# Continuity of operations following a known feral boar exposure in a transitional swine facility

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## Summary

Prevention and mitigation of disease is a constant challenge to the continuity of operations for swine production systems. Certain diseases may severely hamper and even end livestock production on a farm because of the severity of the disease, the regulatory implications, or the public perception caused by a confirmed infection. The case presented here illustrates steps taken by a transitional swine facility, one in which there is potential for exposure to feral swine, to mitigate problems created by exposure to a feral boar infected with pseudorabies virus. These issues may serve as discussion points for other swine facilities in planning for the continuity of their operations in the face of a disease exposure.

**Keywords**: swine, continuity of operations, transitional swine facility, pseudorabies, biosecurity

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**Resumen - Continuidad de operaciones después de una exposición a un macho salvaje en una instalación porcina de transición**

La prevención y mitigación de enfermedades es un reto constante a la continuidad de operaciones en los sistemas de producción porcina. Algunas enfermedades pueden entorpecer gravemente y hasta acabar con la producción de pecuaria debido a la severidad de la enfermedad, las implicaciones reglamentarias, o la percepción pública causada por una infección confirmada. El caso aquí presentado ilustra los pasos tomados por una instalación porcina de transición, en la que hay potencial para exposición a cerdos salvajes, para mitigar los problemas creados por la exposición a machos salvajes infectados con virus de pseudorabia. Estas situaciones pueden servir como temas de discusión para otras instalaciones porcinas en la planeación para la continuidad de sus operaciones al enfrentar la exposición a enfermedades.

**Résumé - Continuité des opérations suivant l'exposition connue à un verrat féral dans une installation porcine de transition**

La prévention et la mitigation des maladies sont un défi constant pour la continuité des opérations dans les systèmes de productions porcines. Certaines maladies peuvent affecter sévèrement et même faire cesser la production sur une ferme à cause de la sévérité de la maladie, les implications règlementaires, ou la perception du public causée par une infection confirmée. Le cas présenté ici illustre la démarche prise par une installation porcine de transition, dans laquelle il y a un potentiel d'exposition à des porcs féraux, afin de mitiger les problèmes créés par l'exposition à un verrat féral infecté par le virus de la pseudorage. Ces enjeux peuvent servir de points de discussion pour d'autres installations porcines dans la planification de la continuité de leurs opérations suite à une exposition à une maladie.

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Prevention and mitigation of disease is an ever-present challenge to the continuity of operations of livestock production systems, with biosecurity being a key component of continuity-of-operations plans. Steps are routinely taken to prevent visitors, vehicles, and unwanted animals from bringing disease onto a farm. The exclusion of disease becomes essential in the case of foreign animal diseases and other diseases of regulatory importance when a positive diagnosis may result in disruptions to the continuity of operations.

Modern swine management may range from raising pigs on pasture to partially or completely confining the animals in enclosure facilities. For regulatory purposes, swine-farm classifications are based on the risk of exposure to feral swine. Commercial swine are considered those that are "continuously managed and have adequate facilities and practices to prevent exposure."[1] Transitional swine are "feral swine that are captive or swine that have reasonable opportunities to be exposed to feral swine."[1] Feral swine are a non-native, invasive variety of swine that were introduced by early American explorers and various hunt clubs, in addition to domestic swine that escaped from swine operations. The number of feral swine in the United States is estimated at 5 million. Texas, with 2 to 3 million, is the state with the highest population of feral swine.[2] Feral swine are of concern to the continuity of operations due to their ability to spread disease to other susceptible animals and people.[2-5] Brucellosis and pseudorabies are of primary concern because of the eradication and control programs managed by the United States Department of Agriculture (USDA), in addition to the cross-species infection potential of these pathogens. While commercial swine are free of these diseases, potential for introduction of disease from feral swine exists in transitional swine operations. There is still a preponderance of smaller transitional farms that market to livestock-show exhibitors, commercial markets, and local farmers' markets.[6] The existence of these transitional farms provides an avenue for disease transmission from feral to domestic swine.[5,7]

Antibodies against pseudorabies virus (PRV) (Aujeszky's disease virus; ADV) have been found in 20% to 61% of feral swine tested through various studies[3,5-9] Pseudorabies virus is highly infectious in domestic pigs; however, feral-swine strains of the virus are thought to be less pathogenic, with a preference for venereal transmission.[10] Many adult swine do not show clinical signs, but the latent infection caused by herpes viruses make them potential reservoirs of infection during recrudescent periods. Official testing for PRV is performed at National Animal Health Laboratory Network participant laboratories and confirmed at the USDA National Veterinary Services Laboratories (NVSL) in Ames, Iowa. The Accelerated Pseudorabies Eradication Program, at the time of this incident, allowed for screening of serum samples with the Semi-Automated Autolex Test (Viral Antigens Inc, Memphis, Tennessee), Latex Agglutination PRV Antibody Test Kit (Meridian Life Sciences, Memphis, Tennessee), or the PRV/ADV gB Ab Test (Idexx Laboratories, Westbrook, Maine). The PRV/ADV g1 Test (Idexx Laboratories) is also an approved differential pseudorabies test originally designed to distinguish antibodies to field-strain virus (or other vaccine strain) from antibodies produced in response to gene-deleted vaccine. The PRV/ADV g1 Test is not generally performed on feral swine, but, because of its high specificity, is often conducted on serum samples from domestic swine that test positive on initial screening tests.

In the scenario reported here, a biosecurity program was in place, but multiple animals were potentially exposed to disease through a feral boar that leapt a double-net wire fence. This breech of biosecurity led to an impairment in the flow of the continuous production cycle on this farm by reducing the number of available females for breeding. The objective of this report is to discuss the continuity of operations on a swine farm following exposure to pseudorabies, which has historically been a disease of economic significance.

## Feral boar exposure

On October 30, 2011, a feral boar was discovered in an outdoor pen containing thirty-four 8-month-old replacement gilts on a 450-sow farrow-to-finish farm in East Texas. The boar evaded trapping by jumping the fences and escaping through a cattle pasture. On the following day, he returned to the same pen of gilts. On subsequent exposure, forethought on the part of farm management lead to the culprit boar being euthanized and samples submitted for diagnostic testing. Because of the vaccination protocol and absence of clinical disease on the farm, the primary biosecurity concerns focused on pseudorabies and brucellosis. All exposed gilts were kept in the same outdoor pen, isolated from all other swine on the farm, to prevent any potential disease from spreading. Initial screening tests on serum from the feral boar performed according to laboratory protocol at the Texas State-Federal Laboratory were reported as hemolyzed on the Semi-Automated Test Autolex PRV, hemolyzed on the Brucellosis Card Test Kit (Becton/Dickinson Microbiology Systems, Cockeysville, Maryland), and invalid on the Rapid Automated Presumptive Test (Viral Antigens, Inc) for brucellosis. Hemolysis interferes with the Autolex and card tests to render the sample unusable. Serum from the feral boar tested positive for pseudorabies antibodies via the PRV/ADV gB Ab Test at NVSL. Pseudorabies virus could not be isolated from the boar's tonsil by cell culture using PK-15, SKp, Madin-Darby Canine Kidney, or ST cells. A recommendation was made to test all exposed gilts after at least 14 days, an interval based on the expected time for seroconversion after exposure to the feral-swine variant of PRV.

## Herd testing

The primary concern was to mitigate the risk of spreading disease to other animals on the farm. The pen in which the feral boar was found was adjacent to a pen of 40 additional gilts. The dividing fence allowed nose-to-nose contact. Because of the direct contact and potential transmission of PRV, all 74 gilts were considered at risk. The next closest group of pigs on the farm was approximately 25 m distant from the pens that the feral boar had breached, and because of the presumed preference of feral-swine strains of PRV for venereal transmission, only the exposed gilts and two boars used for estrus detection in those gilts were quarantined. Figure 1 illustrates the timeline that led to these gilts being deemed free of PRV. Use of boars for estrus detection was discontinued in this group of gilts.

Of the 74 gilts screened at 17 days post exposure, three gilts were positive on the Semi-Automated Autolex Test, but negative on the Latex Agglutination PRV Antibody Test Kit. One of those three was also positive on the PRV/ADV gB Ab Test at NVSL. None of the three suspect gilts were positive on the PRV/ADV g1 Ab Test. All animals were negative for brucellosis antibodies.

At the 30-day post-exposure test for PRV and brucellosis, all 74 gilts and the two boars were tested. Two of the three gilts positive on the Day 17 post-exposure screening continued to show positive results on the Semi-Automated Autolex Test and both were positive on the PRV/ADV gB Ab Test. One of those gilts was also positive on the PRV/ADV g1 Ab Test. No other animals were positive for PRV antibodies, nor were any animals positive for brucellosis antibodies.

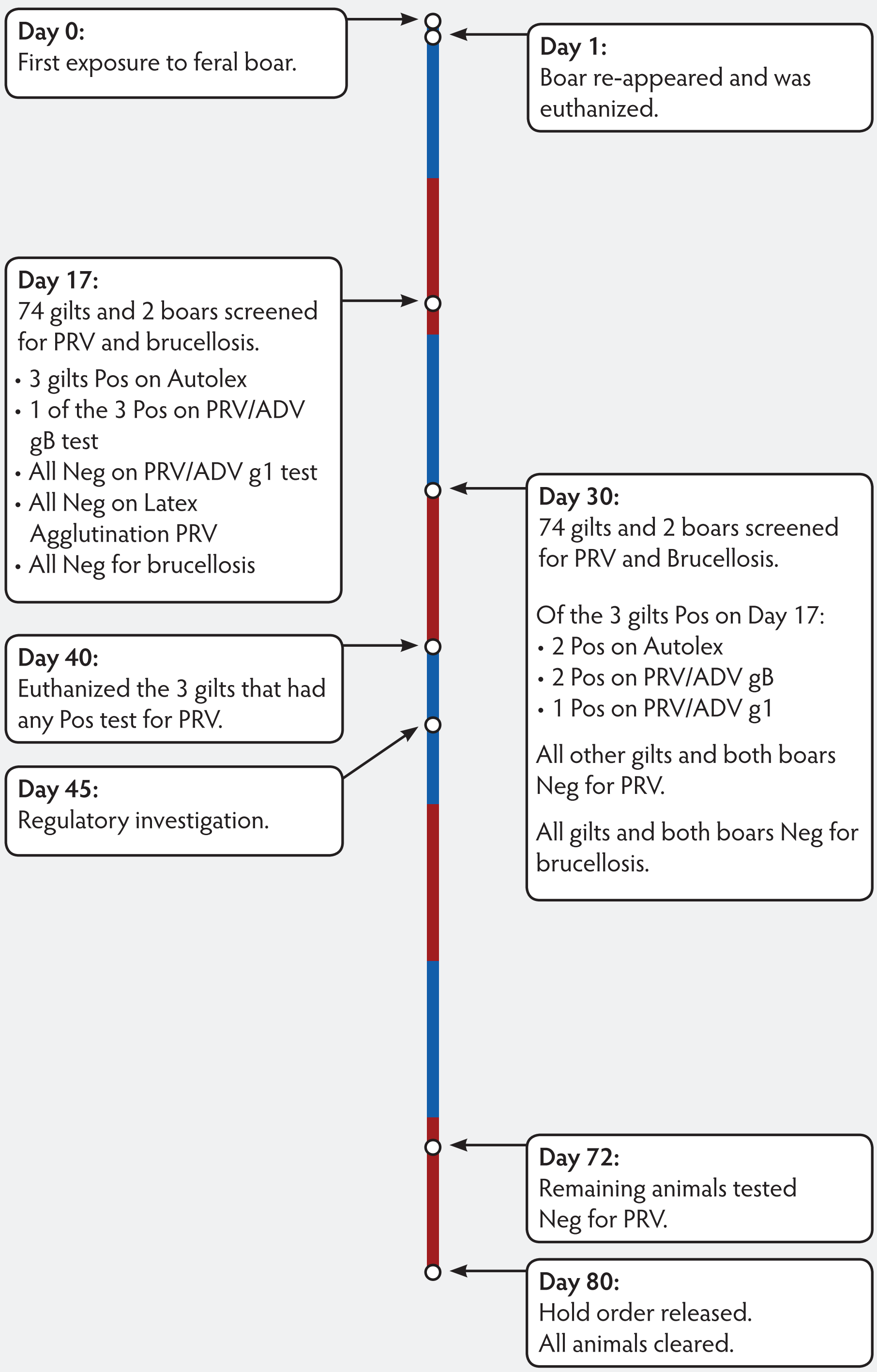
The three gilts that had any positive test for pseudorabies antibodies were euthanized and blood and tissue samples were collected. Gross necropsy findings were unremarkable. Tonsils, serum, and whole blood were submitted to NVSL for testing for PRV and antibodies against PRV. Pseudorabies virus was not isolated.

A USDA-Texas Animal Health Commission epidemiologic investigation was conducted shortly after removal of the three gilts that had tested positive for PRV, and a hold order was issued for the remaining 69 gilts and two boars in the outdoor holding pens exposed to the feral boar. Two gilts were euthanized for other reasons. The hold order was released 1 month later after remaining animals tested negative for pseudorabies and brucellosis antibodies.

## Discussion

The decisions needed to ensure continuous operation of a farm in the face of an infectious disease encompass the disease involved, the animals involved and their role in the produc-

**Figure 1:** Timeline showing events after exposure of a group of replacement gilts to a feral boar that tested positive for antibodies to pseudorabies virus (PRV/ADV gB Ab Test; Idexx Laboratories, Westbrook, Maine). Gilts were housed in outdoor pens in a transitional swine facility in Texas. Sera from the 34 gilts in the pen breached by the feral boar, plus 40 gilts in an adjacent pen and two boars used for estrus detection, were screened for brucellosis (Brucellosis Card Test Kit; Becton/Dickinson Microbiology Systems, Cockeysville, Maryland) and for PRV by four tests: Semi-Automated Autolex Test (Viral Antigens Inc, Memphis, Tennessee), Latex Agglutination PRV Antibody Test Kit (Meridian Life Sciences, Memphis, Tennessee), PRV/ADV gB Ab Test (Idexx Laboratories, Westbrook, Maine), and the PRV/ADV g1 Ab Test (Idexx). PRV = pseudorabies virus; ADV = Aujeszky's disease virus; Ab = antibody; Pos = positive; Neg = negative.




tion cycle, the availability of replacements to fill the role of exposed animals either temporarily or permanently, and the costs involved. A disease incident affects animals and operations differently depending on the age or stage of production of the animals. Preventing further spread of the disease and maintaining the right perception of the situation are important to favorably overcoming the circumstances.

The pathogen responsible for an infection greatly impacts the response. Fortunately, in this case, the disease, though of regulatory importance, did not appear to be highly contagious. There was no evidence of the virus spreading to animals other than those that were most sexually active at the time of exposure. The exposure to a less contagious pathogen allowed for a partial quarantine of the farm. A more virulent disease may result in quarantine of all the swine on the farm, all the animals on the farm, and all the animals on farms within a prescribed distance of the initial farm. A market outlet for the exposed animals may not continue to exist. While this was a small incident with a low-virulent disease and relatively minimal consequences, the point remains that a small, solitary indiscretion in biosecurity may have a tremendous impact on the ability to raise livestock.

In this scenario, the management of the farm allowed for a complete epidemiologic investigation. Feed and diagnostic costs would be minimized if all gilts were marketed to the harvest facility at the initial realization that the feral boar had pseudorabies, but any chance that those gilts could be utilized for their intended purpose would be lost. The next point in time to make a decision regarding the fate of the gilts was after a number tested positive. The concern with PRV is the potential for the virus to spread via respiratory and oral routes in addition to the venereal route. As gilts have estrous cycles of 16 to 24 days and typical estrus periods of 2 days, in a group of 34 gilts such as described in this case, three or four gilts would be expected to be in estrus on any day (without considering synchronized heats). Given this assumption, three to four gilts would be expected to be exposed sexually to a boar. Knowing the number of gilts expected to be in heat on a given day and the preference for feral swine variants of PRV to be transmitted sexually, the number of positive animals detected may be considered expected. From the perspective of a very low to zero prevalence of pseudorabies in domestic swine, the results may be false positives. The regulatory importance of this disease necessitates determining the validity of these positives. The most important factor in maintaining continuous operation of a farm is to ensure the movement of product (ie, piglets) off the farm and supplies (ie, feed) onto the farm. The minimization of this quarantine allowed for movement of weaned animals off the farm to an off-site nursery and movement of feeder pigs to other phases of the production system. The quarantine also allowed for feed and other supplies to be delivered to the farm. Other animals on this farm were not restricted by quarantine in any way.

A more restrictive quarantine could have interfered with movement of weaned animals off the farm or movement of feed onto the farm, creating welfare concerns and perhaps total depopulation. The animals in this case were replacement breeding stock that were acclimated to the sow farm and were in the process of transitioning into the breeding operation. Younger gilts undergoing the acclimation process separate from the exposed gilts could be utilized to maintain the flow of replacement females into the breeding herd. These younger gilts may not have had time to acclimate to the pathogens on the farm, nor be optimally responsive to pre-breeding vaccinations. If this were a batch-breeding system, an exposure and quarantine due to disease might have necessitated the loss of an entire breeding cycle or replacement of affected females if circumstances required liquidation in an attempt to salvage reproductive continuity in the enterprise plan.

The further spread of disease from this feral boar was prohibited by his death; however, the density of feral swine in the area suggests that it is a matter of time before another exposure. Despite the expected or historical effectiveness of a biosecurity plan, disease can always be introduced into a production system. With potential for feral-swine exposure, numerous diseases with economic and zoonotic consequences are possible. The prevalence of those diseases in feral populations is quite variable geographically and temporally. Additionally, at least with PRV, the variant of virus in feral animals appears to possess much less virulence than the virus that historically affected domestic animals. In the face of a biosecurity breach, when a disease has been introduced into a production system, steps must be taken to mitigate the risk, minimize the cost, and ensure continuity of operations.

In an ideal situation, all swine would be confined to barns with no entry for feral swine. On our case farm, double fencing with "hog wire" had been in place for numerous years with minimal feral-swine exposures reported. This farm is not the most modern in terms of fully confining all swine to large barns where there is no possible exposure to feral boars. However, this farm may be considered typical of the numerous small-producer farms that typically raise show pigs for local junior livestock show markets and those that raise pigs for local farmers' markets or organically raised pork consumers.[5] Research into recommendations for fencing options has provided some aid, yet evidence suggests that little can stop a determined feral boar.[2] Many of the interactions between feral and domestic transitionally managed swine may go unrecognized and unappreciated because of typical feral boar behavior and ability to breech biosecurity. The low reported observance of feral swine may be attributed to their nocturnal predisposition.[5] An argument can be made regarding recent drought in the area pushing feral swine to find alternate food sources. Alternatively, this may have been a young boar driven to jump two fences to interact with female swine primed for breeding.

Finally, maintaining the right perspective and proper perception of the situation (eg, exposure of domestic swine to feral swine) will greatly influence the final outcome. Because this case involved a disease which has undergone an eradication program, regulatory-agency involvement was warranted, just as it should be in any other reportable or foreign animal disease. The view of the regulatory side is one of mitigating the situation to avoid the spread of disease and restriction of trade. Ultimately, the decision of what becomes of the animals exposed to a disease, whether illness results or not, rest with the producer governed by regulatory-agency procedures, with various levels of influence from the herd veterinarian, disease experts, public perception, and end consumers of the product they are producing.

In order for production livestock operations to continue to function through a disease emergence and the recovery phase, multiple factors intertwine to shape the outcome. Preventing further dissemination and recurrence of disease may be the immediate call to action. Cost and the ability to maintain, use, or be indemnified for animals involved in the disease situation is often the driving factor in making a business decision. The final disposition of exposed animals following an infectious disease exposure may rely more on the perception of the animals' health and risk of disease spread than on the cost of maintaining the animals through quarantine.

## Implications

- Transitional swine facilities are at a high risk of exposure to disease transmission by feral swine.
- A small breech in biosecurity can have a large impact on the continuity of swine operations.
- Producer decisions in response to a disease exposure are influenced directly and indirectly by numerous sources.
- The ability to continue farm operations after a disease emergence may be guided by the ability to contain the disease, to continue to deliver feed and supplies, and to replace affected animals.

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### Conflict of interest

None reported.

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