

Investigating an Outbreak of Measles in Margibi County, Liberia, October 2015

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Abstract

The emergence and re-emergence of infectious diseases highlights the need to have well-trained field epidemiologists who will be at the forefront in the fight against these diseases, especially during an outbreak. Training for outbreak investigation is most effective when participants can develop their competencies in a practical exercise. To that end, this case study was based on a measles outbreak investigation conducted in Liberia during October 2015 by Liberia Frontline Field Epidemiology Training Program (FETP) residents, simulating steps to perform outbreak investigation in a real-life situation as a field epidemiologist. This case study is ideally suited to reinforce principles and skills already covered in a classroom lecture or in background reading by providing a practical training beyond the scope of theoretical learning. It is primarily intended for training novice public health practitioners who should be able to complete the exercises in approximately 3 hours.

How to Use the Case Study

General instructions: Ideally, 1 to 2 instructors facilitate the case study for 8 to 20 students in a classroom or conference room. The instructor should direct participants to read a paragraph out loud, going around the room to give each participant a chance to read. When the participant reads a question, the instructor directs all participants to perform calculations, construct graphs, or engage in discussions. The instructor may split the class to play different roles or take different sides in answering a question. As a result, participants learn from each other, not just from the instructors. Specific instructor's notes are included with each question in the instructor's version of this case study.

Audience: Residents in Frontline Field Epidemiology Training Programs (FETP-Frontline), Field Epidemiology and Laboratory Training Programs (FELTPs), and others who are interested in this topic.

Prerequisites: Before using this case study, participants should have received lectures or other instruction in outbreak investigation.

Materials needed: Laptop with Microsoft Excel or graph paper, flipchart or white board with markers

Level of training and associated public health activity: Novice - Outbreak investigation

Time required: Approximately 3 hours

Language: English

Participant's Guide

Goal of Case Study – Simulate a real-life outbreak investigation

Learning Objectives – After completion of this case study, the participants should be able to:

1. Retrieve a case definition from national surveillance guidelines
2. Describe the process for reporting and confirming priority diseases
3. Determine if an outbreak has occurred
4. Describe the steps in an outbreak investigation
5. Develop a line list and describe its value
6. Draw and interpret an epidemic curve and describe its value
7. Calculate measures of central location (mean, median, and mode)
8. Calculate and interpret measures of disease frequency (ratio, proportion, and rates)

Introduction

In June 2015, the Liberian Ministry of Health recruited and trained 50 general community health volunteers (gCHV) as leads in the communities to support community-based surveillance of priority diseases. The Ministry provided them with the required resources to facilitate their work in the community, which included case definitions for key notifiable diseases in the country. On 7th October, 2015, the gCHV for Town A was providing health education among households in the community when he identified a 10-year-old female with rash on most parts of her body. He initially diagnosed it as heat rash until he noticed four additional residents with a similar rash, in addition to redness of the eyes and cough, in subsequent households he visited. He was alarmed that these symptoms were suggestive of measles [1].

Question 1. What was the case definition for suspected measles cases the gCHV referenced in this setting?

Question 2. Discuss the process for confirming these suspected cases of measles.

Question 3. Is this an outbreak? Justify your answer.

Question 4. In general, what is the reporting channel/process for an identified key notifiable disease at the community level? How quickly should this proceed?

The gCHV for Town A reported these suspected cases of measles to the health facility in his local district within three hours. In response, the Officer in Charge (OIC) requested that these suspected cases be referred to the health facility for physical examination and specimen collection for laboratory testing and treatment. The OIC informed the District Surveillance Officer (DSO) who also relayed the information to the County Surveillance Officer (CSO) on the same day [1].

Question 5. What are the steps in an outbreak investigation?

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On 8th October, 2015, a team of investigators was dispatched from the county to support the district in conducting further investigation of the suspected measles cases while awaiting laboratory confirmation [1].

Question 6. Who should be part of the investigation team?

Question 7. What initial preparations should be made by the team before they go to the field?

Question 8. What will be your objectives for this investigation?

Part 1

On arriving in the community, the investigation team reviewed the medical records at the catchment facility, including patient folders and charts. They interviewed the health care workers in Heath Facility A, visited the affected village, met with the chief of the town, visited affected household, and interviewed parents and guardians of the affected children. An active case search was conducted in the community, as well as an assessment of the vaccination status of cases (1,2).

Question 9. What immediate action should be taken by the gCHV at this point to help identify more cases and reduce spread of the infection at the community level?

Question 10. What is the difference between active and passive case search? Under what conditions will you conduct active case search versus passive case search?

Question 11. What information should be included in a case definition for active case searching?

The case definition used for the active case search was for a resident of Town A with generalised rash and fever, plus one of the following: cough, coryza (running nose), or conjunctivitis (red eyes); or any resident of Town A suspected by the clinician of having measles between 3rd September, 2015 and 28th October, 2015. Suspected cases were captured in a line list [1].

Question 12a. In general, what is the difference between a suspected, probable, and confirmed case?

Question 12b. Review the case-based forms (see appendix) and classify them as suspected, probable or confirmed case. [Hint: Refer to Liberia IDSR guidelines]

Question 13. What is a line list? What is the importance of a line list?

Question 14. What variables will you capture on your line list in relation to this suspected outbreak? (Refer to case reports in Appendix)

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Question 15. Construct a line list using the measles case investigation forms for the 8 cases reports provided in the Appendix.

Question 16. What is an epidemic curve? Indicate the information that can be derived from an epidemic curve.

Question 17. Using the line list, draw an epidemic curve and interpret the results. Hint: Median incubation period from exposure to measles rash is about 14 days; measles patients can transmit virus from about 4 days before to about 4 days after rash onset.

Question 18. What is the mean, median, range and modal age of the cases?

Question 19. Given that the population of Town A is 800 residents, calculate the case fatality rate and attack rate.

Question 20. What other measures of disease frequency can be calculated from the data provided?

Question 21. Write a one-paragraph summary report of your outbreak investigation, including calculated measures. Use simple terms suitable for a general (public) audience.

Part 2

The outbreak investigation team determined that the index case travelled to Montserrado County to spend time with some family members from 4th – 18th September, 2015. Within that same period, there was an ongoing outbreak in Montserrado County. On 24th September, 2015, he developed symptoms including a skin rash, red eyes, fever, and runny nose. The patient was sent to the health facility in Margibi County on 4th October, 2015 where the clinician diagnosed him with measles; however, a clinical specimen was not collected. Additional cases that were identified were friends of the index case who attended the same school and played, bathed, and ate together. The laboratory was able to test only one out of five samples submitted due to lack of reagents. The sample tested was IgM positive for measles [1].

Question 22. What is an index case? From the line list, who will you consider an index case in this suspected outbreak and why?

Question 23. What additional information will you obtain from the index case?

Question 24. From where and when was the likely source of infection?

Question 25. Discuss the role of the laboratory in an outbreak investigation.

The team conducted further epidemiological studies to identify the factors contributing to the outbreak. It was evident that only one of the cases had received a measles vaccine. On interviewing the guardian of the five-year-old with measles, she admitted that she refused to get her daughter immunised due to her fear (and misconception) that the vaccination would infect her with the Ebola virus. The team also observed that the cases were in close contact with non-cases in the community. The measles immunisation coverage among children under five in the community was found to be 75%.

The team implemented preventive and control measures based on their findings. No additional case was identified after the eight cases were reported. A comprehensive report was developed and shared with all stakeholders [1].

Question 26. What prevention and control measures will you suggest?

Conclusion

An outbreak of measles occurred in Town A located in a district of Margibi County. The likely source of infection was in Montserrado County. Possible contributing factors to the spread of the infection were low immunisation coverage and poor infection prevention and control practises at the community level. Isolation and treatment of cases helped to stop the spread of infection. Measles vaccination outreach was conducted to help improve the herd immunity in the county and its surrounding towns [2].

Measles is a vaccine preventable disease targeted for elimination by the World Health Organisation. An effective measles surveillance system will help in monitoring the progress of this goal and in early detection and rapid response when there is an outbreak to avoid the spread of the infection [2]. The Centers for Disease Control and Prevention (CDC) has laid down systematic epidemiological steps that must be followed when investigating an outbreak. However, these steps can overlap depending on the circumstances of the outbreak [3].

The first step to an outbreak investigation is to prepare for the field by identifying an investigation team and resources. The next step will be to establish the existence of the outbreak and verify the diagnosis. A systematic case search captured in a line list is needed to construct a working case definition with three main components: person, place and time. Using the information from the line list, a descriptive epidemiological analysis is performed. From the analysis, a hypotheses may be developed and evaluated. As necessary, an investigator can re-consider, refine and re-evaluate the hypotheses.

At this stage, it also necessary to compare and reconcile with laboratory and/or environmental studies. Next will be to implement control and preventive measures and initiate or maintain surveillance for the diseases condition under investigation. Intervention and control measures may have to be implemented at an early stage based on the circumstance of the outbreak. Finally, a report on your findings need to be shared with all stakeholders.

Failure to detect early and put interventions in place will set the world back in its goal of eliminating measles.

Background Reading

Centers for Disease Control and Prevention. Section 2: Steps of an Outbreak Investigation. Principles of Epidemiology in Public Health Practice. 3rd ed. Atlanta, GA: CDC; 2012.

Ministry of Health (Liberia). National Technical Guideilnes for Integrated Disease Surveillance and Response. Monrovia, Liberia; 2015.

WHO/AFRO. Guidelines for Measles Surveillance. 2004;(December):1–38.

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Appendices

Appendix 1. Eight measles case investigation forms, Margibi County, Liberia, 2015

ANNEX 9P

Measles - case investigation form

001

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	001
Reporting district	KATAKA
Province of report	MARGIBI
Reporting health facility	LARKAP - TA H/E
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	GIFTY JARLAW
Date of birth (day/month/year)	
Age in years	8
Age in months	
Patient's residence: village/neighbourhood	
Town/City	KOWIEKEN TOWN
Urban/Rural	
District of Residence	KATAKA
Province	MARGIBI
Sex (M/F)	F
Date seen at health facility (day/month/year)	8-OCT-2015
Date health facility notified district (day/month/year)	8-OCT-2015
Date of onset (day/month/year)	6-OCT-2015
Number of vaccine doses	UNKNOWN
Date of last vaccination (day/month/year)	
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	
Outcome (1=Alive; 2=Dead; 3=Unknown)	1
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	2
Date sent form to district (day/month/year)	9-OCT-2015

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ANNEX 9P

Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	002
Reporting district	KATAKA
Province of report	MARGIBI
Reporting health facility	LAKAY-TA H/C
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	MAGIE KOLLE
Date of birth (day/month/year)	
Age in years	5
Age in months	
Patient's residence: village/neighbourhood	KOLLEKEN TOWN
Town/City	
Urban/Rural	RURAL
District of Residence	KATAKA
Province	MARGIBI
Sex (M/F)	F
Date seen at health facility (day/month/year)	8-OCT-2015
Date health facility notified district (day/month/year)	
Date of onset (day/month/year)	7-OCT-2015
Number of vaccine doses	UNKNOWN
Date of last vaccination (day/month/year)	
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	
Outcome (1=Alive; 2=Dead; 3=Unknown)	1
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	2
Date sent form to district (day/month/year)	

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Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	003
Reporting district	KATAKA
Province of report	MARGIBI
Reporting health facility	LARKAT-IA H/C
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	WILLIAM BURMANH
Date of birth (day/month/year)	
Age in years	18
Age in months	
Patient's residence: village/neighbourhood	
Town/City	KOLLEKEN TOWN
Urban/Rural	
District of Residence	KATAKA
Province	
Sex (M/F)	M
Date seen at health facility (day/month/year)	8-OCT-2015
Date health facility notified district (day/month/year)	
Date of onset (day/month/year)	5-OCT-2015
Number of vaccine doses	UNKNOWN
Date of last vaccination (day/month/year)	UNKNOWN
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	
Outcome (1=Alive; 2=Dead; 3=Unknown)	1
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	2
Date sent form to district (day/month/year)	

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ANNEX 9P

Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	004
Reporting district	KATAKA
Province of report	MARGIBI
Reporting health facility	LARKAY-TA H/C
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	NANCIE HASTINGS
Date of birth (day/month/year)	
Age in years	7
Age in months	
Patient's residence: village/neighbourhood	
Town/City	KOLLEKEN TOWN
Urban/Rural	
District of Residence	
Province	KATAKA MARGIBI
Sex (M/F)	F
Date seen at health facility (day/month/year)	7-OCT-15
Date health facility notified district (day/month/year)	
Date of onset (day/month/year)	4-OCT-15
Number of vaccine doses	UNK
Date of last vaccination (day/month/year)	UNK
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	
Outcome (1=Alive; 2=Dead; 3=Unknown)	1
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	2
Date sent form to district (day/month/year)	

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Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	005
Reporting district	KATAKA.
Province of report	MARGIBI
Reporting health facility	LARKAT-IA HC
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	MAAME ADDAE
Date of birth (day/month/year)	
Age in years	10
Age in months	
Patient's residence: village/neighbourhood	
Town/City	KOLLEKEN TOWN
Urban/Rural	
District of Residence	KATAKA
Province	
Sex (M/F)	F
Date seen at health facility (day/month/year)	8-OCT-15
Date health facility notified district (day/month/year)	
Date of onset (day/month/year)	6-OCT-15
Number of vaccine doses	UNK
Date of last vaccination (day/month/year)	UNK
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	
Outcome (1=Alive; 2=Dead; 3=Unknown)	1
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	2
Date sent form to district (day/month/year)	

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Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	006
Reporting district	KATAKA
Province of report	MARGIBI
Reporting health facility	LARKAY-TA H/C
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	PETER ADEWOYI
Date of birth (day/month/year)	
Age in years	16
Age in months	
Patient's residence: village/neighbourhood	
Town/City	KOWIEKEN TOWN
Urban/Rural	
District of Residence	KATAKA
Province	MARGIBI
Sex (M/F)	M
Date seen at health facility (day/month/year)	4-OCT-15
Date health facility notified district (day/month/year)	24-SEP-15
Date of onset (day/month/year)	24-SEP-15
Number of vaccine doses	UNKNOWN
Date of last vaccination (day/month/year)	UNKNOWN
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	OUT-PATIENT
Outcome (1=Alive; 2=Dead; 3=Unknown)	
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	5
Date sent form to district (day/month/year)	

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ANNEX 9P

Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	007
Reporting district	KATAKA
Province of report	
Reporting health facility	KARKA-TA HC
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	AGNES FOMBA
Date of birth (day/month/year)	
Age in years	7
Age in months	
Patient's residence: village/neighbourhood	
Town/City	WOLLEKEN TOWN
Urban/Rural	
District of Residence	
Province	KATA MARGIBI
Sex (M/F)	F
Date seen at health facility (day/month/year)	
Date health facility notified district (day/month/year)	
Date of onset (day/month/year)	6-OCT-15
Number of vaccine doses	
Date of last vaccination (day/month/year)	
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	OUT-PATIENT
Outcome (1=Alive; 2=Dead; 3=Unknown)	1
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	1 IgM positive
Date sent form to district (day/month/year)	

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ANNEX 9P

Measles - case investigation form

MEASLES CASE INVESTIGATION FORM	
Variable/Description	Value/Answer
Country	LIBERIA
ID number	008
Reporting district	KATAKA
Province of report	MARGIBI
Reporting health facility	LARKAY-TA H/C
Disease/Condition	Measles
Date received form at national level (day/month/year)	
Name(s) of patient	
Date of birth (day/month/year)	.
Age in years	11
Age in months	
Patient's residence: village/neighbourhood	
Town/City	KOLLEKE TOWN.
Urban/Rural	
District of Residence	MARGIBI
Province	
Sex (M/F)	M
Date seen at health facility (day/month/year)	8-10-15
Date health facility notified district (day/month/year)	
Date of onset (day/month/year)	7-10-15
Number of vaccine doses	
Date of last vaccination (day/month/year)	
Blank variable #1	
Blank variable #2	
In-patient or Out-patient?	
Outcome (1=Alive; 2=Dead; 3=Unknown)	
Final classification (1=Lab Confirmed; 2=Confirmed by Epidemiological linkage; 3=Compatible; 4=Discarded (IgM negative); 5= Pending (Suspected with specimen lab results pending)	2.
Date sent form to district (day/month/year)	

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1. Maximore LS. Expanded Surveillance Report [Internet]. Monrovia, Liberia; 2015. Available from: http://liberiafetp.com/wp-content/uploads/7.-Margibi_Final-Report.pdf
2. WHO/AFRO. Guidelines for Measles Surveillance. 2004;(December):1–38.
3. CDC. Section 2: Steps of an Outbreak Investigation. In: Principles of Epidemiology in Public Health Practice [Internet]. 3rd ed. Atlanta, GA: CDC; 2012. Available from: <http://www.cdc.gov/ophss/csels/dsepd/ss1978/lesson6/section2.html>