Swine Hemorrhagic Fever Surveillance

Evaluation Brief September 2023

INTRODUCTION

African swine fever (ASF) continues to spread across the globe as classical swine fever (CSF) remains present in the Caribbean and South America. The United States Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) has an integrated surveillance plan that maintains vigilance for swine hemorrhagic fever diseases and improves the country's emergency preparedness. APHIS recently used a RISKSUR framework to evaluate the effectiveness and implementation of this surveillance plan over the past 3 years in the continental United States. APHIS expanded surveillance activities in Puerto Rico and the U.S. Virgin Islands in 2021, after detection of ASF on the island of Hispaniola. APHIS performed a separate evaluation for surveillance activities in those territories and will report those findings separately.

SURVEILLANCE PLAN GOALS

To strengthen ASF and CSF detection capabilities and enhance outbreak preparedness
by testing high-volume sample collection, laboratory capacity, and data management capacities prior to an outbreak scenario, and establishing a baseline of disease absence through timely and consistent surveillance.

Support claims of ASF and CSF disease freedom
by the diagnostic testing of ASF and CSF in targeted subpopulations of swine collected via five surveillance components:

- Foreign Animal Disease (FAD) Investigations
- Sick Pig Veterinary Diagnostic Lab (VDL) Component
- Slaughter & Aggregation Point Component
- Higher Risk Component
- Feral Swine Component

SAMPLING

The evaluation included specimens collected from June 1, 2020, to May 31, 2023, from three targeted swine populations:

- **Commercial** swine are domestic swine raised primarily for food production and confined to a housing facility designed to prevent exposure to feral swine.
- **Higher risk** swine are swine raised in non-commercial settings, such as waste feeders, outdoor raised swine, swine with known or suspected feral swine exposure, and show swine.
- **Feral** swine are free-roaming swine with an increased risk of exposure to ASF and CSF.

During the past three years, APHIS' Foreign Animal Disease Diagnostic Laboratory (FADDL) and National Animal Health Laboratory Network (NAHLN) laboratories tested approximately 43,533 specimens for ASF and CSF and 23,524 specimens for CSF only (Figure 1). An average of 1,864 specimens were tested per month throughout the three-year period. Of note, the average monthly specimen counts increased each year, rising from 1,111 specimens in year one of the evaluation period to 2,638 specimens in year three.

BY THE NUMBERS

Foreign Animal Disease (FAD) Investigations: 118 investigations, 771 specimens
Targets swine populations with certain disease symptoms to rule out ASF, CSF, and other foreign animal diseases. An FAD investigation is initiated by state and federal animal health officials.

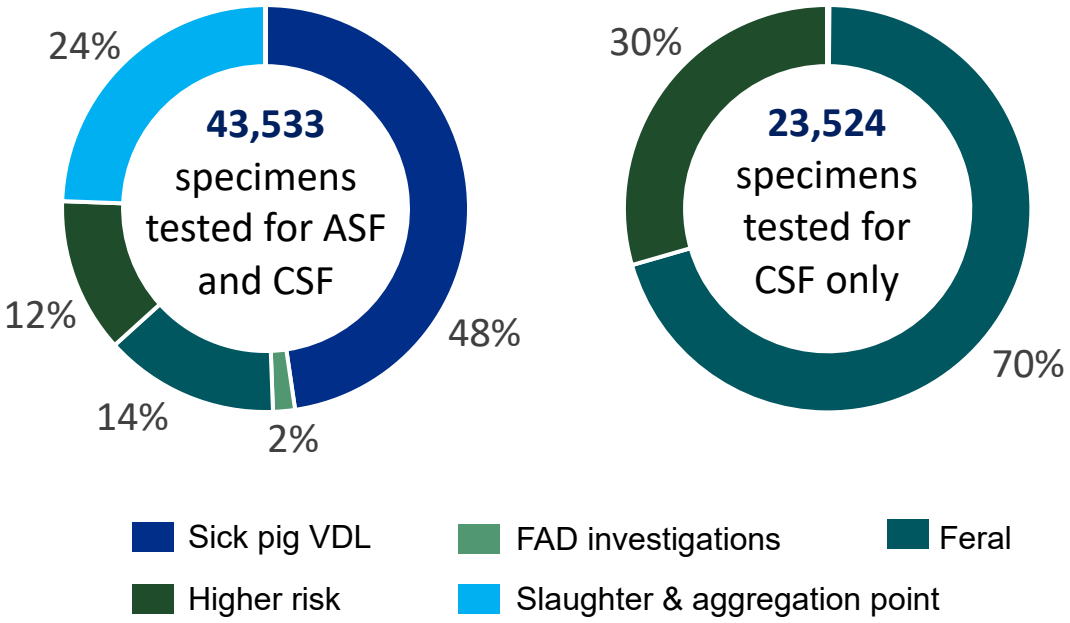
Sick Pig Veterinary Diagnostic Lab (VDL) Component: 20,878 specimens
Targets clinically ill or dead swine on commercial farms.

Slaughter & Aggregation Point Component: 10,643 specimens
Targets clinically ill or dead swine at slaughter facilities and aggregation points such as live animal markets.

Higher Risk Component: 12,385 specimens
Targets clinically ill or dead higher risk swine; apparently healthy animals may be sampled if there are no ill or dead animals available.

Feral Swine Component: 22,605 specimens
Targets feral swine in geographic areas APHIS considers to be of higher risk for disease introduction and transmission.

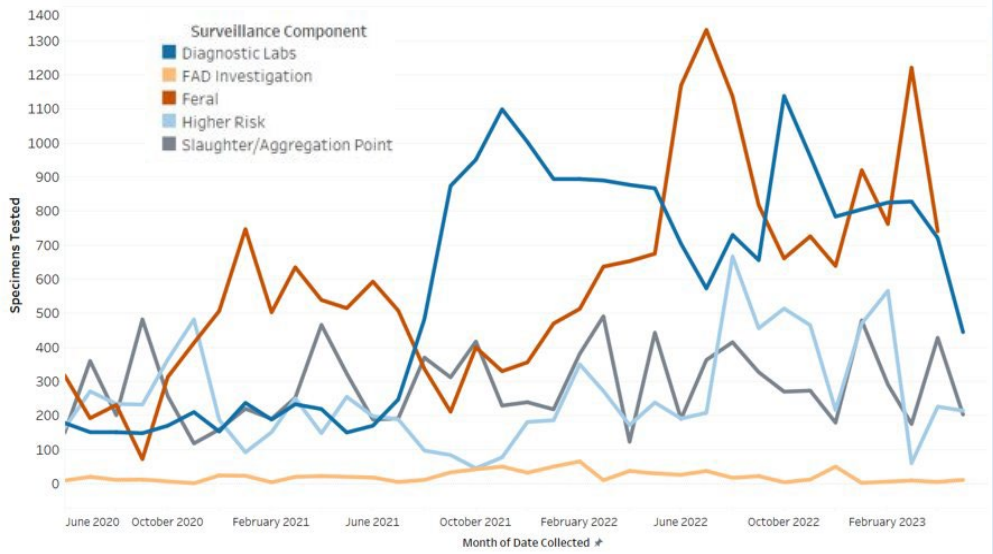
Figure 1: Specimens tested by total and by surveillance component. The number of specimens tested for both ASF and CSF or for only CSF varied by surveillance system component and were carried out in accordance with the Swine Hemorrhagic Fevers Integrated Surveillance Plan.



EFFECTIVENESS METRICS

Sample collection over time is displayed in Figure 2. In fall of 2021, the overall number of specimens tested increased dramatically. The number of specimens tested in the sick pig VDL component increased due to increased stakeholder awareness and engagement with this component. APHIS' addition of four states to the feral swine ASF surveillance in summer 2022 increased the amount of testing that had been occurring in those states. Two significant events—the COVID-19 pandemic and the 2022–2023 highly pathogenic avian influenza outbreak—impacted federal, state, and industry resources, but no appreciable negative impacts were observed in the number of specimens tested nationally.

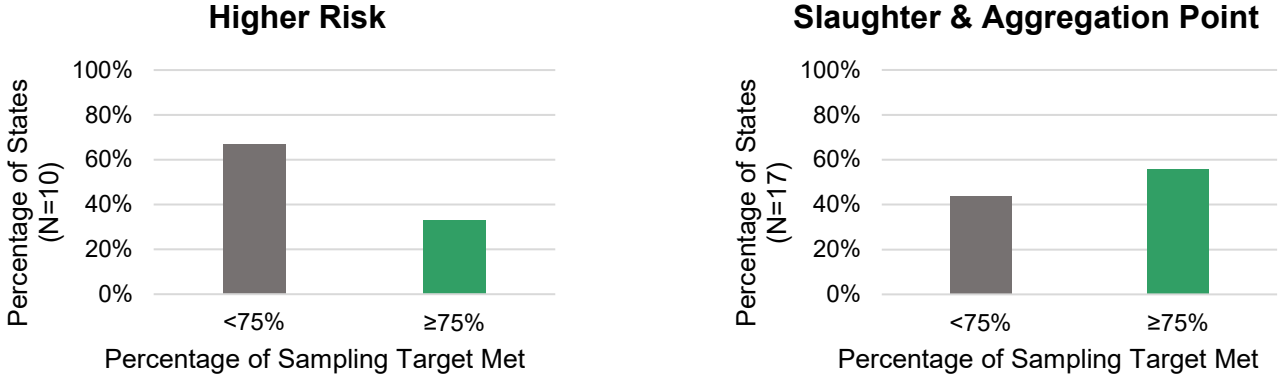
Figure 2. Specimens tested by surveillance component.
The number of specimens tested by surveillance system component by month.



An effective, targeted surveillance system ensures samples represent the different production types and associated risks, as well as the geographic distribution of at-risk populations. Geographic representativeness was evaluated through an analysis of the number of specimens tested compared to sampling target numbers and state swine populations.

APHIS provides targets for annual specimen collection to 10 states for the higher risk component and 17 states for the slaughter & aggregation point component. Figure 3 shows the proportion of these states that met or exceeded 75 percent of their target. APHIS continues to evaluate and adjust target sample numbers to reflect potential changes in swine populations and associated risks, and to identify where increased sampling may best support surveillance objectives.

Figure 3. State sampling targets and performance. The proportion of states that met or exceeded 75 percent of their sampling target based on APHIS guidelines for the higher risk component (left) and slaughter & aggregation point component (right), compared to the proportion that met less than 75 percent of their sampling target.



To achieve geographic representation, the distribution of animals sampled for the sick pig VDL and slaughter & aggregation point components should be proportional to the population distribution of commercial U.S. swine. Comparison of the swine population by state (Figure 4a) and the total specimens tested from the sick pig VDL and slaughter & aggregation point components (Figure 4b) shows that, in general, APHIS, states, and private veterinarians are collecting the most specimens from animals originating from those states with larger swine populations.

Figure 4(a). Average swine population by state. Map of the United States colored on a gradient corresponding to total commercial swine population by state according to NASS Quarterly Hogs and Pigs Inventory reports from June 1, 2020, to March 1, 2023.

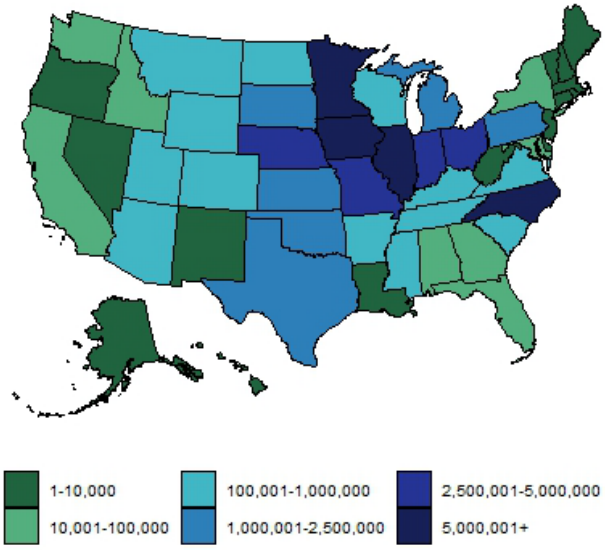
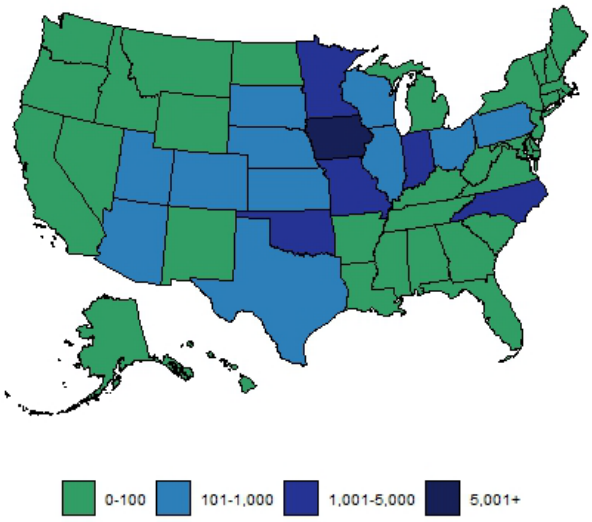


Figure 4(b). Total specimens tested from sick pig VDL and slaughter & aggregation point components. Map of the United States colored on a gradient corresponding to total specimens tested from the sick pig VDL and slaughter & aggregation point components by state from June 1, 2020, to May 31, 2023.



Surveillance among feral swine is risk-based. States with the heaviest feral swine invasions are included in CSF surveillance. Enhancements to feral swine surveillance for ASF were implemented in select counties in Florida, Texas, Louisiana, and Georgia in 2022, due to increased risks of disease introduction. Evaluation of sample collection by state (Figure 5) shows that surveillance is being carried out across the invaded range of feral swine. APHIS will continue to target surveillance sampling in feral swine populations most at risk for a disease incursion.

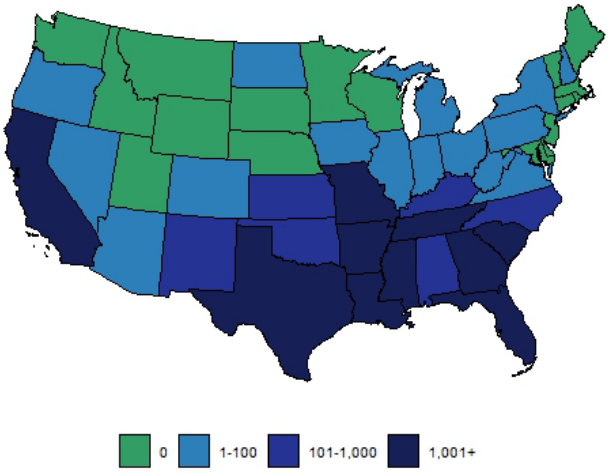


Figure 5. Total feral swine specimens tested. Map of the United States colored on a gradient corresponding to total feral swine specimens tested for CSF only or both ASF and CSF by state from June 1, 2020, to May 31, 2023. Samples collected from Hawaii, Puerto Rico, and Guam are not included.

FUNCTIONAL METRICS

The ease of sampling protocol adoption, variety of accepted sample types, and robust data collection system contribute to the overall functionality of this surveillance plan. Laboratory engagement is demonstrated through the involvement of 12 NAHLN laboratories, 4 of which were added during the 3-year evaluation period. The addition of approved sample types for ASF and CSF surveillance has also increased acceptability and engagement. For example, whole blood was added for the higher risk component, which led to increased specimen volume.

During the last evaluation in 2020, 5.2 percent of specimens were unable to be matched to field data and were therefore not reportable. Since then, plan partners invested significant time and resources to develop tools to support matching processes to address this gap successfully. At the end of this evaluation period, only 0.2 percent (n=569) of specimens were not matched and there are clear processes to quickly get unmatched specimens resolved. Efforts are underway to build out additional capability to link field data to laboratory results and improve the functional metrics.

ACCOMPLISHMENTS AND CHALLENGES

The evaluation identified program successes and areas for improvement as outlined below.

Accomplishments:

- Increased awareness and engagement with the sick pig VDL component, resulting in a fivefold increase in the number of case-compatible specimens tested per month.
- Added 3 sample types to improve sample collection flexibility and efficiency.
- Increased availability of flexible, scalable, and timely surveillance through the addition of four NAHLN laboratories to active surveillance programs.
- Increased data fidelity through automated identification and management of duplicate records, pooled specimens, and other factors impacting data quality.
- Provided consistent sampling from all targeted surveillance components across time and location though effective coordination of federal, state, and industry partners.
- Maintained stable testing rates in the face of significant stresses on personnel and resources during the COVID-19 pandemic and the 2022–2023 highly pathogenic avian influenza outbreaks.

Challenges:

- Limitations among data collection systems to consistently capture clinical signs, age/production type, and premises identification number have been an ongoing challenge since the plan's inception in 2019. Accurate and consistent availability of these data would better support surveillance evaluations and other epidemiologic analysis.
- Data quality issues occasionally delayed linking laboratory results with epidemiologic information gathered by specimen submitters.
- Geographic representativeness could be improved through participation of additional premises and a re-evaluation of state-level sample targets to best support current needs and animal movement patterns.

COLLABORATIVE GOALS FOR IMPROVING THE SURVEILLANCE SYSTEM

Ongoing success of the surveillance plan requires continued collaboration among federal, state, and industry partners, particularly in the following focus areas:

1. Enhance risk-based targeting of swine subpopulations through ongoing disease introduction risk analyses.
2. Re-evaluate state sample target numbers, encourage sample collection from underrepresented states, and identify resource needs to efficiently execute geographically representative disease surveillance.
3. Continue to develop and expand the use of tools to capture and share electronic information through all surveillance components and through all stages of specimen collection, processing, and reporting.

CONCLUSION

The Swine Hemorrhagic Fevers Integrated Surveillance Plan continues to meet its goals by providing ongoing active surveillance for hemorrhagic fevers among the most at-risk animals and populations. By adding approved sample types, expanding surveillance within the NAHLN, and improving data systems, this surveillance plan continues to provide timely and accurate surveillance. For the most recent year assessed, the system tested more than double the number of specimens for ASF and/or CSF when compared to the first year of implementation. The investment in electronic data collection and management systems has allowed real-time monitoring and analysis of surveillance data. Finally, the risk-based, targeted nature of the surveillance system continues to provide an efficient means of achieving the objectives of supporting disease freedom, strengthening detection capabilities, and improving outbreak preparedness.

For more information about CSF and ASF surveillance in the U.S., please view the Swine Hemorrhagic Fevers Integrated Surveillance Plan.

For information about the RISKSUR framework, please visit the RISKSUR website.