

**CONTAGIOUS BOVINE PLEUROPNEUMONIA
STANDARD OPERATING PROCEDURES:
1. OVERVIEW OF ETIOLOGY AND ECOLOGY**

FAD PReP

**Foreign Animal Disease
Preparedness & Response Plan**



**United States
Department of
Agriculture**

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The Foreign Animal Disease Preparedness and Response Plan (FAD PReP) Standard Operating Procedures (SOPs) provide operational guidance for responding to an animal health emergency in the United States.

These draft SOPs are under ongoing review. This document was last updated in **February 2017**. Please send questions or comments to:

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Contagious Bovine Pleuropneumonia (CBPP)

Etiology and Ecology Quick Summary

Disease

Contagious bovine pleuropneumonia, also known as lung sickness.

Mortality and Morbidity

The closer animals are kept together, the higher the morbidity due to aerosol transmission. Mortality varies from 30 to 80 percent.

Susceptible Species

Large ruminants.

Zoonotic Potential (yes/no)?

No.

Transmission

The bacteria are acquired chiefly through inhalation of infectious aerosols during repeated, close contact between animals.

Persistence in the Environment

Survives outside the host for up to 3 days in tropical areas and up to 2 weeks in temperate zones. Persists in unclean shaded pens for as long as 6 months.

Animal Products and By-Products

Remains viable in wool/hair and dry scabs on skin for up to 3 months.

1.1 Introduction

Contagious bovine pleuropneumonia (CBPP) is the most threatening infectious disease of cattle in Africa since rinderpest was eliminated. CBPP was first described in Germany in 1693.¹ From the 1700s to the 1800s, cattle trade and movements brought CBPP from Europe to Africa, North America, and Australia.² CBPP was eradicated from most continents, including North America, by the mid-1900s. CBPP is endemic in Africa, and outbreaks have periodically occurred in southern Europe, parts of Asia, and the Middle East.³ The United States eliminated CBPP in 1892 after an intensive quarantine and slaughter program.

The impact of CBPP on farmers and the economy is significant, costing millions of dollars annually in Africa.⁴ CBPP in cattle targets the lungs, causing anorexia, fever, and respiratory distress. Naïve cattle herds infected with CBPP can experience high mortality rates, and surviving cattle often become carriers that can introduce the pathogen into uninfected herds.⁵ CBPP does not infect humans.

1.1.1 Goals

As a preparedness goal, the Animal and Plant Health Inspection Service (APHIS) will provide etiology and ecology summaries for CBPP and update these summaries at regular intervals.

As a response goal, the Unified Command and stakeholders will have a common set of etiology and ecology definitions and descriptions, to ensure proper understanding of contagious bovine pleuropneumonia when establishing or revising goals, objectives, strategies, and procedures.

1.2 Purpose

The purpose of this document is to provide responders and stakeholders with a common understanding of the disease agent.

1.3 Recent Outbreaks

Between 1995 and 2002, 27 African countries reported CBPP.⁶ For example, Tanzania was hit particularly hard from 1990–2003, when it is estimated that 350,000 cattle died and more than \$40 million was lost due to CBPP; Tanzania reports that approximately \$2–3 million is still lost

¹ Food and Agriculture Organization of the United Nations (FAO). (2001). Contagious bovine pleuropneumonia in Southern Africa. *EMPRES Transboundary Animal Diseases Bulletin*, 19/4. Retrieved from <ftp://ftp.fao.org/docrep/fao/004/y3428e/y3428e00.pdf>.

² Fischer, A., et al. (2012). The Origin of the ‘Mycoplasma mycoides Cluster’ Coincides with Domestication of Ruminants. *PLoS ONE*, 7(4), e36150.

³ OIE World Animal Health Information Database (WAHID). (2015). Contagious Bovine Pleuropneumonia. Disease Distribution Maps. http://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home.

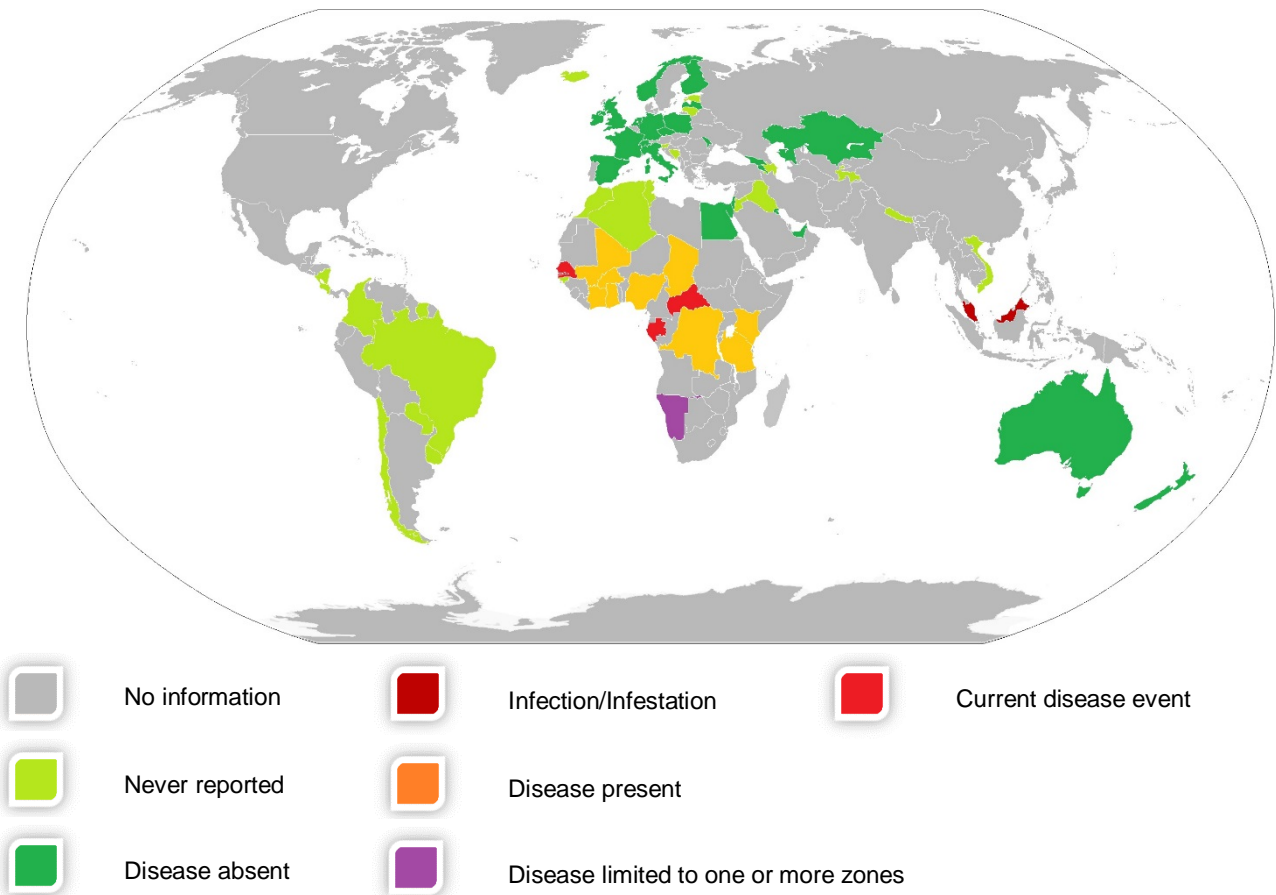
⁴ Tambi, N.E., et al. (2006). An estimation of the economic impact of contagious bovine pleuropneumonia in Africa. *Rev. sci. tech. Off. Int. Epiz.*, 25(3), 999-1012.

⁵ USDA Animal and Plant Health Inspection Service (APHIS). (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

⁶ Tambi, N.E., et al. (2006). An estimation of the economic impact of contagious bovine pleuropneumonia in Africa. *Rev. sci. tech. Off. Int. Epiz.*, 25(3), 999-1012.

every year through vaccination, surveillance, and cattle deaths.⁷ In 2010, the Democratic Republic of Congo and Gabon reported CBPP for the first time. By 2011, the African Union–Interafrican Bureau for Animal Resources (AU-IBAR) reported that 18 African countries had outbreaks of CBPP. There were over 16,800 cases and 3,000 cattle deaths. Within African countries, CBPP remains poorly reported.⁸

Figure 1-1. CBPP Disease Distribution Map⁹



1.4 Etiology

1.4.1 Name

CBPP is also referred to as lung sickness.¹⁰

⁷ Kusiluka, L. and F. Sudi. (2003). Review of successes and failures of contagious bovine pleuropneumonia control strategies in Tanzania. *Preventive Veterinary Medicine*, 59(3), 113-123.

⁸ Center for Agriculture and Biosciences International (CABI). (2015). Contagious Bovine Pleuropneumonia. Retrieved from <http://www.cabi.org/isc/datasheet/88090>.

⁹ OIE WAHID. (2015). Contagious Bovine Pleuropneumonia. Disease Distribution Maps. http://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home.

¹⁰ CABI. (2015). Contagious Bovine Pleuropneumonia. Retrieved from <http://www.cabi.org/isc/datasheet/88090>.

1.4.2 Bacterial Characteristics

The causative agent of the disease has the following characteristics¹¹:

- Family: *Mycoplasmataceae*
- Genus: *Mycoplasma*
- Species: *mycoides*
- Subspecies: *mycoides* small colony (MmmSC)

1.4.3 Morphology

Mycoplasma bacterium are the smallest free-living life forms and most likely evolved from Gram-positive bacteria. *Mycoplasma mycoides* lack cell walls and are resistant to certain antibiotics such as beta-lactams (for example, penicillin).^{12,13,14} The most studied strain of MmmSC is PG1T. Its genome is made up of one chromosome consisting of approximately 1,200 kilobase pairs.¹⁵

1.4.4 Genus Characteristics

All *Mycoplasma mycoides* subspecies cause disease in ruminants. They include *M. mycoides* subspecies *capri*, *M. capricolum* subspecies *capripneumoniae*, *M. capricolum* subspecies *capricolum*, and *M. leachii* as well as MmmSC. Mmm large colony has recently been found to be a serovar of *M. mycoides* subspecies *capri*.¹⁶

1.4.5 Subspecies Characteristics

MmmSC consists of three lineages, European, Southern African, and the rest of Africa. The European strains have lower pathogenicity, possibly accounted for by the fact that they cannot oxidize glycerol. The African strains are more diverse.¹⁷

1.5 Ecology

1.5.1 Susceptible Species

- Cattle (*Bos taurus*),
- zebu (*Bos indicus*),
- Asian buffalo (*Bubalus bubalis*),

¹¹ Veterinary Bacteriology: information about important bacteria. (2016). Retrieved from <http://www.vetbact.org/vetbact/>.

¹² Razin, S., Yogevev, D., & Naot, Y. (1998). Molecular biology and pathogenicity of mycoplasmas. *Microbiology and Molecular Biology Reviews*, 62(4), 1094-1156.

¹³ Muto, A., Osawa, S. (1987). The guanine and cytosine content of genomic DNA and bacterial evolution. *Proceedings of the National Academy of Sciences*, 84(1), 166-169.

¹⁴ OIE. (2013). Contagious Bovine Pleuropneumonia. *Technical Disease Card*. www.oie.int.

¹⁵ Westberg, J., et al. (2004). The genome sequence of *Mycoplasma mycoides* subsp. *mycoides* SC type strain PG1T, the causative agent of contagious bovine pleuropneumonia (CBPP). *Genome Research*, 14(2), 221-227.

¹⁶ CABI. (2015). Contagious Bovine Pleuropneumonia. Retrieved from <http://www.cabi.org/isc/datasheet/88090>.

¹⁷ OIE. (2013). Contagious Bovine Pleuropneumonia. *Technical Disease Card*. www.oie.int.

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- captive bison (*Bison bison*), and
 - yak (*Poephagus grunniens*, formerly *Bos grunniens*).^{18,19}

Sheep and goats in Africa, Portugal, and India have been infected with CBPP.²⁰ African buffaloes (*Syncerus caffer*) seem unaffected by CBPP. Other wildlife have not been shown to play a role in CBPP disease or transmission.²¹

1.5.2 Introduction and Transmission of CBPP

The bacteria are primarily transmitted through the exchange and inhalation of infectious aerosols when animals are in close contact with each other. The bacteria can be found in nasal discharges, saliva, urine, fetal membranes, and uterine excretions. Transplacental transmission can also occur. Infected CBPP cattle without clinical signs may shed the bacteria when stressed.²²

1.5.3 Incubation and Infectious Periods

The incubation period of CBPP varies, but in most cases occurs within 2–8 weeks of exposure. Incubation periods of up to 6 months have been reported.²³

1.5.4 Clinical Signs

Clinical signs will appear in 2–3 weeks, but some cattle die suddenly with no signs other than fever.²⁴ There are three forms of CBPP:

- **Acute:** Acutely affected cattle may be depressed, anorexic, and febrile with reduced milk production. Respiratory signs follow including coughing, panting, and mucoid or purulent nasal discharge. Severely affected animals stand with head and neck extended, elbows out, and breathing with an open mouth. Respiration appears labored and painful. Most adult cattle with acute CBPP die in 1–3 weeks. Calves up to 6 months old may have respiratory signs accompanied by polyarthritis and painful, swollen joints. The acute form occurs in approximately 33 percent of all cases.
- **Subacute:** Subacute CBPP is similar to, but milder than, the acute form of the disease and can develop into chronic infections.
- **Chronic:** Animals with chronic CBPP may have recurrent low-grade fever, poor body condition, and coughing or breathing difficulty during exercise. The severity depends on

¹⁸ CABI. (2015). Contagious Bovine Pleuropneumonia. Retrieved from <http://www.cabi.org/isc/datasheet/88090>.

¹⁹ Center for Food Security and Public Health (CFSPH), Iowa State University. (2008). Contagious Bovine Pleuropneumonia. *Technical Factsheet*. Retrieved from http://www.cfsph.iastate.edu/Factsheets/pdfs/contagious_bovine_pleuropneumonia.pdf.

²⁰ OIE. (2014). Chapter 2.4.9. Contagious Bovine Pleuropneumonia. *Terrestrial Manual*. Retrieved from www.oie.int.

²¹ USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

²² USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

²³ USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

²⁴ CFSPH, Iowa State University. (2008). Contagious Bovine Pleuropneumonia. *Technical Factsheet*. Retrieved from http://www.cfsph.iastate.edu/Factsheets/pdfs/contagious_bovine_pleuropneumonia.pdf.

other factors including nutrition, parasitism, and general health. Cattle may recover from chronic CBPP, although lung lesions may take a long time to heal.²⁵

Cattle recovering from CBPP may not have apparent clinical signs but still have the ability to spread disease. Females may abort or give birth to stillborn calves.^{26,27}

1.5.5 Morbidity and Mortality

Morbidity and mortality rates are extremely varied. CBPP in endemic regions may only affect 5–10 percent of cattle in a herd. In naïve herds or animals kept in close proximity, morbidity rates can be much higher. Mortality is most often seen corresponding with the acute form and rates can be as high as 50 percent. The CBPP strain, cattle breed, animal's nutritional intake, and individual health are some factors that affect morbidity and mortality. Animals that recover from CBPP become fully immune.^{28,29}

1.5.6 Differential Diagnosis

CBPP is hard to differentiate from other causes of cattle respiratory disease. Pneumonia (particularly unilateral illness) in adults and polyarthritis in calves should be considered warning signs for potential CBPP infection. Differentials include:

- acute form
 - bovine pasteurellosis,
 - hemorrhagic septicemia,
 - theileriosis,
 - bovine ephemeral fever, and
 - traumatic pericarditis.
- chronic form
 - ecchinococcosis (hydatid cysts),
 - actinobacillosis,
 - tuberculosis,
 - bovine farcy, and

²⁵ FAO. (2002). Recognizing Contagious Bovine Pleuropneumonia. *FAO Animal Health Manual*. Retrieved from <http://www.fao.org/3/a-y4142e.pdf>.

²⁶ USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

²⁷ CFSPH, Iowa State University. (2008). Contagious Bovine Pleuropneumonia. *Technical Factsheet*. Retrieved from <http://www.cfsph.iastate.edu/DiseaseInfo/disease.php?name=contagious-bovine-pleuropneumonia>.

²⁸ USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

²⁹ CFSPH, Iowa State University. (2008). Contagious Bovine Pleuropneumonia. *Technical Factsheet*. Retrieved from <http://www.cfsph.iastate.edu/DiseaseInfo/disease.php?name=contagious-bovine-pleuropneumonia>.

- pulmonary abscesses.^{30,31}

1.5.7 Reporting Criteria

- CBPP is a U.S. foreign animal disease (FAD) and an OIE-notifiable disease.
- Follow standard FAD reporting procedures according to Veterinary Services (VS) Guidance 12001 (replaces VS memorandum No. 580.4).
- Suspect cases are reported to the State Animal Health Official and the APHIS VS Assistant Director at the District.³²

1.6 Environmental Persistence of CBPP

CBPP is susceptible to both heat and disinfectants.

Table 1-1. Resistance of CBPP to Physical and Chemical Action³³

Action	Resistance
Temperature	Inactivated within 60 minutes at 56°C and 2 minutes at 60°C.
pH	Inactivated by acid and alkaline pH.
Chemicals/Disinfectants	Inactivated by many of the routinely used disinfectants. Inactivated by mercuric chloride (0.01 percent/1 minute), phenol (1 percent/3 minutes), and formaldehyde solution (0.5 percent/30 seconds).
Survival	Survives outside the host for up to 3 days in tropical areas and up to 2 weeks in temperate zones. Many survive more than 10 years frozen.

1.7 Vaccination

Two attenuated MmmSC strains are used for vaccination in enzootic areas (such as Africa):

- Strain T1/44: mild strain
- Strain T1sr: avirulent, but gives shorter immunity (~6 months)

Post injection, localized inflammation may occur. If reaction becomes extreme, antibiotics are necessary or the animal may die. In areas free from CBPP or with low occurrence, vaccination is not recommended. The OIE and the Food and Agriculture Organization of the United Nations (FAO) only support the use of T1/44. In areas free from CBPP or with low occurrence (for example, Europe), vaccination is not recommended.^{34,35}

³⁰ USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

³¹ FAO. (2002). Recognizing Contagious Bovine Pleuropneumonia. *FAO Animal Health Manual*. Retrieved from <http://www.fao.org/3/a-y4142e.pdf>.

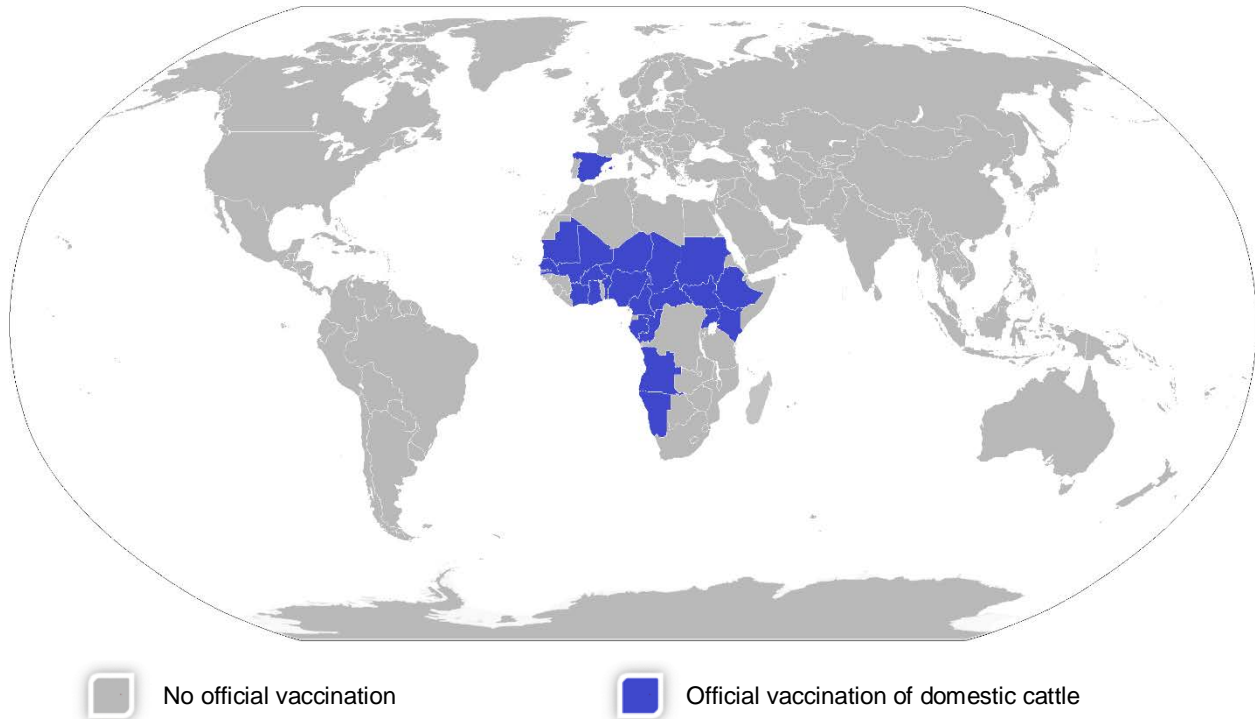
³² USDA APHIS. (2013). Case Definition: Contagious Bovine Pleuropneumonia. Retrieved from http://inside.aphis.usda.gov/vs/em/downloads/fad_prep/case_definitions/contagious_bo_pleuropneumonia.pdf.

³³ OIE. (2013). Contagious Bovine Pleuropneumonia. *Technical Disease Card*. Retrieved from www.oie.int.

³⁴ OIE. (2013). Contagious Bovine Pleuropneumonia. *Technical Disease Card*. Retrieved from www.oie.int.

³⁵ CABI. (2015). Contagious Bovine Pleuropneumonia. Retrieved from <http://www.cabi.org/isc/datasheet/88090>.

Figure 1-2. CBPP Vaccination Status³⁶



1.8 Disease Control

Quarantine, movement control, serological testing and surveillance, depopulation, and vaccination are important to limit the introduction and spread of CBPP.³⁷ Antibiotics have not been shown to stop the spread of disease, only limit clinical signs in animals already infected, since cattle without clinical signs enable the disease to persist in a herd. In many countries where CBPP has been eradicated, it is reportable by law.³⁸

In African countries where CBPP is endemic, no established system of disease reporting, eradication, or prevention plans exist. CBPP can easily go undetected and unreported due to fear of trade bans, civil unrest, and lack of proficient veterinary staff and confirmatory laboratories.³⁹ A regional effort must be established in order to control CBPP.⁴⁰

³⁶ OIE WAHID. (2015). Contagious Bovine Pleuropneumonia. Vaccination Status. Retrieved from http://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home.

³⁷ OIE. (2013). Contagious Bovine Pleuropneumonia. *Technical Disease Card*. Retrieved from www.oie.int.

³⁸ Campbell, J. (2015). Contagious Bovine Pleuropneumonia. *The Merck Veterinary Manual*. Retrieved from <http://www.merckvetmanual.com/mvm/index.html>.

³⁹ CABI. (2015). Contagious Bovine Pleuropneumonia. Retrieved from <http://www.cabi.org/isc/datasheet/88090>.

⁴⁰ Campbell, J. (2015). Contagious Bovine Pleuropneumonia. *The Merck Veterinary Manual*. Retrieved from <http://www.merckvetmanual.com/mvm/index.html>.

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- Fischer, A., Shapiro, B., Muriuki, C., Heller, M., Schnee, C., Bongcam-Rudloff, E., & Jores, J. (2012). The Origin of the 'Mycoplasma mycoides Cluster' Coincides with Domestication of Ruminants. *PLoS ONE*, 7(4).
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Attachment 1.B Abbreviations

APHIS	Animal and Plant Health Inspection Service
AU-IBAR	African Union–Interafrican Bureau for Animal Resources
AVIC	Area Veterinarian in Charge
CABI	Center for Agriculture and Biosciences International
CBPP	Contagious Bovine Pleuropneumonia
CFSPH	Center for Food Security and Public Health
FAD	foreign animal disease
FAD PReP	Foreign Animal Disease Preparedness and Response Plan
FAO	Food and Agriculture Organization of the United Nations
MmmSC	Mycoplasma mycoides subsp. mycoides small-colony type
OIE	World Organization for Animal Health
SOP	standard operating procedure
USDA	U.S. Department of Agriculture
VS	Veterinary Services
WAHID	World Animal Health Information Database