Swine Health Information Center

2017 Progress Report

Executive Summary

Swine Health Information Center

Organization

The Swine Health Information Center (SHIC) began operation as a 501(c)(3) corporation on July 4, 2015. 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, National Pork Producers Council and the American Association of Swine Veterinarians 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 2017 operating budget, a 2017 Plan of Work and a plan for FDIC insured investments, that is modeled after that of the National Pork Board, for the money more than the yearly operating budget.

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 to fulfill their respective objectives.

Swine Health Information Center 2017 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 meetings with international organizations has helped to monitor swine diseases and issues around the world.

Progress on the Swine Health Information Center 2017 Plan of Work

Preparedness

1) In 2016, SHIC Swine Disease Matrix research focused on the ability to detect the Matrix pathogens via nucleic acid detection, using platforms that are commonly available in the U.S. major veterinary diagnostic laboratories, for example PCR testing. That research is being completed. 2017-funded research, now underway, focuses 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.

2) Information about diagnostic tests available for Japanese encephalitis virus (JEV) and Chinese variant pseudorabies virus (PRV) was reviewed and updated. The Seneca Valley Virus factsheet was also updated to reflect new information since 2015. The objective of the fact sheets is to be a resource to give information needed quickly in the face of an outbreak or emerging disease caused by one of the pathogens listed in the Swine Disease Matrix.

3) Research about the potential for feed and feed ingredients to harbor and transmit viral pathogens has been completed. Results of the study shows the potential for PRRSV and other viruses to contaminate and survive in feed ingredients, including soybean meal and distillers dried grains and solubles (DDGs). ASFV, Senecavirus A (surrogate for FMDV and of interest itself) and Bovine Herpesvirus-1 (surrogate for PRV) have also been found to be able to survive in feed ingredients under the shipping time and environmental conditions from China or Eastern Europe. These results suggest a subset of contaminated feed ingredients could serve as vehicles for foreign animal disease, other transboundary disease introduction to the U.S. and possibly circulation of viruses within the U.S. The PRRSV data may provide new insights and areas of further study on the role of area spread.

   Feed contamination risk mitigation research has begun. This project is testing feed additives added to feed during milling or other processes that might be able to neutralize viral pathogens to help mitigate risk.

4) Following the reported discovery of Senecavalley A (SVA) virus contamination in a component used to manufacture vaccines, the USDA-Center for Veterinary Biologics (CVB) agreed to check their reference vaccines for SVA. No live SVA was found. But CVB has implemented SVA contamination screening for all incoming Master Seeds, incoming Master Cells and materials with animal origin ingredients and has published a draft notice recommending biologics manufacturers implement SVA contamination screening of all seed materials and animal origin ingredients.

5) Current statistical methods for selecting diagnostic laboratory sample submission 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. A project is underway, focusing on technical aspects and experimental design related to the development of more efficient and cost-effective surveillance systems, with an emphasis on preparing the swine industry for detecting and eliminating emerging and/or foreign animal diseases.

6) Swine industry experts from the U.S. and Canada have begun the process to create and implement industry-wide, North American standard operating procedures for transportation related biocontainment. The goal is to decrease the incidence of disease associated with transportation of marketed pigs and sows to the first points of concentration. Veterinary practitioners from the U.S. and Canada, National Pork Board, American Association of Swine Veterinarians, Ontario Ministry of Agriculture, Food and Rural Affairs, Canadian Pork Council, packing industry representatives and transportation subject matter experts are collaborating on the project.

7) A descriptive review of the market sow and secondary pig markets to gather information on the scope of these markets for better surveillance, biocontainment and other risk mitigation protocols in the future has been completed. Because there is little objective data available to allow the industry and regulators to make informed decisions about how to respond to animal health emergencies, SHIC also funded a project to objectively describe the scope and complexity of cull sow and secondary pig marketing channels. The project was a small pilot project to determine if it

is possible to collect the data needed to describe cull marketing channels in the U.S. and outline a preliminary method for data capture and analysis to describe the U.S. cull marketing system.

Response

1) A program for supporting nationwide operational disease response with a Rapid Response Corps (RRC) is operational. The goal of this project is to develop a rapid response program for epidemiological investigations of emerging, transboundary and endemic swine diseases. A cooperative agreement with USDA is in place to help fund rapid response investigations, if USDA participation is approved by the herd owner. 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 activation. RRC member training has begun.

2) When or where the next emerging disease will appear cannot be predicted. SHIC is prepared with funds in place that can be quickly mobilized to support filling the immediate research gaps following introduction. This research will provide producers and their veterinarians with critical information that they will need to effectively respond to the disease outbreak. As of the writing of this report, the funds for emerging disease research have not had to be used during 2017.

3) To help more producers and their veterinarians solve outbreaks from unknown causes, SHIC developed a program to help offset diagnostic fees for further investigation after the initial diagnostics are completed. As of the writing of this report, there have been no new investigations in 2017.

4) SHIC coordinated and co-funded with the National Pork Board a USDA research project for diagnostic sensitivity validation of commercial PCR test kits for FMD, CSF and ASF, using oral fluids. The outcome of the project will provide 'surge capacity' testing of oral fluids to validate herd disease status and support continued movement of disease-free pigs during or after an outbreak.

Monitoring

1) Using the capabilities from the completion of the Veterinary Diagnostic Lab Data Standardization project, a novel database application of VDL swine test results, termed 'data warehouses', is being developed. A web-based portal will give access to the warehouses so permissioned users can aggregate, archive, retrieve and analyze veterinary diagnostic data from any number of veterinary diagnostic labs in the USDA's National Animal Health Lab Network. This will also lead to periodic aggregate swine diagnostic data summary reports, in a format to ensure VDL client confidentiality, that will support domestic swine disease monitoring.

2) With the cooperation of other pork industry associations, a Communications Action Plan is in place. The objective is to give producers and veterinarians confidence that, when a call about an emerging disease is made, there will be thoughtful, transparent steps to assess the situation and decide what further actions, if any, are needed with collaboration of the producer and veterinarian of record. That process provides for initial confidentiality of the producer, veterinarian and site identifiers during initial calls.

3) A near real-time global surveillance system for swine diseases has been developed. The project, housed at the University of Minnesota, uses a private-public-academic network to inform it. The process includes identification of potential hazards, screening steps evaluating data collected and timely reporting. The University of Minnesota and USDA/APHIS Center for Epidemiology and Animal Health are collaborating on the project. The project is underway and is verifying its processes as it generates draft reports.

4) A near real-time domestic swine disease monitoring system to generate information useful for economic and animal health decision-making is under development. Data are analyzed to describe disease activity by major pathogen and/or by clinical syndrome, documenting disease activity (presence, incidence) with respect to geography while maintaining appropriate producer confidentiality. The project is underway and verifying its processes as it generates draft reports.

5) Kansas State University researchers are investigating using dust samples to monitor for swine pathogens in U.S. feed mills. There is potential for the findings to lead to development of a diagnostic laboratory panel of assays where a single submitted swab of feed mill dust could be analyzed for multiple feed-based bacteria and viruses – a low-cost tool that could be used to help address feed safety.

6) The Swine Disease Matrix is a list of viruses that are known to be able to infect pigs. The Monitoring and Analysis Working Group has reviewed and updated the Matrix content and the prioritization of the viruses. The Swine Disease Matrix is used to help the Center focus its research and information on high priority pathogens.

7) SHIC joined the Institute for Infectious Animal Diseases – a Department of Homeland Security Center of Excellence – and the National Pork Board to host a workshop to discuss and build upon industry and government efforts to identify and develop a road map to improve our national swine disease surveillance. There was a significant consensus among participants regarding the attributes of an optimal risk-based comprehensive disease preparedness system and the belief that a modern robust national bio-surveillance system is a vital component.

8) During 2017, SHIC identified, tracked and communicated to producers and veterinarians incidents of domestic and international diseases. Incidents included a novel coronavirus causing neonatal diarrhea in China, the first detection of PRRS virus in Uruguay, Senecavirus A (Seneca Valley Virus) in Colombia and a PRRS strain causing increased disease in Manitoba, Canada.

Analysis

1) SHIC has been the primary source of funding for the veterinary diagnostic laboratories of Iowa State University, Kansas State University, University of Minnesota and South Dakota State University to work with Clemson University to standardize the way that they report their swine testing results. The project is completed sufficiently to enable the standardized data to be available for analysis supporting the SHIC domestic disease monitoring project and additional projects modeled through the Morrison Swine Health Monitoring Project.

2) The Morrison Swine Health Monitoring Project (MSHMP) currently monitors approximately 50% of the U.S. 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. Using MSHMP data in a manner that protects the participants' confidentiality, the next evolutionary step for using data to affect animal health and disease outbreaks is being developed. The model under development will analyze how historical environmental, pig movement, neighbor disease status and other on-farm and neighborhood factors might predict the risk of disease outbreaks.

Swine Health Information Center Communications

1) The SHIC website is organized to look and feel updated and to facilitate more intuitive use, increase professionalism of web presence and facilitate organization. During 2017, there were over 11,000 individual sessions with people from across the world, compared to under 10,000 in 2016. New visitors accounted for 65% and returning visitors accounted for 35% of the sessions. When benchmarking against other livestock agriculture websites, the SHIC website had more total sessions, more new users, more pages viewed per session, more time spent on the website per session and more returning users.

2) Media releases included articles posted as an e-Letter by the American Association of Swine Veterinarians (AASV), press releases and monthly SHIC eNewsletters that began in June. The objective of the media releases is to communicate to SHIC's end audiences timely and relevant information and the activities of the center. All e-Letters, eNewsletters and press releases were published in the news section of the SHIC website, http://www.swinehealth.org/news.

3) The SHIC eNewsletter database includes more than 3,000 contacts. Those receiving the monthly eNewsletter include producer and pork industry decision makers, veterinarians who associate themselves with the pork industry, allied industry and industry reporters and news editors for digital, print and radio outlets.

4) Twelve press releases went to industry trade magazines, digital media, industry newspapers and radio stations. Twenty-three articles highlighting SHIC programs, activities and communications were included in the AASV's weekly e-Letter to its members.

Swine Health Information Center 2017 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. There are nine members:

a. Two named by the National Pork Board
    i. Dr. Brett Kaysen, Zoetis, Colorado
    ii. Mark Greenwood, AgStar Financial Services, 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. Mike Terrill, Topigs Norsvin, Minnesota
    iii. Dr. Matthew Turner, JBS USA, Colorado

2) A 2017 operating budget and investment portfolio was developed.

The SHIC Board of Directors approved an operating budget for 2017 and has reviewed and modified the budget during the year to best meet the SHIC mission. The approved operating budget addressing the 2017 Plan of Work was $3,680,000.

Extra funds not needed for the operating budget were invested in securities with Wells Fargo Bank and modeled after the National Pork Board'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 Disease Matrix. It is also responsible for improving the health

of the nation's swine herd through the development and oversight for 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 Disease Matrix research. It is responsible for funding decisions to fulfill other Matrix-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 2017 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. Carthage Veterinary Service 27th Annual Swine Conference
        ii. Maxwell Foods, Goldsboro Milling Company
        iii. Minnesota Pork Congress
        iv. Minnesota Pork Producers Association Research Committee
        v. National Pork Board's Board of Directors
        vi. National Pork Board Swine Health Committee meetings
        vii. National Pork Industry Conference
        viii. National Pork Producers Council Animal Health and Food Security Committee
        ix. National Pork Producers Council Board of Directors
        x. National Pork Producers Council Pork Action Group
        xi. Smithfield Foods, Hog Production Division
        xii. 21st Century Strategic Forums, 21st Century Pork Club
        xiii. UMN Allen D. Leman Swine Conference
            1. SHIC update breakout seminar
    b. Allied industry
        i. American Feed Industry Association
        ii. Animal Health Institute
        iii. APC, Functional Proteins
        iv. Boehringer Ingelheim Vetmedica
        v. Genus PIC
        vi. Global VetLINK
        vii. Institute for Infectious Animal Diseases
        viii. National Corn Growers Association

ix. National Grain and Feed Association
x. National Institute for Animal Agriculture
xi. Tetracore, Inc.
xii. Thermo Fisher Scientific
xiii. United Soybean Board
xiv. U.S. Animal Health Association, including Allied industry, USDA and State Animal Health Officials
xv. Zoetis

c. Veterinarians
    i. 2017 American Association of Swine Veterinarians annual meeting
    ii. 2017 ISU James D. McKean Swine Disease Conference
    iii. Iowa Department of Agriculture and Land Stewardship/USDA field staff
    iv. State Animal Health Officials and their SVA Working Group
    v. Swine Medicine Education Center, Iowa State University
d. Veterinary Diagnostic Laboratories, Colleges of Veterinary Medicine and Academics
    i. Iowa State University Veterinary Diagnostic and Production Animal Medicine
    ii. North American PRRS Symposium and Emerging and Foreign Animal Diseases
    iii. 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
f. International
    i. Consulate General of Canada in Minneapolis
    ii. OIE, International Organization for Animal Health
    iii. OIE, International Organization for Animal Health, Director General
    iv. Ontario Animal Health Network

Progress on the Swine Health Information Center 2017 Plan of Work

Preparedness

1) Swine Disease Matrix research

In 2016, SHIC Matrix research focused on the ability to detect the Matrix pathogens via nucleic acid detection, using platforms that are commonly available in the U.S. major veterinary diagnostic laboratories, for example PCR testing. 2017-funded research, now under way, focuses 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. Specifically, research outcomes are assays with a consistent and reliable means to screen populations using:

i) the ability to detect antibody in sera and oral fluids
ii) high throughput capacity (high volume of samples and quick turnaround time)
iii) DIVA capability if vaccine availability justifies the need for a DIVA assay

Appendix A shows the Swine Disease Matrix with its prioritization scoring and the 2016 viral antigen detection research outcomes. High priority viruses now have PCR antigen detection capability because of SHIC research, USDA research or current veterinary diagnostic lab capabilities**.** SHIC created or updated PCR testing capabilities for 24 of the 46 viruses included in the matrix.

2) Transboundary swine disease factsheets

Factsheets and a review of available diagnostic tests for 34 Swine Disease Matrix transboundary production diseases of swine are completed, with the Factsheets available on www.swinehealth.org. During 2017, these Factsheets were the second most accessed content of the SHIC website.

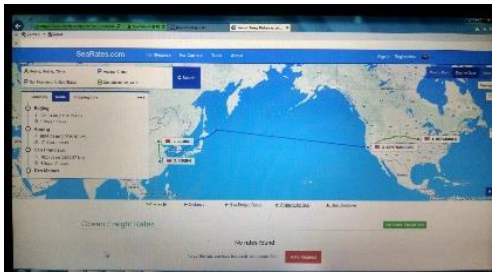
Information on diagnostic tests available for Japanese encephalitis virus and Chinese variant pseudorabies virus was reviewed and updated. Specific information included the type of PCR that is currently available and information about those tests' sensitivity and specificity, types of tissues used for diagnostic validation including information about the use of oral fluids and the expected sites of viral replication during infection. Also included was information on ELISA antibody test capability for testing on sera and oral fluids.

The Seneca Valley Virus factsheet was updated to reflect new information since 2015.

3) Research on potential risks from feed ingredient imports and possible mitigation products

After PEDV 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 U.S. outbreak was such that a more direct involvement of imported feed needed to be investigated.

Research about the potential for feed and feed ingredients to harbor and transmit viral pathogens has been completed. The SHIC Swine Disease Matrix was used to identify target viral pathogens for evaluation in the study. Researchers used "surrogate viruses" in some instances, which allowed study of closely related and structurally similar viruses. Results of the study (summarized in Appendix B and submitted for peer-reviewed publication) conducted by Pipestone Applied Research, South Dakota State University and Kansas State University shows the potential for PRRSV and other viruses to contaminate and survive in feed ingredients, including soybean meal and distillers dried grains and solubles (DDGs). ASFV, Seneca Virus A (surrogate for FMDV and of interest itself) and Bovine Herpesvirus-1 (surrogate for PRV) have also been found to be able to survive in feed ingredients under the shipping time and environmental conditions from China or Eastern Europe.



These results suggest a subset of contaminated feed ingredients could serve as vehicles for foreign animal disease, other transboundary disease introduction to the U.S. and possibly circulation of viruses within the U.S. The PRRSV data may provide new insights and areas of further study on area spread.

Risk mitigation research has begun. This project is testing feed additives that may be added to feed during milling or other processes that might be able to neutralize these pathogens to help mitigate risk.

4) Investigating vaccines as a possible source of introduction of transboundary pathogens

At the 2017 annual meeting of the American Association of Swine Veterinarians, a biologics company reported Senecavalley A (SVA) contamination of two lots of porcine-derived trypsin. Trypsin is routinely used in the manufacture of vaccines.

SVA and FMD are both picornaviruses that cause identical lesions in pigs. This raised the question of vaccines' ability to transmit these and other transboundary viruses.

After discussing this with the USDA's Center for Veterinary Biologics (CVB), the agency immediately initiated testing vaccine samples available in the CVB repository, that are on the market with current expiration dates and were known to be manufactured using porcine-derived ingredients.

According to the report posted on the USDA-CVB website, "CVB found two vaccine serials, which were manufactured by a single firm using the same lot of swine serum, positive for SVA nucleic acid. CVB testing did not detect viable virus in any of the samples, and testing supports that the serum had been adequately irradiated to inactivate the virus."

"The CVB has implemented SVA contamination screening for all incoming Master Seeds, incoming Master Cells and materials with animal origin ingredients. The CVB published a draft notice recommending biologics manufacturers implement SVA contamination screening of all seed materials and animal origin ingredients."

5) Improving surveillance systems

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.

Research about technical aspects and experimental design related to the development of more efficient and cost-effective surveillance systems, with an emphasis on preparing the swine industry for detecting and eliminating emerging and/or foreign animal diseases is underway. The project provides technical and analytical expertise on diagnostic assay assessment and technical and analytical expertise on spatially balanced sampling (generalized random tessellation stratified design - GRTS). For regional surveillance, the potential advantage of the GRTS approach is that is requires fewer samples and, therefore, lower producer cost.

6) Biocontainment at first points of concentration

Swine industry experts from the U.S. and Canada have begun to create industry-wide, North American standard operating procedures (SOPs) for transportation related biocontainment. The goal is to decrease the incidence of disease associated with transportation of marketed pigs and sows to the first points of concentration. Practitioners from the U.S. and Canada, National Pork Board, American Association of Swine Veterinarians, Ontario Ministry of Agriculture, Food and Rural Affairs, Canadian Pork Council, packing industry representatives and transportation subject matter experts are collaborating on the project.

To be successful, the group launching this effort recognizes the need to engage producers, packers, sow assembly yards and buying stations, as well as those who transport pigs in the conversation. Doing so will help to grow the collective industry “political will” essential to implement the recommendations and that will differentiate this project from other transportation biosecurity procedures currently available from multiple programs. Together, with input and support from all stakeholders and clear, mutually-beneficial objectives, standard operating procedures to decrease the spread of pathogens can be developed, implemented and enforced.

7) Inform producers, veterinarians and state and federal animal health officials about the market sow and secondary pig markets

SHIC commissioned a descriptive review of the market sow and secondary pig markets to gather information on the scope of these markets for better surveillance, biocontainment and other risk mitigation protocols in the future.

The review estimated that, in 2016, cull sows were 2.4 percent and cull boars were 0.3 percent of the total pig harvest during that year. It estimated cull sows were 2.7 percent of the 2012 harvest.

The relatively low number of animals in the secondary market means animals can stay at buying stations or collection points for as long as a week when buyers are seeking a large enough group of similar pigs to fill an order. Though a buyer's goal is to have the pigs at these points for as short as time as possible, the reality is that the collection of animals can become a swine health concern.

Most culls and secondary market pigs are sold through a dealer network. Dealer networks vary in location and can be a significant distance from the farm, so transportation time becomes an issue. In high hog density regions, fewer stations may be needed. When production is more remote, more drop-off points are required to collect the number of animals necessary to fill orders. In some cases, hogs may move 1,500 miles or more to get to market.

Because there is little objective data available to allow the industry and regulators to make informed decisions about how to respond to animal health emergencies, a project to objectively describe the scope and complexity of cull sow and secondary pig marketing channels was also completed. The project was a small pilot project to determine if it is possible to collect the data needed to describe cull marketing channels in the U.S. and outline a preliminary method for data capture and analysis to describe the U.S. cull marketing system.

Key findings of the project were

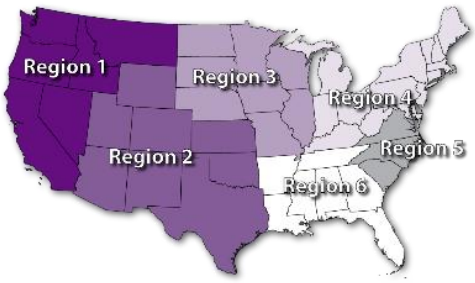
- Capturing detailed information about cull swine shipment locations and farms of origin at the time of harvest was both feasible and practical.
- Collecting market movement data between the farm of origin and the last shipping location to the plant proved to be impossible.
- The majority (86%) of culls that entered the harvest plant did so from a terminal collection point that was close to the source farm.
- About 14% of culls that entered the terminal market traveled more than 240 kilometers from the source farm to the terminal collection point (the collection point just prior to moving to the harvest plant). Some of these culls traveled 5 times as far to the terminal collection point from the source farm than they did from terminal collection point to the market. It is hypothesized that these culls moved between collection points prior to arrival at the harvest plant.

The challenges of the secondary market are clear and with greater understanding of the channels, SHIC hopes to improve management of disease transmission and identify risks associated with foreign animal disease outbreak in these animals.

Response

1) Rapid response program

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 activation.



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. An advisory group of swine veterinarians helps to guide development and implementation of the program.

2) Emerging disease research

The Senecavirus A (Seneca Valley Virus) outbreak in 2015 was the first opportunity for SHIC to rapidly respond to an emerging disease, funding research according to high priority industry needs. When or where the next emerging disease will appear cannot be predicted. SHIC is prepared with funds in place that can be quickly mobilized to support filling the immediate research gaps following introduction. This research will provide producers and their veterinarians with critical information that they will need to effectively respond to the disease outbreak.

As of the writing of this report, the 2017 funds for emerging disease research have not had to be used.

3) Emerging disease discovery through diagnostic fee support

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. In these cases, there is a need for further diagnostic workup.

To help more producers and their veterinarians solve outbreaks from unknown causes, SHIC developed a system to help offset diagnostic fees for further investigation after the initial diagnostics are completed. To request support of diagnostic fees the diagnostician of the case must contact SHIC. In cases of unresolved high or ongoing morbidity or mortality a panel of diagnosticians will review the case and must concur that the most likely differential diagnoses have been addressed. To ensure that a foreign animal disease is not being missed, the SAHO of the premises' state must be aware of the case and the lack of a satisfactory diagnosis and has considered if a foreign animal disease investigation should be initiated.

The program has been offered through multiple communications, but no new cases have been investigated during 2017.

4) FAD test kit sensitivity validation when using oral fluids

Historically, individual animal tissue collection, like sera samples, have been used to monitor herd disease status to enable movement or sale during a disease eradication program. The Secure Pork Supply includes surveillance to demonstrate freedom of disease to enable pig movement or sale during a disease outbreak or eradication program. Validation of oral fluids-based surveillance that will demonstrate herd health status will give animal health officials information needed for them to permit movements from a Control Zone and producers a cost-effective and scientifically sound way to collect samples for establishing herd disease status.

SHIC coordinated and co-funded with the National Pork Board a USDA research project for diagnostic sensitivity validation of commercial PCR test kits for FMD, CSF and ASF, using oral fluids.

Monitoring

1) Veterinary diagnostic portal and data warehouses

Using the capabilities provided by completion of the Veterinary Diagnostic Lab Data Standardization project, a novel and broadly applicable database application of VDL swine test results, termed 'data warehouses' is being developed. A web-based portal will give access to the warehouses that enables permissioned users to aggregate, archive, retrieve and subsequently analyze veterinary diagnostic data from one or any number of veterinary diagnostic labs in the USDA's National Animal Health Lab Network.

Over the course of the project period, inter-laboratory veterinary diagnostic data aggregation (using USDA NAHLN HL-7 standards), archiving and data retrieval from the collaborating VDLs will be provided. This will lead to periodic aggregate swine diagnostic data summary reports, in a format to ensure VDL client confidentiality, that will support domestic swine disease monitoring.

2) Early communication pathway

When a non-regulatory, emerging swine disease arises, early communication about outbreaks is essential. Most of the time veterinarian-to-veterinarian or producer-to-producer contact is the right thing to do. Talking and sharing ideas helps manage the outbreak. But, in cases where broader industry response might be needed or maybe to just notify someone that something different is going on, an additional telephone call could be appropriate.

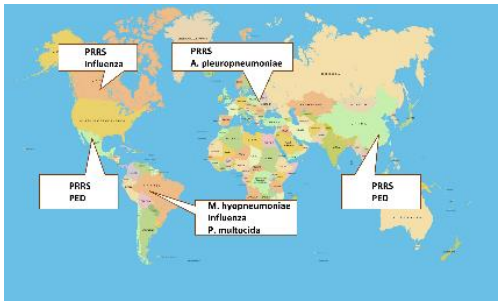
SHIC participated with the other pork industry associations to develop and communicate a Communications Action Plan for non-regulatory diseases. The objective is to give producers and veterinarians confidence that there will be thoughtful steps to assess the situation in collaboration with the producer and veterinarian of record and decide what further actions, if any, are needed. That process provides for initial confidentiality of the producer, veterinarian and site identifiers during initial

calls. Any actions because of those calls will maintain initial confidentiality to the level requested by the producer or veterinarian unless state or federal swine health regulations dictate otherwise.

3) Global swine disease monitoring

The U.S. swine industry is free of several swine diseases now being identified in different countries around the world. Having a systemic way to identify the circulation of diseases from across the globe will help the U.S. industry to prevent the introduction of them or, at least, be better prepared.

A near real-time global surveillance system for swine diseases has been developed. The project, housed at the University of Minnesota, uses a private-public-academic network to inform it. The process includes identification of potential hazards, screening steps evaluating data collected and timely reporting. The University of Minnesota and USDA/APHIS Center for Epidemiology and Animal Health are collaborating on the project.



The project is underway and is verifying its processes as it generates draft reports.

4) Domestic swine disease monitoring

SHIC has developed a near real-time domestic swine disease monitoring system. The project generates information useful for economic and animal health decision-making.

Data are analyzed to describe disease activity by major pathogen and/or by clinical syndrome, documenting disease activity (presence, incidence) with respect to geography while maintaining appropriate producer confidentiality. A joint project between Iowa State University and the University of Minnesota, this new near real-time domestic monitoring system allows:

1. Identifying and characterizing domestic emerging or endemic disease trends
2. Assisting in quantification of the economic impact of disease in specific regions
3. Aiding the progress of regional disease control programs

The system ensures aggregated data quality and integrity for optimum reporting. Frequency of detection of major pathogens are reported by age group, sample type and region. Other pathogens are grouped into pre-defined categories and reported by age group, sample type and region.

The project is underway and verifying its processes as it generates draft reports.

5) Feed ingredient monitoring research

The U.S. pork industry is importing feed ingredients from countries that have endemic swine diseases that are not in the U.S. Ongoing monitoring of feed ingredients to look for the presence of these pathogens will help to inform the U.S. industry and add to the data needed for pathogen-specific risk

assessments. Research will help to inform a HACCP-like approach to feed bio-safety through identifying and controlling critical control points in feed production and delivery.

Kansas State University researchers are investigating using dust samples to monitor for swine pathogens in U.S. feed mills. There is potential for the findings to lead to development of a diagnostic laboratory panel of assays where a single submitted swab of feed mill dust could be analyzed for multiple feed-based bacteria and viruses – a low-cost tool that could be used to help address feed safety.

This research uses Senecavirus A (SVA) to validate detection techniques and will offer a look into prevalence and high-risk locations for SVA entry into the feed system, adding another piece of information about the virus. At the same time, this research could possibly lead to development of centralized protocols for dust sampling that can be a convenient and cost-effective surveillance tool for feed-based pathogens.

While the implications for the U.S. industry are clear, there is equal interest in the outcomes for a broader application. These same tools and strategies can be employed to minimize the risk of Foreign Animal Disease (FAD) spread through feed mills – including viruses like Foot and Mouth Disease (FMD).

6) Swine Disease Matrix review and revision

The Swine Disease Matrix (Appendix A) is a list of viruses that are known to be able to infect pigs. The Matrix was reviewed and updated by the SHIC Monitoring and Analysis Working Group.

Recognizing the Matrix as a living document requiring periodic updates, the Working Group reviewed each disease listed and its impact in three different categories: production economic impact; domestic or international market impact; and the chance of introduction or emergence in the U.S. herd. The overall score assigned in the Matrix is the average of the three categories. Because of the review, scores on diseases in the Matrix were changed to reflect current conditions in the industry.

7) National bio-surveillance system review

SHIC joined the Institute for Infectious Animal Diseases – a Department of Homeland Security (DHS) Center of Excellence – and the National Pork Board to host a workshop to discuss and build upon industry and government efforts to identify and develop a road map to improve our national swine disease surveillance. In addition to the hosts, participants included pork producers, swine veterinarians, DHS, American Association of Swine Veterinarians, National Pork Producers Council and state and federal animal health officials. The workshop also received sponsorship from the DHS Science and Technology Directorate.

The workshop objectives were to

- Identify gaps, tools and research needs for a workable, credible, affordable and robust national bio-surveillance system supporting coordinated early detection, rapid response and efficient control of foreign animal diseases (FADs) and enabling improved prevention of FADs and emerging/re-emerging priority diseases of the U.S. swine industry.

- Develop a road map to address gaps, barriers and research needs (identified in Objective 1) for improvement and implementation of the sustainable and successfully functioning, national, rapid bio-surveillance system that meets the needs of the U.S. swine industry as well as state and federal animal health authorities.

There was a significant consensus among participants in the workshop regarding the attributes of an optimal risk-based comprehensive disease preparedness system and the belief that a modern robust national bio-surveillance system is a vital component.

Information about domestic and international disease incidents

During 2017, SHIC identified, tracked and communicated to producers and veterinarians incidents of domestic and international diseases. These included:

- The bat enteric coronavirus strain HKU2, identified in Guangdong and Hong Kong in 2004 and 2006, has recently moved from bats to pigs in China, causing severe piglet diarrhea and mortality. Some specific mutations in the spike protein of the novel virus, tentatively called swine enteric alphacoronavirus (SeACoV), are presumably responsible for it being able to jump from bats to pigs.

  Because current information shows there has not yet been region to region spread in China, a SHIC Working Group arrived at a consensus that SHIC should closely monitor the situation but not devote resources for diagnostics or to further investigate this virus unless there develops evidence of interregional spread in China, indicating this is more than an isolated incident.
- PRRS was reported in Uruguay. The occurrence of PRRS in Uruguay was reported to the World Organization for Animal Health on July 20, 2017. There were five premises affected in Uruguay. Officials report an epidemiological investigation has started on those five premises and on pig farms where breeding pigs were imported in the last 10 years.

- SVA was found in Colombia. Pigs in the affected Colombian herd had vesicles on the snout and coronary bands reported but tested negative for foot-and-mouth disease and positive for SVA. In a report issued following whole-genome phylogenetic analysis, it was reported that the Colombian strain clusters most closely with the contemporary strain from the U.S.

- A PRRS strain novel to Manitoba has been causing preweaning mortality of 60 percent, up to 10 percent abortion rate and triple the normal rate of mummified fetuses. This more virulent strain of PRRS than Manitoba has previously experienced is thought to not be related to vaccine or previous PRRS status.

Analysis

1) VDL data standardization

SHIC has been the primary source of funding for the veterinary diagnostic laboratories of Iowa State University, Kansas State University, University of Minnesota and South Dakota State University to work with Clemson University to standardize the way that they report their swine testing results.

Swine health test and related data from different Veterinary Diagnostic Labs has needed to be standardized to facilitate quickly compiling, sharing, accessing data for epi analysis. Establishing and adopting the use of universally recognized data standards and message schema are the foundational elements needed to enable the sustainable and scalable systems of connectivity and web-based analytical tools necessary to support the needs of the 21st century pork industry in North America.

An important partner in the effort has been the USDA. They are providing partial funding and their work with the National Animal Health Laboratory Network will help to ensure that the results of the project can be offered to other veterinary diagnostic labs so there will be national coordination.

The project is completed sufficiently to enable the standardized data to be available for analysis supporting the SHIC domestic disease monitoring project and additional projects modeled through the Morrison Swine Health Monitoring Project.

2) The Morrison Swine Health Monitoring Project (MSHMP)

The MSHMP currently monitors approximately 50% of the U.S. sow herd for economically important pathogens. 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.

Using MSHMP data in a manner that protects the participants' confidentiality, a novel approach to predicting disease risk is being developed. This University of Minnesota project could be the next evolutionary step for using data to affect animal health and disease outbreaks. This project will also reinforce the continuing value of sharing data and experiences across production systems and veterinary practices.

The model will analyze how historical environmental, pig movement, neighbor disease status and other on-farm and neighborhood factors might predict the risk of disease outbreaks. Using already available PRRS/PED data to develop the model will bring a better understanding of how risk factors change across the landscape. It will then be applied to real-time data to give producers and their veterinarians information to be better prepared to prevent or respond to emerging disease outbreaks.

Project success will depend on the availability of the data. Cooperating producers and their practitioners are being identified and invited to participate.

Communications

1) The SHIC website has been organized to facilitate intuitive use, increase professionalism of web presence and facilitate organization. Google Analytics of the website traffic was used to measure impact of media efforts. All media releases are to communicate to the end audiences of SHIC timely and relevant information, as well as the activities of the center.

2) Activity on www.swinehealth.org

- Top pages on SHIC website (January 1-November 29, 2017) with (number of visits):
    - Seneca Valley Virus Summary (3,126)
    - Fact Sheets (1,175)
    - News (826)
    - Rapid Response Course – training (793)
    - Swine Disease Matrix (664)
    - Results (621)
    - About (581)
    - Plan of Work (563)
    - June 2017 SHIC Newsletter (518)
- Added Rapid Response Corp Training section
- Moved website hosting to a more optimized and safer hosting environment
- Continuous WordPress and plugin updates
- Removed unused plugins and code from website
- Kept website content updated with relevant pdfs and content
    - Updated Reports
    - Updated Fact Sheets
    - Posted press releases and articles
    - Posted monthly newsletters
- Unified website design and layout across all pages

3) Website impact

- Over 11,000 individual sessions for the year.
    - 34.7% returning visitors
        - Spent 3:21 minutes per visit back
    - 65.3% new visitors
        - Spent 1:26 minutes per visit
- 7,379 separate users
- 23,455 total page views
- Average of 2.12 pages per session
- Average session duration of 2:06

- 71 percent of users were from the USA
- 7 percent were from Canada
- 2 percent from Thailand
- 20 percent other countries (with <2 percent each) -- 102 additional countries reached
- Besides the home page, users were most interested in emerging disease information (SVA, Fact sheets) and news section

- Compared to Ag: livestock benchmark:
    - 49.45 percent more direct sessions
    - 43.54 percent more direct new users
    - 15.52 percent less pages per session
    - 33.09 percent more time spent per session
    - 6.62 percent less new sessions (we had more returning users)

4) Press releases

Twelve press releases, posted on the SHIC website, were issued in 2017:

- 2017 Plan of Work Revealed
- SHIC Rapid Response Corps Announced
- SHIC Diagnostic Fee Support
- SHIC Swine Disease Matrix Updated
- National Bio-surveillance System
- SHIC Study on Potential Pathogen Transmission in Feed
- SHIC Funds Near Real-Time Global Swine Disease Surveillance System
- SHIC Funds Study Evaluating Tools for Mitigation of Foreign Animal Disease Introduction and Transmission in Feed
- SHIC Funds Study Validating Tool for Senecavirus A Detection and Surveillance of Prevalence in US Feed Mills
- US Swine Disease Monitoring System Underway
- SHIC Rapid Response Corps Training Now Live
- SHIC Seeks Pork Industry Stakeholders' Input on 2018 Plan of Work

5) Press release impact

General emails were sent to 235 ag news outlets for each press release. Farm broadcasters became a very important media outreach for SHIC with follow-up interviews after each press release.

- Farmscape online and radio broadcasts
- FeedNavigator.com
- Pig Progress (blog)
- Brownfield Radio Network
    - Established relationship with the Minnesota bureau for follow-up interviews on over 50 percent of the press releases and then shared with all Brownfield outlets
- National ag TV (RFD-TV)

- Podcast interview with Ag News Daily

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 U.S. pork industry. Publications included:

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

6) AASV Weekly e-Letter

Content was provided for 23 articles for the AASV weekly e-Letter, including:

- SHIC 2017 Plan of Work and an end-of-year summary of 2017 progress and results
- SHIC Research: Direct Detection of Seneca A Virus
- SHIC Reviews VDL Submissions and Case Reports on CNS Syndrome
- SHIC Swine Disease Matrix Review/Update
- SHIC Work on Biocontainment Issues
- SHIC Study on Pathogen Transmission in Feed
- Emerging Disease Communications Strategy Formed
- SHIC Commissions Study on Sow and Secondary Market Pig Information
- SHIC Board of Directors Meeting
- SHIC Call for Swine Disease Matrix Research Proposals
- SHIC Funds Near Real-Time Global Swine Disease Surveillance System
- PRRS in Uruguay and SVA in Colombia Demand Attention
- Memo on the Circulating PRRSv Strain in Manitoba
- SHIC Study on Low Cost Tool for SVA Detection
- SHIC Rapid Response Corps Training Live
- SHIC's US Swine Disease Monitoring System Underway
- SHIC Reports PRRSv Diagnostic Progress in Uruguay
- Oral Fluid ELISA Tests Funded
- New Project Intends to Quantify and Predict PRRS and PED Risk
- SHIC Monitoring Bat-Sourced Coronavirus Variant in China
- SHIC Diagnostic Fee Support
- SHIC Solicits 2018 Plan of Work Input

7) SHIC eNewsletters

A monthly SHIC eNewsletter publication schedule began in June. The distribution list remains much the same as during 2016, though constant updates are made.

- >3,000 total contacts in newsletter database
    - 1,400 are veterinarians who associate themselves with the pork industry
    - 800 are decision makers in the pork industry with a focus on medium and large farms
    - 800 are allied industry
    - 15-20 are industry reporters and news editors for industry digital, print and radio outlets

The following chart details SHIC eNewsletter acceptance and impact.

Edition	Date Sent	#Sent	Opens	% Opens	Unsubscribed	Clicks[2]	% Click
June 2017	5/30/2017	3,015	1,063	38.0%	11	212	20.0%
July 2017	7/5/2017	2,999	1,070	38.6%	7	271	25.4%
August 2017	8/3/2017	2,993	883	31.4%	6	132	15.0%
August 2017[1]	8/3/2017	2,993	979	35.4%	6	146	14.9%
September 2017	9/6/2017	2,985	886	30.6%	5	172	19.4%
October 2017	10/4/2017	2,980	853	30.7%	2	159	18.6%
November 2017	11/7/2017	2,982	833	30.4%	5	28	3.4%
		SHIC Average		33.6%			16.7%
	Constant Contact Benchmarks			11.0%			7.2%

[1]the August issue was sent twice because of a content update

[2]Clicks = following a link from the newsletter to the SHIC website

APPENDIX A

Swine Disease Matrix

- 2016 PCR update/development completed
- 2017 PCR update/development in progress
- USDA developed PCR
- Current VDL PCR capability

SWINE DISEASE MATRIX December, 2017				
Representative virus affecting swine	**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
Classical swine fever virus	9	9	5	7.7
African 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-Restin*	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 enchephalitis 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

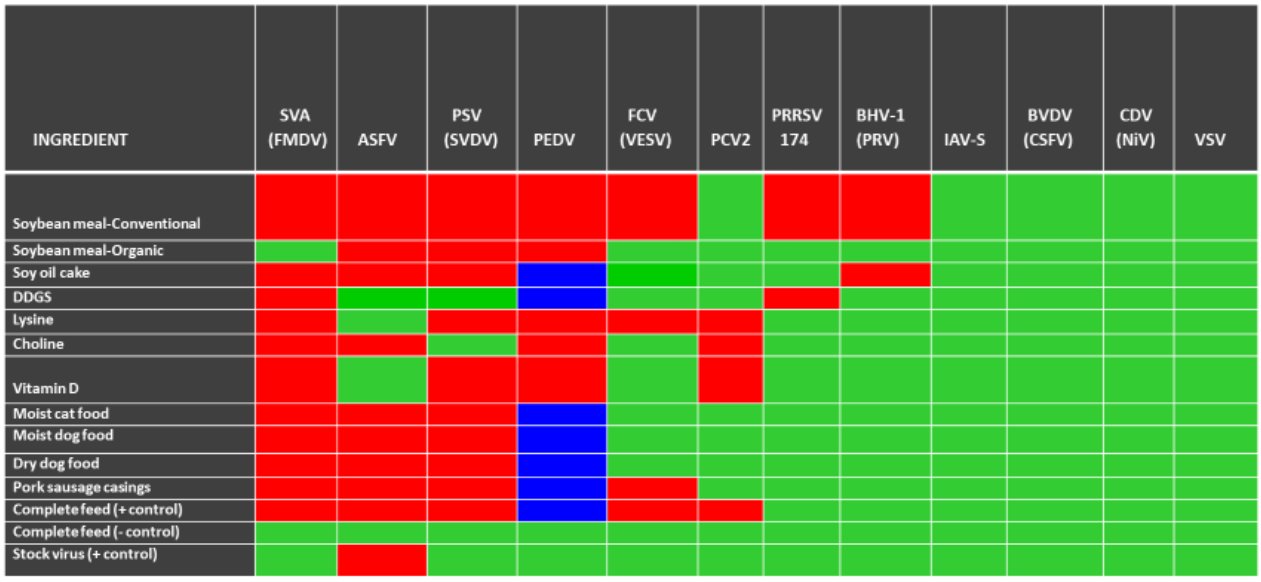
Porcine parainfluenza 1 virus*	3	2	3	2.7
Atypical swine pestivirus*	3	2	3	2.7
Influenza C virus*	2	2	2	2.0
Porcine respiratory coronavirus*	2	2	2	2.0
Hemagglutinating encephalomyelitis virus*	2	2	2	2.0
Encephalomyocarditis virus*	3	1	2	2.0
Hepatitis E virus*	1	3	1	1.7
Porcine adenovirus*	2	1	2	1.7
Porcine kobuvirus*	2	1	2	1.7
Porcine sapovirus*	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
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***				

Appendix B

Virus Survival in Feed Research Summary

SVA = Seneca Valley Virus A, surrogate for FMDV; ASFV = African Swine Fever Virus; PSV = Porcine Sapelovirus, surrogate for SVDV = Swine Vesicular Disease Virus; PEDV = Porcine Epidemic Diarrhea Virus; FCV = Feline Calicivirus, surrogate for VESV = Vesicular Exanthema of Swine Virus; PCV2 = Porcine Circovirus 2; PRRSV 174 = Porcine Respiratory and Reproductive Virus type 174; BHV-1 = Bovine Herpes Virus 1, surrogate for PRV = Pseudorabies Virus; IAV-S = Influenza A Virus in Swine; BVDV = Bovine Viral Diarrhea Virus, surrogate for CSFV = Classical Swine Fever Virus; CDV = Canine Distemper Virus, surrogate for NiV = Nipah Virus; VSV = Vesicular Stomatitis Virus

Results: Summary of virus survival from batch 4 samples (37 DPI or 30 DPI) across both models.



Red = viable virus recovered, Green = no evidence of viable virus, Blue = Not Tested