CONTINUOUS INNOVATION

SWINE PROGRAM

VETERINARY POPULATION MEDICINE

University of Minnesota

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Empowering practitioners and supporting producers for 45 years

It all began in 1974, in a small lecture hall on the University of Minnesota Twin Cities campus in St. Paul. Allen D. Leman, DVM, PhD, a new University of Minnesota veterinarian, and Jim Hanson, DVM, director of the College of Veterinary Medicine’s continuing education program, initiated a conference for Minnesota practitioners to exchange knowledge and tackle key issues in the swine world.

Leman understood how a university could influence and empower veterinarians to be leaders for the swine industry. Back then, access to data and information was at a premium. Today, the conference and others like it provide a vibrant venue to exchange and discuss ideas and experiences, both practical and scientific.

Throughout his career, Leman worked to define the link between swine health and swine management. He was a national and international authority on swine medicine, especially on the production problems of commercial farmers. Leman was largely responsible for the development of the University of Minnesota Swine Program and was its first director from 1981–85.

One of Leman’s lifelong goals was to optimize the health and well-being of pigs while improving commercial swine productivity and profitability. He published more than 100 papers; edited and wrote six textbooks, including the Diseases of Swine; and gave more than 700 extension lectures to swine producers around the globe. His unwavering dedication to the education of practicing veterinarians was manifested, in part, through his leadership of this conference.

Today’s challenge is no longer how to access information but how to digest and make sense of the deluge of data coming at us from endless sources. The time-honored goal and purpose of the Allen D. Leman Swine Conference to provide science-based solutions to the challenges faced at the farm level must find its footing in this new world of near real-time information acquisition, analysis, and reporting.

Leman’s vision for this conference has evolved into a multisession international meeting that draws more than 800 people from more than 20 countries each year. The conference brings together swine veterinarians and other professionals working in swine production and animal health management. It is internationally acclaimed for bringing science-driven solutions to the complex challenges facing the global swine industry. In addition, a Leman China conference, established by Bob Morrison, DVM, PhD, MBA, was initiated in 2012 and extends the goals of the Leman US conference to the swine industry in China. The Leman China Swine Conference serves over 2,000 participants.
The University of Minnesota College of Veterinary Medicine has a strong history of shaping future leaders of the swine industry. This legacy gives graduates a career advantage and a community they can tap years after completing their degree. This legacy is achieved through the continuous evolution of the swine curriculum. “Not only are we adapting to the industry’s ever-changing needs,” says Perle Zhitnitskiy, DVM, MSpVM, “[but] we’re also changing to meet the expectations of the students’ inquiring minds.” Zhitnitskiy is a key educator and curriculum designer in the College’s swine program.

New educational initiatives, such as the creation of Day-1 competencies for swine practice as well as the introduction of modern learning methods, are new additions that reinforce the long-standing philosophy of externship opportunities and case-based clinical rotations.

Student experiences prior to joining the swine program have changed. Today’s students come from St. Paul, Maple Plain, or even Upsala, Minn., and most have had limited exposure to pigs before veterinary school.

“I didn’t discover I liked pigs until I took the ‘piglet class’ during my first year [of veterinary school]. After that, I was hooked!” says Hunter Baldry, DVM ’18. Baldry’s classmate Chris Deegan, DVM ’18, was steered toward swine health and management by a summer research project with Maria Pieters, DVM, PhD.

Both agree that being a graduate from the University of Minnesota is an advantage. “There are many opportunities at the College to gain swine experience, and the swine faculty were very helpful to guide students in finding them,” Deegan explains.

New graduate Marjorie Schleper, DVM ’19, has advice for the next generation interested in practicing swine medicine. “Take some time and learn the basic production practices. You can’t put into place effective health interventions if you don’t understand the basic production systems and tasks.”

Something U of MN swine students frequently hear from their instructors is, “In the end, the pig is always right and the veterinarian’s recommendations are only efficient if they are followed and put in place in the barn.” This is why the U of MN swine curriculum gives students opportunities to walk hog barns and study production baselines during dedicated rotations and through partnerships with practices and production systems in Minnesota and over the United States.

The Minnesota legacy of combining practical experience with expert education to focus on improving swine health and production is not lost on the students. Baldry says it best: “Being a graduate of the University of Minnesota conveys to prospective employers that you have gained a certain level of knowledge in swine medicine, [that you] have a variety of swine-related experiences under your belt, and that you are hardworking and dedicated.”
Relying on farm-specific data that is benchmarked against industry peers is an obvious strategy for today’s swine producers and veterinarians. But it wasn’t always the case. Over 40 years ago, Al Leman and the team he built at the University of Minnesota were leaders in teaching the value of data-driven decision-making. Today, a new generation of faculty is poised to move the industry from interactive spreadsheets to machine learning algorithms that promise to revolutionize the decision-making tools available to swine producers and veterinarians.

A key data platform, the Morrison Swine Health Monitoring Project (MSHMP) provides the strong base from which these new tools will emerge. Created by the university that gave the swine industry its first, dominant records management software, MSHMP is focused on helping people make time-critical choices regarding infectious diseases such as PRRSv and PEDv while working toward foreign animal disease preparedness.

Started in 2011 by the late Bob Morrison, MSHMP brings producers and practitioners together to share data, such as farm location, herd size, disease status, and air filtration status, to allow a robust near-real-time analysis. Early on, participants recognized the value of sharing PRRSv outbreak data from breeding herds for both research and benchmarking.

Adding value

From a small band of 13 participating production systems and swine clinics, the collaborative effort has grown to include over half of the US breeding herd. Such powerful participation gives MSHMP a unique level of representativeness within the industry. Besides increasing the number of participating farms, the program is now monitoring more than PRRSv occurrence and emergent viruses. Today, MSHMP collects data on coronaviruses (e.g., PEDv and PDCoV), Senecavirus A, and central nervous system-related viruses.

MSHMP continues to deliver value to participants and nonparticipants as it is also intended to aid in foreign animal disease preparedness. An example was the PEDv epidemic in 2013, where all the MSHMP participating systems began reporting PEDv occurrence. Their quick and voluntary actions allowed the industry to track the virus as it circulated to approximately half of the breeding herds in the project. Furthermore, during the 2018–19 year, MSHMP detected a significant decrease in the occurrence of both PRRSv and PEDv, a pattern that would not have been detected without this collaborative effort.

Recognizing that MSHMP’s basis in breeding herds is a limitation, project leaders are moving to add growing pig sites in the near future. The process of linking growing pig farms with the breeding herd of origin represents a less-than-simple task, as there are growing pig site ownership dynamics, source comingling, and real-time data flow factors that need to be sorted out. The data challenges aside, MSHMP participants are supportive of this evolution and are willing to continue voluntarily contributing their data.

New leader, same commitment

Cesar Corzo, DVM, MS, PhD, was named to lead MSHMP in 2018. Adding the project to his portfolio makes sense because he also holds the Leman Chair in Swine Health and Productivity, an appointment that requires significant outreach to the industry.
Corzo has worked with producers and practitioners throughout the Americas, having held technical positions at pharmaceutical and breeding stock companies where he was able to apply the infectious disease management and prevention knowledge acquired during his graduate education at the University of Guelph and University of Minnesota. Corzo is interested in disease prevention, specifically in improving biosecurity compliance through understanding farm employee–related factors to develop mechanisms that aim toward improving levels of compliance of biosecurity procedures.

Under Corzo’s guidance, the MSHMP team is exploring technologies to track pig movement from the breeding herd to the growing sites as a means to obtain real-time pig flow data. This will also contribute to generating a pig flow log that will be helpful if any disease investigation is required.

MSHMP’s future includes potential tools to assess regional dissemination of pathogens and predict disease risks, and to characterize pathogen occurrence at the sequence level in time and space. These tools will be based on methodologies and adaptive algorithms that will continue to enable the swine industry to use MSHMP as a key decision-making tool that is powered by the industry.

Join MSHMP

Production systems, clinics, breeding stock companies, and regional programs interested in joining the project can directly contact Cesar Corzo at corzo@umn.edu. As more farms are included in the project, the higher the level of representativeness and the greater the value of this collaborative and voluntary initiative.

**MSHMP by the numbers (2019)**

- **38 Participants**
- **26 Of the 40 largest US pig producers participating**
- **5 Primary supporters**
  - Swine Health Information Center, National
  - Pork Producers Council
  - American Association of Swine Veterinarians
  - Pork Checkoff
  - USDA
- **23,414 PRRSv sequences stored**
- **17 Peer-reviewed papers published from MSHMP data (2016–18)**
Securing animal health requires rapid detection and characterization of emerging and evolving pathogens. To achieve this state of readiness, the University of Minnesota Veterinary Diagnostic Laboratory (VDL) combines close ties to veterinarians and producers with a high volume of diagnostic samples, and expertise covering a comprehensive slate of diagnostic and epidemiological methods. These resources form the basis for the early warning and outbreak investigation capacity that serves Minnesota and the nation.

Engaged

The VDL works with practitioners and producers daily to solve problems. Twenty-five years ago, the challenge was monitoring boar studs for PRRSv, and, at the request of veterinarians, the VDL became the first diagnostic lab to offer same-day testing of boar stud samples. More recently, new problems with a highly virulent “old” pathogen—Streptococcus suis—led to novel methods to identify and characterize new strains. Identifying new disease agents, such as porcine circovirus type 3 (PCV3), resulted from working alongside veterinarians who were investigating similar disease scenarios with no apparent cause.

Experienced

A high caseload is required to detect developing trends or recognize situations that suggest a new pathogen may be present. Over the years, the VDL has run more than 10 million PCR tests, generated over 20,000 PRRSv ORF5 sequences and 10,000 influenza virus sequences. Additionally, data from more than 80,000 bacterial isolates have been used for monitoring antimicrobial susceptibility patterns.

Expert

It takes a diverse skill set to work through the problem-solving steps. A full complement of skills is needed to

• detect new disease agents,
• discern their pathogenic significance,
• develop new diagnostic methods, and
• deploy the new methods for efficient use.

Even just for genomic sequencing, multiple platforms and different types of analyses are needed. For example, Sanger sequencing is used for PRRSv ORF5 analysis, iSeq sequencing for foodborne pathogen surveillance, and MinION and MiSeq sequencing for pathogen discovery and whole genome sequencing. Having access to multiple sequencing platforms through the VDL facilitates a broader range of approaches.

The bigger challenge, however, is the context and discernment piece. Tried-and-true techniques, such as histopathology, applied by experienced pathologists and blended with newer disciplines, such as next-generation sequencing and in situ hybridization, are critical for associating newly identified disease agents with the lesions observed in a clinical disease.

Solving diagnostic challenges requires more than just a “seq-and-ye-shall-find” approach. Instead, it requires practical engagement with producers and veterinarians to unpack problems together, apply the appropriate technologies, and ultimately provide the information needed to make sound animal health decisions.
Antimicrobial resistance: A critically important issue

Antimicrobial resistance (AMR) is among the most complex and poorly understood biological phenomena. Farmers and veterinarians want to know how their production practices and animal health management decisions may be impacting AMR—both in their own herds and in the broader society. These are difficult questions to answer, but, fortunately, advances in scientific technologies are providing scientists with powerful new tools to answer these difficult questions.

Using these cutting-edge technologies, scientists with the University of Minnesota Swine Group are partnering with stakeholders to provide the swine industry with evidence-based recommendations regarding AMR.

Resistome research

Noelle Noyes, DVM, PhD, uses cutting-edge molecular and sequencing platforms to survey all of the resistance genes within the microbiome, which is termed the “resistome.” This comprehensive approach can reveal the full complexity of resistance within a microbial population, which will help scientists better understand and predict how AMR may develop under certain production conditions. To support this work, Noyes maintains internationally recognized databases and bioinformatic pipelines, and holds workshops to train scientists in the use of these tools.

Farm-to-fork resistance dynamics

The University is leading a two-part National Pork Board–funded project to evaluate the impact of PRRSv and antimicrobial use protocols on resistome dynamics in pigs. A unique feature of this work is that pigs were sampled throughout their life cycle, from wean to slaughter—a study made possible through swine industry partnerships. This study will provide concrete results about the potential transmission of AMR through the food chain as well as greater understanding of how resistance develops in growing pigs, both those exposed and those not exposed to PRRSv and subsequent antibiotics.

Threat of exposure

Risks of exposure to resistant bacteria is a particular concern for the people who are in daily contact with pigs. MRSA (methicillin-resistant Staphylococcus aureus) bacteria are among the most important resistant pathogens in human medicine, and since 2004, pigs and other livestock and poultry have been found to be reservoirs for some specific variants of MRSA, termed “livestock-associated MRSA.”

For several years, Peter Davies, BVSc, PhD, has studied MRSA in pigs in the US, with a focus on risks posed to workers (farmers and veterinarians). Much of this work has been funded by the Upper Midwest Agricultural Safety and Health (UMASH) Center, including an ongoing five-year (2016–20) study of the health risks related to MRSA for swine veterinarians. Another project supported by UMASH funding is evaluating the impact of showering as an intervention to prevent potential transmission of AMR bacteria from swine facilities to workers and the general public. This project uses existing on-farm facilities to learn whether current practices may be mitigating AMR transmission.
“I follow the science”

A virologist by training, Declan Schroeder, PhD, is fascinated by genes and genomes. “I want to understand viruses,” he says. This pursuit has led Schroeder to explore viruses in plants, algae, and animals. “A lot of the viruses in algae are present in insects and animals as well,” he says.

Before coming to the University of Minnesota, Schroeder was in the United Kingdom researching viruses in algae and becoming interested in applying his knowledge to honey bees. But since the US has a larger problem with honey bee diseases than the UK, he wanted to find a collaborator stateside. He wanted to work with a molecular biologist at the U of MN to try to connect to the University’s Bee Lab, and that’s when the AGREETT opportunity came up.

“Seeing the broad spectrum of jobs that were advertised within the AGREETT portfolio, I was naturally drawn to investigate further,” he says. “I was then introduced to Michael Murtaugh, PhD, and, long story short, we realized there was a gap of knowledge in understanding how viruses interact with swine and the many parallels in what I was observing in viruses infecting honey bees.”

PRRSv and many honey bee RNA viruses belong to the same “superfamily,” according to Schroeder. “PRRSv is a devilish virus that does not seem to behave like normal viruses,” Schroeder says, “which is because the virus has a high mutation rate and is changing in real time. This is similar to what I have found in honey bees and their viruses.” This concept has only been looked at more recently within the virus research community, and the work is usually limited. “All our knowledge on PRRSv was based on one tiny part of the genome, and I wanted to expand into genome-wide variation.”

But while Schroeder’s research questions brought him to the UMN, the culture of collaboration has kept him here. “I follow projects, ideas, and process—I follow the science, so it was purely the research questions I had that led me here.” Throughout his search for his next pursuit, Schroeder found himself looking for an environment that allowed him to be productive.

“Big data” gets the personal touch

Noelle Noyes, DVM, PhD, purposefully became a veterinarian after spending six years studying international relations and foreign languages in Germany and China and then doing mergers and acquisitions strategy consulting for high-tech companies. After a few years, she ultimately decided that her true passion lay with animal health and welfare.

Understanding the Chinese culture—in terms of politics and media accessibility—gives Noyes an appreciation for epidemic responses, such as those to African swine fever. “The level of biosecurity on a US swine farm is quite impressive and has left an impression on me,” she says. “It just shows the lengths that US swine producers go to keep their herds healthy.”

Preparing for veterinary school, Noyes developed a strong interest in research and data analytics, so she researched dual-degree DVM/PhD programs. She eventually found herself at Colorado State University, where she studied epidemiology and livestock medicine, primarily in beef feedlot production.

Noyes had job offers from the private sector, but she loved the feel at the UMN. “It felt like a place where a lot of the philosophies around research, collaboration, and working with industry and veterinarians was in line with the way I hoped that I could set up my research program,” she says, “so I felt like it was a really good fit and that my approach to research would be supported.”
Kim VanderWaal, PhD, specializes in network analysis—the understanding of connections within populations and the anticipation of their patterns. She started out applying this epidemiological specialty to behavioral ecology among wildlife populations in Africa. These connections are essential to identifying how diseases spread, so VanderWaal has also (more recently) been applying it to two swine industry-wide game changers: PRRSv and PEDv.

VanderWaal says the rich source of swine population data presented to her is compelling. “The potential to make headway in understanding how diseases spread in populations is probably higher in livestock populations than humans,” she says. “We can more closely monitor the health of our livestock and track where animals are than we are able to track the same thing in humans.”

In addition to the extensive amounts of available data, VanderWaal is charged up by the fact that her research has impact. “We work closely with the industry, and often they are the ones identifying problems that need to be researched,” she says. “The practitioners and producers are very cognizant and aware of the research that we are doing and how they might apply..."
Diving into the unknown

Matheus Costa, DVM, PhD, is driven by his curiosity and interest in solutions. “I love research because there are so many questions we need answers for,” he says. He found his passion for research while in veterinary school in Brazil. “I always asked a lot of questions in class, and at one point, a professor told me to do a project to investigate one of my questions because he did not know the answer.”

Costa’s wanted to work with animals since childhood, first considering a career as a biologist and then, ultimately, sharpening his focus on veterinary medicine. “I realized that the way I wanted to interact with animals was different,” he says. “As a vet, I have an opportunity to help solve problems.” Swine nabbed his interest when he started exploring career paths in veterinary school.

The herd health approach to treating swine, as well as the large role in mitigating infectious disease, sold Costa on pursuing a career as a swine veterinarian. Costa is drawn to the dynamic nature of the work. “Every time you go to a barn, you see something different that keeps you engaged,” he says. “It’s a constant combination of production, welfare, and health, and we are constantly trying to improve on aligning those three. The industry is never satisfied—we are always looking ahead to see what’s next. The fact that we are always moving forward and never stopping our effort to improve is a big motivator for me.”

Costa says his favorite part about the work he does is diving into the unknown. This is reflected in his current research, which aims to lessen antimicrobial use in herds, particularly for diseases that lack any other treatment options, such as swine dysentery. In these instances, the approach most often relied upon is to eradicate the bacteria with antibiotics. But Costa is asking, “What if there is an enzyme here interacting with the bacteria to result in clinical signs? What if I can stop that enzyme?”

The bacteria responsible for swine dysentery is—among other things—hindering infected pigs’ bodies from regulating blood vessel production. So, Costa is exploring how he can manipulate the host reaction to improve the host’s ability to live with it.

The swine program here is a huge attraction for anyone wanting to work with pigs and pig health,” Costa says. “I also get to work with legends in the field of swine veterinary medicine. A lot of the references I academically ‘grew up’ reading were written by people I work with now. All this heritage means a lot. The program’s top-notch work continues, and being part of it is pretty neat.”
Beyond vaccines and antibiotics: developing the next generation of medicines

Swine dysentery may be seen as an issue of the past—having largely disappeared from US commercial herds in the 1990s, only to return in the 2000s. Limitations in antibiotic use and the absence of an efficient vaccine may impact producers’ ability to keep swine dysentery under control in the future. To avoid leaving producers and veterinarians without options to treat their animals, Matheus Costa, DVM, PhD, and his team are working on what might be the next generation of medicines: virulence blockers.

Safe and efficacious vaccines are not always available against swine bacterial infections, and the use of antibiotics in food animal species is evermore challenged by stricter regulations on one hand and by the development of antibiotic resistance on the other.

Many bacteria can infect pigs, cause devastating diseases, and impact profits. Among them is *Brachyspira hyodysenteriae*, the causative agent of swine dysentery, which is responsible for hemorrhagic diarrhea in growing pigs.

To find antibiotic alternatives, Costa’s team characterized the gut-level molecular response to *Brachyspira* infection by breaking it down into specific reaction cascades. Several potential targets for a new class of medicines were identified. These compounds, called “virulence blockers”, interact with a pig’s gut lining, acting as a barrier and stopping the chain reaction that can lead to clinical signs of swine dysentery. Virulence blockers do not kill the bacteria, nor do they prevent infection; but they could prevent clinical signs and decrease bacterial shedding in the environment, thus protecting other pigs.

The first results under laboratory conditions are promising. Intestinal secretion levels following *Brachyspira* infection are comparable to those of a noninfected subject. The next step is to test this virulence blocker in pigs to find the best route of administration, determine proper dosage, and evaluate safety.
How investigating the piglet helps us advance influenza control

Weaning-age piglets are responsible for the spread of many diseases, but in the case of influenza, they are also responsible for circulating the virus within the herd.

While examining the role of the sow and the environment in the propagation of influenza virus in sow herds, Montse Torremorell, DVM, PhD, and her team incidentally found viable virus on the udder skin of lactating sows, making Torremorell the first researcher to describe a new route for transmission of influenza in suckling piglets.

Even though all piglets are born influenza negative, they can become infected shortly after birth and start shedding virus in their nasal and oral secretions. While these piglets suckle, they deposit live virus particles on the sow’s underline skin that can in turn infect other piglets in the litter. Thus, a key factor in controlling influenza is to know when and how piglets become infected.

Torremorell and her team designed a new sampling technique called “the udder wipe” to analyze viruses present on the udder skin of lactating sows. Seventy-five percent of these samples showed viable influenza virus that could potentially infect piglets.

Additionally, Torremorell and her graduate student, Jorge Garrido, investigated the role of nurse sows as a possible source of virus. Nurse sows are animals with good mothering ability that have just reared their own litter and are used to adopt poorly performing piglets. They demonstrated that nurse sows did not shed a lot of influenza virus in their respiratory tract but had heavily contaminated udder skin. As a consequence, their newly adopted piglets rapidly became influenza positive. Field studies confirmed that adopted piglets are more likely to test influenza positive than those reared by their own dam.

This is one more piece of the puzzle in trying to figure out how and when piglets become infected, taking us one step closer in the long path to influenza control.
Most sow farms undergo extensive routine surveillance of replacement gilts to ensure they are not infected prior to entering the herd. *Mycoplasma hyopneumoniae*, the agent of enzootic pneumonia, continues to be a concern for swine producers in Minnesota. A recent study by University of Minnesota swine faculty shows the surveillance methods you choose can make a world of difference when it comes to preventing *Mycoplasma* outbreaks.

Various surveillance protocols are used to monitor gilt disease status over time. These include using serum samples to detect antibodies or oral fluid samples to detect bacterial DNA. The challenge is that sampling methods can often miss a few positive animals when the prevalence of the pathogen is low. Maria Pieters, DVM, PhD, head of the Mycoplasma Research Laboratory, and her team are investigating the best way to test naïve populations in which a single naturally infected individual was introduced.

When put in contact with one infected animal for eight weeks, less than 20 percent of the naïve gilts became infected. *M. hyopneumoniae*-specific antibodies were detected in the naturally infected pig only six weeks post-infection, while all contact gilts, including the infected ones, remained negative for antibody detection. Oral fluids remained negative for *M. hyopneumoniae* detection at all samplings during the investigation, regardless of the presence of infected gilts in the group. Meanwhile, detection of *M. hyopneumoniae* DNA was obtained through laryngeal swabs and deep tracheal catheters at all samplings.

“Producers need to use pathogen-specific sampling types and diagnostic methods that are more sensitive to the bacterium,” Pieters says. “When compared to the impact of a disease outbreak, these alternative strategies warrant consideration.”

*Your sampling strategy for *Mycoplasma hyopneumoniae* matters. Pooling samples increases the odds of finding infection while reducing diagnostic costs.*
Investigating Senecavirus A in United States swine herds

Senecavirus A (SVA) is an emerging viral agent often associated with vesicular disease in pigs. Unfortunately, the clinical manifestation of SVA is indistinguishable from foot-and-mouth disease, a reportable disease in the US. Until recently, little research has been conducted on SVA, and there is still a lot to discover.

Cesar Corzo, DVM, MS, PhD, and graduate student Guilherme Preis are estimating the proportion of sow and finisher farms with antibodies against SVA while simultaneously determining the risk factors for seropositivity. This project relies on the collaboration of production systems and independent practitioners. For each farm enrolled in this study, 30 samples are collected from sows or growing pigs and sent to the University of Minnesota Veterinary Diagnostic Laboratory for testing. The goal is to sample 200 swine herds to gather a picture of the US swine industry. So far, 181 farms across 16 states have participated, for a total of more than 5,000 samples.

Preliminary results suggest the proportion of herds exposed to SVA tends to be low, as 24 out of 181 farms have had at least one pig test positive. Two farms had only one positive sample, three had two positive samples, and 19 had three or more positive samples. Out of the 24 farms with at least one positive sample, 17 are sow herds and the remaining seven are finishing sites. The overall mean within-herd prevalence is 37.2%, ranging between 3.3% and 100%.

Further analysis is underway to explore the association between farm-specific data and positive results for Senecavirus A. This project will help the industry understand and perhaps identify risk factors associated with a positive herd.

In a sample of 181 farms across 16 states, relatively few herds included animals infected with Senecavirus A.
Predicting future disease outbreaks at the farm level

What if you could accurately predict the level of risk for a disease outbreak on a swine farm at any point in time? Would you take action to mitigate that risk? University of Minnesota swine faculty are working to give producers and their veterinarians better disease prediction tools.

The risk of disease outbreak is multifaceted and always changing, making it challenging to accurately estimate the risk to any individual farm or system. Take PEDv and PRRSv. These are two of the most devastating diseases producers face, yet the factors driving their spread at regional levels are poorly understood and hard to predict.

Utilizing a subset of data, available from the Morrison Swine Health Monitoring Project, containing weekly PRRSv and PEDv infection status for roughly 30 percent of the US sow herd, a team of researchers at the University of Minnesota, led by Kim VanderWaal, PhD, is developing a platform to forecast and report the risk of PEDv infection at the farm level.

Using pig movements, farm locations, and environmental and weather factors, the team is building machine learning algorithms that forecast the probability for a sow farm to become infected within two weeks. So far, the most important predictors are the infection status of the farm-of-origin for pigs moved into the focal sow farm, the number of pigs moved into neighboring sow or grower-finisher farms (within 5 kilometers of the focal sow farm), and the environmental characteristics of the surrounding neighborhood.

This is the first time that events at neighboring farms (e.g., outbreaks or pig movements) are being used to predict the risk of disease outbreak. Because of its large spatial and temporal scope, incorporation of animal movements, and use of innovative data science methods, the project has the potential to create new knowledge about the interacting processes that contribute to viral spread.

The ultimate goal of the project is to generate farm-level forecasts of PEDv (and later PRRSv) risk in real time later this year. Collaborating producers will have confidential access to their own weekly farm-level forecasts. The project is funded by the Swine Health Information Center and the USDA National Institute of Food and Agriculture.
Swine Disease Eradication Center: At the core of solving disease problems

When the Swine Disease Eradication Center (SDEC) began in 2001, PRRSv elimination was in its infancy. The idea for the SDEC was born of the realization that many questions remained to be answered in order to provide effective guidelines for preventing, controlling, and eliminating infectious diseases in the modern swine industry.

In response to the industry's changing needs, the late Carlos Pijoan, DVM, PhD, founded the SDEC to create a flexible, nimble, and sustainable model for research. Responding faster to industry issues and being more accountable to industry partners were key goals. Pijoan's vision was to provide producers and veterinarians with the knowledge required to effectively control and eliminate diseases. His vision continues today.

“The SDEC exists to discover and communicate knowledge on the transmission, control, and elimination of swine diseases,” says Center director Montse Torremorell, DVM, PhD. Primarily a research endeavor integrated with an outreach effort, the SDEC advisory board, made up of industry partners, meets regularly to guide the Center’s research direction. The process assures the Center’s activities are relevant and applicable.

From emerging PRRSv strains to influenza; from African swine fever to Mycoplasma; and from biosecurity to new technologies, the SDEC board and staff are never short of discussion points. The meetings offer an excellent opportunity to foster new ideas, understand current disease priorities faced by the industry, and obtain feedback on research activities and program direction. The board provides a pragmatic voice to shape the program's direction and research priorities.

“Getting DVM students engaged in research early in their training is critically important. DVM students are discussing swine projects with Maria Pieters, DVM, PhD, and Montse Torremorell, DVM, PhD. From l to r: Kayla Chase, Class of 2023; Clare Chamberlain, Class of 2023; Pieters; Torremorell; and Megan McMahon, Class of 2022.

The SDEC would not exist without the support and contribution of its partner companies and veterinary practices. Advisory board members are quick to explain how SDEC research helps veterinarians and producers make decisions to strive toward healthier herds.

The close working relationships between the University of Minnesota Swine Group and SDEC members creates an open forum for constructive criticism regarding research activities and priorities. The Center fosters collaboration on field-applicable research to generate knowledge that can be translated to disease control efforts.

The team-oriented environment encourages scientists to use novel methods to solve continuing problems. Having a voice at the table, providing direction, and seeing results are the things members value the most. To maximize the SDEC’s impact, the information generated is ultimately disseminated to and discussed with producers, veterinarians, and companies, and also at professional and scientific meetings.

The best SDEC projects have helped the industry understand routes of pathogen transmission, leading to biosecurity protocols and new disease management strategies that also help mitigate transmission risks. Examples include the following:

• Projects on PRRSv transmission have resulted in the introduction of air filtration and enhanced protocols for internal biosecurity practices. Research is now shifting to understand regional spread, control, and prevention of infections in growing pigs as well as to understand PRRSv emergence, evolution, and cost.
“The SDEC has shown leadership in pathogen elimination and eradication research since its inception. As the pathogens we face continue to change, the industry will continue to look to SDEC for leadership in field-based protocols.”

- Gordon Spronk, DVM
Chair
Pipestone Holdings LLC

- Projects assessing the duration of Mycoplasma infections have led to new protocols for gilt acclimation and Mycoplasma detection, which enhance control and elimination programs.
- Projects on influenza are helping galvanize the role of piglets in influenza infections and have resulted in novel sampling techniques, such as udder wipes, which are rendering the identification of infected herds much more cost-effective.
- Projects on biosecurity have included training materials on how to use ultraviolet germicidal chambers for maximum effectiveness.

All these are examples of field-applicable research where the SDEC has had tremendous impact. This collaborative work has leveraged funds and expertise from federal and state agencies, industry commodity groups, and private industry leaders as well as in-kind support from many veterinarians and producers.

Overall, the value of SDEC to industry participants is greatest for those sharing its vision to drive change to achieve healthier herds. If you are interested in becoming part of the SDEC, contact Montse Torremorell at sdec@umn.edu.

“The SDEC has provided value to our practice and clients by helping to answer practical questions that impact health and performance.”

- Jeff Feder, DVM
Veterinarian
Swine Vet Center, P.A.

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Pork Production Systems
- Holden Farms
- Iowa Select Farms
- New Fashion Pork
- Schwartz Farms Inc.

Veterinary Practices
- Carthage Veterinary Services
- Demeter Veterinary Services Inc
- Fairmont Veterinary Clinic
- Pipestone Veterinary Services
- Swine Extension & Consulting Inc.
- Swine Vet Center
- Veterinary Medical Center
A team response to an emerging challenge: African swine fever

“This ASF outbreak may be the worst disease insult the world has seen,” says John Deen, DVM, PhD, Dipl ACW. “China has half the pigs in the world, and there are estimates that half of China’s pigs are now gone. It’s hard to identify another occasion where such a huge effect upon a livestock population has occurred.”

ASF’s deadly consequences are impacting the swine industry across Asia and the world. And while there are currently no vaccines or cures, the University of Minnesota College of Veterinary Medicine (CVM) is tackling the disease from all sides, both at home and abroad.

Prioritizing prevention and early detection

The University of Minnesota Veterinary Diagnostic Laboratory (VDL) is testing for the presence of ASF in swine samples. “Diagnostics play a critical role in ASF, and the VDL is essential in terms of the early discovery of the disease in the US and being prepared,” says Tom Molitor, PhD, chair and professor in the Department of Veterinary Population Medicine (VPM). Jerry Torrison, DVM, PhD, DACVPM, director of the VDL, and his team are also helping develop a Vietnam-specific workforce, for which one of the major topics is diagnostics for ASF.

The Center for Animal Health and Food Safety (CAHFS) is spearheading the task force in Vietnam. The task force is built in partnership with researchers at Universidad Complutense in Madrid, Spain, and focuses on education and capacity building—preparing veterinary professionals and producers for an outbreak and cleanup. The center has also built a toolkit on their website, which is available to producers, policymakers, veterinary students, and local and international partners.

Additionally, every month, CAHFS partners with the Swine Health Information Center to update a monthly report of global swine disease outbreaks, with a focus on ASF. “Providing rapid solutions to emerging challenges requires innovative research and effective partnerships,” says Andres Perez, DVM, PhD, director of CAHFS. “The University of Minnesota and CAHFS are working side by side with swine producers to protect the industry, support the livelihood of farmers, and supply the US and the world with healthy, safe, and affordable food.”

Molitor says the VPM is also offering continuing education courses for any and all swine veterinarians. This effort is being led by Jennifer van de Ligt, PhD, associate director of the Food Protection and Defense Institute and associate professor in the VPM.

Hog health from the start

Pedro Urriola, DVM, MS, PhD, is working with colleague Declan Schroeder, PhD, to improve upon early research on the survivability of the ASF virus found in feed ingredients and its control. They’re using a similar virus that infects a specific microalgae strain as a functionally appropriate surrogate for ASF.

A broad team of UMN faculty are addressing African swine fever. The group includes (left to right) John Deen, DVM, PhD, Dipl ACW; Andres Perez, DVM, PhD; Jennifer van de Ligt, PhD; Declan Schroeder, PhD; Pedro Urriola, DVM, MS, PhD; Jerry Torrison, DVM, PhD, DACVPM; Marie Culhane, DVM, PhD; and Tom Molitor, PhD.
The surrogate virus poses no health risk to pigs, humans, or other animals or plants. “Use of this surrogate assay would allow a fast (48 hours), accurate, and low-cost method of obtaining necessary research data to answer many questions associated with ASFv survival and inactivation in feed and feed ingredients,” Schroeder says.

Cleaning up ASF’s wake

Marie Culhane, DVM, PhD, is working with the Minnesota Board of Animal Health, Minnesota Pork Board, and United States Department of Agriculture to improve preparedness in Minnesota and across the region. When avian influenza broke out in the US in 2014, Culhane’s research was instrumental in helping affected farmers rebound after the disease hit. Now, her insights are being custom-fitted to deal with ASF.

Deen, along with the late Bob Morrison, DVM, PhD, MBA, has spent the last 20 years traveling to China to advance pig production. This work led to the Leman China Conference, which will take place again this October and reaches thousands of farmers and veterinarians. Improving biosecurity has been a focus of Deen’s work with farmers and veterinarians.

“We are helping farmers make plans to address the disease if and when it occurs on one or more of their farms,” says Deen. “We are evaluating testing methods, trying to estimate the risk of introduction under different scenarios of local outbreaks, and also planning for re-establishing herds after a disease outbreak to take advantage of the high prices now being seen in China because of the lack of available pork.”

Discussions are also taking place between Deen and the One Health Center at City University in Hong Kong. In turn, he is trying to help the government develop viable control strategies. Deen will return to China this fall to continue his work with his long-standing partners abroad, whose contributions, he says, have been innumerable.

Partnering with China, looking ahead

“Our work benefits the world, not just the US population,” says Molitor. “We are bringing our expertise in research and work with other agents to the table to help China and other groups address this devastating epidemic that presents a major risk to this country.” Molitor says the Leman China Conference in October 2018 took a leadership role in sharing knowledge about ASF right after the disease swept across Asia. “We changed the program to bring in experts on biosecurity to focus on ASF,” he says. “And ASF will remain a major focus this October as well.”
Fueled by fellowships

The Swine Program at the University of Minnesota College of Veterinary Medicine (CVM) offers a variety of fellowships that allow graduate students to explore their research interests in swine production and medicine. As a result, fellows graduate from the CVM as compassionate leaders in their field and are prepared for any direction their career path may take them. The three fellowships—the Morrison Fellowship, the Carlos Pijoan Fellowship, and the Leman Fellowship—align with the CVM’s mission to improve the health of animals, humans, and the environment while discovering new knowledge and skills. The impact of these fellowships is a new generation of scientists that are able to conduct applied research while combining swine and human health.

The Carlos Pijoan Fellowship

The Carlos Pijoan Graduate Student Fellowship aims to build problem-solving skills in students to improve the health and productivity of pigs. The most recent recipient, Gustavo Lopez, DVM, PhD student, is currently researching the influenza A virus, specifically focusing on the transmission dynamics of influenza in pig farms and the role humans play in the transmission of influenza.

When did you first know you wanted to work in veterinary medicine and, more specifically, with swine?

My father owns a poultry farm back home in Venezuela, so as I grew up, I started to get more involved with meat production systems. However, it wasn't until my fourth year of vet school at Universidad Central de Venezuela (UCV) that I decided to focus on swine. The swine department at UCV consisted of very good teachers, including University of Minnesota graduates Vitelio Utrera, MSc, PhD, and Jean Paul Cano, DVM, PhD. They encouraged their students to pursue swine medicine by taking us to swine farms and arranging internships both locally and internationally.

What is your favorite part of working with swine?

My favorite part of working with swine is the production dynamics that have to be considered when making important decisions, such as vaccinations, treatments, eradication, etc. Each year, new things are discovered about swine diseases, and as veterinarians, it’s important that we stay updated in order to understand more about a specific disease. Our role is to improve health, but at the same time, we need to maintain productivity and efficiency.

How has the Carlos Pijoan Graduate Student Fellowship helped you?

The Pijoan Fellowship has been instrumental in helping me pursue my dream of advancing my analytical and critical thinking skills while also advancing the field of swine diseases. In particular, I’m able to contribute to the understanding of influenza epidemiology and its control.

What advice do you have for future swine graduate fellows?

Learn as much as you can and do not focus solely on your research. The research done by the swine group at the U is world-famous and we are privileged to be a part of it, so make the most of it. Go to the seminars, ask questions, and talk to other faculty and students about what they’re doing.
The Bob Morrison Fellowship

The graduate fellowship supported by the Bob Morrison Legacy Fund aims to develop industry leaders capable of developing knowledge-based solutions to issues facing swine health and production. Alyssa Betlach, DVM, was the first recipient of the award and is currently researching the epidemiology of Mycoplasma hyopneumoniae, the species of bacteria known to cause porcine enzootic pneumonia. In addition, Betlach works as an associate veterinarian at the Swine Vet Center in St. Peter, Minn.

What is your favorite part of working with swine and swine producers?

I enjoy working with swine producers to help maximize the health and production on their farms and to develop strategies for pathogen surveillance and disease control. I am inspired by the constant passion and motivation that producers have toward improving their farm productivity and health. Together, we are always learning from and challenging each other.

Why did you choose the University of Minnesota for your graduate degree?

I chose to pursue my graduate degree at the University of Minnesota because the U of MN is world-renowned for education in swine medicine and applied research. Throughout the industry, key leaders have obtained their graduate degrees from the U of MN. I earned my DVM at the U of MN, where I was able to develop close relationships with swine faculty. So it seemed natural for me to work with and learn from the faculty.

How has the Bob Morrison Legacy Fund helped you?

During one of my conversations with Dr. Morrison, he said, “Research needs to directly benefit the producer.” Like many others, I greatly admired his insight, which has inspired me to conduct practical and applicable research and think “big.” The fund has provided me with the opportunity to collaborate regionally and internationally with veterinarians, producers, and researchers on mycoplasma research, as well as to further my education in swine production and epidemiology.

What is your dream job in the field of swine veterinary medicine?

I have my dream job working within the field and at the university. I wear multiple hats, and I work with an amazing team of colleagues and producers. Also, I am able to learn from and collaborate with U of MN swine faculty on the cutting edge of research and technology. One day, I hope to inspire young students to pursue their career in swine production, medicine, and/or research.
The Allen D. Leman Fellowship

Jose Angulo, DVM, MS student, is the most recent recipient of the Leman Fellowship, named for the late Allen D. Leman, DVM, PhD. Angulo was also the recipient of the Dr. Alex Hogg Memorial Scholarship in 2018, which was given by the American Association of Swine Veterinarians.

When did you first know you wanted to be a swine veterinarian?

I’ve always wanted to be a vet, but it wasn’t until my fourth year of veterinary school that I decided to focus on swine specifically. There I did a rotation in a large, integrated pork production company and learned the importance of production system veterinarians. I have worked in this industry for 18 years!

What is your research currently focusing on?

I’m working with Montserrat Torremorell, DVM, PhD, on a field research study to understand PRRSv in growing pigs. There are not many research projects being done in this area, and the economic impact of PRRSv in growing pigs is highly significant. The field research is being conducted in wean-to-finish sites, which allows us to monitor the pigs through the growing phases and identify PRRSv incidence and associated risk factors.

What impact do you hope your research has on the swine industry?

With our research, we hope to shed light on PRRSv infections in growing pigs, specifically when they are being infected and what production practices are more associated with these infections. We hope that our research will help veterinarians and producers focus on minimizing the risk of PRRSv infections. This may minimize virus circulation in growing pigs, as well as regional virus spread.

How has the Leman Fellowship helped you?

Being accepted into the master’s program at the College of Veterinary Medicine is an incredible opportunity for me to advance my knowledge of disease epidemiology while contributing to the swine industry. This program has equipped me with the tools to generate expertise and provide practical solutions to veterinarians and producers for swine health improvements. I would not be able to achieve these goals without the financial support from the Leman Fellowship.

“I will always be grateful to have been the first Carlos Pijoan Fellow at the University of Minnesota College of Veterinary Medicine. It was a great opportunity to join the team as a graduate student and certainly a great challenge and responsibility to hold the Pijoan Fellowship position. You want to honor his name by applying science to make a difference in the field and bring justice to his legacy. That ‘challenge,’ partnered with the opportunity to work closely with the swine team at the University, provided a unique experience that really positively transformed my career.”

—Daniel Linhares, DVM, MBA, PhD
Assistant professor and director of graduate education
Veterinary Diagnostic and Production Animal Medicine
Iowa State University College of Veterinary Medicine
Future Direction

The University of Minnesota College of Veterinary Medicine Swine Group strives to stay a renowned swine research powerhouse dedicated to solving the issues facing the swine industry. We’re investing in the future, refining our approach, increasing our engagement with the industry, and sharpening our focus on solving problems using a highly networked and collaborative world-class university. We are:

Data-driven

The Morrison Swine Health Monitoring Program will continue to take the industry’s pulse by gathering real-time data and sharing reliable disease prevalence information. Future efforts will focus on increasing the number of participating farms as well as collecting transport information to track pig movements between farms to better understand and predict disease spread.

Eliminating disease

We will increase our knowledge of transmission, control, and elimination of swine diseases through our collaboration with the Swine Disease Eradication Center industry partners. This continuous avenue of communication brings forward new research questions based on the problems encountered by producers and is a fertile ground to develop new projects. We’re committed to eliminating swine disease.

Fostering the future

Nurturing the inquisitive minds the swine industry needs to be successful is our highest priority. Our second cohort of mid-career practicing veterinarians in the Morrison Forum for Advancing Swine Production Medicine is the latest initiative. Expanding our online courses to transfer knowledge whenever and wherever it’s needed is another. Our veterinary students will be even more grounded in real-world problem-solving through the emerging Swine Veterinary Educational Network.

Sharing expertise

The continuously innovative Allen D. Leman Swine Conference fosters interactions between participants and experts. More skills-based preconference workshops, greater integration of veterinary students, and additional opportunities for social interaction among all participants makes this industry-leading conference a must-attend event for the swine industry’s leaders.

Join us as we strengthen the global swine industry. We’re listening!

Learn more at z.umn.edu/swine