

Outbreak of Rift Valley Fever, River Nile State, Sudan– 2019: A Teaching Case-Study

Student's Guide

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Abstract

Rift Valley Fever (RVF) is a viral zoonosis disease transmitted through a mosquito vector that primarily infects animals but also has the capacity to infect humans. Most human infections are caused by direct or indirect contact with the blood or organs of infected animals. Sudan, like many African countries, is considered endemic for RVF. In 2019, an outbreak took place at the River Nile State of Sudan and continued for six months resulting in the spread of RVF into other states.

The goal of this case study is to strengthen the capacity of trainees in outbreak investigation of a zoonotic disease using an integrated approach. This case study examines the factors that triggered the RVF outbreak and consequently resulted in its spread. It allows participants to discuss risk factors and the importance of integrating response efforts including surveillance and outbreak investigation and control. The case study is designed for training novice field epidemiology trainees. The case study can be administered in 3-4 hours.

Keywords: Rift Valley Fever, Outbreak, Zoonotic diseases, One health, Sudan

How to Use the Case Study

General instructions: This case study should be used as adjunct training material for novice epidemiology trainees to reinforce the concepts taught in prior lectures. The case study is ideally taught by a facilitator in groups of about 20 participants. Participants are to take turns reading the case study, usually a paragraph per student. The facilitator guides the discussion on possible responses to questions. The facilitator may make use of flip charts to illustrate certain points. Additional instructor's notes for facilitation are coupled with each question in the instructor's guide to aid facilitation.

Audience: This case study was developed for novice field epidemiology students. These participants are commonly health care workers working in the country departments of health whose background may be as medical doctors, nurses, environmental health officers or laboratory scientists who work in public health-related fields. Most have a health science or biology background.

Prerequisites: Before using this case study, participants should have received lectures on disease surveillance and outbreak investigation.

Materials needed: Flash drive, flip charts, markers, computers with MS Excel

Level of training and associated public health activity: Novice – Outbreak Investigation

Time required: 3-4 hours

Language: English

Goal of Case Study

The goal of this case study is to strengthen the capacity of trainees in outbreak investigation of a zoonotic disease using an integrated approach.

Learning Objectives

At the conclusion of the teaching session, participants will be able to:

- Describe criteria that warrant a field investigation
- Explain the key tasks needed to investigate an outbreak
- Describe the etiology and risk factors of Rift Valley fever
- Exemplify methods for integrating responses to a zoonotic disease outbreak
- Analyze, evaluate, and interpret surveillance data collected during an outbreak
- List prevention and control measures
- Identify ethical issues related to disease outbreaks that affect the livelihoods of the population

Introduction

The River Nile state is one of the 18 states of Sudan, it lies towards the north-east of the country and is bordered by Egypt from the north, the Red Sea and Kassala states from the east, the Northern State from the west and Khartoum state to the south. It has an area of 122,123 km² (47,152 mi²) and an estimated population of 1,433,700 in 2019.

The state has 7 localities and is known for its agriculture, pyramids, gold, railway, and cement and iron factories. About 68 % of the population live in rural areas, while 29.9% live in urban areas and around 2.5% are nomads (Central Sector Commission, 2010).



Figure 1. Map of Sudan showing the River Nile State, source: <https://en.wikipedia.org/>

Sudan is generally well known for its livestock sector which is one of the largest in Africa and plays a major role in the economy (Figure 1). Sudan is a vast country and the livestock markets are widely distributed in different states (Wilson, 2018). Cattle, sheep, goats, and camels provide milk and meat for locals, while live animals and their meat are also exported to nearby countries such as Egypt, Saudi Arabia, and Yemen. Agriculture, including livestock, is

responsible of 80 % of economic activities in the River Nile state and the main types of livestock present are sheep, cattle, and goats.

Sudan is affected by a heavy burden of vector-borne diseases, including malaria, visceral and cutaneous leishmaniasis, schistosomiasis, dengue, onchocerciasis and lymphatic filariasis. Sudan has witnessed several outbreaks of zoonotic arbovirus diseases such as Rift-Valley fever (2007-2008), Crimean-Congo haemorrhagic fever (2008), yellow fever (2005, 2012) and dengue (2014-2018). However, the recent history of epidemics at the River Nile state in particular include: Rift Valley Fever in 2007, a Measles outbreak in 2012, Acute watery diarrhea in 2016-17, and a Measles outbreak 2018 (River Nile MOH report, 2019).

Rift Valley fever (RVF) is a viral zoonosis that was first identified in Kenya in 1931. This mosquito-borne disease primarily affects animals but also has the capacity to infect humans. The majority of animal infections result from the bites of infected mosquitoes, while most human infections are caused by direct or indirect contact with the blood or organs of infected animals. Contact between humans and animals can happen during care or slaughtering of infected animals, or with the ingestion of raw animal milk (WHO, 2009).

In eastern Africa, RVF is commensurate to periods of heavy rainfall that occur during the warm phase of what is known as the El Niño/Southern Oscillation (ENSO) phenomenon. With such climatic changes, mosquito breeding and populations, acting as vectors and reservoirs of the disease, are increased. Spread of RVF from endemic areas can occur with the movement of livestock and the introduction of viremic animals in conducive areas, such as irrigation schemes. At the primary foci site, the virus is maintained in the vectors and/or hosts. At the secondary foci, the virus is imported and subsequently spread between new ruminants through vectors for RVF such as certain *Culex* and *Anopheles* mosquito species (WHO,2009).

There is very limited data about animal outbreaks available, thus most of information on RVF is based on human case data. However, it must be noted that the location of the human cases may not always reflect the real place where the virus emerged, as many reports refer to hospitals where the sick were treated. Furthermore, the virus amplifies in animals, and its distribution may be much wider and is affected by the movement of these animals.

RVF is considered endemic in many African countries, but transmission differs depending on countries' ecosystems. Nevertheless, distinction must be made between virus activity, outbreak,

and disease. In the perspective of users - ministries of health, ministries of agriculture, FAO, and WHO - the objective is to focus on major epidemics.

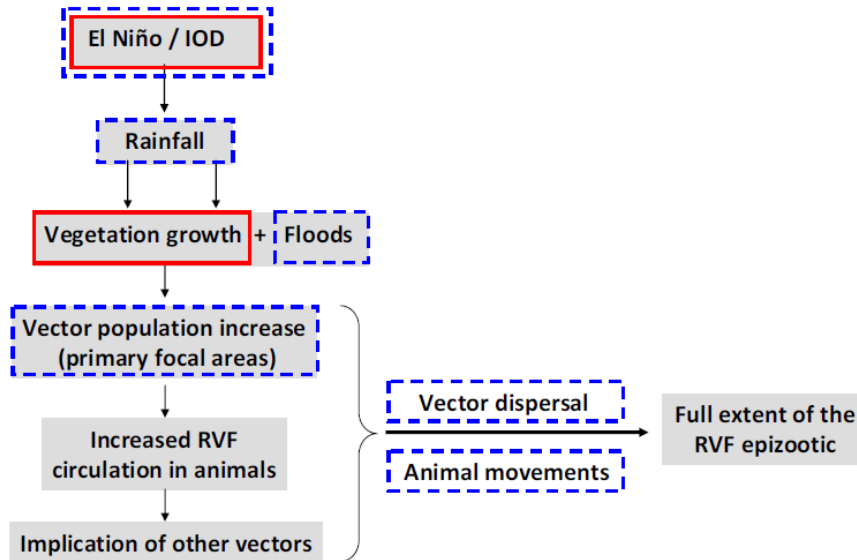


Figure 2. El Niño/Southern Oscillation (ENSO) phenomenon.

Dashed blue boxes indicate key factors to be monitored for RVF outbreak risk mapping. Solid red boxes indicate where existing models are connected.

Source: Joint FAO - WHO experts consultation, 2009

Part 1: Story

On the 6th of June 2019, the second day of Eid El-Fitr, a national holiday, and amid the revolution and a turbulent political situation in Sudan, a medical officer at a health center located at the Sedon administrative unit at the Aldamer locality in River Nile State (north of the Atbara River state) called the Health Emergency directorate at the Ministry of Health/River Nile state and notified them that there have been several recent cases of an unknown febrile illness affecting residents in the area; the illness seemed quite similar to malaria, however three deaths have occurred.

Part 1 Questions

Question 1. Before considering a further course of action, what other questions might you ask over the phone?

Question 2. What criteria that you would use in deciding whether to start a field investigation of a possible outbreak?

Question 3. Assuming you will conduct an outbreak investigation, what are the steps that you would follow?

Part 2: Methods

After receiving the call from Sedon, the Ministry of Health sent a team from the Epidemiology Department to investigate. The team noted that the area of the outbreak has special characteristics where most of its inhabitants are nomads from the Arabian Rashaida tribe. These tribes have a considerable number of cattle and sheep that travel with them, and their livelihood depends on grazing and farming in the rainy season where they move between valleys from one place to another and cross the borders to neighboring states (Kassala, Red Sea, etc.). Furthermore, it is part of their culture to live very closely with their animals, often sharing the same space. These tribes are also considered disadvantaged and have low levels of education and health status.

Agriculture in the affected area uses axial irrigation, which favors the breeding of mosquitoes in large quantities. During investigation, the team took four samples from cases and three of them tested positive for RVF. Control and prevention measures were accordingly started jointly between the locality and state level, and the response included the following areas for action:

- Surveillance and epidemiological investigation.
- Treatment of cases
- Vector control activities.
- Health promotion
- Environmental health and food control

- Veterinary participation
- Coordination

Part 2 Questions

Question 4. What type of surveillance does the team need to conduct?

Question 5. What risk factors do you think are involved in the occurrence of this outbreak?

Part 3: Results

The outbreak started to expand and the number of villages where the epidemic spread at the Sedon administrative unit reached 38 villages. Few other cases were reported from other administrative units and other localities (Barbar, Atbara) that could be linked to Sedon's outbreak. The last case recorded was on the 20th of August 2019. By that time the total number of suspected cases was 1,129 in the state leading to the death of 19 people.

After the decline of the epidemic in the locality of Al-Damer and the cessation of reports of new cases by the 20th of August, a short lived period (about one month) of zero cases was witnessed, however on the 18th of September 2019, a report was received from Barbar locality, particularly from the area of Fatwar located in the Al-Bawga administrative unit in the west bank of the Nile. The report stated that there are large number of deaths and abortions among animals in the area, accompanied by the emergence of symptoms of fever and an increase in malaria cases in the region. During that time, the rainy season started in Sudan and there were flash floods in 17 of its 18 states including River Nile state.

Immediately after receiving the communication, an investigation team from the ministry headed towards Barbar locality and interviewed the local health system department to verify the notification. The team then headed to the area of concern and carried out a field investigation. Five blood samples were taken from patients present at the time of the visit and sent to the national laboratory, where all tested positive for RVF.

The outbreak in Barbar spread to the east and west sides of the riverbank and extended north to an area overlapping with the locality of Abu Hamad.

On the 23rd of October 2019, a notification was received of a suspected case at Aldamer locality, the case resided in the Atbarawi administrative unit adjacent to the Sedon unit, where the outbreak first occurred that year. The investigation team took a blood sample which was confirmed to have RVF. Afterwards, reports started rolling from the area of Abuson and its neighboring villages in Sedon in the west bank of the Atbara River parallel to areas of the previous epidemic.

This prompted for control measures to proceed in both localities (Aldamer & Barbar) at the same time and the involvement of community committees in surveillance and control measures to help combat the expanding outbreak. A federal team also visited to provide support.

Part 3 Questions

Question 7. Using the dataset (Annex 1) please draw an epidemic curve of cases for the outbreak that started in September and calculate the case fatality rate.

Question 8. What are the risk factors that contributed to the spread of RVF in Fatwar?

Question 9. Are cases in Fatwar considered of secondary foci or primary foci? What is the impact of that on control measures?

Question 10. What is the role of climate and what should be integrated for forecasting and risk assessment of RVF?

Part 4: Discussion

The outbreak was considered to be controlled in December after the expansion of control measures and the involvement of community and partners. The following summarizes the events of the outbreak.

In the Barbar and Abuhamad:

- The total number of suspected cases in Barbar locality was 160, with one death recorded
- The number of suspected cases in the Abu Hamad locality reached 10 cases with three deaths recorded
- Number of villages affected in the Barbar locality were 17
- There were some sporadic cases in Atbara locality and the Al-Matama locality
- The last case recorded in the Barbar locality was on the 1^{9th} of December 2019

Aldamer locality:

- The number of suspected cases in Aldamer locality was 59 leading to 3 deaths
- Fourteen villages were affected
- The last positive case recorded in the Aldamer locality was on the 24th of November 2019

Part 4 Questions

Question 11. What are the proper measures and criteria to announce that an area is free from an outbreak?

Question 12. Describe the role of community participation in prevention and control of the Rift Valley Fever.

Part 5: Conclusion

The epidemic in Atbara continued for about 6 months, however secondary foci occurred in another five states due to the movement of animals. The state with the largest secondary foci was

Red Sea state in the east of Sudan. Even though the epidemic was concentrated in certain focal areas, there was concern among livestock traders, especially in distant western states of the country of the effect of this announcement on livestock trade, which provoked a discussion about the multiple ethical issues that arise with such outbreaks.

Part 5 Questions

Question 13. What actions should the team have conducted to prevent the spread of the outbreak to other states?

Question 14. Discuss the socioeconomic implications of announcing an outbreak in a country that is dependent on livestock trading. Please refer to the International Health Regulations (IHR) guidelines in your answer.

Annex 1: Dataset

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Disclaimer: Original data of this cases study have been modified for teaching purposes.

References and related readings

- Central Sector Commission. 2010. Socio-economic and opportunity mapping Assessment report for River Nile and Northern States

- Jeffrey Mariner. 2018. *Rift Valley Fever Surveillance*. FAO Animal Production and Health Manual No. 21. Rome. Food and Agriculture Organization of the United Nations (FAO). 80 pages.
- Joint FAO - WHO experts consultation. Rift Valley fever outbreaks forecasting models. Rome: World Health Organization 2009
- World Health Organization 2018. Introduction to Rift Valley fever: Managing Infectious Hazards. Accessed at https://www.who.int/docs/default-source/documents/emergencies/rift-valley-fever/rvf-presentation.pdf?sfvrsn=9ab8f0d3_4
- Muga GO, Onyango-Ouma W, Sang R, Affognon H. Review Article: Sociocultural and Economic Dimensions of Rift Valley Fever *Am. J. Trop. Med. Hyg.*, 92(4), 2015, pp. 730–738. doi:10.4269/ajtmh.14-0363
- Rasmussen SA and Goodman RA. *The CDC Field Epidemiology Manual*. New York: Oxford University Press, 2019.
- River Nile State Ministry of Health and Social Development. Final report of Rift Valley Fever Outbreak May-December 2019.
- Wilson RT. Livestock in the Republic of the Sudan: Policies, production, problems and possibilities. *Animal Husbandry, Dairy and Veterinary Science*. Volume 2(3), 2018 1-12