**Project/Activity Number:** NC229

**Project/Activity Title:** Detection and Control of Porcine Reproductive and Respiratory Syndrome Virus and Emerging Viral Diseases of Swine

**Period Covered:**12/05/2021 to 12/04/2022

**Date of Report:** 1/2/2023

**Annual Meeting Dates:** 12/02/2022 – 12/04/2022

**NC229 Annual Meeting Participants in conjunction to the 2022 NAPRRS/NC229 International Conference of Swine Viral Diseases (total = 164)**

**NC229 Executive Meeting attendees (total = 17)**

Roman Pogranichniy **(Kansas State University)**, Diego Diel (**Cornell University**), Scott Kenney, Andreia Arruda, Renukaradhya Gourapura (**The Ohio State University**), Ying Fang, Federico Zuckermann, Dongwan Yoo, Raymond Rowland (**University of Illinois**), Hiep Vu (**University of Nebraska**), Pablo Pineyro-Pineiro, Phillip Gauger **(Iowa State University)**, Laura Miller **(USDA ARS Nation Animal Disease Center)**, Joan K. Lunney, **(USDA-ARS Beltsville Agricultural Research Center)**, Declan Schroeder, Kim VanderWaal **(University of Minnesota)**, Jonathan Pasternak **(Purdue University).**

**Brief Summary of Minutes of Annual Business Meeting from 3:30 pm – 5:30 pm on 12/02/2022:**

The 2022 NC229 Business Meeting was held on December 2nd, 2022, in conjunction with the NAPRRS/NC229: International Conference of Swine Viral Diseases at the Intercontinental Hotel. The meeting was open to all NC229 members. Annual reports from 15 stations were shared with the audience by representatives from each station. Fifty-three people attended the Business Meeting. The business meeting centered on the topics noted below-(detailed agenda in table 1 of report appendix):

1. Drs. Pogranichniy (Chair) and Dr. Rowland (Academic Advisor) inaugurated the annual NC229 scientific meeting.
2. Drs. Pogranichniy (Chair), Pineyro-Pineiro (Vice-Chair), and the scientific program committee were recognized for their outstanding efforts in organizing the scientific program.
3. Dr. Pogranichniy (Chair) discussed the need to form a core group that will be in charge of writing the next renewal and the possibility of writing a sustainability grant proposal.
4. Dr. Colby presented updates regarding funding opportunities for the upcoming year.
5. Dr. Colby announced the renewal of the Dual Purpose with Dual Benefits: Research in Biomedical and Agriculture Using Agriculturally Important Domestic animals.

# 1. Accomplishment

# Objective 1. CONTROL OF PRRSV:

## 1.1. PRRS immunology/vaccinology

1. Ribosome profiling of porcine reproductive and respiratory syndrome virus reveals novel features of viral gene expression.
2. Assessment of the potential role of the gut microbiota in the response of pigs to PRRSV-killed virus vaccination. This knowledge may pave the road for developing novel strategies to enhance vaccine efficacy**.**
3. Developed amachine learning algorithm to predict cross-reactivity from genetic sequence data.
4. Defined mechanisms of immune evasion that contribute to PRRSV disease pathogenicity, which can be targeted through recombinant vaccines to improve vaccine efficacy.
5. Demonstrated that PRRSV-induced hypothyroidism is not directly responsible for changes in fetal developmental processes.

## 1.2. PRRS epidemiology

1. Evaluation of the influence of partial immunity in quasispecies evolution.
2. Investigation of risk factors associated with the incidence of wild-type PRRSV introductions into wean-to-finish herds located in the Midwest with an effort to improve biosecurity practices.
3. Investigation of PRRSV microevolution and diversity over time in PRRSV-positive farms.
4. Assessed and modeled additional transmission routes (vehicles and feed) for PRRSV

## 1.3. PRRS Surveillance and Diagnostics.

1. Collaborative project among multiple VDLs, with the goal to aggregate swine diagnostic data and report in an intuitive format (web dashboards and monthly PDF report), describing *dynamics of pathogen detection by PCR-based assays over time, specimen, age group, and geographical area*.
2. Developed methods to rapidly detect and characterize the etiology of new and emerging viruses that may impact swine health.

# Objective 2 Developing effective and efficient approaches for detection, prevention, and control of pressing viral diseases of swine of recent emergence:

## 2.1. African Swine Fever Virus

1. Four Universities have been approved the Select Agent status by USDA-APHIS to conduct research on ASFV (University of Nebraska-Lincoln, The Ohio State University, Cornell University, and University of Minnesota).
2. Development of several vaccine candidates for African swine fever virus.
3. Developed a risk-free in situ non-animal surrogate assay to validate ASFV mitigation protocols.
4. Evaluated characteristics of supply chains for the transmission of foreign viral animal diseases and application of block-chain technology to trace imported ingredients.
5. In collaboration with the swine industry, monitoring the evolution of the global spread of ASF through the Swine Disease Global Surveillance project.
6. Validation of a simple and reliable method for profiling antibody response to ASFV.

## 2.2. Swine Influenza Virus

1. Development of new swine influenza vaccine candidates and establish the pregnant sow-fetus models to assess the safety and efficacy of influenza vaccines.
2. Investigated farm workers' roles in introducing seasonal influenza viruses into swine farms.
3. Investigated the genetic diversity of the influenza A virus in vaccinated pigs.
4. Conducted genetic and antigenic characterization of new and emerging swine IAVs, including phylogenetics and network analysis.
5. Identified the molecular mechanisms by which viruses infect and adapt to swine.
6. Evaluate and improve existing and new diagnostic tests and testing strategies for swine IAV surveillance, detection, and recovery from disease outbreaks.
7. Characterize swine innate and adaptive immune responses to swine IAVs and determine correlates of protection.

## Porcine Circovirus

1. Developed an infectious clone for PCV3.
2. Developed a co-infection model of PCV3 and PRRSV to test PCV3 and PRRSV vaccines in a dual-challenge model.

## 2.4 Swine Pestiviruses

1. Developed a new real-time PCR to detect atypical porcine pestivirus (APPV).

## 2.5. Senecavirus A (SVA)

1. Estimated the seroprevalence of ASV and assessed risk factors in the US swine industry.
2. Determined the minimum infectious dose of SVA in both neonates and market-weight pigs.
3. Assessed dynamics and duration of antibodies response to SVA in a breeding herd.
4. Identified viral genes associated with virulence and mechanisms of viral pathogenesis.
5. Conducted molecular characterization to predict the evolution of new SVA strains.
6. Evaluated new SVA vaccine platforms and determined whether vaccines against SVA would cross-react with FMDV or interfere with FMDV serological surveillance.

# 2. Impact Statement

## 2.1 Multi-State Impacts

1. The Morrison Swine Health Monitoring Project (MSHMP), the only voluntary swine monitoring project has continued to share the disease occurrence report on a weekly basis with industry stakeholders and has proved once again (e.g. L1C 1-4-4) that is a tool that can track disease occurrence objectively as it has a denominator of farms which ultimately prepares the industry for an FAD emergency.
2. The Allen D. Leman Swine Conference is an annual educational event for the global swine industry organized by faculty at the University of Minnesota College of Veterinary Medicine. It is internationally acclaimed for bringing science-driven solutions to the complex challenges facing the industry. This year the conference was attended by over nine hundred participants from over 20 countries, including swine veterinarians and other professionals working in swine production and animal health management. The conference had a good mix of applied research in areas of swine health and productivity and highlighted topics such as African swine fever, PRRS, *Mycoplasma hyopneumoniae*, influenza, pre-weaning mortality, antibiotic resistance, models of pig production, *Streptococcus suis*, risk assessment and biosecurity. The conference was delivered in a hybrid format in 2021 and in person in 2022.
3. ARS scientists in Ames, Iowa, with APHIS colleagues, developed a publicly available interactive software system called octoFLUshow to visualize influenza A virus gene sequences collected in the USDA Influenza A virus surveillance system. When deployed alongside sampling algorithms (smot: simple manipulation of trees and flutile: flu utilities) federal scientists, academic researchers, and diagnostic labs can determine representative swine IAV genetic sequences that can be further characterized to determine phenotype. These tools will aid agricultural production and diagnostic capabilities through the identification of important changes in genetic diversity and allow for the identification of novel viruses. The software and interactive website are publicly available in repositories accessed through https://flu-crew.org.

**3. Multi-state grants or awards (total= 48): See Appendix**

**4. Peer-reviewed publications (total = 94): See Appendix**

## 5. Book Chapters or Monographs(total=3): See Appendix

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