# Zoonotic Exposure to Porcine Deltacoronavirus, United States, 2019–2021

Patricia A. Boley,[1] Grace Hartley, Linda J. Saif, Andrew S. Bowman, Jacqueline M. Nolting, Scott P. Kenney

Author affiliations: The Ohio State University, Center for Food Animal Health, Wooster, Ohio, USA (P.A. Boley, L.J. Saif, S.P. Kenney); The Ohio State University, College of Veterinary Medicine, Columbus, Ohio, USA (G. Hartley, A.S. Bowman, J.M. Nolting)

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Porcine deltacoronavirus (PDCoV) is a swine coronavirus with zoonotic potential. We detected PDCoV-neutralizing antibodies in 10 of 300 human serum samples; positive sample sources included 1 adult and 9 juveniles. Our findings provide evidence of human exposure to PDCoV and highlight the importance of monitoring animal coronaviruses with zoonotic potential.

Coronaviruses readily cross species barriers, raising concern for human health because of understudied genera such as deltacoronaviruses. Porcine deltacoronavirus (PDCoV) is a globally distributed enteric coronavirus of swine that causes substantial economic losses to the pork industry and has demonstrated the capacity for cross-species infection (*1*,*2*). PDCoV uses attachment factors and cellular receptors that are conserved across multiple host species, which can enable cross-species transmission (*3*–*5*). In addition, PDCoV infection has been reported in children with swine exposure in Haiti, suggesting zoonotic potential (*6*).

To assess evidence of human exposure in the United States, we screened 200 commercially acquired adult serum samples collected in 2021 and 100 serum samples obtained from juvenile swine exhibitors participating in agricultural exhibitions during 2019–2021 who reported daily or near-daily contact with swine (Appendix, http://wwwnc.cdc.gov/EID/article/32/12/26-0303-App1.pdf). We tested serum samples by using a whole-virion ELISA optimized for human serum. We evaluated positive results by performing virus neutralization testing. Because validated human positive-control serum samples were unavailable, we used porcine hyperimmune PDCoV serum for assay development and optimization. We tested adult and juvenile serum samples side-by-side by using identical laboratory methods. However, the cohorts differed in age, source population, availability of exposure information, and sample collection history. Pig exposure histories were available for juvenile exhibitors but not for the commercially acquired adult serum samples, precluding direct comparison of swine-contact histories between groups. Juvenile swine exhibitor participation was approved by The Ohio State University institutional review board (protocol no. 2019H0152).

We identified 10 human serum samples that were positive by ELISA (Figure, panels A, B) and capable of neutralizing PDCoV in vitro. One (0.5%) of 200 adult samples and 9 (9.0%) of 100 juvenile exhibitor samples were seropositive. The seropositive adult sample was from a Hispanic female blood donor who was 42 years of age. Positive juvenile samples originated from Oklahoma (n = 3), Florida (n = 3), Ohio (n = 2), and Georgia (n = 1) and were identified in 2020 (n = 5) and 2021 (n = 4). Because of the convenience-based sampling design, uneven geographic representation, and limited pilot dataset, our findings should not be interpreted as evidence of geographic clustering. Juveniles with frequent swine contact had higher odds of seropositivity than adults with undetermined swine contact (odds ratio 19.7 [95% CI 2.5–157]; Fisher exact test p = 0.00028), corresponding to a risk ratio of 18.0 (95% CI 2.6–125) and an absolute risk difference of 8.5% (95% CI 2.8%–14.2%).

All 10 ELISA-positive samples neutralized PDCoV at titers of 1:80–1:320. In contrast, 4 ELISA-negative samples demonstrated no neutralizing activity, whereas 2 ELISA-negative samples neutralized PDCoV at a 1:5 dilution (Table; Appendix Figure 1). ELISA optical density values did not correlate linearly with neutralizing antibody titers, consistent with known differences between binding-antibody assays and functional neutralization assays (*7*). We evaluated available antiserum against multiple coronaviruses, including porcine epidemic diarrhea virus, transmissible gastroenteritis virus, porcine respiratory coronavirus, bovine coronavirus, human coronavirus NL63, and SARS-CoV-2, and did not identify substantial cross-reactivity in the PDCoV ELISA (Appendix Figure 2). Although antigenic overlap between porcine coronaviruses has been reported (*8*,*9*), the detection of PDCoV-neutralizing antibodies strengthens the interpretation that those samples reflect PDCoV exposure.

Our findings provide serologic evidence consistent with human exposure to PDCoV and dem-

[1]Current affiliation: US Department of Agriculture , National Bio and Agro-Defense Facility, Manhattan, Kansas, USA

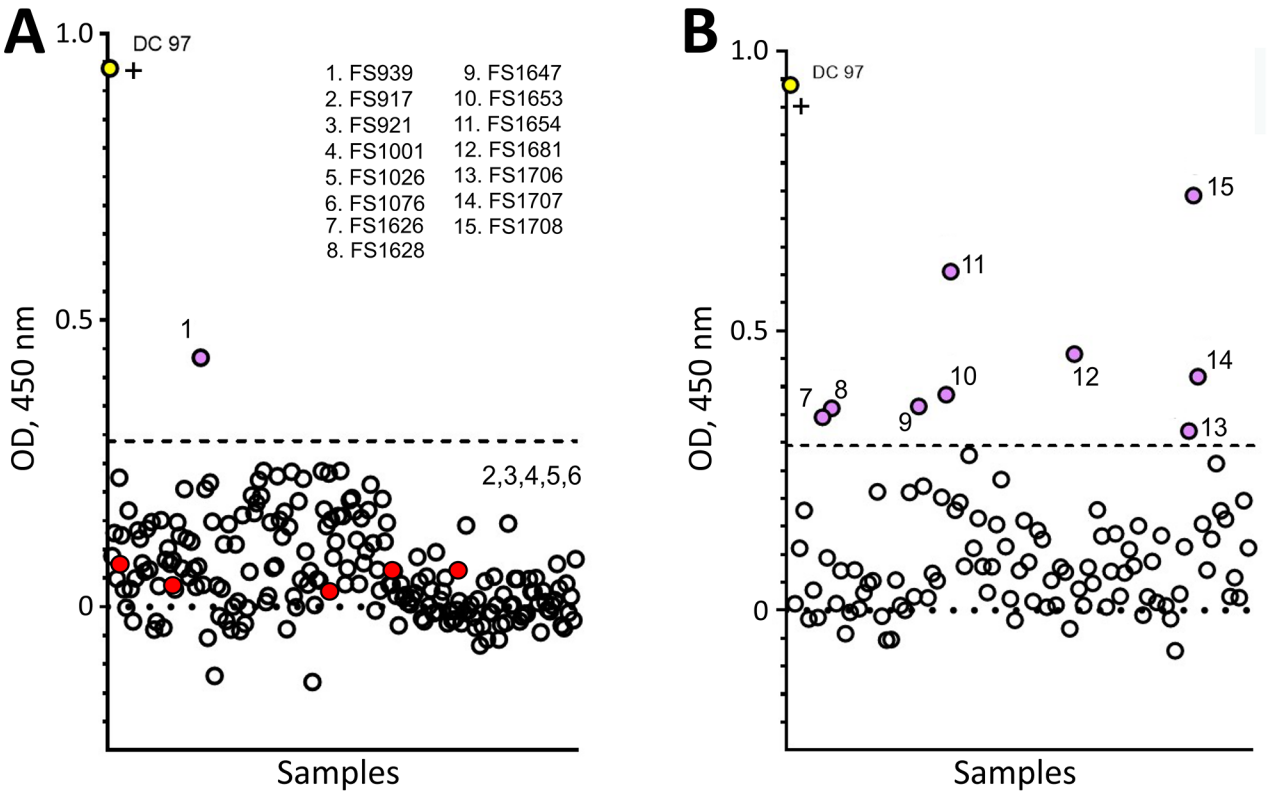



**Figure.** ELISA OD values for commercially acquired adult and juvenile swine exhibitor serum samples with potential exposure to porcine deltacoronavirus, United States, 2019–2021. A) ELISA OD (450 nm) values for adult serum samples (n = 200). Purple circle indicates positive sample and open or red circles indicate negative samples; red circles indicate samples that were also tested by using viral neutralization. Yellow circle indicates positive control. B) ELISA OD (450 nm) values for juvenile serum samples (n = 100). Purple circles indicate positive samples and open circles indicate negative samples. Yellow circle indicates positive control. Dashed horizontal lines indicate the OD threshold for a positive result. OD, optical density.

onstrate a higher frequency of seropositivity among juveniles with documented swine contact than among adults from the general population. Those observations are consistent with previous reports of PDCoV infection in children in Haiti and with experimental evidence supporting the broad host-range potential of this virus (*6*). Swine are recognized sources of several zoonotic pathogens, and

**Table.** ELISA optical density and virus neutralizing testing titers for adult and juvenile serum samples exposed to porcine deltacoronavirus, United States, 2019–2021*

| Sequential ID | Sample ID | Source | Mean ELISA OD (+/–) | VNT titer |
|---|---|---|---|---|
| Positive control | DC97 | Pig | 0.9396 (+) | 1:2560† |
| 1 | FS939 | Adult human | 0.4350 (+) | 1:80 |
| 2 | FS917 | Adult human | 0.0665 (–) | NN |
| 3 | FS921 | Adult human | 0.0366 (–) | NN‡ |
| 4 | FS1001 | Adult human | 0.0400 (–) | NN |
| 5 | FS1026 | Adult human | 0.0400 (–) | NN |
| 6 | FS1076 | Adult human | 0.0025 (–) | 1:5 |
| 7 | FS1626 | Juvenile human | 0.3454 (+) | 1:320 |
| 8 | FS1628 | Juvenile human | 0.3614 (+) | 1:160 |
| 9 | FS1647 | Juvenile human | 0.3645 (+) | 1:160 |
| 10 | FS1653 | Juvenile human | 0.6078 (+) | 1:160 |
| 11 | FS1654 | Juvenile human | 0.3856 (+) | 1:320 |
| 12 | FS1681 | Juvenile human | 0.4581 (+) | 1:320 |
| 13 | FS1706 | Juvenile human | 0.3207 (+) | 1:160 |
| 14 | FS1707 | Juvenile human | 0.4179 (+) | 1:320 |
| 15 | FS1708 | Juvenile human | 0.7419 (+) | 1:160 |

*NN, nonneutralizing; OD, optical density; VNT, viral neutralizing titer.
†DC 97 pig hyperimmune serum was neutralizing at 1:1280 and 1:2560 dilutions.
‡One well at 1:5 had no cytopathic effect.

occupational studies have demonstrated that persons with swine exposure can experience subclinical infection with multiple swine-associated agents (*10*). However, detection of PDCoV antibodies indicates previous exposure but does not establish active infection, clinical disease, or human-to-human transmission.

The limitations of this study include convenience sampling, limited epidemiologic metadata, and the absence of validated human positive-control samples. Adult and juvenile cohorts were not directly comparable because of differences in demographics, source populations, and available exposure data, and swine-contact histories were unavailable for adult donors. Of consequence, the observed differences in seropositivity should be interpreted cautiously and cannot be used to infer population-level prevalence or transmission risk.

In conclusion, we detected neutralizing antibodies against PDCoV in 10 human serum samples, including 9 from juvenile swine exhibitors with frequent swine contact and 1 from an adult blood donor of unknown swine-exposure status. Those findings provide evidence of human exposure to PDCoV and highlight the importance of monitoring animal coronaviruses with zoonotic potential. Although the public health implications of PDCoV infection in humans are currently unclear, enhanced serologic and virologic surveillance is warranted to determine the extent of spillover, identify risk factors for infection, and evaluate whether PDCoV poses an emerging threat to human health.

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### About the Author

Dr. Boley is a biological science laboratory technician with the US Department of Agriculture at the National Bio and Agro-Defense Facility in Manhattan, Kansas, USA. Her research interests include coronaviruses, emerging zoonotic diseases, and chemoprevention of liver cancer.

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Address for correspondence: Scott P. Kenney, Center for Food Animal Health, 1680 Madison Ave, Wooster, OH 44691, USA; email: scottpkenney@gmail.com