Rift Valley fever

Rift Valley fever in Madagascar: an updated map of the distribution of the disease in 2008

Introduction

Rift Valley fever (RVF) is an arthropod-borne zoonotic disease caused by a ribonucleic acid (RNA) virus of the *Phlebovirus* genus of the family Bunyaviridae. As well as being a severe threat to human health, RVF outbreaks cause high economic losses to farmers through the death and abortion of RVF-infected animals, and indirect impacts on food production, food safety, rural micro-economies, international trade and the welfare of the poorest people.

The presence of RVF in Madagascar was demonstrated during an entomological investigation in 1979, when the virus was isolated from mosquitoes collected in the moist-tropical primary forest of Perinet, Moramanga District (120 km east of the capital, Antananarivo). No signs of the disease were reported in animals or humans, but a serological survey confirmed that RVF virus (RVFV) was circulating at a very low level (less than 1 percent) in livestock. Then, in April 1990, during the rainy season, RVF was identified as being responsible for a significant wave of abortions in cattle in Fenoarivo Atsinana District, on the eastern coastal plain. Of 15 suspected human cases tested in hospitals, one died and five were confirmed. Seroprevalence among cattle owners in the village where livestock abortions were recorded reached 9 percent, with a large majority of the victims being young men. The following year, from February to April 1991, severe rates of abortion in cattle were reported in the central highlands, around Antananarivo, and six fatal human cases were confirmed.


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Oxen in rice field in the highlands of Madagascar

RVF outbreaks had a dramatic impact on countries in the Horn of Africa (Kenya and Somalia) and on the United Republic of Tanzania in late 2006 and the first half of 2007, and on the Sudan in September 2007. Southern African countries (Swaziland and South Africa) and islands in the Indian Ocean (the Comoros and Mayotte) were affected in 2007 or 2008. In Madagascar, RVF was officially reported to the World Organisation for Animal Health (OIE) on 9 April 2008, when samples sent to the OIE Reference Laboratory (Onderstepoort Veterinary Institute, South Africa) tested positive for the disease. The central part of Madagascar had experienced livestock mortality since December 2007, but these cases had been erroneously attributed to prevalent tick-borne diseases. During the first half of 2008, human cases were reported in the south and centre and on the eastern coast of the island. The *Institut Pasteur de Madagascar* (IPM) confirmed 67 human cases from 134 tested. From January to May 2008, 22 out of 119 animal cases were confirmed, and from November 2008 to May 2009,

IPM confirmed another 19 out of 47 human cases and 24 out of 88 animal cases, while the Ministry of Health reported 712 suspected human cases between January and May 2009.

Following an official request from the Government of Madagascar, an emergency mission of experts from FAO, the World Health Organization (WHO) and OIE was deployed and helped to develop a national action plan. With financial support from the United Nations Central Emergency Response Fund and the Office of United States Foreign Disaster Assistance, the national authorities have been implementing projects, with technical support from FAO, since June 2008. Preliminary results are reported in the following sections.

Evaluation of the extent of the outbreak

A country-wide, cross-sectional survey of livestock (cattle, sheep and goats) was conducted, using two stratification factors: ecoclimatic characteristics and bovine density. More than 4 000 cattle and small ruminants from 30 of Madagascar's 111 districts were sampled. The survey was conducted over a short period (August 2008) to assure the consistency of results.

Serological analyses were performed by the *Laboratoire National de Diagnostic Vétérinaire* (LNDV). Molecular analyses were conducted at IPM, which also trained LNDV technicians and conducted an inter-laboratory trial with LNDV.

Enzyme linked immunosorbent assay (ELISA) serological assays for the detection of immunoglobulin G (IgG) and immunoglobulin M (IgM) were performed. IgG can persist for months or even years after infection, so is used as a reliable indicator of past contact with the virus. In contrast, IgM has low persistence. IgG-positive/IgM-negative samples were therefore considered as past infection, while IgM-positive samples were considered as recent infection.

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Rice fields in the highlands of Madagascar

IgM was detected in nine cattle (0.3 percent) and 33 small ruminants (3.3 percent). Of the 33 IgM-positive small ruminant samples, 25 were IgG-negative. Most of these samples were collected in the southern and north-western districts (Figure 1).

Past infections (IgG-positive/IgM-negative) were detected in 887 cattle (25.8 percent) and 244 small ruminants (24.7 percent) and in all areas, confirming the wide circulation of RVF. In most areas, the prevalence in cattle was between 15 and 35 percent, with lowest values in the country's south (Figure 2); prevalence increased with age in districts of the south and northwest.

Sentinel surveillance and passive surveillance systems

Specific standard operating procedures (SOPs) for passive surveillance and guidelines for RVF surveillance and emergency response were developed, as well as a case definition to facilitate the reporting of suspected cases. Guidelines for sampling,

Figure 1: Prevalence of immunoglobuline M (recent infection) in cattle

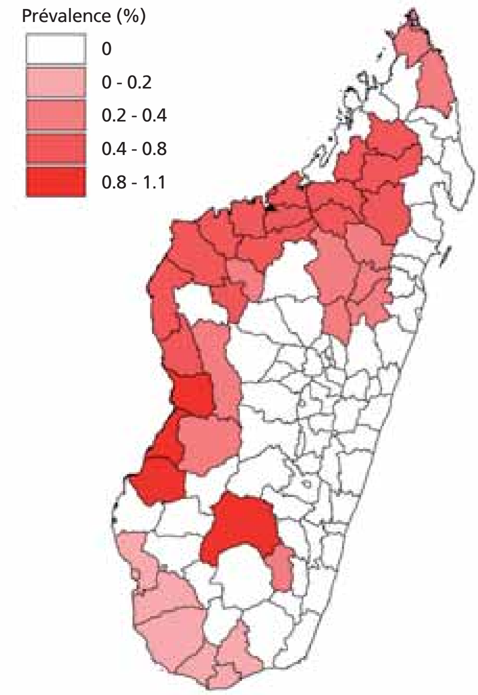
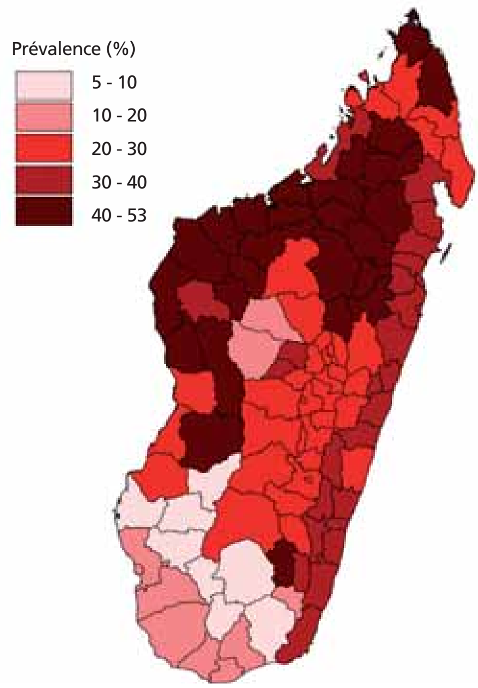


Figure 2: Prevalence of immunoglobuline G (past infection) in cattle



Protocols for the surveillance and control of RVF in Madagascar

types of samples to be collected, procedures for sending samples to the central facilities, and information material to be provided about collection were described in the surveillance protocol, and presented during training workshops.

Thirteen sites were selected for the establishment of sentinel herds. On each site, a veterinarian visited livestock owners every week and informed the central *Direction des Services Vétérinaires* (DSV) about cases of mortality, morbidity and abortion, via SMS. Written reports were produced monthly. After compilation and analysis, DSV sent a weekly consolidated situation report to the decentralized units. Then, DSV, LNDV and IPM disseminated all the biological and clinical surveillance data by e-mail to all RVF actors: the Ministry of Livestock, the Ministry of Health, IPM, LNDV, FAO and WHO.

The establishment of this surveillance system was a major improvement for the veterinary and public health authorities. In spring 2008, suspected and confirmed cases in animals were reported, mainly around Antananarivo, but FAO experts had detected RVF-infected animals in some remote areas during their initial investigations with veterinary services. This demonstrated the country's limited capacity to identify and report animal disease outbreaks during the 2007/2008 rainy season. In autumn 2008, a month after the first training of veterinarians organized by FAO and DSV, a veterinarian in the remote districts of Fianarantsoa I and Fianarantsoa II launched an alert when acute deaths among cattle were reported. Implementation of local control measures immediately after detection of the first cases prevented the disease from spreading outside the region. This first alert of the new wave of outbreaks was made possible by the surveillance network. An evaluation of the sentinel herds-based surveillance system was carried-out in October 2009.

Prevention of human contamination and control of the spread of the disease

A field mission was organized in eight districts, to assess the level of knowledge of RVF among the general population and at-risk workers, and to guide the development of appropriate communication materials. Documents were produced, copied and disseminated for this awareness campaign, and three short films and one radio message (in six dialects) were broadcast on radio and TV during the 2007/2008 rainy season (Figure 3). In October 2008 the Ministry of Education included RVF as part of the school curriculum. FAO developed a chapter on RVF in a manual on natural disasters.

An intensive campaign was developed for professionals working in slaughterhouses. Training, the distribution of personal protective equipment (PPE), including boots, gloves, aprons and masks, and information campaigns were organized in 2008 and 2009. A tamper-free stamp was also supplied, for use in the meat certification process.

Figure 3: Communication material for the training and awareness campaign in the at-risk populations

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Early morning scene at a slaughterhouse in the capital; close contact with infected blood is of major risk for humans

Identification of vectors

RVFV is transmitted by numerous species of arthropods, with mosquitoes belonging to the genera *Aedes, Anopheles, Culex, Eretmapodites* and *Mansonia* playing a major role. However, the species involved in transmitting RVF in Madagascar are not known. FAO supported entomological investigations by IPM in areas where RVF cases have been confirmed. More than 7 000 mosquitoes were collected in the districts of Fianarantsoa I and II. Of these, more than 4 000 were unfed mosquitoes belonging to 12 different species. Viral genetic material was detected in three mosquito species belonging to the genera *Anopheles* and *Culex,* making them good vector candidates for RVF in Madagascar.

Points for discussion

The results of the cross-sectional, country-wide sero-survey in livestock suggest that RVFV has circulated in the recent past in all regions of Madagascar. These results complement those of a post-outbreak serological survey conducted in humans over recent months (Andriamandimby *et al.*, 2010). In this study, no evidence of RVF in humans was found in southern districts, while results confirmed that RVFV had circulated in some livestock, and traces of recent infection were also found. Based on this large-scale survey, the whole of Madagascar should be considered affected by RVF.

The increase of IgG prevalence with age in southern and northwestern areas suggests that virus transmission occurs annually. This hypothesis is also supported by the results of a sero-survey performed in 1996, when the detection of some IgM-positive animals originating from southern areas indicated that the virus was circulating during an inter-epizootic period (Zeller, 1998). RVF sentinel surveillance in livestock will contribute to exploring the hypothesis of RVF-endemic areas in Madagascar.

Animal transportation for trade probably played a major role in the extent of the disease in Madagascar. Livestock from the southern breeding areas embarked on boats in the port of Tulear, from where they travelled to different destinations in Madagascar, including significant numbers of animals reaching the slaughterhouses around Antananarivo. RVFV could be transferred from these possibly endemic areas to other parts of the country in a very short period, with viremic animals.

Sentinel herd surveillance was successfully implemented, and the first evaluation of the system was positive. One of the keys to this success has been the contracting of local, private veterinarians to undertake field surveillance. Their weekly visits to the communities bring veterinarians closer to livestock owners, while increasing their incomes. However, RVF outbreaks usually occur after (very) long inter-epidemic periods (the previous outbreak in Madagascar occurred in 1991), and the mobilization of actors can only be sustained if the sentinel surveillance system is expanded to integrate surveillance for other diseases. For example, several zoonotic diseases provoke abortions in livestock (e.g., brucellosis, Q fever, RVF and Wesselsbron virus), so a surveil-

lance network for abortive diseases in ruminants would probably ensure the continued involvement of veterinarians and the authorities, at limited cost.

It is important to undertake long-term surveillance and training projects. Without continuous awareness among the actors, Madagascar may not be ready if another outbreak occurs in a few years time. One constraint is the rapid turnover of staff at the decision-making level. To deal with this constraint, which is also seen in many other countries, FAO has produced guidelines for the implementation of RVF surveillance and control; these are currently being reviewed for publication.

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