



# ***Preparedness Plan for Early Detection and Prevention of Epizootic Diseases in Lebanon***

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*The purpose of this plan is to ensure advanced preparation for a timely, consistent and coordinated response across the concerned authorities in the event of epizootic diseases outbreaks which could affect Lebanon. This Preparedness Plan follows the guidelines of the FAO and the OIE, and has been developed in accordance with the recommendations of those organizations, but has been adapted to meet the specific needs of the veterinary service staff in Lebanon.*

*Preparedness Plan for Early Detection and Prevention of Epizootic Diseases in Lebanon sets out the structures and systems that would be implemented in an outbreak of disease and describes the Government's capability to provide the resources to implement the control policies. It is generic – it would apply in the event of an outbreak of foot and mouth disease- FMD, brucellosis or Peste des Petits ruminants – PPR.*

*The preparedness plan sets out specific measures and actions required by the national authorities involved to support an effective response. This plan also specifies the roles, tasks & responsibilities of all the concerned authorities, necessary human and financial resources and the procedures in case of a suspected and/or confirmed outbreak .*

*The fundamental components to develop this preparedness plan are:*

- Early detection*
- Rapid response (containment) of FMD, brucellosis or PPD outbreak*

*Early detection, reporting and diagnosis of disease together with rapid response & effectively implemented measures are essential in an attempt to contain an outbreak already in place. If an outbreak occurs, it is necessary to prevent any further spread of infection by carefully monitoring and restricting movements of animals and animal products, by strengthening biosecurity measures, by cleansing and disinfecting the infected holding, by establishing protection and surveillance zones around the outbreak and by vaccination.*

*These are the subject of disease specific parts of the plan explaining the requirements for tackling each disease. But it would also provide the basis for dealing with other epizootic diseases.*

*This Plan is however a living document and its annual revision provide a valuable opportunity to review, revise and update the arrangements.*

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## ***I. Introduction***

Transboundary animal diseases (TADs) are those diseases which have the potential for serious and rapid spread that develops into epidemic proportions, which are of serious socioeconomic or public health importance, which are of major importance in international trade of animals and animal products, and where disease prevention and control requires cooperation among several countries.

The Preparedness Plan sets out the system that would be implemented in an outbreak of disease and describes the capabilities of Government of Lebanon, the Ministry of Agriculture, the Animal Resources Directorate and the other concerned authorities to provide the resources to implement the control policies.

This plan provides clear structures and helps to achieve cooperation and effective delivery, and demonstrates the progress that the Ministry of Agriculture and the Animal Resources Directorate have made in improving the emergency preparedness and contingency planning.

***The livestock population is as follows (2009 statistics):***

<b>Species</b>	<b>Total</b>	<b>Production industry</b>
Dairy Cattle	61470	smallholder/village production or extensive pastoral systems
Beef	26,692	smallholder/village production or extensive pastoral systems
Sheep	238,693	smallholder/village production or extensive pastoral systems
Goats	408,015	smallholder/village production or extensive pastoral systems
Pigs	10,954	smallholder/village production

The Lebanese livestock sector has suffered from major diseases such foot-and-mouth disease- FMD, and brucellosis. These diseases are causing great losses in animal production, subsequently affecting food security and rural livelihoods, food safety, and national and international trade of the animal and their production.

This document contains the contingency plans of the following diseases:

### **1. Foot and mouth disease**

Foot-and-mouth disease (FMD) is one of the most serious transboundary animal diseases. It is a highly contagious viral disease, and may have rapid and unanticipated national and international spread and can cause crippling socio-economic consequences, through high production and trade losses.

The FMD is endemic in the Middle East. In 2005-2006, the Middle East has been severely affected by two separate types A epidemics, one which emerged in Iran (A Iran 2005) in 2005-2006. It then moved westwards into Turkey (including the European part of Thrace). It has continued to spread in 2006, circulating in Turkey and Iran, and which has been detected in Pakistan, Saudi Arabia and Jordan. An incursion of an African type A virus

(type A Egypt 2006) into Egypt, causing widespread outbreaks in January – July 2006. This type differs genetically considerably from the Middle Eastern viruses and was closely related to FMD viruses from East Africa. These two serotypes are still circulating in 2007 but with a lesser impact. In 2007, the apparition of the type 1 PanAsia, which probably originated from a strain circulating in India in 2000, is the main event. It has affected Turkey, Jordan, Iran, Palestinian Autonomous Territory and probably Lebanon, causing death in small animals.

Almost all countries operate vaccination programs mainly supplied by large ruminants, and some implement programs in small ruminants without a specific and adapted strategy. These programs that conduct to avoid virus circulation in ruminant population, have not proven effective. These vaccination programs use vaccines from a wide variety of sources, including producers based within the region and international suppliers from Europe and India. The present inconsistency in vaccination in the region is a factor affecting control.

So considering the different situations in these neighboring countries, we can conclude that the region is still fragile and the potential spread of the virus is a serious threat. Lebanon is put at high risk of the spreading of FMD since its located in a region where some countries have been previously infected, and since it was previously infected (Strain O -2004 statistics). With respect to 2007 outbreaks, the strain was A Iran 2005 after the virus isolation test was done in a reference international laboratory -Pirbright); In addition to that, the northern & eastern borders of Lebanon, & through illegal trading, can be considered as possible borders of entry if outbreaks re-enter Syria through Turkey (A - O PanAsia), Jordan (O PanAsia, A Iran 05), or livestock trade.

Once introduced, the potential spread of FMD is considered high due to the geographical nature of Lebanon, to the distribution of the livestock population in certain areas, & the animal rearing systems. With respect to the system of rearing, 30% of the livestock is raised in large scale commercial farms where products are being sold to slaughter houses & to factories to be processed. The rest is being reared in small scale farms not exceeding 10 cows / farm, and where the products are for the owner's sufficiency and the neighborhoods, and where the problem might arise because farmers might not be aware of the clinical symptoms of the disease and of the measures that should be taken once the disease is introduced to their farm.

The risk also arises with the transportation of the livestock from the farm to the slaughter houses, where livestock are transported in open trucks with no sanitary measures applied. In addition to that, litter of the slaughter houses is washed by water which enters the drainage system, & this would increase the spreading of diseases. Therefore, slaughter houses play an important role in spreading of the disease, based on the distance between the slaughter houses and the farms. 35% of livestock is being transported from the farms to the official slaughter houses. The rest is being marketed alive and slaughtered in small abattoirs in suburbs and villages without being inspected officially before slaughtering and therefore the potential impact on the spread of infectious diseases between farms & other farms, and farms & abattoirs is considered high; that is why a movement permit should be enforced and a national pre-movement control of livestock & health certification of animals should be implemented in order to strengthen the preventive measures of FMD control.

Transhumance or nomadic practice through the Syrian –Lebanese borders would constitute a risk for the entry of FMD & other diseases into the country especially that these animals spread over almost all the Lebanese territories. With respect to wild life, wild boars present in the South, North, Mount Lebanon, and Bekaa valley might be a natural reservoir of the



FMD infection that are difficult to control & eradicate.

With respect to vaccination & after the 2003 virus strain identification (O), ARD staff is vaccinating (till mid 2009) with (Asia 1, A22, and O) to be on the safe side if the strains enter Lebanon through Syria from Turkey; But after a strain typing test took place in mid 2009 (strain is A Iran 2005), and after the Fanar Laboratory established a bank serum of animals (Bovine, ovine, Caprine, & poultry) from all over the Lebanese territories, ARD received a vaccine grant from the EU & started its vaccination campaign.

Lebanon is geographically small, and the disease is continuously reintroduced to the country, but there isn't enough number of veterinarians to mount an effective response against an incursion of the disease; moreover, it is not difficult to recognize the disease by symptoms & to apply the rapid test, but it is difficult to recognize a carrier if introduced to the farm with a new flock except with further testing. Also it is difficult to identify the strain circulating within the country without further diagnosis from an accredited laboratory. For all the reasons mentioned above, it is impossible to predict where and when, or if at all, an outbreak of the FMD may occur. However, the high potential of FMD virus spreading requires prevention and preparedness.

## **2. Brucellosis**

Brucellosis is one of the most endemic bacterial diseases in Lebanon infecting a large number of cattle, sheep, and goat, and also infecting humans. Brucellosis is usually caused by *Brucella abortus* in cattle, *B. melitensis* or *B. ovis* in small ruminants, *B. suis* in pigs and *B. canis* in dogs. Abortions, placentitis, epididymitis and orchitis are the most common consequences, although other syndromes are also reported. The main impact is economic; deaths are rare except in the fetus and neonate. Brucellae are facultative intracellular bacteria that can survive within host cells causing a chronic infectious disease that may persist throughout the life of an animal.

With respect to Lebanon and its location in a region where some neighboring countries are infected, and since it is infected (Type *B. melitensis*, *B. abortus*); Lebanon is put at high risk of the spreading of bacteria. In addition to that, the northern & eastern borders of Lebanon with Syria, & through illegal trading or livestock trade, can be considered as possible borders of entry.

In humans, brucellosis can be a serious, debilitating and sometimes chronic disease that may affect a variety of organs. Most cases are caused by occupational exposure to infected animals or the ingestion of unpasteurized dairy products. Moreover, a socio-economic impact is due to the fact that the Lebanese people, especially rural people, has some traditions of drinking raw milk or eating uncooked cheese (green cheese) & Lebneh zarf (milk product) which increases the percentage of people being infected with Brucellosis.

With respect to Lebanon, it is difficult to recognize the disease by symptoms unless abortion occurs (further testing is required for confirmation) or to recognize a carrier if introduced to the farm with a new flock, but the milk ring test on a milk sample or Rose Bengal on blood samples could be applied upon suspicion. In addition to that, & to specify *Brucella* species, culture on aborted fetus should be performed, and this culturing won't be not done in the Fanar Laboratory until the virology unit is established. Once introduced, the potential spread of Brucellosis is considered high due to the geographical nature of Lebanon, & to the distribution of the livestock population in certain areas if not monitored by the farmers & the veterinary services.



For all the reasons mentioned above, it is impossible to predict when and where an outbreak of Brucellosis may occur. However, the high potential of Brucellosis bacteria spreading requires prevention and preparedness.

### **3. Peste des petits ruminant**

Peste des petits ruminant (PPR) is a highly acute contagious viral disease of small ruminants, sheep & goats. Heavy losses can be seen, especially in goats. All of the affected animals in a herd may die. It may also infect cattle, buffalo, & pigs which show no clinical signs & don't transmit the disease to other animals.

In the past, PPR was thought to be restricted to West Africa, but it has since been recognized from the equator to the Sahara desert, as well as in Asia, Indian subcontinent, and the Middle East. Other areas, such as southern Africa and central Asia, are threatened. Increased recognition of PPR is one reason for the expanded geographic range, and the virus is spreading. Considering the available information, we can conclude that the region is infected and the potential increase in spreading of the virus is a serious threat.

With respect to Lebanon, it's at high risk of the spreading of PPR taking into consideration the available information of the endemicity of the disease in the region. Although all the reports received by ARD from the regional departments don't indicate the presence of any clinical symptoms of the disease, but the results of the sero surveillance sample testing showed the presence of PPR in the Lebanese livestock & we must not forget that the management system of sheep & goats is extensive & postural; thus the spreading of the disease would be very quick once introduced. For all the reasons mentioned above, it is impossible to predict where and when an outbreak of the PPR may occur. However, the high potential of PPR virus spreading requires prevention and preparedness. It is not difficult to recognize the disease by symptoms in sheep & goats (the risk might increase in incubation period), but difficult to recognize it in cattle & pigs since they show no clinical signs.

## ***II. Legal Powers***

There is the national legislation for the control of animal diseases in Lebanon which should be upgraded according to the new international standards and requirements in order to provide legal basis for taking the following actions: Notification of disease, ban of movement, zoning, isolation, curing, vaccination, or culling/slaughter of infected or suspected animals, disposal, cleaning & disinfection, payment of compensation, enforcement & penalties.

### **The most related legal acts: Decrees, laws, and preventive measures**

1. The Law of veterinary quarantine numbered 12,301 dated 20/3/1963 which stipulates that animal health emergencies will be handled at the national level and that the ARD will assume overall responsibility for responding to the emergency, and will be directly answerable to the appropriate government minister. It also states that all the veterinary staff, including the private, will provide essential services during an animal health emergency on condition that they are provided with the required training to ensure that they are prepared to act immediately in the event of an epizootic.
2. Official Veterinary Inspection Law dated 5/12/1913
3. Reporting system decree dated 5/12/1913

In addition to several memos concerning the implementation of biosecurity measures in poultry farms

#### **• Ministry of Agriculture - Animal Resource Directorate (ARD)**

The ARD staff consists of 58 veterinarians, agriculture engineers, & veterinary technicians who are responsible for preparing the national strategies and plans for animal disease control and eradication (structure of the administration & their responsibilities –*Annex 1*). They are in charged for planning and carrying out the vaccination campaigns and the general surveillance program. The ARD staff would be responsible to early detect & rapidly respond to an outbreak in order to control the disease & prevent further dissemination.

#### **• The National Emergency Animal Diseases Steering Committee**

The committee, consisting of representative from the concerned authorities, is responsible to cope with the animal diseases (HP AI, FMD, Brucellosis, PPR...) for the containment of an outbreak.

### ***III. Financial provisions***

***The main prerequisite to an efficient preparedness plan is providing permanent financial resources for animal diseases emergencies including Foot and Mouth disease, Brucellosis and PPR.***

The council of Ministers, taking into consideration all the consequences that might arise during an animal disease outbreak, must approve, in advance, of a permanent fund being available immediately upon an animal disease outbreak.

The plans should be approved by all interested government parties, including economic planning authorities and the Ministry of Finance. The conditions under which funds may be released should be specified in advance. The funds may be held as special funds, & normally they would be provided to the Animal Resource Director when an emergency disease has been diagnosed or there are reasonable grounds to suspect that the disease is present; & the outbreak is controllable in accordance to the contingency plans prepared & approved of previously.

These funds must provide sufficient financial provision for personnel, equipments & consumable items, slaughter, transport, disposal, cleaning & disinfection, compensation & vaccination.

The fund should also cover the on going activities for the early detection of a disease & the rapid response & control. Moreover, it is necessary to provide appropriate resources for ARD to implement properly the required activities in this preparedness plan.

Several emergency funds were recognized from the High Relief Committee through the Council of Ministers & were used to recruit veterinarians, agriculture engineers, & veterinary technicians, & to purchase PPEs, equipments, kits & reagents. Another ministerial fund was recognized to purchase a conventional PCR & RT-PCR to the Fanar Laboratory.

In addition, several funds were provided to ARD by international organizations (FAO, OIE, WHO). They were used for launching awareness programs, training veterinary teams, & purchasing the required PPEs, equipments (MOA & Fanar Laboratory), & kits & reagents (Fanar Laboratory).

#### ***IV The chain of command and the establishment of National & Local Disease Control Centers***

To control major diseases of livestock, it is most important to develop a culture of reporting any and all suspected cases. There must be efficient mechanisms in place for transmission of information and instructions from the central veterinary services right down to the frontline of the disease control campaign in the field and laboratory; and for feedback of information to headquarters. For these things to happen quickly and efficiently in an emergency, the national veterinary services is placed in a command structure or line management system especially for the duration of the emergency response to an outbreak; Furthermore, there should be forward planning so that the most appropriate structures and lines of responsibilities can be rapidly put in place when an emergency arises. Planning includes updating or organizing the following in advance of any emergency:

- The law of veterinary quarantine no. 12,301 dated 20/3/1963 states that animal health emergencies will be handled at the national level and that the ARD will assume overall responsibility for responding to the emergency, and will be directly answerable to the appropriate government minister.
- It also states that all the veterinary staff, including the private, will provide essential services during an animal health emergency on condition that they are provided with the required training to ensure that they are prepared to act immediately in the event of an epizootic.
- The reporting system decree dated 1913.
- A mechanism for cooperation among different ministries, if necessary, to control the disease (e.g. police, army, customs, wildlife authorities, fire service, education, media and health).

In order to enable coordinated national approach for early detection & rapid response at different national levels for strategic, tactical, & operational level, several committees & control centers were established with clearly defined tasks (*Annex 2*).

##### ***The National Emergency Animal Diseases Steering Committee***

Members of the National Emergency Animal Diseases Steering Committee are representatives of the all concerned authorities: Ministry of Agriculture, Ministry of Public Health, Ministry of Environment, Ministry of Interior and Municipalities, Ministry of Economy, Ministry of Information, Ministry of Finance, High Relief Committee, & any other concerned authority. The main function of this committee is to cope with all TAD outbreak situations. The president of the committee is the Minister of Agriculture.

##### ***National Crisis Center - ARD***

Responsibilities and command structures: the Minister of Agriculture is the president of the national emergency animal diseases steering committee and CVO has overall technical responsibility for preparedness and management of animal disease emergencies.

For that reason, the National Animal Disease Control Center is located at the ARD. In the event of an outbreak of the epizootic diseases, the center would be responsible to the CVO for coordinating all emergency disease control measures in the country. The center is situated

within the National Veterinary Service headquarters, and the National Epidemiology Unit (Fanar Laboratory) works in close collaboration with it. The veterinary service staff delegates day to day responsibilities for implementing agreed policy to the head of the center (Animal Resources Director).

The responsibilities of the center in the emergency response would include:

- implementing the disease control policies decided by the National Emergency Animal Diseases Steering Committee and CVO;
- establishing a hotline (*Annex 3*);
- directing and monitoring the operations of Regional Animal Resources Departments;
- maintaining up-to-date lists of available personnel and other resources, and details of where further resources may be obtained;
- deploying staff and other resources to the regional departments;
- ordering and dispersing essential supplies, including vaccines if they are to be used;
- monitoring the progress of the campaign and providing technical advice to the CVO;
- advising the CVO on the definition and proclamation of the various disease control zones;
- maintaining up-to-date lists and contact details of risk enterprises, etc.;
- liaising with other groups involved in the emergency response, including those that may be activated as part of the National Disaster Plan;
- preparing international disease reports and, at the appropriate times, cases for recognition of zonal or national freedom from the disease;
- managing farmer awareness and general publicity programs, including press releases, and creating a public relations center to liaise with the media;
- general and financial administration, including record-keeping.

The National Animal Disease Control Center should be fully equipped with a range of maps covering all parts of the country (preferably at 1:50 000 or 1:20 000), and with suitable communication equipment for liaison with regional animal departments, Fanar laboratory, etc. by telephone, e-mail and fax as appropriate. The center should also be linked with the Emergency Disease Information System.

### ***The Local Animal Disease Control Centers***

During an emergency, the Regional Animal Resources Directorate Departments in the mohafaza of the infected focus, act as the Local Animal Disease Control Center. Teams are able to travel to and from any site necessary for surveillance or any other disease control activities in one day. The regional and district veterinary officers should be in charge of disease control operations in their area, and have the right to enter farms, collect samples and take any measures deemed necessary to prevent the movement of livestock, livestock products and any other potentially contaminated materials within and outside the areas under their control. They should be provided with the necessary materials for collection, storage over short periods (a refrigerator) and transmission of samples; protective clothing; stores of disinfectant; maps (1:20 000), a vehicle and fuel; and the means to contact the CVO as required (telephone, fax, & emails). The cooperation of other services, e.g. the police, agricultural extension officers and the media; preventing dissemination of disease is done through the municipality. They should be provided with the materials needed to carry out a public information campaign and more intensive farmer training and information. Most important, they should at all times be in possession of accurate information relating to the status of the disease in the country and to isolate, vaccinate, and monitor.

There must be efficient mechanisms in place for transmission of information and instructions

from the central veterinary services right down to the frontline of the disease control campaign in the field and laboratory; and for feedback of information to headquarters. For these things to happen quickly and efficiently in an emergency, the national veterinary services must be placed in a command structure or line management system at least for the duration of the emergency response to an the epizootic diseases outbreak.

### ***The Specialist Diagnostic Team***

The specialist diagnostic team must be legally assigned by a ministerial decree including their job description, so that the team can be immediately mobilized when there is a report of a suspect outbreak of vesicular disease from the field. These arrangements should be made well in advance of any emergency. Members should be available, prepared and equipped to travel to a disease outbreak site at short notice. The site should have all the equipment needed for the preliminary investigation of a disease, for collection and transport of diagnostic specimens, and for rapid and immediate communications.

The composition of the specialist diagnostic team should include:

- a specialist epidemiologist;
- a veterinarian with extensive experience of endemic diseases in susceptible livestock species from ARD
- veterinarian from the regional Animal Resources Department

The team would travel to a disease outbreak site with local veterinary staff directed by the chief veterinary officer, & accompanied with the local authority assistance (e.g. Municipality member, agricultural representatives and local leaders) to facilitate subsequent actions. The specialist diagnostic team would be expected to:

- make clinical examinations;
- collect histories;
- make preliminary epidemiological investigations, particularly with regard to trace backs and trace forwards;
- collect a range of diagnostic specimens for any endemic or exotic diseases that might be included in the differential diagnosis and transport these back to the laboratory.

The team should also have the authority to take immediate disease control actions that are necessary at the outbreak site. They should be empowered to provide any immediate instructions to local animal health officials, give instructions to farmers, report back immediately to the ARD on their assessment of the situation, including steps taken to secure a confirmatory diagnosis. They should also instruct on further disease control strategies, including declaration of infected and surveillance zones, any necessary measures to improve disease reporting from the outbreak area and the desirability of setting up a local disease control center.

### ***Concerned Authorities***

#### The High Relief Committee:

Supervise, coordinate, and execute all stamping out processes among the concerned teams, and supply funds and the necessary workers & equipments (Poklain for trench digging .....).

#### Mohafez of the infected area:

1. Supervises the whole work & interferes, when necessary, with the teams in the field through the concerned team authority.
2. Coordination Between different authorities & the municipality & the people



#### Ministry of Agriculture:

1. The CVO is the technical leader of all the teams who supervises all the technical work done in the field. (examine, take samples, inquire epidemiologically, monitor, and perform all the technical measures to be taken in a suspected & confirmed farm, perform surveillance in the protection & surveillance area...)
2. Provides PPE to all the teams
3. Declare the free status of the infected farm or area
4. Responsible for the repopulation decision

#### Civil defense:

1. Help in culling and burying the infected animals in the designated trenches, supplying water for disinfection, and help in disinfecting the farms.

#### Ministry of Finance:

1. Providing necessary funds to HRC

#### Ministry of Interior Affairs-Internal security:

1. Protect the quarantine area.
2. Provide security if difficulties arise
3. Provide wooden poles & plastic red & white tape to identify the infected premises and the entrance/exit to the farm.
4. Provide night-time illumination devices for their teams
5. Escort the trucks carrying the dead birds to the disposal area if burying is to take place outside the infected farm, & back to the quarantine area to be thoroughly disinfected.
6. Record the names of people going in & out of the exit, & monitor the exit.

#### Ministry of Public Health: (If the disease is zoonotic)

1. Collect samples from people in direct contact with animals.
2. Monitor people's health in the infected area.
3. Trace and take the required measures if a proven case of brucellosis appears in humans.
4. Monitor teams' health working in the infected area

#### Red Cross association:

1. Helping the personnel from Ministry of Public Health (Transportation of suspected people, first aid...)

#### Municipality of the area:

1. Coordination between teams and the farmers

#### Ministry of Water Resources and Ministry of Environment:

1. Selecting the trench site in the infected area in a way that underground water and overall environment is not polluted.
2. Monitor the digging process of the trench

#### Ministry of economy:

1. Monitor food from animal origin distributed in & from the infected area in order to dispose it hygienically with the collaboration of the MOA.

#### Ministry of social affairs:

1. Assuring the well being of the whole population in the infected area including the young, the susceptible people, and elderly.



Ministry of information:

1. Diffusing official information and propagating public awareness programs issued by the Ministry of Agriculture and the Ministry of Public Health.

Concerned syndicate:

1. Cooperation between farmers & different teams

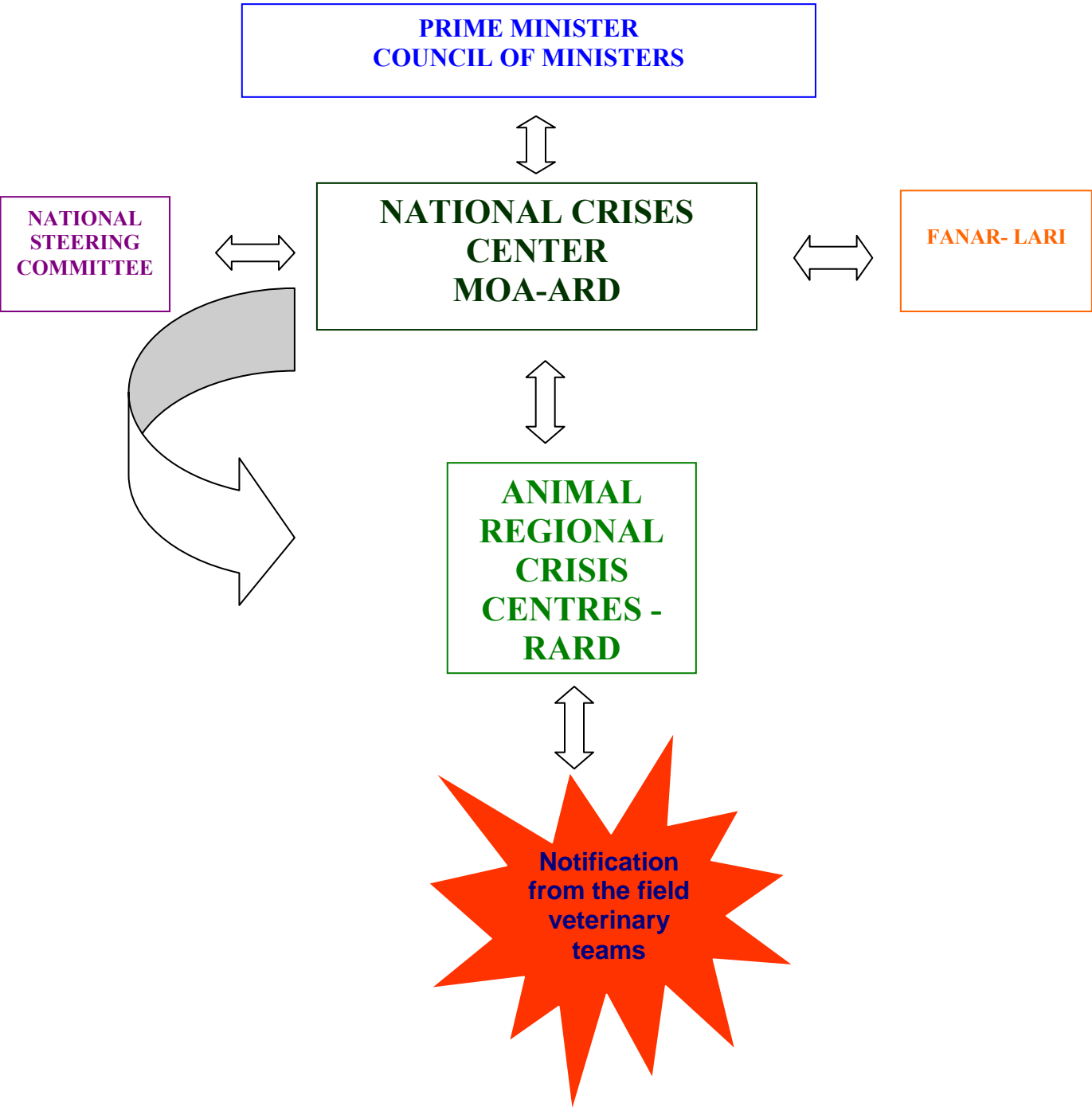
***Fanar – LARI***

The official laboratory Fanar Laboratory is responsible to perform all the required tests to confirm whether a farm is infected or not. The staff of the Fanar Laboratory should be available 24/24 during an outbreak crisis.

***Prime Minister - Council of Ministers***

1. Supervise the whole situation
2. Assign the concerned authority to cope with crisis as the MOF to release funds ...

**GENERAL SCHEME OF THE CHAIN OF COMMAND**



(Chain of command detailed scheme - *Annex 2*)

## ***V. Disease Control Strategies, Control Policies and Control Measures applied in case of suspicion or confirmation of epizootic diseases***

The control strategies should be based on disease surveillance, reporting and epidemiological analysis, that will lead to improved awareness and knowledge of the distribution and behavior of FMD, brucellosis and PPR outbreaks (and of infection) and this should lead to establishing an early warning mechanisms which will enable us to detect rapidly the introduction of or sudden increase in the incidence of the epizootic diseases before it develops to epidemic proportions and causes serious socio-economic consequences.

The Control strategic objectives involve the actual risks:

1. Reduce shedding of the infectious agent
  - During rearing
  - Carriers
  - Vaccination
2. Avoid contamination with the infectious agent
  - Animal products
  - Feed
  - Animal excretions (urine & feces)
  - Workers & visitors
  - Inanimate objects
  - Drinking water within the farm
  - Wind

The Control strategies for FMD, Brucellosis and PPR depend on epidemiological factors, livestock husbandry systems, community acceptance and likely cost. The basic principles that can be applied to the control of epizootic diseases are:

- Denial of access of the infectious agent to susceptible host animals: through import controls and quarantine, including control of animals in transit; and through good hygiene and sanitary practices; removing potentially contaminated materials from the environment by cleaning, disinfection and/or safe destruction; and preventing the feeding of contaminated materials to livestock.
- Avoiding contact between infected and susceptible animals through zoning, quarantine of infected or potentially infected farms or areas, livestock movement controls.
- Reducing the number of susceptible animals through blanket vaccination programs.
- Identifying virus or bacteria strain so that the vaccine types used must carefully match to the prevailing field virus strain or bacteria type.
- Intensifying the farmers awareness campaign

The control strategies should include:

## **1. Awareness program**

### **i. Public livestock farmers & traders awareness**

These campaigns should be mainly targeted at rural and peri-urban communities that will be affected by the disease and FMD, Brucellosis and PPR control actions. The target groups should include livestock farmers, community leaders, and other key stakeholders. Campaigns should inform people of the nature of the disease, routes of spreading, risk factors, measures to be taken in case of suspicion, and the importance of quick notification and help seeking from the nearest government animal health official as soon as an unusual disease outbreak is seen in ruminant animals and pigs. Campaigns should emphasize that the epizootic disease control primarily benefits livestock producers and not only the government.

### **ii. Public & private Veterinarians awareness**

These campaigns should be targeted through training workshops to introduce the private & public veterinarians to the updated routes to control the epizootic diseases, contingency plans, rapid response, & to the chain of reporting in case of an outbreak.

## **2. Surveillance**

Passive surveillance and active surveillance, sero-surveillance & epidemiological surveillance should take place in parallel. Trained veterinarian teams should undertake intensive passive & active surveillance for the epizootic diseases, with frequent clinical examination of herds, on condition that they wear protective clothing and practice good personal decontamination procedures to prevent taking infection to the next farm they inspect. In addition, there should be a data recording systems for surveillance where the surveillance teams should fill forms including the following information: District, province, region, day of visit, owner, address, latitude and longitude, the species, number of animals, breed, production system (housing or grazing), and breeding policy; fertility and abortion rates (if there is any), and other signs; and history of disease, control measures and vaccinations.

*The surveillance teams should be aware of the diseases surveillance indicators: Performance, Diagnostic and Resource (Workload) indicators will vary with both the species (bovine, ovine, caprine or porcine) affected and also the phase of the diseases program, i.e. high or unknown prevalence; mass vaccination; test and removal, segregation or slaughter; and freedom.*

Surveillance should be followed by an Epidemiological analysis of surveillance data for decision-making in disease control programs, including investigation sources of infection for individual herds.

Moreover, it is very essential to supply the Fanar Laboratory with the required equipments, kits & reagents to perform all internationally recommended diagnostic techniques.

## **3. Vaccination & Monitoring**

It is essential for vaccination programs to be carefully planned and then systematically implemented to achieve specific goals. It is particularly important to engage as a matter of routine in disease surveillance, activities that will provide early warning of any changes in the serotypes or subtypes circulating within the country. Indicators of this might be a sudden upsurge in the incidence of the disease or the occurrence of vaccination breakdowns. Such

occurrences should be immediately investigated and diagnostic samples collected for the infectious agent characterization.

### *ESSENTIAL PREREQUISITES FOR VACCINATION PROGRAMS*

- *Political and community support*
- *Commitment by all stakeholders to a comprehensive vaccination program applied consistently for a sufficient period of time*
- *Planning based on sound epidemiological evidence*
- *Availability of safe and potent vaccines*
- *Knowledge of circulating the epizootic disease agents serotypes and strains throughout the course of the vaccination program*
- *Availability of adequate "cold chains"*
- *Accessibility of target livestock populations to vaccination*
- *Well-trained vaccination teams*
- *Disease surveillance systems to monitor effectiveness of vaccination and detect remaining pockets of infection*
- *Establishment of a vaccine bank*

Ideally, there should be a compulsory registration system for livestock and their vaccination. Failing this, they should be identified by ear tagging in order to confirm that they have been vaccinated and when. In Lebanon, the farms vaccinated are recorded since not all animals subjected to vaccination are ear-tagged. So it's highly recommended that an ear tagging campaign takes place, moreover, the livestock farms should be mapped on the GIS system.

Vaccination teams should be well trained and adequately equipped with transport, injecting equipment (and the means for sterilizing it), cold-chain transportation, animal restraining equipment, recording forms, protective clothing and disinfectant.

#### **i. FMD Vaccination:**

The FMD vaccine is supplied by the MOA & given freely to farmers. The target livestock species, cattle, are vaccinated by the ARD teams every six months, but a vaccination strategy should be implemented on sheep, goats and pigs; It's worth mentioning that a small percentage of farmers vaccinate their sheep & goats on their own expenses.

Field samples of FMD virus strains should be routinely collected from all outbreaks and representative areas in the country at least once or twice a year and sent to the laboratory for strain characterization. This will ensure that the most appropriate vaccine strains can be selected for use in the country and the epidemiological evolution of the disease can be tracked. For that reason, a virus typing test should be implemented at the Fanar Laboratory in addition to a further confirmatory test in an international reference laboratory.

#### **ii. Brucellosis vaccination**

In the case of Brucellosis intensive mass vaccination should be carried out in all cattle, sheep or goats herds and flocks in the country, using either B. abortus (strain S 19 or RB 51) or B. melitensis (strain Rev.1) to vaccinate sexually immature & adult animals.

#### **iii. PPR vaccination**

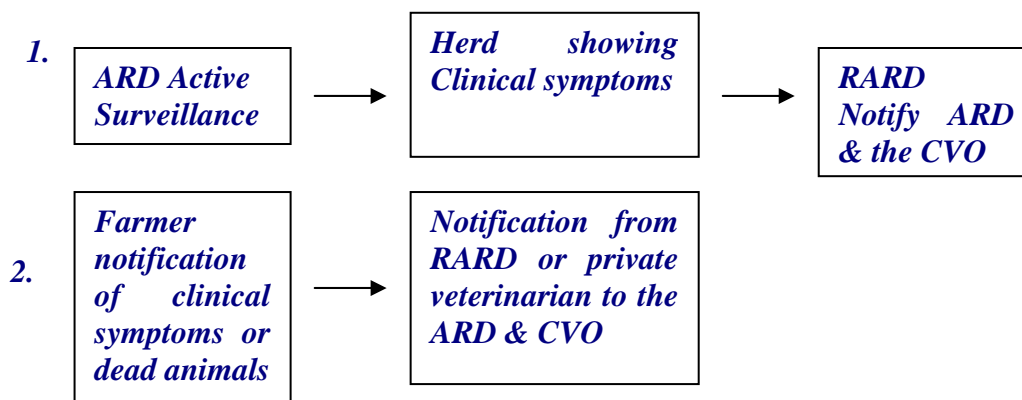
In the case of PPR , mass vaccination should be applied for all sheep & goats herds over the lebanese territories at the age of 3 months & above

#### 4. Measures in case of a suspicion /confirmation of an outbreak.

In order to eliminate and stop dissemination of the disease the ARD implements following disease control measure: quarantine, movement restriction and control, screening, zoning, vaccination in response to outbreak and disinfection of infected premises, stamping out or partial stamping out. These measures are done on condition that all teams will be equipped with the required preventive clothing in accordance to their functions. In addition to PPE & cleaning equipments (shovels, forks, thick nylon bags...) & disinfectants (Virkons, formaldehyde, Castle H 110, or NaOH) and their sprayers, there are the following equipments & materials: poklain, disinfecting troughs and containers, quick lime, cleaning soaps & detergents; moreover, minimizing as much as possible the number of people present inside the quarantine area is a must. In addition & in parallel, an epidemiological inquiry should be carried out in each affected farm to trace back and follow up the infection; its origin, history, the disease and its determinants, disease pattern in order to determine the control strategies and the prevention of the spreading of the disease to other areas, and the re-introduction of the disease to the country.

The veterinary team in the suspected farm should contain at least one official veterinarian. Inform the head of the Regional Animal Resources Department and the ARD of the suspicion of FMD, brucellosis and PPR.

##### Notification



##### a. Measures in holdings where outbreaks are suspected

###### *Performed by the ARD teams*

1. Identify the owner of the farm.
2. Collect information concerning the:
  - Location, characteristics and number of all other animals on the farm
  - Presence of staff and vehicles
  - Recent movement of people, equipment, vehicles and animals
  - The availability, on site, of disinfectants and equipments
3. All animals must be kept indoors
4. Separate sick from healthy animals
5. No animals may enter or leave the suspected holding
6. No animal products, feed, materials, waste, manure, slurry, litter or anything likely to transmit the disease may leave the holding
7. The movement of persons, vehicles and equipment to or from the holding is subject to the conditions and authorisation of the ARD
8. Appropriate means of disinfection are used at the entrances and exits of stables or barns, and of the holding itself in accordance with the instructions of the ARD

9. Putting the farm under restriction which states that the personnel on the farm will not visit any establishment containing live animals until the results from Fanar Laboratory are released, & that the surveillance team must take all necessary precautions if they want to visit other farms.
10. Identify locations on the farm where vehicles leaving the farm can be washed and disinfected (internally & externally) & organize washing & disinfecting procedures
11. Identify a changing room containing large plastic bags, cardboard boxes, latex gloves, disinfectants
12. Insure that on leaving the premises, staff leaves their disposable gear inside the changing room, wash & disinfect exposed body parts & shoes & wash their clothing as soon as they return home.
13. Insuring that all staff on the premises put on the PPE and that the team has the required kits (Epidemiological inquiry form- attached at the end of this booklet -, papers & pens, 2 extra PPE sets, paper tissues, leak proof & water resistant plastic bags, rubber bands, electric torch, thin plastic bags, tape, Scissors, Forceps, knife, Sampling swabs, Syringe 3ml, Disposable sterile needle 19G, Vacutainer set consisting of test tube + Sterile needle 21G + Disposable holder, travel bag, Blood test tubes, labels, Swap, Disinfectant (Virkon S, Formaldehyde, Castle H110, NaOH), Knapsack Mist Blower, Sprayer, Autopsy kits, Samples shipment boxes (icebox), Epidemiological Inquiry Form, & Manual \*. (list of PPE & equipment-**Annex 4**)
14. Take samples from the suspected farm to be sent to the Fanar laboratory and to an international reference laboratory for further confirmation. Note that samples from different holdings must not be pooled and each sample must be accompanied by the appropriate form.
15. An epidemiological inquiry should be carried out in each affected farm to trace back and follow up the infection; its origin, history, the disease and its determinants, disease pattern in order to determine the control strategies and the prevention of the spreading of the disease to other areas, and the re-introduction of the disease to the country. This enquiry should clarify the clinical situation on the farm, including ill & suspect animals, and all susceptible species present on the farm, and must begin from the most peripheral units. Any vaccination performed should be mentioned in the clinical investigation in order to be reported in the epidemiological inquiry. In the epidemiological inquiry, animal movements should be recorded up to 20 days prior to the onset of the first clinical signs. Also people & vehicles movement should be reported. (Epidemiological inquiry-**Annex 5**)

b. Measures in holdings where outbreaks are confirmed: (ARD)

### 1. FMD outbreak

**Zoning:** It is one of the early actions to be taken when there is an incursion of FMD in a country. Although this zone is generally recommended to be at least a 10-km radius around disease foci, the actual size and shape of the zones may be determined by ARD according to administrative boundaries or geographic barriers, or be driven by epidemiological or resource imperatives. Also measures of movement control should be taken to prevent the spread of FMD to other areas.

#### i- Infected zones:

Since the infected premises are epidemiological entities where animals have become infected - whether a single farm or household or an entire village, or even a livestock market or abattoir. Dangerous contact premises are those for which there are reasonable epidemiological grounds to suspect that they have become infected, even though the disease is not yet clinically apparent. The infection may be caused by close proximity with infected farms; mingling of animals; movement of people, vehicles, equipment, materials, etc. The infected zone encompasses the area immediately surrounding one or more infected villages. While its size and shape are influenced by topographical features,



physical barriers, administrative borders, epidemiological considerations (including the likelihood and possible direction of windborne spread), the size and shape of the infected zone(s) are also influenced by the type of disease control activities to be carried out & should be in parallel with movement restrictions, and active disease surveillance to reveal the true extent of the outbreak.

#### Actions to be taken in infected zones

The overall aims in the infected zone are to:

- Prevent the further spread of infection through quarantine and movement control of livestock, their products, human & vehicles & any other potentially contaminated materials within & out of the infected zone. It is essential to ensure that neither animals nor animal products are smuggled out of the zone.
- Isolate (zone) the sources of infection rapidly, through quarantine measures of potentially infected animals
- Vehicles and other equipment should be disinfected before leaving the premises, paying particular attention to the interior transport compartment of vehicles used for the transport of live animals. Human shoes should also be disinfected before leaving the infected premises.
- Safe disposal of feces and urine-excretions and decontamination procedures.
- Cleaning and disinfection of the surroundings of infected premises, with particular attention to where animals have gathered together, including animal houses, sheds, pens, yards, water troughs, and so on. Potentially contaminated materials such as manure, bedding, straw and feedstuffs should be removed and disposed of in the same way as for carcasses. Preliminary thorough cleaning should be undertaken with copious water to which soaps and detergents may be added. Appropriate disinfectants for FMD include sodium hydroxide (2 percent w/v in water), sodium carbonate (4 percent w/v in water) and citric acid (0.2 percent w/v). Sodium carbonate is preferred to sodium hydroxide as it is less corrosive.
- Monitor markets of livestock and abattoirs.
- In parallel, intensive surveillance should take place around the infected premises to detect spreading of the infection in an area specified as the **protection zone** (radius at least 3 km around the infected holding). In addition, these measures should take place in this zone: (*ARD specialized surveillance field teams for the protection zone*)
  1. a census of all the holdings is made as soon as possible;
  2. all commercial holdings are visited by the team as soon as possible for a clinical examination of the animals and, if necessary, the collection of samples for laboratory tests
  3. all backyard holdings are visited by the team before the lifting of the protection zone
  4. additional surveillance & sample collection is immediately implemented in order to identify any further spread of the infectious agent in the holdings located in the protection zone.
  5. all animals must be kept indoors
  6. The ARD shall ensure that within protection zones, the movement and transport from holdings on to roads, excluding private service roads of holdings, or by rail, of animals and animal products are prohibited.
  7. Prohibition on the removal or spreading of used litter, manure or slurry from holdings

8. The ARD shall ensure that fairs, markets, shows or other gatherings of animals or other captive birds are prohibited in protection zones.
  9. the cleansing, disinfection and treatment of holdings and any materials or substances therein which are contaminated or likely to be contaminated with the epizootic disease infectious agents are carried out under the ARD supervision
  10. The measures provided shall be maintained for at least 21 days following the date of completion of preliminary cleansing and disinfection on the infected holding and until holdings located in the protection zone have been tested.
- Surveillance teams should monitor all healthy animals around the infected animals & make sure that these animals are subjected to the FMD vaccination program of the ARD, if not the animals should be vaccinated immediately.

ii. Surveillance zones:

The surveillance zone should be larger than the infected zone it surrounds, and can include more than one infected zone. It acts as a buffer zone between infected and FMD-free zones. Known livestock movement patterns should be taken into account when defining surveillance zones, which may cover a whole province or administrative region and, in some cases, the whole country. With respect to Lebanon, a surveillance zone should be at least 20 km & it may cover a whole Caza.

Actions to be taken in surveillance zones after an outbreak

- Active disease surveillance for FMD should be enhanced. Susceptible species livestock in the zones should be inspected at about weekly intervals and their owners questioned about disease occurrences and livestock movements, etc. Any sick animals should be thoroughly investigated, including dispatch of diagnostic samples to the laboratory.
- Movements of susceptible animal species and products from infected zones should be banned. Movement from surveillance to free zones may be allowed but only after sero-surveillance, health inspection, and the issue of an official permit.
- Abattoirs, dairy factories and other risk enterprises could be allowed to operate but only when subjected to strictly enforced zoo-sanitary codes of practice.
- Sales of live animals, meat and dairy products can continue unless it is considered that they constitute a threat for the further spread of the disease. Sales should be subjected to record-keeping, surveillance and rigidly enforced codes of practice, including the official issue of movement permits.
- Rapid tests that determine the state of infection could be applied in movements.
- Insuring that all animals were subjected to vaccination, if not vaccinate them immediately.

*Taking into consideration:*

- **In the case of FMD & PPR**, immediately impose the check points and disinfection units at the exits from the protection and surveillance zone borders (ARD- Internal Security-MOPH)
- **In the case of FMD & PPR**, the ARD may establish further restricted zones around or adjacent to the protection and surveillance zones, taking account of the epidemiological inquiry, the geographical situation, particularly natural boundaries, the location of holdings and the number of animals and patterns of movements and trade.
- The ARD may, where epidemiological information or other evidence indicates, implement a preventive eradication program, including preventive slaughtering or culling of animals, in holdings and areas at risk.

- In case of shortage in equipments, material, or personnel for stamping out, cleaning & disinfection, another resolution might be hiring personnel to support the teams by the HRC according to cabinet decree no. 101 dated 1/3/2006.

### iii. FMD Free zones

Since Lebanon is a small country (10,452km<sup>2</sup>), these zones encompass the rest of the country. However, because of the potential of FMD for wide dissemination, it would be unwise to regard any part of a country in the throes of a new outbreak as not requiring a high level of surveillance. The emphasis in free zones should be on strict quarantine measures to prevent entry of the disease from infected zones and accumulate internationally acceptable evidence that the zones are indeed FMD free. These zones are subjected to the same degree of information dissemination as the zones in which the outbreak occurs. This information should be extended, through good and rapid communication, to neighbouring countries. Surveillance should continue to provide confidence of continuing freedom. These zones are subjected to the same degree of information dissemination as the zones in which the outbreak occurs. This information should be extended, through good and rapid communication, to neighbouring countries.

### Actions to be taken in disease-free zones

- Movement of susceptible animals from infected zones should be banned, while movement of susceptible animals from surveillance zones should be monitored.
- Samples should be collected randomly from livestock farms & sent to Fanar laboratory for confirmation of the freedom state.

### iv- Wild Animal involvement

The only threat comes from wild boars found in some areas in the South, North, Bekaa, & Mount Lebanon., & this situation might greatly complicates responses to FMD outbreaks. The potential or actual role of wild boars as reservoir or maintenance hosts for FMD needs to be assessed epidemiologically in partnership with wildlife authorities.

## **2. Brucellosis outbreak**

With respect to Lebanon, we already know that the disease is chronic & we have a prior history of infection; however, the spreading of the infection is due to the direct & indirect contact with infected animals. Bio-typing of the Brucella species may be used to assist in identifying potential sources of infection. This includes differentiation of wild from vaccine strains, which occasionally may cause abortion. In addition to that, all the measures taken to control Brucellosis should be in continuous collaboration with the Ministry of Public Health.

First measure to be taken upon an outbreak is zoning:

### i. Infected zones:

It is recommended to be the area surrounding the infected farm or herd, should be specified as needed according to the density of susceptible herds in the area, & to the topography of the area, & to be determined by the official veterinary services.

### Actions to be taken in infected herd or farm

Same measures mention in section V.4.b.1.i.(FMD outbreak-infected zones)

#### ii. Brucellosis Free zones

Same measures mention in section V.4.b.1.iii.(FMD free zones)

#### iii. Wild Animal involvement

As mentioned before, & due to the few number of wild mammals in Lebanon, the potential impact of their involvement is low; nevertheless, this needs to be assessed epidemiologically in partnership with wildlife authorities

### **3. PPR outbreak**

According to international recommendations, in PPR prevention & control, the strategies should be divided into several stages in order to reach the final stage where the infection is eradicated:

#### Investigation Phase:

- Epidemiological investigation to detect the epidemiological features influencing PPR eradication strategies
- Formation of the strategies for PPR eradication
- In parallel, specifying the international requirements for the verification of PPR eradication & national freedom from the disease

#### Operational Phase:

- Surveillance (Passive & active)
- Samples collection
- Serum bank establishment
- Samples testing (laboratory support & testing strategies)
- Epidemiological Data Analysis to determine the areas & the percentage of spreading
- Vaccination strategy: supplemented by other PPR control measures, a vaccination strategy should be formed depending on the results of sero-surveillance & the evaluation of disease situation in the country.
- In parallel, & if the results of sero-surveillance state that there is a small number of animals infected with PPR, stamping out of the infected animals could be an option with the required measures following stamping out as burying the stamped out animals hygienically, & cleaning & disinfection of the premises of the infected animals. If a large percentage of the Lebanese livestock was infected, the infected would be isolated until dead or cured, & the rest would be vaccinated.
- Raising measures on importation & exportation of susceptible animals.
- Tests should be available at the Fanar laboratory to differentiate between vaccinated & infected herds if we use the Elisa method, & if the required kits for PCR were purchased, there would be no problem.
- When establishing the stage where PPR Antibodies are present only in vaccinated herds, the vaccination exit strategy pathway should start.

### Stand down & further investigation phase:

- After last vaccination, monitoring the Lebanese herds through sample collection & sample testing for 5 years should take place until declaring freedom of the disease if no outbreaks appear during this period
- Continue the monitoring & the sero-surveillance to establish the declaration of freedom of infection

All this should be done in collaboration with the concerned authorities & the international organizations.

**Zoning:** It is one of the early actions to be taken when there is an incursion of PPR in a country. The actual size and shape of the zones may be determined by administrative boundaries or geographic barriers, or be driven by epidemiological or resource imperatives. Also measures of movement control should be taken to prevent the spread of PPR to other areas.

#### i. Infected zones

Same measures mentioned in section: 4.1.i (FMD outbreak-infected zones)

#### ii. Surveillance zones

Same measures mentioned in section V.4.b.1.ii (FMD outbreak –surveillance zones)

#### iii. PPR Free zones

Same measures mention in section V.4.b.1.iii.(FMD free zones)

#### iv- Wild Animal involvement

As mentioned before, Lebanon is not rich in the wild animals population, the only threat comes from wild pigs found in some areas in the South, North, & Mount Lebanon., but since pigs are not considered as reservoirs for PPR, the potential impact is low.

### 4. Disease Freedom

**FMD:** After at least a period of 5 year blanket vaccination & monitoring strategy,

**Brucellosis:** After a period of seven years of blanket vaccination& monitoring strategy

**PPR:** After 5 years of free vaccinated herds

A massive surveillance should take place to detect the remaining infected animals if they exist & the following measures should take place:

1. All sick or infected animals on the holding shall be culled without delay under ARD supervision. The culling shall be carried out in such a way as to avoid the risk of spread of the disease. Stamping out is performed by one team of the ARD within the infected farm. (ARD-civil defence - Farm workers)
2. All dead or culled animals and animal products carcasses shall be disposed under official supervision. (ARD-civil defence - Farm workers)
3. The number of required vehicles for carrying the dead or culled animals and animal product out of the farm if the burying is to take place outside the infected farm must



- be determined & the route to be taken by the vehicles must be identified. The vehicles must be thoroughly disinfected after finishing the job. (ARD- HRC- Municipality)
4. In parallel, the trench should be dug (size decided according to the number of dead or culled animals and quantity of animal product that will be buried) & covered with a layer of Calcium oxide (lime) at the bottom & the sides. After burying the trench should be covered with another layer of Calcium oxide-lime & a layer of earth at least 1m thick. (HRC-MOWR-MOE)
  5. Destroy all substances and waste, such as feed, litter, manure and all non disinfectable material present on the farm, by collecting them in plastic bags & burying them in the trench. (ARD-civil defence - Farm workers)
  6. The stables or barns, pastures or land, the equipment, the vehicles used for transport the animals, carcasses, animal products, feed, manure, slurry and any other material or substance likely to be contaminated shall undergo cleansing, disinfection and all procedures for eliminating the infectious agents. Wash with hot water & detergent walls, floors, & ceilings of the infected farm, then disinfect them. (list of disinfectants-*Annex 6*) Metal structures such as cages may be disinfected using hot water + disinfectant. With respect to all equipment inside the house such as drinkers & food hoppers, they should be washed thoroughly with hot water & detergents & disinfected. Add chlorine, empty, wash with hot water & detergents, & disinfect the water reservoirs. Empty the feed in feed tanks in bags which should be buried in the above mentioned trench, wash the feed tanks with a hot water-pressure pump, & fumigate it (silos). Clean thoroughly & disinfect properly all units which are physically or functionally connected to the establishment as the hatchery, storage rooms and vehicles. After washing & disinfecting all the units must be fumigated twice with at least two weeks between fumigations with Potassium permanganate & formaldehyde put in fumigation utensils. (ARD-civil defence- Farm workers)
  7. The operation manual that describes all control measures applied after suspicion or confirmation of the epizootic disease (FMD, brucellosis, PPR) must be distributed to all concerned authorities and all different teams. This manual is based on the national preparedness plan & the international guidelines of the FAO & OIE. The field staffs will be informed immediately if any changes took place. (ARD)
  8. After the final cleaning & disinfection, the OVS should collect samples from the infected focus for 21 days to detect any possible presence of infectious agent. If no presence of the agent is detected, the farm will be declared free but will not be repopulated, until further notice from the MOA. (ARD)

### **C) Measures in contact holdings (ARD)**

Based on the epidemiological inquiry,

1. The ARD competent shall decide if a holding is to be considered as a contact holding (a holding which is epidemiologically connected with infected farms).
2. The ARD may apply the measures from holdings where outbreaks are confirmed to contact holdings and in particular if the contact holding is located in an area with a high density of animals.

### **D) Additional biosecurity measures (ARD)**

1. In order to prevent the spread of the epizootic disease, the ARD may, order the implementation of additional biosecurity measures in holdings in the protection and surveillance zones and in the further restricted zones.

2. Those measures may include restrictions on movements of vehicles or persons for food and feed supply, animal transportation to slaughterhouses, the collection for disposal of carcasses and other movements of personnel.

### ***E) Simulation exercise***

A simulation exercise should be implemented for each disease. The purpose of simulation exercises is to practise and evaluate the preparedness plan, to train users in its operation, and to strengthen intersectoral links between ARD & the concerned authorities.

The exercise objectives are:

1. Better cooperation between different authorities
2. Test the Preparedness Plan & specify the actions that would take place before, during and after an epizootic disease outbreak for each concerned authority.
3. Train staff on its implementation (outbreak suspicion, outbreak confirmation, post-outbreak management.)
4. Test operational response arrangements, exposing communication.
5. Examine the liaison and interdependencies between the key operational partners
6. Test the capability of the ARD and its operational partners within the parameters of the exercise

## ***VI. Diagnostic Laboratories***

The Lebanese Agriculture Research Institute (LARI), the national official laboratory for diagnosis of animal diseases, is located in Fanar (suburbs of Beirut) is the official diagnostic laboratory & an agreement was signed between the Ministry of Agriculture and the General Directory for Agricultural Research Institute on the mechanism of receiving & analyzing the samples of animal origin to test it for animal disease.

It's equipped to perform autopsy of sick or dead animals, microbiological analysis, serology - ELISA test (detection of antibodies or antigens), & RT-PCR test (viral detection according to specific prime). No virus isolation or culture is performed. The total expected capacity is 900 serology tests, 200 PCR/week. Tests in the Fanar laboratory are being done according to the OIE Guidelines & diagnostic manual.

Logistics of the Fanar Laboratory, to cope with diagnosis of animal diseases, including hiring 3 laboratory technicians (2 with an MS degree & 1 with a BS degree), and procurement of equipments, tools, kits, and reagents, are being supplied by LARI, the MOA, and the FAO through LARI budget, emergency funds, TCPs, & SFERA projects.

Submission of samples to reference international laboratories should always be subject to prior agreement with the recipient and be transported in containers meeting IATA regulation standards. For that reason & as part of our contingency planning, Lebanon should establish procedure for sending samples to the appropriate reference laboratory.

Steps to be followed:

- ❖ Agreement between ARD and any transport agency.
- ❖ Determination of the nature and range of diagnostic specimens or isolated agents to be



sent for confirmatory diagnosis or further characterization; any transport media to be added; method of packaging and refrigeration; labeling of package, including correct address; & any necessary customs or International Air Transport Association (IATA) declarations.

## ***VII. Training***

Veterinarians or other animal health workers in either the public or private sector have direct, first-hand experience with different animal diseases. For that reason, a systematic updated training program for all those people who, in their professional capacity, may possibly be the first to come into contact with an incursion or outbreak of the diseases must be given comprehensively because the diseases may strike in any part of the country. Training must extend to all staff, from the CVO downwards, & to rural veterinary staff in the country, as well as another training campaign must extend to selected officials (agricultural extension officers, local authorities) and livestock owners. Training should be done to secure a confirmatory diagnosis, including collection and transport of diagnostic specimens, and in the immediate disease control actions that need to be instituted at a disease outbreak site. However, more specialized training will be needed for personnel who are nominated as members of the specialist diagnostic teams.

Regular training should be provided to the ARD & the concerned authorities to implement the required actions in the preparedness plan. These training programs include:

- Training in clinical diagnosis
- Epidemiological inquiries (surveillance & tracing)
- Procedures at the infected farms
- Procedures within the protection & surveillance zone
- Procedures at national crisis center ARD
- Procedures at RARD
- Procedures of notification & publicity

At the field level, official veterinary teams (veterinarians, agriculture engineers, animal husbandry specialists, veterinary technicians) have been set up to implement the surveillance after being subjected to continuous training through several workshops and training seminars on clinical symptoms, sampling, farm biosecurity, control measures, and reporting.

### ***VIII. Publicity & Disease Awareness***

Publicity & disease awareness programs must be launched to inform farmers and the public about the prevention & control of epizootic animal diseases. Since September 2007, several awareness programs have been launched in collaboration between the MOA, & the MOPH, FAO, OIE & WHO. Lectures was addressed to public all over the Lebanese territories. Public brochures, travellers' brochures, maps on migratory birds' route, & biosecurity measures in animal farms poster were issued and distributed. For preventive measures, guidelines were shown on T.V. channels and posters placed on main roads. A private sector also contributed in the awareness campaign, by issuing brochures, posters, plate mats, and a video-clip. Also in cooperation with the farmers associations, meetings and lectures for raising biosecurity awareness and immediate reporting to ARD staff should be permanently organized.

The awareness program should be constantly carried out, providing the new information to farmers & the general public about the epizootic diseases epidemiology in the country and all necessary preventive and biosecurity measures to be implemented in farms. It should be implemented by the veterinary teams.

*In case of suspicion or confirmation of FMD, brucellosis and PPR the national hotline telephones will be open in order to provide all necessary information.*

## **Annexes:**

*Annex 1: The Veterinary Services*

*Annex 2: Chain of command & action plan*

*Annex 3: Hotlines*

*Annex 4: List of PPE & equipment*

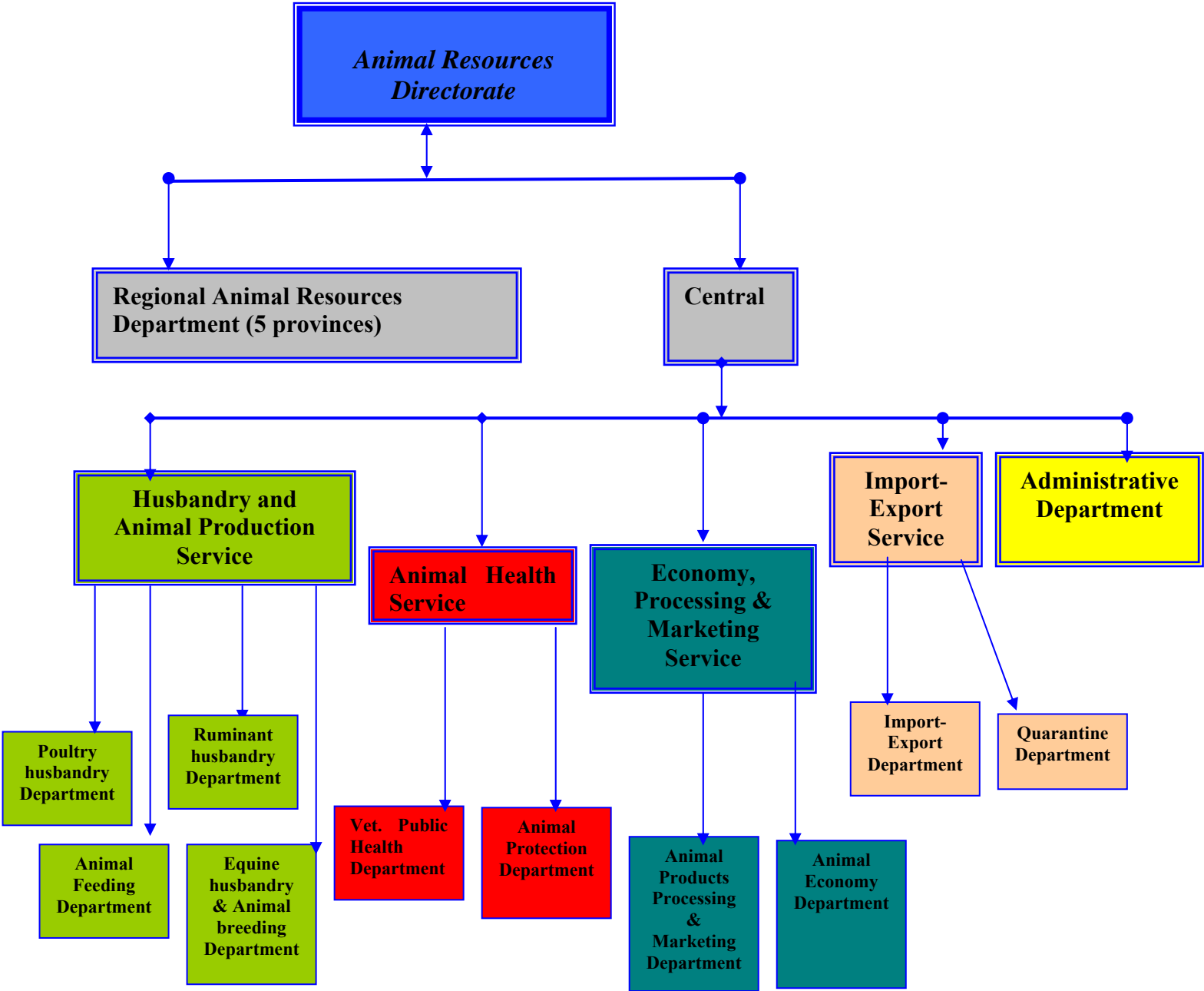
*Annex 5 Epi-Inquiry*

*Annex 6 List of Disinfectants*

*Annex 7: Nature of FMD - The specific FMD countries situation*

*Annex 8: Nature of Brucellosis*

*Annex 9: Nature of PPR*



## **1. ARD Central Administration:**

### **Structure of the Directorate of Animal Resources**

The Animal Resources Directorate (ARD) represents the official veterinary services.

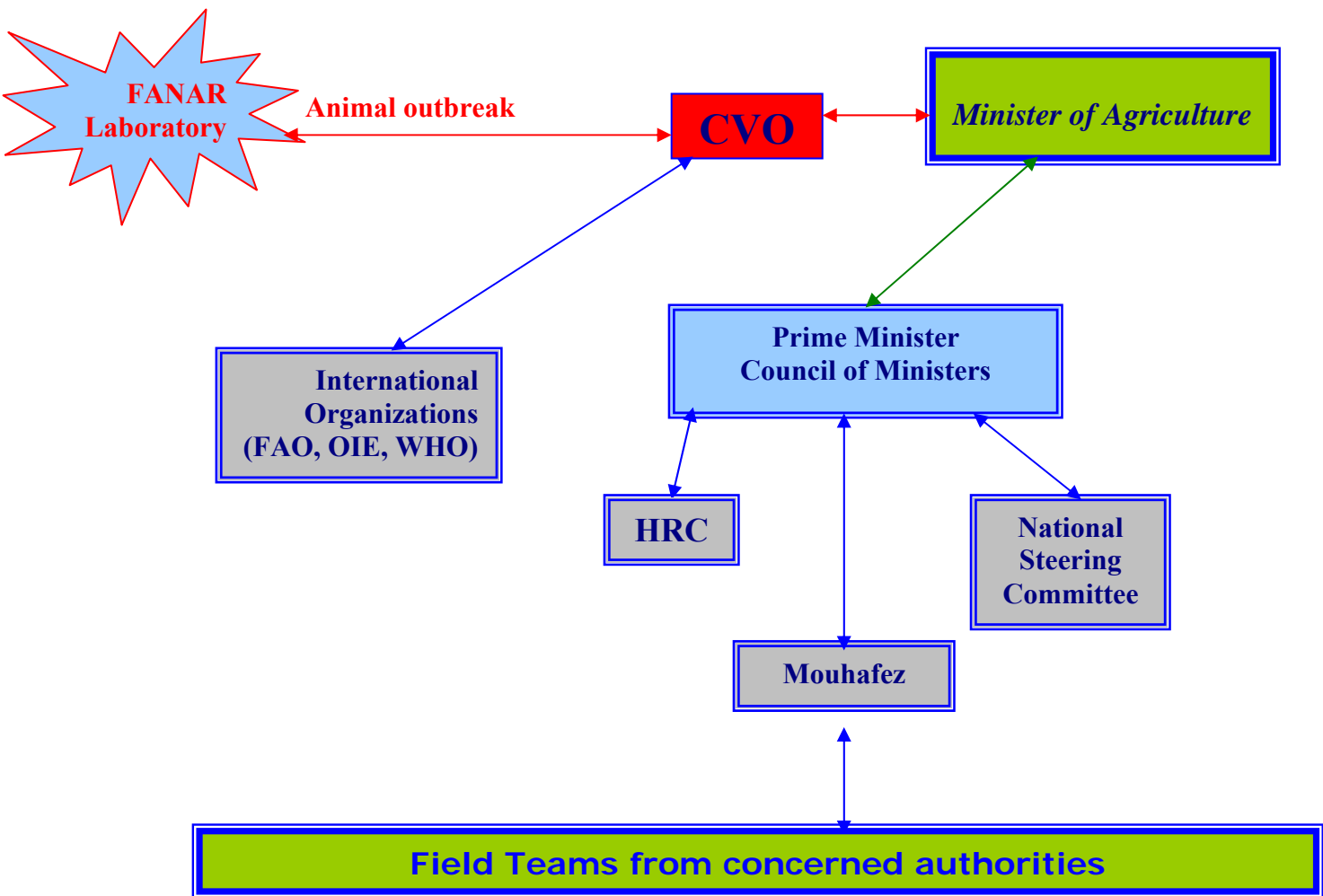
<b>Service</b>	<b>Department</b>	<b>Function of Service</b>
<b>Animal Health Service</b>	<b>1.</b> Veterinary Public Health Department <b>2.</b> Animal Protection & Welfare Department	Animal disease control, public health protection from zoonosis, veterinary drugs & vaccines registration, vaccination program, slaughterhouse control, laboratory diagnosis, meat and animal origin products inspection.
<b>Husbandry and Animal Production Service</b>	<b>1.</b> Animal Feeding Department <b>2.</b> Ruminants husbandry Department <b>3.</b> Poultry husbandry Department <b>4.</b> Equine husbandry & Animal breeding Department	Farm organizing and management, identification of animals, registration, control of systems of management and production.
<b>Economy, Processing &amp; Marketing Service</b>	<b>1.</b> Animal Products Processing & Marketing Department <b>2.</b> Animal Economy Department	Establishing norms and standards for animal origin in close collaboration with Libnor to improve quality of products for trade.
<b>Import-Export &amp; Quarantine Service</b>	<b>1.</b> Import-export Department <b>2.</b> Quarantine Department	Control safety and sanitary conditions on Import/export, implementing rules and regulations concerning sanitary measures on imports/ exports related to animal and public health requirements.
<b>* Regional Animal Resources Departments</b>	<b>1.</b> Animal Resources Services (5 Provinces) <b>2.</b> Quarantine Station & Border Check Points	They are responsible for the enforcement of the veterinary policy and decisions taken at the central level, related to the vaccination campaigns and disease control and control, and inspection of all animal products on premises.
<b>Administrative Department</b>	-	All administrative work of the directory including personal, documentation

## **2. ARD Regional Administration:**

Veterinary Services are present in each province as a regional animal resources department. Their structure consists of veterinary officers, animal production engineers and veterinary technicians. They are responsible for the enforcement of the veterinary policy and decisions taken at the central level, related to the vaccination campaigns and disease control, and inspection of all animal products on premises. Job description of each department is established according to law-decree number 5246 dated 20/6/1994.

Annex 2: Chain of Command

Chain of command





### a- Field Teams from concerned authorities



### Animal outbreak:

- If an animal outbreak took place, the Minister of Agriculture will inform the Prime Minister, who in turn will inform the Minister of Public Health (For zoonotic diseases), and the HRC to take action and implement the action plan with his team.

### b- Involved authorities

The team consists of representatives from:

1. Mohafez of the infected province
2. HRC - High relief committee general director Supervise the action plan
3. Ministry of Agriculture- Head of ARD
4. Ministry of Public Health
5. Ministry of Internal Affairs and Municipalities(internal security, civil defence)
6. Ministry of Environment
7. Ministry of Water Resources
8. Ministry of Economics
9. Ministry of Social Affairs
10. Red Cross Association
11. Any other concerned authority

### *Annex 3*

#### *Hotline of the ARD (during official working hours)*

- Central office –ARD- 01/848445- 01/849624- 01/849634
- Mount Lebanon Animal Resource Department 01/288379
- Animal Resource Department in the North 06/433754-06/432407-06/433729
- Bekaa Animal Resource Department 08/822856-08/818572-08/540305
- Animal Resource Department in the South 07/720026-07/723531-07/723379
- Nabatiyeh Animal Resource Department 07/765018-07/760018

#### *Hotline (24/24)*

- ARD-Animal Resource Director **DR. Nabih Ghosh** 03/305382
- Mount Lebanon Animal Resource Department-**Dr. Nabih Ghosh** 03/305382
- Animal Resource Department in the North - **Dr. Ikbal Ziada** 03/828312
- Bekaa Animal Resource Department- **Dr. Nadim El-Tilyani** 03/855218 / **Dr. Ali Raad**\_(Baalback-Hermal) 03/212017
- Animal Resource Department in the South - **Dr. Zaki Aboud** 03692642
- Nabatiyeh Animal Resource Department - **Eng. Hadi Makki** 03/396782

#### ***Annex 4: List of PPE & equipments***

*All teams will be equipped with the required preventive clothing in accordance to their jobs. In addition to cleaning equipments (shovels, forks, thick nylon bags,...)& disinfectants (Virkons, Formaldehyde, Castle H 110, NaOH) and their sprayers, there are the following equipments & materials:*

- poklain
- Small carts to be used inside the farms.
- Disinfecting troughs and containers
- Quick lime
- Cleaning soaps & detergents

#### **PPE**

- Conical bottom tube 15ml
- Conical bottom tube 50ml
- Scissors
- Forceps
- Sampling swabs
- Syringe 2.5 ml
- Syringe 3ml
- Syringe 5ml
- Disposable sterile needle 21G
- Disposable sterile needle 19G
- Disposable sterile needle 18G
- Gloves
- Vacutainer set consisting of pet tube + Sterile needle 21G +disposable holder
- Travel bag
- N95 masks
- Dust musk with a valve
- Regular Masks
- Boot cover
- Personal Protective Equipment kits - overall
- Head cover
- Protective eyeglasses

- **Blood tubes**
- **Swap**
- **Disinfectant (Virkon S)**
- **Disinfectant (Formaldehyde)**
- **Disinfectant (Castle H 110)**
- **Disinfectant (NaOH)**
- **Knapsack Mist Blower**
- **Sprayer**
- **Vaccines carriers (boxes for transport)**
- **Autopsy kits**
- **Samples shipment boxes**
- **Culling bags**

## ***Annex5: Epi-inquiry***

### Epidemiological investigation phase:

Since the aim of the prevention & control program is to eradicate the disease, the investigation phase commences once a report suspecting an animal disease has been received by the veterinary services either through the active surveillance or through passive surveillance. It should be a well-understood legal obligation of any citizen (private vets, farmers) who suspects the presence of an animal disease (or any other serious animal disease) to report to a member of the ARD or the animal resources departments. Once a report of possible animal disease has been received, the following actions must take place:

- immediate investigation of the report, including collecting specimens to confirm the diagnosis with the minimum delay;
- prevention of spread of the disease during the investigation phase;
- reporting to the appropriate national authorities;
- evaluation of the evidence by personnel with sufficient knowledge of the disease to make an informed decision as to whether to proceed to the alert phase (isolation, ...) or wind down (monitoring, ..... ) operations.

On receiving information possibly indicating an animal disease, the diagnostic team should start an investigation by visiting the location of the index case(s) to gather information about the clinical and epidemiological features of the case, and collect specimens that may aid diagnosis. The specimens should be transmitted on ice or in 50 percent glycerosaline (if refrigeration is not available) to the laboratory as soon as possible. The remaining animals should be examined. If there are sufficient grounds to suspect an animal disease, such immediate quarantine and movement restrictions should be imposed.

If the investigation reveals that the circumstances are not suggestive of the disease, or an alternative diagnosis can be made, a false alarm may be declared and operations may wind down.

## Epidemiological inquiry forms:

### الامراض الوبائية التحقيق الوبائي

التاريخ: ---/---/----

الطبيب البيطري: -----  
المرض المشتبه به: -----  
نوع العينات: -----  
أخذت العينات من قبل: -----  
نتيجة الفحص المخبري: -----

اسم المزرعة: -----  
عنوان المزرعة: -----  
المحافظة: ----- البلدية: ----- القضاء: -----  
تلفون: -----

رقم المزرعة لدى وزارة الزراعة – مديرية الثروة الحيوانية: -----

المالك: -----  
عنوانه: -----  
تلفون: -----

المربي: -----  
عنوانه: -----  
تلفون: -----

أعطيت المعلومات من قبل -----  
طبيب المزرعة البيطري المعتمد: ----- تلفون: -----

### معلومات عن المزرعة

نوع المؤسسة: -----

☐ بيتية

☐ تجارية

نظام التربية: ☐ مكثف

☐ رعوي

مساحة المزرعة: ----- عدد الحظائر: -----

نوع الانتاج: -----

☐ حلوب

☐ تسمين

### عدد الحيوانات الموجودة في المزرعة وأنواعها

حلوب ☐ العدد: -----

تسمين ☐ العدد: -----

أخرى ☐ النوع: ----- العدد: -----

تاريخ شراء القطيع: ---/---/---- الجنس: ----- العمر: -----

الجنس: ----- العمر: -----

## نظام التربية

مكثف ☐ رعوي ☐ بيتي ☐

العدد: -----

رعي مشترك:

اسم المربي: ----- عنوانه: -----

هاتف: -----

هل الموقع مسيج: ☐ نعم ☐ كلا ☐

امكانية الاحتكاك مع حيوانات برية: ☐ نعم ☐ كلا ☐

نوع الحيوانات البرية: -----

-----

حيوانات أخرى موجودة في المزرعة:

☐ نعم ☐ كلا ☐

نوعها وعددها: -----

-----

وجود برك مائية أو مستنقعات قريبة:

نعم ☐ -----

كلا ☐

خزانات مياه مكشوفة:

نعم ☐ نوعها: -----

كلا ☐

وجود خنازير:

كلا ☐ نعم ☐ عددها: -----

ملاحظات: -----

-----



## مسح المزرعة

يجب وضع خريطة للمساحة الموبوءة على أن تكون مرسومة بوضوح بحيث تظهر وحدة الإنتاج ، الحيوانات داخل البيوت، وتظهر الطرق الرئيسية باتجاه الموقع، بُعد المزارع الأخرى عنها.

## تحركات الحيوانات

أ- دخول حيوانات جديدة

كلا ☐ نعم ☐

( ٢٠ يوما" قبل العوارض السريرية الأولية أو بدء النفوق)

تاريخ الدخول:----/----/---- أنواع الحيوانات:----- عددها:-----

المصدر:

مزرعة ☐ تاجر ☐ اسواق المواشي ☐

اسم المزرعة / التاجر----- رقم تسجيل المزرعة / المؤسسة التجارية:-----

عنوان-----

بلدية----- محافظة----- قضاء----- هاتف:-----

ب- خروج الحيوانات / منتجاتها الى مزارع أخرى/ مؤسسات/ مسالخ

كلا ☐ نعم ☐

(خلال فترة ٢٠ يوم قبل ظهور العوارض السريرية الأولية واليوم الذي وضعت فيه المزرعة تحت الحظر)

تاريخ:----/----/---- رقم التسجيل:----- أنواع-----

وجهة الارسال:

مزرعة أخرى ☐ مؤسسة ☐ مسلخ ☐ غيرها:-----

اسم المؤسسة----- رقم التسجيل:-----

عنوان-----

بلدية----- محافظة----- قضاء-----

تحركات الناس: الاشخاص ووسائل النقل الداخلة الى المزرعة:

طبيب بيطري ☐

علف ☐

منتجات الحيوانات ☐

حيوانات نافقة ☐

محروقات ☐

نقل حيوانات ☐

جمع/اعادة تكرير الفرشة ☐

مشاركة بالمعدات مع مزارع أخرى ☐

أخرى: حدد-----

(خلال فترة ٢٠ يوم قبل ظهور العوارض السريرية الاولى واليوم الذي وضعت فيه المزرعة تحت الحظر)

تاريخ الدخول	وسيلة النقل	اسم المؤسسة	هاتف	اسم السائق	هاتف	ملاحظات

#### مزارع أخرى ملك المربي:

نعم ☐ كلا ☐

رقم المزرعة: -----

عنوان: -----

بلدية ----- محافظة ----- قضاء -----

هاتف: -----

الانواع الحيوانات الموجودة في المزرعة: ----- عددها: -----

ممتلئة ☐ فارغة ☐

#### مزارع حيوانات قريبة من المزرعة المصابة:

نعم ☐ كلا ☐

١- رقم المزرعة: -----

عنوان: -----

بلدية ----- محافظة ----- قضاء -----

هاتف: -----

الانواع الحيوانات الموجودة في المزرعة: ----- عددها: -----

ممتلئة ☐ فارغة ☐

٢- رقم المزرعة: -----

عنوان: -----

بلدية ----- محافظة ----- قضاء -----

هاتف: -----

الانواع الحيوانات الموجودة في المزرعة: ----- عددها: -----

ممتلئة ☐ فارغة ☐

٣- رقم المزرعة: -----  
عنوان: -----  
بلدية ----- محافظة ----- قضاء -----  
هاتف -----  
الانواع الحيوانات الموجودة في المزرعة: ----- عددها: -----  
ممتلئة ☐ فارغة ☐

٤- رقم المزرعة: -----  
عنوان: -----  
بلدية ----- محافظة ----- قضاء -----  
هاتف -----  
الانواع الحيوانات الموجودة في المزرعة: ----- عددها: -----  
ممتلئة ☐ فارغة ☐

## معلومات عن تاريخ أعراض الأمراض السريرية

(خلال فترة ٢٠ يوم قبل ظهور العوارض السريرية الأولية واليوم الذي وضعت فيه المزرعة تحت الحظر)

النفوق الأسبوعي:

(المعلومات بخصوص نسبة النفوق تؤخذ قبل فترة تحدد بناءً على الحد الأقصى لحضانة المرض المشتبه به)

الاسبوع	من	الى	عدد الحيوانات النافقة

ملاحظات:

تاريخ ظهور الأعراض السريرية -----/-----/-----

تاريخ بدء النفوق: -----/-----/----- عدد النفوق اليومي: -----

الأعراض السريرية التي لاحظها المربي بالترتيب الزمني: -----

هذه المعلومات يجب أن تؤخذ عندما وضعت المزرعة تحت الحظر مع ذكر الأعراض والنفوق منذ الاشتباه

ملاحظات	عدد الحيوانات المخالطة التي ستعدهم	عدد الحيوانات النافقة في المزرعة المحظورة	عدد الحيوانات المريضة في المزرعة المحظورة	مجموع الحيوانات في المزرعة المحظورة (حي + نافق)

- هل يوجد برنامج لتحصين الحيوانات؟

نعم ☐ كلا ☐

تاريخ التلقيح	نوع اللقاح (حي - ميت)	الاسم التجاري	مصدر	طريقة التحصين	ملاحظات

- فريق التلقيح:

العائلة ☐ عمال ☐ طبيب بيطري ☐ فريق خارجي ☐ آخرون ☐ -----  
 أسماء الملقحين: ----- هاتف: -----  
 ملاحظات: -----

- أدوية بيطرية:

خلال ١٥ يوم قبل اكتشاف المرض: كلا ☐ نعم ☐ حدد: -----  
 -----  
 -----

- الفريق المسؤول عن اعطاء الدواء البيطري:

العائلة ☐ عمال ☐ فريق خارجي ☐ آخرون ☐ -----  
 ملاحظات: -----  
 -----  
 -----  
 -----

تحري عن الاعراض السريرية لدى كل نوع:

نوع الحيوانات: -----

نوع المرض: -----

اعراض	العوارض السريرية	نعم	كلا	ملاحظات
اعراض عامة	حرارة مرتفعة			
أعراض الجهاز الهضمي	فقدان الشهية			
	التقرحات المميزة التي تظهر في اماكن الاغشية المخاطية في اللسان والشفاه والفم واللثة			
	تقرحات على اللثة ، الشفة السفلى من مقدمة اللسان وزوايا الفم			
	لعاب رغوي لزج			
	رائحة النفس ننته وكرهه			
	اسهال			اللون: ----- البنية: -----
	هزال شديد يتبعه نفوق الحيوان قد تصل نسبة النفوق الى (٩٠%)			
أعراض الكلى والجهاز البولي	تقوس الظهر (نتيجة ألم في الكلى)			
	أعراض بولية			
أعراض تنفسية	سرعة في التنفس			
	سرعة في النبض			
	أعراض تنفسية			
	افرازات انفية براقية (شفافة اللون) تصبح بعد ذلك قيحية.			
	عطس وسعال			
أعراض الجهاز الدوري	عدم انتظام في دقات القلب			
	وزمات طرفية			
	التهاب عضلة القلب تسبب موت حديثي الولادة			
	فقر دم			
أعراض الجهاز العصبي	خمول			
	شلل نصفي			
العين	التهاب الملتحمة العينية مع افرازات تتسبب في التصاق الجفنين			

أعراض جلدية	التقرحات المميزة التي تظهر بين أربطة الاقدام وفي حلقات الضرع		
أعراض الجهاز الحركي	الرعشة		
	العرج		
	ورم المفاصل		
	تقوس الظهر		
أعراض الجهاز التناسلي	اجهاض		
	التهاب الضرع		
	مشيمة معلقة		
	التهاب الخصية		
	التهاب القناة المنوية		
	عقم		
	افرازات مهبلية		
أعراض الغدد اللبنية (الضرع)	تدني في انتاج الحليب	حاد ----- طفيف -----	
أعراض أخرى			

ملاحظات: -----  
-----  
-----  
-----  
-----

الاسم الطبيب البيطري: -----

توقيعه: -----



## أمراض وبائية

نوع المرض: -----

بطاقة العينة

المحافظة ----- القضاء ----- البلدة/القرية -----

الطبيب البيطري -----

هاتف ----- فاكس ----- تاريخ -----/-----/-----

المزرعة: تابعة لبلدية ----- قضاء: -----

محافظة: ----- هاتف -----

رقم المزرعة -----

المالك -----

عنوان -----

هاتف -----

نوع الحيوانات الموجودة في المزرعة وبرنامج التحصين

☐ بقر حلوب عدد ----- ☐ بقر تسمين عدد -----

☐ غنم حلوب عدد ----- ☐ غنم تسمين عدد -----

☐ ماعز حلوب عدد ----- ☐ ماعز تسمين عدد -----

☐ خنازير عدد -----

☐ حيوانات أخرى (حدد) ----- عددها -----

اللقاحات:

اسم اللقاح	تاريخ التلقيح	اسم اللقاح	تاريخ التلقيح

جمع العينات من /الى

☐ بؤرة وبائية مشتبه بها تاريخ التبليغ -----/-----/-----

☐ بؤرة وبائية مؤكدة

☐ تحقيق وبائي لمزرعة في منطقة المسح الوبائي المكثف (محيط ٣ كلم – وسطها المزرعة الموبوءة):

اسم المزرعة ----- رقمها -----

☐ تحقيق وبائي لمزرعة في منطقة المسح الوبائي (محيط ١٠ كلم – وسطها المزرعة الموبوءة):

اسم المزرعة ----- رقمها -----

☐ حظر انتقال الحيوانات من /الى المزرعة الموبوءة

☐ برنامج مراقبة

☐ برامج أخرى -----

سمات تعريف العينات المرسله الى المختبر:

اسم المربي:

عنوان المزرعة:

هاتف:

المرض المشتبه به	نوع الحيوان	تعريف الحيوان / رقمه	نوع العينات	عدد العينات
			دم	
			سواب	
			حيوان نافق	
			أخرى	

تاريخ سحب العينات: -----/-----/-----

الاسم الطبيب البيطري: -----

توقيعه: -----

## *Annex 6: list of disinfectants*

Specifications and modes of usage of presently available disinfectants

Name	Concentration	Minimum contact time	Usage
Detergent	Appropriate	10 minutes	Cleaning
Virkon S	1 Kg/ 200 liter water	10 minutes	Farm & equipment disinfection
Formaldehyde	<ul style="list-style-type: none"><li>○ For washing → 1/100</li><li>○ For fumigation → 10g potassium permanganate/20ml formaldehyde in 20ml water for 1m<sup>3</sup></li></ul>	<ul style="list-style-type: none"><li>○ –</li><li>○ 15-24 hours</li></ul>	<ul style="list-style-type: none"><li>○ Farm &amp; equipment disinfection.</li><li>○ Fumigation utensils (clay) should be distributed all over the poultry house</li></ul>
Castle H110	1 part /64 parts of water	10 minutes	Floor disinfection
NaOH	8/1000 -2%	-	Farm & equipment disinfection
Chlorine water	10-20/100	-	Farm & equipment disinfection
Phenol	3/100	-	Farm & equipment disinfection

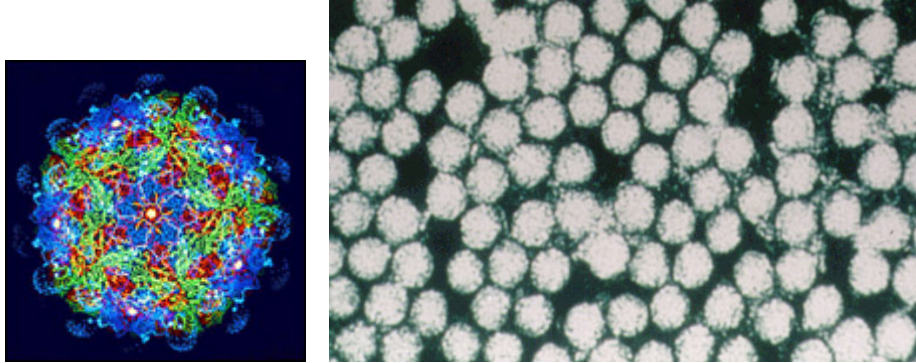
## Annex 7: Nature of FMD

### ETIOLOGY

#### Classification of the causative agent

A virus of the family **Picornaviridae**, genus **Aphthovirus**.

Seven immunologically distinct serotypes: A, O, C, SAT1, SAT2, SAT3, Asia1



#### Resistance to physical and chemical action

Temperature:	Preserved by refrigeration and freezing and progressively inactivated by temperatures above 50°C. Suspensions of virus will retain infectivity for eight to ten weeks at ambient temperatures of about 22°C, and for up to ten days at 37 °C. Sun light has little effect on the virus.
pH:	Inactivated by pH <6.0 or >9.0. It is most stable at pH 7.4-7.6.
Disinfectants:	Inactivated by sodium hydroxide (2%), sodium carbonate (4%), and citric acid (0.2%). Resistant to iodophores, quaternary ammonium compounds, hypochlorite and phenol, especially in the presence of organic matter
Survival:	Survives in lymph nodes and bone marrow at neutral pH, but destroyed in muscle when is pH <6.0 i.e. after <i>rigor mortis</i> . Can persist in contaminated fodder and the environment for up to 1 month, depending on the temperature and pH conditions

### EPIDEMIOLOGY

- One of the most contagious animal diseases, with important economic losses
- Low mortality rate in adult animals, but often high mortality in young due to myocarditis

#### Hosts

- Bovidae (cattle, zebu, domestic buffaloes, yaks), sheep, goats, swine, all wild ruminants and suidae. Camelidae (camels, dromedaries, llamas, vicunas) have low susceptibility. The disease is generally most severe in cattle and pigs.
- Human infections have been reported but are extremely rare and mild.

#### Sources of virus

- Incubating and clinically affected animals
- Breath, saliva, faeces, and urine; milk and semen (up to 4 days before clinical signs)
- Meat and by-products in which pH has remained above 6.0
- Carriers: particularly cattle and water buffalo; convalescent animals and exposed vaccinates (virus persists in the oropharynx for up to 30 months in cattle or longer in buffalo, 9 months in sheep). African Cape buffalo are the major maintenance host of SAT serotypes

## ***Virus survival***

***In the environment.*** The FMD virus can retain infectivity for considerable period in the environment provided it is protected from desiccation, heat and adverse pH conditions. For example, the virus may survive for 14 days in dry fecal material; six months in slurry in winter; 39 days in urine; 28 days on the surface of soil in autumn; and three days on the surface of soil in summer.

***In the host (Including pathogenesis of the disease).*** The respiratory system is the major route of infection in ruminant species, and very small doses of virus can initiate infection. The virus can also enter through abrasions in the skin or the mucosae as a result of injury caused by damage from grass seeds, feeding on rough fodder, foot rot, trauma from milking machines or from fingernails during nose restraint cattle. After inhalation, the virus –laden droplets are transported by ciliary action to the pharyngeal area. Following primary multiplication in the pharyngeal mucosa and draining lymph nodes, the virus is transported in the bloodstream to secondary sites that include the glandular organs, other lymph nodes, and epithelial tissues in and around the mouth and feet, and the mammary glands in females. The vagina and prepuce may also be involved. Cardiac muscle is a secondary target in young animals.

The virus is excreted in large quantities in expired air, in all secretions and excretions (including milk and semen) and from ruptured vesicles. Excretion of the FMD virus can begin up to four days before clinical disease becomes apparent, and this is of great epidemiological significance. Most excretion of the virus ceases four to six days after the appearance of vesicles, when circulating antibodies develop. The virus tends to persist in foot lesions for a day or two longer than in mouth lesions, so that foot lesions may be a better source of virus for diagnostic purposes in older cases. The FMD virus has been detected in the milk and semen of experimentally infected cattle for 23 and 56 days respectively.

After clinical recovery, up to 80% of ruminant animals may become persistently infected, "carrier state" which is the carriage of the virus beyond 28 days after primary infection. Such persistent infection is established in the pharyngeal and cranial oesophageal tissues. The duration of the carrier state varies with the host species, strain of virus and other factors. The maximum reported carrier periods for different species are:

- 3.5 years for cattle
- 9 months for sheep
- 4 months for goats
- 5 years or more for African buffaloes

The virus can be recovered intermittently from such animals by oesophageal-pharyngeal (OP) probing collections. The quantity and frequency of virus that can be collected decline progressively with time.

***In animal products.*** Although the FMD virus is inactivated in the meat of carcasses that undergo the normal post-slaughter acidification processes, it can retain infectivity for very long periods in frozen or chilled lymph nodes, bone marrow and residual blood clots, and for shorter periods in offal. Other products in which the virus can retain infectivity for long periods include uncooked salted and cured meats, green-salted hides, unpasteurized milk and some other dairy products.

## ***Transmission***

- **Most contagious of animal diseases:** pigs are regarded as important amplifying hosts for the disease because of their ability to be infected orally and their capacity to excrete large quantities of virus in their exhaled breath. Cattle are regarded as good indicator hosts because of their extreme sensitivity to infection by the respiratory route, and the unusual development of severe, classical clinical signs in these animals. Sheep are regarded as maintenance hosts because infection with some virus strains can be spread through flocks with little overt sign of disease. Note that not all FMD viruses behave in the same way epidemiologically nor will they all have the same host range.
- **Direct contact:** It is most significantly transmitted where the stocking density is high where it spread rapidly in intensive farming areas. Conversely, disease spread in extensive grazing areas in hotter climates can be more insidious. Levels of protection (either from convalescence or vaccination) can dampen the movement of viruses in a herd or flock. The disease can be disseminated very rapidly by movement of infected animals through livestock markets and shows.
- **Indirect contact:** (humans, droplets, animal foodstuff, bedding, livestock holding areas, saliva, milk, faeces, and urine vehicles, implements).
- **Swill feeding of pigs:** Uncooked swill that contains virus-contaminated meat scraps or dairy products has a high potential for spreading infection. Swill originating from aircraft and ships has been incriminated as a major source of infection and has been responsible for a number of cases of international spread of the disease.
- **Windborne spread.** Infection by wind over considerable distances in temperate climates is believed to have occurred in several outbreaks in Europe. Although most windborne spread over land is confined to 10 km, a spread over water of 250 km may have occurred in the case of the Isle of Wight outbreak in 1981. The pattern of windborne spread has generally been from pigs at source to cattle downwind, and is likely to occur only when there are high concentrations of the appropriate livestock species at these locations. Additionally, the following climatic conditions are required: slow and steady wind speed and direction, high relative humidity (optimally above 60 percent), weak sunlight and absence of heavy rain. Long-distance windborne transmission has not been observed in Africa, the Middle East, Asia or Latin America.
- **Artificial breeding.** Transmission of the FMD virus can occur through artificial insemination using infected semen. However, embryo transplantation using properly collected and washed embryos with intact zona pellucidas (using protocols described by the International Embryo Transfer Society [IETS]) does not constitute a risk.

## ***Disease patterns***

The introduction of the virus (or a new serotype) to previously free herds, areas or countries is likely to lead to a very rapidly spreading epidemic with high morbidity rates.

The epidemiological pattern of the disease tends to be different in temperate and tropical/semiotropical parts of the world. In the former, the greater survival of the virus in the environment means that indirect transmission through fomites may be as important as direct contact between infected and susceptible animals. Windborne virus spread is possible under some environmental circumstances.

On the other hand, in hotter climates indirect means of transmission assume less relative importance than direct means of transmission. It is often the movement of potentially infected animals and livestock trading patterns that provides the key to understanding the epidemiology of FMD in such areas.

## ***DIAGNOSIS***

Incubation period is 2-14 days

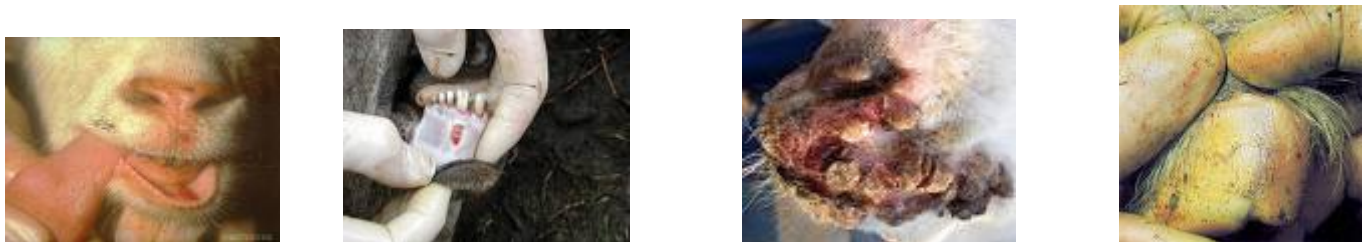
### ***Clinical diagnosis***

#### **Cattle**



- Pyrexia, anorexia, shivering, reduction in milk production for 2-3 days, then
  - smacking of the lips, grinding of the teeth, drooling, lameness, stamping or kicking of the feet: caused by vesicles (aphthae) on buccal and nasal mucous membranes and/or between the claws and coronary band
  - after 24 hours: rupture of vesicles leaving erosions
  - vesicles can also occur on the mammary glands
- Recovery generally occurs within 8-15 days
- Complications: tongue erosions, superinfection of lesions, hoof deformation, mastitis and permanent impairment of milk production, myocarditis, abortion, death of young animals, permanent loss of weight, loss of heat control ('panthers')
- Although there is a very high morbidity rate, the mortality rate in adult animals is generally less than 5 percent. There is often a prolonged convalescence with significant losses of meat and milk production, and of draught power. Pregnant animals may abort. Long-term sequelae may include foot deformities and permanent damage to the udder. Occasionally, endocrine gland damage leads to heat intolerance and a chronic "panting" syndrome characterized by dyspnoea and ill thrift.
- Infection of very young calves may cause sudden death, without vesicular lesions, as a result of cardiac lesions. The mortality rate in such animals can be 50 percent or even higher, aggravated by the fact that milk production in affected dams is diminished or will not allow the offspring to nurse.
- Highly productive animals tend to suffer more severely. The clinical signs of FMD in native breeds of cattle in endemic areas are usually milder than those described above.

#### **Sheep and goats**



- Lesions are less pronounced. Foot lesions may go unrecognized.
- Vesicles are most likely to occur on the dental pad and the posterior portion of the dorsal surface of the tongue. They tend to be small and heal rapidly.

- Foot lesions are difficult to identify and most often occur along the coronary band and interdigital skin. It is often necessary to reflect the hair at the coronary band in order to visualize lesions. Lameness is often the only overt sign of FMD in a flock and must be distinguished from other causes of lameness. Foot lesions in sheep and goats are particularly prone to secondary bacterial infections, including foot rot.
- Agalactia in milking sheep and goats is a feature. Sudden deaths commonly occur in young lambs and kids as a result of cardiac lesions. The mortality rate may be as high as 90 percent, but is more usually about 50 percent.

## Pigs



- Early signs of FMD in pigs include fever, inappetence and reluctance to move. The most pronounced vesicles are on the feet. These vesicles cause acute lameness, pain and recumbency, particularly if the pigs are housed on concrete. Pigs may walk on their knees. Vesicles may occur on the coronets, interdigital skin, dew claws or bulbs of the heel. Lesions may also develop on the knees and hocks. Vesicles that encircle the coronet may lead to separation of the keratinized layers of the hoof from the corium. In severe cases there may be sloughing of the hoof. Otherwise, a line of separation between old and new horn moves steadily down the hoof at a rate of about 1 mm a week, starting a week after the rupture of coronary band vesicles. The age of FMD lesions in pigs can often be estimated in this way.
- Vesicles often occur on the snout. Usually there is a single large vesicle on the dorsum of the snout behind the nasal rostrum. Vesicles on the tongue are relatively uncommon in pigs, and when they occur are small and heal rapidly.
- Sows often develop vesicles on their teats. Pregnant sows may abort. There may be high mortality in suckling piglets, with sudden deaths from myocarditis, but no vesicular lesions. In some herds this is the first overt sign of the disease.
- High mortality in piglets a frequent occurrence.

## Lesions

- Vesicles or blisters on the tongue, dental pad, gums, cheek, hard and soft palate, lips, nostrils, muzzle, coronary bands, teats, udder, snout of pigs, corium of dewclaws and interdigital spaces
- Post-mortem lesions on rumen pillars, in the myocardium, particularly of young animals (tiger heart)

## DETERMINING THE AGE OF FOOT-AND-MOUTH DISEASE LESIONS

Being able to determine the age of lesions, especially when FMD is first recognized in a herd, is a useful aid to determining the approximate time of first infection, and thus in tracing back to the origin of infection. The table below gives some indicators as to the appearance of lesions at various phases of their development. It is of more value in cattle and pigs than in small ruminants, given the fact that clinical disease in sheep and goats is relatively mild.

Approximate age of lesions	Appearance of lesions
1 day	Unruptured vesicles containing some fluid, early signs of necrosis in overlying epithelium
1-2 days	Unruptured, fluid-filled vesicles, overlying epithelium necrotic
1-3 days	Vesicles ruptured, erosions present and ragged pieces of epithelium adhering to the margins of the lesions. In the earlier phase, the exposed centre of the lesion is bright red; later the redness begins to change as fibrin deposition occurs
4 days-1 week	Erosions with little epithelium attached, margins of lesions becoming "smoother" (no longer ragged) because of early healing with regrowth of epithelium at the edge of the lesion
7-10 days	Healing advanced with fibrous tissue formation



## ***Immunity***

Circulating neutralizing antibodies develop within four to ten days of infection. Convalescent animals usually have a very long immunity to reinfection (as long as at least five years) with closely related virus of the same serotype, but remain fully susceptible to other serotypes.

The degree of protection after vaccination is greatly influenced by the antigenic relationship between the vaccine strain and the challenge strain. Vaccines provide only partial immunity against antigenic variants of the same serotype. Potent vaccines confer immunity as early as four days after injection. However, vaccinal immunity is not long lasting and therefore revaccination at regular intervals (e.g. 6-12 months) is required. Manufacturers of commercial FMD vaccines normally recommend a primary immunization regime of an initial dose followed within three to four weeks by a second dose of vaccine. However, in endemic situations it is more usual to give two doses at six months apart and to revaccinate thereafter at yearly intervals. A proportion of vaccinated animals, although protected against the clinical disease, may become subclinically infected after natural challenge and excrete virus. It is important to note that animals incubating the disease when vaccinated may still develop the disease, sometimes in a milder form, and that vaccinated, exposed animals may still transmit infection for 7-14 days after vaccination and exposure.

## ***Field diagnosis***

Susceptible animals exhibiting excess salivation, lameness and other suggestive clinical signs should be examined carefully for vesicular lesions. If these are found, FMD should be strongly suspected and appropriate action taken immediately to secure a definitive diagnosis and prevent any further spread of the disease while this is being done. This action includes collecting appropriate diagnostic specimens (or calling for a visit to be made by a specialist diagnostic team), notifying the provincial veterinary officer (PVO) and/or chief veterinary officer (CVO), and implementing or advising on immediate quarantine measures. Personal disinfection should be carried out after inspecting suspect animals and in no circumstances should another farm be visited on the same day.

## ***Differential diagnosis***

### **Clinically indistinguishable:**

- Vesicular stomatitis
- Swine vesicular disease
- Vesicular exanthema of swine

### **Other differential diagnosis:**

- Rinderpest
- Mucosal disease
- Infectious bovine rhinotracheitis
- Bluetongue
- Bovine mammillitis
- Bovine papular stomatitis
- Bovine viral diarrhoea

## ***Laboratory diagnosis***

### **Procedures**

#### ***Identification of the agent***

- ELISA
- Complement fixation test (CFT)
- Virus isolation: inoculation of primary bovine thyroid cells and primary pig, calf and lamb kidney cells; inoculation of BHK-21 and IB-RS-2 cell lines; inoculation of mice
- Another tests include pen-side tests for the detection of the FMD virus by RT-PCR, Classical, or real Time PCR and the one under development & validation is the application of automated, mobile equipment for the rapid application of the RT-PCR test in the field.

#### ***Serological tests***

- ELISA
- Virus neutralization test (prescribed tests in the *Manual*)

## Samples

- 1 g of tissue from an unruptured or recently ruptured vesicle. Epithelial samples should be placed in a transport medium which maintains a pH of 7.2-7.4 and kept cool (see *Manual*)
- Vesicle liquids placed in tubes & put in refrigerator.
- Oesophageal-pharyngeal fluid collected by means of a probang cup. Probang samples should be frozen to below -4°C immediately after collection.

NB!!

Special precautions are required when sending perishable suspect FMD material within and between countries.

## PREVENTION AND CONTROL

### *Sanitary prophylaxis*

- Protection of free zones by border animal movement control and surveillance
- Slaughter of infected, recovered, and FMD-susceptible contact animals
- Disinfection of premises and all infected material (implements, cars, clothes, etc.)
- Destruction of cadavers, litter, and susceptible animal products in the infected area
- Quarantine measures (*Code* Chapter 2.1.1.)

### *Medical prophylaxis*

Inactivated virus vaccine containing an adjuvant.

Immunity: 6 months after two initial vaccinations, 1-month apart, depending on the antigenic relationship between vaccine and outbreak strains

## REFERENCES AND OTHER INFORMATION

- [Reference experts and laboratories](#)
- Classified as an OIE [List A](#) disease (A010)
- [Chapter 2.1.1. in the Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.](#)
- [Terrestrial Animal Health Code](#)
  - Numerous other references - see the [Index](#)
- *World Animal Health.*
- Current [Animal Health Status](#) (*Disease Information*, [List of FMD free countries](#))
- FAO Animal Health Manual No. 16-ISSN 1020-5187

## ***Annex 9: Nature of Brucellosis***

Brucellosis results from infection by various species of *Brucella*, a Gram negative, facultative intracellular coccobacillus or short rod in the family Brucellaceae. Six named species occur in animals: *B. abortus*, *B. melitensis*, *B. suis*, *B. ovis*, *B. canis* and *B. neotomae*. One or more unnamed species of *Brucella* have been found in marine mammals. Formal names proposed for marine mammal isolates are *B. maris* for all strains, or *B. pinnipediae* for strains from pinnipeds (seals, sea lions and walruses) and *B. cetaceae* for isolates from cetaceans (whales, porpoises and dolphins). Some species of *Brucella* contain biovars. Five biovars have been reported for *B. suis*, three for *B. melitensis*, and up to nine for *B. abortus*.

Each *Brucella* species is associated most often with certain hosts. *B. abortus* usually causes brucellosis in cattle, bison and buffalo. *B. melitensis* is the most important species in sheep and goats, but *B. ovis* can also cause infertility in rams. *B. canis* causes disease almost exclusively in dogs. *B. neotomae* is found in rodents, but has not been linked to disease. *B. suis* contains more diverse isolates than other *Brucella* species, and these isolates have broader host specificity. *B. suis* biovars 1, 2 and 3 are maintained in pigs; European hares are also a reservoir for biovar 2. Biovar 4 mainly affects reindeer and caribou, and is not normally found in pigs. This biovar was formerly known as *B. rangiferi*. Biovar 5 occurs in rodents.

In humans, brucellosis can be caused by *B. abortus*, *B. melitensis*, *B. suis* biovars 1-4 and, rarely, *B. canis* or marine mammal *Brucella*. Live vaccines for *B. abortus* and *B. melitensis*, as well as the *B. canis* M- strain (a less virulent strain used as an antigen for serological testing), are also pathogenic for humans. *B. ovis*, *B. neotomae* and *B. suis* biovar 5 have not been linked to human disease.

Genetic and immunological evidence suggests that all members of the genus *Brucella* are closely related, and some microbiologists have proposed that this genus be reclassified into a single species (*B. melitensis*), which contains many biovars. This proposal is controversial, and both taxonomic systems are currently in use. The multiple species nomenclature is used in this factsheet.

### ***Transmission***

*B. abortus*, *B. melitensis*, *B. suis* and *B. canis* are usually transmitted between animals by contact with the placenta, fetus, fetal fluids and vaginal discharges from an infected animal. Animals are infectious after either an abortion or full term parturition. Although ruminants are usually asymptomatic after their first abortion, they can become chronic carriers, and continue to shed *Brucella* in milk and uterine discharges during subsequent pregnancies. Dogs may also shed *B. canis* in later pregnancies, with or without symptoms. Entry into the body occurs by ingestion and through the mucous membranes, broken skin and possibly intact skin.

Most or all *Brucella* species are also found in semen. Males can shed these organisms for long periods or lifelong. The importance of venereal transmission varies with the species. It is the primary route of transmission for *B. ovis*. *B. suis* and *B. canis* are also spread frequently by this route. *B. abortus* and *B. melitensis* can be found in semen, but venereal transmission of these organisms is uncommon. Some *Brucella* species have also been detected in other secretions and excretions including urine, feces, hygroma fluids, saliva, and nasal and ocular secretions. In most cases, these sources seem to be relatively unimportant in transmission; however, some could help account for direct non-venereal transmission of *B. ovis* between rams.

*Brucella* can be spread on fomites including feed and water. In conditions of high humidity, low temperatures, and no sunlight, these organisms can remain viable for several months in water, aborted fetuses, manure, wool, hay, equipment and clothes. *Brucella* can withstand drying, particularly when organic material is present, and can survive in dust and soil. Survival is longer when the temperature is low, particularly when it is below freezing.

Accidental hosts usually become infected after contact with maintenance hosts. Although the ruminant udder is usually colonized during the course of an infection, it can also be infected by direct contact (for example, by bacteria on the hands of farm workers). This can result in the long-term shedding of species not normally found in ruminant milk, such as *B. suis*. Humans usually become infected by ingesting organisms or by the contamination of mucous membranes and abraded skin. In the laboratory and probably in abattoirs, *Brucella* can be transmitted in aerosols. Common sources of infection for people include contact with animal abortion products; ingestion of unpasteurized dairy products from cows, small ruminants or camels; ingestion of undercooked meat, bone marrow or other uncooked meat products; contact with laboratory cultures and tissue samples; and accidental injection of live brucellosis vaccines. Human to human transmission is rare, but has been reported after blood transfusion, bone marrow transplantation or sexual intercourse. Rare congenital infections seem to result from transplacental transmission or the ingestion of breast milk. Congenital infections might also occur if the infant is exposed to organisms in the mother's blood, urine or feces during delivery.

### ***Disinfection***

*Brucella* species are readily killed by most commonly available disinfectants including hypochlorite solutions, 70% ethanol, isopropanol, iodophores, phenolic disinfectants, formaldehyde, glutaraldehyde and xylene; however, organic matter and low temperatures decrease the efficacy of disinfectants. Disinfectants reported to destroy *Brucella* on contaminated surfaces include 2.5% sodium hypochlorite, 2-3% caustic soda, 20% freshly slaked lime suspension, or 2% formaldehyde solution (all tested for one hour). Alkyl quaternary ammonium compounds are not recommended. Autoclaving (moist heat of 121°C for at least 15 minutes) can be used to destroy *Brucella* species on contaminated equipment. These organisms can also be inactivated by dry heat (160-170°C for at least 1 hour). Boiling for 10 minutes is usually effective for liquids. Xylene (1ml/liter) and calcium cyanamide (20 kg/m<sup>3</sup>) are reported to decontaminate liquid manure after 2 to 4 weeks. *Brucella* species can also be inactivated by gamma irradiation (e.g. in colostrum) and pasteurization. Their persistence in unpasteurized cheese is influenced by the type of fermentation and ripening time. The fermentation time necessary to ensure safety in ripened, fermented cheeses is unknown, but is estimated to be approximately three months. *Brucella* is reported to persist for weeks in ice cream and months in butter. This organism survives for very short periods in meat, unless it is frozen; in frozen meat, survival times of years have been reported.

### ***Incubation Period***

The incubation period is difficult to determine in humans but has been estimated at five days to three months. Most infections seem to become apparent within two weeks. Aerosolization of bacteria in biological weapons could result in a shorter incubation period.

### ***Clinical Signs***

Brucellosis is a multisystemic disease with a broad spectrum of symptoms. Asymptomatic infections are common. In symptomatic cases, the disease is extremely variable and the clinical signs may appear insidiously or abruptly. Typically, brucellosis begins as an acute febrile illness with nonspecific flu-like signs such as fever, headache, malaise, back pain, myalgia and generalized aches. Drenching sweats can occur, particularly at night. Splenomegaly, hepatomegaly, coughing and pleuritic chest pain are sometimes seen. Gastrointestinal signs including anorexia, nausea, vomiting, diarrhea and constipation occur frequently in adults but less often in children.

In many patients, the symptoms last for two to four weeks and are followed by spontaneous recovery. Others develop an intermittent fever and other persistent symptoms that typically wax and wane at 2 to 14 day intervals. Most people with this undulant form recover completely in three to 12 months. A few patients become chronically ill. Relapses can occur months after the initial symptoms, even in successfully treated cases. Hypersensitivity reactions can mimic the symptoms of brucellosis.

Complications are seen occasionally, particularly in the undulant and chronic forms. The most common complications are arthritis, spondylitis, epididymo-orchitis and chronic fatigue. Neurological signs occur in up to 5% of cases. They may include personality changes, meningitis, encephalitis and peripheral neuropathy. Uveitis, optic neuritis and papilledema have been reported. Endocarditis is one of the most serious complications, and is often the cause of death in fatal cases. Many other organs and tissues can also be affected, resulting in a wide variety of syndromes including nephritis, dermatitis, vasculitis, lymphadenopathy, deep vein thrombosis, granulomatous hepatitis, cholecystitis, osteomyelitis, anemia, leukopenia and thrombocytopenia. Abscesses can occur in internal organs.

The symptoms of congenital brucellosis are variable. Some congenitally infected infants are delivered prematurely, while others are born at full term. Common symptoms include low birth weight, fever, failure to thrive, jaundice, hepatomegaly and splenomegaly. Some newborns with congenital brucellosis have respiratory difficulty or severe respiratory distress, hypotension, vomiting and other signs of sepsis. Other infants may be asymptomatic or have only mild symptoms at birth. Whether brucellosis can lead to spontaneous abortion in humans is controversial.

### ***Communicability***

Brucellosis is not usually transmitted from person to person. Rarely, bacteria have been transmitted by bone marrow transplantation, blood transfusion or sexual intercourse. Rare congenital infections have also been documented. In some cases, the infant appeared to be infected through the placenta, and in others by the ingestion of breast milk. Brucellosis was reported in an obstetrician who swallowed secretions while trying to clear a congenitally infected infant's respiratory tract at birth.

### ***Diagnostic Tests***

Microscopic examination of stained smears can be useful for a presumptive diagnosis, particularly if the direct examination is supported by other tests. Brucellae are coccobacilli or short rods, usually arranged singly but sometimes in pairs or small groups. They are not truly acid-fast; however, they are resistant to decolorization by weak acids, and stain red against a blue background with the Stamp's modification of the Ziehl-Neelsen method. Other organisms such as *Coxiella burnetii* can resemble *Brucella*.

In humans, the definitive diagnosis is by culture or serology. *Brucella* species can sometimes be isolated from the blood early in the infection; bone marrow is often positive at this stage. Occasionally, bacteria can be recovered from the cerebrospinal fluid, urine or tissues. *Brucella* spp. can be isolated on a variety of plain media, or selective media such as Farrell's medium

or Thayer-Martin's modified medium. Enrichment techniques can also be used. Colony morphology varies with the species. Colonies of smooth forms (*B. abortus*, *B. suis*, *B. melitensis* and marine mammal *Brucella*) are round with smooth margins. When the plates are viewed in daylight through a transparent medium, these colonies are translucent and a pale honey color. From above, they are convex and pearly white. *B. ovis* and *B. canis* are rough (R) forms. The colonies are round, shiny and convex, but their rough nature can be seen by examining the colony with oblique illumination. Most *Brucella* species form colonies within a few days, but isolates from seals grow slowly and may take 7 to 10 days to become visible on selective media. *Brucella* isolates can be identified to the species and biovar level by phage typing and cultural, biochemical and serological characteristics. Care should be taken during identification, as marine mammal isolates are sometimes misidentified initially as terrestrial strains. Genetic techniques can also be used for biotyping.

Most human infections are diagnosed by serology. Tests used include serum agglutination, a modified Coombs' (antiglobulin) technique, ELISAs and immunoblotting (Western blotting). Serologic diagnosis is complicated by previous exposures and other factors; a definitive diagnosis usually requires a fourfold rise in titer. Immunostaining can sometimes demonstrate the presence of *Brucella* spp. in a clinical specimen. PCR techniques can also be used for diagnosis. Chronic brucellosis can be extremely difficult to diagnose, if the serologic results are equivocal and the organism cannot be cultured.

### ***Treatment***

Antibiotics are usually the mainstay of treatment; long-term treatment may be required. Some forms of localized disease, such as endocarditis, may require surgery.

### ***Prevention***

Human brucellosis is usually prevented by controlling the infection in animals. Pasteurization of dairy products is an important safety measure where this disease is endemic. Unpasteurized dairy products and raw or undercooked animal products (including bone marrow) should not be consumed.

Good hygiene and protective clothing/equipment are very important in preventing occupational exposure. Precautions should be taken to avoid contamination of the skin, as well as inhalation or accidental ingestion of organisms when assisting at a birth, performing a necropsy, or butchering an animal for consumption. Particular care should be taken when handling an aborted fetus or its membranes and fluids. Risky

agricultural practices such as crushing the umbilical cord of newborn livestock with the teeth or skinning aborted fetuses should be avoided. The Strain 19 *B. abortus* vaccine and *B. melitensis* Rev-1 vaccine must be handled with caution to avoid accidental injection or exposure. Adverse events have also been reported with the *B. abortus* RB51 vaccine, although it is safer than Strain 19. Persistent infections with vaccine strains have occasionally been reported in vaccinated animals. These strains can be shed in the milk or aborted fetuses and can infect humans. Obstetricians should also take precautions when assisting at human births, particularly in regions where brucellosis is common. Recently, an obstetrician became infected by ingesting amniotic fluid and secretions from a congenitally infected infant. In the laboratory, *Brucella* spp. should be handled under biosafety level 3 conditions or higher. Human vaccines are not available.

## ***Morbidity and Mortality***

Brucellosis is usually an occupational disease; most cases occur in abattoir workers, veterinarians, hunters, farmers, reindeer/caribou herders and livestock producers. Brucellosis is also one of the most easily acquired laboratory infections. People who do not work with animals, tissues or bacterial cultures usually become infected by ingesting unpasteurized dairy products. Other cultural practices, such as eating bone marrow from reindeer and caribou infected with *B. suis*, are risk factors in some populations. In endemic areas, the reported incidence ranges from fewer than 0.01 to more than 200 cases per 100,000 population. Human brucellosis is rare in the U.S.; the annual incidence is less than 0.5 cases per 100,000 persons; approximately 100 cases have been reported annually for the past ten years. However, some studies suggest that this disease is underdiagnosed and underreported in the U.S.

Many human infections are asymptomatic or self-limiting; however, some symptomatic infections can be prolonged, with slow recovery and a small possibility of complications. Increased numbers of symptomatic infections could be seen after a biological attack with aerosolized bacteria. The incidence and severity of disease varies with the species of *Brucella*. *B. melitensis* is considered to be the most severe human pathogen in the genus. *B. abortus* and *B. suis* biovars 1, 3 and 4 are also important human pathogens. *B. suis* biovar 2 and *B. canis* infections are rarely reported in humans. However, serologic studies have reported antibodies to *B. canis* in 13% of hospital patients in Mexico, 0.3% of sera tested in Germany, 0.4% of US military populations, 0.6% of Florida residents and 68% of Oklahoma residents. As of July 2007, only four human infections with marine mammal *Brucella* have been reported. One infection occurred in a researcher exposed in the

laboratory. Two patients with community-acquired neurobrucellosis were reported in the U.S. The source of infection could not be determined in either case, but both patients had recently emigrated from Peru and regularly consumed raw fish (in cerviche) and unpasteurized cheese. One had no significant exposure to marine mammals; the other regularly swam in the ocean but had not been directly exposed to marine mammals. The fourth case occurred in New Zealand, in a man with spinal osteomyelitis. This patient had not been exposed to marine mammals, but he was a fisherman who had regular contact with uncooked fish bait and raw fish. He had also eaten raw freshly caught fish. Brucellosis is rarely fatal if treated; in untreated persons, estimates of the case fatality rate vary from less than 2% to 5%. Deaths are usually caused by endocarditis or meningitis.

## ***Infections in Animals***

### ***Species Affected***

Most species of *Brucella* are maintained in a limited number of reservoir hosts. Maintenance hosts for *Brucella abortus* include cattle, bison (*Bison* spp.), water buffalo (*Bubalus bubalus*), African buffalo (*Syncerus caffer*), elk and camels. A feral pig population was recently reported to maintain *B. abortus* in the U.S. Sheep and goats are the reservoir hosts for *B. melitensis*. Sheep are also the maintenance hosts for *B. ovis*. In addition, *B. ovis* occurs in farmed red deer (*Odocoileus virginianus*) in New Zealand. *B. canis* is maintained in dogs and *B. neotomae* in rodents. *B. suis* contains more diverse isolates than other *Brucella* species, and these isolates have broader host specificity. *B. suis* biovars 1, 2 and 3 affect swine. Biovars 1 and 3 are found in both domesticated pigs (*Sus scrofa domestica*) and wild or feral pigs. Biovar 2 currently occurs mainly in wild boar (*Sus scrofa scrofa*) and European hares (*Lepus capensis*); however, this biovar can be transmitted from these reservoirs to domesticated pigs, and spreads readily in these herds. Biovar 4 is maintained in caribou and reindeer (*Rangifer tarandus* and its various subspecies). Biovar 5 is found in small rodents. Marine *Brucella* species have been found by culture or serology in many pinniped and cetacean species including seals, sea lions, walruses, porpoises, dolphins, whales and a European otter.

Other species can become accidental hosts, particularly after close contact. *B. abortus*, *B. melitensis* and *B. suis* infections are reported occasionally in many species including horses, cattle, sheep, goats, camels, pigs, moose, chamois, alpine ibex, raccoons, opossums, dogs, coyotes, foxes and wolves. Experimental infections with marine mammal isolates have been described in cattle, sheep and guinea pigs, and unpublished experiments suggest that piglets can be infected transiently. In contrast, *B. ovis* and *B. canis* seem to be relatively host-specific. Experimental *B. ovis* infections have been reported in goats and cattle, but there is no evidence that these species are infected in nature. Dogs are the only species known to be naturally infected with *B. canis*, although antibodies to this organism have been found in other carnivores. Experimental *B. canis* infections can be established in domesticated livestock and chimpanzees; however, these species are considered highly resistant to natural exposure.

### ***Incubation Period***

The incubation period varies with the species and stage of gestation at infection. In cattle, reproductive losses typically occur during the second half of the pregnancy; thus, the incubation period is longer when animals are infected early in gestation. In this species, abortions and stillbirths usually occur two weeks to five months after infection. In pigs, abortions can occur at any time during gestation. In dogs, abortions are most common at approximately 7 to 9 weeks of gestation, but early embryonic deaths have also been reported after 2 to 3 weeks.



## Clinical Signs

### *Bovine brucellosis (B. abortus)*



In cattle, *B. abortus* causes abortions, stillbirths and weak calves; abortions usually occur during the second half of gestation. The placenta may be retained and lactation may be decreased. After the first abortion, subsequent pregnancies are generally normal; however, cows may shed the organism in milk and uterine discharges. Epididymitis, seminal vesiculitis, orchitis and testicular abscesses are sometimes seen in bulls.

Infertility occurs occasionally in both sexes, due to metritis or orchitis/epididymitis. Hygromas, particularly on the leg joints, are a common symptom in some tropical countries. Arthritis can develop after long-term infections. Systemic signs do not usually occur in uncomplicated infections, and deaths are rare except in the fetus or newborn. Infections in nonpregnant females are usually asymptomatic.

Similar symptoms occur in other ruminants including camels, bison and water buffalo; however, experimentally infected moose develop more serious disease and die rapidly.

### *Ovine and caprine brucellosis (B. melitensis)*



*B. melitensis* mainly causes abortions, stillbirths and the birth of weak offspring. Animals that abort may retain the placenta. Sheep and goats usually abort only once, but reinvasion of the uterus and shedding of organisms can occur during subsequent pregnancies. Milk yield is significantly reduced in animals that abort, as well as in animals whose udder becomes infected after a normal birth. However, clinical signs of mastitis are uncommon. Acute orchitis and epididymitis can occur in males, and may result in infertility. Arthritis is seen occasionally in both sexes. Many non-pregnant sheep and goats remain asymptomatic.

*B. ovis* can also cause poor semen quality in red deer stags, but abortions have not been reported in hinds.

### *Ovine epididymitis (B. ovis)*



*B. ovis* affects sheep but not goats. This organism can cause epididymitis, orchitis and impaired fertility in rams. Initially, only poor quality semen may be seen; later, lesions may be palpable in the epididymis and scrotum. Epididymitis may be unilateral or, occasionally, bilateral. The testes may atrophy. Some rams shed *B. ovis* for long periods without clinically apparent lesions. Abortions, placentitis and perinatal mortality can be seen in ewes but are uncommon. Systemic signs are rare.

### *Porcine and rangiferine brucellosis (B. suis)*



In pigs, the most common symptom is abortion, which can occur at any time during gestation, and weak or stillborn piglets. Vaginal discharge is often minimal and abortions may be mistaken for infertility. Occasionally, some sows develop metritis. Temporary or permanent

orchitis can be seen in boars. Boars can also excrete *B. suis* asymptotically in the semen and sterility may be the only sign of infection. Swollen joints and tendon sheaths, accompanied by lameness and incoordination, can occur in both sexes. Less common signs include posterior paralysis, spondylitis and abscesses in various organs. Although some pigs recover, others remain permanently infected. Fertility can be permanently impaired, particularly in boars. Some animals remain asymptomatic.

In hares, *B. suis* biovar 2 infection is characterized by nodules in the internal organs, particularly the reproductive organs, as well as the subcutaneous tissues and muscles. The nodules can become purulent. The animal's body condition may be minimally affected.

In caribou and reindeer, *B. suis* biovar 4 can cause abortion and retained placenta. Metritis and mastitis can also occur. Males may develop orchitis. Lameness can occur in both sexes from arthritis, bursitis, tenosynovitis and/ or hygromas. Subcutaneous abscesses are also seen.

### ***Canine brucellosis (B. canis)***



*B. canis* can cause abortions and stillbirths in pregnant dogs. Most abortions occur late, particularly during the seventh to ninth week of gestation. Abortions are usually followed by a mucoid, serosanguinous or gray-green vaginal discharge that persists for up to six weeks. Early embryonic deaths and resorption have been reported a few weeks after mating, and may be mistaken for failure to conceive. Some pups are born live but weak; most die soon after birth. Other congenitally infected pups can be born normal and later develop brucellosis. Clinical signs occur during subsequent pregnancies in some dogs, but not in others. Epididymitis, scrotal edema, orchitis and poor sperm quality may be seen in males. Scrotal dermatitis can occur due to self-trauma. Unilateral or bilateral testicular atrophy can be seen in chronic infections, and some males become infertile.

Lymphadenitis is common in infected dogs. Lethargy or fatigue, exercise intolerance, decreased appetite, weight loss and behavioral abnormalities (loss of alertness, poor performance of tasks) are occasionally reported; however, most affected dogs do not appear seriously ill. Occasionally, discospondylitis of the thoracic and/or lumbar vertebrae can cause stiffness, lameness or back pain. Uveitis, endophthalmitis, polygranulomatous dermatitis, endocarditis and meningoencephalitis have also been reported. Fever is uncommon, and deaths are rare except in the fetus or newborn. Many infected dogs remain asymptomatic.

### ***Brucellosis in horses***



In horses, *B. abortus* and occasionally *B. suis* can cause inflammation of the supraspinous or supra-atlantal bursa; these syndromes are known, respectively, as fistulous withers or poll evil. The bursal sac becomes distended by a clear, viscous, straw-colored exudate and develops a thickened wall. It can rupture, leading to secondary inflammation. In chronic cases, nearby ligaments and the dorsal vertebral spines may become necrotic. *Brucella*-associated abortions are rare in horses.

### ***Brucellosis in marine mammals***



There is little information on the effects of brucellosis in marine mammals. Reproductive disease is difficult to assess in wild animals, but *Brucella* has been isolated from the reproductive organs of some marine species. In rare cases, infections have also been linked to lesions or clinical disease. *Brucella*-associated abortions and placentitis were reported in two captive bottlenose dolphins. Lesions consistent with a possible abortion were also reported in a wild Atlantic white-sided dolphin. Recently, *Brucella* was isolated from a dead newborn Maui's dolphin in New Zealand; the animal was born alive but died before taking its first breath. *Brucella*-associated epididymitis has been reported in porpoises, and orchitis from suspected brucellosis was reported in minke whales.

*Brucella* infections have been linked with systemic disease in a few marine mammals. *Brucella*-associated meningoencephalitis was reported in three stranded striped dolphins. Other signs of *Brucella*-associated systemic disease have been seen mainly in Atlantic white-sided dolphins; the lesions included hepatic and splenic necrosis, lymphadenitis and mastitis. *Brucella* has also been identified as a possible secondary invader or opportunistic pathogen in debilitated seals, dolphins and porpoises. It has been isolated from several subcutaneous abscesses. In addition, this organism has been found in organs with no microscopic or gross lesions, and in apparently healthy animals.



## ***Communicability***

Brucellosis is a communicable disease in animals. Large numbers of bacteria are found in aborted fetuses, fetal fluids and membranes, as well as vaginal discharges and milk. Other secretions and excretions including semen, urine and hygroma fluids can also contain organisms. Bacteria have been reported in the feces of some animals including a harbor seal. Infectious bacteria are also found in the bursa of horses with poll evil or fistulous withers. Some animals can shed *Brucella* long-term or lifelong.

## ***Post Mortem Lesions***

### ***Brucella abortus, B. melitensis and B. suis***

Some aborted fetuses appear normal; others are autolyzed or have variable amounts of subcutaneous edema and bloodstained fluid in the body cavities. In ruminant fetuses, the spleen and/or liver may be enlarged, and the lungs may exhibit pneumonia and fibrous pleuritis. Abortions caused by *Brucella* spp. are typically accompanied by placentitis. The cotyledons may be red, yellow, normal or necrotic. In cattle and small ruminants, the intercotyledonary region is typically leathery, with a wet appearance and focal thickening. There may be exudate on the surface.

In adults, granulomatous to purulent lesions may be found in the male and female reproductive tract, mammary gland, supramammary lymph nodes, other lymphoid tissues, bones, joints and other tissues and organs. Mild to severe endometritis may be seen after an abortion, and males can have unilateral or bilateral epididymitis and/or orchitis. In *B. abortus*-infected cattle, hygromas may be found on the knees, stifles, hock, angle of the haunch, and between the nuchal ligament and the primary thoracic spines.

In hares, *B. suis* biovar 2 infections are associated with nodules of varying sizes in internal organs, particularly the reproductive organs but also the spleen, liver, lung and most other organs. The skin and subcutaneous tissues can also be affected. These nodules often become purulent. Despite the nodules, the hare's body condition may be good.

### ***Brucella ovis***

In rams infected with *B. ovis*, lesions are usually limited to epididymitis and orchitis. Epididymal enlargement can be unilateral or bilateral, and the tail is affected more often than the head or body. Fibrous atrophy can occur in the testis. The tunica vaginalis is often thickened and fibrous, and can have extensive adhesions. Although placentitis is uncommon, it is occasionally seen in infected ewes.

### ***Brucella canis***

Aborted puppies are often partially autolyzed and have evidence of generalized bacterial infection. Fetal lesions can include subcutaneous edema, subcutaneous congestion and hemorrhages in the abdominal region, serosanguinous peritoneal fluid, and degenerative lesions in the liver, spleen, kidneys and intestines.

The lymph nodes are often enlarged in affected adults. The retropharyngeal and inguinal lymph nodes are often involved, but generalized lymphadenitis also occurs. The spleen is frequently enlarged, and may be firm and nodular. Hepatomegaly may also be seen. Scrotal edema, scrotal dermatitis, epididymitis, orchitis, prostatitis, testicular atrophy and fibrosis occur in some infected males, and metritis and vaginal discharge may be seen in females. Less commonly reported lesions include discospondylitis, meningitis, focal non-suppurative encephalitis, osteomyelitis, uveitis, and abscesses in various internal organs.

### ***Brucella in marine mammals***

In marine mammals, brucellosis has been linked to lesions in a few animals. Reported lesions include meningoencephalitis, subcutaneous abscesses, placentitis/ abortion, epididymitis, chronic purulent or granulomatous orchitis, lymphadenitis, mastitis, spinal discospondylitis, peritonitis, a mineralized lung granuloma, hepatic abscesses, hepatic and splenic necrosis, and macrophage/ histiocytic cell infiltration in the liver, spleen and lymph nodes. In dolphins with meningoencephalitis, the lesions were described as severe, chronic, widespread, nonsuppurative meningitis most severe in the brainstem. The meningitis was accompanied by periventricular encephalitis. *Brucella* has also been recovered from apparently normal tissues and animals with no lesions.

## ***Diagnostic Tests***

Brucellosis can be diagnosed by culture, serology or other tests.

### ***Microscopic examination***

Microscopic examination of smears stained with the Stamp's modification of the Ziehl-Neelsen method can be used for a presumptive diagnosis. Organisms may be found in abortion products, vaginal discharges, milk, semen or various tissues. *Brucella* species are not truly acid-fast, but they are resistant to decolorization by weak acids, and stain red against a blue background. *Brucellae* are coccobacilli or short rods, usually arranged singly but sometimes in pairs or small groups. This test is not definitive. Other organisms such as *Chlamydophila abortus* and *Coxiella burnetii* can resemble *Brucella*. Direct examination may not detect the small numbers of organisms present in milk and dairy products.

### ***Culture***

*Brucella* species can be recovered from numerous tissues and secretions, particularly fetal membranes, vaginal secretions, milk (or udder secretions in nonlactating cows), semen, arthritis or hygroma fluids, and the stomach contents, spleen and lung from aborted fetuses. Blood cultures are often used to detect *B. canis* in dogs. In this species, bacteremia (which may be intermittent) can persist for up to five years and possibly longer. Oral, nasal, tracheal, vaginal and anal swabs, as well as feces, can be submitted for culture from marine mammals.

At necropsy, bacteria can be isolated from a variety of organs including lymph nodes, spleen, uterus, udder, testis, epididymis, joint exudate, abscesses and other affected tissues. In ruminants with suspected *B. abortus* or *B. melitensis* infections, the spleen, mammary and genital lymph nodes, udder and late pregnant or early post-parturient uterus are the most reliable samples to collect. The preferred tissues to collect in rams suspected of *B. ovis* infection are the epididymis, seminal vesicles, ampullae and inguinal lymph nodes. In dogs, recommended biopsy or necropsy samples include lymph nodes, prostate, epididymis, testis, uterus, spleen, liver and bone marrow. The lymph nodes and spleen are most likely to be positive in non-bacteremic dogs.

*Brucella* spp. can be isolated on a variety of plain media, or selective media such as Farrell's medium or Thayer-Martin's modified medium. Enrichment techniques can also be used. Colony morphology varies with the species. Colonies of smooth forms (*B. abortus*, *B. suis*, *B.*

melitensis and marine mammal *Brucella*) are round with smooth margins. When the plates are viewed in daylight through a transparent medium, these colonies are translucent and a pale honey color. From above, they are convex and pearly white. *B. ovis* and *B. canis* are rough (R) forms. The colonies are round, shiny and convex, but their rough nature can be seen by examining the colony with oblique illumination. Most *Brucella* species form colonies within a few days, but isolates from seals grow slowly and may take 7-10 days to become visible on selective media. *Brucella* isolates can be identified to the species and biovar level by phage typing and cultural, biochemical and serological characteristics. Care should be taken during identification, as marine mammal isolates are sometimes misidentified initially as terrestrial strains. Genetic techniques can also be used for biotyping. The vaccine strains (*B. abortus* strains S19 and RB51, and *B. melitensis* Rev-1) can be distinguished from field strains by their growth characteristics and sensitivity to antibiotics and other additives.

Animal inoculation is rarely used to isolate *Brucella*, but may be necessary if other techniques fail. Guinea pigs or mice can be used.

### **Serology**

Brucellosis is often diagnosed by serology. Serological tests are not completely specific and cannot always distinguish reactions due to *B. melitensis* from cross-reactions to other bacteria, particularly *Yersinia enterocolitica* O:9.

In cattle, sheep and goats, serology can be used for a presumptive diagnosis of brucellosis, or to screen herds. Serological tests commonly used to test individual cattle or herds include the buffered *Brucella* antigen tests (rose bengal test and buffered plate agglutination test), complement fixation, indirect or competitive enzyme-linked immunosorbent assays (ELISAs) and the fluorescence polarization assay. Rivanol precipitation, acidified antigen procedures and the serum agglutination test (tube or microtiter test) are also available. Supplemental tests such as complement fixation or rivanol precipitation are often used to clarify the results from plate or card agglutination tests. ELISAs or the *Brucella* milk ring test (BRT) can be used to screen herds by detecting antibodies in milk. In vaccinated cattle, the native hapten -based gel precipitation tests (gel diffusion or radial immunodiffusion tests) are sometimes used to distinguish vaccination from infection. In sheep and goats, *B. melitensis* can be diagnosed with the buffered *Brucella* antigen tests, complement fixation or ELISAs. Native hapten -based gel precipitation tests are also used in vaccinated sheep and goats. The bulk milk ring test is not used in small ruminants. Serological tests used to detect *B. ovis* include ELISAs, agar gel immunodiffusion (AGID) and complement fixation. Other tests including hemagglutination inhibition and indirect agglutination have also been described.

Serological tests used to detect *B. canis* in dogs include rapid slide agglutination (card or RSAT) tests, tube agglutination, an indirect fluorescent antibody (IFA) test, AGID and ELISA.

In swine, serology is generally considered to be more reliable for identifying infected herds than individual pigs. Serological tests used in swine include ELISAs, the buffered *Brucella* antigen tests and complement fixation. A fluorescence polarization assay has been developed. Supplemental serological tests used in cattle may also be used in swine.

The serological tests used in marine mammals have been adapted from livestock *Brucella* tests. They include the buffered *Brucella* antigen tests, serum agglutination tests, complement fixation, AGID, ELISAs and rivanol test. In general, these tests have not yet been validated for marine mammals; threshold values have not been established and can vary between laboratories.

### **Other tests**

Immunostaining techniques are sometimes used to detect *Brucella* antigens in tissue samples. A brucellin allergic skin test can be used to test pigs for *B. suis*, or unvaccinated small ruminants and cattle for *B. melitensis* or *B. abortus*, respectively. Polymerase chain reaction (PCR) techniques are also available for most species.

## **Treatment**

There is no practical treatment for infected cattle or pigs, but long-term antibiotic treatment is sometimes successful in infected dogs. Some dogs relapse after treatment. Antibiotic treatment has also been used successfully in some valuable rams, but it is usually not economically feasible. Fertility may remain low even if the organism is eliminated. In horses with fistulous withers or poll evil, the infected bursa may need to be surgically removed.

## **Prevention**

Brucellosis is usually introduced into a herd or kennel in an infected animal, but it can also enter in semen. Herd additions should come from brucellosis-free areas or accredited herds. *B. ovis*-free accredited rams may be available in some areas. Animals from other sources should be isolated and tested before adding them to the herd. Domesticated animals should always be kept from contact with wild animal reservoirs. Commercial *B. abortus* and *B. melitensis* vaccines are available for cattle, sheep and goats. Vaccination can interfere with serological tests; this is minimized when only young animals are vaccinated. Vaccination for *B. ovis* is practiced in New Zealand and some other countries, but not in the U.S. Successful vaccines have been difficult to develop for pigs; this species is generally not vaccinated except in China. No vaccines are made for dogs. Vaccines have not been successful in preventing fistulous withers or poll evil in horses.

*B. abortus*, *B. melitensis* and *B. suis* can be eradicated from a herd by test-and-removal procedures, or by depopulation. Some swine programs are designed to retain desirable genetic characteristics in the herd. Good management can reduce the incidence of infection in an infected herd. Whenever possible, animals should give birth in individual pens. Transmission is reduced by immediate disposal of the placenta, contaminated bedding and other infectious material, followed by thorough cleaning and disinfection. The prevalence of *B. ovis* can be decreased by examining rams before the breeding season and culling rams with palpable abnormalities. However, palpable lesions are not found in all infected rams, and laboratory testing of rams should also be considered. Test-and-removal methods directed at rams can eradicate this organism from a flock. *B.-ovis*-free infections in ewes are generally prevented by controlling infections in rams. Infections in other species are generally prevented by controlling *Brucella* species in their maintenance hosts.

Nationwide eradication programs for *B. abortus*, *B. melitensis* and *B. suis* include quarantines of infected herds, vaccination, test-and-slaughter and/or depopulation techniques, cleaning and disinfection of infected farms, various forms of surveillance and tracebacks. *B. ovis* has been eradicated from sheep in the Falkland Islands by test-and-removal methods directed at rams. In areas where a *Brucella* species is not endemic, infected herds are usually quarantined and the animals are euthanized. In the U.S., *B. suis* has been eradicated from commercial swine, and *B. abortus* has nearly been eradicated from domesticated ruminants. Various control methods are being directed at wild animal reservoirs including wild bison and elk herds in the Greater Yellowstone Area, and wild and feral swine.

Canine brucellosis can be controlled similarly to livestock brucellosis, by sanitation and the removal of infected dogs. Housing in individual cages reduces the spread of the organism. Repeated testing and the removal of seropositive or culture-positive animals, combined with

quarantine and testing of newly added dogs, have been used to eradicate brucellosis from some kennels. Long-term antibiotic therapy may be tried in some infected dogs. Neutering can be used as an additional control measure.

Specific control methods have not been established for brucellosis in marine mammals. General principles of infection control including isolation, disinfection and good hygiene should be used with infected animals. Some authors suggest that centers involved in marine mammal rehabilitation should routinely screen animals for *Brucella*.

### ***Morbidity and Mortality***

*B. abortus*, *B. melitensis* and *B. suis* are associated with a high morbidity rate in naïve herds, and a much lower morbidity rate in chronically infected herds. In naïve cattle, *B. abortus* spreads rapidly, and 30% to 80% of the herd may abort. In herds where this organism has become endemic, only sporadic symptoms occur and cows may abort their first pregnancies. A similar pattern is seen in *B. melitensis*-infected sheep and goats. Likewise, when *B. suis* is first introduced into a herd, there may be a significant increase in returns to service, abortions and stillbirths, weak piglets, lameness/ arthritis, posterior paralysis and other signs. The pre-weaning mortality rate usually increases. However, in endemic swine herds, brucellosis may appear as non-specific infertility, a slightly reduced farrowing rate, and irregular estrus cycles. In domesticated pigs, the abortion rate from *B. suis* varies widely, from 0% to 80%. Fertility can be permanently impaired after infection with some species of *Brucella*. Deaths are rare in adult animals of most species; however, *B. abortus* can be lethal in experimentally infected moose, and possibly in bighorn sheep.

*B. ovis* has little effect on sperm quality in some individual animals, but causes severe decreases in sperm motility, concentration and morphology in others. Approximately 30-50% of all infected rams have palpable lesions of the epididymis. Estimates of the abortion rate vary. Some sources report that *B. ovis* causes abortion and perinatal lamb mortality rates of 1–2%, while others suggest that these outcomes are rare. Limited experimental studies have reported abortion rates from 0% to 8%. Abortions and increased perinatal mortality have not been reported in red deer hinds.

*B. canis* spreads rapidly in confined populations, particularly during breeding or when abortions occur. Although death is rare, except in the fetus and neonate, significant reproductive losses can be seen particularly in breeding kennels. Up to 75% fewer puppies may be weaned from affected kennels.

The morbidity and mortality rates for brucellosis in marine mammals are unknown.

## ***Annex 7: Nature of PPR***

### ***Nature of the disease***

- PPR is an acute highly contagious viral disease of goats, less commonly sheep and closely related wild bovidae, and is clinically mimics cattle plague, characterized by fever, erosive stomatitis, enteritis, pneumonia, and death.
- PPR is regarded as the most economically important viral disease of small ruminants particularly goats in areas where these animals are intensively reared. In the regions where PPR occurs in an epizootic form it may have dramatic consequences for animal owners due to high mortality rates. In endemic areas where subacute reactions is usually occurs, it opens the door to many other infections and its impact on animal production is certainly considerable.
- OIE classification: list (A).

Latent infections may be activated and complicate the clinical picture.

### ***History and Occurrence***

- PPR was first described in 1942 in Cote d'Ivoire , and it was soon recognized in Benin, Sengal, and Nigeria. PPR is wide spread in the northly countries of sub-saharan Africa and has been identified in the Sudan, Ethiopia, Egypt, Arab peninsula, and Middle East. Recently PPR has been reported in India and Jordan. PPR is endemic in the Sahel area west of Africa and central Africa.
- In Egypt the first epidemic was recorded in January 1987 in goats at Kafr Hakim, Embeba, Giza governorate and in lambs in 1989 at Fayoum Governorate.

### ***Etiology***

- PPR virus is a Morbillivirus of the Family Paramyxoviridae, RNA genome and has a particular affinity for lymphoid and epithelial tissues of the GI tract, in which it produces characteristic lesions. PPR viruse strains are antigenically homogeneous.
- PPR and RP viruses are distinct pathogens with close antigenic relationship and cross-protection. Also, it has some antigenic relationship to viruses of canine distemper in dogs, measles in humans, and equine influenza recently described in Australia.
- PPR virus can be isolated in primary sheep and goat kidney and vero cells producing cytopathic effect "CPE" similar to that RP virus characterized by syncytium formation, intracytoplasmic and intranuclear inclusion bodies.
- As with RP virus, PPR virus is very fragile it does not survive outside the host for many hours; also the virus is inactivated by putrefaction, and inactivated in sunlight within 2 hours.
- PPR virus is inactivated by strong acid or alkaline conditions within 10 minutes, and chemical agents as 5 % chloroform, 2 % phenol, and 2 % formalin.

### ***Hosts***

- The natural hosts are goats, sheep, and closely related wild bovidae as Laristan sheep, Dorcas gazelles, and Nubian ibex.
- Goats are clearly more susceptible than sheep and the disease often occurs in goats without affecting sheep in close proximity. The highest incidences are found in young stock less than two years old.
- Cattle and pigs when infected experimently develop serum-neutralizing antibodies without symptoms "dead-end hosts".
- Nomadic goats and sheep in the Sahel area west of Africa have a high innate resistance and undergo subclinical infections whereas settled flocks south of the Sahel and indigenous goats and sheep in the Middle East posses a low innate resistance.

### ***Transmission***

- The virus is present in all body excretions and secretions such as tears, nasal discharge, sputum, and diarrheic feces.
- As in RP, PPR virus spreads by direct contact or close indirect contact and infection is mainly by inhalation of infective aerosols but could also occur through the conjunctiva and oral mucosa.
- As with RP, the transimission cycle of PPR virus is maintained through a regular supply of susceptible hosts plus sufficient animal movement to allow mixing of the population.
- As in RP, it is generally accepted that there is no carrier state in PPR.

### ***Key signs***

PPR has acute and sub-acute forms.

#### **The acute form**

- The acute form occurs frequently in goats with a clinical course mimics that of cattle plague but crusty scabs and pneumonia development is more prominent in PPR.

- After an IP 2-6 days the first clinical sign is short fever 40-41°C accompanied by dullness, serous oculonasal discharge that rapidly becomes profuse and purulent. The nasal discharge may block the nares and encrust the muzzle, causing the animal to snort and sneeze, whereas the ocular discharge may mat the eye lids together.
- Congestion and necrosis affects the gums, the lower lip, and may extend over the entire oral mucosa. The tongue becomes coated with fetid diphtheric plaques, the lips swollen, and the animal unable to eat.
- Profuse diarrhea begins 2-4 days after the onset of fever and feces may be mucoid and blood tinged.
- Pulmonary involvement usually occurs during the later stage of the disease and the death usually occurs within a week of the onset of illness. The mortality rate in goats is generally high and ranges from 77-90%, but goats of the endemic Sahel area have a lower rate.
- In the absence of complications recovery may occur within 8-10 days from illness.

#### Sub-acute form

- Subacute reactions are more common in sheep but they also occur in goats and are manifested by low-grade signs and lesions.
- Most affected animals recover within 2 weeks and a few die. Sheep fatality rate is less than 10 %.
- Bacterial bronchopneumonia and labial orf lesions are the commonest complications, but other latent enteric pathogens and blood parasites may be exacerbated.



### *Immunity*

- Surviving goats and sheep develop a strong lifelong immunity associated with the presence of humoral neutralizing antibodies.

### *lesions*

- The carcass is dehydrated and solid with fluid fetid feces.
- Eyelids, nares, and lips are usually encrusted with discharges.
- Necrotic erosions are found throughout the oral cavity, pharynx, and less frequently esophagus.
- As in RP, Congestion of capillaries along the crests of the longitudinal folds in the large intestine and rectal mucosa "Zebra Striping."
- The abomasum and small intestine are congested rather than eroded.
- Mesenteric lymph nodes are congested and edematous.
- Purulent bronchopneumonia is a prominent finding that masks the underlying viral Broncho-
- Pneumonia manifested as areas of red consolidation.



### *Diagnosis*



- A presumptive diagnosis of the acute forms of PPR can be made from the epidemiology, clinical signs, and lesions but subacute form may require laboratory diagnosis.
- Samples and specimens
- For virus isolation or viral antigen detection, from live animals during early stages of fever until the beginning of the erosions, ocular or nasal swabs, scrapings of early oral lesions, blood with heparin or EDTA "buffy coat". From deceased animals portions of the spleen, lymph nodes, and lungs collected within 2 hours of death. The specimens should be chilled on ice, but not frozen, and examined as soon as possible.
- For serology collect serum from acutely ill and recovered animals.
- For histopathology slices of lymph node, spleen, tonsils, and mucosal lesions are collected in 10 % formalin saline for.
- The virus is isolated by inoculation of buffy coat, swab material, or 10% tissue suspension onto lamb or kid kidney, CPEs develops after 4 days which are indistinguishable from that of RP virus. CPEs specificity is confirmed serologically by comparative titration against antisera to homologous and heterologous antisera, the homologous titre usually being much higher than the heterologous. The isolates can be examined with cELISA based on monoclonal antibodies and specific cDNA probes.
- Specific viral antigens in 30% tissue suspensions or in undiluted swap material of suspected cases is detected by hyperimmune sera to RP or PPR viruses by AGID and counter immunoelectrophoresis "CIEP". Antigen can also be detected by immunohistochemical staining of tissues "immunoperoxidase staining" and dot-ELISA.
- In survivors, a four-fold or greater increase in neutralizing antibodies in paired serum samples confirms the presumptive diagnosis. Seroconversion in paired serum samples is mainly used only for disease surveillance.
- Confirmation by the experimental transmission of the disease requires strict isolation facilities and can be done by i.v inoculation of 5 ml blood from suspected animal at the height of the disease into susceptible goat, sheep, and cattle. PPR usually causes severe disease in goats, milder disease in sheep and subclinical infection in cattle.
- Differential diagnosis
- PPR should be differentiated clinically from RP, bluetongue, contagious caprine pleuropneumonia "CCPP", contagious ecthyma, foot and mouth disease, sheep and goat pox, Nairobi sheep disease, heartwater, bacterial and parasitic diarrhea, and viral and parasitic pneumonia.

## ***Treatment***

There is no specific treatment and the disease is notifiable. In valuable individuals, good nursing, fluid replacement to compensate electrolyte losses from diarrhea, and antibiotics to suppress bacterial infections that complicate viral pneumonia should be considered.

## ***Prevention and control measures***

- Eradication is the usual goal in countries which PPR appears for the first time.
- PPR management in endemic areas:
- Control is enhanced by segregation of new stock from unknown sources or that bought at live stock markets, or that returned unsold unless the entire herd has been vaccinated.
- The tissue culture attenuated RP vaccine is effectively used to protect sheep and goats for at least one year. In endemic areas kids and lambs should be vaccinated at 3-4 months of age. Furthermore, a homologous PPR tissue culture vaccine have been developed giving long-live immunity in small ruminants.

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