

# PREPARATION OF RIFT VALLEY FEVER CONTINGENCY PLANS



---

# Contents

|   |           |
|---|-----------|
| Acronyms and abbreviations  | vii       |
| <b>INTRODUCTION</b>   | <b>1</b>  |
| Chapter 1   |           |
| <b>SUGGESTED FORMAT AND CONTENTS OF A NATIONAL<br/>RIFT VALLEY FEVER CONTINGENCY PLAN</b> | <b>3</b>  |
| Nature of the disease   | 3         |
| Risk analysis for RVF   | 3         |
| Prevention strategies   | 4         |
| Early warning contingency plan  | 4         |
| Strategies for control and eradication of RVF   | 5         |
| Organizational arrangements for RVF emergencies   | 5         |
| Support plans   | 5         |
| Action plans  | 5         |
| Appendixes  | 5         |
| Chapter 2   |           |
| <b>NATURE OF THE DISEASE</b>  | <b>7</b>  |
| Definition  | 7         |
| World distribution  | 7         |
| Aetiology   | 9         |
| Epidemiological features  | 9         |
| Clinical signs  | 12        |
| Pathology   | 13        |
| Immunity  | 15        |
| Diagnosis   | 16        |
| Chapter 3   |           |
| <b>RISK ANALYSIS FOR RIFT VALLEY FEVER</b>  | <b>19</b> |
| Introduction  | 19        |
| Principles of risk analysis   | 19        |
| Who should carry out the risk analyses?   | 20        |
| Risk assessment for RVF   | 20        |
| The value of risk assessment for RVF  | 23        |

|  |           |
|--|-----------|
| Chapter 4  |           |
| <b>PREVENTION STRATEGIES FOR RIFT VALLEY FEVER</b>   | <b>25</b> |
| Introduction   | 25        |
| Prevention strategies for countries in Africa  | 25        |
| Prevention strategies for countries in the Middle East   | 26        |
| Prevention strategies for countries in other regions   | 26        |
| <br>   |           |
| Chapter 5  |           |
| <b>EARLY WARNING CONTINGENCY PLANNING FOR RIFT VALLEY FEVER</b>  | <b>29</b> |
| Introduction   | 29        |
| Training of veterinary and other animal health staff in early recognition of RVF and collection and dispatch of diagnostic specimens | 31        |
| Livestock farmer and trader awareness/education programmes   | 32        |
| Specialist diagnostic team   | 33        |
| Laboratory diagnostic capabilities   | 34        |
| International Reference Laboratories and Collaborating Centres   | 35        |
| Forecasting systems for RVF  | 36        |
| RVF serological and clinical surveillance programmes   | 37        |
| <br>   |           |
| Chapter 6  |           |
| <b>EARLY REACTION CONTINGENCY PLANNING FOR A RIFT VALLEY FEVER EMERGENCY</b>   | <b>39</b> |
| Introduction   | 39        |
| Disease control strategies to be used when RVF outbreaks are expected  | 39        |
| Disease control strategies to be used after RVF has been confirmed   | 43        |
| International collaboration  | 44        |
| <br>   |           |
| Chapter 7  |           |
| <b>ORGANIZATIONAL ARRANGEMENTS DURING A RIFT VALLEY FEVER EMERGENCY</b>  | <b>47</b> |
| Coordination between national animal and human health authorities  | 47        |
| Responsibilities and command structures  | 48        |
| Consultative Committee on Emergency Animal Diseases (CCEAD)  | 50        |

---

|  |           |
|--|-----------|
| <b>National Animal Disease Control Centre</b>                                    | <b>50</b> |
| <b>Local Animal Disease Control Centres</b>                                      | <b>51</b> |
| Chapter 8  |           |
| <b>SUPPORT PLANS</b>   | <b>53</b> |
| <b>Financial plan</b>  | <b>53</b> |
| <b>Resource plan</b>   | <b>54</b> |
| <b>Legislation</b>   | <b>56</b> |
| Chapter 9  |           |
| <b>ACTION PLAN</b>   | <b>57</b> |
| <b>Investigation phase</b>   | <b>57</b> |
| <b>Alert phase</b>   | <b>58</b> |
| <b>Operational phase</b>   | <b>58</b> |
| <b>Stand-down phase</b>  | <b>59</b> |
| Chapter 10   |           |
| <b>TRAINING, AND TESTING AND REVISION OF<br/>CONTINGENCY PLANS</b>               | <b>61</b> |
| <b>Simulation exercises</b>  | <b>61</b> |
| <b>Training</b>  | <b>61</b> |
| <b>The need for regular updating of RVF contingency plans</b>                    |           |
| <b>APPENDIXES</b>  |           |
| <b>1. International Rift Valley fever reference experts and<br/>laboratories</b> | <b>63</b> |
| <b>2. Rift Valley fever vaccine sources</b>                                      | <b>65</b> |

---

## Acronyms and abbreviations

|                   |   |
|-------------------|---|
| <b>AGID</b>       | agar gel immunodiffusion  |
| <b>AUSVETPLAN</b> | Australian Veterinary Emergency Plan  |
| <b>BERMS</b>      | basin excess rainfall monitoring systems  |
| <b>CCD</b>        | cold cloud density  |
| <b>CCEAD</b>      | Consultative Committee on Emergency<br>Animal Diseases                                  |
| <b>CVO</b>        | chief veterinary officer  |
| <b>EDTA</b>       | ethylene-diamine-tetra-acetic acid  |
| <b>ELISA</b>      | enzyme linked immunosorbent assay   |
| <b>EMPRES</b>     | Emergency Prevention System for<br>Transboundary Animal and Plant Pests and<br>Diseases |
| <b>FAO</b>        | Food and Agriculture Organization of the<br>United Nations                              |
| <b>FMD</b>        | foot-and-mouth disease  |
| <b>FVO</b>        | field veterinary officer  |
| <b>GIEWS</b>      | Global Information and Early Warning<br>System on Food and Agriculture                  |
| <b>GIS</b>        | Geographical Information System   |
| <b>IATA</b>       | International Air Transport Association   |
| <b>IFA</b>        | immunofluorescence assay  |
| <b>IGAD</b>       | Intergovernmental Authority on<br>Development   |
| <b>IHA</b>        | inhibition of haemagglutination   |
| <b>ITCZ</b>       | intertropical convergence zone  |
| <b>NDVI</b>       | normalized differentiated vegetation index  |
| <b>NGO</b>        | non-governmental organization   |
| <b>OIE</b>        | International Office of Epizootics/Office<br>International des Epizooties               |
| <b>PCR</b>        | polymerase chain reaction   |
| <b>PPR</b>        | peste des petits ruminants  |
| <b>ProMED</b>     | Program for Monitoring Emerging<br>Diseases   |
| <b>RSSD</b>       | remote sensing satellite data   |
| <b>RVF</b>        | Rift Valley fever   |
| <b>SN</b>         | serum neutralization  |

|                |  |
|----------------|--|
| <b>SPOT</b>    | Experimental Earth Observation System            |
| <b>SST</b>     | surface sea temperatures                         |
| <b>TAD</b>     | transboundary animal disease                     |
| <b>TADInfo</b> | Transboundary Animal Diseases Information System |
| <b>UNDP</b>    | United Nations Development Programme             |

## Introduction

Rift Valley fever (RVF) is one of the most serious transboundary animal diseases. It is a mosquito-borne viral disease, which causes periodic severe epidemics, principally involving ruminant animals. RVF is also an important zoonosis and one of the significant acute haemorrhagic fevers affecting human beings. Until recently it had only been recognized in the African continent, but in 2000 it occurred in the Arabian Peninsula. As well as its severe socio-economic and public health consequences, RVF is a major constraint to international livestock trade.

Transboundary animal diseases (TADs) for the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) are those diseases that are of significant economic, trade and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epidemic proportions; and where control/management, including exclusion, requires cooperation among several countries. The International Office of Epizootics (OIE) International Animal Health Code includes RVF in List A diseases, defined as “communicable diseases which have the potential for serious and rapid spread, irrespective of national borders; which are of serious socio-economic or public health importance; and which are of major importance in the international trade of animals and animal products”.

This manual provides information on the nature of RVF and the principles and strategic options for its prevention, control and elimination. Guidelines are provided for individual countries threatened by RVF to formulate their overall national policy on control and eradication of a possible incursion of the disease. The manual also identifies personnel, equipment and other facilities that are needed in a national RVF contingency plan. An outline of suggested format and contents of a national RVF contingency plan is provided as a guide but should be modified to suit the needs and circumstances of individual countries.

Due consideration was given to the provisions in the OIE International Animal Health Code in the preparation of the manual. It is suggested that the manual be used in conjunction with the

*Manual on the preparation of national animal disease emergency preparedness plans* (FAO, 1999a) cited below.

Sources of information recommended for use with this manual include:

**Australian Veterinary Emergency Plan (AUSVETPLAN) Disease Strategy.** 1996. *Rift Valley fever*, 2<sup>nd</sup> ed. Agriculture and Resource Management Council of Australia and New Zealand.

**FAO.** 1999a. *Manual on the preparation of national animal disease emergency preparedness plans*. FAO Animal Health Manual No. 6. Rome.

**FAO.** 1999b. *Manual on livestock disease surveillance and information systems*. FAO Animal Health Manual No. 8. Rome.

**FAO.** 2001. *Manual on procedures for disease eradication by stamping out*. FAO Animal Health Manual No. 12. Rome.

**FAO.** 2002. *Manual on the recognition of Rift Valley fever*. FAO Animal Health Manual. Rome. (in preparation)

**International Office of Epizootics.** 2000. *Manual of standards for diagnostic tests and vaccines*, 4<sup>th</sup> ed. Paris.

**International Office of Epizootics.** 2001. *International Animal Health Code: mammals, birds and bees*, 10<sup>th</sup> ed. Paris.

**Swanepoel, R. & Coetzer, J.A.W.** 1994. Rift Valley fever. In *Infectious diseases of livestock with special reference to Southern Africa*, Vol. 1, p. 687-717. (J.A.W. Coetzer, G.R. Thomson & R.C. Tustin, eds.) Cape Town, Oxford University Press.

The manual will be reviewed regularly and revised in the light of experience. Suggestions and recommendations for any amendments should be sent to:

EMPRES (Livestock)  
Animal Health Service  
FAO Animal Production and Health Division  
Viale delle Terme di Caracalla, 00100 Rome, Italy  
Tel.: +39 06 57054798/4184  
Fax: +39 06 57053023  
E-mail: [empres-livestock@fao.org](mailto:empres-livestock@fao.org)  
[www.fao.org/empres](http://www.fao.org/empres)



## Chapter 1

## Suggested format and contents of a national Rift Valley fever contingency plan

An RVF contingency plan should be a well-articulated strategy document designed to define actions to be taken in the event of an RVF emergency. It should contain details of the resources needed to meet such an emergency as well as an action plan for efficient and rapid deployment of both human and material resources for effective containment of the disease and elimination of infection. While it is not feasible to produce a model contingency plan that will be a perfect fit for all situations and circumstances in different countries, the suggested format and contents as described below will serve as guidelines for individual countries to design their own national RVF contingency plans. Suggestions for aspects to be included in a national RVF contingency plan are given below.

---

**NATURE OF THE  
DISEASE**

This component should describe the essential features of RVF such as:

- aetiology
- world evolution and distribution
- epidemiological features
- clinical signs
- pathology
- immunology
- diagnosis: field, differential and laboratory

Most of these aspects, as described in the manual, are generic; others may need to be modified to reflect the prevailing circumstances in individual countries.

---

**RISK ANALYSIS FOR  
RVF**

This provides information on just how serious a threat RVF is for a country in comparison with other transboundary animal diseases,

where and how RVF might be present, and what its potential consequences are. Risk analysis should indicate just how much effort needs to be put into contingency planning and it should also provide the rationale for the disease control strategies selected.

Risk analyses need to be updated regularly to take account of changing circumstances, both within and outside the country.

---

**PREVENTION  
STRATEGIES**

In the enzootic areas of Africa, RVF virus activity occurs in a cryptic manner at a low level most years. No clinical disease would be identifiable at such times, but low-level sero-conversion rates may be detected in the susceptible species and random isolates may be made from mosquitoes. Better baseline data are required for many countries in Africa to understand where and at what level this activity occurs. Research in eastern and southern Africa has shown that clinical disease only occurs in certain ecological zones.

In countries beyond the enzootic areas of Africa and the Arabian Peninsula, prevention strategies should describe the measures to be taken in order to minimize the risk of introduction and establishment of RVF in the country or in RVF-free areas of the country, taking into account the assessed risks of introduction and the available strategies for reducing these risks by the control of transboundary livestock movements and management of the importation of animal products.

---

**EARLY WARNING  
CONTINGENCY  
PLAN**

This includes all the initiatives that need to be taken to ensure both that an incursion of RVF can be recognized and reacted to before it reaches epidemic proportions in the country and also for monitoring the progress of eradication campaigns. The plan will include disease surveillance and epidemiological capabilities such as emergency disease reporting mechanisms and animal health information systems; training of animal health staff in recognition of the disease; and public awareness programmes.

There is scientific evidence that RVF virus activity at epizootic levels is likely to occur after the heavy cycles of rainfall that lead to flooding of grasslands and river floodplains. This is correlated in those parts of Africa where it has been investigated. Currently available remote sensing satellite information systems allow much improved predictive capability by measuring southern ocean temperature oscillations. Early warning is now a realistic possibility for RVF epizootics and monitoring will be a fundamental component of the plan.

---

|  |  |
|--|--|
| <b>STRATEGIES FOR CONTROL AND ERADICATION OF RVF</b>   | This component addresses the issues of control of RVF epizootics in enzootic/epizootic areas of Africa and the Arabian Peninsula. It includes the strategies and programmes that need to be implemented first to contain an RVF epidemic outside known epizootic areas and then progressively to control and eradicate it through zoning, quarantine, livestock movement controls and targeted vaccination campaigns – in a way that minimizes the socio-economic consequences. It also describes how eradication of the disease is to be verified.  |
| <b>ORGANIZATIONAL ARRANGEMENTS FOR RVF EMERGENCIES</b> | The administrative structures of national veterinary services, which have evolved mainly to deal with routine animal health programmes, are not necessarily appropriate for emergency disease control. This component describes the organizational arrangements to be put in place when there is an RVF emergency so that all necessary resources are efficiently exploited to respond to the emergency. These arrangements will vary according to the infrastructure, capability of the veterinary services and bureaucratic arrangements of the country concerned.   |
| <b>SUPPORT PLANS</b>                                   | Support plans underpin the technical plans. They include financial and resource plans and legislation. They are of vital importance and are a key to the success or failure of an eradication campaign.  |
| <b>ACTION PLANS</b>                                    | These are the mechanisms whereby the various phases of the plan are implemented, from the initial investigation phase to the final stand-down phase.   |
| <b>APPENDIXES</b>                                      | <p>A list of names and contact addresses including telephone numbers, fax and e-mail addresses of the following could be placed as appendixes to the contingency plan:</p> <ul style="list-style-type: none"><li>• RVF regional and world reference laboratories</li><li>• international organizations offering possible assistance</li></ul> <p>Also included may be information on:</p> <ul style="list-style-type: none"><li>• national animal health laws</li><li>• anything specifically relevant to an individual country</li></ul> <p>It should be emphasized yet again that the following chapters only provide the framework for countries to develop their own RVF contingency plans, taking their particular circumstances into</p> |

account. The strategies of different countries for countering RVF will vary considerably according to their veterinary and other infrastructure capacity, the stage of development of their livestock industries, and their potential for export of livestock and livestock products.

## Chapter 2

**Nature of the disease**

---

**DEFINITION** RVF is an acute mosquito-borne viral disease mainly affecting ruminant animals and humans. It can cause abortions in pregnant animals and a high mortality in young animals. However, most indigenous livestock species in Africa demonstrate a high level of resistance to the disease. In humans RVF causes a severe influenza-like illness, with occasionally more serious haemorrhagic complications and death. Over its range, it causes major epidemics at irregular intervals of 5-35 years.

---

**WORLD DISTRIBUTION** RVF was first identified in an outbreak of abortions and deaths in exotic wool sheep and illness in humans that occurred in the Rift Valley of Kenya after heavy rainfall in 1930-31. Outbreaks have since occurred in the highlands of Kenya at irregular intervals of 3-15 years. The most recent epizootic in the East African region was in 1997-98 in the drier areas of northeast Kenya and southwest Somalia after heavy El Niño-associated rains. This caused human deaths and some livestock losses, particularly of camels, but more significantly, disruption to livestock exports to the Middle East from the Horn of Africa.

The disease was first recorded in southern Africa in 1950, when a major epizootic in South Africa caused an estimated 100 000 deaths and 500 000 abortions in sheep. A second extensive epizootic occurred in Namibia and South Africa in 1974-75. Periodic severe outbreaks have also been experienced in Mozambique, Zambia and Zimbabwe.

In 1973, RVF outbreaks occurred in irrigation areas of the Sudan. In 1977 the disease was recognized in Egypt and caused an estimated 600 human deaths as well as heavy losses in sheep, goats, cattle, buffaloes and camels along the Nile Valley and Delta. RVF outbreaks again occurred in Egypt in 1993.

In 1987, a serious outbreak of RVF occurred in the Senegal River basin of southern Mauritania and northern Senegal. This outbreak first came to attention through severe illness and deaths of people

in the area, but there was also a high abortion rate in sheep and goats. A further outbreak of the disease occurred there in 1998.

The RVF virus is probably present in all countries of sub-Saharan Africa. Many of these countries, outside eastern and southern Africa, do not have populations of the highly susceptible exotic livestock breeds that serve as disease hosts and act as indicators of RVF virus activity. Human disease may be the first indication that RVF virus amplification is occurring at high levels in these countries, where the indigenous ruminants may not show any clinical signs of disease other than insignificant low levels of abortion.

Until recently RVF was thought to be restricted to Africa. However, it was reported in the Tihama region of both Saudi Arabia and Yemen in September 2000. The Tihama plain – about 50 km wide – is in the west of these countries, between the mountains and the Red Sea, on the eastern side of the Great Rift Valley. It is a semi-arid zone with alluvial fanning from the mountains that form the scarp of the Rift. Its ecological characteristics are similar to those in the corresponding western side of the Rift Valley in Africa, where RVF occurs. RVF virus activity is highly associated with such limited riverine alluvium zones. There were extensive abortions in sheep and goats and some 855 severe human cases with 118 deaths. The virus was similar to that circulating in Kenya and Somalia in 1997-98.

RVF, however, has the potential for further international spread, particularly with the climatic changes that might be expected with global warming. High-risk receptive areas are, for example, the

*Typical swamp area  
susceptible to  
mosquito breeding*



Tigris/Euphrates Delta zone to the northeast in Iraq and the Islamic Republic of Iran.

---

**AETIOLOGY**

The RVF virus is a member of the *Phlebovirus* genus of the Bunyaviridae. It is a single-stranded RNA virus with three segments. The Zinga and Lunya viruses first isolated, respectively, in the Central African Republic in 1969 and in Uganda in 1955, are identical.

The RVF virus is serologically related to other phleboviruses, but can be differentiated from these by virus-serum neutralization tests. There is only one serotype of RVF virus. The virus is inactivated by lipid solvents (e.g. ether) and by strong solutions of sodium or calcium hypochlorite (residual chlorine should exceed 5 000 ppm).

---

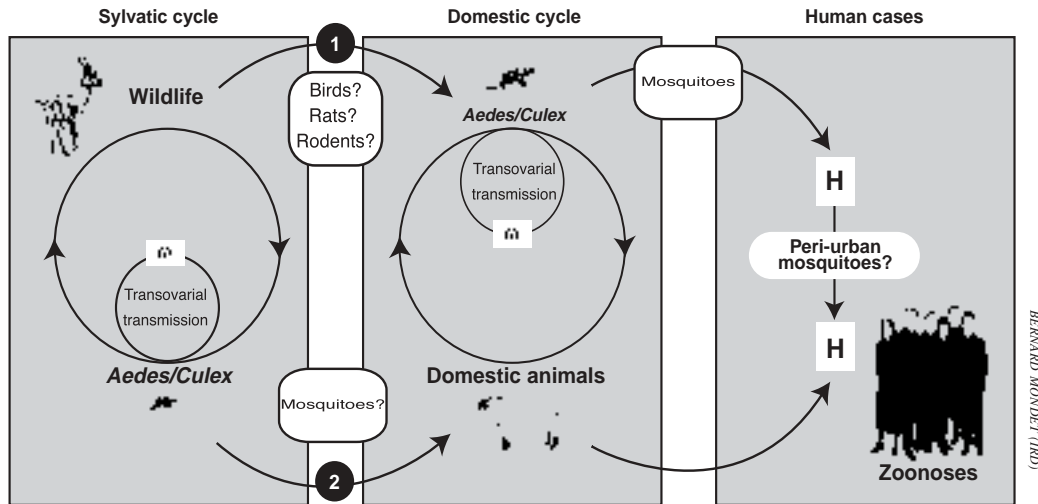
**EPIDEMIOLOGICAL  
FEATURES****Susceptible species**

Although many mammalian species are susceptible to RVF infection, birds are not. Of the livestock species, sheep are the most susceptible, followed in order by goats, cattle, camels and water buffaloes. In Africa, exotic livestock breeds are far more susceptible to the clinical disease than indigenous breeds. Infection in the latter is usually subclinical. There is a high level of genetically determined resistance to RVF in indigenous breeds of sheep, goats and cattle, mainly *Bos indicus*, in Africa. Other susceptible animal species to RVF virus infection include antelopes, Cape buffaloes, monkeys, cats, dogs and rodents.

Human beings are susceptible to RVF. The disease manifests itself in a small percentage (2.5-5 percent) as one of the viral haemorrhagic fevers with a high fatality rate. Other clinical presentations are severe hepatitis or ocular lesions. There may also be meningo-encephalitis.

**RVF transmission**

The virus circulates between vertebrate hosts and mosquitoes. It does not require continuous vector-host-vector feeding cycles for maintenance. Interepizootic maintenance exists by transovarial transmission of the virus in the eggs of *Aedes* spp. of the Neomelaniconium group. These are flood-breeding mosquito species whose eggs may remain dormant in floodplains or a grassland habitat for long periods. The virus is transmitted biologically in



Theoretical cycle of RVF virus transmission

mosquitoes and many mosquito species are efficient vectors – notably species of the *Culex*, *Aedes*, *Anopheles*, *Eretmapodites* and *Mansonia* genera. Other biting insects may transmit the virus mechanically. Animals are infectious during their viraemic period, which may be brief (6-18 hours) or persist for up to six to eight days. There is no carrier state in animals. Non-vector-borne transmission is not significant in animals.

Infected mosquitoes may be transported for long distances in low-level wind or air currents, which may lead to the rapid spread of the virus from region to region or even internationally. This may have been a factor in the spread to and within Egypt in 1977 and 1993.

Humans can become infected from mosquito bites but the majority of human cases are thought to result from handling the blood, tissues, secretions or excretions of infected animals, notably after abortion. This may be through handling, milking, slaughtering, butchering or autopsying such animals. Laboratory-acquired infections also occur.

### Epidemic RVF disease patterns

In Africa, major epidemics occur at irregular intervals of 3-15 years or even longer in the forest edge, highland or coastal zones with high rainfall and humidity. In the semi-arid to arid areas, epidemic activity is much less frequent, possibly only once in every 25-50 years. The frequency depends upon the ecological characteristics of the country or parts of the country. The periodicity of RVF epizootics may be greatly changed by the increasing southern ocean temperatures, which influence precipitation in Africa and elsewhere to a major extent. There is evidence of



greater amplitude of these oscillations in the recent past with dramatic effects upon flooding and drought conditions worldwide.

For epidemics to occur, three factors must be present:

- the pre-existence or introduction of the virus in the area (see section on Interepidemic virus survival below);
- the presence of large populations of susceptible ruminants;
- climatic or environmental conditions that encourage a massive build-up in vector mosquito population. The latter usually occurs when there are warm conditions and unusually heavy and persistent rainfalls that cause surface flooding and lead to the hatching of infected *Aedes* spp. mosquito eggs and large numbers of vector mosquitoes. Alternatively, it may occur in the absence of rainfall, where there is a great deal of surface water, as in a river floodplain, originating from heavy rainfall in river basins that may be hundreds of kilometres away in the mountains, or from irrigation (as was the case in the Gezira area of the Sudan and in Egypt).

During RVF epidemics, extremely high levels of virus amplification occur in the period when the vector populations are at their greatest. Most susceptible animals become infected at such times. These periods of intense virus activity usually persist for 6-12 weeks. The degree of morbidity and mortality experienced in livestock will depend upon whether the population is made up predominantly of exotic and improved breeds or relatively resistant indigenous animals. Quite high levels of virus activity can occur in *Bos indicus* zebu-type cattle, for example, with no clinical manifestation whatsoever. Likewise the number of human cases will depend upon the number of people exposed and their level of contact with infected animals or mosquitoes.

#### **Interepidemic virus survival**

During the long interepidemic periods, low levels of virus activity may occur in certain foci within the epidemic and enzootic areas and these will remain undetected unless intensive surveillance activities are carried out. Virus activity may be revealed by random isolations from mosquitoes or by occasional human disease. Small local RVF outbreaks may occur, when and where the micro-environmental conditions are favourable and susceptible livestock are present. However, the incidence of infection is usually so low as to be undetectable. Clinical disease in humans or animals is generally missed in the absence of specific, well-focused, active surveillance.

Transovarial and sexual transmission of RVF virus occurs in

some species of *Aedes* mosquitoes of the Neomelaniconium group. The eggs of these mosquitoes, and the virus that they carry, may remain viable for very long periods in the mud of dried-up surface pools or shallow depressions (locally known as *dambos* or pans), or in floodplains. Infected mosquitoes hatch from these when they are again flooded. This is the reason why the virus persists during prolonged interepidemic periods in the grasslands and semi-arid regions of eastern, western and southern Africa.

#### **Cryptic (or sylvatic) RVF**

In Africa, the infection cycle among indigenous, domestic and wild vertebrate animals and mosquitoes is subclinical, both in livestock and people. In the rain forest and wetter wooded areas of the country, the virus circulates silently between wild and domestic species and insect vectors. This is referred to as cryptic or sylvatic RVF virus activity. Cryptic RVF is extremely difficult to identify and occurs in most of the countries of sub-Saharan Africa.

---

#### **CLINICAL SIGNS**

##### **Sheep and goats**

Clinical disease occurs in susceptible sheep (such as imported wool sheep) of all ages, but is most severe in young lambs. The morbidity rate in infected flocks approaches 100 percent. The mortality rate may be as high as 95 percent in lambs less than one week old, about 40-60 percent in weaner lambs, and 5-30 percent in adult sheep. The abortion rate may approach 100 percent.

In peracute cases, sheep are either found dead or suddenly weaken and collapse when driven. In acute cases, there is a very short incubation period – less than 24 hours – followed by fever, rapid pulse, weakness, unsteady gait, vomiting, mucopurulent nasal discharge and death in 24-72 hours. Other signs often observed are lymphadenitis, colic, haemorrhagic diarrhoea and petechial or ecchymotic haemorrhages in visible mucous membranes.

Subacute disease is more likely in adult sheep. Diphasic fever is accompanied by anorexia and weakness. There may be some vomiting and evidence of abdominal pain, with or without haemorrhagic gastroenteritis. Hepatitis with jaundice develops in most cases. Abortion is an almost inevitable consequence of infection of pregnant ewes, and may occur in either the acute or convalescent stages of the disease.

RVF in goats is similar to that in sheep but is usually not quite so severe. It is important to remember that the indigenous hair sheep and

goats in Africa may show none of the above signs and no clinical signs other than some abortions. Flocks with or adjacent to exotic animals with severe RVF disease may show no signs at all.

#### **Cattle and water buffaloes**

In cattle, as in sheep, the most severe disease is seen in young animals. The mortality rate in exotic calves of *Bos taurus* breeds, such as Friesians, may be up to 30 percent, or even higher in neonates. Some animals up to 6 and even 12 months may be severely ill and debilitated with hepatitis and jaundice for some months. The acute disease is similar to that in sheep. In adult cattle the mortality rate is less than 2-5 percent. Cows abort. They may show fever, a sharp drop in milk production, with lymphadenitis, anorexia and malaise. Haemorrhage from the mouth and nares often occurs, with colic and haemorrhagic diarrhoea. In extensively ranched cattle, abortions may not be observed and a drop in calving rates may be the only sign recognized.

#### **Camels**

Although infection is generally subclinical in mature animals, pregnant camels may abort at any stage of pregnancy and neonatal deaths can occur. Abortion rates of 70 percent of those pregnant have occurred with many deaths in foals up to 3-4 months of age.

#### **Humans**

After an incubation period of two to six days, patients experience an influenza-like disease with a sudden onset of fever, debility, headache, backache and other muscle pains, and often photophobia and vomiting. The fever is diphasic. There is usually a degree of liver damage with jaundice. In uncomplicated cases, the illness generally resolves itself within a week. Many cases are mild. However, RVF in people who have pre-existing diseases such as shistosomiasis or malnutrition may be severe or even fatal.

Complications of RVF that occur in a small percentage of human infections include:

- retinitis, with permanent loss of vision in 1-10 percent of such cases
- haemorrhagic fever with hepatitis, which is often fatal
- meningo-encephalitis.

---

#### **PATHOLOGY**

##### **Gross pathology**

The most characteristic lesions are of various degrees of necrosis

### **SAFETY PRECAUTIONS**

Many cases of Rift Valley fever have occurred in veterinarians, laboratory workers, farmers and others through handling infected blood or tissues or other virus-contaminated materials.

Great care should be taken in carrying out autopsies on animals suspected of having died of the disease, and in handling aborted fetuses. Rubber gloves and face masks should be worn and personal disinfection should be thorough. Autopsied carcasses should be disposed of by burial, burning or incineration. A high level of biocontainment is also required in laboratories handling infectious materials associated with the RVF virus.

People at high occupational risk of contracting RVF infection should consider being immunized. An experimental inactivated tissue culture vaccine for human use manufactured in the United States may be made available for this purpose.

of the liver. There are also petechial and ecchymotic haemorrhages on all serous surfaces, lymph nodes, subcutis, the kidneys and in various tissues.

When severely affected – for example, in young lambs – the liver is swollen and the capsule tense, giving an external impression of firmness. However, on section the organ is quite friable, congested and contains many haemorrhages. When not masked by blood, the colour of the liver ranges from pale grey-brown to yellow-brown. Numerous grey-white foci, 1-2 mm in diameter, are scattered throughout the parenchyma. The gall bladder may be oedematous and contain petechial or ecchymotic haemorrhages. All the carcass lymph nodes are likely to be enlarged, oedematous and haemorrhagic.

The gastrointestinal tract exhibits varying degrees of inflammation, from catarrhal to haemorrhagic and necrotic. Petechial or ecchymotic haemorrhages are present in most internal organs. Ascites, hydropericardium, hydrothorax and pulmonary oedema may be present. The fluid in the body cavities is frequently bloodstained and the carcass jaundiced.

### **Histopathology**

In the livers of young animals, there are well-defined primary foci of severe coagulative necrosis, which may be centrilobular. These

are accompanied by diffuse and massive pan-necrosis involving most (or all) of the rest of the parenchyma. Some livers also show mineralization of scattered (or small groups of) necrotic hepatocytes. The primary necrotic foci are later infiltrated by histiocytes, lymphocytes and neutrophils, many with marked pyknosis and karyorrhexis. Intracytoplasmic Councilman-like bodies may be present in degenerate hepatocytes or free in sinusoids. Eosinophilic inclusion bodies are often found in the nuclei of cells that are still recognizable as hepatocytes.

In older animals, the hepatic necrosis may be less extensive and confined to focal areas of individual lobules.

---

**IMMUNITY**

IgM antibodies first appear three to five days after the onset of RVF infection, at which time viraemia ceases. They persist for one to two months, or even three to four months in some animals. IgG antibodies appear 10-14 days after the onset of infection and persist for at least one to two years or for life. Convalescent immunity after natural infection lasts for a long time. The offspring of immune mothers may have passively acquired maternal immunity for the first three to four months of their lives.

---

**DIAGNOSIS**

**Field diagnosis**

RVF epidemics should always be strongly suspected when there is a sudden onset of large numbers of abortions in sheep, goats, cattle or camels and deaths in lambs, kids or calves. This is specially the case if there is surface flooding in savannah or semi-arid areas following prolonged rains (or in irrigated areas); if the mosquito populations are high; and if there is concurrent illness in human populations. The disease in domestic animals may only be noticed after the illness in people has been identified as RVF.

There may also be sporadic cases or small outbreaks in non-epidemic circumstances, which are more difficult to diagnose in the field and may therefore be missed.

**Differential diagnosis**

There are a number of diseases that may be confused clinically with RVF. It should also be remembered that conditions favourable for an RVF outbreak may also be favourable for other insect-borne diseases such as bluetongue, Nairobi sheep disease and Wesselsbron disease. Other livestock diseases and transboundary diseases such

as peste des petits ruminants (PPR), rinderpest, contagious caprine and bovine pleuropneumonias and foot-and-mouth disease (FMD) may also occur through dislocation of farming communities and movement of animals as a result of flooding. The simultaneous occurrence of other diseases may compound diagnostic difficulties.

Together with all causes of abortion in ruminant animals, diseases to be taken into consideration in the differential diagnosis of RVF include:

- Wesselsbron disease
- Bluetongue
- Enterotoxaemia
- Nairobi sheep disease
- Hepatotoxins
- Rinderpest
- Peste des petits ruminants

#### **Laboratory diagnosis**

**Collection and transport of diagnostic specimens.** Whole blood, liver, lymph nodes and spleen are the tissues of choice for isolation of the virus. Blood samples should be collected from febrile animals into ethylene-diamine-tetra-acetic acid (EDTA) or heparin to which antibiotics have been added as preservatives (penicillin 200 units and streptomycin 200 µg/ml, final concentration). Samples of liver and spleen should be collected aseptically both from freshly dead animals at autopsy and from aborted foetuses, if available, and placed in sterile containers. Duplicate tissue specimens should be collected in neutral buffered formalin for histopathology.

Blood samples, about 20 ml each, should be collected from animals in the acute and convalescent phases of the disease, for serum.

**Histopathology.** The finding of characteristic histological lesions with pan-necrosis (see section on Histopathology on p. 14) in the livers of young animals or foetuses is suggestive of RVF.

**Virus isolation.** The RVF virus can be isolated from whole blood or homogenates of fresh tissues by intracerebral injection of suckling mice or intraperitoneal injection of adult mice or hamsters. It can also be readily isolated in various primary cell cultures (e.g. primary lamb and calf kidney or testis) or cell lines (e.g. BHK-21 and Vero). The identity of the isolated virus is confirmed by polymerase chain reaction (PCR), enzyme linked immunosorbent

assay (ELISA), fluorescent antibody staining or virus-serum neutralization tests.

**Antigen detection.** The RVF antigen may be detected by direct or indirect immunofluorescence tests on impressions smears or cryostat sections of liver, spleen and brain. A rapid diagnosis can sometimes be made by agar gel immunodiffusion (AGID) tests on fresh tissues. Immunocapture-ELISA and histochemical staining of cryostat sections or formalin fixed tissues and PCR are now much more widely used for RVF.

**Antibody detection.** The ELISA test has now replaced the older inhibition of haemagglutination (IHA), immunofluorescence assay (IFA) and serum neutralization tests as the test of choice. ELISA systems are available to test for the presence of IgM and IgG, which are extremely valuable in epidemiological investigations. The virus serum neutralization test in microtitre tissue culture systems is still the definitive test system. It is highly specific with little or no cross-neutralization with other phleboviruses. It can be used to detect antibodies in all animal species. However, as it requires the use of live virus, it is not recommended for use outside endemic countries unless a high level of biocontainment is available in laboratories.

Other serological tests are less specific, but still have a very useful role.

The indirect ELISA test is a reliable and sensitive test and can provide results within hours. There are tests for both IgM and IgG antibodies. In an index case in an outbreak situation the low-level serological cross-reactions with other members of the *Phlebovirus* genus may cause problems. Doubtful results should therefore be interpreted with caution and may need to be confirmed by serum neutralization (SN) tests at a reference laboratory.

**Detection of viral genetic material.** A reverse transcriptase PCR test is now available for detection of viral genetic material. Sequencing of the NS (S) protein-coding region of the genome may be used for phylogenetic analysis (genetic fingerprinting) of virus isolates.

Chapter 3

## Risk analysis for Rift Valley fever

---

### INTRODUCTION

Risk analysis is something that people do intuitively in their everyday lives and in their professional work. Only recently has it developed into a more formal discipline that is being used increasingly in many fields. In animal health it has perhaps been most widely applied in quarantine. Quarantine risk analyses are used for helping to decide the most appropriate health conditions for imported animals and animal products and for strategies for quarantine operations.

Risk analysis is a tool that can also be used to very good advantage for animal disease emergency preparedness planning. In this context, it is most readily applied to preparedness planning for exotic diseases (or exotic strains of endemic disease agents) and it will be described for this purpose in this chapter. However, there is no reason why risk analysis cannot be applied to other animal health emergency planning.

---

### PRINCIPLES OF RISK ANALYSIS

Risk analysis comprises four components: risk identification, risk assessment, risk management and risk communication.

In the first component, the risks of an event occurring or of taking a particular course of action are identified and described. The likelihood of these risks occurring is then estimated. If risks do occur, their potential consequences are evaluated and used to modify the risk assessment. For example, if an exotic disease has a high risk of entry to a country, but only a low risk of establishment there or trivial potential socio-economic consequences, it will only get a low overall score on a risk assessment. Conversely, a low risk of introduction but significant consequences of the disease will be rated more highly.

Risks can be assessed in a quantified, semi-quantified or qualitative way. It is inherently very difficult to quantify (or actually put probability numbers to) risks in many biological systems because



of the lack of historical precedents and serious gaps in available biological data. Risks should be quantified as far as is practicable. If this cannot be done, qualitative risk assessments are recommended for exotic diseases. Risks can be described as extreme, high, medium and low, or qualified by a simple scoring system, for example, 1-5 for both the level of risk and for the degree of potential consequences. This will help to establish a prior ranking for identified risks, which will provide a solid platform for contingency planning.

---

**WHO SHOULD  
CARRY OUT  
THE RISK  
ANALYSES?**

The risk assessment component is best carried out by the Epidemiological Unit in the National Veterinary Service as part of the national early warning system for TADs and other emergency diseases. Risk management and risk communication are tasks for everyone, but should be coordinated by the chief veterinary officer (CVO).

It should be remembered that risks do not remain static. They will change with factors such as climate change; evolution and spread of epidemic livestock diseases internationally; emergence of new diseases; and changing international trading patterns in the country. Risk analysis should therefore not be regarded as a one-off activity but be repeated and updated regularly.

Risk analysis for RVF should be considered on a regional basis and not purely at the national level. The determinants of factors conducive to RVF epizootic activity are, for example, the characteristics of the intertropical convergence zone (ITCZ) in Africa, the Southern Oscillation index and remote sensing satellite data (RSSD) such as cold cloud density (CCD), the normalized differentiated vegetation index (NDVI) and basin excess rainfall monitoring systems (BERMS). These are regional and continental climatic factors that affect large areas of Africa. Coordinated networking of such information needs to be undertaken by EMPRES, the Intergovernmental Authority on Development (IGAD), the United Nations Development Programme (UNDP) and other agencies with monthly bulletins assessing the ongoing levels of risk.

---

**RISK  
ASSESSMENT  
FOR RVF**

As described above, risk assessment consists in identifying the risks, assessing the likelihood of their occurrence and modifying them by an evaluation of their potential consequences.

The international status and evolution of outbreaks of RVF (and

other important TADs) as well as the latest scientific findings should be constantly monitored. Analysis of this information should be a routine function of the Epidemiological Unit of the National Veterinary Service. Apart from the scientific literature, the most valuable source of information is the International Office of Epizootics (OIE), for example through its weekly disease reports, the annual OIE *World Animal Health* and the OIE HandiSTATUS database. Disease intelligence is also available from FAO, particularly in the *EMPRES Transboundary Animal Diseases Bulletin*, which is published quarterly (and is also available on the Internet at [www.fao.org/empres](http://www.fao.org/empres)). The Program for Monitoring Emerging Diseases (ProMED), an Internet server and mailing service, currently provides a useful forum for rapid dissemination of official and unofficial information on animal, plant and human disease occurrences around the world. Information may also be obtained from designated OIE and FAO experts and reference laboratories and from regional animal health groups.

Having identified and listed the exotic disease threats, the next step is to assess the seriousness of the threat of entry of each disease to the country and the routes and mechanisms by which the disease may enter. Relevant questions to be answered for RVF include the following:

- What is the current geographic distribution and incidence of RVF?
- Is distribution fairly static or has there been any history of spread to new countries, regions or continents?
- How close is the disease? What is the status of neighbouring countries, not only regarding the known presence of RVF, but also regarding confidence in their veterinary services to be able to detect and control outbreaks of the disease?
- If RVF is present in neighbouring countries, where are the nearest outbreaks to shared borders?
- Is the RVF virus already present in the country? If so, where?
- What animals are likely to be the target for RVF in the country? Are they of susceptible or non-susceptible genotypes?
- Are potential mosquito vector species for RVF present in the country?
- What are the mosquito vector species that might be involved in the enzootic and epizootic cycles of RVF? What is known of their distribution, ecology and population biology?
- What is the history of past RVF outbreaks?
- How often do weather and environmental conditions conducive

to RVF virus activity occur in different areas in the country?  
How well can these be predicted?

- Have there been any changes in surface water patterns in the country, such as the building of irrigation schemes, dams, river barrages and lakes?
- If the RVF virus is still exotic, are the import quarantine procedures adequate to keep it out of the country?
- Is the virus likely to become established if it enters the country?
- Are the epidemiological and environmental conditions that might be conducive to RVF monitored on a longitudinal basis?
- Are baseline data available on the level of cryptic RVF virus activity in different ecological zones of the country?
- Are longitudinal data available on the biology of potential RVF vector mosquitoes in the country?
- Are good baseline data available on RSSD such as NDVI, CCD and BERMS in the known or suspected potential RVF epizootic areas?
- Can these data be correlated with historical RVF epizootic activity in the region?

The next step is to evaluate how serious the socio-economic and public health consequences might be if the disease occurs. There are a number of questions to be answered:

- How large are the susceptible livestock populations in the country? Are they in areas ecologically favourable for the generation of huge populations of RVF mosquito vectors?
- How important are these livestock industries for the national economy and to meet the nutritional and other needs of the community?
- Will many people be in danger of contracting the disease?
- What effect will the presence of the disease have on the export trade in livestock? To what extent could eventual losses be avoided?
- Will it be difficult to recognize the disease quickly in different parts of the country?
- How difficult will it be to mount an effective disease control programme in different parts of the country? How costly will these programmes be?
- Will it be possible to eradicate RVF from the country?

By addressing these questions and issues it will be possible to build up a risk profile for RVF and judge the magnitude of the risk presented by the disease in qualitative, if not quantitative, terms.

It will also be possible to get an idea of how RVF ranks in relation to other high-priority risk diseases, and decide what resources need to be devoted to preparedness for RVF in comparison with other diseases. Possible pressure points for entry and/or occurrence of the disease can be ascertained, showing where preventive and disease surveillance activities need to be strengthened, and establishing whether the veterinary services and contingency planning are adequate to deal with the risk.

It is clear that many risk factors will vary over time, which is one of the many reasons why this manual needs to be periodically reviewed.

---

**THE VALUE  
OF RISK  
ASSESSMENT  
FOR RVF**

The type of risk assessment described will help to:

- determine where RVF ranks in the priority list of serious disease threats for the country and what level of resources should be devoted to preparing for it in comparison with other diseases;
- determine how and where quarantine protocols and procedures need to be strengthened;
- determine how laboratory diagnostic capabilities need to be strengthened;
- plan training courses for veterinary staff together with farmer awareness and publicity campaigns;
- build up an RVF risk profile for different areas of the country;
- determine how and where active disease surveillance needs to be strengthened;
- plan disease response strategies;
- plan how to minimize livestock export trade losses.

## Chapter 4

## Prevention strategies for Rift Valley fever

---

**INTRODUCTION**

RVF is a very serious and important zoonosis. Countries at risk should take whatever steps they can to prevent the entry and/or occurrence of the disease. As with all serious livestock diseases, a comprehensive quarantine programme should be regarded as the first line of defence. However, no records show to date that RVF has been transported by animal movement from one country or area to another. The movement of animals has not been associated with new foci of disease in Africa, as has been the case with lumpy skin disease and many other animal diseases. It has been suggested that RVF entered Egypt via camels from the Sudan; while this cannot be disproved, the very brief and low level of viraemia in camels, with the 12-14 day journey, makes it extremely unlikely. Vector movement in air currents is a well-documented and proven means for the dissemination of plant insect pests and malaria. Animal movement should be closely monitored if animals are being imported from known epizootic areas, and this should only take place in demonstrably validated interepizootic periods. Insect vector movement in low-level air currents is uncontrollable and vigilance is necessary to monitor for possible RVF introductions in the receptive areas deemed to be of high risk.

The potential for countries in different regions of the world to implement effective strategies for RVF varies enormously.

---

**PREVENTION STRATEGIES FOR COUNTRIES IN AFRICA**

It is virtually impossible to prevent RVF outbreaks in regions of Africa where outbreaks have occurred in the past. Livestock movement controls are unlikely to play any role in propagating RVF in the enzootic/epizootic areas of Africa. This is probably even the case where there are no endemic cycles of infection (such as in Egypt). Continuing mass livestock vaccination programmes during interepidemic periods are unlikely to be an economically viable proposition. However, consideration should be given to routine vaccination of high-grade animals.

This does not mean that nothing can be done. On the contrary, the emphasis must change to early warning programmes (Chapter 5) to detect the first evidence of a likely epidemic and early reaction programmes (Chapter 6) so that disease outbreaks in livestock and humans can be aborted or at least their effects ameliorated.

Many countries in sub-Saharan Africa are embarking upon agricultural and livestock development programmes, whereby they also create conditions for the generation of huge mosquito populations. This happens when countries initiate improved water conservation/utilization schemes or make changes to river systems to allow more irrigation. Countries should be aware of the increased risk of RVF outbreaks following the creation of such extensive new mosquito habitats. This has been the case of the Gezira scheme in the Sudan and the Senegal River barrage in Senegal. The likelihood is that low-level cryptic RVF activity has been taking place for generations in such areas and will be amplified to epizootic proportions if susceptible livestock populations are introduced.

---

**PREVENTION  
STRATEGIES FOR  
COUNTRIES IN THE  
MIDDLE EAST**

A large traditional livestock trade exists between countries in the Horn of Africa and countries in the Middle East. A major challenge is to manage the risk of spreading RVF with such livestock shipments. Importing countries must be given adequate safety assurances with respect to RVF, while the livestock trade, which is vital for the livelihoods of agropastoralists in both regions, is maintained as far as possible.

Joint planning and the implementation of programmes by animal health authorities in both exporting and importing countries could achieve this. An FAO/UNDP Expert Consultation on Risk Assessment and Risk Reduction of RVF Transmission in Trade Exchanges between the Horn of Africa and the Arabian Peninsula was held from 15 to 16 May 2001. The meeting proposed a framework of action, which includes activities to be carried out by both exporting and importing countries during periods of epizootic RVF, pre-epizootic RVF conditions and between epizootics. The proposals are summarized in the table on p. 27, prepared by the Expert Consultation.

---

**PREVENTION  
STRATEGIES FOR  
COUNTRIES IN  
OTHER REGIONS**

RVF could be introduced to countries in other regions by aerial movement of infected vectors or through the importation of domestic or wild ruminants from infected countries, although this could only happen if importation took place within the short incubation

| Level of RVF risk                                       | Activity in exporting country   | Activity in importing country  |
|---|---|--|
| HIGH<br>Epizootic RVF                                   | Define extent of infection<br>Longitudinal monitoring of infection in livestock populations (i.e. clinical surveillance, virus isolation/ IgM antibodies)<br>Determine the point at which virus activity has returned to pre-epizootic levels                 | Cease all imports of livestock from affected regions<br>Resume trade 3-6 months after the last evidence of infection OR when the country considers the high risk has disappeared   |
| POTENTIALLY HIGH<br>Pre-epizootic conditions identified | Increase the level of monitoring in known RVF epizootic areas, such as floodplains, by clinical surveillance for abortion in livestock, disease in humans and serology in livestock<br>Consider vaccination of trade stock at least one month before movement | Increase vigilance at ports of entry<br>Increase random sampling at ports for evidence of recent infection (IgM antibody in the absence of a history of vaccination)<br>If vaccinated animals are to be accepted they should be randomly sampled at ports for IgG antibodies |
| LOW<br>Interepizootic period                            | Monitor sentinel herds in high-risk areas (floodplains, etc.)<br>Consider vaccination of all trade animals at 9-12 months of age  | Regular random sampling of trade animals for IgM antibodies  |

### RECOMMENDED OIE GUIDELINES FOR THE IMPORTATION OF DOMESTIC AND WILD RUMINANTS FROM INFECTED COUNTRIES

When importing from infected countries, Veterinary Administrations should require for domestic and wild ruminants the presentation of a veterinary certificate attesting that:

1. Vaccinated animals
  - a) showed no clinical sign of RVF on the day of shipment;
  - b) were vaccinated using a vaccine complying with the standards described in the Manual not less than 21 days and not more than 90 days prior to shipment;
  - c) were kept in a quarantine station in the country of origin for the 30 days prior to shipment and showed no clinical sign of RVF during that period.
2. Unvaccinated animals
  - d) showed no clinical sign of RVF on the day of shipment;
  - e) were subjected to the diagnostic tests for RVF with negative results within 30 days before entry into quarantine;
  - f) were kept in a quarantine station in the country of origin for the 30 days prior to shipment and showed no clinical sign of RVF during that period;
  - g) were subjected to the diagnostic tests for RVF with negative results not less than 14 days after entry into quarantine;
  - h) were protected from insect vectors during quarantine and transportation to the place of shipment.

(Extracted from the OIE International Animal Health Code, 10<sup>th</sup> Edition, 2001, Article 2.1.8.7)

period for the disease. Adoption of the recommended guidelines of the OIE International Animal Health Code for such importations would prevent this (see Box on p. 27).

Another possible mechanism is to transport RVF-infected mosquitoes or people through international flights. They can be moved from RVF endemic countries within a matter of hours. Although there are numerous examples of the establishment of vector-borne diseases (e.g. malaria) through the escape of infected insects in areas near international airports, international standards exist for aircraft disinfection and airport insect abatement programmes, which are designed to prevent the entry of RVF and other insect vector-borne diseases. People infected with the RVF virus may have a high enough viraemia to reinfect biting mosquitoes so that it is theoretically possible for an incoming airline passenger to introduce the disease to a new country. Consequently, cooperation is required with health ministries to ensure that the correct human quarantine procedures are implemented for incoming passengers at international airports. These procedures include identification, isolation and hospitalization of any person who displays symptoms suggestive of RVF or other serious haemorrhagic fever. People arriving from endemic countries should also be warned to seek medical assistance promptly if they become ill within a week of arrival.



## Chapter 5

# Early warning contingency planning for Rift Valley fever

### INTRODUCTION

Early warning enables rapid detection of the appearance of or sudden increase in the incidence of serious livestock diseases before they develop to epidemic proportions and provoke serious socio-economic consequences. It embraces all the initiatives, mainly based on disease surveillance, reporting and epidemiological analyses that lead to improved awareness and knowledge of the distribution and behaviour of disease outbreaks (and of infection). Early warning enables forecasting of the probable occurrence, source and evolution of disease outbreaks and monitoring of the effectiveness of disease control campaigns.

Early warning programmes are critical for RVF. They provide the cornerstone for contingency planning for the disease. In regions where RVF is present, forecasting of the high probability of epidemics at least three months, and possibly up to six months, before they start will enable an effective response to be mounted against the disease. Conversely, if a RVF outbreak does not come to official attention until it is under way, the capacity of animal and human health authorities to mount an effective disease control campaign against it will be severely limited.

As is the case with all aspects of contingency planning for RVF, it is essential that there be close cooperation with counterpart officials in the Ministry of Health and that joint national and local early warning systems be developed.

The success of a country's capability for forecasting and rapid detection of outbreaks of RVF depends on the following:

- established networking with regional and international RVF monitoring bodies (such as EMPRES and IGAD) and awareness of the monthly regional risk assessment data generated from RSSD sources;
- good farmer and public awareness programmes for RVF and other high-threat epidemic livestock diseases, which involve improving the veterinary/farmer interface;

- training of field veterinary officers (FVOs), veterinary auxiliary staff, agricultural extension officers, local authorities and livestock owners in the clinical recognition of RVF and other serious epidemic livestock diseases and the need for prompt action;
- development of strong epidemiological capabilities within the national animal health services, whereby available forecasting information on environmental and epidemiological conditions conducive to RVF can be accessed from FAO and other international sources, interpreted and acted upon;
- sustained active disease surveillance, to supplement passive monitoring, based on close coordination among livestock owners, field and laboratory/epidemiology veterinary services, and the use of techniques such as participatory questionnaires, serological surveys and abattoir monitoring to supplement field searching for clinical disease;
- dependable emergency disease reporting mechanisms to regional and/or national/federal veterinary headquarters;
- implementation of an emergency disease information system (such as the Transboundary Animal Diseases Information System [TADInfo])
- enhancement of laboratory diagnostic capabilities for RVF within provincial and national veterinary laboratories;
- development of strong linkages between national laboratories and regional and world reference laboratories;
- strengthening of national epidemiological capabilities to support emergency preparedness and disease management strategies;
- prompt and comprehensive international disease reporting to OIE by all countries and to regional animal health organizations;
- close liaison with veterinary authorities in neighbouring countries both at a national and a local level near shared borders.

It is beyond the scope of this manual to discuss the above issues in detail. For more information, reference should be made to the *Manual on the preparation of national animal disease emergency preparedness plans* (FAO Animal Health Manual No. 6) and the *Manual on livestock disease surveillance and information systems* (FAO Animal Health Manual No. 8). However, some of the most important issues for RVF early warning preparedness will be described below.

---

**TRAINING OF  
VETERINARY AND  
OTHER ANIMAL  
HEALTH STAFF IN  
EARLY RECOGNITION  
OF RVF AND  
COLLECTION AND  
DISPATCH OF  
DIAGNOSTIC  
SPECIMENS**

In many countries, even those in which RVF outbreaks have occurred in the past, few veterinarians and animal health workers have had any direct, first-hand experience with the disease. If RVF is considered to be a major threat, this deficiency needs to be rectified. A systematic training programme should be established for all those who, in their professional capacity, may possibly be the first to come into contact with an incursion or outbreak of the disease. Training programmes should be comprehensive and regular, both because the disease may strike in any part of the country and also because of staff turnover. Training must extend to staff in the remotest parts of the country, as well as to selected officials (agricultural extension officers, local authorities) and livestock owners.

It will obviously be neither practicable nor necessary to train personnel to a high level of expertise in the disease. It is sufficient for trainees to be familiar with the basic clinical, pathological and epidemiological features of RVF and know what they need to do if they suspect its presence. Perhaps the most important thing to inculcate in people is a “mind-set”; if they are confronted by an unusual disease outbreak involving abortion storms and deaths in young ruminant animals, either in the field or in the diagnostic laboratory (through submitted diagnostic specimens), they should include RVF in the range of their differential diagnostic possibilities and act accordingly. People should be trained in the steps they need to take 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. More specialized training will be needed for personnel who are nominated as members of specialist diagnostic teams (see below).

A number of training possibilities may be selected, as appropriate.

- Sending key field or laboratory staff to another country to gain first-hand experience when there is an RVF outbreak there, or making use of any other opportunities for field and laboratory staff to profit from the experience of countries that are in the process of controlling an outbreak (e.g. by attending workshops).
- International training opportunities presented from time to time. Several countries with access to microbiologically high-security laboratory and animal facilities run training courses in which exotic diseases can be demonstrated by experimental infection of susceptible livestock species. Laboratory staff may be trained at world or regional reference laboratories; training programmes are also arranged occasionally by international organizations.

- National emergency disease training workshops, which should be organized as the mainstay of training and targeted at government field and laboratory veterinary officers, public health and quarantine veterinarians and private veterinarians. Ideally, these workshops should include representatives from neighbouring countries and should filter down, by means of workshops organized by those who have been trained, to farmer level.
- Field diagnostic manuals, which are most useful if they are prepared in a simple, practical and graphic format whereby they can always be carried in a vehicle and are available for quick reference at the site of a disease outbreak.

---

**LIVESTOCK FARMER  
AND TRADER  
AWARENESS/  
EDUCATION  
PROGRAMMES**

These programmes are one of the most critical, but sometimes neglected, aspects of preparedness planning for emergency diseases. They are necessary for fostering “ownership” and support for emergency disease control/eradication campaigns from livestock farmers and other key stakeholders. They also engender a bottom-up approach to planning and implementation of disease control programmes, to complement the more traditional top-down approach adopted by governments.

Communication strategies should aim to make stakeholders aware of the nature and potential consequences of RVF and other important livestock diseases and of the benefits to be derived from prevention and control/eradication. Furthermore, these strategies should always have an element of rallying the community to the common cause of preventing and fighting a disease epidemic, ideally resulting in farmer sanitary defence groups and farmer organizations.

One of the important messages to get across is that it is essential to notify and seek help from the nearest government animal health official as soon as an unusual disease outbreak is observed. The way to do this needs to be carefully explained. Publicity campaigns should not be directed only towards farmers but also to local authorities and livestock traders.

Livestock traders are an important target group for public awareness campaigns and are often overlooked. The movement of animals through livestock traders is often the key epidemiological factor in the spread of contagious epidemic livestock diseases. The need to build up a climate of trust and confidence between animal health officials and livestock traders is as important as that discussed for farmers and the general themes for emergency disease awareness

*Trade of livestock between the Horn of Africa and the Arabian Peninsula (Port of Berbera, northern Somalia)*



should be similar. More emphasis should be placed on the importance of doing the “right thing”, about sourcing animals from disease-free areas where possible; not buying any sick stock; and following any rules about quarantine, vaccination, testing or identification of animals. The potential consequences of the occurrence of a disease for internal and international trade should be emphasized.

---

**SPECIALIST  
DIAGNOSTIC TEAM**

It is recommended that a specialist RVF diagnostic or emergency disease investigation team be nominated within a country so that it can be mobilized when there is a report of a suspect outbreak of the disease from the field. These arrangements should be made well in advance of any emergency. Members should be available and equipped to travel to a disease outbreak site at short notice. They should carry all the equipment needed for the preliminary investigation of a disease and for collection and transport of diagnostic specimens.

The composition of the diagnostic team will vary according to circumstances, but could include:

- a veterinary virologist and /or pathologist from the central or regional veterinary diagnostic laboratory;
- a specialist epidemiologist, preferably with first-hand experience of or training in RVF;
- a veterinarian with extensive experience of endemic diseases in susceptible livestock species; and
- a specialist entomologist.

Ideally, a joint medical and veterinary specialist diagnostic team should be mobilized in any outbreak situation. The team would

travel to a disease outbreak site with local veterinary staff if so directed by the CVO (and would be provided with the transport to do so). They would be expected to make clinical examinations, collect histories and make preliminary epidemiological and entomological investigations. They should collect a range of diagnostic specimens specifically for RVF and for any endemic or exotic diseases that might be included in the differential diagnosis and transport them back to the laboratory.

The team should also be able to take any necessary immediate disease control actions at the outbreak site and have the appropriate authority to do this; they should be empowered to provide any immediate instructions to local animal health officials.

The team would be expected to report back immediately to the state/provincial/regional veterinary officer and the CVO on their assessment of the disease outbreak. They should report on the steps taken to secure a confirmatory diagnosis and give advice on further disease control strategies, including declaration of infected and surveillance zones. They may also advise on any necessary measures to improve disease reporting from the outbreak area and on the desirability of setting up a local disease control centre.

---

**LABORATORY  
DIAGNOSTIC  
CAPABILITIES**

The rapid and certain diagnosis of diseases can only be assured in fully equipped laboratories, with a range of standardized diagnostic reagents, with experienced staff and a sufficient throughput of diagnostic specimens to maintain expertise. The relatively simple facilities required for testing sera by ELISA are a realistic possibility for most countries with P-2 facilities. Additionally, the development of diagnostic expertise for exotic diseases for tests, which require handling live RVF virus (e.g. SN tests), should only be attempted in laboratories with appropriate biosafety facilities (P-3/P-4).

It would therefore be impractical and excessively costly for most countries to maintain a national veterinary diagnostic laboratory with full capacity for confirmatory diagnosis of all transboundary and other emergency diseases, many of which will be exotic. However, it is to be expected that all countries with significant livestock populations will have a veterinary diagnostic laboratory. This must be equipped and competent to undertake a broad range of standard techniques in pathology, virology, bacteriology and serology to the level where preliminary identification of aetiological agents for most, if not all, emergency livestock diseases can be attempted. If RVF is deemed to be a high-threat disease, consideration

should be given to developing capabilities for some primary key diagnostic tests for the RVF antigen (formolized tissue and immunohistochemistry or PCR) and antibody detection (ELISA tests).

Specimen transport containers should be kept at both central and state or provincial veterinary laboratories and be made readily available for FVOs and specialist diagnostic teams. Containers should ideally consist of primary leakproof glass universal bottles with a metal screw top and rubber washer or good-quality plastic screw-top jars. These are then packed into a leakproof secondary container (e.g. a steel paint tin or a plastic or styrofoam™ cool box) with absorbent material and an ice pack, and finally put into a well-labelled robust outer container. Specimen advice notes should also be provided.

---

**INTERNATIONAL  
REFERENCE  
LABORATORIES AND  
COLLABORATING  
CENTRES**

A network of FAO and OIE Reference Laboratories and Collaborating Centres for RVF exist around the world and are available for providing advice and assistance to countries. Their names, full contact details, subjects and geographic areas of responsibility are given in Appendix 1.

As part of their RVF contingency planning, countries should establish contact and a dialogue with the appropriate reference laboratories and collaborating centres. The countries should determine the nature and range of diagnostic specimens or isolated agents to be sent for confirmatory diagnosis or further characterization. The specific means of transport, method of packaging and refrigeration, labelling of package (including correct address and any necessary customs or International Air Transport Association [IATA] declarations) should all be determined. This information should be documented in country plans.

Potential or confirmed aetiological agents from emergency disease outbreaks must be sent to the appropriate International Reference Laboratory for further characterization. It is recommended that several isolates from different geographic locations and at different phases of the outbreak be forwarded. Submission of samples to any laboratory outside the country of origin should always be subject to prior agreement with the recipient and transportation in containers meeting IATA regulation standards.

Reference laboratories and collaborating centres can provide, for example, opportunities for training, provision of specialized advice in planning and standardized diagnostic reagents.

---

**FORECASTING  
SYSTEMS FOR RVF**

The three essential prerequisites for an epidemic to occur are a susceptible livestock population, a massive build-up in the populations of vector mosquitoes and the presence of a virus. Assuming the continuing presence or at least the close proximity of the virus in regions where the disease has occurred previously, the first two factors become the key to early forecasting of likely RVF activity.

Early work on forecasting was centred at a study site in Kenya where ground truth data for RVF virus activity had been generated for many years. Periodic outbreaks of RVF over a 40-year period were found to correlate with the positive value of a statistic based upon the number of rain days and the quantity of rainfall. The three-month rolling mean value formed a positive spike when RVF virus activity occurred and this was a function of cumulative persistent rainfall, rather than heavy precipitation over a short period. Data were based upon longitudinal rainfall data generated and recorded in the old-fashioned manner. The characteristics of the ITCZ were also important as a determinant of prevailing conditions conducive to RVF virus activity. These data allowed forecasting of RVF outbreaks, with a four- to ten-week period during which vaccination could be carried out before cases occurred.

More sophisticated studies were possible when RSSD became available. These data enabled national and regional monitoring of rainfall and climatic patterns and their effects upon the environment. CCD measurements are closely correlated with rainfall and have replaced the laborious daily collection of rainfall data from many stations. Climatic patterns are regional in East Africa and the Horn of Africa and may be studied on this basis. Detailed analysis was made with virus isolation data over a 25-year period and the NDVI for the study areas. NDVI data are derived from probes measuring relative “greenness” and “brownness” of the vegetation. As the water table rises to the point where flooding may occur, the ratio approaches 0.43 to 0.45. This point was reached at each of the epizootic periods in the study period.

More recent retrospective studies using the same ground truth data have included the surface sea temperatures (SST) for the Indian and Pacific Oceans. When these are combined with NDVI data, they approached 100 percent accuracy in predicting periods of RVF virus activity during the study period. This has a pre-epizootic predictive period of two to five months before virus activity occurs.

A new statistic has been derived from satellite data, known as BERMS. These measure rainfall in the catchment areas of river/



wadi systems and are based upon digital maps of basin and river networks. They can predict periods when flooding might occur, which is particularly valuable for the floodplain zones in the Horn of Africa countries and the Arabian Peninsula. Early data suggest that BERMS might be able to predict virus activity five months before its occurrence. The advantages of RSSD for RVF predictive epidemiology are in the relatively low costs of the systems used for analysis. These are readily available on a country and regional basis and give time for preventive measures such as the vaccination of susceptible stock and mosquito larval control methods, wherever possible. There are discrete floodwater mosquito breeding sites in the West African Sahelian zones, which lend themselves to control with larvicides. The floodplain zones in the Horn of Africa do not allow such control methods.

International agencies are best placed to analyse satellite and other data and to provide risk countries with early warning about likely weather patterns conducive to increased RVF activity. FAO, through its Global Information and Early Warning System on Food and Agriculture (GIEWS) and EMPRES/Livestock Programme, will take a central role in generating these data on a continuing basis, thus providing an early warning/risk assessment service.

It must be recorded that little work has been done in other parts of Africa to validate the RSSD systems because the ground truth data has not been available and it takes many years of dedicated work to generate such data. Recent outbreaks in Somalia and northeast Kenya in 1997-98 showed retrospectively that the foci of RVF virus activity in these countries could be correlated with high NDVI values.

---

**RVF  
SEROLOGICAL  
AND CLINICAL  
SURVEILLANCE  
PROGRAMMES**

Activities should be directed towards active disease surveillance in order to build up baseline information on interepidemic virus transmission patterns, areas at risk and early warning of any increased virus activity or build-up in vector mosquito populations. This surveillance should be carried out by regular field visits and contact with livestock farmers and communities and should include periodic purposefully designed and geographically representative serological surveys and participatory epidemiological techniques. The detection of RVF virus activity by serology is usually too late to be of any relevance to control.

Sentinel herds are an important means of obtaining baseline epidemiological information on RVF. These are small ruminant

*Suitable area for mosquito breeding in the Afar region of Ethiopia*



VINCENT MARTIN

*Sentinel herd monitoring by a field agent in Mauritania*



FABIEN SCHNEEGANS

herds located in geographically representative areas. Locations where mosquito activity is likely to be greatest, e.g. near rivers, swamps and dams, should be selected.

Arrangements should be made with owners to ensure that sentinel animals are available for regular inspection and sampling and that the animals are permanently identified by eartagging. Arrangements should also be made so that any illness in the herds can be reported and investigated quickly. Serum samples should be collected at regular intervals from 20-30 young adult small ruminant animals in the herds and tested for both IgM and IgG antibodies against RVF. As a general guide, sentinel herds should be sampled twice to four times annually, with an emphasis during and immediately after rainy seasons.

## Chapter 6

## Early reaction contingency planning for a Rift Valley fever emergency

---

**INTRODUCTION**

It may be impossible to eradicate RVF from a country in which it has become established. Nevertheless, countries that are free of the disease and are threatened by it should prepare contingency plans that have eradication as their goal. This goal should be pursued for as long as epidemiological monitoring of the disease control campaign indicates that eradication remains a viable option.

Countries where RVF virus persists should prepare contingency plans based on the premise that epidemics of the disease are forecast and/or detected as early as possible and immediate action taken to prevent outbreaks or at least limit their geographic range and size. The aim is thus to minimize the socio-economic, trade loss and public health consequences of the disease.

---

**DISEASE CONTROL  
STRATEGIES TO BE  
USED WHEN RVF  
OUTBREAKS ARE  
EXPECTED**

The early warning that epidemiological and environmental conditions suggest pre-epizootic conditions for RVF and that outbreaks are likely to occur provides a window of opportunity for national animal and human health authorities to mount an effective response. This opportunity will be progressively lost as RVF virus activity in the field becomes apparent. It is always a difficult decision for national animal health authorities to commit funds and resources to combat a possible disease threat in advance of actual outbreaks. In the future, this decision-making process will become easier as long-range forecasting methodology for RVF becomes more precise.

**Accurate definition of high-risk areas**

When there is a forecast that RVF activity may be imminent, the first thing is to define the areas that are likely to become infected. This definition should be based on:

- scientific evaluation of satellite and other data on weather patterns and vegetation growth, etc.;
- information on topographical features such as altitudes, watercourses, dams, likely flood areas and irrigation systems, to demarcate the extent of potential mosquito breeding habitats;
- epidemiological and entomological evidence from the field, gathered by active surveillance targeted to define the range of primary and secondary RVF vector species and likely density;
- distribution and density of susceptible livestock populations;
- historical information on the virus/disease distribution and epidemic behaviour during previous RVF outbreaks;
- definition of potential extension zones for RVF in the country based upon the ecological zones and livestock populations;
- estimation of the likely duration period for RVF virus propagation based upon historical ecological and climatic information. In semi-arid zones this is unlikely to be longer than 6-12 weeks; in more temperate grasslands, the initial period of intense virus activity may have seasonal upsurges from six months to two years.

This information can be compiled and evaluated using the Geographical Information System (GIS).

### **Public awareness programmes**

Public awareness and education programmes are critical factors in the success of control and eradication campaigns against major diseases. They are far more relevant when one of the deadly haemorrhagic fevers of human beings is being considered. Once the high-risk areas for RVF outbreaks have been identified, a public awareness programme, targeted at livestock-raising communities and others at risk, should be mounted. This should be delivered by medical and animal health personnel by whatever means are most effective in reaching the target audience – meetings, posters, radio, television or newspapers.

Information that needs to be communicated includes:

- what RVF is, when and how it presents itself in humans and animals, what it looks like, how it is spread and what are its consequences;
- the need to contact and seek assistance from local animal and human health officials if there is any illness in livestock or people and how and where officials can be contacted;
- benefits of the disease prevention and control activities that might be taken to reduce the impact of RVF;



RVF public awareness poster produced in Senegal

- actions that people should take to avoid mosquito bites, e.g. use of mosquito repellents, wearing long clothing, avoiding swampy or flooded areas, insecticide spraying in/around dwellings and using impregnated mosquito nets at night;
- the role of vaccination;
- the fact that sick or freshly dead animals are a potential source of infection and should be buried, not butchered;
- neither normal nor sick animals should be traded or moved.

### Vaccination

**Available vaccines.** Both attenuated (live) and inactivated vaccines have been used to immunize animals against RVF. The modified live Smithburn vaccine has been widely used in eastern and southern Africa to protect the exotic and exotic cross-breeds of sheep, goats and cattle imported into Africa to improve livestock production. The vaccine is easily produced and is relatively inexpensive. A single vaccination protects sheep and cattle within five to seven days and produces a long-lasting immunity. It is quite safe when used in non-pregnant adult animals and in relatively resistant genotypes. Its main disadvantage is that it is not safe for use in pregnant ewes or young lambs. Foetal abnormalities, including

microencephaly, hydrancephaly and arthrogryposis, may occur, particularly when pregnant sheep are vaccinated in the first semester of pregnancy. Up to 30 percent of ewes may abort and others develop hydrops amnii towards the end of the term. Young lambs may suffer neurological effects. The vaccine is safe for use in pregnant cattle of *Bos taurus* and *indicus* breeds.

There is at least a theoretical risk of reversion to virulence, although this has not occurred to date. For this reason it is not recommended that the live vaccine be used in non-endemic areas.

A live mutagen-attenuated vaccine, MP-12, has also shown considerable promise experimentally as a safe and effective vaccine.

The inactivated vaccine is quite safe for all types of animal (including pregnant animals) but is poorly immunogenic. It is more difficult to produce and is very expensive. At least two to three doses are required to produce an adequate level of immunity and even then breakdowns may occur during epizootics.

***Vaccination campaigns.*** A mass vaccination campaign in the RVF epizootic areas should be seriously considered when and where climatic and epidemiological evaluations suggest that there is a high probability of outbreaks of RVF. The earlier this is done, the greater the chances of success in preventing the more serious consequences of the disease. An early warning of at least two to four months would be required to mount an effective campaign and ensure that adequate supplies of vaccine are available.

The modified live Smithburn vaccine is the most appropriate vaccine to use in such a mass campaign. A value judgement would need to be made as to whether to vaccinate all animals. There may be less overall loss by including pregnant sheep even though some abortions and foetal abnormalities may occur. Many of the indigenous breeds of sheep and goats in Africa do not abort when vaccinated during pregnancy. Those in the Sahelian zones appear to be more susceptible than elsewhere.

Vaccination should cease in areas where evidence of RVF virus transmission has been detected. However, vaccination may be continued in other risk areas but combined with a high level of disease surveillance.

#### **Insect vector control**

At present, the options for insect vector control programmes as components of an RVF campaign are very limited. Mass insecticide spraying may be impractical and prohibitively expensive, as well

as environmentally unacceptable. However, ultra-low volume insecticide spraying of well-defined mosquito breeding and resting sites may be a valuable intervention in some circumstances. Moving susceptible animals away from areas of high mosquito activity or stabling animals to protect them from mosquito bites are unlikely to be viable options.

The best vector control strategy is through larvicidal treatment of potential mosquito breeding sites. At this stage, this must be regarded as experimental for RVF. The most practical way of application is through burying larvicides in the mud of pans before flooding occurs. Toxins derived from *Bacillus thuringiensis* and *sphaericus* and larval growth inhibitors, such as methoprene, have been used experimentally and given excellent results. Larvicide treatment is applicable where well-defined, discrete areas are expected to flood and where the likely floodwater area can be estimated. The Sahelian areas of West Africa are the best candidate areas for this approach, where the *walo* and *dieri* or seasonal water pans of alluvial clays are quite discrete.

**DISEASE CONTROL  
STRATEGIES TO BE  
USED AFTER RVF  
HAS BEEN  
CONFIRMED**

When RVF virus activity has been confirmed in a country where the disease is enzootic and which is exporting livestock, the veterinary authorities should:

- define the extent of the infected areas and target populations;
- define any potential extension zones for RVF in the country, based upon ecological considerations;
- monitor physical indicators of flooding and the satellite derived data on the occurrence (BERMS), persistence of floodwater and rainfall, SST, CCD and NDVI to predict a time scale for epidemic virus activity;
- monitor mosquito populations in RVF-affected areas;
- monitor longitudinally and estimate levels of RVF virus activity (case rates/virus isolation/ELISA testing);
- carry out surveillance for clinical disease and sero-conversions to RVF (IgM and IgG);
- determine the date of the last evidence of RVF virus activity;
- determine a point in time, three to six months after the above date, when all the information flow suggests that no RVF virus activity is occurring and that the situation has reverted to that prevailing before the RVF epizootic.

Vaccination in outbreak areas is not recommended at this time, when there is evidence of high levels of RVF transmission by

mosquitoes. Needle transmission will exacerbate the situation. It is not an option when RVF is confirmed in floodplain zones, when multifocal simultaneous emergence of RVF infection occurs.

Peri-focal vaccination could however be considered in areas where past epidemiological experience has shown that there is only likely to be gradual extension of RVF from outbreak foci; this may include areas that are marginal for mosquito activity (e.g. higher altitude plateaus).

Livestock should not be moved into/out of the high-risk epizootic areas during periods of greatest virus activity, unless they can be moved to an area where no potential vector species exist (such as at high altitudes).

#### **Livestock movement and trade**

All trade should cease once pre-epizootic conditions have been recognized and until at least six months after the last evidence of RVF virus activity has been obtained.

Local people may traditionally move their animals away from flood zones to higher drier areas during the danger periods when there is flooding. Herders have been known to move their animals from the floor of the Rift Valley to the top of the scarp at its edge. This generally takes animals away from the infected mosquito populations and disease ceases within three to five days. There is no reason to prevent such animal movements.

There is real danger that sheep and goats may be moved from an epizootic area where no clinical disease may be apparent because of the genetic resistance of the livestock. Any such movement for trade could result in viraemic animals arriving in a distant country within the incubation for the disease. Viraemic animals constitute a real hazard if introduced into an RVF-free country that has large mosquito populations. Foci of RVF virus propagation could develop. These animals also present a danger to any human beings who slaughter them.

Local animal health authorities may wish to impose movement controls within their own country during RVF epizootics and even to prevent slaughter activities during the periods of greatest risk.

---

#### **INTERNATIONAL COLLABORATION**

RVF should be viewed in regional terms on the basis of shared ecological zones and climatic conditions. The history of past RVF epidemics demonstrates that these natural ecological zones frequently traverse territory in two or more neighbouring countries, for



example, Kenya, the United Republic of Tanzania and Somalia; South Africa and Namibia; Mauritania and Senegal; and with Saudi Arabia. It is therefore very important for countries to cooperate with each other on a regional basis in their efforts against this serious disease.

This regional international collaboration should extend *inter alia* to:

- joint collaboration and complementary contingency planning;
- networking epidemiological surveillance and early warning programmes;
- networking current information on disease incidents and reports;
- development of joint capabilities and resources, e.g. task force and diagnostic facilities;
- regional scientific meetings and training programmes.

## Chapter 7

## Organizational arrangements during a Rift Valley fever emergency

---

**COORDINATION  
BETWEEN NATIONAL  
ANIMAL AND HUMAN  
HEALTH  
AUTHORITIES**

A close working relationship needs to be developed between the Ministries of Agriculture and Health (or their equivalent) so that an effective response can be mounted against RVF and other serious livestock diseases that have a significant public health component (e.g. rabies and Japanese encephalitis).

Agreement should be reached in advance on a joint framework for preparing RVF contingency plans and other preparedness programmes that are consistent with each other and complementary. Agreement should also be reached on the most efficient mechanisms and division of responsibilities for coordinating emergency responses and for implementing disease control and eradication programmes. Opportunities for sharing resources between the two ministries, where appropriate, should also be explored, so as to avoid unnecessary duplication.

Areas in which collaboration and sharing of resources should be developed include:

- Coordinated RVF epidemiological surveillance and evaluation programmes.
- Development of efficient mechanisms for the rapid exchange of emergency disease reports and other key epidemiological information between the two ministries. These arrangements should apply at the local and regional levels as well as at the national headquarters of both ministries. This is critical to ensure rapid response to new RVF incidents.
- A single diagnostic laboratory facility for RVF or at least the sharing of diagnostic reagents and of expertise between government veterinary and medical laboratories (it is unlikely that there will be two laboratories providing the required level of disease security in any country).
- Joint specialist diagnostic teams and field missions.
- Joint training and public awareness programmes.

- Shared cold-chain facilities for vaccines.
- Agreed responsibilities for insect vector control programmes.

---

**RESPONSIBILITIES  
AND COMMAND  
STRUCTURES**

The country CVO (or equivalent, such as the Director of Veterinary Services) should have overall technical responsibility for preparedness for and management of animal disease emergencies including RVF. The appropriate government minister would of course be ultimately responsible.

In recent years the national veterinary services of many countries have been restructured and rationalized. This has included, *inter alia*, regionalization and devolution of veterinary services; privatization of veterinary services and/or downgrading of government services; separation of policy functions from operational functions; and separation of administrative responsibilities of veterinary laboratories and veterinary field services.

These new structures have evolved to meet the demands of delivering routine animal health services better. However, they are often not well suited to managing a major animal health emergency, such as an RVF epidemic. In such an emergency there is a need to make decisions rapidly based on analysis of the best information that can be made available from all sources; have the capacity to convert those decisions into clear orders that can be conveyed down the chain to those who are charged with the responsibility of carrying them out; and to know that orders have been carried out and with what results. Therefore, there must be efficient mechanisms in place for transmission of information and instructions from the national veterinary services headquarters 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 RVF outbreak.

While responsibility for implementation of various activities may be delegated to the private sector and/or non-governmental organizations (NGOs), the national veterinary services must remain accountable for the overall programme, and thus should ensure that adequate quality assurance procedures are applied for all implementing agencies.

There should be forward planning so that the most appropriate structures and lines of responsibilities can be rapidly and seamlessly put in place

when an RVF emergency arises. Planning may include organizing one or more of the following well in advance of any emergency:

- An agreement that animal health emergencies will be handled at the national level and that the CVO will assume overall responsibility for responding to the emergency, and will be directly answerable to the appropriate government minister.
- A mechanism for cooperation among different ministries if necessary to control the disease (e.g. police, army, education, media and health). This cooperation usually necessitates the establishment of an interministerial committee. In view of the bureaucracy that may attend the constitution of such a committee in an emergency, it is advisable for the commission to exist on a permanent basis.
- An agreement with regional or provincial authorities that their veterinary staff will come under the line management of the national CVO for an animal health emergency response programme. Arrangements also need to be put in place to ensure that regional field and laboratory veterinary services are fully involved in emergency preparedness planning and training activities, and are in collaboration with national veterinary headquarters in providing early warning of emergencies (including emergency disease reporting to national headquarters).
- Similar arrangements for all essential government veterinary services, including the central veterinary laboratory, to come within the command structure of the CVO (if this is not already the case) for the purposes of the emergency response.
- Pre-existing contractual agreements for private sector veterinary organizations, universities, other academic institutions and research institutes to provide essential services during an animal health emergency.
- Negotiation with the national veterinary association over terms and conditions for hiring practitioners and other private sector veterinarians as temporary government veterinary officers if needed.

In many countries the private sector is extremely small, or non-existent, and it may be necessary to rely upon non-veterinary assistance for disease control. There should therefore be a mechanism to mobilize resources available in other related sectors, e.g. agricultural extension, with appropriate training. It is vital to identify all the potential role-players in the control of animal diseases and ensure that they are prepared to act immediately in the event of an epizootic.

---

**CONSULTATIVE  
COMMITTEE ON  
EMERGENCY  
ANIMAL  
DISEASES (CCEAD)**

Countries may find it very useful to establish a CCEAD that can be convened as soon as there is an RVF or other animal disease emergency, and can meet regularly during the course of the emergency response. This would be principally a technical committee whose role would be to review epidemiological and other disease control information; recommend the activation of agreed contingency plans; maintain oversight of the campaign; and advise the CVO and the appropriate minister on the future planning of the campaign and on implementation of the plans.

A suggested composition of the CCEAD might be:

- CVO (Chairperson)
- Director of Field Veterinary Services/Director of Disease Control
- Head of the Epidemiological Unit
- Directors of State, Provincial or Regional Veterinary Services
- Director of the National Veterinary Laboratory
- Director of any regional veterinary laboratories covering the outbreak areas
- Senior representatives of farmer groups or organizations
- Representatives of other key groups, e.g. National Veterinary Association and universities
- Other technical experts, as required (with observer status)

If the command structure recommended in the section on Responsibilities and command structures (see p. 48) cannot be implemented for one reason or another, it becomes more essential to establish a CCEAD so there can be a consensus approach to the conduct of the RVF campaign.

Consideration should be given to having a joint CCEAD with public health authorities. If this is not practicable, there should at least be a technical liaison officer from the Ministry of Health present at CCEAD meetings.

---

**NATIONAL ANIMAL  
DISEASE CONTROL  
CENTRE**

Countries should establish a permanent National Animal Disease Control Centre. In the event of an outbreak of RVF or another emergency animal disease, the centre would be responsible to the CVO for coordinating all emergency disease control measures in the country. The centre should preferably be situated within the National Veterinary Services headquarters and the National Epidemiology Unit should be either attached to the centre or work in close collaboration with it. The CVO may delegate day to day responsibilities for implementing agreed policy to the head of the centre, who would normally be a senior government veterinarian.

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

- implementing the disease control policies decided by the CVO and the CCEAD;
- directing and monitoring the operations of Local Animal Disease Control Centres (see below);
- planning, implementing and evaluating the results of RVF surveillance programmes;
- liaising with the meteorological office and with long-range weather forecasting groups to determine areas at risk of RVF outbreaks;
- maintaining up-to-date lists of available personnel and other resources, and details of where further resources may be obtained;
- deployment of staff and other resources to the local centres;
- 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;
- 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 programmes, including press releases, and creating a public relations centre to liaise with the media;
- general and financial administration, including the keeping of records.

The National Animal Disease Control Centre should be fully equipped with a range of maps covering all parts of the country (preferably at 1:50 000), and with suitable communication equipment for liaison with regional veterinary services or specially designated Local Animal Disease Control Centres, veterinary laboratories, etc. by telephone, radio, e-mail and fax as appropriate. The centre should also be linked with the Emergency Disease Information System.

---

**LOCAL ANIMAL  
DISEASE CONTROL  
CENTRES**

During the RVF emergency, district offices of the veterinary services closest to the outbreaks or, if there are none, district offices of the agricultural extension services, should act as Local

Animal Disease Control Centres. Ideally teams should be able to travel to and from any site necessary for surveillance or any other disease control activities in one day. Otherwise, possible locations for temporary local disease control centres (e.g. local government offices) should be identified and negotiated for in advance.

The regional and district veterinary officers should be in charge of disease control operations in their area, and have the right to inspect livestock whether they are on farms, in extensive grazing or nomadic situations. The officers should have the authority and the human resources to be able to collect samples for diagnosis and surveillance, and to take any measures deemed necessary to control the disease. These measures may include vaccination of susceptible livestock, restriction of animal movements and insect vector abatement programmes.

Local Animal Disease Control Centres should be provided with the materials for collection, storage over short periods (a refrigerator) and transmission of samples; vaccine cold storage and vaccination equipment; insecticide stores and spraying equipment; vehicles and fuel; and the means to contact the CVO as required. Provided the necessary political structures exist, they should be able to enlist the cooperation of other services, e.g. the police, agricultural extension officers and the media. 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 throughout the country and on likely risk areas.

## Chapter 8

## Support plans

Support plans provide the vital backing that will make the implementation of the RVF or other emergency disease contingency action plans possible.

---

**FINANCIAL PLAN**

Experience has shown that delay in obtaining finances is one of the major constraints to rapid response to emergency disease outbreaks. The immediate application of even modest funds will more than likely save major expenditure later. Forward financial planning is therefore an essential component of preparedness.

A financial plan needs to be developed that provides for the immediate provision of contingency funds to respond to disease emergencies. *These funds are required over and above normal operating costs for government veterinary services.* The plan should be approved by all interested government parties, including economic planning authorities and the Department of Finance.

Funds may cover the cost of the whole control/eradication campaign. More usually they will cover the initial phases of the campaign, pending a review of the outbreak, the control programme and the funds required to carry it through.

The conditions under which funds may be released should be specified in advance. Normally funds would be provided to the CVO when he or she advises that:

- epidemiological and meteorological evaluations indicate that there is a high risk of RVF occurring within the next few months or that an outbreak of RVF is actually suspected or has been diagnosed;
- effective control measures can be applied;
- there are approved plans in place to apply these measures.

The funds may be held as special funds, which are sequestered for the purpose, or there may be drawing rights provided up to a predetermined realistic amount against a specific government account.

In some countries it may be desirable for funds to be provided from both the government and private sector for emergency programmes



against serious livestock diseases such as RVF. This funding would be agreed upon after a review of the nature and proportion of public and private good benefits to be derived from the effective control or elimination of the disease. If appropriate, a funding formula may be agreed upon that covers payment of a fixed percentage of the cost of the total campaign by each sector, or whereby each sector pays for specific components in the campaign. If the private sector is to contribute, it should be determined who stands to benefit in the sector (and therefore should share the cost). This may include processing industries and traders as well as farmer organizations. It also needs to be predetermined how the private sector funds will be raised, for example, by livestock industry levies (e.g. on livestock transactions or slaughtering) that are held in quarantined funds or by industry-wide insurance. Voluntary individual insurance policies are satisfactory for insuring against consequential losses from a disease or disease control actions but are unsatisfactory for raising funds for the campaign itself.

In many cases the funding of the whole emergency disease eradication campaign may be beyond the resources of the country. If this is the case, forward planning should be carried out to identify potential international donor sources for the campaign. This could include emergency support from FAO or appropriate international agencies. Procedures for applying for funding and requirements for preparing and submitting an application should be predetermined.

---

**RESOURCE PLAN**

The first step in preparing a resource plan is to make a *resource inventory*. This is a listing of all the resources needed to respond to a moderate-sized RVF outbreak or other high-priority emergency disease. The plan includes personnel, equipment and other physical resources. The following resource list for different operations should be regarded as indicative rather than exhaustive.

**National Animal Disease Control Centre**

Senior disease control veterinarians and epidemiologists, financial and administrative officers and extra staff for recording and processing epidemiological and other information; national and regional maps (1:50 000 and 1:10 000); computers and software for animal health information systems, financial accounting, etc; and equipment for communicating with local headquarters (e.g. telephone, fax and e-mail, if available).

### **Local Animal Disease Control Centres**

Senior disease control veterinarians and epidemiologists, technical support and administrative officers; suitable offices and office equipment; maps; a telephone and fax, where possible; pro formas for various disease control operations (in some circumstances, more sophisticated equipment such as computers with the concomitant advantage of e-mail may be present and functional); cold storage for vaccines and diagnostic samples; and simple laboratory facilities for processing diagnostic samples.

### **Diagnostic laboratories**

Trained laboratory staff; standard laboratory equipment plus any specialized equipment for key emergency diseases; and diagnostic reagents for antigen and antibody detection.

### **Diagnosis/surveillance**

Veterinarians and support veterinary auxiliary staff; transport; maps; communication equipment; leaflets or posters on the disease(s); equipment for collecting and transporting diagnostic samples, including blood; and animal restraint equipment.

### **Vaccination**

Supervising veterinarian and personnel; vaccines; transport and cold storage during transport; syringes and needles; animal restraint equipment; and ear-tagging equipment or other means for identifying vaccinated animals.

The next step is to prepare a list of existing resources and their specifications, quantities and locations. A register should be maintained of specialist staff together with their qualifications and expertise/experience with RVF. These resource lists and staff registers should be maintained at the National Animal Disease Control Centre and, where appropriate, at Regional Offices.

Comparison of the inventory lists of needed and available resources will inevitably highlight many deficiencies. The resource plan should identify how these deficiencies will be rectified in an emergency.

There are several options for accessing the necessary extra resources:

- a list of where essential equipment and stores may be purchased, hired or borrowed – where items are hard to obtain or take time to prepare (e.g. pro formas); it may be desirable to maintain a central store;

- arrangements for the supply of personnel and equipment from other government agencies, e.g. transport and communication equipment from the armed forces;
- arrangements through veterinary associations for the temporary employment or secondment of veterinary practitioners in an emergency.

Supply of diagnostic reagents presents special problems as international sources of these are limited. An international reference laboratory for RVF should be consulted about sources of reliable diagnostic agents.

It should be noted that to maintain adequate diagnostic capacity, laboratories should routinely perform basic tests on specimens of known and unknown status to ensure competence, and should send test samples to reference laboratories from time to time to cross-check results even when they are negative.

The resource plan and associated inventory lists need to be regularly updated.

---

**LEGISLATION**

Acts of parliament or government regulations that provide the legislative framework and power to carry out all necessary disease control actions need to be put in place as part of preparedness planning. These regulations may include legislation to:

- make RVF and other proclaimed animal diseases compulsorily notifiable;
- allow the entry of officials (or other designated persons) on to a farm or other livestock enterprise for disease surveillance purposes (including the collection of diagnostic specimens) and to carry out any other approved disease control actions, such as vaccination or insect vector abatement;
- authorize the proclamation of infected and disease control zones;
- authorize any livestock movement controls;
- authorize any other necessary disease controls.

## Chapter 9

**Action plan**

The action plan is a set of instructions covering most aspects of the controls to be implemented during an RVF emergency, from the first indication that there is high risk of an outbreak of the disease to the finalization of the control programme and resumption of livestock exports (if appropriate).

Since veterinary structures differ from country to country, this chapter provides only a guideline of the actions to be carried out during the phases of an RVF outbreak. Each country should develop its own action plan in which the responsible person or persons are clearly identified. Lines of communication between livestock owners and field and national veterinary services must be identified and made known to all parties. These communication lines underpin the command structure to be activated in the event of suspected RVF. The success of implementation of the action plan depends on each link in the command chain functioning as specified in the plan.

---

**INVESTIGATION  
PHASE**

Countries that are deemed to be at high risk of RVF outbreaks (particularly those where the disease has previously occurred) should maintain a continual watch for epidemiological and climatic conditions that will give warning that an epizootic may be imminent, by:

- monitoring the susceptibility of ruminant animal populations by serological surveys and for evidence of any increased virus activity through sentinel herds and clinical surveillance in risk areas;
- ground observation of rainfall patterns and surface water;
- maintaining liaison with, and obtaining forecasts and advice from international institutions/groups that analyse RSSD for this purpose.

The risk of an RVF epizootic may be of such a high magnitude as to warrant moving straight into the operational phase (see below). However, whenever there is warning of the increased likelihood of RVF occurring, the following actions need to be taken:

- intensify active disease surveillance programmes in risk areas;
- initiate public education and awareness campaigns;
- advise relevant ministers;
- review the RVF contingency plan and support plans – in particular with regard to diagnostic capabilities and vaccine supply;
- enhance liaison and collaboration with animal health authorities in neighbouring countries that are also at risk.

---

#### **ALERT PHASE**

The alert phase commences when there is an actual field report of abortions and deaths in sheep, goats or cattle and/or illness in people suggestive of RVF. The immediate priorities are to secure a diagnosis and determine the extent of the infection. Actions to be taken include the following:

- the specialist diagnostic team (or emergency disease investigation team) should be sent to the suspect area(s) to make diagnostic and epidemiological evaluations, collect diagnostic specimens and take any necessary immediate disease control actions on site;
- confirmatory diagnostic tests should be carried out at the national laboratory or diagnostic specimens sent to an appropriate international laboratory;
- the actions recommended for the investigation stage (see above) should be elevated to an even higher level;
- activation of the agreed national RVF contingency plan should commence, and animal and human health authorities should collaborate closely;
- neighbouring and importing countries should be given advance warning of the possible presence of RVF.

---

#### **OPERATIONAL PHASE**

The operational phase may commence even before a definitive diagnosis of RVF is made. If it is forecast that there is a high risk of an imminent outbreak of the disease, serious consideration should be given to initiating vaccination and/or insect vector abatement programmes in high-risk areas.

When the disease is diagnosed, the operational phase should include the following actions:

- the CCEAD meets regularly to plan, implement and review the disease control campaign;
- appropriate international disease reporting is undertaken, e.g.

to OIE and FAO;

- any necessary vaccination and/or insect vector abatement programmes are initiated;
- livestock movement controls are put in place;
- steps are taken to ameliorate the spread and severity of the disease in people and animals in affected areas;
- public awareness campaigns are intensified;
- active disease surveillance is carried out to determine the extent of the spread of the disease and the course of the outbreaks;
- negotiations are undertaken with importing countries with a view to minimizing international trade losses and to agree on measures to be taken before any bans can be lifted.

---

**STAND-DOWN  
PHASE**

When an RVF epizootic abates, emphasis should be given to helping affected livestock farming communities to recover and to initiate rehabilitation programmes that will enable them to “get on their feet again”.

In the case of livestock-exporting countries, the emphasis should also be placed on undertaking detailed epidemiological studies to provide objective evidence that the RVF virus is no longer actively circulating in ruminant animal populations in either the whole country or in specific regions. This will provide the basis for lifting any international bans and for the resumption of vital exports.

Finally, the outbreak and control campaign should be reviewed in order to revise the RVF contingency plan where necessary.

Chapter 10

## Training, and testing and revision of contingency plans

---

### **SIMULATION EXERCISES**

Simulation exercises are extremely useful for testing and refining contingency plans in advance of any disease emergency. They are also a valuable way of building teams for emergency disease responses and training individual staff.

Realistic disease outbreak scenarios should be devised for the exercises, using real data where possible (e.g. for livestock locations and trading routes). A scenario may cover one or more time phases during the outbreak, with a range of possible outcomes. However, neither the scenario nor the exercise should be too complicated or too long. It is best to test just one system at a time (e.g. operation of a Local Animal Disease Control Centre). Simulation exercises may be undertaken purely as a paper exercise or as mock activities, or combining both approaches. At the completion of each simulation exercise there should be a “post-mortem” of the results. Such a review will identify areas where plans have to be modified as well as further training needs.

A full-scale disease outbreak simulation exercise should only be attempted after individual components of the disease control response have been tested and proved. Any earlier exercise of this nature may be counterproductive. Care must be taken that simulation exercises are not confused with actual outbreaks in the minds of the media and the public.

---

### **TRAINING**

All staff should be thoroughly trained in their roles, duties and responsibilities in an RVF emergency. More intense training will obviously need to be given to those in key positions. It should also be borne in mind that any staff member, from the CVO downwards, may be absent or may need to be relieved during a disease emergency for one reason or another. Backup staff should therefore be trained for each position.

**THE NEED FOR  
REGULAR  
UPDATING OF RVF  
CONTINGENCY  
PLANS**

Contingency plans, once prepared, should not be treated as static documents but be regarded as living documents that need to be regularly reviewed and updated as warranted by changing circumstances. In updating the plans, the following factors need to be taken into account:

- changing epidemiological situations, both within the country and externally;
- new scientific advances that allow earlier forecasting of climate patterns conducive to RVF outbreaks;
- improved RVF surveillance procedures;
- new vaccines;
- changes in livestock production systems and trade requirements (internal or export);
- changes in national legislation or in the structure or capabilities of government veterinary services (or other government parties);
- experiences (both within the country and in neighbouring countries), results from training or simulation exercises and feedback from major stakeholders, including farmers.



Appendix 1

## International Rift Valley fever reference experts and laboratories

---

**FOOD AND  
AGRICULTURE  
ORGANIZATION OF  
THE UNITED  
NATIONS (FAO)**

**FAO World Reference Laboratory for Rift Valley fever**

Centers for Disease Control (CDC)

Division of Vector-Borne Infectious Diseases

Rampart Road

Colorado State University

Foot Hills Research Campus

PO Box 2087

Colorado 80522

United States

Tel.: +1 970 2216400

Fax: +1 970 2216476

[www.cdc.gov/ncidod/ncid.htm](http://www.cdc.gov/ncidod/ncid.htm)

**FAO Reference Laboratory for Arthropod Transmitted Viral  
Diseases for Eastern and Southern Africa**

Onderstepoort Veterinary Institute (OVI/ARC)

Agriculture Research Council

Onderstepoort Complex

Private Bag X05

Onderstepoort 0110

South Africa

Tel.: +27 12 5299511

Fax: +27 12 5299543

**FAO collaborating centres**

Institut Pasteur de Dakar

Dr Mathiot, Directeur

Département de Virologie

BP 220 Dakar

Senegal

Tel.: +221 8399200  
Fax: +221 8399210  
E-mail: mathiot@pasteur.sn

Institut Pasteur de Paris  
Dr Bouloy, chef de laboratoire  
25 rue du Dr Roux  
75015 Paris  
France  
Tel.: +33 01 40613157  
E-mail: mbouloy@pasteur.fr

Institut Sénégalais de Recherche Agricole (ISRA/LNERV)  
Laboratoire national de l'élevage et de recherches vétérinaires  
BP 2057 De Hann  
Dakar  
Senegal  
Tel.: +221 8325146/8322762  
Fax: +221 8322118  
E-mail: thiongane@sentoo.sn  
[www.aupelf-uref-org/sngal\\_ct/rec/isra/isra.htm](http://www.aupelf-uref-org/sngal_ct/rec/isra/isra.htm)

---

**OIE REFERENCE  
LABORATORY  
FOR RVF** **Dr G.H. Gerdes**  
Onderstepoort Veterinary Institute  
Onderstepoort Complex  
Private Bag X05  
Onderstepoort 0110  
South Africa  
Tel.: +27 12 5299114  
Fax: +27 12 5299418  
E-mail: magda@moon.oivi.ac.za

Appendix 2

## **Rift Valley fever vaccine sources**

The currently used RVF Smithburn vaccine as well as an inactivated vaccine are produced by Onderstepoort Biological Products in South Africa at the address below.

Onderstepoort Biological Products,  
Private bag X07  
Onderstepoort 0110  
South Africa  
Telephone +27 (0)12 522 1500  
Fax: +27 12 522 1591  
Sales office e-mail: [sales@obpvaccines.co.za](mailto:sales@obpvaccines.co.za)  
Web site: <http://www.obpvaccines.co.za>