DISEASE RESPONSE STRATEGY
PESTE DES PETITS RUMINANTS

FAD PReP
Foreign Animal Disease Preparedness & Response Plan

National Center for Animal Health Emergency Management

USDA

APHIS

United States Department of Agriculture • Animal and Plant Health Inspection Service • Veterinary Services

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The Foreign Animal Disease Preparedness and Response Plan (FAD PReP)—*Disease Response Strategy: Peste des Petits Ruminants (2012)* provides strategic guidance for responding to an animal health emergency caused by peste des petit ruminants (PPR) in the United States.

This *PPR Disease Response Strategy* was last updated in **May 2013**. Please send questions or comments to:

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INTRODUCTION

Peste des petits ruminants (PPR) is a highly contagious disease of sheep and goats that was first observed in Cote d'Ivoire in 1942. Since 1942, it has spread throughout the countries of East, North, and West Africa, the Middle East and some Asian countries. PPR is economically important, especially to developing countries where subsistence farmers are most affected by this disease, which has very high rates of morbidity and mortality.

Recent spread of PPR into Turkey has raised concerns that it could potentially make its way through Europe, bringing the disease uncomfortably close to the United States. This response strategy was drafted in light of these concerns. It is intended to provide animal health emergency responders with the critical information necessary to mount an effective response effort against PPR in the United States. This disease strategy will cover the pertinent etiology and ecology of PPR, as well as control and eradication strategies. Sources of further information on PPR are listed at the end of this document.

Other documents provide further detail on incident coordination and general foreign animal disease (FAD) response. The *APHIS Foreign Animal Disease Framework: Roles and Coordination* (FAD PReP Manual 1–0) provides an introduction to APHIS FAD preparedness and response, an overview of the roles and responsibilities of different government agencies involved in an FAD response effort, as well as information on funding, incident management, and communication strategy. Additionally, an overview of FAD response strategies is available in the *APHIS Foreign Animal Disease Framework: Response Strategies* (FAD PReP Manual 2–0). These documents and others are available here: http://www.aphis.usda.gov/animal_health/emergency_management/. They are also available on the APHIS Intranet for APHIS employees: http://inside.aphis.usda.gov/vs/em/fadprep.shtml.

NATURE OF THE DISEASE

Peste des petits ruminants virus (PPRV) belongs to the Morbillivirus genus of the *Paramyxoviridae* family. Rinderpest and the measles virus also belong to this family and genus. This pleomorphic virus is enveloped with a single-stranded ribonucelic acid (RNA) genome. There is only one recognized serotype of PPR but partial sequencing of a prominent protein has allowed their categorization into four lineages which reflect geographic origin.

PPR primarily affects sheep and goats, but some wild ungulates are susceptible: Laristan sheep, gemsbok, gazelles, buffaloes, springbuck, impala, and wild goats. There is no known reservoir and no carrier state. PPRV infection results in variable disease presentation among susceptible populations varying by species, breed, and age of the affected animal. PPRV does not affect humans.

Transmission

Transmission occurs via direct contact with infected animals and through aerosols formed by the coughing and sneezing of sick animals. Fomites, such as bedding, feed, and water troughs can also serve as a means of disease transmission, if only for a short time due to the unstable nature of PPRV in the environment.

Incubation Period

The incubation period is 4–6 days but can range between 3–10 days. For purposes of the World Organization for Animal Health (OIE) *Terrestrial Animal Health Code* (2012) the incubation period is 21 days.[1]

Clinical Signs

Clinical signs typically appear within 2–6 days of infection and can vary according to different factors such as PPRV lineage, species affected, breed, and immune status. While there is only one serotype, there are several different forms of the disease (acute, peracute, and subacute) that determine the severity of the course of illness.

In general the disease causes fever (104–106°F/40–41°C), mucopurulent (mucus and pus) oculo-nasal discharge, conjunctivitis, and necrosis of the mucosal membranes. Death is usually the result of bronchopneumonia or dehydration from severe diarrhea.

Morbidity and Mortality

Morbidity and mortality vary with the species affected and the age of the population, generally morbidity can reach 100 percent and mortality 90 percent. Morbidity is higher among goats than sheep, and animals 3 months to 2 years of age are more severely affected than those younger or older.

Among susceptible goat populations, mortality rates of 50–100 percent can be expected. High rates of mortality have also been reported among captive wildlife found in zoos.

[1] World Organization for Animal Health (OIE). 2012. Article 14.8.1 "General Provisions." *Terrestrial Animal Health Code*. www.oie.int.

Differential Diagnosis

According to the OIE, the differential diagnosis should include the following diseases:

- bluetongue,
- coccidiosis,
- contagious caprine pleuropneumonia,
- contagious ecthyma,
- foot-and-mouth disease,
- heartwater,
- pasteurellosis,
- mineral poisoning, and
- rinderpest.

Laboratory Diagnosis

When PPR is suspected, laboratory diagnostic testing will be performed at the National Veterinary Services Laboratories, Foreign Animal Disease Diagnostic Laboratory (NVSL FADDL) at Plum Island, NY. Confirmatory tests include histopathology, polymerase chain reaction (PCR), virus isolation (VI), and virus neutralization (VN). Tables 1 and 2 provide a look of what specimens are needed to perform each test and how those specimens should be packaged for shipping to NVSL FADDL.

Table 1. Diagnostic Tests Performed for PPR at NVSL FADDL[2]

Procedure	Specimen	Minimum test time (days)
Histopathology	Fixed tissue	7
PCR	Blood, tissue	2
Virus isolation	Blood, tissue, swab	14
Virus neutralization	Serum	5

[2] National Veterinary Services Laboratory. "Catalog of Services/Fees." 2011. Available at http://www.aphis.usda.gov/animal_health/lab_info_services/diagnos_tests.shtml.

Table 2. Sample Collection for Diagnostic Testing[3]

Specimen	Medium	Shipping preservative
Serum	Red top tube (10 ml)	Ice pack
Whole blood	Green top tube (10 ml) Purple top tube (10 ml)	Ice pack
Dacron swab: nasal, ocular, oral, fecal	TBTB (3 ml)	Ice pack
Fresh tissue: bronchial lymph node (LN), mesenteric LN, lung, spleen, intestinal mucosa	Separate Whirlpak bag per tissue type	Ice pack
Set of tissues	Formalin (10:1)	Formalin

Note: TBTB = tris-buffered tryptose broth.

For detailed information concerning the handling and shipping of diagnostic specimens as well as overall guidance on FAD investigation please see Veterinary Services (VS) Guidance Document 12001.1 (previously APHIS VS Memorandum 580.4) and the *FAD Investigation Manual*.

Treatment and Vaccination

A homologous attenuated vaccine of the Nigeria 75/1 (Lineage 1) strain has been used successfully to protect sheep and goats with no adverse side effects. Vaccinated animals do not transmit virus to in-contact animals and remain immune to PPRV for at least 3 years, which is usually the economic life span of these animals. This vaccine does not possess DIVA (differentiation between infected and vaccinated animals) capabilities; because of this, recombinant vaccines have been developed. Two vaccines using capripoxvirus as a vector for the respective expression of the hemagglutinin (H) protein and the fusion (F) protein of PPRV have been shown to induce long-lasting immunity and have DIVA capability when an enzyme-linked immunosorbant assay (ELISA) is used. An added benefit is that these recombinant vaccines protect against both capripoxvirus and PPRV.[4]

Persistence of PPRV

PPRV is fairly fragile and cannot exist for long periods of time in the environment. Specifics regarding the persistence of PPRV are not available, but because this virus is very similar to rinderpest, reasonable assumptions may be drawn from what is known about the chemical and physical susceptibility of rinderpest. Table 3 contains information on the persistence of PPRV to physical and chemical action.

[3] National Veterinary Services Laboratory. "Disease Specific Guide to Sample Collection." Available at http://www.aphis.usda.gov/animal_health/lab_info_services/collection_submission.shtml.

[4] Abubakar M et al. 2011. "Diagnosis and control strategies for peste des petits ruminants virus: Global and Pakistan perspectives." *Pakistan Veterinary Journal*. 31(4): 267–274.

Table 3. Resistance to Physical and Chemical Action

Action	Resistance
Temperature	Half-life calculation of 2 hours/37°C (98.6°F); virus destroyed at 50°C (122°F)/60 minutes
pH	Stable between pH 5.8 and 10.0; thus inactivation at pH < 4.0 or > 11.0
Disinfectants/ chemicals	Effective agents include alcohol, ether and common detergents; susceptible to most disinfectants, e.g., phenol, sodium hydroxide 2 percent/ 24 hours
Survival	Survives for long periods in chilled and frozen tissues

Source: OIE. 2009. Technical Disease Cards, Peste des Petits Ruminants www.oie.int.

Criteria for Proof of Freedom

According to the OIE Terrestrial Animal Health Code (2012)[5]

> A country may be considered free from PPR when it has been shown that PPR has not been present for at least the past three years.
>
> This period shall be six months after the slaughter of the last affected animal for countries in which a stamping-out policy is practiced with or without vaccination against PPR.

A zone shall be considered as infected with PPR until:[6]

1. at least 21 days have elapsed after the confirmation of the last case and the completion of a stamping-out policy and disinfection procedures, or

2. six months have elapsed after the clinical recovery or death of the last affected animal if a stamping-out policy was not practiced.

PPR Response: Control and Eradication

The APHIS goals of an FAD response are to (1) detect, control, and contain the disease in animals as quickly as possible; (2) eradicate the disease using strategies that seek to stabilize animal agriculture, the food supply, the economy, and protect public health and the environment; and (3) provide science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated animal products.

Achieving these three goals will allow individual livestock facilities, States, Tribes, regions, and industries to resume normal production as quickly as

[5] World Organization for Animal Health (OIE). Article 14.8.2 "PPR free country." *Terrestrial Animal Health Code*, 2012. www.oie.int.

[6] World Organization for Animal Health (OIE). Article 14.8.3 "PPR infected zone." *Terrestrial Animal Health Code*, 2012. www.oie.int.

possible. They will also allow the United States to regain PPR-free status without the response effort causing more disruption and damage than the outbreak itself.

Case Definitions

Currently there are no finalized or draft versions of APHIS Veterinary Services, Centers for Epidemiology and Animal Health, National Surveillance Unit (NSU) case definitions for PPR. The NSU is developing case definitions for OIE listed diseases, of which PPR is one, as well as endemic diseases of interest. Any future draft case definitions for PPR can be found here: http://inside.aphis.usda.gov/vs/ceah/nsu/case_definitions.shtml (for APHIS employees only).

REPORTING

PPR is a U.S. FAD and an OIE-listed (notifiable) disease of sheep and goats based on its highly contagious nature and potential for high levels of morbidity and mortality. Suspect cases should be reported to a State Animal Health Official or the Area Veterinarian in Charge, who will decide if the report is credible and assign a Foreign Animal Disease Diagnostician (FADD) to further investigate the possibility of PPR infection. For more information on the conduct of FAD investigations please refer to VS Guidance Document 12001.1 (which replaced VS Memorandum 580.4) and the *FAD Investigation Manual*.

Control and Eradication Strategies

Control and eradication strategies are based on three epidemiological principles:

1. Prevent contact between PPRV and susceptible animals.
2. Stop the production of PPRV in infected or exposed animals.
3. Increase the disease resistance of susceptible animals to PPRV or reduce the shedding of PPRV in infected or exposed animals.

The primary control and eradication strategy for PPR in domestic sheep and goats is stamping-out. Stamping-out is the depopulation of clinically affected and in-contact susceptible animals. The response strategy may make use of vaccination to control the outbreak depending on a multitude of factors, including the size and complexity of the outbreak and the number and density of animals affected.

Stamping-Out: Critical Goals

- Within 24 hours of (or as soon as possible after) a premises being classified as an Infected Premises (IP), infected sheep/goats will be depopulated in the quickest, safest, and most humane way possible. In some cases, sheep/goats on Contact Premises (CP) may also be depopulated as soon as possible.
- Where resources are limited, premises will be prioritized so that those with the highest potential for active PPR spread are 'stamped-out' first.
- Based on the epidemiology of the outbreak, prioritizing the sheep/goats to depopulate first may be necessary.
- Public concerns about stamping-out require a well-planned and proactive public relations and liaison campaign. Stakeholders, the public, and the international community must be involved.
- Care should be taken to consider mental health implications for owners and responders in the event a stamping-out strategy is implemented.

SURVEILLANCE

Visual and diagnostic surveillance is essential for control and eradication of an FAD agent. The purpose of surveillance is to define the extent of the disease, detect new outbreaks, and establish disease-free zones. Surveillance activities can aid in establishing priorities in terms of control and mitigation strategies and help evaluate the efficacy of response efforts. They are also critical to maintaining continuity of business and proving disease freedom following an outbreak.

Surveillance personnel are involved in the case definition development and classification process, premises classification, and collection, assessment, and reporting of surveillance findings. Therefore, coordination between personnel conducting surveillance activities and those responsible for quarantine and movement control, biosecurity, disease reporting, and health and safety is critical for an effective response effort.

Currently there is no active surveillance being conducted in the United States for PPR.

EPIDEMIOLOGY INVESTIGATION AND TRACING

Epidemiological investigation and movement tracing during an outbreak are critical in controlling and eradicating FAD outbreaks. The epidemiological investigation involves identifying the index case, characterizing the nature of the outbreak, identifying risk factors for transmission, and developing mitigation strategies. The results of an investigation and tracing lead to identification of all IP and CP and subsequent premises classification. Tracing identifies all movements from or onto IP.

Tracing

Trace Back: Identifying the origin of all animals, animal products, suspected contaminated fomites, people, vehicles, and possible vectors that have been imported onto an IP in order to establish the original source of infection.

Trace Forward: The tracing of all animals, people, and fomites that have left IP and could have possibly transmitted infection to new premises. The premises that received the animals and goods should be investigated and kept under surveillance or quarantine.

Epidemiological investigation and tracing are the responsibility of two staff components within the Incident Command System (ICS): the Epidemiology Cell (Situation Unit, Planning Section) and the Tactical Epidemiology Group (Disease Surveillance Branch, Operations Section).

QUARANTINE AND MOVEMENT CONTROL

The first principle, prevent contact between PPR virus and susceptible animals, can be partly accomplished through quarantine and movement control (QMC). The use of strict biosecurity measures and QMC has been used quite successfully during outbreaks in African countries.

Quarantine refers to imposing restrictions on entering or leaving a premises, area, or region where disease exists or is suspected. Quarantine stops the movement of infected animals, contaminated animal products and fomites from Infected, Contact, and Suspect Premises.

Movement control refers to activities regulating the movement of people, animals, animal products, vehicles, and equipment in an area subject to certain criteria. Movement control is accomplished through a permit system that allows entities to make necessary movements without creating an unacceptable risk of disease spread.

Each State's animal health emergency response plan should describe the implementation of quarantine and movement controls, including a permit system. U.S. Department of Agriculture (USDA) may impose a Federal quarantine and restrict interstate commerce from the infected States, asking the States (or adjoining countries) to provide resources to maintain and enforce the quarantine.

All decisions in regard to quarantine and movement control will be based on science-based assessments of the disease agent, routes and risk of transmission, and the interaction of other factors such as available vectors and weather.

Zone, Area, and Premises

Appropriate premises designations are required for implementation of quarantine and movement control measures. The Incident Commander will work with the Disease Surveillance Branch (Operations Section) and Situation Unit (Planning Section) to establish an Infected Zone (IZ) and a Buffer Zone (BZ) within 12 hours of the identification of the index case. Once the Control Area [CA (IZ +BZ)] is established, quarantine and movement controls, including a permit system will be implemented. See Attachment A for further information on zone, area, and premises designations.

Wildlife Management and Vector Control

Wildlife management and vector control (WMVC) is an important component of an FAD outbreak response effort. Wild animals may become exposed or contribute to the transmission of the disease to domestic animals either as biological or mechanical vectors. Furthermore, wild animals may potentially complicate efforts to establish freedom from disease. WMVC involves identifying susceptible wildlife species, determining how many species may be infected, and preventing the spread by implementing control measures.

In the event of a PPR outbreak in domestic sheep and/or goats, APHIS VS will work in close collaboration and coordination with other agencies, entities, and units that have primary jurisdiction over wildlife.

Mass Depopulation and Euthanasia

USDA APHIS personnel, in coordination with Incident Command, make the final decision on whether to euthanize or depopulate animals. In a PPR outbreak, euthanasia or mass depopulation should be provided to the affected animals as safely, quickly, efficiently, and humanely as possible. In addition, the emotional and psychological impact on animal owners, caretakers, their facilities, and other personnel should be minimized. The method of depopulation will depend on facility characteristics, method characteristics (practicality, reliability, irreversibility, compatibility), personnel considerations, carcass considerations, equipment considerations, and the environment where the animals are maintained.

Disposal

Proper disposal of animal carcasses and materials (e.g., bedding, feed) can be used to prevent or mitigate pathogen spread. The goal is to conduct operations in a timely, safe, biosecure, aesthetically acceptable, and environmentally responsible manner. Wastes requiring disposal following an FAD outbreak include carcasses, animal products, contaminated manure, litter, bedding, contaminated feed, contaminated personal protective equipment, contaminated materials and equipment that cannot be cleaned and disinfected, and antimicrobials from cleaning and disinfecting.

Disposal will involve more Federal authorities due to its wider reaching impact on health and the environment. USDA will coordinate with the Department of Health and Human Services (HHS), the Department of Homeland Security, and the Environmental Protection Agency (EPA) to provide technical assistance and guidance in alignment with State and local regulations.

Cleaning and Disinfection

The goal of cleaning and disinfection (C&D) is to inactivate pathogens at IP and prevent the off-site spread of pathogens. When performing C&D procedures, it is vitally important to do so in the safest manner possible. When planning a C&D task the following components should be carefully thought through: definition of the area to be cleaned and disinfected, C&D methods, personnel, regulatory permits, and materials, supplies, and equipment needed. The plan should also include the scientific rationale for C&D parameters, the process by which the premises will be certified and recorded as successfully cleaned and disinfected, protocols for cleaning and disinfection, and procedures for handling damaged private property due to activities.

There are various methods of C&D that may be applied to a site. Examples include steam cleaning, pressure washing, or scrubbing by hand; shoveling, vacuuming, or sweeping out bulk materials; chemical disinfection, and physical (heat, ultraviolet light, or desiccation) methods. As previously mentioned in Table 3, PPR is susceptible to alcohol, ether, and other disinfectants, such as 2 percent sodium hydroxide (for 24 hours) and phenol. Currently, there are no EPA registered products for use against PPR.

C&D protocols, procedures, and methods, along with safety issues and precautions, are more thoroughly discussed in the *National Animal Health Emergency Management System (NAHEMS) Guidelines: Cleaning and Disinfection* (see References and Resources section for more information).

Appraisal and Compensation

Appraisal and compensation for assets lost during a disease response effort reduce the spread of disease by encouraging owners to report suspected disease. The Department of Agriculture is authorized by the Animal Health Protection Act (7 U.S.C. 8301 et seq.) to pay claims to owners for any assets taken or destroyed in the course of a response effort. Title 9 of the Code of Federal Regulations (CFR) Part 53 outlines the expenses that the Department may pay for purchasing, destroying, and disposing of animals and materials in these situations. Fair market value appraisals will be provided for animals and materials destroyed to prevent the spread of an FAD. Please refer to the APHIS Livestock Appraisal, Indemnity, and Compensation website for further information.

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Attachment A Zone, Area, and Premises Designations

Table A-1 and A-2 contain a summary of the zone, area, and premises designations. For more information please refer to the *APHIS Foreign Animal Disease Framework: Response Strategies* (FAD PReP Manual 2-0) available at http://inside.aphis.usda.gov/vs/em/fadprep.shtml (for APHIS employees), or http://www.aphis.usda.gov/animal_health/emergency_management/ (publicly available).

Table A-1. Summary of Premises Designations

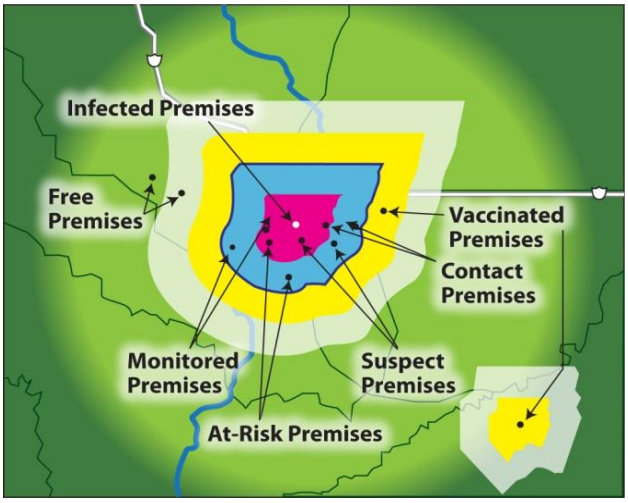
Premises	Definition	Zone
Infected Premises (IP)	Premises where a presumptive positive case or confirmed positive case exists based on laboratory results, compatible clinical signs, case definition, and international standards.	Infected Zone
Contact Premises (CP)	Premises with susceptible animals that may have been exposed to PPR, either directly or indirectly, including but not limited to exposure to animals, animal products, fomites, or people from Infected Premises.	Infected Zone, Buffer Zone
Suspect Premises (SP)	Premises under investigation due to the presence of susceptible animals reported to have clinical signs compatible with PPR. This is intended to be a short-term premises designation.	Infected Zone, Buffer Zone, Surveillance Zone, Vaccination Zone
At-Risk Premises (ARP)	Premises with susceptible animals, but none of those susceptible animals have clinical signs compatible with PPR. Premises objectively demonstrates that it is not an Infected Premises, Contact Premises, or Suspect Premises. At-Risk Premises seek to move susceptible animals or products within the Control Area by permit. Only At-Risk Premises are eligible to become Monitored Premises.	Infected Zone, Buffer Zone
Monitored Premises (MP)	Premises objectively demonstrates that it is not an Infected Premises, Contact Premises, or Suspect Premises. Only At-Risk Premises are eligible to become Monitored Premises. Monitored Premises meet a set of defined criteria in seeking to move susceptible animals or products out of the Control Area by permit.	Infected Zone, Buffer Zone
Free Premises (FP)	Premises outside of a Control Area and not a Contact or Suspect Premises.	Surveillance Zone, Free Area
Vaccinated Premises (VP)	Premises where emergency vaccination has been performed. This may be a secondary premises designation.	Containment Vaccination Zone, Protection Vaccination Zone

Table A-2. Summary of Zone and Area Designations

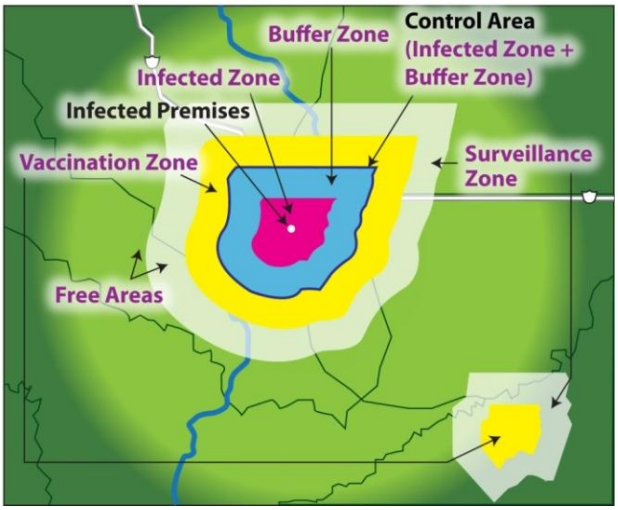
Zone/Area	Definition
Infected Zone (IZ)	Zone that immediately surrounds an Infected Premises.
Buffer Zone (BZ)	Zone that immediately surrounds an Infected Zone or a Contact Premises.
Control Area (CA)	Consists of an Infected Zone and a Buffer Zone.
Surveillance Zone (SZ)	Zone outside and along the border of a Control Area.
Free Area (FA)	Area not included in any Control Area.
Vaccination Zone (VZ)	Emergency Vaccination Zone classified as either a Containment Vaccination Zone (typically inside a Control Area) or a Protection Vaccination Zone (typically outside a Control Area). This may be a secondary zone designation.

Figure A-1. Example Premises, Zones, and Areas

Premises



Zones and Areas



Attachment B Abbreviations

APHIS	Animal and Plant Health Inspection Service
BZ	Buffer Zone
C&D	cleaning and disinfection
CA	Control Area
CFR	Code of Federal Regulations
CP	Contact Premises
DIVA	differentiation between infected and vaccinated animals
ELISA	enzyme-linked immunosorbent assay
EPA	Environmental Protection Agency
FAD	foreign animal disease
FAD PReP	Foreign Animal Disease Preparedness and Response Plan
FADD	Foreign Animal Disease Diagnostician
FADDL	Foreign Animal Disease Diagnostic Laboratory
HHS	Department of Health and Human Services
ICS	Incident Command System
IP	Infected Premises
IZ	Infected Zone
LN	lymph node
NAHEMS	National Animal Health Emergency Management System
NSU	National Surveillance Unit
NVSL	National Veterinary Services Laboratories
OIE	World Organization for Animal Health
PCR	polymerase chain reaction
PPR	peste des petits ruminants
PPRV	peste des petits ruminants virus
QMC	quarantine and movement control
RNA	ribonucleic acid
TBTB	tris-buffered tryptose broth
TDD	telecommunications device for the deaf

USAHA	United States Animal Health Association
USDA	U.S. Department of Agriculture
VI	virus isolation
VN	virus neutralization
VS	Veterinary Services
WMVC	wildlife management and vector control