Post-epidemic dynamics of PEDV in the United States: Current trends and patterns

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Main Points:

- Since July 2014, the number of PEDV yearly outbreaks reduced both numerically and in geographical distribution.
- PEDV outbreaks occur seasonally, with most cases being detected during winter.
- Spatial-temporal clusters of PEDV outbreaks were detected, most of which occurred prior to 2019.

Porcine epidemic diarrhea (PED) is a swine enteric viral disease first documented in the U.S. swine population in 2013, at which time it sparked a major epidemic. Since then, PEDV has persisted in the U.S. breeding herd with low incidence during the post-epidemic period. Despite continued monitoring and surveillance, there is minimal research and understanding of the endemic phase of PEDV in the country. Our objective was to characterize PEDV in the U.S. breeding herd in the post epidemic period (spatial-temporal distribution of cases and associated factors).

We used data from 1100 breeding farms in 27 states, whose PED statuses were routinely reported to the Morrison Swine Health Monitoring Project (MSHMP) between July-2014 and June-2021. We stratified the data into six regions over which mixed-effects logistic regression analyses and spatial-temporal analyses were done. For the study period, a total of 625 outbreaks of PEDV were recorded on 373 farms. The total number of farms breaking per year reduced from 95 farms in 32 counties in 11 states between July-2014 and June-2015 to 53 farms in 28 counties in 9 states between July-2020 and June-2021, indicating an overall decrease in occurrence and spatial extent of PEDV. Outbreaks were seasonal, with most outbreaks occurring during winter (January -March – $p = 0.001$, relative risk =2.2). However, in some regions, seasonal clusters started in December. Ten spatial-temporal clusters of PED cases ($p < 0.05$), spanning 2.5 km2 to 833.7 km2 and 1-5 months, were recorded in four regions (Table 1). Eight of the clusters were observed between 2015 and 2019 in three regions and one in 2021 in one region. Farms in these clusters were from 16 systems.

Table 1. PEDV spatial-temporal clusters identified between July-2014 and June-2021 described by region, time of occurrence, diameter, ratio between number of observed versus expected cases, and number of systems involved.

Region	Cluster	Time (month-year)	Area (km^2)	Observed vs Expected	# Systems
A	1	Dec-17 to Feb-18	250.8	5.2	3
B	1	Jan-16 to Apr-16	833.7	8	6
B	2	Dec-15 to Feb-16	205	7.2	7
C	1	Feb-21 to Mar-21	149.4	3.1	1
D	1	Feb-17 to Mar-17	56.8	19.3	1
E	2	Dec-16 to Jan-17	2.5	33.8	1
E	3	Jan-15 to Mar-15	30.5	11.7	2
E	4	Nov-15 to Dec-15	88.7	11.7	4
E	5	Nov-19 to May-20	13.2	10.5	2
E	6	Oct-16 to Feb-17	42	14.5	1

After controlling for the season, farm type, and year, the occurrence of PED cases on breeding farms was associated with county-farm-density, with farms located in medium-density counties (0.013-0.031 farms/km^2) twice more likely to experience outbreaks than farms in low-density counties (< 0.013 farms/km^2) ($p < 0.001$). As such, farms in some regions were more likely to experience outbreaks than other regions, and the odds of PED outbreaks on farms decreased through the study period. The overall decline in PED cases over the years and the decrease in spatial extent likely reflects ongoing efforts employed by production systems to control and prevent PEDV during the post-epidemic period. This presents an opportunity for concerted and coordinated efforts to understand PEDV dynamics in nursery and growing herds and continue strategic steps towards regional control and elimination.