Measles outbreak investigation in Buah health district, Grand Kru County, Liberia, February-April 2020

Francis Bobway[1,2,&], Faith Tina Whesseh[3], Chukwuma David Umeokonkwo[3], Obafemi Joseph Babalola[3], Jimmy Lawubah[1, 2], Himiede Wede Seysay[3], Lily Sanvee-Blebo[2], Boye Nuyelleh[1, 2], Maame Amo-Addae[3]

[1]Liberia Field Epidemiology Training Program, Congo Town, Liberia, [2]Grand Kru County Health Team, Barclayville, Liberia, [3]Africa Field Epidemiology Network, Monrovia, Liberia

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[&]CORRESPONDING AUTHOR
Francis Bobway, Liberia Field Epidemiology Training Program, Congo Town, Liberia.

bobway92@gmail.com

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ABSTRACT

Introduction: Measles is a highly contagious illness and remains one of the leading causes of death of children worldwide. Measles is one of the epidemic-prone diseases for weekly reporting in the revised Integrated Disease Surveillance and Response in Liberia. In 2020, Liberia reported a total of 623 measles cases, of which, Grand Kru County accounted for 28.6%. We present the epidemiological characterization of the measles outbreak in Grand Kru County in 2020. **Methods:** The study employed a descriptive cross-sectional design. We conducted an active case search using the outbreak case definition and interviewed affected persons and caretakers using the case investigation forms. We conducted contact tracing, line-listed cases and reviewed medical records of patient charts. The following variables for analysis were used: laboratory results, age categories, sex, community of residence, and vaccination status. We calculated frequencies and proportions using Epi-info version 7.2 software to summarize socio-demographic characteristics, outcome and vaccination status and presented the timeline of the outbreak in Epi-curve using epi-weeks. **Results:** A total of 178 measles cases were identified during the outbreak. Of the total cases, 4.5% (8/178) were positive and 95.5% (170/178) were epidemiologically linked. The median age was 6 (interquartile range: 3-12) years with females accounting for 57.3% of the cases. The age group 0-4 years accounted for 39.3% (70/178) of the total cases, followed by 5-9 years 28.1% (50/178) and 10-14 years 18.5% (33/178). Parluken community reported 65.2% (116/178) of the cases, followed by Forpoh Wropluken at 14.1% (25/178). Twenty-one percent (37/178) of the cases were vaccinated while 79.0% (140/178) were not vaccinated. The attack rate was 126.2 per 10,000 population and the case fatality rate was 1%. **Conclusion:** This was a confirmed measles outbreak in Buah Health District, Grand Kru County. The attack rate was high, but the case fatality rate was low. The majority of the cases were not vaccinated against measles. There is a need to improve vaccination coverage through routine immunization and supplemental immunization activities.

Introduction

Measles is a highly contagious systemic illness and remains one of the leading causes of death of children worldwide [1]. The reported cases of death among children under 5 years had increased from an estimated 89,780 in 2016 to 207,500 in 2019 [2]. The disease is common in many developing countries, particularly in parts of Africa and Asia [3]. More than 95% of measles deaths occur in countries with low per capita incomes and weak health infrastructures [4]. Measles outbreaks can be particularly deadly in countries experiencing or recovering from natural disasters or conflict [4]. Damaged health infrastructure and health services interrupt routine immunization, and overcrowding in residential camps greatly increases the risk of infection [5].

Despite the availability of safe, affordable and effective measles vaccines, Africa reported approximately 147,900 measles deaths, leading to a major public health problem [6]. It was projected that measles mortality was estimated to reduce by 62% between 2000 and 2019, and Africa observed a 57% reduction in the same year 2019 [7]. The coverage of the first dose of the measles vaccine in Africa was 69% in 2019 [8]. Although this is a considerable improvement from 53% in 2000, the coverage is not sufficient for the prevention of endemic transmission of the measles virus, which requires at least 93-95% of population immunity [9].

In 2020, Liberia reported a total of 623 measles cases, of which Grand Kru County accounted for 28.6% [10]. On the 19th of February 2020, the national reference laboratory released results of eight confirmed measles cases reported from Buah District, Grand Kru County [10]. An outbreak of Measles was declared, and the district rapid response team (DRRT) was activated to respond to the outbreak with the following objectives: control the outbreak, characterize the outbreak and establish possible risk factors.

Methods

Study Setting

Grand Kru County is located in the southeastern part of Liberia with an estimated population of 77,468 inhabitants, of which 14,108 constitute the Buah district. Only 45% of the county population have easy access to the health delivery system (people who live within 5km away from the health facility) and an estimated measles coverage for the county in 2020 was 80.2% and 37.0% for the Buah district. The county has five health districts and 23 health facilities (2 private and 21 public). Of the twenty-three health facilities 83% (19/23) are involved with immunization activities.

Study population and design

The target population of this study were individuals who were positive for measles or came in contact with a positive case in any of the health facilities or communities in the Buah health district, while we employed a cross-sectional study design.

Cases that met the case definition and had records of basic information such as laboratory classification, age, sex, date of reporting, date of onset, place of detection, vaccination status, and date seen were included in the study, while those with the above missing information were excluded.

Measles Surveillance System

Measles surveillance in Grand Kru is carried out through the Integrated Disease Surveillance and Response (IDSR) platform. This platform is a national reporting system covering priority diseases in all health facilities across the five health districts within the county. Information flows from the communities (community health assistants (CHAs) and community health volunteers (CHVs)), health facility surveillance focal persons (SFP), the district surveillance officers (DSOs), through the county surveillance officer (CSO), to the national level National Public Health Institute of Liberia/Ministry of Health **Figure 1**. Suspected cases have the samples drawn by the health workers at the health facilities and sent to the National Reference Laboratory through the Riders for Health **Figure 2**. The specimen collection and transport medium begin at the health facility level with Riders for Health serving as liaison between the county and the National Reference Laboratory for specimen collection and transportation. However, there is a vice-versa flow of information between national, county, districts, health facilities and communities within the surveillance system.

Outbreak case definition

The outbreak case definitions were based on the Liberia 3rd revised IDSR guideline:

Suspected case

"Any person with sudden onset of fever (≥38.5°C rectal or 38.0°C axillary) and maculopapular (non-vesicular) generalized rash and one of the following symptoms: cough, coryza or conjunctivitis (red eyes), that visited or resided in Parluken community from the 14th of February to the 23rd April of 2020 or whom the clinician suspect of measles".

Probable case

"A suspected case who had contact with a confirmed case".

Confirmed case

"A suspected case laboratory confirmed by the presence of IgM antibodies of measles virus in the serum".

Epidemiological linkage

"A suspected case who visited an outbreak setting or had contact with a confirmed case".

Data collection

Data was extracted by DSOs, and SFPs, at the various health facilities. We reviewed weekly IDSR reporting ledgers, diagnosis and treatment ledgers, patients´ charts, vaccination ledgers and laboratory submission forms.

Data analysis
We cleaned and analyzed data in Microsoft Excel. Variables such as age, sex, address, and vaccination status were calculated using frequency and proportion. To determine the extent of the outbreak, we calculated the attack rate and case fatality rate, and our results were presented using tables and graphs.

Availability of data and material
The data from which this write-up was developed belong to the Ministry of Health Liberia and are not publicly accessible. Nevertheless, the data can be availed from the corresponding author with rational requests and with authorization from the Ministry of Health Liberia.

Ethical considerations
The County Health Team granted permission to use the data from the outbreak response for this publication. Confidentiality of the participants was maintained throughout the study.

Results

Epidemiological information of index case
On February 1, 2020, one of the CHAs of Parluken suspected a measles case and referred the patient to the Dwenken clinic. This patient was a 13-years old female and a resident of Parluken community, Buah Health District. She was vaccinated against measles on the 25th of October 2007 but started to develop signs and symptoms of measles-like fever, cough, generalized body rash, sore throat, headache, running nose and red eyes on the 28th of January 2020. The surveillance focal person SFP at the clinic suspected measles using standard cases definition and immediately collected specimens for testing. On February 18, 2020, the National Reference Laboratory through the National Public Health Institute released the patient result positive for measles by IgM.

A total of 178 measles cases were identified during the outbreak. Of the 178 cases, females accounted for 57.3% (102/178). The age group 0-4 years accounted for 39.3% (70/178) followed by 5-9 years 28.1% (50/178), 10-14 years 18.5% (33/178), 15-19 years 5.6% (10/178) and ≥ 20 years and above 8.4% (15/178). The median age was 6 (interquartile range: 3-12) years. Parluken community reported 65.2% (116/178) of the total cases, followed by Forpoh Wropluken 14.1% (25/178) and Jlateken 8.4% (15/178). Twenty-one per cent (37/178) of the cases were vaccinated against measles, while 79.0% (140/178) were not vaccinated **Table 1**.
Symptoms like fever, maculopapular rashes, and red eyes were reported or identified in all the cases, 100% (178/178), while cough and running nose accounted for 71.9% (128/178) and 93.8% (167/178) respectively **Table 2**.
The outbreak started during epi-week 7, intervention was initiated during the same epi-week 7. From the intervention initiated, additional 43 cases and 2 deaths were reported in epi-week 8. The peak of the outbreak was in epi-week 9, where 30.3% (54/178) of the cases were reported. The attack rate was 126.2 per 10,000 populations including a pregnant woman and the case fatality rate was 1.0% **Figure 3**.

Discussion

An outbreak of measles was confirmed at Buah health district in Grand Kru County. The outbreak had a high attack rate. This could probably be due to the low level of immunization coverage among the cases. Lack of immunization with measles-containing vaccines makes children vulnerable to measles infection. Similar findings had been reported in previous outbreaks. The county is predominately rural with a poor road network and swampy areas making it difficult to travel. This could have impacted the routine immunization services in the area. Although the attack rate was high, the case fatality rate was low. Similar to our findings, studies conducted in Myanmar and Ethiopia in 2019 and 2022 showed a high attack rate during measles outbreaks [11, 12]. Whereas, in Ethiopia and Nigeria, a study conducted in 2019 and 2020 findings showed that there was a high case fatality rate during the measles outbreak which is contrary to our findings [13, 14].
The index case attended a school function in the Parluken community where she interacted with many people which could be one of the reasons for the spread of the outbreak. The highest number of cases were reported from Parluken community. Females accounted for the highest proportion of cases during the outbreak, while the majority of the cases were in the age group 0-4 years. This is probably due to inefficient vaccination outreaches conducted in the affected communities and limited support from stakeholders to enhance routine immunization services and health workers have to walk long distances to provide immunization services in isolated and hard-to-reach settlements. The results are similar to the studies conducted in Central Africa Republic, Guinea and Nigeria in 2017, 2019 and 2020 and showed the age group less than 5 years were mostly affected [8, 15, 16]. In addition, the studies conducted in Liberia, the Philippines and South Africa in 2019 and 2022 showed that females were mostly affected during measles outbreaks [17-19]. Contrary to our findings, a study conducted during a measles outbreak in California and Uganda in 2015 and 2020 showed the spread of the outbreak was due to direct contact with a positive case and travel history to an endemic area [6, 20, 21]. Further studies conducted in Uganda, and Nigeria in 2018 and 2021 showed that most cases reported had symptoms like fever, maculopapular rash and red eyes which correspond with our findings [20, 22].

Conclusion

This was a confirmed measles outbreak in Buah health district, Grand Kru County. The attack rate was high, but the case fatality rate was low, while the highest number of

cases were reported from the Parluken community with low immunization coverage among the cases which might be one of the contributing factors to the spread of the outbreak. We recommend that the County Health Teams and partners should work with the District Health Teams to establish temporary outreach camps in the various districts to support supplemental immunization activities and outreach services and strengthen routine immunization services in the communities.

What is known about this topic

- Measles affects children mostly under 5 years
- It is a vaccine-preventable disease
- It has a high burden in low and middle-income countries

What this study adds

- Gaps in immunization coverage in rural or hard-to-reach communities lead to the spread of measles cases
- Early intervention could minimize the mortality from a measles outbreak

Competing interests

The authors declare no competing interests.

Authors´ contributions

FCB conceptualized the study, FCB, JL participated in the outbreak response, MAA, OJB, FTW LSB supervised the outbreak investigation, FCB, CDU, FTW were involved in the initial manuscript drafting, OJB, FTW, CDU, JL, MAA, and LSB revised the manuscript for intellectual content, all authors read and approved the final version of the manuscript for submission.

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Tables and figures

Table 1: Demographic Characteristics of Measles cases in Buah health district, Grand Kru County, February to April 2020

Table 2: Distribution of signs and symptoms among cases in Buah district, Grand Kru County, February to April 2020

Figure 1: Diagram of reporting flow chat for the surveillance system in Liberia

Figure 2: Diagram of laboratory confirmation of specimen collection and testing in Liberia

Figure 3: Measles cases reported in Buah health district, Grand Kru County, February - April 2020

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Table 1: Demographic Characteristics of Measles cases in Buah health district, Grand Kru County, February to April 2020		
Characteristics	**Frequency (N=178)**	**Percentage (%)**
Gender		
Female	102	57.3
Male	76	42.7
Age (Years)		
0-4	70	39.3
5-9	50	28.1
10-14	33	18.6
15-19	10	5.6
≥20	15	8.4
Vaccination Status		
Vaccinated	37	21.0
Not Vaccinated	140	79.0
Community of resident		
Parluken	116	65.2
Forpoh Wropluken	25	14.1
Jlateken	15	8.4
Planplanken	6	3.4
Chewriken	4	2.2
Sieken	3	1.7
E. Man Village	2	1.1
Others	7	3.9

Table 2: Distribution of signs and symptoms among cases in Buah district, Grand Kru County, February to April 2020		
Sign and symptoms	**Number of cases**	**Percent**
Fever	178	100
Maculopapular rash	178	100
Red eyes	178	100
Running nose	167	93.8
Cough	128	71.9

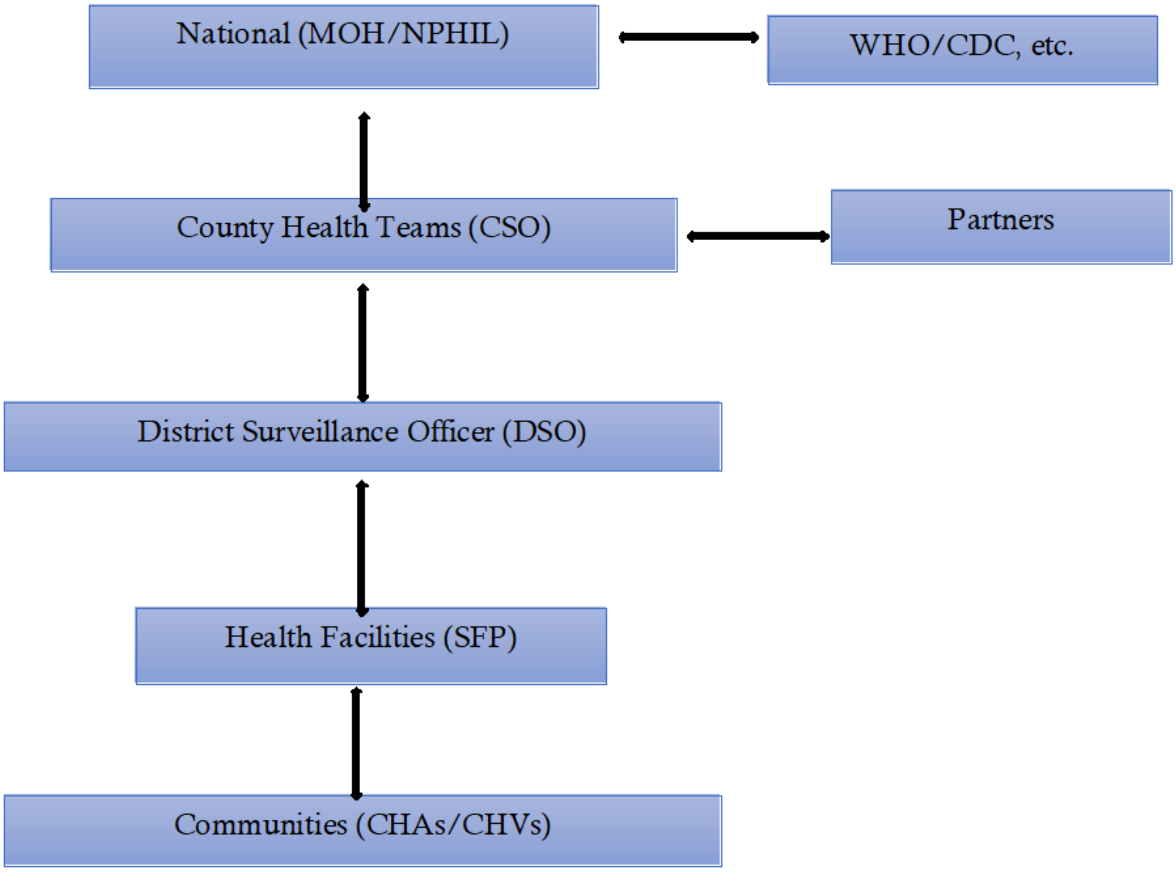

Figure 1: Diagram of reporting flow chat for the surveillance system in Liberia

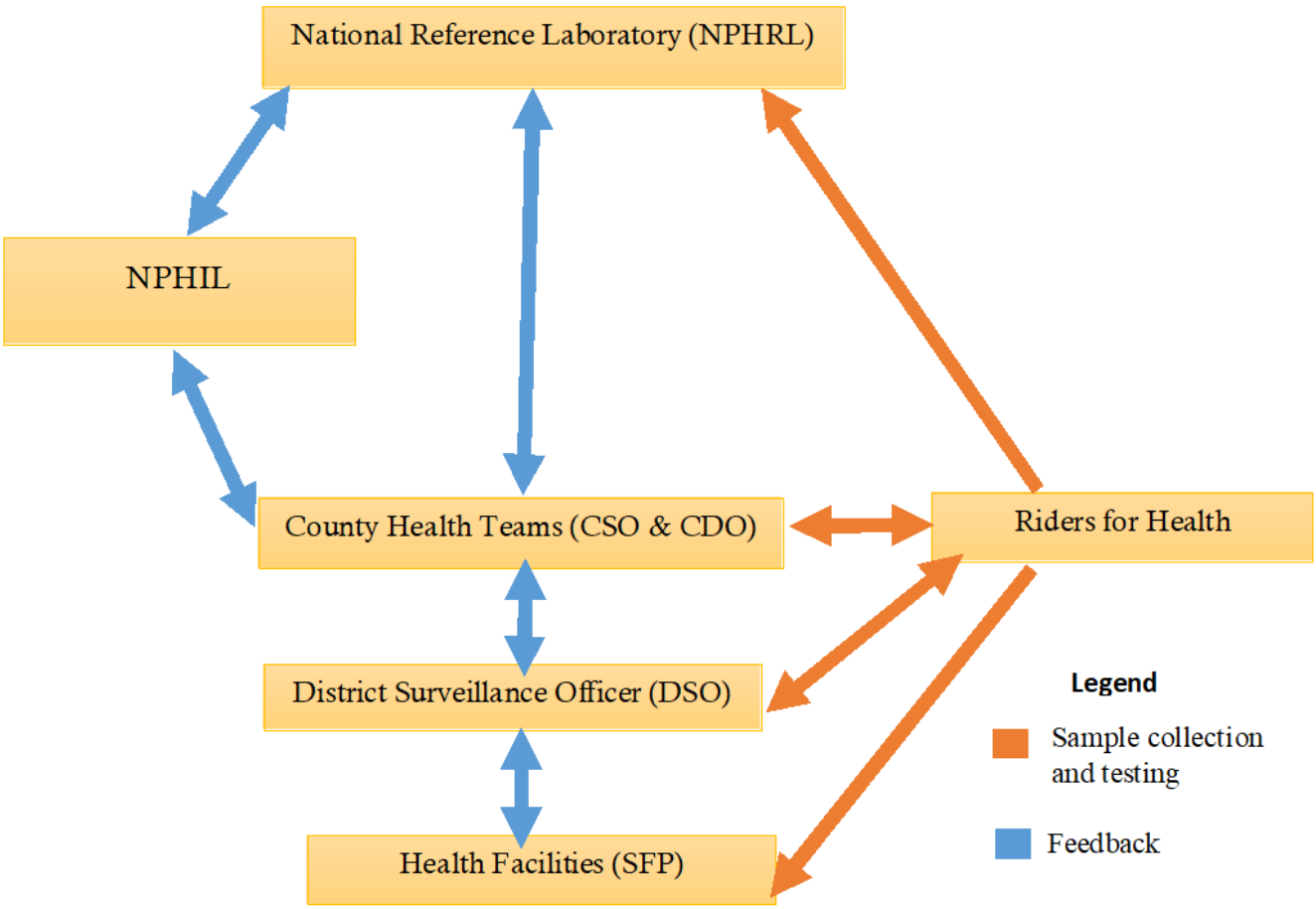

Figure 2: Diagram of laboratory confirmation of specimen collection and testing in Liberia

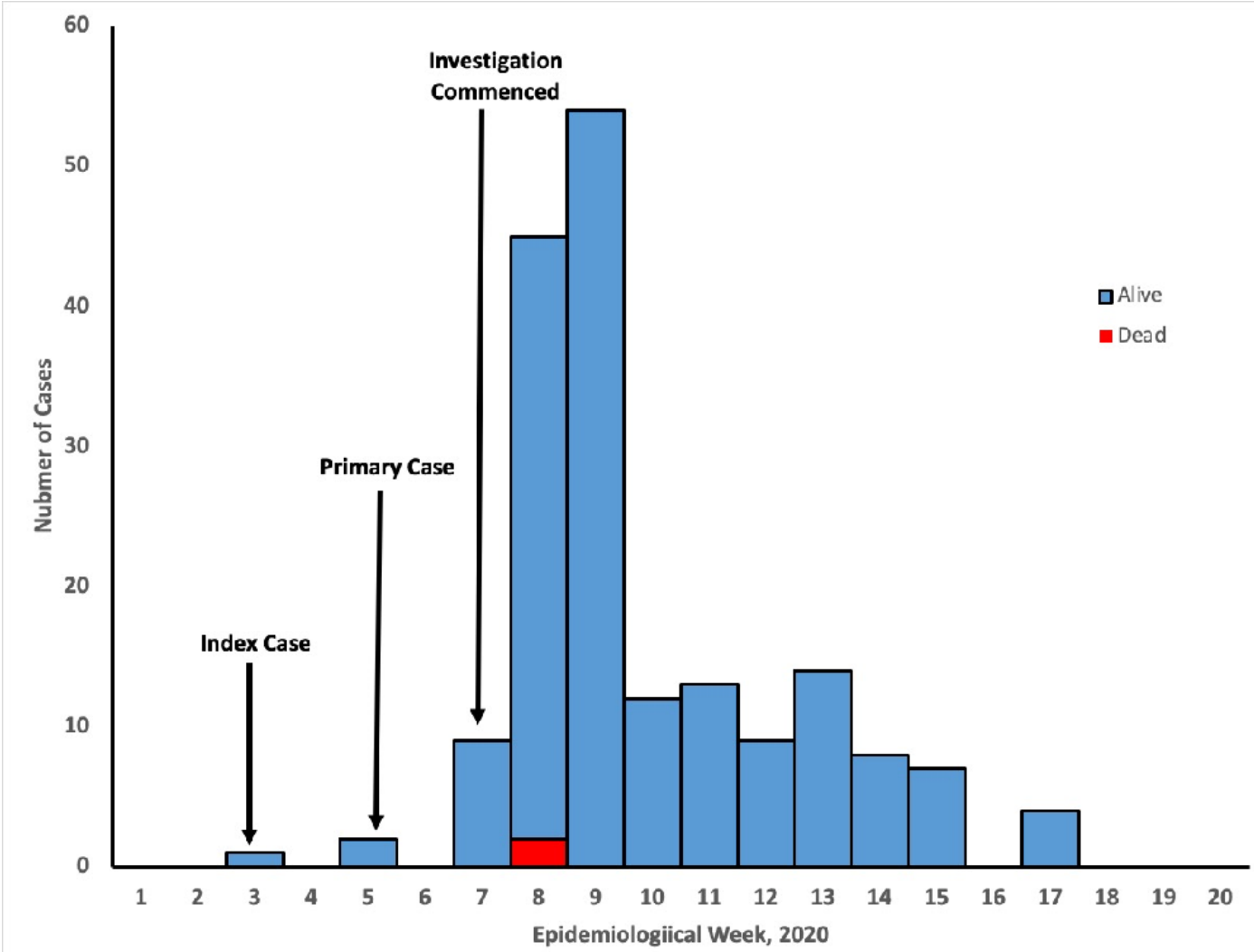

Figure 3: Measles cases reported in Buah health district, Grand Kru County, February - April 2020