



Swine Health Information Center

# Swine Health Information Center 2019 Progress Report

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## Executive Summary

### Swine Health Information Center

#### ***Swine Health Information Center Organization***

The Swine Health Information Center (SHIC) began operation as a 501(c)(3) corporation on July 4, 2015 (Appendix A). The mission of SHIC is to protect and enhance the health of the United States swine herd through coordinated global disease monitoring, targeted research investments that minimize the impact of future disease threats and analysis of swine health data.

The National Pork Board (NPB), National Pork Producers Council (NPPC) and the American Association of Swine Veterinarians (AASV) have each appointed two representatives to the SHIC Board of Directors. Three at-large producer representatives are also members of the Board. The Board approved a 2019 operating budget, a 2019 Plan of Work and a plan for FDIC insured investments, that is modeled after that of the National Pork Board.

A Monitoring and Analysis Working Group and a Preparedness and Response Working Group have been formed to provide program oversight and decision-making. Each are actively meeting via conference calls to fulfill their respective objectives.

#### ***Swine Health Information Center 2019 Outreach***

There has been personal outreach to pork producers, veterinarians, allied industry and state and federal animal health officials to foster collaboration, develop projects, increase understanding of SHIC and its mission and inform them about the research and programs. Their feedback has helped focus and refine SHIC responsibilities, research and programs. Presence and participation in international meetings and with international organizations have helped to monitor swine diseases and issues around the world.

### Progress on the Swine Health Information Center 2019 Plan of Work

#### ***Preparedness***

##### ***Swine Viral Disease Matrix***

- 1) The initial publication of the Polymerase Chain Reaction (PCR) Assay Catalog for diagnostic laboratories contained 17 new SHIC-funded diagnostic tests. The catalog has been updated as the SHIC Diagnostic Assay Catalog and now includes Enzyme Linked Immunosorbent Assays (ELISAs) for detection of antibodies in serum and oral fluids against hepatitis E, sapelovirus, teschovirus, swine influenza virus, porcine circovirus 3 (PCV3) and atypical porcine pestivirus.
- 2) 2019 research continued to fill in identified preparedness gaps for Viral Matrix priority pathogens:
  - a. SHIC has sponsored research at the University of Minnesota to analyze porcine circovirus Type 3 (PCV3)-related submissions to the University of Minnesota Veterinary Diagnostic Lab. Preliminary results show statistically significant correlation between PCV3 and the clinical sign of fetal death as well as histological lesions of myocarditis, vasculitis of the heart, and vasculitis of the spleen.

- b. In the event of a foot-and-mouth disease (FMDV) outbreak in North America, effective control and elimination will require efficient, cost effective detection. Consequently, SHIC funded a project at Iowa State University with the long-term objective of creating and validating an FMD 3ABC antibody indirect ELISA for use with swine oral fluids.
- c. In 2019, through a grant from the USDA Foreign Ag Service, SHIC is funding the analysis of Vietnamese field oral fluid samples as part of the analytic sensitivity needed for diagnostic validation of African swine fever (ASF) PCR tests using oral fluids. The outcome of the project will provide testing of oral fluids to validate herd disease status and support continued movement of disease-free pigs during or after an outbreak.

### ***Monitor and Mitigate Risks to Swine Health***

#### *Identify and mitigate swine disease risks by international monitoring*

- 1) The Global Swine Disease Monitoring Report facilitates near real-time identification of international disease hazards posing risks to the domestic pork industry. The report is posted on the SHIC website and included in its monthly e-newsletter, always ranking as one of the most read articles.
- 2) A recently completed SHIC-funded study looked at international transportation biosecurity practices of four cooperating US breeding stock companies. Investigators found participating breeding stock companies have robust biosecurity procedures for both import/exports due to their investment in maintaining the health status of these pigs.
- 3) A new Senecavirus A (SVA) outbreak continued in Brazil during 2019 and was reported by SHIC via the AASV e-letter and the SHIC monthly e-newsletter. One open question is whether there is a new mutant SVA circulating in Brazil, with greater pathogenicity, or if this was just a fall in immunity of the Brazilian herd after the three years between the two outbreaks.
- 4) SHIC and NPB co-funded a project analyzing the risk of ASF and classical swine fever (CSF) being introduced into the US through prohibited swine products carried by air passengers. Results suggest the mean risk of ASF virus introduction into the US in this way has increased 183%, compared to the risk estimated before the disease spread into China, East Asia, and Western Europe in 2018 and 2019.
- 5) SHIC, AASV, NPB, and NPPC met multiple times with the Department of Homeland Security (DHS) Customs and Border Protection (CBP) during 2019 to voice concerns about the lack of secondary screening of travelers after declaring contact with foreign farms or animals. In collaboration with these other pork industry associations, SHIC continues to collect information about the customs experience and share it with DHS CBP to help assess performance and improve prevention of foreign disease introduction.

#### *Improve transport biosecurity from first points of concentration*

- 6) A SHIC-funded pilot study to investigate the transfer of contamination from livestock trailers to barns during marketing events was completed. The results of the pilot study are now being used to evaluate if implementing a staged loading procedure when loading out market pigs is effective at preventing the transfer of swine pathogen contaminated particles from livestock trailers to the barn.

*Investigate the ability of common inputs to production to act as biologic or mechanical vectors for disease introduction onto farms*

- 7) A SHIC-funded project at Kansas State University improved the half-life calculations of ASF in feed ingredients exposed to transatlantic shipment conditions, identified animal feed ingredients which support survival of ASF, CSF, and pseudorabies virus (PRV) exposed to transpacific shipment conditions and investigated antiviral chemical feed additive mitigants.
- 8) An ongoing study, partially funded by SHIC, examined 14 feed additives, including medium chain fatty acid blends, organic acid mixtures and acid/aldehydes, to determine their ability to negatively affect viral survival and thus function as cost-effective mitigants. Although none of the feed additives completely removed viral contamination, data from this study suggest that the use of approved additives may reduce the risk of viral infection via contaminated feed.
- 9) SHIC encouraged the American Feed Industry Association (AFIA) as they updated feed mill biosecurity guidelines. In collaboration with AFIA, a Feed Risk Task Force, with USDA, FDA and the Canadian Food Inspection Agency invited to provide input, was formed and met twice in 2019.
- 10) SHIC participated in a feed processor ASF task force to define prevention, detection, and response protocols for feed ingredients, feed manufacture, and on-farm feed delivery for feed processing facilities.
- 11) SHIC sponsored a workshop to increase understanding of the vitamin supply chain and identify potential risk factors for introducing foreign animal disease to the US. The vitamin supply chain meeting report describes current industry understanding of vitamin manufacturing, transport, and vitamin premix composition/manufacturing processes as well as quality assurance and biosecurity programs.
- 12) SHIC brought together soybean industry stakeholders to increase understanding of the soy supply chain and identify potential risk factors for introducing foreign animal disease into the US. Presentations and discussion focused on potential risk factors of products such as soybean meal acting as vectors for ASF and foreign animal disease transmission.
- 13) SHIC funded an investigation into the possibility that a Brazilian feed mill and/or its ingredients could be a source of Senecavirus A (SVA) transmission. There were no samples positive for SVA and few positive for rotavirus. Nearly all samples had prolific amounts of bacteria so resources were shifted to better quantify bacterial presence, with fecal-indicating bacteria used as indicators of biosecurity breaches.

***Improve Swine Health Information***

*Develop the industry capacity for detection of emerging disease, rapid response and continuity of business*

- 1) SHIC is continuing to support the Morrison Swine Health Monitoring Project (MSHMP). MSHMP currently monitors approximately 50% of the US sow herd for economically important pathogens. In the short term, this project contributes to the control and prevention of important swine diseases and in the longer term, builds capacity for data collection, organization and providing capability to facilitate response to emerging pathogens.

- 2) Analysis of MSHMP's data helps to control and prevent swine diseases. Projects during 2019:
  - a. SHIC-funded analysis described key differences in the biosecurity aspects of breeding herds with relatively low porcine reproductive and respiratory syndrome (PRRS) incidence, compared to those with relatively high PRRS incidence, so ongoing biosecurity assessments can be more efficient and take less time.
  - b. SHIC funded a study applying machine-learning to predict porcine epidemic diarrhea virus (PED) outbreaks on sow farms. As a result, a machine-learning model was developed to predict the probability that a sow farm will become infected two weeks in advance. In addition, high-resolution maps to identify current and future PED risk in North Carolina are being developed. These projects have the potential to predict the near-future risk for PED outbreaks and make intervention recommendations to minimize costs and maximize treatment efficacy.
- 3) SHIC has funded a thorough study of the National Poultry Improvement Plan (NPIP), its associated organizational structure and operations, and industry participation and execution across the various segments of the US poultry industry, in order to assess the potential for establishing a similar program for the US swine industry. The report was supplied to a focus group of producers, state animal health officials, NPIP experts and allied industry with the objective of ensuring that it is clear, complete and objective. Edits according to the comments of the group were made and a final report was accepted by the SHIC Board of Directors.

*Make industry swine health information available to help uncover, communicate and mitigate regional and national risks to herd health*

- 4) During the World Organization for Animal Health (OIE) annual meeting, member countries considered and passed a resolution regarding ASF. Within Resolution No. 33 is a framework for addressing this global threat, recognizing the need for collaborative preparedness, prevention, detection, and control measures.
- 5) SHIC continues to support a domestic swine disease monitoring program, the "Swine Disease Reporting System". The monthly reports include veterinary diagnostic laboratory data on PED, porcine Deltacoronavirus (PDCoV), and PRRS. It also reports on the incidence and causes of central nervous system syndromes in pigs. Added, in 2019, are data about *Mycoplasma hyopneumonia* and syndromic enteric and respiratory disease.

***Surveillance and Discovery of Emerging Disease***

*Investigate newly identified agents associated with disease*

- 1) Next Generation Sequencing was directly applied to the fecal and intestinal tissue samples from chronically diarrhetic nursing pigs and a new variant of porcine sapovirus was identified. This appears to be the first detection of a single porcine sapovirus infection in piglets with diarrhea in the United States. A real time RT-PCR to detect viral RNA in clinical samples and determine the viral load from intestine tissue and fecal samples and the ability to test for the virus directly in fixed tissues are being developed.
- 2) Development and evaluation of a serum/oral fluid ELISA to detect antibodies against atypical porcine pestivirus (APPV) have been completed. APPV is the most common cause of congenital tremor in pigs. This is the first study to experimentally infect swine with APPV and monitor the infection dynamics over time.

*Ensure detection of emerging disease to facilitate rapid response*

- 3) Current statistical methods for selecting sample size, i.e., how many pigs and which pigs to sample, worked well for traditional farms, but does not work for modern farms because of industry evolution since they were developed. Progress during 2019 investigated improvements that can be made toward a nationally coordinated swine health surveillance system to prepare, detect and rapidly respond to emerging and foreign animal diseases.
- 4) There continues to be incidents of high morbidity/high mortality where an etiology is either not identified or there is a strong supposition that the identified pathogen is not the likely cause of the outbreak. For these cases, SHIC offers diagnostic fee support when the initial, producer-funded diagnostics are unrewarding.
  - a. The Iowa State University Veterinary Diagnostic Lab has confirmed *Streptococcus equi ssp zooepidemicus* in two recent, potentially related cases of high mortality in sows for slaughter and feeder pigs in assembly yards in the Midwest. Isolates are being sequenced using Next Generation Sequencing, a species-specific PCR is being developed to retrospectively and prospectively test swine tissue to evaluate spread of this species within US swine herds and a challenge study is being done to shed more light on mechanisms of pathogenicity of the bacteria.
  - b. In 2019 SHIC continued further diagnostic work into understanding a hemorrhagic tracheitis syndrome that has been moving east to west across Canada. Initially limited to an area and to one or a few companies, it has moved westward, affecting multiple systems in multiple areas
  - c. A Midwest herd is experiencing ongoing mortality in the late finisher phase associated with outbreaks of acute tremors and cyanosis rapidly progressing to death. Further diagnostics, including Next Generation Sequencing, are searching for the etiology.

***Responding to Emerging Disease****Support a rapid, unified industry response to emerging disease outbreaks.*

- 1) The US pork industry has aligned its efforts to be better prepared to quickly respond to foreign animal and transboundary production disease by creating the National Swine Disease Council. The council is made up of key industry leaders, the North American Meat Institute and representatives from SHIC, NPB, NPPC, and AASV. USDA, as well as state animal health officials, attend meetings and provide input.
- 2) Veterinarians receiving diagnostic test results identifying porcine astrovirus 3, porcine sapelovirus, or porcine teschovirus may need more information to improve management of the central nervous syndromes associated with these viruses. SHIC, in collaboration with AASV, held a webinar titled Disease Management of Viral Myelitis to address these challenges for veterinary practitioners and pork producers.

*African Swine Fever*

- 3) As ASF circulates around the world, reports of varying degrees of pathogenicity bring into question the possibility of the current, epidemic strain drifting into different, related strain(s). SHIC has funded a project to report the current state of knowledge regarding possible strain differences and pathogenicity.

- 4) SHIC, NPB, NPPC, and AASV jointly authored and offered seven important resolutions individually addressing ASF and foreign animal disease prevention, preparedness and response during the US Animal Health Association annual meeting.
- 5) A USDA-Foreign Ag Service grant titled, "Building capacity to support the control of African Swine Fever (ASF) in Vietnam," has been awarded to SHIC, with active support from NPPC. The approximately \$1.7 million grant will fund the multi-phase project, helping to build strategic partnerships while increasing trade of US pork to the region. The work will include swine health field projects, including collection and analysis of disease samples, which will help inform North American pork producers about effective ASF preparedness and response.

In September, SHIC Executive Director Dr. Paul Sundberg traveled to Vietnam as this process was launched. During this initial visit, key stakeholders were identified and Dr. Sundberg and colleagues met with staff from laboratories as well as producer companies to set up the infrastructure for implementation of the work outlined in the grant.

*Identify high risk events likely to be responsible for introducing emerging disease onto farms*

- 6) The Rapid Response Corps (RCC) program, now operational, developed a rapid response program for epidemiological investigations of emerging, transboundary and endemic swine disease outbreaks. The program has set up six regions across the country, small enough for RRC members to be able to drive to a farm in their region and begin the investigation within 72 hours after invitation from the producer. There were no active RRC investigations during 2019.

***Swine Health Information Center Communications***

- 1) [www.swinehealth.org](http://www.swinehealth.org)
  - a. A website redesign was completed and made live in December 2019. The redesign provides easier access to the most popular information on the website as well as categorizes information better with enhanced search capabilities within the site.
  - b. Google Analytics of the SHIC website traffic are used to measure impact of communications efforts. All e-newsletters, postings, and media releases communicate to the desired SHIC audiences, providing timely and relevant information, as well as activities of the center.
  - c. There were over 23,000 individual SHIC website sessions during 2019, a 44% increase over 2018. Most visitors were from the US, Philippines, Canada, the UK and Australia with a total of 57,104 page views, an increase of 44% over 2018.
- 2) Press releases
  - a. For press release distribution, general emails were sent to 250 ag news outlets and individual emails were sent to the top five pork press editors for each press release. Nearly 100 percent of the press releases were picked up by national industry editors.
- 3) The SHIC e-newsletter
  - a. A monthly SHIC e-newsletter publication schedule continued in 2019. More than 3,000 subscribers are in the distribution database. "Percent opens" for the e-newsletter was 33.8% (Constant Contact benchmark is 11.0%) and "percent clicks" through to articles on the SHIC website was 19.0% (Constant Contact benchmark is 7.2%).



## Swine Health Information Center 2019 Progress Report

### Swine Health Information Center Organization

1) The Swine Health Information Center is a 501(c)(3) corporation governed by a Board of Directors. The producer members of the Board of Directors are active pork producers or representatives of pork producing companies or allied industry that have an interest in the mission of the Center and that serve as champions for the Center's objectives and goals. Jeremy Pittman, DVM, has joined the SHIC Board of Directors. Dr. Pittman is a staff veterinarian for Smithfield Hog Production – North Region. His responsibilities include oversight on 133,000 sows farrow-to-finish in North Carolina and Virginia. He also serves on the Smithfield Science and Technology Committee. Dr. Pittman assumes the seat previously held by Dr. Mike Terrill, CEO of Topigs Norsvin Americas, who resigned after four years of service on the SHIC Board of Directors. There are nine Board of Directors members:

- a. Two named by the National Pork Board
  - i. Gene Noem, pork producer and Director, Genus PLC, Iowa
  - ii. Mark Greenwood, Compeer Financial, Minnesota
- b. Two named by the National Pork Producers Council
  - i. Dr. Howard Hill, pork producer and NPPC past-president, Iowa
  - ii. Bill Luckey, pork producer and past member of NPPC Board of Directors, Nebraska
- c. Two named by the American Association of Swine Veterinarians
  - i. Dr. Matt Anderson, Suidae Health and Production and AASV past-president, Iowa
  - ii. Dr. Daryl Olsen, AMVC and AASV past-president, Iowa
- d. Three at-large producer members
  - i. Mark Schwartz, pork producer, Minnesota
  - ii. Dr. Jeremy Pittman, Smithfield Hog Production, North Carolina
  - iii. Dr. Matthew Turner, JBS USA, Colorado

2) A 2019 operating budget and investment portfolio was developed.

The SHIC Board of Directors approved an operating budget for 2019 and has reviewed and modified the budget during the year to best meet the SHIC mission. The approved operating budget addressing the 2019 Plan of Work was \$2,636,080.

Extra funds not needed for the operating budget were invested in securities with Wells Fargo Bank and modeled after NPB's investment plan. The investments are a series of FDIC insured Certificates of Deposit, laddered to provide on-going operating funds as the certificates reach maturity.

3) SHIC Working Groups have been formed to provide input and oversight as the Center fulfills its mission.

The Working Groups give the opportunity to provide program oversight and decision-making, supplemented and informed by subject matter expertise. To complete the SHIC Plan of Work, two working groups have been formed.

The Monitoring and Analysis Working Group is charged with assessing foreign, transboundary production disease risk using information from a variety of sources. The outcome of this assessment is the on-going prioritization of the Swine Viral Disease Matrix (Appendix B) and Swine Bacterial Disease Matrix (Appendix C). It is also responsible for improving the health of the nation's swine herd through the development and oversight of on-going projects. These include monitoring for domestic diseases affecting swine health and analyzing health and other data to support on-farm and prospective producer decision making. The Working Group reviews and selects research and program activities that address its Plan of Work.

The Preparedness and Response Working Group is responsible for oversight of the swine viral and bacterial disease matrices research. It is responsible for funding decisions to fulfill other matrices-related research objectives. It also provides advice and oversight of SHIC's role in the emerging swine diseases response plan. That includes the appropriate SHIC response to an emerging swine disease and for the information and analysis necessary to support the proportional pork producer and pork industry response to these emerging diseases. The Working Group reviews and selects research and program activities that address its Plan of Work.

### Swine Health Information Center 2019 Outreach

- 1) There has been personal outreach to pork producers, veterinarians, allied industry and state and federal animal health officials to foster collaboration, develop projects, increase understanding of SHIC and its mission and inform them about the research and programs. The feedback has helped to focus and refine SHIC responsibilities, research and programs. Following is a list of organizations and meetings where SHIC's research and programs were presented or discussed.
  - a. Pork producers
    - i. AMVC Swine Health Services; Carthage Veterinary Service; Christensen Farms; JBS; The Maschoff's; Iowa Select Farms; Pipestone; Prestage Farms; Schwartz Farms; Seaboard Foods; Smithfield Foods, Hog Production Division; Swine Vet Center; 21<sup>st</sup> Century Strategic Forums, 21<sup>st</sup> Century Pork Club
    - ii. Canadian Pork Producers Association
    - iii. Fairmont Veterinary Clinic annual producer meeting, Fairmont, Minnesota
    - iv. NPB's Board of Directors
    - v. NPB's Swine Health Committee
    - vi. NPB's ASF Task Force
    - vii. NPB/AASV Depopulation Working Group
    - viii. National Pork Industry Conference
    - ix. NPPC's Animal Health and Food Security Committee
    - x. NPPC's Pork Action Group
    - xi. NPPC's Trade Committee
    - xii. National Swine Disease Council
    - xiii. Ohio Pork Congress
    - xiv. Purina Elite Swine Producer meeting
    - xv. Standard Nutrition Company

- xvi. UMN Allen D. Lemah Swine Conference
  - 1. Feed Research/Safety breakout seminar
- b. Allied industry
  - i. American Feed Industry Association
  - ii. Animal Nutrition Association of Canada
  - iii. Boehringer Ingelheim Vetmedica
  - iv. Compeer Swine Operational Peer Group – ASF Forum
  - v. DFS Animal Nutrition
  - vi. Genus PIC
  - vii. IDEXX
  - viii. Institute for Infectious Animal Diseases
  - ix. Kemin Industries
  - x. National Association of Farm Broadcasters
  - xi. National Grain and Feed Association
  - xii. Nebraska Grain and Feed Association
  - xiii. NOVUS International
  - xiv. Soybean processors and exporters – United Soybean Board/USSEC; National Oilseed Processors Association; ADM; Cargill; Land O’ Lakes
  - xv. Tetracore, Inc.
  - xvi. Thermo Fisher Scientific
  - xvii. US Animal Health Association, including allied industry, USDA and State Animal Health Officials
    - 1. Swine Health Committee
    - 2. Global Animal Health and Trade Committee
  - xviii. Vitamin manufacturers – Adisseo; ADM; BASF; Cargill; DSM; JNJ Oriental; Land O’ Lakes/Nutra Blend; VitaPlus
  - xix. Zoetis
- c. Veterinarians
  - i. 2019 AASV annual meeting
  - ii. AASV Board of Directors meetings
  - iii. Swine Medicine Education Center, Iowa State University
- d. Veterinary Diagnostic Laboratories, Colleges of Veterinary Medicine, and Academics
  - i. Kansas State University Ag Biosecurity Coordination Network
  - ii. Kansas State University Veterinary Diagnostic Laboratory
  - iii. Iowa State University Veterinary Diagnostic and Production Animal Medicine
  - iv. South Dakota State University Veterinary Diagnostic Laboratory
  - v. University of Minnesota Veterinary Diagnostic Laboratory
- e. USDA
  - i. Ag Research Services
  - ii. Animal and Plant Health Inspection Service, Administrator
  - iii. Animal and Plant Health Inspection Service, Deputy Administrator, Veterinary Services

- iv. Animal and Plant Health Inspection Service, Veterinary Services Leadership Team and Veterinary Services staff
- v. Center for Epidemiology and Animal Health
- vi. Center for Veterinary Biologics
- vii. National Import Export Services
- viii. National Veterinary Services Laboratory
- ix. USDA ASF Response Exercises
- f. Department of Homeland Security
  - i. Customs and Border Protection
- g. Food and Drug Administration
  - i. Center for Veterinary Medicine
- h. State animal health officials and state agencies
  - i. Multistate Partnership for Security in Agriculture – Emergency Preparedness and Response Officials of 18 states
  - ii. National Association of State Animal Health Officials ASF Working Group
- i. International
  - i. 2019 ABRAVES Brazil
  - ii. 2019 Shakespeare Meeting, Stratford, Ontario
  - iii. Agrocere PIC
  - iv. Canadian Innovation Pork ASF Working Group
  - v. OIE, International Organization for Animal Health
  - vi. OIE, International Organization for Animal Health, Director General
  - vii. Ontario Animal Health Network
  - viii. US/Canada ASF Forum, Ottawa, Canada

## Progress on the Swine Health Information Center 2019 Plan of Work

### Preparedness

#### 1. Swine Viral Disease Matrix

In 2016, SHIC matrix research focused on the ability to detect the viral matrix pathogens via nucleic acid detection, using PCR testing – a platform that is commonly available in the major US veterinary diagnostic laboratories. 2017-funded research focused on the development and validation (analytic and diagnostic) of antibody detection assays for monitoring for emerging diseases, determining freedom from disease (after an outbreak), or defining the extent of disease spread. During 2018, and now 2019, development of additional tests helped to fill in gaps in diagnostic preparedness.

##### *PCR Assay Catalog Update*

The initial publication of the Polymerase Chain Reaction (PCR) Assay Catalog for diagnostic laboratories with 17 new SHIC-funded tests demonstrated how far the pork industry has advanced in ability to test for emerging diseases. The catalog has been updated as the SHIC Diagnostic Assay Catalog because it now includes Enzyme Linked Immunosorbent Assays (ELISAs) for detection of antibodies in serum and oral fluids against hepatitis E, sapelovirus, teschovirus, swine influenza virus, porcine circovirus 3 (PCV3) and atypical porcine pestivirus. The updated catalog provides diagnosticians at veterinary diagnostic labs, who are working every day with swine health case submissions, pertinent information summarizing the research behind the test development and covering technical background information including sample types and analytical and diagnostic sensitivity and specificity. It also includes contact information of the experts for questions about availability and use.

##### *Continued Viral Matrix Pathogen Research*

2019 research continued to fill in identified gaps in preparedness for Viral Matrix priority pathogens:

##### *a. Porcine circovirus Type 3 (PCV3)*

PCV3 can, and has been, found in multiple tissues and samples and associated with various clinical signs. It is also found in healthy pigs. SHIC has sponsored research at the University of Minnesota, to take a deep dive into past University of Minnesota Veterinary Diagnostic Lab submissions. The goal is to mine diagnostics data obtained over the last two years and determine how closely certain clinical signs and pathologic lesions are associated with the presence of PCV3 alongside the viral load.

Preliminary results from the research show statistically significant correlation between PCV3 and the clinical sign of fetal death as well as histological lesions of myocarditis, vasculitis of the heart, and vasculitis of the spleen. A newly developed and validated SHIC-funded PCR assay will enable the performance of rapid, sensitive, and specific detection and differentiation of PCV3 and PCV2 strains with high strain coverage in clinical samples to better understand the implications of PCV3 infection.

*b. FMD diagnostics*

FMDV remains uncontrolled in most of the world. North America is among the few "FMDV-free without vaccination" areas of the world. In the event of an FMDV outbreak in North America, effective control and elimination will require rapid detection. And rapid detection will rely on an efficient surveillance sampling technology and immediate access to accurate diagnostic assays. Consequently, SHIC funded a project at Iowa State University with the long-term objective of creating and validating an FMD 3ABC antibody indirect ELISA for use with swine oral fluids.

*c. Oral fluid validation for ASF monitoring and surveillance*

During 2017-2018, SHIC co-funded, with NPB and USDA, a USDA research project for validation of analytic specificity of commercial PCR test kits for FMD, CSF and ASF, using oral fluids. In 2019 SHIC is funding the analysis of Vietnamese field oral fluid samples as part of the analytic sensitivity needed for diagnostic validation of the PCR tests. The outcome of the project will provide testing of oral fluids to validate herd disease status and support continued movement of disease-free pigs during or after an outbreak.

## **Monitor and Mitigate Risks to Swine Health**

### **1. Identify and mitigate swine disease risks by international monitoring**

*Global Swine Disease Monitoring Reports*

Initially funded by SHIC in 2017, the Global Swine Disease Monitoring Report is a program for systematically monitoring swine diseases around the world. It facilitates near real-time identification of international disease hazards posing risks to the domestic pork industry. Being able to access accurate and reviewed information quickly is important to producers and the industry, according to the SHIC Monitoring and Analysis Working Group in their support of continued funding of the program.

Compiled and reviewed by staff at the University of Minnesota, the output of the rubric is a final single score for each event. The report is posted on the SHIC website and included in its monthly e-newsletter, always ranking as one of the most read articles. Collaboration and review are also provided by the USDA Veterinary Services Center for Epidemiology and Animal Health.

*International Transport Biosecurity*

A recently completed SHIC-funded study looked at international transportation biosecurity practices of four cooperating US breeding stock companies. One question of high interest was about the possibility of transport crates being reused after exposure in another country and returning something other than pigs back into the US. In the process they found crates are not reused and are marked as "one-use" due to swine health biosecurity concerns. Investigators found participating breeding stock companies have robust biosecurity procedures for both import/exports due to their investment in maintaining the health status of these pigs. Additionally, they discovered exports/imports are frequent, however, imports from outside North America occur less often.

*International contacts for on-the-ground foreign disease information.*

A new SVA outbreak was continuing in Brazil during 2019 and was reported by SHIC via the AASV e-letter and the SHIC monthly e-newsletter. Most cases initially were in finishing pigs, moving to nurseries and then to farrowing. Lesions are usually very severe, such as completely detached hooves, and healing was delayed, sometimes taking more than 10 weeks. There are reports of farrowing sites with suckling piglet mortality rates approaching 30%. One open question is whether there is a new mutant SVA circulating in Brazil, with greater pathogenicity, or if this was just a fall in immunity of the Brazilian herd after the three years between the two outbreaks.

*Understanding Disease Introduction Risk from International Air Travel*

According to a study by Cristina Jurado, et al. (doi: 10.1111/tbed.12996, 2018), on average 8,000 pork derived products are annually confiscated by CBP at United States ports of entry such as international airports, harbors or mail offices. Their study, using CBP data from January of 2010 to March of 2016, aimed at analyzing the risk of ASF and CSF being introduced into the US through prohibited swine products carried by air passengers and identifying locations and time periods at higher risk where and when preventive and mitigation measures should be implemented.

SHIC and NPB co-funded a project with the University of Minnesota to update this risk estimate. Results suggest the mean risk of ASF virus introduction into the US in this way has increased 183%, compared to the risk estimated before the disease spread into China, East Asia, and Western Europe in 2018 and 2019. Results also suggest the risk that ASF virus is currently reaching US airports in air passengers' luggage, prior to customs inspection, is high, which is consistent with the detection of ASF virus in seized pork in a number of Australian and Asian airports. Likely, the risk decreases substantially after customs inspection. Most of the risk (greater than 50%) was associated with flights originated from China and Hong Kong, followed by the Russian Federation (27%).

*Improve screening following international travel*

Keeping ASF out of the United States requires more than diligence on the farm. International travelers returning home, or those visiting from other countries, present another significant risk. All international travelers entering the United States after visiting a farm or being in contact with animals in a country (or countries) with ASF, or any other foreign animal disease, should declare this information to Department of Homeland Security (DHS) Customs and Border Protection (CBP) via written form, airport kiosk, or verbally. SHIC, AASV, NPB, and NPPC met multiple times with CBP during 2019 to voice concerns about the lack of secondary screening after declaring contact with foreign farms or animals. In collaboration with the other pork industry associations, SHIC is collecting information about the customs experience and the industry associations are sharing it with DHS CBP to help assess performance and improve prevention of foreign disease introduction.

## **2. Improve transport biosecurity from first points of concentration.**

### *Prevent pathogen transfer during marketing events*

Because groups of pigs in the United States are typically marketed over several weeks, the opportunity exists for pigs still on feed to become infected during a marketing event. The pigs remaining in the group are then subject to the production losses and become a source of virus for other swine farms. It has been demonstrated that livestock trailers can serve as a source of transmission for PRRS and PED.

SHIC funded a pilot study to determine if a fluorescent powder could be used to study the transfer of contamination from livestock trailers to barns during marketing events. The results of the pilot study are being used to evaluate if implementing a staged loading procedure when loading out market pigs is effective at preventing the transfer of swine pathogen contaminated particles from livestock trailers to the barn. Staged loading involves two lines of separation which adds an extra “layer” of biosecurity so that when contamination crosses the first line of separation, the second line of separation serves as a backstop to reduce the likelihood that that contamination is transferred from the load-out chute and alleyway to the barn where the pigs are located.

## **3. Investigate the ability of common inputs to production to act as biologic or mechanical vectors for disease introduction onto farms**

### *Feed risk research and information*

After PED was introduced into the United States in 2013, a USDA pathways analysis concluded that the most likely route of introduction was using contaminated containers moving between countries and being used to import feed or feed ingredients. However, the pattern of the US outbreak was such that a more direct involvement of imported feed needed to be investigated. USDA and FDA believe there are currently many unknowns and data gaps that should be identified to help define or validate feed risk. In the absence of information regarding the predictive ability of unvalidated test results to accurately determine the potential risk associated with feed, they believe the design and implementation of a testing strategy is not feasible. At this time, it is up to the pork industry to address potential risk of foreign animal disease introduction into the US from imported feed ingredients.

### *ASF, CSF and PRV feed risk and mitigation*

Understanding the risk and mitigation of other foreign animal diseases such as ASF, CSF and pseudorabies virus (PRV) in feed and feed ingredients is critical to protecting the health of the US swine herd. SHIC funded a study at Kansas State University to identify animal feed ingredients which support survival of ASF, CSF, and PRV exposed to transpacific shipment conditions, improve the half-life calculations of ASF in feed ingredients exposed to transatlantic shipment conditions ([https://wwwnc.cdc.gov/eid/article/25/12/19-1002\\_article](https://wwwnc.cdc.gov/eid/article/25/12/19-1002_article)), and investigate antiviral chemical mitigants as a tool for reducing the risk of introduction and transmission of CSF, ASF and PRV in feed and feed ingredients. Improved ASF half-life estimates in feed ingredients were calculated to include both standard error and 95% confidence intervals. Additionally, antiviral chemical feed additive mitigants were tested for efficacy against foreign animal diseases in in vitro cell culture models and transboundary shipping models. Overall, this research has improved our ability to quantify risk of ASF,



CSF and PRV in feed, implement science-based storage times to mitigate ASF in feed, and identify effective feed additives for risk mitigation of foreign animal diseases through feed.

#### *Feed additive mitigation research*

Proactive mitigation of high-risk pathogens in feed with feed additives could be a way for us to protect North American herds from PED, PRRS, and foreign animal diseases. An ongoing study, partially funded by SHIC, examined 14 feed additives, including medium chain fatty acid blends, organic acid mixtures and acid/aldehydes, to determine their ability to negatively affect viral survival and function as cost-effective mitigants. Although none of the feed additives completely removed viral contamination, data from this study suggest that the use of approved additives may reduce the risk of viral infection via contaminated feed.

#### *Feed mill biosecurity guidelines and Feed Risk Task Force*

As ASF continued to move across China, Southeast Asia and western Europe in 2019, SHIC collaborated with several industry partners to continue to assess potential feed-related risks of introduction and dissemination. SHIC encouraged AFIA as they updated feed mill biosecurity guidelines. In collaboration with AFIA, a Feed Risk Task Force, with USDA, FDA and the Canadian Food Inspection Agency invited to provide input, was formed and met twice in 2019. The Task Force objective says, "There is agreement that there is risk of introduction of pathogens into and within the US via imported feed products. The Task Force will evaluate the risk and help decide what actions need to be taken to protect the US pork industry from that risk. Actions should be achievable, based on science and minimize trade disruptions."

#### *Feed mill prevention, detection and response*

Once a pathogen is introduced into the North American pork industry, there is a potential for its dissemination within the US via feed manufacturing and delivery. SHIC participated in a feed processor ASF task force, along with Iowa State University, Kansas State University, DFS Animal Nutrition, Standard Nutrition Company, Iowa Select Farms, Iowa Department of Ag and Land Stewardship, NPB and allied industries. The objective was to define prevention, detection, and response protocols for feed ingredients, feed manufacture, and on-farm feed delivery for feed processing facilities. The outcomes included developing a feed processing emergency response plan, a Secure Pork Supply Plan model relevant to feed manufacturers and a proper feed manufacturing facility recommission procedure.

#### *Feed-related risk from imported vitamins*

SHIC sponsored a workshop to increase understanding of the vitamin supply chain and identify potential risk factors for introducing foreign animal disease to the US. The vitamin supply chain meeting report describes current industry understanding of vitamin manufacturing, transport, and vitamin premix composition/manufacturing processes as well as quality assurance and biosecurity programs. It informs pork producers about the need to select reputable suppliers for all feed ingredients and describes the challenges of potential mitigation procedures for vitamin products and premixes. The vitamin supply chain report also includes a detailed listing of vitamin manufacturers in China and their web sites as well details on biosecurity procedures and third-party audits of many of these facilities.

### *Feed-related risk from imported soybean products*

SHIC brought together soybean industry stakeholders to increase understanding of the soy supply chain and identify potential risk factors for introducing foreign animal disease to the US. Presenters and discussion focused on potential risk factors of products such as soybean meal acting as vectors for ASF and FAD transmission. Prevention, mitigation, and differentiation strategies, along with research and education were discussed. At the workshop's conclusion, participants were asked to prioritize the three top actions they believed should occur. Those responses were analyzed with mitigation strategies and processes being the top collective priority followed by communication, education, and collaboration, then importer outreach and communication, import biosecurity protocols, virus testing and sampling, surrogate model validation, and risk assessment for ASF. All documents from the workshop can be found on the SHIC website.

### *Feed mill SVA transmission study in Brazil*

Three partner feed mills located in Brazil have reported high levels of SVA in finishing barns fed from the associated mills, and samples of soybean meal as well as meat and bone meal collected from the mill have been confirmed to contain SVA. SHIC funded an investigation into the possibility that the mill itself and/or its ingredients are a source of SVA transmission. The objectives were to assess the distribution and mitigation of SVA, an FMD surrogate, in a swine feed mill and evaluate potential risk of pathogen entry into the United States from Brazilian feed ingredients. Samples were analyzed for rotavirus, *Enterobacteriaceae*, and SVA. These three pathogens were selected due to their likelihood to be contaminated (SVA) or their indication of fecal contamination leading to viral (rotavirus) or bacterial (*Enterobacteriaceae*) hazard risk. Both rotavirus and *Enterobacteriaceae* have been reported to be effective indicators of fecal contamination and overall hygiene in feed or ingredients. There were no samples positive for SVA, and few positive for rotavirus. Nearly all samples had prolific amounts of bacteria, so resources were shifted to better quantify bacterial presence, with fecal-indicating bacteria used as indicators of biosecurity breaches.

## **Improve Swine Health Information**

### **1. Develop the industry capacity for detection of emerging disease, rapid response and continuity of business**

#### *Morrison Swine Health Monitoring Project*

SHIC continues to support the Morrison Swine Health Monitoring Project (MSHMP). The MSHMP currently monitors approximately 50% of the US sow herd for economically important pathogens. Weekly, veterinarians for these producers share site identities, locations, diagnostic information and, when requested, management interventions and production data.

In the short term, this project contributes to the control and prevention of important swine diseases. Longer term, the project builds industry capacity for data collection, organization and providing capability to facilitate response to emerging pathogens.

*Analysis of MSHMP data*

There were two 2019 MSHMP data analysis projects in 2019 that help to inform producers and veterinarians about disease management:

- a. PRRS-related biosecurity practices can be prioritized by assessing the number of production events in facilities of all sizes and production styles that had a direct impact on outbreaks. The objective of the SHIC-funded analysis was to describe key differences in the biosecurity aspects of breeding herds with relatively low PRRS incidence, compared to those with relatively high PRRS incidence, so ongoing biosecurity assessments can be more efficient and take less time. High PRRS incident farms had a higher monthly frequency of people entering and exiting the farm, in addition to a higher frequency of pig movements. On-farm rendering was the production practice having the largest difference in frequency between low versus high PRRS incidence farms. The study summary gives additional information about area density, downtime and other differences between the two groups
- b. SHIC collaborated with MSHMP participants to enable a study applying machine-learning to predict PED outbreaks on sow farms. The researchers were able determine it is possible to predict the probability of an outbreak when considering animal movements and environmental conditions. Another goal was to see if shared producer data could be used to develop critical tools for the prevention of disease spread and implementation of risk mitigation. Further, this work serves as a model for near real-time disease forecasting.
  - As a result, a predictive machine-learning model that estimates the probability of a PED break biweekly has been developed. The forecasting model uses data on pig movements, geolocations of farms, environmental, and weather factors to predict the probability that a sow farm will become infected two weeks in advance. Thus, the goal is farm-level forecasts for two weeks in the future that can be updated and delivered as new data emerges each week allowing ample time to mitigate the risk or minimize the impact. The platform may also be applied to other diseases, such as PRRS, although ongoing analysis suggests that PRRS breaks are more difficult to predict.
  - North Carolina's PED outbreak time-series from 2013 to 2019 (using MSHMP data) has also been analyzed. Approximately 50% had at least one recurrent outbreak, and the proportion of farms with more than two recurrent outbreaks varied from 2.3% to 5.9%. High-resolution maps to identify current and future PED risk in North Carolina are being developed. This has the potential to predict the near-future risk for PED outbreaks in North Carolina and make intervention recommendations to minimize costs and maximize treatment efficacy.

*Consideration of future pork industry organizational needs*

The US Pork Industry - an export-centric industry that spans much of the lower 48 states - must manage animal health-related market risks. That an "event" will occur at some point in the future seems increasingly probable, and the economic consequences of an introduction of a trade-impacting disease has continued to increase due to the growth in US pork exports. SHIC has funded a thorough study of the National Poultry Improvement Plan (NPIP), its associated organizational structure and operations, and industry participation and execution across the various segments of the US poultry industry, in order to assess the potential for establishing a similar program for the US swine industry.

The report was supplied to a focus group of producers, state animal health officials, NPIP experts and allied industry with the objective of ensuring that it is clear, complete and objective. Edits according to the comments of the group were made and a final report was accepted by the SHIC Board of Directors.

## **2. Make industry swine health information available to help uncover, communicate and mitigate regional and national risks to herd health**

### *ASF at the World Organization for Animal Health (OIE)*

ASF continues to impact the swine industry worldwide. During the World Organization for Animal Health (OIE) annual meeting, member countries considered and passed a resolution regarding ASF. Within Resolution No. 33 is a framework for addressing this global threat, recognizing the need for collaborative preparedness, prevention, detection, and control measures. Of particular note is the recommendation for OIE to develop specific guidelines for implementation of zoning and compartmentalization. An ad hoc working group will meet this year to draft these guidelines, which could help continue international pork marketing even after a contained ASF outbreak.

### *Continue to evolve and refine domestic swine disease monitoring and reporting*

SHIC continues to support a domestic swine disease monitoring program, the “Swine Disease Reporting System”. It is a veterinary diagnostic laboratory collaborative project resulting from the veterinary diagnostic lab data standardization project SHIC supported in 2016 and 2017. The monthly report analyzes data from Iowa State University, University of Minnesota, South Dakota State University and Kansas State University veterinary diagnostic laboratory cases with molecular tests (PCR-based assays and virus genotyping) for PED, PDCoV, and PRRS. Added, in 2019, have been data about *Mycoplasma hyopneumonia* and syndromic enteric and respiratory disease. It also reports on the incidence and causes of central nervous system syndromes in pigs. An advisory group has been formed to help give context to the data and interpret it. The goal is to aggregate swine diagnostic data from participating reporting veterinary diagnostic laboratories and present it in an intuitive format via shared reports and web dashboards.

## **Surveillance and Discovery of Emerging Disease**

### **1. Investigate newly identified agents associated with disease**

#### *Porcine sapovirus*

A veterinary diagnostic lab received a case from a farm experiencing an ongoing problem with piglet diarrhea in the lactation phase for more than two years. PED, PDCoV, transmissible gastroenteritis virus (TGE), or rotavirus were not detected from small intestines using real-time RT-PCR assays. Additionally, there was no significant bacterial growth from the small intestines. Next Generation Sequencing was directly applied to the fecal and intestinal tissue samples and a sapovirus, that appears to be a new variant of the virus, was detected. Although sapovirus has been reported in association with enteric disease in pigs, it is often in mixed infection with other pathogens. This appears to be the first detection of a single porcine sapovirus infection in piglets with diarrhea in the United States. A real time RT-PCR to detect viral RNA in clinical samples and determine the viral load from intestine tissue and fecal samples and the ability to test for the virus directly in fixed tissues are being developed.

*Atypical porcine pestivirus*

Iowa State University recently completed SHIC-funded research on development and evaluation of a dual matrix serum/oral fluid atypical porcine pestivirus (APPV) ELISA using known status samples. As part of its mission to protect the health of the US swine herd, SHIC funded this research to provide tools for an emerging disease which has not yet broadly affected domestic pigs though it presents potential for concern. APPV is the most common cause of congenital tremor in pigs. This is the first study to experimentally infect swine with APPV and monitor the infection dynamics over time out to 70 days post inoculation. There is limited information concerning the ecology, epidemiology, and pathophysiology of APPV.

**2. Ensure detection of emerging disease to facilitate rapid response.***Improving swine disease surveillance*

An effective surveillance system should provide data for production and/or business planning, document freedom from specific pathogens and provide for a rapid and effective response to emerging and/or foreign animal diseases. Current statistical methods for selecting sample size, i.e., how many pigs and which pigs to sample, worked well for traditional farms, but does not work for modern farms because of industry evolution since they were developed. Progress during 2019 investigated improvements that can be made toward a nationally coordinated swine health surveillance system to prepare, detect and rapidly respond to emerging and foreign animal diseases.

*Offer diagnostic fee support to help detect emerging diseases.*

There continues to be incidents of high morbidity/high mortality where an etiology is either not identified or there is a strong supposition that the identified pathogen is not the likely cause of the outbreak. For these cases, SHIC offers diagnostic fee support when the initial, producer-funded diagnostics are unrewarding.

*a. Streptococcus equi subspecies zooepidemicus*

The Iowa State University Veterinary Diagnostic Lab (ISU VDL) has confirmed *Streptococcus equi ssp zooepidemicus* in two recent, potentially related cases of sows for slaughter and feeder pigs in assembly yards in the Midwest. *Streptococcus equi ssp zooepidemicus* is commonly found in nature, particularly in horses, and has been recently found in dog kennels as well. There have also been confirmed cases in swine in western Canada recently. This, and any strep, has the potential to infect multiple species, including humans.

The bacterial sepsis caused by the strep in the two swine cases has resulted in high mortality rates. The Iowa State University veterinary diagnostic lab shared information on these unique cases with the Swine Health Information Center (SHIC) as well as the US swine veterinary and pork industry stakeholder communities. As part of SHIC's mission, it is offering support to further characterize the strep bacteria from the two cases from the ISU VDL to increase understanding of its epidemiology. Isolates from different swine clinical cases with high mortality will be sequenced using Next Generation Sequencing, a species-specific PCR that will be used to retrospectively and prospectively test swine tissue to evaluate spread of this species within US swine herds will be

developed and a challenge study will be done to shed more light on mechanisms of pathogenicity of the bacteria will be done.

*b. Hemorrhagic tracheitis*

In 2019 SHIC continued further diagnostic work into understanding a hemorrhagic tracheitis syndrome that has been moving east to west across Canada. The syndrome has been recognized in Quebec for 5 – 6 years. Initially limited to an area and to one or a few companies, it has moved westward, affecting multiple systems in multiple areas. From the clinical picture, it appears to be associated to a virus. Clinical signs typically include severe cough affecting a high percentage of animals that lasts 7-10 days, with low to moderate mortality. Further investigation includes the potential association with porcine hemagglutinating encephalomyelitis virus (PHEV).

*c. Central nervous system (CNS) and dermatitis syndrome*

A Midwest herd is experiencing ongoing mortality in the late finisher phase associated with outbreaks of acute tremors and cyanosis rapidly progressing to death. The outbreak started in August in 10-week old pigs experiencing CNS symptoms. In November the herd of 5-month old pigs started experiencing sudden death from acute tremors and prostration with severe cyanosis and blotchiness of the skin. SHIC is supporting further diagnostic work, including Next Generation Sequencing, in search of an etiology.

## Responding to Emerging Disease

### 1. Support a rapid, unified industry response to emerging disease outbreaks.

#### *National Swine Disease Council*

In 2013, when pork producers faced an outbreak of PED, the US pork industry put a renewed emphasis on farm biosecurity. Today, the US pork industry has aligned its efforts to be better prepared to quickly respond to foreign animal and transboundary production disease by creating the National Swine Disease Council. The council is made up of key industry leaders, the North American Meat Institute and representatives from SHIC, NPB, NPPC, AASV, USDA, as well as state animal health officials, attend meetings and provide input. Starting with the formation of the council and identification of member participants, the producers and their organizations will turn their focus toward providing recommendations in collaboration with state and federal animal health officials, and other industry stakeholders, to respond to emerging swine diseases that could potentially threaten herd health and negatively affect the US pork industry.

#### *Disease management of viral myelitis*

Veterinarians receiving diagnostic test results of porcine astrovirus 3, porcine sapelovirus, or porcine teschovirus may need more information to improve management of the central nervous syndromes associated with these viruses. To address these challenges, SHIC, in collaboration with AASV, held a webinar titled Disease Management of Viral Myelitis for veterinary practitioners and pork producers. The webinar included a brief overview of viral myelitis as well as current diagnostic tools. Diagnosticians Dr. Bailey Arruda, Iowa State University Veterinary Diagnostic Lab (VDL), and Dr. Matthew Sturos, University of Minnesota VDL, talked about their experiences with cases and ways to

approach management from the perspective of scientific design. Practitioners presented management approaches they have used when they receive these diagnoses.

## 2. African Swine Fever

### *Analysis of ASF strain data to identify gaps and inform preparedness and control*

As ASF circulates around the world, reports of varying degrees of pathogenicity bring into question the possibility of the current, epidemic strain drifting into different, related strain(s). SHIC has funded a proposal to report the current state of knowledge regarding pathogenicity and possible strain differences. This will compile available scientific information to help understand if updates for regulations and policy framework, research to prevent introduction and control and management recommendations for the industry after entry are needed. Genetic diversity of strains, association between sequence data and epidemiological or pathogenic features, and development and performance of molecular diagnostic tools are being assessed.

### *USAHA resolutions*

Following the annual meeting of the US Animal Health Association (USAHA), resolutions are sent to the USDA Animal and Plant Health Inspection Service – Veterinary Services (APHIS-VS) to convey the importance of pork industry issues from the organization’s membership. SHIC collaborated with NPB, NPPC and AASV and contributed by providing background and support of the science behind proposed resolutions. The approved resolutions are intended to protect the health of the US swine herd.

**RESOLUTION:** Adequate Funding for National Animal Vaccine and Veterinary Countermeasures Bank USAHA urges USDA and State Animal Health Authorities to support a total of \$92 million for the National Animal Vaccine and Veterinary Countermeasures Bank (NAVVCB), with a minimum of \$20 million for each of the first four years and \$12 million in the fifth year, of the funding established in the 2018 Farm Bill to provide adequate number of doses of foot-and-mouth disease vaccine and surge capacity. This \$92 million for NAVVCB is to include a reasonable stockpile of foreign animal disease testing kits/reagents needed for outbreak response.

Additionally, the 2018 Farm Bill prevention funding the National Animal Disease Preparedness and Response Program (NADPRP) should not be used to fund current USDA APHIS activities with the states nor should it inhibit full appropriation of the National Animal Health Laboratory Network (NAHLN) laboratory authorization within USDA, National Institute of Food and Agriculture, Food and Agriculture Defense Initiative and APHIS budgets.

**RESOLUTION:** African Swine Fever/Classical Swine Fever Surveillance Program and Tissues for Official ASF Testing in National Animal Health Laboratory Network Laboratories

USAHA urges USDA APHIS to validate and approve the items listed below. Collectively, these efforts aim to enhance the cost-effectiveness, sustainability, and breadth of coverage provided by the ASF/Classical Swine Fever (CSF) Surveillance Program.

The USDA APHIS ASF/CSF Surveillance Program at USDA NAHLN laboratories shall:

- Validate methods and implement a provision for using pooled samples for ASF/CSF polymerase chain reaction testing from case-compatible diagnostic case submissions, and

- Revise the premises identification number requirement so as not to exclude cases from the ASF/CSF Surveillance Program, provided traceability of the sample is assured.

Foreign animal disease (FAD) diagnostic capabilities and capacities at USDA NAHLN laboratories shall:

- Continue to expand the number of ante-mortem sample types (e.g., oral fluids, processing fluids, swabs, serum) approved for FAD diagnostic testing that are well suited for herd level detection and high-throughput test methods at veterinary diagnostic laboratories, and
- Expand the number of assays, testing methodologies (nucleic acid and antibody detection, and sequencing analysis) and reagent supplier options approved for FAD diagnostic testing conducted at USDA APHIS NAHLN laboratories.

RESOLUTION: Valid Sampling Methods and Protocols for Feed and Feed Inputs

USAHA urges the Food and Drug Administration Center for Veterinary Medicine and USDA APHIS-VS to work with the US pork industry to develop valid sampling methods and protocols to detect pathogens in foreign feed and feed inputs that can be applied at the point of embarkation to the US or upon arrival at the port of entry.

RESOLUTION: Efficient Diagnostic Sample Validation and Approval for Foreign Animal Diseases of Swine

USAHA urges the USDA APHIS-VS to work with US pork industry to validate and approve swine oral fluids, swine processing fluids, and meat juice for detection of antigen and antibody for CSF, ASF, and foot-and-mouth disease (FMD).

RESOLUTION: Foreign Animal Disease Prevention

USAHA urges the Department of Homeland Security (DHS), United States Customs and Border Protection (CBP) to 1) on a quarterly basis, provide interdiction metrics to pork industry representatives, 2) work with the FMD Cross-Species Team to develop education designed to increase awareness for passengers that are in transit from foreign ports into the US on the importance of protecting agriculture and being truthful on the US Customs Declaration form, 3) work with the FMD Cross-Species Team to develop biosecurity education for travelers diverted for secondary screening after declaring they have been on a farm or in contact with animals in a foreign animal disease positive nation, and 4) modify the US Customs Declaration form to include language regarding a traveler's proximity to packing and processing plants, live and/or wet markets, research facilities, laboratories, or any other location where there is a likelihood that cross-contamination could occur directly or indirectly between the traveler and animals, fresh animal products, or animal excretions.

RESOLUTION: Evaluating and Recognizing Compartments

USAHA urges USDA APHIS-VS to host a meeting with the US pork industry and State Animal Health Officials to discuss the proposed criteria that will be used to evaluate and recognize livestock/livestock products compartments domestically and internationally.

RESOLUTION: Stop Movement – Criteria for Implementing and Releasing

USAHA urges USDA APHIS-VS to work with the United States pork industry and state animal health officials to develop criteria for implementing and releasing national movement standstills due to the occurrence of a trade and commerce limiting foreign animal disease of swine.



*Building capacity to support the control of African Swine Fever (ASF) in Vietnam*

A grant awarded to the Swine Health Information Center (SHIC), with active support from NPPC, aims to start a dialogue between the US and Vietnamese officials, sharing veterinary knowledge and ways to prevent ASF from further spreading. The approximately \$1.7 million grant from the USDA's Foreign Animal Service division will fund the multi-phase project, helping to build strategic partnerships while increasing trade of US pork to the region. The work will include swine health field projects, including collection and analysis of disease samples, which will help inform North American pork producers about effective ASF preparedness and response.

Application for the grant was a collaborative effort among SHIC and NPPC, the University of Minnesota, Epi Insights in New Zealand, and the Canadian Food Inspection Agency National Center for Foreign Animal Disease. The group's input into the proposal and experimental design were key to the proposal's success. Additionally, USDA Animal Research Service on Plum Island and USDA Center for Epidemiology and Animal Health in Fort Collins have been working with the collaborators.

In Section 1 of the two-year project, the groups will train the Vietnamese veterinary workforce on ASF prevention and control, helping to build local veterinary capacity. Concurrently in Section 2, ASF-related field projects will be implemented, including those helping to inform the US pork industry about effective ASF preparedness and response.

*Section 1: Sharing knowledge and ideas. Strengthening veterinary services capacity for mitigating African Swine Fever impact on Vietnam*

The goal is to create a capacity building program to train veterinarians, laboratory workers, and/or farm advisors or managers on topics described by the OIE as necessary for assurance of functional national veterinary services organizations, with a focus on ASF prevention and control. The program will be developed as a collaborative effort led by the University of Minnesota. The program will involve delivery of three training courses using a blend of mentored online delivery and face-to-face workshops.

As part of the training, students will develop a capstone project proposal as they gain practical knowledge of topics through the didactic training. Along with producing objective data about ASF in Vietnam, the capstone proposals will also provide the opportunity to teach participants about project management, budgeting, and stakeholder management. Project mentors will guide the participants in writing the capstone proposals in a way that lends itself for use as ministerial briefing papers, along with the more traditional outputs of scientific conference proceedings and peer-reviewed scientific papers.

Students will be proposed by the Vietnamese Ministry of Health in consultation with local partners, such as private companies and universities.

**Scope of work:**

- The program will be implemented using a hybrid model, with two in-person interactions (workshops), one at the beginning and one at the end of the program, and four on-line courses covering the key aspects of ASF prevention and control.

- The courses implemented in the program will focus on:
  - Principles of epidemiology, disease diagnosis, and surveillance
  - Principles of biosecurity
  - ASF preparedness, response, and national and international animal disease regulation
- A certificate of approval, issued by the University of Minnesota's Center for Animal Health and Food Safety, as an OIE collaborating center, will be awarded to those who complete the program and pass a final comprehensive examination.
- Although the program will primarily focus on ASF, the principle lessons will be applicable to other swine diseases.
- Didactic training and support of capstone project plans will occur over a six-month period.
- Approximately 20 veterinarians, laboratory workers, and/or farm advisors or managers from Vietnam will be trained.

### *Section 2: Implementation of field projects, and collection and analysis of samples*

Along with producing valuable biological and epidemiological data about the ASF field situation in Vietnam, which will be shared with the Vietnamese Department of Animal Health, these field projects are a means of significantly increasing the number of people that are positively affected by the investment in capstone project development and capacity building. These field projects will be implemented simultaneously with the capacity building program. The projects have the potential to expand the reach of the training to individuals in laboratories, public and private veterinarians, producers, feed manufacturers, slaughterhouse staff, and animal disease researchers. The topic or objective of these projects are being developed and will be determined based on consultations with local partners, including producers and universities. However, the following topics are anticipated with others being considered:

- Identification of pathways of viral entry onto the farms to assist enhancing biosecurity.
- Validating the use of swine oral fluids to confirm farm positive/negative status; appropriate sampling frequency and number will be assessed.
- Exploring the potential to isolate the virus on only one area of the farm, enabling other areas to continue to provide meat free of ASF contamination.
- Validation of cleaning and disinfection procedures that enable repopulation of the farm as soon as is safe.

In September, SHIC Executive Director Dr. Paul Sundberg traveled to Vietnam as this process was launched. In this first phase, as key stakeholders were identified, collaboration and tours of ASF-affected farms in Vietnam offered a first-hand look at the disease's impact. During this initial visit to Vietnam, Dr. Sundberg and colleagues in the project met with staff from laboratories as well as producer companies to set up the infrastructure for implementation of the work outlined in the grant. A USDA/Vietnamese Department of Animal Health meeting of "first responders" was an opportunity to listen to the government agencies talk about policies and communications.

On the visit to an ASF-affected farrow-to-finish farm, mortality had been steady with one to several pigs dying every day. Staff on the farm did not describe a dramatic initial die-off. Pigs continue to get recruited into the disease and predictably die five to 10 days after they were initially noticed off-feed

or with fever. At the finishing farm toured, pigs ranged from 20 to 40 kg (44 to 88 pounds) bodyweight and were almost uniformly severely affected by ASF. Nearly all were extremely reluctant to rise and move, and when they did, generally just relocated and laid back down. By touch, most all pigs had easily detectable fever. There was some evidence of respiratory disease, but that was not dramatic. Diarrhea was common in all pens with digested blood apparent in the feces. Frank blood was easy to identify on the backs of pigs, walls of pens, and floors of pens but it was not obvious what the source of the blood was.

### **3. Identify high risk events likely to be responsible for introducing emerging diseases onto farms.**

#### *Rapid Response Corps*

This project, now operational, developed a rapid response program for epidemiological investigations of emerging, transboundary and endemic swine disease outbreaks. The program has set up six regions across the country, small enough for Rapid Response Corps (RRC) members to be able to drive to a farm in their region and begin the investigation within 72 hours after invitation from the producer.

RRC members are veterinarian consultants, state animal health officials or their representatives, epidemiologists and, when appropriate, federal animal health officials. RRC members are trained through videos on the SHIC website that are also available for viewing by anyone that's interested.

SHIC's goal for testing the program includes exercising the system for future emerging or foreign animal disease response needs, learning what went well, identifying what can be done better, and discovering what work needs to be done to continue to support the process. There were no active RRC investigations during 2019.

## **Communications**

Google Analytics of the SHIC website traffic are used to measure impact of media efforts. All media releases, e-newsletters, and postings communicate to the desired SHIC audiences, providing timely and relevant information, as well as activities of the center. A website redesign was completed and made live in December 2019. The redesign provides easier access to the most popular information on the website as well as categorizes information better with enhanced search capabilities within the site, particularly for research results.

### **1. Activity on [www.swinehealth.org](http://www.swinehealth.org)**

- Top pages on SHIC website (January 1-November 21, 2019) with (number of visits):
  - Global Disease Monitoring Reports (11,431)
  - Seneca Valley Virus Summary (3,365)
  - Domestic Disease Monitoring Reports (1,690)
  - Fact Sheets (1,157)
  - Research Results (1,036)
  - Swine Disease Matrix (833)
  - Declaring Farm Visits in ASF Positive Countries to Customs (775)
  - Feed Risk and Mitigation (769)

- Continuous WordPress and plugin updates
- Kept website content updated with relevant pdfs and content
  - Updated Reports
  - Updated Fact Sheets
  - Posted press releases and articles
  - Posted monthly newsletters

## 2. Website impact

- Over 23,000 individual sessions for the year (16,000 in 2018, a 44% increase).
  - 14.5% returning visitors
  - 85.5% new visitors
- 23,289 separate users (16,177 in 2018, a 44% increase)
- 57,104 total page views (46,844 in 2018, a 22% increase)
- Average of 1.74 pages per session (1.92 in 2018, a 9% decrease)
- Average session duration of 1:24 (1:35 in 2018, a 12% decrease)
- 12,300 users were from the USA
- 2,066 were from Philippines
- 1,321 from Canada
- 529 from United Kingdom
- 505 from Australia
- 392 from South Korea
- 376 from Brazil
- 350 from Taiwan
- 341 from Thailand
- 337 from Singapore

## 3. Press releases

Five press releases were issued in 2019:

- SHIC Releases 2019 Plan of Work
- SHIC Receives USDA Grant to Open ASF Dialogue in Asia
- Jeremy Pittman, DVM, Joins SHIC Board of Directors
- SHIC Convenes Feed Ingredient Workshops to Address ASF Threat
- (Media Alert) SHIC/AASV Webinar Provides Viral Myelitis Resources

In addition, two joint press releases with other pork industry associations were issued in 2019:

- Research on Viral Transmissions in Feedstuffs Yields New Information
- National Swine Disease Council News

Key media remain engaged by direct contact plus receive the SHIC eNewsletter and monitor social media posts. Several articles from the e-newsletter drove interviews and follow information from researchers.

#### 4. Press release impact

General emails were sent to 250 ag news outlets for each press release. Farm broadcasters continued as a very important media outreach for SHIC with follow-up interviews after each press release. Delivery method of podcasts and online interviews continued to be utilized more.

Individual emails were sent to the top five pork press editors with each press release. Nearly 100 percent of the press releases were picked up by these national editors covering the US pork industry. Publications included:

- Pork Magazine and associated daily e-newsletter
- National Hog Farmer and associated daily e-newsletter (two editors)
- Feedstuffs and associated daily e-newsletter and weekly Food Animal Report
- Successful Farming and associated daily e-newsletter

#### 5. Event Interview Opportunities

Multiple media interviews were given throughout the year. Participation in the National Association of Farm Broadcasters annual meeting resulted in 17 interviews in a short period of time. It also expanded and reinforced our reach with ag media, prompting the opportunity for more interviews.

#### 6. AASV Weekly e-Letter

As of November 21, content was provided for 40 articles for the AASV weekly e-Letter, including:

- 2018 Progress Report
- SHIC Sponsored Research Looks for Cost-effective Ways to Mitigate Potential Risks from Feed Transmission
- Global Swine Disease Monitoring Report (multiple times)
- 2019 Plan of Work
- SHIC Shares New AFIA Biosecurity Guidance Following ASF Outbreaks
- SHIC Provides Update on SVA in Brazil
- SHIC Reports ASF in Vietnam, Seized Pork in Taiwan, and Another Chinese Province
- SHIC-Funded Study Offers to Predict PEDV Outbreaks
- SHIC Helps Uncover Risk for ASF Introduction into the US via Air Passengers' Luggage
- US Pork Organizations Share New CFIA Feed Import Requirements
- US Pork Organizations Share USDA's ASF Entry Assessment
- US Pork Organizations Share USDA Literature Review Regarding Non-Animal Origin Swine Feed Ingredients
- US Pork Organizations Share USDA's Non-Animal Origin Feed Ingredient Risk Evaluation Framework
- SHIC-Sponsored Studies Show Correlation Between PCV3 and Lesions and Improves Diagnostic Tools
- SHIC Collaborates with University of Minnesota to Host Workshop to Examine Vitamins' Role in Feed Security

- SHIC-Funded Study Demonstrates Transfer of Livestock Trailer Contamination to Barns
- US Customs and Border Protection Responds to Reports About Lack of Secondary Screening
- SHIC Supports OIE African Swine Fever Resolution
- SHIC Helps to Offer a New Approach on Feed Mitigation Evaluation
- SHIC-Funded Study Examines Biosecurity of International Genetics Transport
- SHIC-Sponsored Workshop Considers Vitamin Supply Chain and Disease Risk
- SHIC Research Enables Response Should APPV Become an Emerging Disease
- Second SHIC-Sponsored Workshop Addresses Soybean Supply Chain and ASF Feed Risk
- Jeremy Pittman, DVM, Joins SHIC Board of Directors
- SHIC-Funded Domestic Swine Disease Monitoring Program Presented for Veterinary Diagnosticians' Input
- SHIC-Funded Studies on PRRS Biosecurity Provide Tools to Prevent Outbreaks
- SHIC Renews Popular Global Swine Disease Monitoring Report
- SHIC Engages in Collaborative ASF Prevention and Preparedness Activities
- US Pork Industry Receives USDA Grant to Open ASF Dialogue in Asia
- SHIC Gathers International Swine Disease Intel
- SHIC Project Enables Validation of FMDV ELISA for Swine Oral Fluid Specimens
- SHIC Study Assesses Tools for Mitigation of FAD Introduction and Transmission in Feed
- Korean African Swine Fever Outbreak Update
- Strep Diagnosis in Swine Assembly Yards Spurs Response
- SHIC Work on Asian ASF Study Begins with Trip to Vietnam
- Swine Industry Meets with CBP to Discuss FAD Prevention Efforts
- SHIC Support of Domestic Disease Monitoring and MSHMP Provides Tools for PRRS Prevention
- SHIC Supported Genetic Analyses Conducted on Recent Strep Cases in US Assembly Yards
- USAHA Swine-Specific Resolutions Result of Industry Collaboration
- SHIC/AASV Webinar Provides Viral Myelitis Management Resources

## 7. SHIC e-newsletters

A monthly SHIC e-newsletter publication schedule continued in 2019. The distribution list has over 3,000 subscribers and is consistently updated.

The following chart details SHIC e-newsletter acceptance and impact.

Edition	Date Sent	# Sent	Opens	Opens %	Unsubs	Clicks <sup>1</sup>	Click %
January 2019 regular	1/10/2019	2985	952	33.1%	3	247	25.9%
January 2019 bi-monthly update	1/22/2019	2982	1026	35.7%	1	87	8.5%
February 2019 newsletter	2/6/2019	2999	911	31.7%	3	171	18.8%
February 2019 ASF in Vietnam	2/19/2019	2996	1212	42.3%	1	64	5.3%
March 2019 newsletter	3/7/2019	3017	905	31.4%	2	130	14.4%
April 2019 newsletter	4/3/2019	3047	1000	34.6%	5	238	23.8%
May 2019 newsletter	5/9/2019	3063	1072	37.0%	2	301	28.1%
June 2019 newsletter	6/11/2019	3085	879	30.3%	0	223	25.4%
July 2019 newsletter	7/11/2019	3105	851	29.2%	1	186	15.1%
August 2019 newsletter	8/7/2019	3104	954	33.0%	3	342	20.3%
September 2019 newsletter	9/5/2019	3120	979	33.8%	0	227	17.6%
October 2019 newsletter	10/3/2019	3148	1001	34.4%	3	250	20.3%
November 2019 newsletter	11/7/2019	3165	867	33.5%	10	304	23.5%
			<b>Average:</b>	<b>33.8%</b>		<b>Average:</b>	<b>19.0%</b>
			Benchmark: 11.0%*			Benchmark: 7.2%*	

<sup>1</sup> Clicks = following a link from the newsletter to the SHIC website.

\* Benchmarks are industry standard averages per Constant Contact, the email distribution platform used for the SHIC newsletter.

## Appendix A

# Background of the SHIC-NPB Contract Funding the Swine Health Information Center

The following “Exhibit A”, the initial, 2015 Plan of Work from the SHIC-NPB contract funding the Center’s work, gives the concepts leading to the Center’s formation and shows its initial, draft budget. This initial plan has been continually reviewed, updated and modified by the SHIC Board of Directors as they direct the Center’s policies, plan of work and budget.

## Exhibit A

### Lessons Learned from PED

The experience of PED provides many lessons. First, the likelihood of identifying the pathway of introduction for production diseases (not classical foreign animal diseases like FMD, CSF or ASF) is extremely small given the breadth of inputs the industry gets through foreign trade. There will be more foreign production diseases that will enter the U.S.

Second, the U.S. pork industry can’t expect the USDA, alone, to protect pigs from these emerging diseases. The resources necessary to do so simply are not available. The industry needs to take more responsibility for response to emerging disease. With PED, time was wasted developing effective diagnostic tests and capabilities. This can be improved. And producer willingness to share information about their disease status helped to inform producer actions and industry response. With industry-directed epi analysis of this data, the health of pigs on the farm can benefit.

Third, better state-federal-industry coordination is essential. Pork producers taking responsibility and working with state and federal animal health officials will help to avoid the debacle that we had with the first year of PED. That responsibility includes an industry functional program doing research, monitoring global diseases and enabling producers to share information in a secure manner – something that needs to urgently be done before the next production disease arrives.

### Swine Health Information Center

The Swine Health Information Center will be responsible for those programs. It will be a 501(c)3 organization separate from NPPC, AASV and NPB. Its function will be to focus on emerging and endemic swine disease threats. To keep overhead low and efficiency high, it will contract with NPB and others for needed services.

The Center is not a surveillance program but will be an organized system for monitoring disease trends. Analysis of the volunteered swine health data will help inform producers’ swine health and management decisions.

Sharing information will help to see trends and risks much more quickly. Voluntary participants will independently decide what and how much information they want to share. This will also determine how much information they will see. A technology that enables data analysis without taking ownership or control of the data will be used.



The Center cannot prevent diseases from getting into the country and it is not a response plan. But it will be a tool to help respond more quickly and efficiently to swine diseases. It will research the biggest existing threats to swine health that are already in SE Asia and elsewhere, so the U.S. will be better prepared to respond to these diseases through better diagnostics and information.

**Center deliverables**

The Center will monitor foreign and endemic disease risks and vulnerabilities. Gathering and coordinating this information from a variety of private, company and government resources will help to inform pork producers of emerging swine disease risks and help pork producers to be better prepared. It will also better focus research resources.

The Center will fund and manage research needed to improve diagnostic capabilities to detect and respond to emerging production diseases. That research will help to fill in the diagnostic and information gaps identified through the Swine Disease Matrix. And, as global monitoring changes disease priorities, the Center will keep the Matrix up to date to ensure focus on the highest risk diseases.

Using new technology without the need to capture producer information into a separate database, the Center will provide epidemiological analysis of disease data that will help to improve swine health on the farm. This will also give producers the information they need to help them to make decisions on their farms that will affect biosecurity and biocontainment.

As the Center progresses, it can provide the record-access infrastructure to support the Secure Pork Supply plan for producer participants. And it can give the industry a way to manage national swine health information to support international trade of U.S. pork products.

**Swine Health Information Center Mission**

The mission of the Center is to protect and enhance the health of the US swine herd through coordinated global disease monitoring, analysis of swine health data and targeted research investments that minimize the impact of future disease threats.

**Swine Health Information Center Scope of Work****1) Swine Disease Matrix project**

Organizing and funding the research needed for diagnostic and informational preparedness for prioritized, potential production diseases will be a core activity of the Center.

**2) Global swine health and issues identification**

Through global disease monitoring, the Center will manage the Swine Disease Matrix and heighten awareness and actions about emerging diseases. The result will be improvement of the biosecurity and biocontainment ability to protect the U.S. swine herd.

**3) Swine health data analysis and monitoring for trends**

Enhancing the capabilities of the Swine Health Monitoring Project is a priority of the Center. The Center will also enable producers to get information about emerging and endemic disease trends. It will review and provide support to improve active disease introduction risk assessments, which will help producers improve their farms' biosecurity.

## Funding

A onetime Checkoff investment of \$15M of supplemental money will fund the Center for its 5-year life. This money is supplemental from 2014-15 Checkoff funds and is outside of the regular NPB program budget.

Funding of the Center past its 5-year life will depend on it being able to demonstrate a sufficient return on the investment to justify keeping it running. Ongoing funding may come from Checkoff funds, U.S. pork allied industries, for example grain commodity associations, animal health products companies and additional funding to the diagnostic research from the pork industries of other countries. (Note: Following is the Draft Budget as in the 2015 contract, Exhibit A)

	Year 1	Years 2 - 5 (ave/year over 4 years)
<b>Administration</b>		
Office	\$10,000	\$10,000
Legal	\$10,000	\$10,000
Accounting (NPB contract)	\$10,000	\$10,000
Administrative assistant (NPB contract)	\$10,000	\$10,000
Graphics/printing (NPB contract)	\$10,000	\$10,000
IT support (NPB contract)	\$10,000	\$10,000
Research admin support (NPB contract)	\$10,000	\$10,000
Miscellaneous	\$7,500	\$7,500
Subtotal	\$77,500	\$77,500
<b>Program</b>		
Matrix Research	\$7,000,000	
AgConnect contract (\$3,372,327)	\$675,000	\$675,000
IIAD staff time; Program Manager TBD; stakeholder meetings; training; software developers (2) TBD; TCAT staff time; server and hardware purchase, housing and maintenance; help desk; UMN Perez project management; UMN post doc TBD; UMN statistician TBD		
Travel	\$35,000	\$35,000
Programs	\$200,000	\$200,000
ad hoc Task Forces meetings (3 x once per year)	\$60,000	\$60,000
Board of Directors meetings (1 per year)	\$15,000	\$15,000
Dedicated graduate students (2)	\$150,000	\$150,000
Subtotal	\$8,135,000	\$1,135,000
<b>Staff</b>		
Exec salary	\$205,000	\$231,939
Benefits (32%)	\$65,600	\$74,220
Communications staff	\$60,000	\$67,884
Benefits (32%)	\$19,200	\$21,723
Subtotal	\$349,800	\$395,766
<b>Subtotals per year</b>	\$8,562,300	\$1,608,266
<b>Total Years 2 - 5</b>		\$6,433,066
<b>Grand Total</b>	<b>\$14,995,366</b>	

## Appendix B

SWINE VIRAL DISEASE MATRIX	September 2018			
	Production impact	Domestic/Foreign market impacts	Likelihood of introduction into the U.S. or emergence of a domestic disease	Numerical Average
Foot and mouth disease virus	9	9	9	9.0
African swine fever virus	9	9	7	8.3
Classical swine fever virus	9	9	5	7.7
Pseudorabies virus*	8	8	5	7.0
Influenza A virus	4	8	8	6.7
Nipah virus*	8	9	2	6.3
Ebola-Reston*	8	9	2	6.3
Porcine epidemic diarrhea virus	6	4	7	5.7
PRRS virus (Chinese high path)*	6	5	5	5.3
PRRS virus	6	3	6	5.0
Porcine teschovirus (Teschen/PTV1)*	5	5	5	5.0
Japanese encephalitis virus*	5	5	4	4.7
Getah virus*	5	5	4	4.7
Transmissible gastroenteritis virus	5	4	4	4.3
Menangle virus*	4	4	4	4.0
Porcine sapelovirus*	5	1	6	4.0
Porcine circovirus	4	2	5	3.7
Circovirus 3*	4	2	5	3.7
Porcine rotavirus	4	1	5	3.3
Swine vesicular disease virus	4	3	2	3.0
Vesicular exanthema of swine virus*	3	4	2	3.0
Porcine rubulavirus*	5	2	2	3.0
Seneca Valley virus*	3	3	3	3.0
Porcine parvovirus	3	1	5	3.0
Porcine deltacoronavirus	3	2	3	2.7
Porcine parainfluenza 1 virus*	3	2	3	2.7
Atypical swine pestivirus*	3	2	3	2.7
Influenza C virus*	2	2	2	2.0
Porcine respiratory coronavirus*	2	2	2	2.0
Hemagglutinating encephalomyelitis virus*	2	2	2	2.0
Encephalomyocarditis virus*	3	1	2	2.0
Hepatitis E virus*	1	3	1	1.7
Porcine adenovirus*	2	1	2	1.7
Porcine kobuvirus*	2	1	2	1.7
Orthoreovirus*	2	1	1	1.3
Sendai virus*	1	1	2	1.3
Porcine cytomegalovirus*	2	1	1	1.3
Porcine sapovirus*	1	1	1	1.0
Vesicular stomatitis virus*	1	1	1	1.0
Chikungunya virus*	1	1	1	1.0
Rabies virus	1	1	1	1.0
Porcine bocavirus*	1	1	1	1.0
Porcine astrovirus*	1	1	1	1.0
Swine pox virus*	1	1	1	1.0
Porcine torovirus*	1	1	1	1.0
Swine papillomavirus*	1	1	1	1.0

\* Fact Sheet found on [www.swinehealth.org](http://www.swinehealth.org)

## Appendix C

<b>SWINE BACTERIAL DISEASE MATRIX</b>			<b>August 2018</b>
Total score = Potential Public Health Impact + Need for more efficacious intervention tools + Diagnostic Tools + Impact on pig health, welfare, production sustainability + Market impact			
	<b>Average Total Score</b>		<b>Average Total Score</b>
<i>Streptococcus suis</i>	28.3	<i>Clostridium perfringens</i>	12.6
<i>Salmonella enterica</i>	22.2	<i>Mycoplasma suis</i>	12.2
<i>Mycoplasma hyopneumoniae</i>	21.8	<i>Bacillus anthracis</i>	12.2
<i>Escherichia coli</i>	21.7	<i>Listeria monocytogenes</i>	10.8
<i>Haemophilus parasuis</i>	21.1	<i>Trueperella abortus suis</i>	10.5
<i>Mycoplasma hyorhinis</i>	19.1	<i>Yersinia enterocolitica</i>	10.2
<i>Brachyspira hyodysenteriae</i>	17.4	<i>Staphylococcus hyicus</i>	10.0
<i>Actinobacillus pleuropneumoniae</i>	16.1	<i>Mycobacterium spp.</i>	9.6
<i>Actinobacillus suis</i>	15.9	<i>Burkholderia pseudomallei</i>	9.4
<i>Brucella suis</i>	15.7	<i>Yersinia pseudotuberculosis</i>	8.8
<i>Mycoplasma hyosynoviae</i>	15.2	<i>Coxiella burnetii</i>	8.0
<i>Brachyspira hamptonii</i>	15.0	<i>Actinobaculum suis</i>	7.8
<i>Staphylococcus aureus</i> including LA-MRSA	14.8	<i>Chlamydomphila psittaci</i>	7.6
<i>Pasteurella multocida</i>	14.5	<i>Chlamydomphila pecorum</i>	7.2
<i>Campylobacter coli</i>	14.1	<i>Clostridium botulinum</i>	7.0
<i>Leptospira spp.</i>	13.8	<i>Streptococcus porcinus</i>	7.0
<i>Campylobacter jejuni</i>	13.6	<i>Clostridium chauvoei</i>	6.0
<i>Erysipelothrix rhusiopathiae</i>	13.6	<i>Clostridium novyi</i>	6.0
<i>Clostridium difficile</i>	13.5	<i>Treponema pedis</i>	6.0
<i>Enterococcus spp.</i> including VRE	13.5	<i>Clostridium septicum</i>	5.6
<i>Bordetella bronchiseptica</i>	13.1	<i>Staphylococcus dysgalactiae</i> subsp.	5.5
<i>Brachyspira pilosicoli</i>	13.0	<i>Rhodococcus equi</i>	5.3
<i>Lawsonia intracellularis</i>	13.0		