

Final report of research project, submitted to the AASV Foundation  
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## Use of aggregated veterinary diagnostic laboratory PCR results to monitor the activity of pathogens in the US swine industry

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### Introduction.

Swine veterinary diagnostic laboratories (VDLs) are constantly testing a massive amount of material to detect swine pathogens. Aggregated results obtained by PCR-based tests may be useful indicator of disease megatrends affecting the US swine industry. Aggregated information from rRT-PCR results for Porcine Reproductive and Respiratory Syndrome Virus (PRRSV), Porcine Epidemic Diarrhea Virus (PEDV), Porcine Deltacoronavirus (PDCoV), and Transmissible Gastroenteritis Virus (TGEV), from four major VDLs (Iowa State University, University of Minnesota, South Dakota State University, and Kansas State University) is available at the Swine Disease Reporting System (SDRS). The purpose of this study was to develop an algorithm to scan the SDRS PCR results for significant changes from historic patterns of RNA detection for PRRSV, PEDV, and PDCoV using aggregated VDLs results.

### Materials and Methods:

Standardized submission data and results of tests performed on porcine samples were retrieved by participating VDLs, with test result status determined for each accession as positive, suspect, inconclusive or negative using SAS 9.4 (SAS Institute Inc., Cary, North Carolina). Data for a 4-year period from 2015 through 2018 are fitted with 4 cycles, each corresponding to the 52-week yearly periods using PROC SQL and PROC SORT scripts on SAS 9.4. Weekly proportion of PCR-positive results over total number of accession ID cases was calculated. Three years of historical data (2015-2017) were used to fit a cyclic regression model using PROC ROBUSTREG scripts on SAS 9.4. The findings were used to predict the expected percentage of PCR-positive results for the year of 2018 using PROC SCORE. Moreover, 95% confidence interval of the expected results was calculated using PROC MEANS to represent 'upper' and 'lower' confidence limit lines around the expected values. Charts were built using PROC SGPANEL scripts on SAS 9.4. The final graphs have been reported at the Swine Health Information System (SHIC) website under Domestic Disease Monitoring reports.

### Results:

The number of PRRSV-positive cases were above the upper confidence limit band (i.e. expected level based on historic data) for the spring and summer months of 2018 (Figure 1). The relatively higher detection rate was mostly from sow farms cases, in part due to increased use of aggregates of processing fluids as a sample type. For PEDV, the observed number of PCR-positive cases was in line with the expected levels predicted by the cyclic regression model during all year of 2018 (Figure 2). The number of PCR-positive results for PDCoV was above expected values on the first semester of 2018, with higher detection rate in samples from sow farms during the winter months and in samples from wean to market farms on spring months. Also, there were significant spikes on tests from wean to market farms at the end of all years (Figure 3).

### Conclusions:

Using anonymous, aggregated data from VDLs to monitor pathogen detection is valuable and informative. Charts can be built in a near real time fashion, and report megatrends of disease detection in the USA swine industry. This tool has the ability to inform the swine industry regarding disease diagnostic trends on a national or state level. The capability developed by this project which applies a statistical approach having the ability to predict and track changes on disease detection generates early alerts for emerging challenges, and reports macro-epidemiological aspects associated with endemic pathogen detection keeping the US swine stakeholders posted of agent detection and activity. The use of historical data for proactive applicability to monitor pathogen activity can be used, for

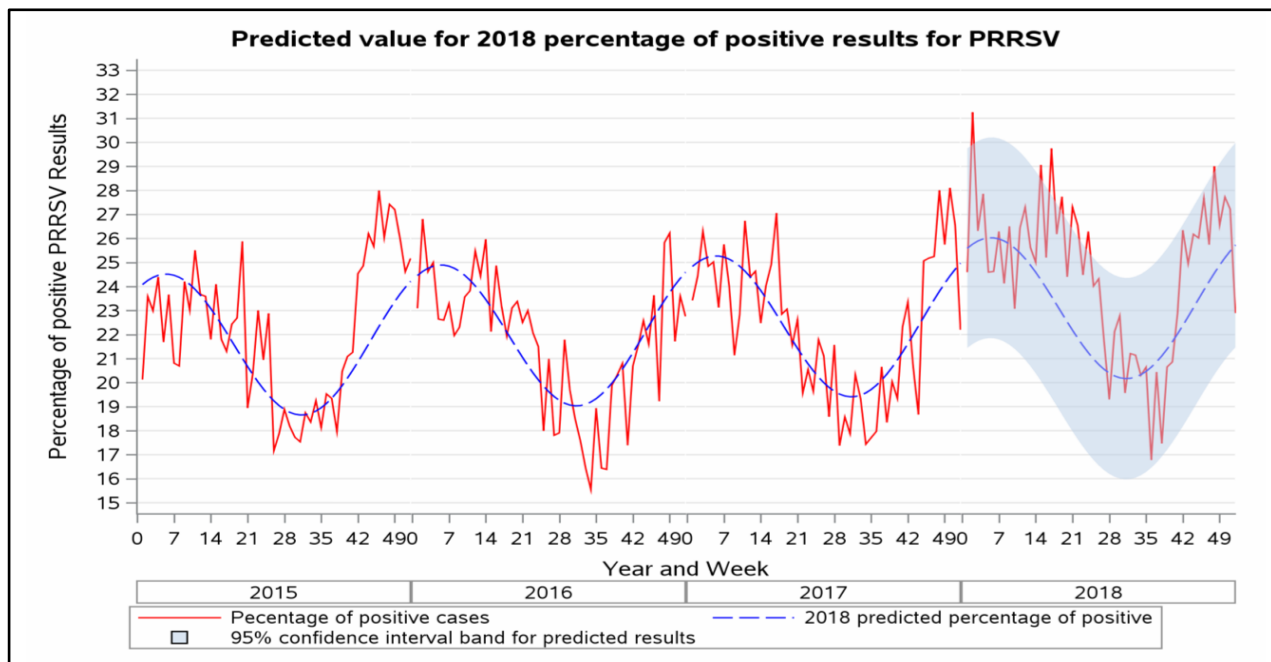
example, as an additional piece of information to assist veterinarians and producers to take decision involving biosecurity measures, animal movements, and or vaccination strategies. Continuous input from swine veterinarians and producers is encouraged to allow continuous improvement of this project.

## Results dissemination and applicability:

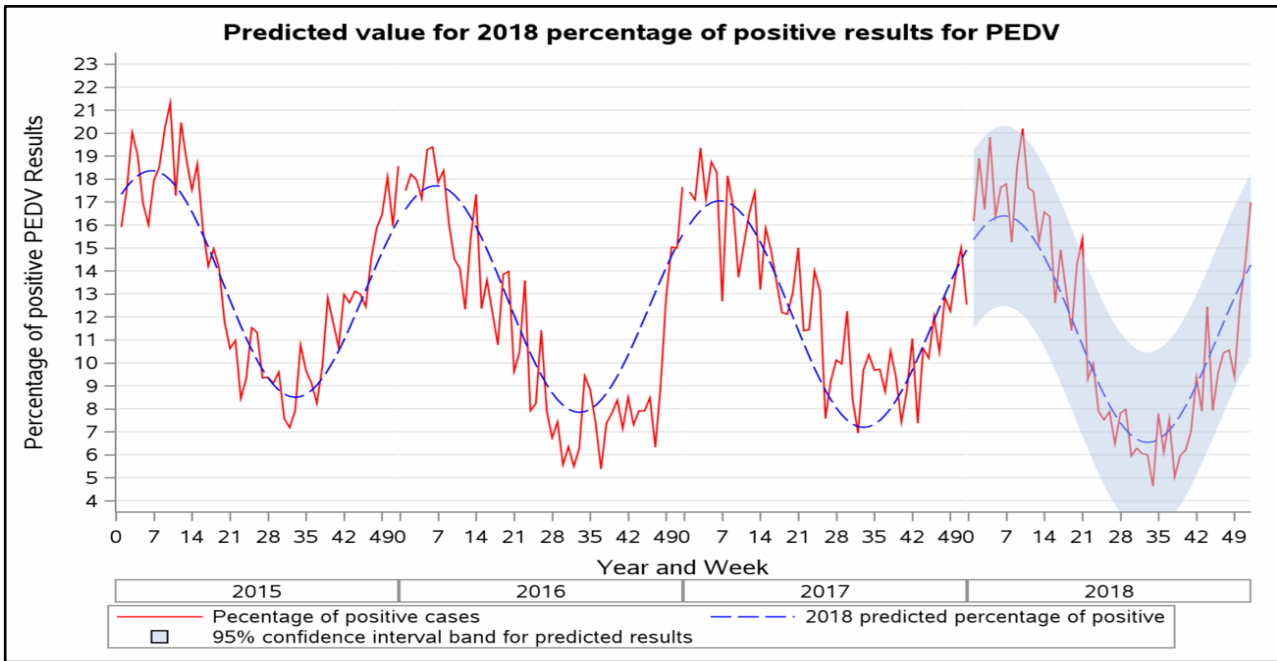
This project generated a novel tool for the US swine industry, by informing the expected proportion of PCR-positive results for each week of the year, and informing when detection level is significant different than expected values. Increased pathogen detection may be a sign of increased disease incidence, or emergence of highly virulent strains. Conversely, lower pathogen detection may be a signal of novel pathogen introduction (e.g. there was a higher number of TGE tests resulting negative when PED emerged).

These reports are only useful if they are broadly disseminated to the US swine industry. As a strategy to inform a large audience, graphs with the 2018 predicted values and real results obtained during year of 2018 were incorporated to the monthly reports released by the SDRS project. For 2019, predicted values were calculated and are going to be monthly updated with the obtained results. Monthly updated information will be incorporated and released in the SDRS monthly reports. SDRS monthly reports are currently uploaded at the Swine Health Information Center under Domestic Disease Monitoring project, available online at <https://www.swinehealth.org/domestic-disease-surveillance-reports/> and are welcome to be added to the AASV library, and/or AASV page to be shared with AASV members. Also, this project will be presented as a poster at the 50<sup>th</sup> AASV Annual Meeting. A manuscript with the finds is under preparation for a peer reviewed journal.

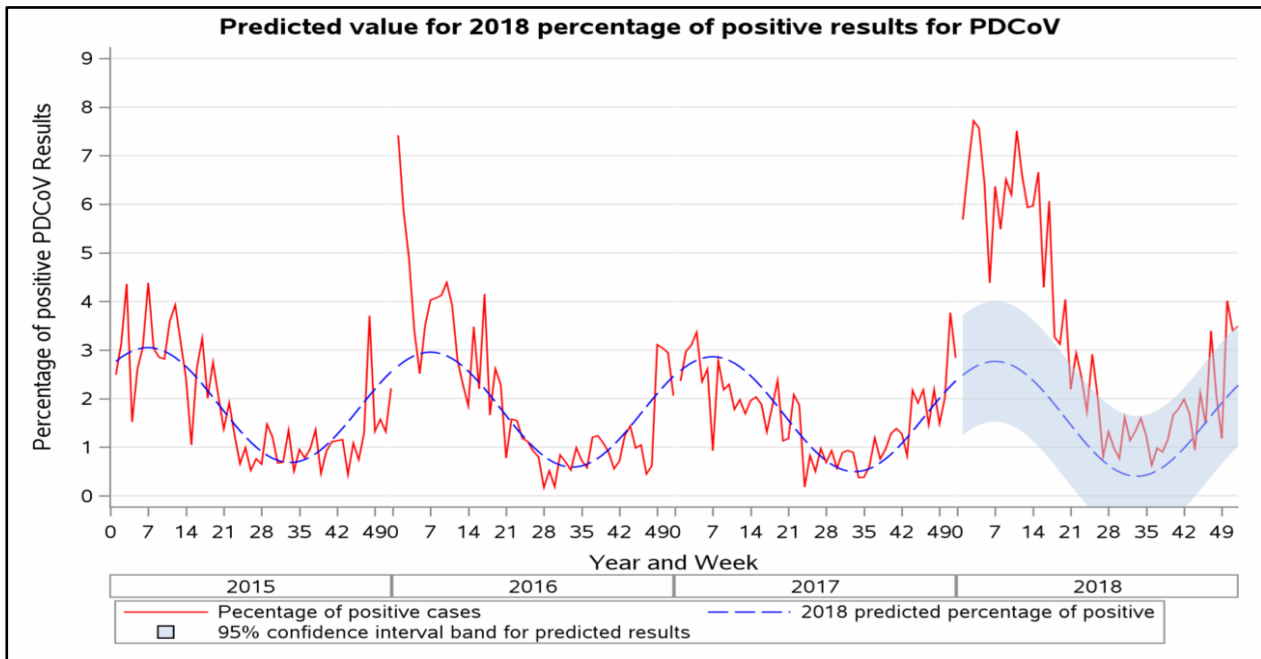
There is a marked seasonal pattern of pathogen detection, with increased number of positive cases during ‘cold’ months. We highlight the importance of disease monitoring at the farm level, allowing veterinarians to early detect changes in disease status. When outbreak alerts are issued reinforcement of farm biosecurity, review of animal and people flow, audit truck decontamination procedures are example of measures that could potentially help containing further pathogen spread.



**Figure 1:** expected percentage of positive results for PRRSV RNA by rRT-PCR, with 95% confidence interval band for predicted 2018 percentage of positive results.



**Figure 2:** expected percentage of positive results for PEDV RNA by rRT-PCR, with 95% confidence interval band for predicted 2018 percentage of positive results.



**Figure 3:** expected percentage of positive results for PDCoV RNA by rRT-PCR, with 95% confidence interval band for predicted 2018 percentage of positive results.