

## Analysis of National Lassa Fever Surveillance Data, Sierra Leone, 2012 – 2018

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### ABSTRACT

**Introduction:** Globally, about 500,000 Lassa fever (LF) cases occur annually with West Africa recording 300,000 infections and 5,000 deaths. LF is one of Sierra Leone's immediately reportable diseases under the integrated disease surveillance and response strategy. However, limited epidemiological analysis has been conducted. We described the demographic, and geographical distribution of reported LF cases and determined trend, incidence, and case-fatality rates of LF in Sierra Leone. **Methods:** We analyzed secondary data from LF sentinel site database for Sierra Leone from 2012 - 2018. We reviewed, cleaned, edited, the data using Microsoft Excel 2016. We calculated proportions, rates, and ratios using the number of deaths, positive cases, suspected cases, and the population at risk with a constant as a multiplier. We mapped LF incidence and presented data using tables, graphs, and maps. **Results:** Of 2,879 suspected cases reported, 14.2% (408/2879) were confirmed for LF. Median age of confirmed cases was 21 years (0-75 years). Females formed 59% (240/408) of the confirmed LF cases. Kenema district recorded the highest incidence ( 21/100,000 population) in 2012 and (24/100,000 population) in 2013. LF incidence was highest in 2013 with 26/100,000 population. The overall CFR was 38.8% (157/408). The trend of cases dropped from 2012 - 2018. **Conclusion:** Incidence of LF in Sierra Leone decreased with cases occurring all year round. Females and those aged 10-39 years were the most affected. The LF program and the Ministry of Health and Sanitation should conduct community sensitizations on LF to promote early health-seeking behavior in high incidence districts.

**KEY WORDS :** Lassa fever, Surveillance, Data, Sierra Leone

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## Introduction

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Lassa fever (LF) is an acute viral hemorrhagic fever disease. It was first reported in Nigeria in 1969 and is caused by the LF virus which is an enveloped ribonucleic acid virus belonging to the Arenaviridae family [1]. The incubation period of LF ranges from 5-21 days, with fever and other non-specific symptoms such as headache, sore throat, myalgia, and gastrointestinal symptoms being the most common manifestations. Bleeding occurs less frequently [2]. This non-specific clinical presentation makes LF extremely difficult to identify on clinical grounds alone, particularly during the early phase of the disease [3]. Globally, an estimated 300,000 - 500,000 cases occur annually [4]. Unlike most viral hemorrhagic fevers, which are recognized only when outbreaks occur, LF is endemic in West Africa, with an estimated 300,000 cases and 5,000 deaths reported yearly [5]. These estimates, however, under-represents the true number of cases since some patients do not report to the health facilities for treatment, as such, they are not captured during routine surveillance.

In Sierra Leone, about 10% - 16% of yearly hospital admissions are due to LF cases [6]. This reflects the impact of the disease in the country. LF is one of Sierra Leone's immediately reportable diseases under the integrated disease surveillance and response (IDSR) strategy [7]. Although Sierra Leone has been implementing case-based disease surveillance for LF, limited epidemiological analysis has been conducted. Regular LF data analysis is a critical part of disease surveillance to monitor the disease and evaluate prevention and control efforts. We described the demographic, and geographical distribution of reported LF cases and determined the trend, incidence, and case-fatality rates of LF in Sierra Leone.

## Methods

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### Study design

We conducted a descriptive study using secondary data from LF surveillance in Sierra Leone for the period 2012 to 2018.

### Study site and population

Sierra Leone is a small West African country with a population of 7,874,335 inhabitants and a growth rate of 3.2% [8]. The country is divided into four regions namely; North, South, East, and West. Administratively, the country is divided into sixteen (16) districts distributed in the four regions in the country (Figure 1). The eastern region lies along the LF belt and has a population of 1,642,370, representing 23.2% of the country's population [8]. The country's system is tiered with over 1,307 public and private health facilities. The population in this study includes records of all categories of people such as community members, healthcare personnel, children, and adults who had LF from 2012 - 2018.

### Description of surveillance system and data collection

Lassa fever surveillance in Sierra Leone is conducted through a sentinel surveillance system, which is both active and passive. Healthcare workers are required to immediately report LF cases to the districts and include those cases in the weekly Integrated Disease Surveillance and Response reports submitted to the districts weekly. The data capture and management system is situated at the Kenema government hospital in Kenema district located in the Eastern region. All laboratory specimens of suspected LF cases in Sierra Leone are sent to the LF laboratory for testing and data is entered into LF program database.

LF confirmed cases from the country are also referred to the LF treatment center in Kenema. Surveillance data on LF is recorded in a paper-based forms which are entered and stored in Excel format.

### IDSR Lassa fever case Definitions (suspected, confirmed), and positivity rate

A suspected case was defined as an acute onset of fever of less than 3 weeks duration in a severely ill patient AND any 2 of the following; haemorrhagic or purpuric rash; epistaxis (nose bleed); haematemesis (blood in vomit); haemoptysis (blood in sputum); blood in stool; other haemorrhagic symptoms and no known predisposing factors for haemorrhagic manifestations, and a confirmed cases was defined as a suspected case with laboratory confirmation or epidemiologic link to confirmed cases or outbreak. The positivity rate was defined as

the proportion of confirmed cases per total suspected cases multiplied by 100.

### Data collection

We obtained data for this study from the LF sentinel surveillance database stored in Microsoft (MS) excel format at the Kenema government hospital. We extracted data on demographics, reporting district, date of onset of symptoms, laboratory results, and outcome of positive cases.

### Data analysis

We computed median and range for continuous variables and frequencies and proportions for categorical variables. We calculated the incidence rate per 100,000 population and mapped the incidence by districts. We calculated the case fatality rate as the proportion of death among confirmed cases of LF. Cases with missing variables of interest were excluded from the analysis. The data was analyzed using MS excel 2016 and QGIS software version 3.12.2 and presented using tables, graphs, maps, and charts.

### Ethical consideration

Approval for the analysis and use of LF surveillance data was obtained from the Ministry of Health and Sanitation (MoHS), and the Tulane university LF sentinel site in Kenema. We maintained the confidentiality of patient information by ensuring that personal identifiers were excluded from the dataset before the analysis. The result of the analysis was only shared with authorized stakeholders and organizations.

### Results

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A total of 2,879 suspected LF cases were reported in Sierra Leone for the period under review. Of these, 14.2% (408/2,879) were confirmed positive for LF. The median age of the confirmed cases was 21 years (range 0 - 75 years). Most, 30.9% (242/408) were between the age group 20 - 29 years. More than half, 58.8% (240/408) were females. The majority, 72% (292/408) of the confirmed LF cases were reported from Kenema district, followed by Bo district, 15% (61/408). Port Loko, Kono, Kambia, and Western Area districts reported zero confirmed cases for the

period under review [Table 1](#). The lowest proportion of confirmed LF cases was recorded in 2018 with 4.4% (18/408).

The incidences of LF in 2012 and 2013 were higher than the other years, with each year recording about 27 and 26 cases per 1,000,000 population respectively. The lowest incidence of LF occurred in 2018, with 2 cases per 1,000,000 population. Kenema district reported the highest incidence of LF in 2012 and 2013 at 21 and 25 cases per 100,000 population respectively. This was followed by Bo, 10 and 4 cases per 100,000 population in 2012 and 2013, and Kenema, 2 and 3 cases per 100,000 population in 2012 and 2013 respectively [Figure 1](#).

The trend of confirmed LF cases showed high peaks in 2012 - 2013, with the highest peak in July 2012. The LF cases also showed more peaks during the rainy season months in Sierra Leone, that is, from May to October throughout the seven years. There were however no cases reported from June to November in 2015 [Figure 2](#).

Of the 408 confirmed LF cases, 157 died, giving a case fatality rate (CFR) of 38.8% (157/408). Generally, there was a decrease in the positivity rate of LF, although it increased in 2017. The highest positivity rate was recorded in 2012, and the lowest in 2016 [Figure 3](#). There was an increase in suspected and positive cases in 2012 and 2013, however, the case fatality rate was low in those years, and further declined in 2014. The case fatality, however, started increasing in 2015 and peaked in 2016, and declined in 2017 [Figure 4](#).

### Discussion

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From the analysis of LF data in Sierra Leone, this study found the age group 20 - 29 years to be the most affected, followed by those aged 0 - 9 years. This was probably due to the fact that this age group involves people that are active and more exposed to some of the risk factors of the disease including farming, hunting, and domestic activities. Several studies have reported similar findings that LF mostly affects young adults [\[9-11\]](#). A finding by the current data that the majority of the cases were female could be as a result of females being more exposed to the disease through contact with rats and their excreta during the processing of crops, grains, and other

domestic activities. The finding that females are mostly affected by LF is similar to the analysis conducted in Sierra Leone and Liberia where females were reported as the most affected with LF [12]. The high proportion of LF cases among those aged 0-9 years could be attributed to the high proportion of cases among females since children of this age are usually close to their mothers and may be exposed to LF infections. However, other studies conducted in Nigeria found that males were the most affected [10, 11]. Our findings are consistent with a study conducted in Sierra Leone with high proportion of cases among children ten years and bellows [13]. However, another study in Nigeria reported that those aged 15 - 34 years were the most affected followed by those aged 35 - 54 years [14]. The variation in the results could be due to the study setting, time, and population.

The distribution of LF confirmed cases were concentrated in the Southern and Eastern Districts of the country which is expected since the incidence of LF in the northern region is very low. Four districts including Kambia, Kono, Western Area, and Port Loko districts did not record a positive case for the period under review. As is the case with other studies, the South and East districts are the most affected. For example, the South-East and South-South in Nigeria are the most affected regions according to a similar analysis conducted in 2017 [10]. This is because the South-East regions in Sierra Leone and Liberia are endemic with LF

The decreasing trend of LF in general and the overall low case fatality rate in the current study is contrary to other data on LF trends in Nigeria and Liberia where increasing trends of LF were reported for particular study periods [4, 15]. The overall, gradual decrease in confirmed cases of the disease from 2012 - 2018 could be attributed to underreporting, improved prevention, and control efforts of the disease in the country. For example, the Ebola outbreak interrupted surveillance and response activities the response for LF. The high CFR positivity rate of LF in the present study is consistent with a study in Nigeria who reported a higher CFR when compared to the current study [4]. The high CFR of LF in the current study suggests that reporting within 24 hours and effective management of LF patients in the treatment facility in Sierra Leone should be improved. With the highest LF case fatality rate recorded in 2016, factors such as delay

of LF patients in seeking medical care among other factors could have contributed to this finding [16]. Also, fear by patients and mistrust of communities on the healthcare system following the Ebola outbreak could have contributed to the high CFR in 2016 [17].

Although our study observed a decrease in positivity rate of LF over time, a study in Nigeria reported an increase in positivity rate [4]. The decrease in the positivity rate of LF in Sierra Leone over time could be attributed to the increased community awareness on LF prevention, the provision and use of personal protective equipment, and decrease in incidence of the disease [4, 18, 19].

The lowest proportion of suspected LF recorded in 2014 - 2015 in the present study could be attributed to the Ebola outbreak which occurred during that period [20]. The health sector, during that time, was focused mainly on interventions to contain the outbreak, and surveillance for other priority diseases was interrupted. This could have contributed to the low incidence for that period.

The finding that approximately half of the LF cases were reported during the rainy season is inconsistent with other findings which suggests that the incidence of LF is high during the dry season. This is contrary to another study conducted in Nigeria and Liberia who found a higher incidence of LF during the dry season [12]. The finding from our study suggests that LF could as well be high during the rainy season and can occur all year round.

This study has some limitations. The true estimates of LF in Sierra Leone for the study period has not been determine due some cases that were excluded from the analysis due to missing variables and cases that did not seek care at the health facility. The use of projected population to estimate the incidence could have affected its estimation.

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## Conclusion

There is decrease in the incidence of LF in Sierra Leone. Cases of LF occurs all year round. Females and the age group -20 - 29, followed by those aged 0 -9 years were the most affected. Kenema district recorded the highest LF incidence throughout the



seven years period. The overall positivity rate of LF was low and an overall high CFR.

We are therefore recommending that the LF program and the Directorate of health security and emergencies (DHSE) conduct refresher training for health facility staff and community health workers (CHWS) on early case detection and reporting of LF giving priority to districts with low or zero incidence. The above institutions should also embark on intensive and monthly community sensitization on LF clinical presentation to promote early health-seeking behavior with a focus on high incidence districts. The disease surveillance officers to immediately investigate and timely report all suspected cases of LF and in all districts. Disease surveillance officers should also intensify Community Based Surveillance and active case search to help detect unreported cases.

### What is known about this topic

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- LF is highly fatal disease and is endemic in West Africa
- Risk factors for LF infection include exposure to urine or faeces of infected *Mastomys* rats, direct contact with blood, urine, faeces or other bodily secretions of a person infected with LF

### What this study adds

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- This study adds the estimation of the incidence of LF in Sierra Leone
- It also adds information on the trend of LF in Sierra Leone for seven years.

### Competing interests

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The authors declare no competing interests.

### Authors' contributions

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KK and RND developed the protocol. KK, RND, and SA analyzed and interpreted the data. KK, DB, and JSS reviewed several drafts of the manuscript and made significant contributions throughout the writing process.

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### Tables and figures

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**Table 1:** Socio-demographic characteristics of confirmed Lassa fever cases, Sierra Leone, 2012-2018

**Figure 1:** Incidence of Lassa fever per 100,000 population by district, Sierra Leone, 2012 - 2018

**Figure 2:** Distribution of confirmed Lassa fever cases by month, Sierra Leone, 2012 - 2018

**Figure 3:** Cases and positivity rate of Lassa fever, Sierra Leone, 2012 - 2018

**Figure 4:** Lassa fever cases, deaths and case fatality rate, Sierra Leone, 2012 - 2018

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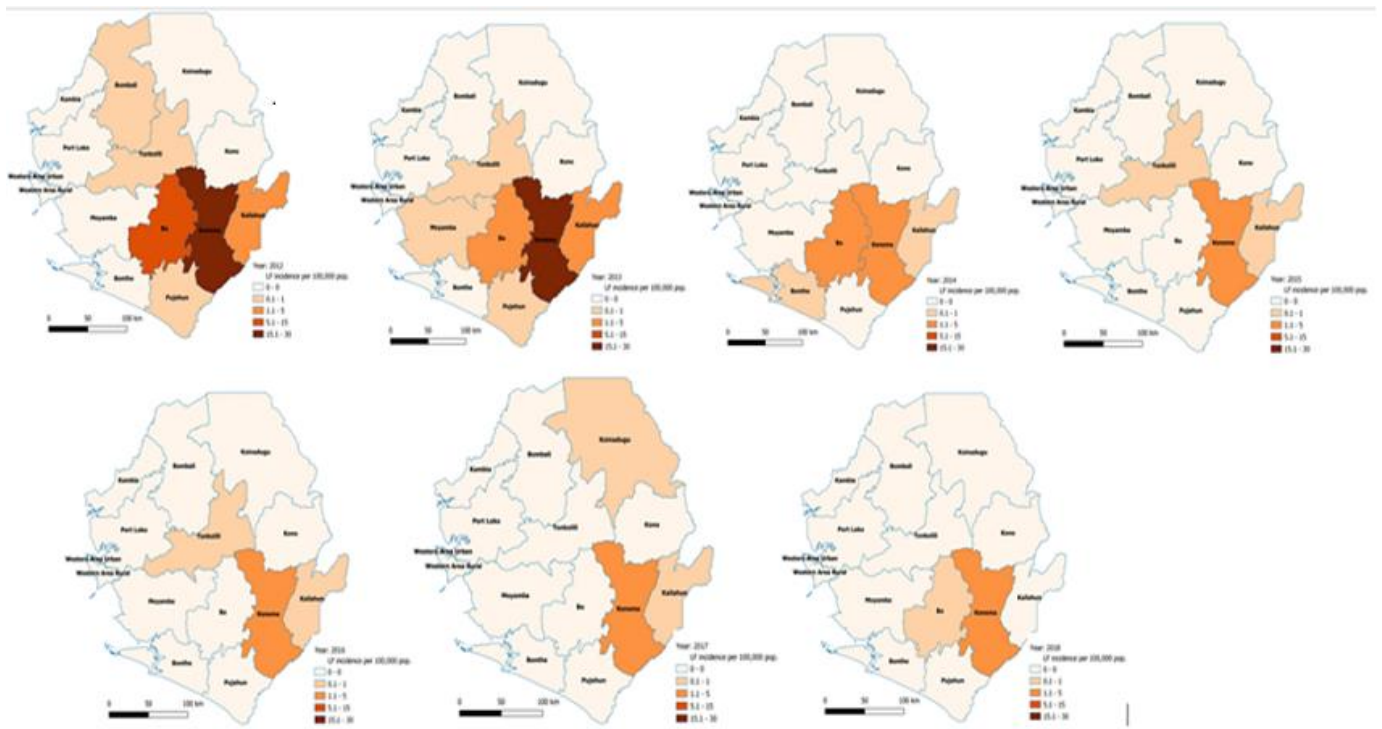
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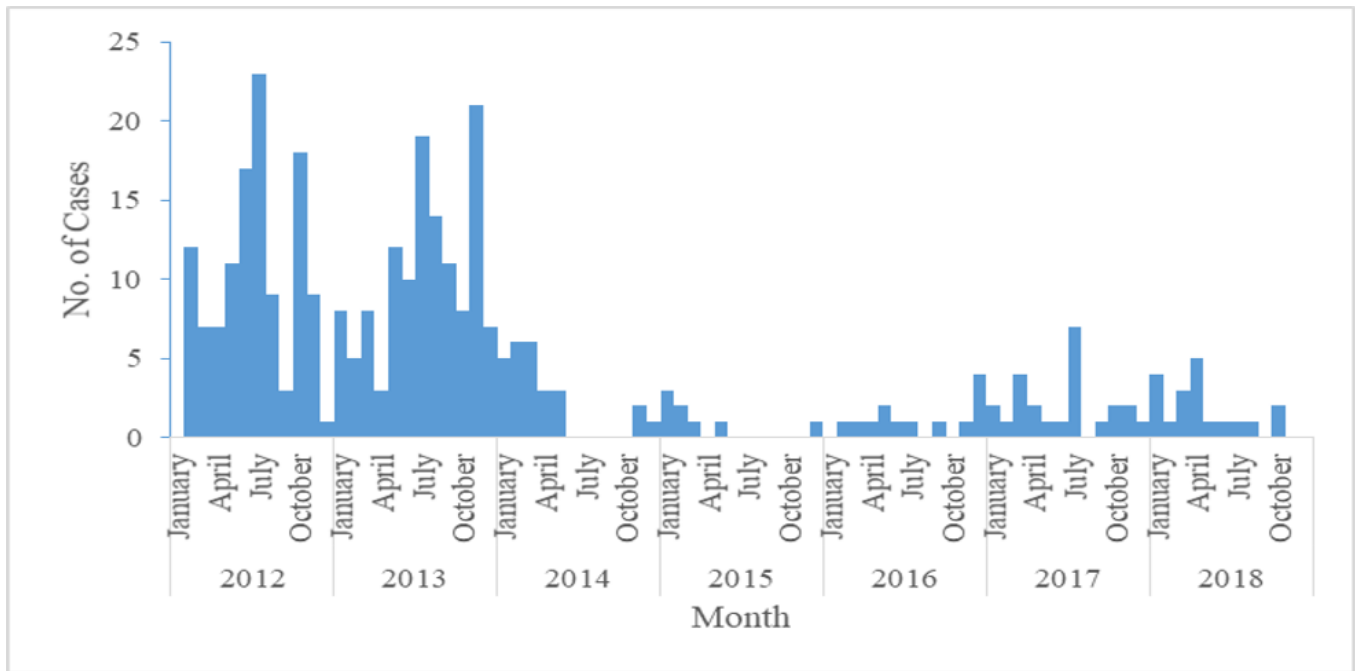
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<b>Table 1: Socio-demographic characteristics of confirmed Lassa fever cases, Sierra Leone, 2012-2018</b>		
<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Age-category (years)</b>		21.3
0-9	87	
10-19	77	18.9
20-29	126	30.9
30-39	67	16.4
40-49	26	6.4
≥50	25	6.1
<b>Sex</b>	168	41.2
Male		
Female	240	58.8
<b>Districts</b>		
Bo	61	14.9
Bombali	1	0.3
Bonthe	2	0.5
Kailahun	32	7.8
Kenema	292	71.6
Koinadugu	4	1.0
Moyamba	1	0.3
Pujehun	4	1.0
Tonkolili	11	2.7
Port Loko	0	0.0
Kono	0	0.0
Kambia	0	0.0
Western Area	0	0.0
<b>Reporting year</b>		
2012	144	35.3
2013	142	34.8
2014	29	7.1
2015	26	6.4
2016	25	6.1
2017	24	5.9
2018	18	4.4

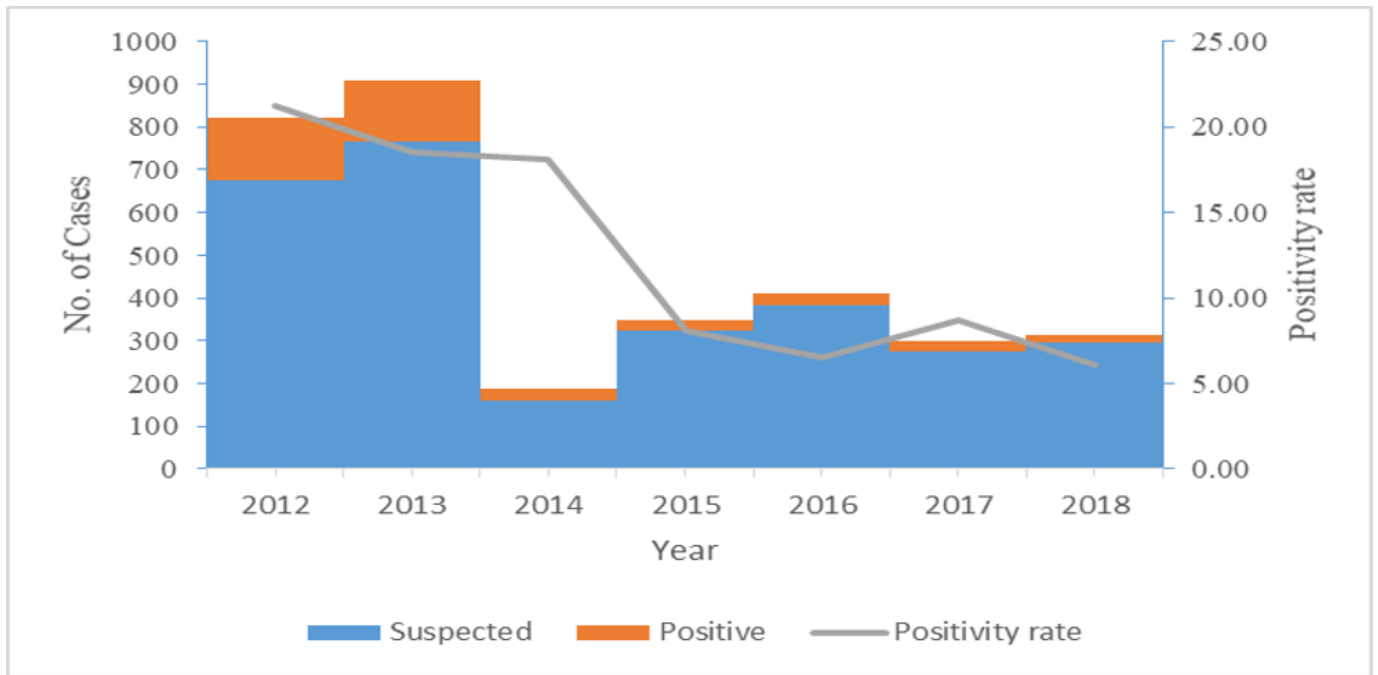




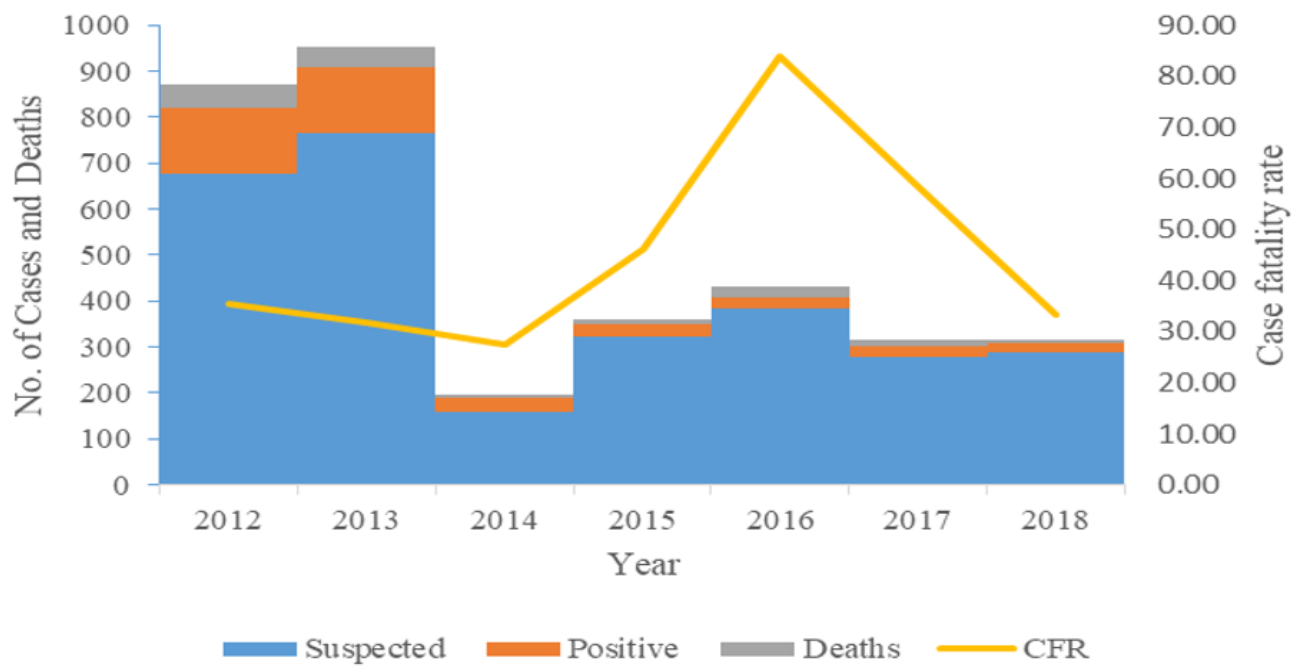
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**Figure 2:** Distribution of confirmed Lassa fever cases by month, Sierra Leone, 2012 - 2018



**Figure 3:** Cases and positivity rate of Lassa fever, Sierra Leone, 2012 - 2018



**Figure 4:** Lassa fever cases, deaths and case fatality rate, Sierra Leone, 2012 – 2018