Deborah Murray*
3:00 PM	Leading change to improve piglet survivability *Larry Coleman*
3:30 PM	BREAK
4:00 PM	Update on feeding strategies for the highly prolific sow *Mariana Boscato Menegat and Steve Dritz*
4:30 PM	Sow mortality: Impact on performance and root causes *Clayton Johnson*
5:00 PM	Roundtable Q&A
5:30 PM	Session concludes

Concurrent session #2: Emerging Diseases

2:00 PM – 5:30 PM

Session chair: Pete Thomas

2:00 PM	Next generation sequencing/metagenomics: Interpretation for the practitioner *Doug Marthaler*
2:30 PM	Porcine circovirus type 3 (PCV3) *Emily Byers, practitioner perspective* *Susan Detmer, pathologist/research perspective*
3:00 PM	Porcine parainfluenza virus *Aaron Lower, practitioner perspective* *Phil Gauger, pathologist/research perspective*
3:30 PM	BREAK
3:45 PM	Porcine sapelovirus *Brian Payne, practitioner perspective* *Bailey Arruda, pathologist/research perspective*
4:15 PM	Porcine deltacoronavirus *Katie Wedel, practitioner perspective* *Dick Hesse, pathologist/research perspective*
4:45 PM	Senecavirus A *Laura Bruner, practitioner perspective* *Fabio Vannucci, pathologist/research perspective*
5:15 PM	Wrap-up
5:30 PM	Session concludes

Concurrent session #3: Managing Endemic Disease

2:00 PM – 5:30 PM

Session chair: Caleb Robb

2:00 PM	Regional IAV-S vaccination strategies for breeding herds *Clayton Johnson*
2:25 PM	Systems approach to PRRSV management *Hans Rotto*
2:50 PM	Perennial herd closure *Ethan Spronk*
3:15 PM	Tech tools for disease management *Maryn Ptaschinski*
3:40 PM	BREAK
4:10 PM	*Mycoplasma hyopneumoniae*: Lateral transmission and gilt exposure methods *Paul Yeske*
4:35 PM	Experiences managing wean-to-finish PEDV in a production system *Lynn Pavlovic*
5:00 PM	Subclinical ileitis: Diagnostic monitoring, R^2, and economics *Nathan Winkelman*
5:30 PM	Session concludes

TUESDAY, MARCH 6

General session: Antibiotics

8:00 AM – 12:00 noon

Session chair: C. Scanlon Daniels

8:00 AM	Crucial to criminal: The range of perspectives on antimicrobial use in pork production *Locke Karriker*
8:45 AM	Antimicrobial use: Current EU perspective *Mark E C White*
9:30 AM	What to expect when you're not expecting: A veterinarian, producer, and feed mill perspective of an educational FDA audit *Pete Schneider*
10:00 AM	BREAK
10:30 AM	Measuring antibiotic use in pork production: Why, how, and for whom? *Peter Davies*
11:00 AM	The challenges of antibiotic use monitoring programs in beef and dairy production systems *Mike Apley*
11:30 AM	Monitoring – preparing – responding: SHIC's quickly moving on industry needs *Paul Sundberg*
12:00 noon	Session and meeting conclude

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For use by or on the order of a licensed veterinarian. Federal law prohibits the extra-label use of this drug in food-producing animals. Swine intended for human consumption must not be slaughtered within 5 days of receiving a single-injection dose. Use with caution in animals with known or suspected CNS disorders. Observe label directions and withdrawal times. See product labeling for full product information.

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CAUTION: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian. Federal (U.S.A.) law prohibits the extra-label use of this drug in food-producing animals.

PRODUCT DESCRIPTION: Each mL of Enroflox 100 contains 100 mg of enrofloxacin. Excipients are L-arginine base 200 mg, n-butyl alcohol 30 mg, benzyl alcohol (as a preservative) 20 mg and water for injection q.s.

INDICATIONS:

Cattle - Single-Dose Therapy: Enroflox 100 is indicated for the treatment of bovine respiratory disease (BRD) associated with *Mannheimia haemolytica, Pasteurella multocida, Histophilus somni* and *Mycoplasma bovis* in beef and non-lactating dairy cattle; and for the control of BRD in beef and non-lactating dairy cattle at high risk of developing BRD associated with *M. haemolytica, P. multocida, H. somni* and *M. bovis.*

Cattle - Multiple-Day Therapy: Enroflox 100 is indicated for the treatment of bovine respiratory disease (BRD) associated with *Mannheimia haemolytica, Pasteurella multocida* and *Histophilus somni* in beef and non-lactating dairy cattle.

Swine: Enroflox 100 is indicated for the treatment and control of swine respiratory disease (SRD) associated with *Actinobacillus pleuropneumoniae, Pasteurella multocida, Haemophilus parasuis* and *Streptococcus suis.*

RESIDUE WARNINGS:

Cattle: Animals intended for human consumption must not be slaughtered within 28 days from the last treatment. This product is not approved for female dairy cattle 20 months of age or older, including dry dairy cows. Use in these cattle may cause drug residues in milk and/or in calves born to these cows. A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for veal.

Swine: Animals intended for human consumption must not be slaughtered within 5 days of receiving a single-injection dose.

HUMAN WARNINGS: For use in animals only. Keep out of the reach of children. Avoid contact with eyes. In case of contact, immediately flush eyes with copious amounts of water for 15 minutes. In case of dermal contact, wash skin with soap and water. Consult a physician if irritation persists following ocular or dermal exposures. Individuals with a history of hypersensitivity to quinolones should avoid this product. In humans, there is a risk of user photosensitization within a few hours after excessive exposure to quinolones. If excessive accidental exposure occurs, avoid direct sunlight. For customer service, to obtain a copy of the Safety Data Sheet (SDS) or to report adverse reactions, call Norbrook at 1-866-591-5777.

PRECAUTIONS:
The effects of enrofloxacin on cattle or swine reproductive performance, pregnancy and lactation have not been adequately determined.
The long-term effects on articular joint cartilage have not been determined in pigs above market weight.
Subcutaneous injection can cause a transient local tissue reaction that may result in trim loss of edible tissue at slaughter.
Enroflox 100 contains different excipients than other enrofloxacin products. The safety and efficacy of this formulation in species other than cattle and swine have not been determined.
Quinolone-class drugs should be used with caution in animals with known or suspected Central Nervous System (CNS) disorders. In such animals, quinolones have, in rare instances, been associated with CNS stimulation which may lead to convulsive seizures. Quinolone-class drugs have been shown to produce erosions of cartilage of weight-bearing joints and other signs of arthropathy in immature animals of various species. See Animal Safety section for additional information.

ADVERSE REACTIONS: No adverse reactions were observed during clinical trials.

ANIMAL SAFETY:
In cattle safety studies, clinical signs of depression, incoordination and muscle fasciculation were observed in calves when doses of 15 or 25 mg/kg were administered for 10 to 15 days. Clinical signs of depression, inappetance and incoordination were observed when a dose of 50 mg/kg was administered for 3 days. An injection site study conducted in feeder calves demonstrated that the formulation may induce a transient reaction in the subcutaneous tissue and underlying muscle. In swine safety studies, incidental lameness of short duration was observed in all groups, including the saline-treated controls. Musculoskeletal stiffness was observed following the 15 and 25 mg/kg treatments with clinical signs appearing during the second week of treatment. Clinical signs of lameness improved after treatment ceased and most animals were clinically normal at necropsy. An injection site study conducted in pigs demonstrated that the formulation may induce a transient reaction in the subcutaneous tissue.

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I02 September 2016

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FOUNDATION NEWS

Rock the Boat – SEAL the Deal!

San Diego – the site of the upcoming AASV Annual Meeting – is known for its marvelous year-round climate, being ranked by the Weather Channel as number one in the nation. There is no better place to escape the late winter doldrums. It is a great place to visit, relax, and enjoy activities with family, friends, and colleagues.

We hope that one of the most enjoyable activities during the meeting next March will be the AASV Foundation's annual fundraising auction. We are looking forward to your support and participation in the auction to help ensure the future of your profession. The auction committee has lofty goals and we can only achieve them with your help!

Since the 1920's, the San Diego Harbor area has been the home of the US Navy, Airforce, Marines, and Coast Guard stations. The well-known and elite Navy SEALs train and deploy from there. San Diego is home to the largest naval fleet in the world and has the only submarine and ship-building yard on the West Coast. With this in mind, the committee has chosen "**Rock the Boat – SEAL the Deal**" as our 2018 auction theme.

The Navy SEALs are known for their slogan, *Have a Shared Sense of Purpose*. Please remember ***our*** shared sense of purpose as we strive to make the AASV Foundation's endowed funds self-sustainable, ensuring our future effectiveness.

Your 2018 auction committee is actively soliciting donations for both the live and silent auctions. Please be generous investing in the future of the foundation, and make your commitments as soon as possible. Our success depends on you, the membership, so help us put together another fun-filled auction night at our annual meeting. We are confident of our endeavor and the commitment of AASV members. Remember that the value of the auction items will determine the live and silent auction tiers: Your generosity counts!

If you have questions or just want to discuss possibilities, please contact any of the committee members. Download the donation form at `www.aasv.org/foundation/2018/Donationform.pdf` and submit a description and image of your item(s) by December 1. Your contribution will be recognized in the printed auction catalog as well as on the auction Web site, and your name will appear in the JSHAP full-page spread recognizing all of our auction item donors. If that's not enough, there's a good chance Dr Harry Snelson will say something witty about your donation in the AASV e-Letter, too!

The AASV Foundation is committed to ensuring the future of the swine veterinary profession. Proceeds from the auction enable funding for AASV Foundation programs, including

- Administering endowments for the Howard Dunne and Alex Hogg Memorial Lectures
- Administering the Hogg Scholarship for a swine veterinarian pursuing an MS or PhD
- Administering funding for Veterinary Student Scholarships
- Funding scholarships for veterinarians pursuing board certification in the American College of Animal Welfare
- Co-sponsoring travel stipends for veterinary students attending the AASV Annual Meeting
- Providing swine externship grants to veterinary students
- Funding swine research with direct application to the profession
- Providing support for Heritage Videos
- Providing tuition support for out-of-state veterinary students to attend the Swine Medicine Education Center.

2018 AASVF Auction Committee

Butch Baker, chair

Natalie Baker
Laura Bruner
Dyneah Classen
Joe Connor
Jack Creel
Jer Geiger
Bill Hollis
Derald Holtkamp
Daryl Olsen
Sarah Probst Miller
Nathan Schaefer
Cameron Schmitt
Chase Stahl
Jon Van Blarcom
John Waddell

On your mark, get set, go!

As AASV's 50th anniversary draws near in 2019, the AASV Foundation board has set a "big, hairy, audacious goal" of building the foundation's endowed funds to $2 million by the 2019 AASV Annual Meeting. The annual auction, fundraising events, and support from industry and members fund the majority of the programs fulfilling the foundation's mission, but growth of the endowed funds is largely due to supporters who become Leman, Heritage, or Legacy contributors.

Since the foundation's inception, the recruitment of endowed contributions has been left mostly to the efforts of a few stalwart members, such as Drs K. T. Wright, Connie Schmidt, and the late Rod Johnson. But if current AASV Foundation Chairman Dr John Waddell has his way, that will soon change! Dr Waddell is challenging the AASV past presidents, along with the current and past foundation board members, ***to each recruit at least three new contributors to become Leman, Heritage, or Legacy donors (or to increase their support from one level to the next) by 2019***.

Dr Waddell has backed up his challenge with an incentive: not only will those who

achieve the goal receive recognition, but the member who recruits the most by the end of 2018 will also receive complimentary registration and suite lodging for the 2019 (50th) AASV Annual Meeting in Orlando! The following scoring system will be used to determine the rankings. It allots 1 point for each $1000 contribution-pledge, as follows:

New Leman Fellow: 1 point
New Heritage Fellow: 5 points
New Legacy Fund: 50 points
Leman to Heritage: 4 points
Heritage to Legacy: 45 points

When a contributor enrolls in one of the endowed giving programs, or increases their contribution to the next level, they'll be asked to specify the past president or foundation board member to credit with the challenge points.

Already, the "Past Presidents' Challenge" has generated new donors for the foundation. The AASV's Webmaster and IT Specialist David Brown became the most recent Leman Fellow, crediting his enrollment to the late Dr Bob Morrison, who, as the first executive editor of *Swine Health and Production,* hired Dave to do work for AASV back in 1992. In addition, Dr Matt Ackerman, a Leman Fellow since 2001, has joined the ranks of the Heritage Fellows. He attributed his contribution to his former business partner and AASV past president, Dr Larry Rueff. The game is on!

Dr Waddell emphasizes that previous endowed contributions count towards achieving the next giving level. So a Leman Fellow who has already contributed $1000 needs only an additional $4000 to reach the Heritage level. Similarly, if a Heritage Fellow has already made a $5000 commitment, the difference of $45,000 will achieve Legacy Fund status.

For more information about the AASV Foundation endowment, or to make a contribution, see **www.aasv.org/foundation** or contact the AASV: 515-465-5255 or **aasv@aasv.org**.

Scholarships support welfare certification efforts

Earlier this year, in an effort to increase the number of swine veterinarians who are board certified in the American College of Animal Welfare (ACAW), the AASV Foundation instituted the ACAW Scholarship program. The foundation is pleased to announce that a review committee led by foundation board member Dr Lisa Tokach has approved two applicants to receive the new scholarships: Drs Madonna Benjamin and Monique Pairis-Garcia.

Dr Benjamin is an assistant professor in the Department of Large Animal Clinical Sciences at Michigan State University (MSU), where her clinical activities include serving as swine health extension veterinarian for MSU Extension. In her role on the extension team, she has been a part of efforts to contribute to swine welfare through low stress handling, digital imaging for body composition and locomotion scores, and using simulator pigs for training on effective, safe, and humane methods of swine euthanasia. Dr Benjamin's research interests include human-animal interaction, the use of systematic observation techniques to identify compromised animals within a population, and factor determinants of timely euthanasia.

Dr Madonna Benjamin

Dr Benjamin received her DVM degree from the University of Guelph in 1995 and a Master's degree in applied ethology from MSU in 1998. She was employed by Elanco Animal Health in research and technical support, with early research that included cause and effect of downer pigs during transport. Dr Benjamin established Veterinary Science Consulting Inc in Alberta, Canada, a swine practice with an "overarching goal to improve the well-being and prosperity of both livestock (pigs) and producers," before returning to join the faculty at MSU. She has already made significant progress towards the completion of her plan of study. The scholarship funds will support her attendance at numerous welfare workshops, short courses, and symposia to prepare for the board examination, which she anticipates sitting for in the summer of 2018.

Dr Pairis-Garcia received her DVM degree from Iowa State University (ISU) in 2011, followed by a PhD in animal physiology in 2014, also earned at ISU. Since then, she has been employed as an assistant professor in The Ohio State University College of Food, Agriculture, and Environmental Sciences, with a 65% extension/35% teaching appointment focused primarily on animal welfare and behavior in livestock industries. Despite not having a research appointment, she values applied research as an effective means of extension to improve swine welfare and has directed her research efforts toward timely and humane euthanasia, on-farm welfare assessments and audits, and alternative


Dr Monique Pairis-Garcia

management practices to improve animal welfare on-farm.

Dr Pairis-Garcia is a member of AASV's Pig Welfare Committee as well as the National Pork Board's Animal Welfare Committee. She holds Professional Animal Auditor Certification Organization (PAACO) certification in swine, poultry, and slaughter facilities, and works extensively in training auditors. Like Dr Benjamin, she hopes to take the board examination in 2018, and plans to use the scholarship funds to support attendance at ACAW conferences as well as to purchase textbooks to assist with her studies preparing for the exam. She looks forward to supporting science-based improvement in swine welfare and ensuring that swine veterinarians have a voice in future decision-making related to animal welfare expectations and legislation.

Vet Students: Ten $5000 scholarships to be awarded in 2018

The AASV Foundation is pleased to announce that Merck Animal Health has doubled its support for the AASVF-Merck Veterinary Student Scholarship Program, enabling the foundation to award ten $5000 scholarships to sophomore and junior veterinary students in 2018. Now in its third year, the program seeks to identify future swine veterinarians and assist with their educational expenses. Applications are due December 31, 2017, for scholarships that will be announced at the 2018 AASV Annual Meeting.

Second- and third-year veterinary students enrolled in AVMA-accredited or AVMA-recognized colleges of veterinary medicine in the United States, Canada, Mexico, South America, or the Caribbean Islands are eligible to apply. All applicants must be current (2017-2018) student members of AASV. To apply, students submit a resume and the name of a faculty member or AASV member to serve as a reference, along with written answers to four essay questions. The application and instructions are available at **https://www.aasv.org/foundation/2018/AASVF-MerckScholarships.php**.

A committee of four conducts the selection process. Two foundation board members and two AASV members-at-large rank the applicants by scoring their past and current activities, level of interest in swine veterinary medicine, future career plans, and financial need. The scholarship recipients will be announced during the 2018 AASV Annual Meeting in San Diego, and the scholarship funds will be disbursed after the conference.

The AASVF-Merck Veterinary Student Scholarship Program is but one way in which the AASV Foundation fulfills its mission of "supporting the development and scholarship of students and veterinarians interested in the swine industry." For more information on scholarships and other AASV Foundation programs, see **www.aasv.org/foundation**.

Swine veterinarians invited to apply for Hogg Scholarship

The American Association of Swine Veterinarians Foundation is pleased to offer the Hogg Scholarship, established to honor the memory of longtime AASV member and swine industry leader Dr Alex Hogg. Applications for the $10,000 scholarship will be accepted until February 1, 2018, and the scholarship recipient will be announced on Sunday, March 4, during the Foundation Luncheon at the AASV 2018 Annual Meeting in San Diego.

The intent of the scholarship is to assist a swine veterinarian in his or her efforts to return to school for graduate education (resulting in a master's degree or higher) in an academic field of study related to swine health and production.

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

The scholarship application requirements are outlined below and on the AASV Web site at **https://www.aasv.org/foundation/hoggscholarship.htm**.

Hogg Scholarship application requirements

An applicant for the Hogg Scholarship shall have

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

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

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

Applications and requests for information may be addressed to AASV Foundation, 830 26th Street, Perry, IA 50220-2328; Tel: 515-465-5255; E-mail: **aasv@aasv.org**.

Foundation news continued on page 329

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BIG-PICTURE PROTECTION

Foundation news continued from page 327

Foundation to fund research in 2018: Submit proposals by January 16

As part of its mission to fund research with direct application to the profession, the American Association of Swine Veterinarians Foundation is accepting research proposals to be considered for funding in 2018. Proposals are **due January 16, 2018**, and may request a maximum of $30,000 (US$) per project. A maximum of $60,000 will be awarded across two or more projects. The announcement of projects selected for funding will take place at the AASV Foundation Luncheon in San Diego, California, on Sunday, March 4, 2018 (awardees will be notified in advance).

Proposed research should fit one of the five action areas stated in the AASV Foundation mission statement (see sidebar).

The instructions for submitting proposals are available on the AASV Foundation Web site at **https://www.aasv.org/foundation/2018/research.php**.

Proposals may be submitted by mail or e-mail (preferred).

A panel of AASV members will evaluate and select proposals for funding on the basis of the following scoring system:

- Potential benefit to swine veterinarians/swine industry (40 points)
- Probability of success within timeline (35 points)
- Scientific/investigative quality (15 points)
- Budget justification (5 points)
- Originality (5 points)

For more information, or to submit a proposal:

AASV Foundation, 830 26th Street, Perry, IA 50220-2328; Tel: 515-465-5255; Fax: 515-465-3832; E-mail: **aasv@aasv.org**.

AASV Foundation Mission Statement

The mission of the AASV Foundation is to empower swine veterinarians to achieve a higher level of personal and professional effectiveness by

- Enhancing the image of the swine veterinary profession,
- Supporting the development and scholarship of students and veterinarians interested in the swine industry,
- Addressing long-range issues of the profession,
- Supporting faculty and promoting excellence in the teaching of swine health and production, and
- Funding research with direct application to the profession.

Cool weather, hot golf at foundation fundraiser

Forty-four golfers on 11 teams took to the field to support the AASV Foundation at Veenker Memorial Golf Course in Ames, Iowa, on Thursday, August 24. The weather was pleasant with only a gentle breeze, but one team blew through the course, dominating the best-ball competition. The GlobalVetLINK foursome of Tyler Eagan, Tyler Holck, Dan Shipton, and Bryan Steffen made one eagle, 14 birdies, and three pars on their way to an impressive score of 56 on the par-72 course.

"Tiebreaker" was the name of the game for the remaining teams, whose scores were largely clustered in the mid- to upper 60s. The second- and third-place teams were both hosted by Boehringer Ingelheim and shared a score of 64, with a single tiebreaker stroke on hole #7 separating the two. The BI/Orange City Vet Clinic foursome of Jeff Blythe, Dave Bomgaars, Dave Iverson, and Tom Wetzell claimed 2nd place honors, while BI's other foursome, Keith Bretey, Jeff OKones, Doug Quam, and Justin Rustvold, took 3rd. Tiebreaker scores were also needed to determine placings for the teams that scored 66s and 67s.

In addition to the best-ball team competition, golfers enjoyed a variety of individual contests across the course, thanks in part to strong sponsorship support. Golf hole sponsors included Aurora Pharmaceutical, Ceva Animal Health, GlobalVetLINK, Huvepharma, Insight Wealth Group, NPPC, and Pharmgate Animal Health. Lunch for the golfers was sponsored by APC, while Zoetis kept golfers hydrated with their support of the beverage cart.

The annual golf outing raises funds to support foundation programs, including scholarships, research grants, travel stipends for veterinary students to attend the annual meeting, tuition support for the Swine Medicine Education Center, swine externship grants, and more.

The event concluded with a pork dinner sponsored by Boehringer Ingelheim, during which the event coordinator, Josh Ellingson, recognized the following team and individual contest winners:

Championship flight

First place team hosted by GlobalVetLINK (score of 56): Tyler Eagan, Tyler Holck, Dan Shipton, Brian Steffen

Second place team hosted by Boehringer Ingelheim (score of 64): Jeff Blythe, Dave Bomgaars, Dave Iverson, Tom Wetzell

Third place team hosted by Boehringer Ingelheim (score of 64): Keith Bretey, Jeff OKones, Doug Quam, Justin Rustvold

Fourth place team hosted by NPPC (score of 66): Jack Bain, Craig Boelling, Doug Fricke, Kelly Sheets

First flight

First place team hosted by AMVC (score of 66): Steve Schmitz, Paul Thomas, Nick Weihs, Gavin Yager

Second place team hosted by Fast Genetics (score of 67): Darrell Neuberger, Kent Schwartz, Steve Sornsen, Jeff Zimmerman

Third place team hosted by Phibro Animal Health (score of 67): Mark Brinkman, Dennis Dwyer, Mark Rooney, Grant Weaver

Fourth place team hosted by Huvepharma and Aurora Pharmaceutical (score of 68): Jim Murray, Dale Oldenkamp, Chris Sparks, Mark Weaver

Second flight

First place team hosted by Iowa State University Veterinary Diagnostic Laboratory (score of 69): Eric Burrough, Drew Magstadt, Pablo Pineyro, Chris Rademacher

Second place team hosted by AMVC (score of 71): Josh Ellingson, Jason Hocker, Daryl Olsen, Ryan Saltzman

Third place team hosted by Iowa State University Swine Medicine Education Center (score of 86): Justin Brown, Anna Forseth, Heather Kittrell, Scott Radke

Individual contests

Hole #1, **Closest to the pin, 2nd shot:** Brian Steffen

Hole #8, **Closest to the pin:** Mark Brinkman

Hole #9, **Longest putt:** Brian Steffen

Hole #10, **Longest drive:** Mark Brinkman

Hole #10, **Longest drive in fairway:** Mark Weaver

Hole #16, **Closest to the pin:** Doug Quam

Hole #18, **Longest putt:** Nick Weihs

The team hosted by GlobalVetLINK took top honors at this year's AASV Foundation Golf Outing. Left to Right: Tyler Holck, Tyler Eagan, Brian Steffen, Dan Shipton.

The second place team by a tie-breaker was hosted by Boehringer Ingelheim. Left to right: Dave Iverson, Dave Bomgaars, Tom Wetzell, Jeff Blythe.

Boehringer Ingelheim also hosted the third place foursome of (left to right) Jeff OKones, Doug Quam, Justin Rustvold, Keith Bretey.

Photos by Kelly Boesch, courtesy of Andrew Kleis at Insight Wealth Group.

GLOBAL KNOWLEDGE:
Individual Application

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Swine industry implements group to address emerging diseases

The American Association of Swine Veterinarians (AASV) has been working with the National Pork Board, National Pork Producers Council, Swine Health Information Center (SHIC), and United States Department of Agriculture (USDA) to develop a response plan for emerging swine diseases. A draft of this plan currently in development, entitled the Emerging Swine Production Disease (ESPD) Plan, includes a recommendation to institute an advisory group called the Swine Disease Response Council (SDRC). The SDRC members will represent producers, veterinarians, state and federal animal health officials, and researchers.

The SDRC is fashioned along the lines of the Pseudorabies Control Board. The control board was instrumental during the pseudorabies eradication program to evaluate issues and offer recommendations to USDA and state animal health officials to further the eradication effort. Drs Matt Ackerman and Tim Snider represent AASV on the SDRC, and Dr Harry Snelson provides AASV staff support.

An ESPD differs from a foreign animal disease (FAD) in designation as well as in who has the responsibility for determining and conducting the response. If an FAD is suspected or diagnosed, state and federal animal health officials will take the lead and activate the response plan. Industry will play a supportive role. An ESPD is an emerging disease that is negatively impacting swine producers, but determined not to be an FAD. In this case, the swine industry will take the lead on determining the response, if any. SHIC will be notified and will coordinate analysis, characterization, and prioritization for research.

The purpose of the SDRC is to offer recommendations on how the industry and animal health officials should respond to emerging diseases. While the council has no legal authority and its recommendations are not binding, it is an industry-led collaborative group of stakeholders with the goal of rapidly bringing all interested parties together to evaluate an emerging situation and develop a strategy for addressing the outbreak. The SDRC held its inaugural meeting on June 21. The objective of the meeting was to increase members' knowledge of the ESPD Plan and to apply the knowledge using historical emerging disease outbreaks as test cases for the plan.

As outlined in the ESPD Plan, during an emerging disease event SHIC would work in collaboration with the USDA's Center for Epidemiology and Animal Health to identify and characterize the event. SHIC could then deploy Rapid Response Teams (RRTs) to conduct diagnostic and epidemiological investigations to provide additional information. Industry stakeholders would consider the information and determine whether or not to activate the SDRC. If activated, the SDRC would analyze the information collected and provide recommendations regarding potential response options and identify resource needs.

The RRTs play an integral role in describing the outbreak at the farm level. It is essential that these teams are mobilized quickly and complete their work with urgency, that results are rapidly communicated, and that the SDRC has initial information on which to make recommendations within a goal of 4 days. The RRTs should work to identify the index case(s), identify the extent of geographical spread, and attempt to determine the source of the infection.

The SDRC would provide ongoing recommendations as the situation changes, based on reporting back of progress on the response options recommended. Potential response options are listed below and described in greater detail in the draft ESPD Plan. These options represent a range of potential actions, both passive and active, that could be taken, and the response council may recommend as many options as they feel would be valuable in addressing the emerging disease situation.

Passive response options:

1. No response.
2. Maintain/expand situational awareness.
3. Referral.

Active response options:

1. Investigation of epidemiologically distinct cases.
2. Disease reporting for investigation purposes and situational awareness.
3. Voluntary disease reporting/surveillance projects for research, investigation purposes, and situational awareness.
4. Mandatory disease reporting for investigation purposes and situational awareness.
5. Diagnostic and biological development.
6. Field investigative studies (nationally coordinated).
7. Coordinated surveillance in US swine.
8. Disease control measures (voluntary).
9. Disease control measures (regulatory).

Resources are always a limiting factor when addressing an emerging disease. Timeliness is critical. The ability to rapidly and efficiently respond is often hindered by a lack of qualified people to collect samples and conduct response activities. The ESPD Plan proposes that the swine industry could work independently or cooperatively with state and federal animal-health authorities to develop a certification program. For this approach to be successful the plan would need to be developed to determine the objectives of

the certification program, the surveillance necessary for certification, the response plan for when the disease is found, and funding pathways necessary to maintain the program and measures of success and failure.

The ESPD document identifies two response phases for ESPD outbreaks: the Investigation Phase and the Decision Phase. The Investigation Phase is the period of time from the suspected, presumptive, or confirmed presence of an ESPD in the United States until evidence is gathered to estimate the extent of the outbreak. During this phase the SHIC will coordinate the mobilization of RRTs with state and federal animal-health officials. The Decision Phase is the period of time where information from the investigation is analyzed, the incident is typed as 1, 2, or 3, and recommended actions are developed and implemented to mitigate the incident.

The incident types are defined as follows:

TYPE 1 – Short-term disease strategies are warranted. The infection is of a known etiology and limited to a few premises, and the risk pathways can be mitigated. TYPE 1B differs only in that the etiology is unknown.

TYPE 2 – Medium-term disease control strategies warranted. The infection is of a known etiology and spread is limited to a few focal areas. There is adequate knowledge about the disease, but little to no likelihood of controlling it using movement controls or depopulation. Disease spread is expected to be minimized using vaccine, treatment, or control strategies, and the needed tools will shortly be available to mitigate the negative impacts on animal health, welfare, and producer profitability. Again, TYPE 2B indicates an unknown etiology.

TYPE 3 – Long-term disease control strategies needed. The infection (of known or unknown etiology) is widespread with little chance for control. It is expected to take greater than 1 year to develop the needed tools and information to mitigate negative effects of the disease on swine health and welfare and producer profitability.

Hopefully, this has given you some insight into the plan for responding to emerging production diseases going forward. This plan is part of a multi-faceted strategy to detect, track, prevent, and respond to emerging swine disease threats globally. The ESPD Plan is a living document and is currently under review by USDA and industry stakeholders. A draft of the plan can be viewed at `https://www.aasv.org/documents/ESPD061417.pdf`.

Harry Snelson, DVM
Director of Communications

Emerging Swine Production Disease Plan acronyms

- SHIC = Swine Health Information Center
- ESPD = Emerging Swine Production Disease
- SDRC = Swine Disease Response Council
- FAD = foreign animal disease
- RRT = Rapid Response Teams

Cumulative index

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

Index by title 2017

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References: 1. USDA, APHIS, VS, NAHMS. Swine 2012 Part II: Reference of swine health and health management in the United States, 2012. February 2016. **2.** Dykhuis Haden C, Painter T, Fangman T, Holtkamp D. Assessing production parameters and economic impact of swine in influenza, PRRS and *Mycoplasma hyopneumoniae* on finishing pigs in a large production system. In: Proceedings of the 43rd American Association of Swine Veterinarians Annual Meeting; March 10–13, 2012; Denver, CO: 75–76. **3.** Vincent AL, Perez DR, Rajao D, et al. Influenza A virus vaccines for swine. *Vet Microbiol*. 2017;206: 35–44. doi:10.1016/j.vetmic.2016.11.026. Epub 2016 Nov 24.

Upcoming meetings

2017 ISU James D. McKean Swine Disease Conference

November 2-3, 2017 (Thu-Fri)
Ames, Iowa

Hosted by Iowa State University

For more information:
Registration Services
Tel: 515-294-6222; Fax: 515-294-6223
E-mail: registrations@iastate.edu
Web: http://register.extension.iastate.edu/swinedisease

For questions about program content:
Dr Chris Rademacher, Conference Chair
Iowa State University
E-mail: cjrdvm@iastate.edu

Pig Welfare Symposium

November 7-9, 2017 (Tue-Thu)
Des Moines Marriott Downtown
700 Grand Avenue, Des Moines, Iowa

Hosted by the National Pork Board

For more information:
Web: http://www.pork.org/pig-welfare-symposium/

Australasian Pig Science Association 16th Biennial Conference (APSA 2017)

November 19-22, 2017 (Sun-Wed)

For more information and to register:
Dr Cameron Ralph, APSA Secretary
Tel: +61 8 8313 7781
E-mail: cameron.ralph@sa.gov.au
Web: http://www.apsa.asn.au/

2017 Joint Meeting: North American PRRS Symposium and National Swine Improvement Federation

December 1-3, 2017 (Fri-Sun)
Intercontinental Chicago Magnificent Mile
505 N Michigan Avenue, Chicago, Illinois

For more information:
http://www.vet.k-state.edu/na-prrs/index.html

Passion for Pigs 2017 Tour

Here are the dates and locations for the 2017 tour series:
November 15, 2017 (Wed), Mankato, Minnesota
December 5, 2017 (Tues), Columbia, Missouri

For more information:
Julie A Lolli, Executive Coordinator
Tel: 660-651-0570; E-mail: julie.nevets@nevetsrv.com
Web: http://www.passionforpigs.com/

2018 Pig-Group Ski Seminar

February 7-9, 2018 (Wed-Fri)
Copper Mountain, Colorado
Tel: 866-837-2996 (Group Reservation Code 3658)

For more information:
Lori Yeske, Pig Group
Tel: 507-381-1647
E-mail: pyeske@swinevetcenter.com
Web: http://www.pigski.com

American Association of Swine Veterinarians 49th Annual Meeting

March 3-6, 2018 (Sat-Tue)
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Web: http://www.aasv.org/annmtg

10th European Symposium of Porcine Health Management (ESPHM)

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

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

25th International Pig Veterinary Society Congress

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

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

Photo Corner

1000-sow farrow-to-feeder pig farm in the northern plains

Photo courtesy of Dr John Waddell