

Widespread Rift Valley Fever Emergence in Senegal in 2013–2014

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Rift Valley fever (RVF), which caused epizootics and epidemics among human and livestock populations, occurred in Senegal in 2013–2014. A multidisciplinary field investigation was carried out in 3 regions of Senegal. We found 11 confirmed human cases of Rift Valley fever, including severe cases with encephalitis and retinitis, 1 pool of mosquito (*Aedes ochraceus*), and 52 animals tested positive for the disease. Symptoms such as encephalitis and macular retinitis were the most severe cases reported so far in Senegal. The outbreak was widespread due to animals' movements, leading to the largest RVF outbreak in Senegal in terms of geographic spreading and reaching areas that never reported RVF activity previously.

Keywords. animal movements; field investigations; outbreak; Rift Valley fever; Senegal.

Rift Valley fever (RVF) is an acute viral anthroponosis causing epizootics and epidemics that can be associated with a huge economic loss and a high toll of morbidity and mortality among human and livestock populations in Africa, Saudi Arabia, and Yemen [1, 2]. Rift Valley fever virus (RVFV) causes death and abortion of pregnant females among livestock, whereas human infection leads to mostly mild febrile illness, although 1%–2% of cases may progress to more severe syndromes including hepatitis, encephalitis, retinitis, and/or a hemorrhagic syndrome [3]. In Senegal, RVFV has been repeatedly reported among humans, livestock, and mosquitoes [4–9], especially in 2 areas: the Sahelian and the Sudano-Guinean zones [10]. Between September and October 2013, multiple RVFV epizootics foci were

identified by the National Veterinary Services as part of an RVF surveillance system, which was based on sentinel herds along the Senegal River and tested by serology and genome detection whenever abortions and deaths occurs among livestock [7]. During that time period, 5 RVF cases were confirmed among humans and identified countrywide, including in the city's capital [11], suggesting an epidemic/epizootic spatial spread that was unprecedented. In this study, we report multidisciplinary field investigations and laboratory findings in 3 regions of Senegal: Mbour, Linguere, and Kedougou.

METHODS

The National Veterinary Service has an ongoing surveillance for RVF outbreaks. When abortion and death in livestock occurred, biological samples were sent to National Veterinary Research Laboratory for virological tests (serologic, reverse-transcription polymerase chain reaction [RT-PCR]) [7]. During the investigation, a suspect case was defined as “any patient living in Mbour department or Kedougou region between 1 September 2013 and 28 February 2014 with fever, influenza-like syndrome associated with jaundice, retinitis, bleeding or neurological symptoms”. A confirmed case was “any suspect case whose sample was positive for anti-RVF IgM and/or RVF molecular assay”. Contact was defined as “any family members and neighbors of RVF confirmed cases showing risk of exposure to RVFV”. For animal investigation, ruminants living in contact with confirmed and/or suspect cases were sampled. Arthropods were collected using CDC light and animal-baited traps and aspirators, sorted by species and sex in the field and stored in liquid nitrogen until tested for the RVFV isolation or genome detection as previously described [12]. Human and animal sera were tested for immunoglobulin (Ig)M and IgG antibodies [13] and acute sera by RT-PCR for RVFV. Partial sequencing from the segments S, M, and L of RVFV genome isolated from human and mosquitoes were also performed. Data were analyzed using R software. Due to small numbers of samples, corrected χ^2 test and Kruskal-Wallis test were respectively used for qualitative and quantitative variables to investigate differences in measures between subgroups. Significance was assigned at $P < .05$.

The protocol of this outbreak field investigation was examined and approved by the Senegalese National Health Research Committee.

RESULTS

From September to October 2013, the National Veterinary Research Laboratory detected 52 wild and domestic animals that tested positive for RVFV by RT-PCR in the northern Saint Louis region (8 wild *Dorcas Gazellas* in Gueumbeul natural

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Table 1. Rift Valley Fever Seroprevalences in Investigated Localities in Mour and Kedougou Departments

Localities	Human Sampled	RVF IgM		RVF IgG		Animal Sampled	RVF IgG	
		n (%)	P Value	n (%)	P Value		n (%)	P Value
Linguere	1	1		—		—		
Mbour	196	8 (4.1%)	.0112	17 (8.7%)	.0008	40 ^a	30 (75%)	2.569e-07
Kedougou	338	2 (0.6%)		7 (2.1%)		97 ^b	25 (25.8%)	
Total	535	11 (2.1%)		24 (4.5%)		137	55 (40.1%)	

Abbreviations: Ig, immunoglobulin; RVF, Rift Valley fever.

^a 39 goats, 1 sheep.

^b 10 goats, 73 sheep and 14 cattle.

park and 37 goats in Diama villages) and in the capital Dakar region (7 goats) [11] (Tables 1 and 2, Figure 1). On November 2013, 1 mild human infection in Linguere and 2 severe infections in Mbour were identified and led to an investigation of 196 individuals in Mbour (116 in Ngagane village, 80 in Joal). A parallel surveillance of acute febrile illness in Kedougou allowed detection of 2 confirmed cases, leading to the investigation of 338 individuals in the Kedougou region. During that investigation, 6 more IgM-positive cases were identified in the Mbour region. Tables 1 and 2 show that 2.05% (11 of 535) of investigated individuals tested positive for RVFV (IgM), whereas 4.49% (24 of 534) had evidence of past infection (IgG). Human samples tested negative for RVF RT-PCR. The median age of RVF-confirmed patients was 23 years (13 to 32 years), and the sex ratio (M/F) was 1.75. Among the 11 confirmed cases, 45.5% (5 of 11) were symptomatic with high fever 100% (5 of 5), jaundice 60% (3 of 5), encephalitis 40% (2 of 5), and macular retinitis with optic disc edema 20% (1 of 5). Thus far, these cases were the most severe reported in Senegal, although no hemorrhagic symptoms or deaths were reported, and all patients recovered after hospitalization and intensive care or symptomatic treatment.

Tables 1 and 2 show that the Mbour area, with an IgM seroprevalence of 4.1% (8 of 116), was significantly more affected than the Kedougou area, with an IgM seroprevalence of 0.6%

(2 of 338) ($P < .05$). Although it would be difficult to associate the IgG antibodies to this recent RVF outbreak, we found that 82.3% of people showing RVF IgG antibodies were significantly exposed to recent aborted animals, compared with 17.7% who were not in contact, in the Mbour area ($P < .001$).

In our investigations regarding animals, we found that 137 animals (49 goats, 74 sheep, and 14 bovines) tested negative for RVF IgM, including 40 in Mbour and 97 in Kedougou; however, the RVF IgG antibodies were 75% (30 of 40) and 25.8% (25 of 97), respectively ($P < .0001$).

Furthermore, 645 arthropods RVF potential vectors belonging to 4 species (*Aedes aegypti*, *Culex nebulosus*, *Anopheles gambiae*, and *Culex quinquefasciatus*) were collected in Mbour; however, due to the dry season, entomologic investigation was not carried out in Kedougou. No RVFV strains were isolated from mosquitoes in Mbour, but 1 pool (*Aedes ochraceus*) of mosquitoes of 437 collected in the Linguere district tested positive by PCR and virus isolation in November 2013. In addition, phylogenetic analyses showed that the strains from human and mosquito in Linguere, which clustered together, were more closely related to the ArD 38661 strain (Figure 2, Segment S) previously described in Senegal in 1984 [10]. This finding suggests the circulation of the same strain in both human and mosquito populations in 2013 through either a reemergence of this latter strain or a new introduction of RVFV. These strains

Table 2. Rift Valley Fever Reported Epizootics in Senegal in 2013

Region	Localities	Susceptible Population	RVF RT-PCR + n (%)	Apparent Mortality Rate	Apparent Fatality Rate
Saint Louis	Gueumbeul Natural Park	Dorcas Gazellas N = 33	8 (24.2%)	3 (9.1%)	37.5%
	Diama Peulh, Diama	Goats N = 168	31 (18.5%)	6 (3.6%)	19.4%
	Guinthe Ndiaye, Ngnith	Goats N = 40	6 (15%)	2 (5%)	33.3%
	Subtotal	N = 301	45 (14.9%)	11 (3.7%)	24.4%
Dakar	Sangalkam	Cattles N = 190	7 (3.7%)	0	0.0%
Total		N = 492	52 (10.6%)	11 (2.2%)	21.20%

Abbreviations: RT-PCR, reverse-transcription; polymerase chain reaction; RVF, Rift Valley fever.

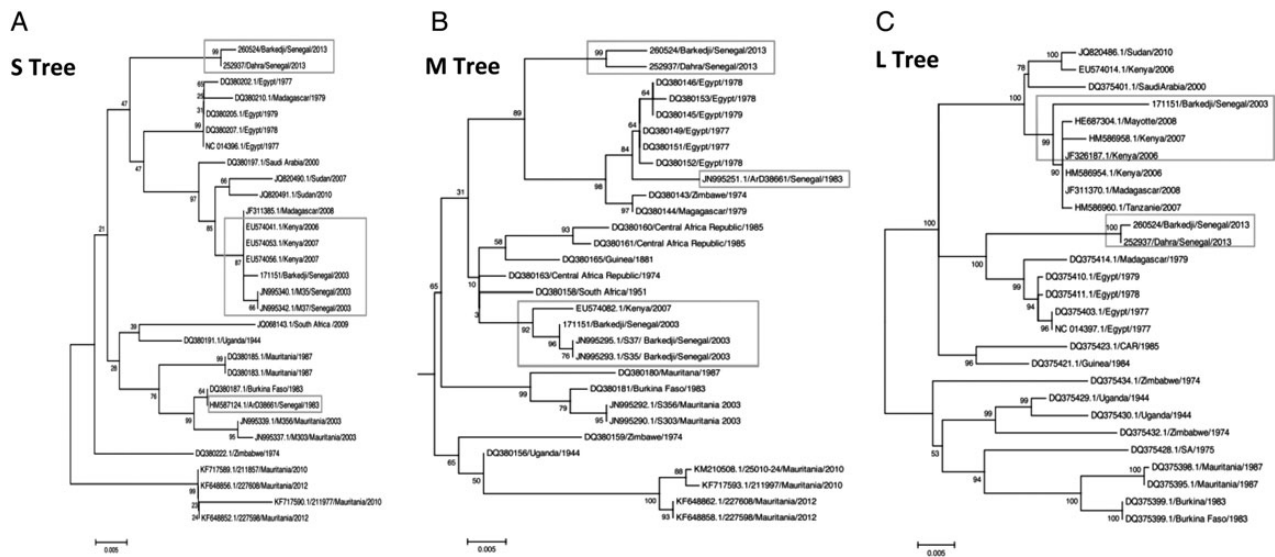


Figure 1. Phylogenetic trees of NSs (A), G2 (B), and partial L (position 301–3728 base pairs) (C) genes of the small, medium, and large ribonucleic acid segments of Rift Valley fever (RVF) viruses. 260524/Barkedji/Senegal/2013, 252937/Dahra/Senegal/2013, and 171151/Barkedji/Senegal/2003 indicate strains sequenced in this study. Bootstrap values are indicated along branches. Scale bar indicates nucleotide substitutions per site.

were also different from the RVF strain found in Linguere in 2003 [6] and were closely related to the Eastern African strains (Figure 2).

DISCUSSION

This study confirmed that RVF outbreak occurred in Senegal in 2013–2014 with 11 human confirmed cases, including the most severe cases of encephalitis and retinitis. The relatively few number of confirmed human cases is certainly due to the delay in field investigation, which was approximately 3 months after the beginning of the outbreak. Moreover, this finding corresponded with the decreasing period of IgM and the pic of IgG

antibodies and could lead to an underestimation of the incidence of this outbreak, especially in the Mbour area. This should lead to increased awareness, reinforcement of sentinel animals [9], and human RVF surveillance to avoid a large-scale RVF outbreak, which could have disastrous human and financial impacts in the future.

CONCLUSIONS

One of the most striking features of this epidemic/epizootic is its unusual wide geographic spread throughout Senegal, including cities and the capital. This situation could be explained by the fact that the outbreak is coincidental with the month

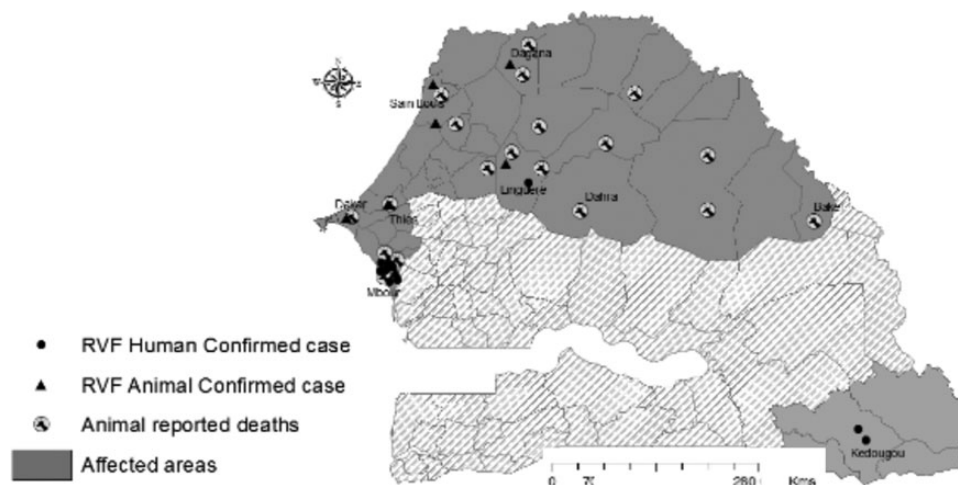


Figure 2. Geographical distribution of animal and human Rift Valley fever (RVF) cases in Senegal in 2013–2014.

preceding the celebration of the Eid el Kebir, a major Muslim event in Senegal during which sheep are slaughtered by each family. During this period, animal movements are extremely frequent due to importation of animals from neighboring countries; however, most of the animals were from Mauritania. The RVFV was often traced to Senegal, and emergence of animal markets throughout Senegal and in big cities such as Dakar and Mbour covered the deficits. As a result, the Mbour and Kedougou areas were progressively affected in November and February, respectively, when animals returned from affected areas, as previously described in a report from the Kedougou region in 2012 [8]. The circulation of RVFV in Dakar, which has the highest human density, and Mbour, a major tourist resort area visited yearly by Europeans, raises the question of a potential risk of exportation of the disease. Therefore, a thorough RVF risk assessment in urbanized areas should be performed to evaluate the potential risk of reemergence, particularly in areas where livestock breeding in households are common. In addition, an early warning system associated with surveillance and rapid response to outbreak mechanisms should be implemented to prevent and control any nascent transmission that may spread quickly.

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