EMPRES WATCH
emergency prevention systems

Rift Valley fever outbreaks in Madagascar and potential risks to neighbouring countries

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1. INTRODUCTION

Rift Valley fever (RVF) is an arthropod-borne disease of ruminants, camels and humans caused by the Phlebovirus. It is a significant zoonosis which may present itself as an uncomplicated influenza-like illness, or worse as a haemorrhagic disease with severe liver involvement and ocular or neurological lesions. In animals, RVF may be unapparent in non-pregnant adults, but outbreaks are characterized by the onset of a large number of abortions and high neonatal mortality. Human infections have also resulted from the bites of infected mosquitoes, most commonly the Aedes mosquito. Mosquitoes from six genera (Aedes, Culex, Mansonia, Anopheles, Coquillettidia and Eretmapodites), including more than 30 species, have been recorded as infected, and some of them have been shown to have a role as vectors. Most of these species acquire the infection by biting infected vertebrate animals, but some (specifically Aedes spp.) pass the virus transovarially (i.e. from the female to its offspring by infection of eggs in the ovary), These infected pools of eggs can survive through desiccation for months or years and restart transmission after flooding; other species (Culex spp.) may then become involved as secondary vectors. Transovarial, or 'vertical', transmission explains how the virus can persist for many years or decades between outbreaks.

Transmission to humans can also occur through close contact with infected material (slaughtering, butchering, assisting with animal births, conducting veterinary procedures, etc.) or by ingesting the unpasteurized or uncooked milk of infected animals. To date, no human-to-human transmission of RVF has been documented.

RVF virus has been recorded from South Africa to Saudi Arabia, including Madagascar. It occurs in varied bioclimatic ecotypes, ranging from wet and tropical countries such as The Gambia, irrigated regions such as the Senegal River Valley or the Nile Delta, to hot and arid areas such as Yemen or Chad. The occurrence of RVF can be endemic or epidemic, depending on the climate and vegetation of different geographic regions. In the high rainfall forest zones in coastal and central African areas, it is reported in endemic cycles which are poorly understood. Currently available evidence suggests that this may happen annually after heavy rainfall, but at least every 2-3 years otherwise. In contrast, in the epidemic areas in East Africa, RVF epidemics appear in 5 to 15 year cycles. These areas are generally relatively high rainfall plateau grasslands, which may be natural or cleared from forests. In the much drier bushed savannah grasslands and semi-arid zones, which are characteristic for the Horn of Africa, epidemic RVF has manifested itself only a few times in the past 40 years, in 1961-62, 198283, 1989, 1997-98 and 2007-08. RVF may also spread outside traditionally endemic areas, or even out of the continent of Africa, mostly due to the large range of vectors capable of transmitting the virus. Such a situation occurred following the unusual floods of 1997-98 in the Horn of Africa countries, with subsequent disease spread to the Arabian Peninsula in 2000.

CONTENTS

2. DISEASE ECOLOGY AND CLIMATIC DRIVERS IN EAST AFRICA

The ecology of RVF has been intensively studied in East Africa. Historical information shows that pronounced periods of RVF virus activity in Africa have occurred during periods of heavy, widespread and persistent rainfall frequently associated with the El Niño phenomenon.

Widespread rainfall in the region is caused by changes in the Intertropical Convergence Zone (the zone of confluence of air currents from north and south in the African continent, as a consequence of El Niño events triggered by large-scale changes in sea surface temperature in the Pacific and Indian Oceans).

3. OUTBREAK OF RVF IN MADAGASCAR

3.1 Historical information

RVF in Madagascar was reported for the first time in 1979, when it had little impact on animal or human populations. However, in 1990-91, several outbreaks marked by heavy abortion rates in cattle were described on the east coast and the central highlands near Antananarivo (Morvan et al., 1991). Between February and April 1991, unusual numbers of bovine abortions around Antananarivo were reported by the official veterinary services.

The strains responsible for these outbreaks were closely associated to African RVF virus strains but different from the RVF strains previously isolated in Madagascar. The virus that caused the 1990 outbreak may therefore have been introduced through, for example, the import of live infected animals (Morvan et al., 1992).

In 2006, Madagascar sent official notification to the World Organisation for Animal Health (OIE) confirming the presence of RVF infection, but without clinical signs.

3.2 Outbreaks in animals

The Ministry of Agriculture reported RVF in animals to the OIE on 9 April 2008. The cases had been confirmed by the FAO/OIE Reference Laboratory at Onderstepoort in South Africa in February 2008 following the start of the outbreak on 4 February 2008 in Avaradrano, Antananarivo, when two out of nine heads of cattle were affected. The OIE report is available at http://www.oie.int/wahid-prod/public.php?page=single_report&pop=1&reportid=6952.

FIGURE 1. Location of the RVF infected area/outbreak and bovine density

Credit: FAO/Lorenzo De Simone

The location of the current outbreak of RVF is within the province of Antananarivo-Avaradrano. This and surrounding provinces are characterized by low ruminant density with the exception of Ambatolampy which has approximately 125 head/km2. (Figure 1)

3.3 Human cases

As of 17 April 2008, the Madagascar Ministry of Health had reported a total of 418 suspected human cases, including 17 deaths (case fatality rate: 4%), of RVF in the regions of Alaotra Mangoro, Analamanga, Itasy, Vakinakaratra and Anosy. Infection with RVF virus was laboratory confirmed in 59 human cases (WHO).

In Mayotte, disease surveillance has been intensified since February 2007 because of the risk of RVF from East African countries. The Pasteur Institute in Paris has confirmed positive cases of RVF in samples obtained from cattle (zébus mahorais). Since March 2007, additional surveillance has been initiated in animals and humans potentially exposed to RVF. Results of the enhanced surveillance activities are awaited.4. Risk Assessment for Rift Valley fever outbreaks

4. RISK ASSESSMENT FOR RIFT VALLEY FEVER OUTBREAKS

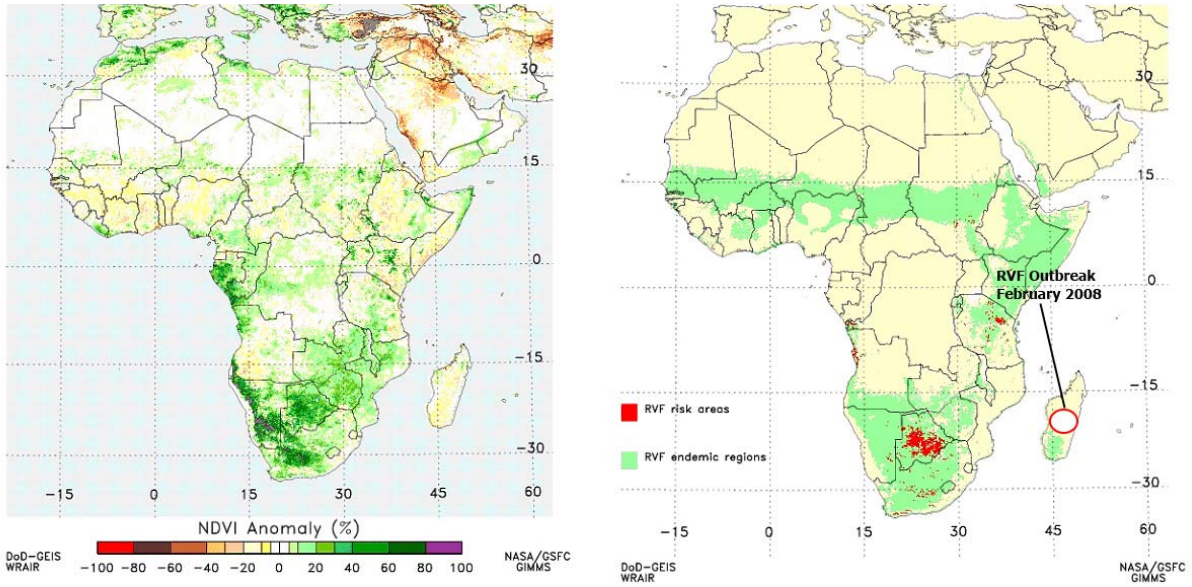
4.1 Monitoring of climatic indicators

Vegetation growth responds to increased rainfall, and variations in vegetation can be easily measured by satellite. In East Africa, vegetation index maps have been used together with ground data to monitor vector populations and RVF viral activity, and a correlation between these two parameters has been established. Vegetation measurements can be used in a more proactive way to forecast RVF before cases reach epidemic proportions. Data sets used in these predictions include satellite outputs, mainly from Advanced Very High Resolution Radiometer sensors (AVHRR) on board polar-orbiting satellites operated by the National Oceanographic and Atmospheric Administration (NOAA) of the United States of America, which are used to generate various indices that are then correlated with rainfall (such as vegetation index [NDVI] or Cold Cloud Duration [CCD]). Predictive models have been greatly improved by the addition of Pacific and Indian Ocean sea surface temperature anomaly measurements, together with rainfall and NDVI data.

At FAO headquarters, near real-time climatic data, such as rainfall estimates and NDVI indices obtained from Artemis[1] , are collected and processed to produce risk maps by calculating vegetation index and rainfall anomalies, comparing current conditions with long-term mean conditions. Resulting maps show areas

1. In order to assist these programmes, FAO established the Africa Real Time Environmental Monitoring System (ARTEMIS) in 1988. The objective of ARTEMIS is to provide a routine flow of satellite imagery in near real-time indicating the status of the growing season and vegetation development over Africa.

FIGURE 2. NDVI anomalies (a) and Rift Valley Fever Risk map (b) for February 2008



NDVI anomalies during February 2008, showing elevated vegetation conditions in East Africa (+60 - +80 %) and south western Africa associated with above normal rainfall. Areas shown in red indicate areas at risk for RVF activity; those shown in green are within an RVF endemic region or in areas where RVF virus has been identified; and those shown in yellow have negligible risk.
Source: A.Anyamba, NASA Goddard Space Flight Center

experiencing above normal rainfall. A major partner institution is the NASA Goddard Space Flight Center (United States of America) which produces RVF monthly risk maps based on the persistence of NDVI anomalies (extremes in vegetation growth).

Positive NDVI anomalies were recorded over most of the African continent in February 2008, with the largest departures from normal readings concentrated over Southwest and East Africa (Figure 2).

4.2 Situation in Madagascar

The area in Madagascar in which the current cases are located had not been predicted by NASA on the basis of correlation between disease risk and precipitation/NDVI anomalies (Justice et al, 1986, Linthicum, 1983). In fact, this area falls outside the endemic RVF area predicted by the model (Figure 2). However, this is the same area in which cases were identified in the 1990-91 outbreak in Madagascar. It is therefore critical to identify the factors related to the emergence of RVF in Madagascar. It may be that the ecology of RVF in this area differs from that identified on the mainland of Africa; it may be necessary to enhance or adjust the way in which the models monitor indicators of RVF activity in this area. On the other hand, the location of reported cases in the central highlands may be related to disease detection rather than disease incidence.

4.3 Forecast

The regional weather forecast for the next three-month period (June-August 2008) provided by the International Research Institute for Climate and Society (IRI), indicates that above-average rainfall is not expected for Madagascar and the southern part of Africa. However, it is predicted that the central part of Africa will see heavier precipitation than normal for this period.

Considering that RVF outbreaks were reported in Kenya, Tanzania and Sudan in 2007, and that South Africa is currently experiencing an outbreak of RVF, disease surveillance should be heightened and preparedness plans put in place throughout the eastern part of the African continent. RVF surveillance efforts should be pursued in non-affected areas because the disease can still spread.

5. RECOMMENDATIONS

The situation of RVF in Madagascar is very serious because the two-month delay in disease reporting may have facilitated the spread of the disease and the consequent confirmation of human cases and deaths. This could indicate that the infection is well-established in animals in this new epidemic. Areas where ecological factors are appropriate for disease emergence, or where movement of animals from infected areas are suspected, should be intensively monitored.

Preventive measures should include:

a. Public awareness campaigns that inform animal owners of potential risk factors for RVF, including the risks of moving animals into affected areas or introducing animals from affected areas into unaffected areas.
b. Increased disease surveillance.
c. Animal movement control to prevent infected animals moving to a new and potentially unaffected area.
d. Strategic animal vaccination, if it is decided to use vaccination. The use of attenuated vaccines in out-

break situations is not recommended).

e. Use of mosquito repellents and mosquito nets over beds or cots.

Countries located in the southern part of East Africa and islands close to Madagascar, such as Mayotte or Comoros, should increase disease surveillance activities according to OIE standards, particularly in areas of these territories with previous occurrence of RVF. If there are no reports of clinical signs compatible with RVF, disease surveillance should focus on vectors (mosquitoes) and serology of susceptible ruminants only.

There is little official information about cattle trade to and from Madagascar. In recent years, the country's only official exports have been some shipments to the nearby Comoros islands, while the only official imports have come from Mauritius and New Zealand (UN Comtrade, 2008). Importing meat or animals from Madagascar represents a risk practice. However, countries should not apply trade restrictions to livestock imports from zones of Madagascar if disease surveillance is in place with negative results. Madagascar is a RVF-infected country/zone, meaning that clinical disease in humans and animals has occurred within the past six months according to OIE standards. Even in the presence of disease or infection, the OIE Terrestrial Animal Health Code allows trade of ruminants and meat from infected countries if certain specific conditions of quarantine or vaccination are met. This is based on the principle of timely and prompt notification of infection or disease to the OIE.

6. FAO IN ACTION

At international level, FAO's EMPRES (Emergency Prevention System for Transboundary Animal Diseases) programme provides an overall initiative for coordination of the RVF-Early Warning System, where data integration and analysis are performed before being disseminated to recipient countries, international organizations and key stakeholders in the form of RVF bulletins and risk assessments.

EMPRES promotes the use of remote sensing for forecasting RVF and other arbovirus occurrence and field validation studies in a country/region: its use may allow for preventive measures to be instituted promptly, such as awareness and public service announcements over radio and television, early vaccination of susceptible livestock and rapid implementation of mosquito larval control methods.

Regarding the specific situation of RVF in Madagascar, FAO/OIE CMC-Animal Health, in collaboration with EMPRES and WHO, has sent a mission to Antananarivo in response to a request from the national authorities. This mission will evaluate the situation of RVF in the field and will support the efforts of the Ministry of Agriculture and the Ministry of Health to control RVF outbreaks in Madagascar.

FAO EMPRES encourages and offers technical assistance to countries in Southern and Eastern Africa to activate disease prevention, surveillance and early warning, and to update RVF contingency plans.

7. RVF RESOURCES

Background and additional information on RVF in livestock can be found at the following links:

-FAO EMPRES Watch: Possible RVF activity in the Horn of Africa
http://www.fao.org/docs/eims/upload//217874/EW_hornafrica_nov06_rvf.pdf

-FAO Rift Valley Fever
http://www.fao.org/ag/againfo/programmes/en/empres/disease_rvf.asp

-FAO Preparation of Rift Valley Fever Contingency Plans
http://www.fao.org//DOCREP/005/Y4140E/Y4140E00.HTM

-WHO Rift Valley Fever Fact Sheet
http://www.who.int/mediacentre/factsheets/fs207/en/index.html

-OIE Rift Valley Fever Disease Card
http://www.oie.int/eng/maladies/fiches/a_A080.htm

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