# Epidemiological Investigation According to the 'One Health' Approach of a Confirmed Case of Rift Valley Fever in the Ngaoundaye Health District in 2025 in the Central African Republic

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## Abbreviations

| | |
|---|---|
| AR | Attack rate |
| CAR | Central African Republic |
| ELISA | Enzyme Linked Immunoassay Sorbent |
| HD | Health district |
| Nb | Number |
| RVF | Rift Valley Fever |
| VRVF | Virus of Rift Valley Fever |
| qRT-PCR | Reverse Transcription Quantitative Polymerase Chain Reaction |

## Summary
### Introduction
Rift Valley fever (RVF) is a viral zoonosis that primarily affects domestic animals but can also infect humans. The aim of this work was to describe the RVF outbreak in time, space and person according to the 'One Health' approach in the Ngaoundaye district.

### Materials and Methods
This was a cross-sectional and descriptive study conducted from January 15 to 31, 2025. A multidisciplinary team as part of 'One Health', consisting of an epidemiologist, a specialist in animal health, and an entomologist, was deployed for the investigation. Data were collected through the administration of a questionnaire and the review of records. Blood samples were taken from suspected cases as well as from animals, and mosquito catches were performed.

## Results

A total of 64 suspected cases including one death, one confirmed case, and 120 contacts were recorded. Among 671 domestic animals examined, 237 (35%) were sick, including 2 that died. Out of 239 samples taken from pigs, goats, ducks, chickens, and cattle, the RVF virus was isolated in two out of 38 cattle (5%). The results of 810 specimens from captures and larval surveys were negative. The ages of the cases ranged from 7 months to 75 years, with an average age of 20 years. Thirty-two (56%) of the suspected RVF patients were female. Children under 10 years of age accounted for 40.4%. The clinical signs observed in suspects were intense fatigue, epistaxis, and fever, respectively 46%, 74%, and 93%.

## Conclusion

This crisis reminds us of the importance of environmental sanitation in the fight against diseases in general and the necessity of separating humans from animals. There is a need to organize transhumance to better manage the safe transportation of animals from one country to another. The investigation using the 'one health' approach has provided all the information about humans, animals, and the environment for responding to this disease.

## Introduction

Rift Valley fever (RVF) is a viral zoonosis that primarily affects livestock but can also infect humans [5]. The infection can cause severe pathology in both animals and humans [1]. This disease was first identified in 1931 during an investigation of an epidemic affecting sheep on a farm in the Rift Valley, Kenya [1,11]. Other outbreaks have been reported in sub-Saharan Africa and the Middle East, notably between 1977 and 2003, explosive outbreaks occurred in Egypt, Mauritania, Kenya, Somalia, Tanzania, Saudi Arabia, and Yemen [12,13].

In the Central African Republic (CAR), four sporadic cases have been recorded respectively in Boali in the Bossembele health district (HD), Chimbolo in the Bambari HD, in 2023 in Safa in the Mbaiki HD and 2024 in Pana in the Ngaoundaye DS [10]. Faced with this situation, the Ministry of Health and Population, through the Directorate of Epidemiological Surveillance and Public Health Emergency Management, in collaboration with the Ministries of Livestock and Animal Health and the Ministry of the Environment, had conducted an in-depth investigation in the district in the epidemic.

The objective of this work was to describe the RVF epidemic in time, space and person according to the "One Health" approach in the district of Ngaoundaye.

## Materials and Method

The investigation was conducted in Ngaoundaye and its surroundings from January 15 to 31, 2025. A multidisciplinary team within the framework of 'One Health' consisting of epidemiologists, animal health specialists, and entomologists was deployed for the survey. Data on confirmed cases, suspects, and contacts were collected using a pre-established questionnaire. The search for cases was guided by the review of consultation records in health facilities. With the help of community relays, suspected cases were sought in the community.

The epidemiologist was responsible for collecting data from the index case, suspects, and records. The collected data allowed for the characterization of the epidemic in terms of time, place, and people. The veterinarians investigated both sick and healthy domestic animals, including cattle, goats, sheep, pigs, and poultry. They questioned the animal owners and also visited the enclosed areas, chicken coops, to genuinely inquire about the health status of these animals and their living conditions. In both cases, for humans and animals, blood samples were taken for laboratory testing.

The evaluation of natural or artificial larval habitats, as well as the capture of daytime and nighttime mosquitoes and larvae, was carried out by the entomologist. The aim of the entomological survey was to inventory the mosquito species present in the environment, identify the vectors of the epidemic, estimate the densities of the vectors, and measure the entomological risk indicators for the resurgence of viral infections, and to study the bioecology and bionomy of the vectors.

For laboratory analysis, the direct ELISA method (Enzyme Linked Immunoassay Sorbent) was used for the qualitative detection of virus markers. It is an immuno-enzymatic technique for detecting antigen capsids directed against antibodies in serum or plasma. The IDvet Monolysa 4th generation kit manufactured in France by Biorad Laboratory was used. The first serological test used is Monolisa 1, which is 99% sensitive. A positive result from the first test is confirmed by Monolisa 2, which is 97% specific.

Mosquitoes have been captured. The collected data has been entered into Excel, version 2016, and analyzed with Epi Info 7. The ratio was determined for sex. Age was then grouped into classes for further analysis. The count and frequency (percentage) of qualitative variables were determined. The attack rate was determined as the number of cases in a locality reported to the at-risk population for the disease in that locality.

## Results

A total of 64 suspected cases including one death (1.6%), one (1) confirmed case, and 120 contacts have been recorded. The suspected cases of RVF were observed between week 50 of 2024 and week 10 of 2025. The peak was recorded

in week 3 (figure 1). The overall attack rate (AR) was 3.9 per 1000 inhabitants. The neighborhoods Goré, Pana_1, and Mont Pana had attack rates of 20.2, 10.7, and 9.5 per 1000 inhabitants respectively (table I). The age of the suspected cases ranged from 7 months to 75 years. The average age was 20 years.

The confirmed case was reported in week 51 of the year 2024. He resides in the Pana 1 neighborhood (Ngaoundaye). He works at the RCA-Chad-Cameroon borders. He is a male auxiliary of the Gendarmerie, aged 27. He lives with a wife and three children. His clinical signs included headaches, intense fatigue, abdominal pain, and bleeding from natural orifices and the injection site. He had been treated in hospitalization.

Thirty-four (53%) suspected FVR patients were female. Children under the age of 10 represented 40.6% (Table II). The clinical signs observed in the suspects were intense fatigue, epistaxis, and fever at rates of 39%, 77%, and 92% respectively (Figure 2).

Among 671 examined domestic animals, 237 (35%) were sick, including 2 deaths recorded. Of 239 samples taken from pigs, goats, ducks, chickens, and cattle, the FVR virus was isolated in two out of 28 cattle, which represents a proportion of 7% (Table III). In the surveyed households, 44% of potential breeding sites were found in the village of Touga, with 50% of the sites testing positive (Table IV). The anthropogenic breeding sites were all dry. In this village, the aggressiveness rate of mosquitoes was 53% between 5 PM and 6 PM, with 69% of Culex duttoni found along the Lim River (Table V). The results from 810 specimens obtained from larval captures and surveys were negative.
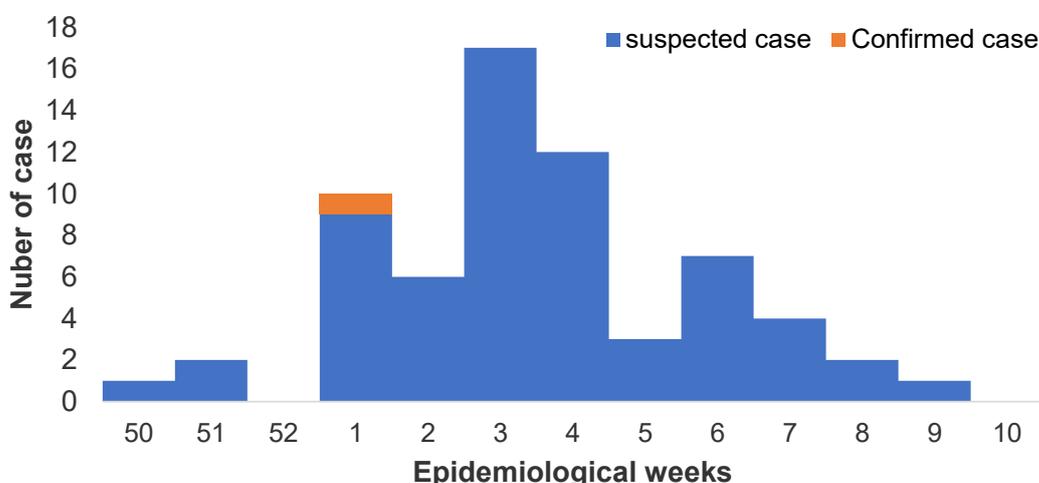


Figure 1: Distribution of Suspected and Confirmed FVR Cases in Ngaoundaye 2024-2025

| N° | Neighborhood | Population | Number | Attack rate (%o) |
|----|--------------|-----------|--------|------------------|
| 1 | Balli | 888 | 1 | 1,1 |
| 2 | Bang | 1001 | 3 | 3,0 |
| 3 | Bolélé | 590 | 5 | 8,5 |
| 4 | Balé | 618 | 3 | 4,9 |
| 5 | Baouda | 712 | 1 | 1,4 |
| 6 | Gami | 610 | 2 | 3,3 |
| 7 | Goré | 495 | 10 | 20,2 |
| 8 | Koussé | 1595 | 9 | 5,6 |
| 9 | Lapounzoui | 503 | 4 | 8,0 |
| 10 | Liberté | 452 | 1 | 2,2 |
| 11 | Mont Pana | 634 | 6 | 9,5 |
| 12 | Makele | 400 | 1 | 2,5 |
| 13 | Mann | 1924 | 1 | 0,5 |
| 14 | Mbinai | 1045 | 1 | 1,0 |
| 15 | Mboum | 647 | 1 | 1,5 |
| 16 | Ngouboué | 887 | 1 | 1,1 |
| 17 | Ngouboye | 397 | 1 | 2,5 |
| 18 | Palikole | 505 | 1 | 2,0 |
| 19 | Pana 1 | 560 | 6 | 10,7 |
| 20 | Pana 2 | 874 | 1 | 1,1 |
| 21 | Touga | 467 | 3 | 6,4 |
| 22 | Toukol | 575 | 2 | 3,5 |

Table 1: Attack Rate of RVF by Neighborhood in Ngaoundaye

| Age class | Mal | Femel | Effective | Percentage |
|---|---|---|---|---|
| 0-10 | 10 | 16 | 26 | 40,6 |
| 11-20 | 5 | 4 | 9 | 14,1 |
| 21-30 | 5 | 9 | 14 | 21,9 |
| 31-40 | 4 | 5 | 9 | 14,1 |
| 41-50 | 2 | 0 | 2 | 3,1 |
| 51-60 | 2 | 0 | 2 | 3,1 |
| 61-70 | 1 | 0 | 0 | 0,0 |
| 71-80 | 2 | 0 | 2 | 3,1 |
| **Total** | **31(48,4%)** | **34(53%)** | **64** | |

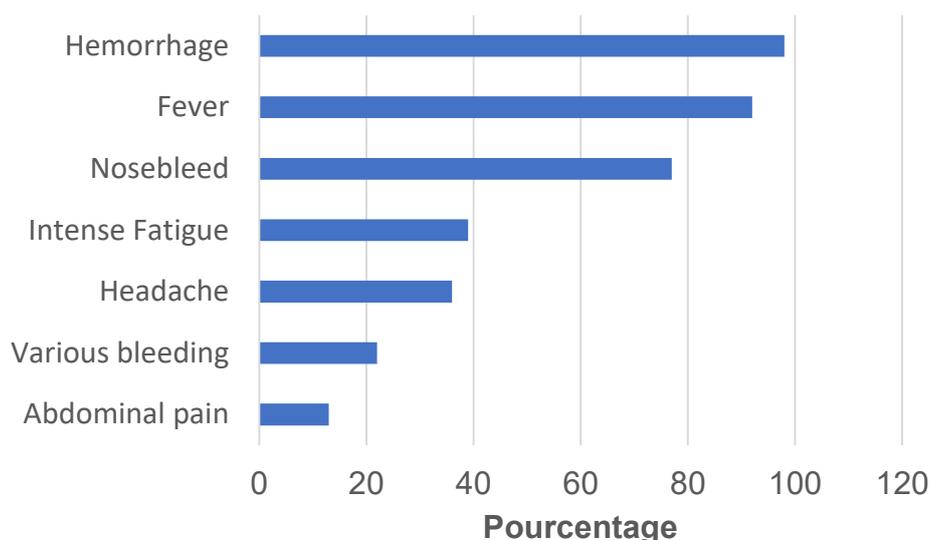**Table 2: Distribution of Suspected RVF Patients by Age and Gender**



**Figure 2: Distribution of Suspected RVF Cases According to Clinical Signs**

| Species | Effective | Sick animals | First Sampling | 2$^{nd}$ sampling |
|---|---|---|---|---|
| Pork | 121 | 67 | 2 | 45 |
| Goat | 112 | 63 | 2 | 166 |
| Duck | 53 | 22 | 0 | 0 |
| Chicken | 356 | 85 | 0 | 0 |
| Beef | 29 | 0 | 38 | 28 |
| **Total** | **671** | **237** | **42** | **239** |

**Table 3: Distribution of Suspected RVF Animals and Those Sampled**

| Location | Number of Households | Number of People | Potential Lodgings | % | Positive Lodgings | % |
|---|---|---|---|---|---|---|
| Touga | 15 | 87 | 12 | 44,4 | 3 | 50 |
| Mont-pana | 25 | 92 | 7 | 25,9 | 0 | 0 |
| Liberté | 38 | 123 | 3 | 11,1 | 0 | 0 |
| Border RCA-Tchad | 0 | 0 | 3 | 11,1 | 1 | 16,7 |
| Border RCA-Cameroun | 0 | 0 | 2 | 7,4 | 2 | 33,3 |
| **TOTAL** | **78** | **302** | **27** | **100** | **6** | **100** |

**Table 4: Census of Larval Habitats, Households, and Residents by Locality in Ngaoundaye in 2025**

| Genres/Species | Time slots | | | | | | | | Location | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4-5 pm | | 5-6 pm | | 6-7 pm | | 7-8 pm | | Location | | Total | |
| | Nb | % | Nb | % | Nb | % | Nb | % | Interior | Exterior | Nb | % |
| *An. gambiae s.l* | 1 | | 1 | | 2 | | 0 | | 0 | 4 | 4 | 0,7 |
| *An. coustani* | 1 | | 0 | | 0 | | 1 | | 1 | 1 | 2 | 0,2 |
| *Ae.vexans* | 34 | | 62 | | 14 | | 0 | | 0 | 110 | 110 | 14 |
| *Ae. aegypti* | 0 | | 1 | | 0 | | 0 | | 0 | 1 | 1 | 0,1 |
| *Culex duttoni* | 107 | | 303 | | 92 | | 53 | | 0 | 476 | 555 | 69 |
| *Culex pipiens* | 5 | | 12 | | 0 | | 0 | | 0 | 17 | 17 | 2 |
| *Lutzia tigripes* | 19 | | 52 | | 50 | | 0 | | 0 | 121 | 121 | 15 |
| Total | 167 | 21 | 431 | 53 | 158 | 20 | 54 | 6 | 01 | 730 | 810 | 100 |

Nb = Number

**Table 5: Species of Mosquitoes Captured at Dusk in the Village of Touga, at the Catholic Church and at the Hospital of Ngaoundaye in 2025**

## Discussion

From 2019 to 2024, the CAR detected sporadic and localized cases of RVF. Despite investigations and sampling of contacts, no other cases could be confirmed. The management of RVF in Ngaoundaye remains similar. Although several investigations have been conducted in the outbreak area, all samples from the suspects were negative. This exposes the diagnostic issue of this disease with a low positivity rate (1.6%) in humans and its mode of transmission. According to BA, no other positive cases have been diagnosed from 185 human samples [1].

Even though several animal species are exposed to RVF, only cattle had hosted the virus despite cohabiting in the same environment with ports, goats, and poultry. Once again, RVF shows a preference for the bovine species. This confirms the study conducted by Mbouna in Senegal, which observed negative results in small ruminants [8]. Indeed, in our context, the cattle were transported from one country to another during transhumance. Ngaoundaye is located in a three-border area, meaning between Chad, Cameroon, and the CAR. These animals were in contact with different herds. They were exposed to a variety of infectious diseases.

The 'one health' investigation offers an opportunity for comprehensive epidemic management as each sector assesses the situation, determines the extent of the disease, and proposes appropriate public health measures for disease control. The city of Nngaoundaye was in a state of unsanitary conditions with close contact between humans and animals. The house of the confirmed case is surrounded by a garbage dump, a pig pen, and a slaughterhouse. An environmental hygiene and sanitation program is necessary to prevent further zoonoses. A study was conducted by Domonbabele in Burkina Faso and collaborators on producers' perceptions of vector-borne and zoonotic diseases related to livestock in urban areas in light of the close contact between humans and animals. It is found that the close contact poses real hygiene problems and transmission of vector-borne and zoonotic diseases [1].

Regarding the description of the disease, young subjects in general and children under 10 years in particular were affected in 4 out of 10 cases. The majority of suspected cases were under 20 years old. The impact on young age was also observed by Mahamadou Doutchi in Niger, "the average age was 23 years with extremes of 3 and 70 years" [7]. In the CAR, the population is mainly young and active. It is the young subjects who are active and therefore more exposed to any infectious disease such as RVF. While the sex ratio was 1.1 in favor of the female sex. A slight increase in the number of female subjects was also found in Senegal with a 'sex ratio of 0.7' [8]. In contrast, authors such as Mohamed Lemine and Binyam Cedric reported a predominance of male patients with male/female sex ratios of 4/1 and 8/1 respectively [5,9].

Finally, the RVF was expressed through several symptoms. It was frequently observed in the suspects intense fatigue, epistaxis, and fever. The Hemorrhagic form represented 82.3% in the work of Doutchi and colleagues [9]. The entomological investigation had highlighted a significant frequency of larval breeding sites and vectors responsible for the transmission of the RVF, namely Culex duttoni. However, the confirmation of the presence of the virus in mosquitoes was not established after laboratory culture. Many species of mosquitoes are known to be effective vectors, particularly those in the genera Culex, Aedes, Anopheles, Eretmapodites, and Mansonia. Our result corroborates that of Souleymane

Mahamane Iro when they stated that 'The family Culicidae, which includes the genus Culex among others, was the most abundant, with a predominance of the species Cx. pipiens (31.9%; n = 793).' The qRT-PCR performed on a sample of 96 mosquitoes was positive for VFVR in a Cx. dipiens. Out of 150 serum samples from small ruminants collected, none tested positive for anti-RVF immunoglobulin M. Potential vectors of RVF accounted for 96.5% of the captures [8].

## Conclusion

This epidemic occurred in a context of unsanitary conditions and close proximity between inhabitants and animals in the city of Ngaoundaye. It is a conducive circumstance for the occurrence of diseases with epidemic potential. This crisis reminds us of the importance of environmental sanitation in the fight against diseases in general and the need to separate humans from animals.

The porosity of borders and the existence of multiple transhumance corridors are factors that favor the outbreak of this epidemic. It is necessary to organize transhumance to better manage the safe transportation of animals from one country to another. The investigation using the 'one health' approach has provided all the information about humans, animals, and the environment. That is why, in the event of a zoonotic epidemic, it is essential to promote multisectoral investigation.

## Acknowledgment

## Conflict of Interest

None

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