

Rubella Outbreak Investigation at General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018

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Abstract: *Background:* In African countries, rubella is widely under-recognized public health problem, and information on its epidemiology is very limited. In Ethiopia, rubella is not prioritized disease under surveillance and its vaccine has not been introduced into infant vaccination schedule. Rumor of suspected rubella outbreak received on January 26/2018. The purpose of investigation was to establish rumor existence, describe cases epidemiologically, identify causative agent and source of the outbreak to support outbreak control activities. *Methods:* A1:2 unmatched case-control study conducted at General Tadesse Biru Primary School, Addis Ababa, Ethiopia from February 3-25/2018. Total of 41 cases and 82 controls included. Controls selected conveniently from same school and data collected using structured questioner. Data analysis done using Epi-info software version 7.2.1.0. *Result:* Total of 41 rubella cases identified. Index case and source of outbreak were not identified. Rubella sample positivity rate was 20%. First case seen on 5th January and last case on 19th February/2018. Most 23 (56.1%) cases were females and 17 (41.46%) among grade 1 and 2 students. Median age of cases was 10 years (IQR=4). Overall attack rate in the school was 1.39% and case fatality rate zero. All cases were complaining rash and 80.49% had fever. Educational status of grade 5-6 and 7-8 had 0.13- and 0.12-time reduced risk of developing rubella disease than grade 1-2 at P-value less than 0.05, respectively. *Conclusion:* Although index case and source of infection not identified, the outbreak might be driven by contact and sharing transportation service. Late notification causes late investigation and control. Provision of health education at school and community increase people's awareness on rubella that contribute to control the outbreak.

Keywords: Rubella Outbreak Investigation, School, Addis Ababa, Ethiopia, 2018

1. Introduction

Rubella is an infection caused by the rubella virus, often mild with half of people not realizing that they are infected. Rubella usually spread through the air via coughs of people who are infected. Diagnosis is confirmed by finding the virus in the blood, throat, or urine. There is no specific treatment for rubella; however, management is a matter of responding to symptoms to diminish discomfort. The virus tends to peak during the spring in countries with temperate climates.

Before the vaccine against rubella was introduced in 1969, widespread outbreaks usually occurred every 6–9 years in the United States and 3–5 years in Europe, mostly affecting children in the 5–9 years old age group. In Ethiopia, rubella vaccination has not been introduced into the infant vaccination schedule. [1-3]

Rubella can cause congenital rubella syndrome (CRS) in the newborn. As per the World Health Organization (WHO) estimate worldwide more than 100,000 children per year are born with CRS. [4, 5]

In African countries, including Ethiopia, CRS is widely under-recognized as a public health problem, and information on rubella and CRS epidemiology is very limited. Data on the burden of disease in developing countries have been also considered insufficient to make global recommendations for vaccine use. Surveillance for rubella or CRS does not exist in Ethiopia; however, the measles case-based surveillance system, established in 2004, includes laboratory testing for the detection of measles and rubella-specific antibodies. However, little is known of the magnitude and distribution of other febrile rash illnesses including rubella. [6-9]

Rubella is still common in some regions of the world and Susan E. Reef, team lead for rubella at the C.D.C.'s global immunization division, who joined in the announcement, said there was no chance it would be eradicated worldwide before 2020. The move in many countries towards accelerated measles control and measles elimination raises the question of the marginal cost of including rubella control strategies with this initiative. [6, 10]

Many countries had eradicated rubella from their country due to high attention they give to the disease, integrated effort, strong surveillance, data availability and provision of vaccine. On January 22, 2014, the World Health Organization (WHO) and the Pan American Health Organization declared and certified Colombia free of rubella and became the first Latin American country to eliminate the disease within its borders. On April 29, 2015, the Americas became the first WHO region to officially eradicate the disease. The last non-imported cases occurred in 2009 in Argentina and Brazil. Rubella is the third disease to be eliminated from the western hemisphere with vaccination after smallpox and polio. [11, 6, 10]

On January 26/2018 one of Ethiopian Public Health Institute (EPHI) staff had received a rumor of suspected rubella outbreak at General Tadesse Biru Primary School (GTBPS), Gulele sub city, Addis Ababa, Ethiopia. This outbreak investigation aims to confirm existence of the rumor, describe cases epidemiologically, identify source and control the outbreak at General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018.

2. Objective

2.1. General Objective

The general objective of this outbreak investigation was to confirm existence and control the outbreak at General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018.

2.2. Specific Objectives

The specific objectives of this outbreak investigation were:

- 1) To confirm the existence of the outbreak
- 2) To describe cases epidemiologically by person, place and time
- 3) To identify the source of the outbreak and other associated risk factors
- 4) To control and prevent current and future outbreak through appropriate intervention measures

3. Methods

The investigation was conducted at General Tadesse Biru Primary School found in District 09 of Gulele Sub city, Addis Ababa, Ethiopia 2018. The investigation was conducted from February 3 -25/2018. The study population were all students at General Tadesse Biru Primary School. Additional four cases (identified by active case searching from the community) and eight controls for these cases were also included from the community. The investigation team visited General Tadesse Biru Primary School for more information gathering about the rumor. Additionally, the school director, teachers, suspected cases and their families were interviewed. Burayu Health Center was visited for medical record and Burayu town Health Extension workers (HEWs) were also interviewed. The national measles laboratory located at EPHI were also visited for case-based review and to know results of collected samples.

A1:2 Unmatched Case-control study was also conducted. All suspected cases were included and controls, almost with similar exposure with the cases, were selected by convenient sampling method. Eight controls selected from the community for the four cases traced from the same community by active case searching and all the rest cases and controls were selected from General Tadesse Biru Primary School. Structured questionnaire was used for the data collection.

All questions were explained for data collectors and each question was requested clearly for cases and controls in similar manner. Data completeness and consistency was also checked before finishing each interview. Data was analyzed by using Epi-info software version 7.2.1.0. Permission was received from EPHI to do the investigation and informed verbal consent received from study units.

A total of eleven (11) adequate serum samples were collected from suspected cases and the rest suspected cases were linked epidemiologically.

Operational Definitions

Case: any student from GTBPS who fulfills the criteria for suspected rubella case during the study period.

Case Fatality Rate (CFR): The case fatality rate is the proportion of cases resulting in death.

Confirmed Rubella case: A suspected case from which rubella IgM antibody detected *or* rubella virus isolated *or* rubella viral RNA detected by RT-PCR *or* significant rise in rubella IgG antibody in paired sera. [12]

Control: was selected student from GTBPS with almost similar characteristics (exposure) to the cases except complaining sign and symptoms of the disease during the study period.

Epidemiologically linked Rubella Case: A suspected case which has not been adequately tested by laboratory and was in contact with a laboratory-confirmed rubella case 12–23 days before the onset of symptoms [12].

Rubella outbreak: If 2 or more laboratory-confirmed cases which are temporally related (with dates of rash onset occurring between 12 and 46 days apart) and

epidemiologically or virologically linked, or both. [12]

Suspected rubella case: is any person with fever and generalized maculopapular rash or clinician diagnosed rubella [13].

4. Result

4.1. Background

A total of 41 rubella cases were identified by home-to-home active case searching, line list review and General Tadesse Biru Primary School (GTBPS) visit. Of these, 4 cases were traced from the community during active case searching. Although the school registered suspected cases; they didn't identify the index case for the school and source of infection was also not known. The school had notified to Selam Health Center lately.

4.2. Laboratory Investigation Result

A total of ten (10) serum samples were collected from suspected cases and transferred to the national measles laboratory. All samples were tested negative for measles, two tested positives for rubella and two give equivocal result. This gives rubella positivity rate of 20%.

4.3. Descriptive Analysis

In describing cases epidemiologically 23 (56.1%) of the cases were females and 17 (41.46%) were from grade 1-2 students followed by grade 3-4 10 (24.39%). The overall attack rate in the school was 1.39% and highest attack rate (2.22%) seen among grade 1-4 students. Attack rate among female students were 1.78% and 1.31% among males. No one had developed complication and the overall case fatality rate was zero (Table 1).

The median age of cases was 10 years (IQR=4). Only 4 cases were traced from the community by active case searching with age greater than 15 years. Most of the cases were in the age group of 5 to 9 and 10 to 14 years (43.9% each). Bivariate analysis of age and sex variable revealed that, half of the cases 9 (50%) among males were between age group of 5 - <10 years, while the most affected age group among female cases were 10 - <15 years 10 (43.48%).

The analysis also revealed that students from 2 regions (Addis Ababa and Oromia), 4 zones/sub cities and 5 main kebeles were affected by the outbreak. Most 28 (68.29%) of the cases were from Oromia region and more than half 25 (60.97%) of cases were from Burayu town followed by Gulele Sub city 11 (26.83%), Sululta 3 (7.32%) and Kolfe keraniyo 2 (4.88%). The investigation results also revealed that 8 (19.51%) of the cases were from Keta kebele followed by Gefersa 7 (17.07%).

All cases were Oromo by ethnicity and almost half 19 (46.34%) of the cases were protestant religion follower followed by orthodox 13 (31.71%) and Muslims 9 (21.95%). More than half 22 (53.66%) of case's parent had learned above secondary school. Most 30 (73.17%) of the cases didn't know average monthly income of the family.

The first case was seen on 5th January/2018 and last case on 19th February/2018. Due to late investigation because of late notification almost one third (29.27%) of the cases didn't remember exact disease onset date. High number of cases was seen (pick) on 18th January/2018 (4cases) (Figure 1). In most of the cases 18 (43.90%) the rash had started from their face. Cases were complaining rash 41 (100%), fever 33 (80.49%), arthralgia 30 (73.17%), loss of appetite 24 (58.54%), lymphadenopathy 23 (56.1%) and cough 22 (53.66%).

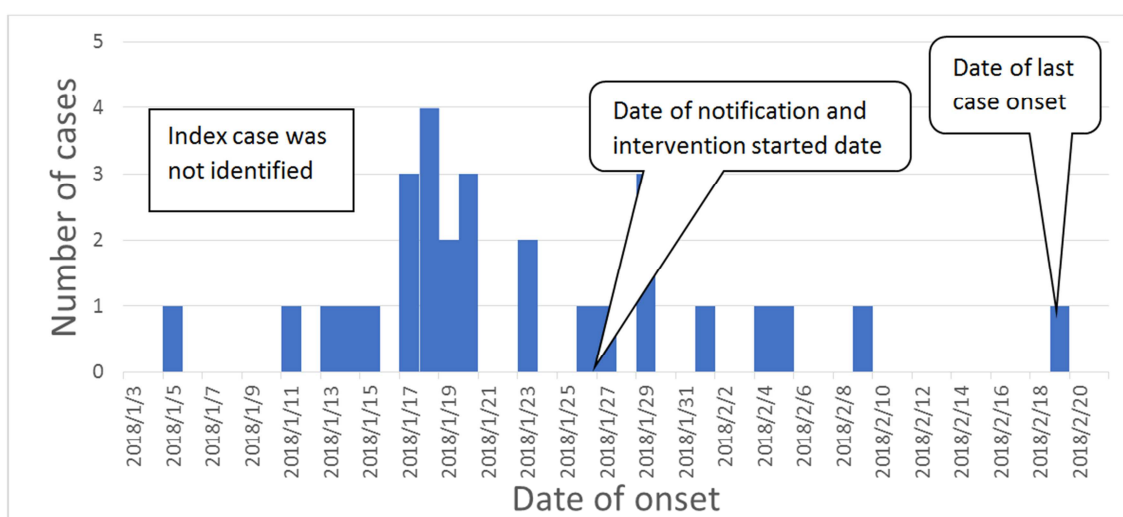


Figure 1. Epi-curve of rubella cases by date of onset, General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018.

In analyzing the house condition, 36 (87.80%) of cases have a house with at least one window and 24 (58.54%) of cases leave within 2 kilo meter distance from a health facility. The maximum family size of cases was twelve and lowest

was two. Almost half of the cases 21 (51.22%) have family size of less than or equal to five, ranging from 2 to 12.

Twenty-seven (65.85%) of the cases didn't know modes of transmission as well means of preventing transmission. Out

of those who know modes of transmission and prevention; 5 (35.71%) of cases know that rubella can be transmitted by close contact with affected individual. Six (42.86%) cases had mentioned more than one method of preventing transmission.

Majority 17 (41.46%) of cases know that any age of any sex can be affected by rubella (Figure 2) and 12 (29.27%) cases perceive that rubella is cured by medical treatment

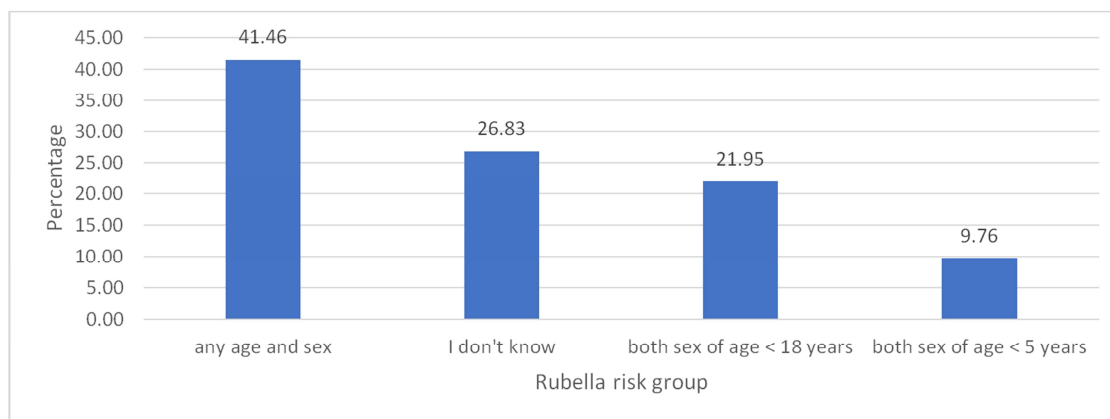


Figure 2. Distribution of rubella cases perception by rubella risk group, General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018.

Majority 29 (70.73%) of the cases didn't went to health facility to seek medical treatment. The rash has persisted for more than 3 days in almost half of the cases 20 (48.78%).

4.4. Hypothesis Generation

Based on the finding from descriptive analysis, the following hypothesis was developed: the risk of contracting rubella disease has an association with educational status of cases and their family, awareness status on modes of transmission, age group and female sex.

followed by traditional treatment 7 (17.07%). Of the total 41 cases; more than half 26 (63.42%) of them didn't take any treatment. Of those who take treatment; 10 (66.67%) of them had used modern type of treatment (antibiotics, TTC ointment and antipyretic) and the rest used traditional type of treatment like perfuming and fendisha. All cases had no travel history to any place out of their residence within 21 days before the rash onset and all cases had contact history.

4.4.1. Risk Factor Analysis

A total of 41 cases (all cases) and 82 controls, from the same school and community having almost similar exposure and characteristics with cases were selected conveniently. Most of the controls 46 (56.1%) were males. Majority 56 (68.29%) of controls were in age group of 10 to 14 years and median age was 12 (IQR=2.5). Majority 37 (45.12%) of controls were from grade 5-6. Forty-six (56.10%) of the controls parent had learned above secondary school (Table 1).

Table 1. Socio-demographic characteristics of cases and controls, General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018.

Variable	Options	Control number (%)	Case number (%)
Sex	Male	36 (43.9%)	23 (56.1%)
	Female	46 (56.1%)	18 (43.9%)
Age group	0-<5	2 (2.44%)	0 (0%)
	5 - <10	12 (14.63%)	18 (43.9%)
	10 - <15	56 (68.29%)	18 (43.9%)
	15 - <20	9 (10.98%)	2 (4.88%)
	20 - <25	2 (2.44%)	2 (4.88%)
	25 - <30	1 (1.22%)	1 (2.44%)
	Kindergarten	3 (3.66%)	1 (2.44%)
Cases/control educational status	Grade 1-2	9 (10.98%)	17 (41.46%)
	Grade 3-4	16 (19.51%)	10 (24.39%)
	Grade 5-6	37 (45.12%)	8 (19.51%)
	Grade 7-8	14 (17.07%)	4 (9.76%)
	Above 8	3 (3.66%)	1 (2.44%)
Parent educational status	Above Secondary school	46 (56.1%)	22 (53.66%)
	Secondary school	12 (14.63%)	5 (12.2%)
	Elementary school	8 (9.76%)	5 (12.2%)
	Read and Write	4 (4.88%)	4 (9.76%)
	Illiterate	2 (2.44%)	3 (7.32%)
	I don't know	10 (12.2%)	2 (4.88%)

Majority 78 (95.12%) of controls had house with at least one window and 48 (58.54%) of them didn't know modes of

transmission for rubella. Most of the controls 57 (69.51%) perceive that rubella can affect any sex of any age group.

4.4.2. Hypothesis Testing

Bivariate logistic regression model was used to test the association between all possible risk factors hypothesized above with contracting rubella disease. Educational status of cases and their family, cases awareness status on modes of transmission, age group and sex were the variables included in the bivariate logistic regression model. Those variables with P-value less than or equal to 0.25 were included in

multiple logistic regression model to control confounding effect of one variable on the other. Sex, educational level of the patient and their family were variables included in multivariate logistic regression model. Of those variables, educational status of grade 5-6 and 7-8 had 0.13- and 0.12-times reduced risk of developing rubella disease than a person of grade 1-2 at 95% CI of 0.04-0.42 and 0.03-0.52, respectively (Table 2).

Table 2. Multivariate logistic regression analysis of possible Rubella risk factors, General Tadesse Biru Primary School, Addis Ababa, Ethiopia 2018.

Variable	Category	Case	Control	COR (P-Value)	AOR (95% CI)
Sex	Male	18 (43.9%)	46 (51.10%)	0.61 (0.20)	0.55 (0.22-1.35)
	Female	23 (56.1%)	36 (43.90%)	*1*	*1*
Patient educational status	Grade 3-4	10 (24.39%)	16 (19.51%)	0.31 (0.05)	0.44 (0.12-1.57)
	Grade 5-6	8 (19.51%)	36 (43.90%)	0.11 (0.00)	0.13 (0.04-0.42)
	Grade 7-8	4 (9.76%)	14 (17.07%)	0.14 (0.01)	0.12 (0.03-0.52)
	Above grade 8	1 (2.44%)	3 (3.66%)	0.16 (0.13)	0.21 (0.01-2.97)
	kindergarten class	1 (2.44%)	3 (3.66%)	0.16 (0.13)	0.12 (0.01-1.60)
	Grade 1-2	17 (41.46%)	10 (12.20%)	*1*	*1*
	illiterate	3 (7.32%)	22.44	3.14 (0.23)	3.56 (0.45-28.44)
Family educational status	read and write	4 (9.76%)	4 (4.88%)	2.09 (0.33)	1.77 (0.31-10.18)
	elementary	5 (12.20%)	8 (9.76%)	1.30 (0.67)	1.67 (0.42-6.66)
	secondary	5 (12.20%)	12 (14.63%)	0.87 (0.82)	0.87 (0.24-3.16)
	above secondary	22 (53.66%)	46 (56.10%)	*1*	*1*

1 reference and P-value is significant at < 0.05.

5. Discussion

The school was newly opened by September/2017 and currently it is teaching 2669 students (1375 males and 1294 females). According to WHO guideline for rubella outbreak investigation and response in the WHO European region, 41.5% of the cases had fulfilled the clinical criteria for rubella surveillance and all of the cases fit with rubella outbreak definition. All cases had also fulfilled the surveillance cases definition for suspected rubella case and the outbreak definition. Such an outbreak was happened for the first time since the school opening. [12]

The occurrence of the outbreak causes student absenteeism from school but, it didn't cause an increase in health facility visit. This is because of people's perception that rubella has no medical treatment, rather traditional home treatment. Case parents were absent from their work to provide traditional therapy such as perfuming, fendisha (Amharic term) rather than visiting health facilities for secondary bacterial super infections and symptomatic treatment. This in turn cause productivity loss and challenge to have all the cases detail history (line list which reduce recall bias) and provision of health education for health facility visitors.

The rubella sample positivity rate was 20% which is very low compared to sample positivity rate of an outbreak occurred in Benshangul region (57%) and Addis Ababa (40%). Initially all samples were tested negative for measles which was also true for an outbreak occurred in Benshangul Gumuz region. The positive rubella test result in different outbreaks occurring in the country indicates increased incidence of rubella cases in the absence of rubella surveillance. [14, 15]

A total of 123 participants were included, which was two

times higher and 1.4 times less than the number of study participants in a study conducted at German Navy and Zimbabwe, respectively. Out of those 123 study participants, 52% were males, while all and 51.7% the study participants were males in a study conducted at German Navy and Zimbabwe. [16, 17]

Most study participants were in the age group of 10-14 years which is different from study conducted at Zimbabwe and German Navy where most of the study participants were in age group of 5-9 and 21-25 years, respectively. The median age of cases and controls in this study was 10 years (IQR=4) and 12 years (IQR=2.5), respectively which is higher than a study conducted at Zimbabwe where it was 6.5 years (IQR=4) and 5.5 years (IQR=8) for cases and controls respectively. The median age in rubella outbreak occurred in a school found in Addis Ababa was 4.6 years, lower than current study finding. [15-17]

In this study the overall attack rate in the school was 1.39% which was higher than attack rate in Dibate woreda (AR=0.3%) and very lower than attack rate in Wombera district (AR=8.8%) and rubella outbreak occurred in a school found in Addis Ababa (AR=10.92%). The attack rate among female students (1.78%) were higher than attack rate in males (1.31%) which was comparable finding with another outbreak occurred in school found in Addis Ababa. The case fatality rate for both outbreaks was zero. [14, 15]

Most of the cases, 56.1% in this study were females whereas in an outbreak occurred in Wombera and Dibate districts found in Metekel Zone of Benshangul Gumuz Region of Ethiopia, both sexes were affected almost equally. These findings also supported by finding from outbreak investigation conducted in Addis Ababa. A study conducted in Ethiopia also revealed 94.7% of the cases were under 15

years of age, which is higher than finding in this study where 87.8% of the cases were under 15 years of age. [14, 15, 18]

This study shows that 78.1% of cases didn't take antibiotic which was lower than finding from study conducted at Benshangul Gumuz region where 90% of cases didn't take antibiotic. Majority (48.78%) of the cases had family size of greater than 5 which is higher than study conducted in Benshangul Gumuz region (56.3% of cases had family size of >5). [14, 18]

A study conducted at Zimbabwe revealed that all care givers perceived rubella illness as measles and immunization is important for prevention which is supported by finding from this study. Our study revealed that 14.63% and 23.17% of cases and control, respectively know rubella is transmitted by close contact with rubella patients which is higher than finding in Zimbabwe where only 10.2% and 6.8% of cases and controls, respectively, know that. [17]

A study conducted at Zimbabwe revealed that, the majority of caregivers (97.8%) reported the situation to the health facility within two days of onset of rash but in this study no case families (care givers) had reported to a health facility. This indicates low community awareness status and weak linkage between communities and health sectors/departments. [17]

The multi variate logistic regression analysis indicates that the risk of contracting rubella disease among students of grade 5-6 and 7-8 is 0.13 and 0.12 times lower than students of grade 1 and 2 at P-value less than 0.05.

The school was closed for semester break (one-week duration), which creates good opportunity to minimize transmission between students. There was also good change in communities' awareness towards the event. Family members had minimized contact with cases and avoid sharing of clothes to minimize transmission, which contribute a lot to control the outbreak.

Rubella was not included among the 22 prioritized diseases and events included in the country's surveillance system. Rubella laboratory test was done after measles test result was negative. This might hinder allocation of budget for rubella related activities. Rubella vaccination was not included in the countries expanded program on immunization and there was no national rubella guideline. This might be due to lack of organized data and low attention given to rubella.

During the outbreak investigation process, we had conducted active case searching and provide health education in relation to the outbreak. In the health education, we had covered the three most common differential diagnostic diseases (measles, rubella and chickenpox). We had also announced 8335 a free toll found at National Emergency Operation Center for notifying any public health threat including the current event. Health education was also given at schools by Health Extension workers and Woreda PHEM Officers.

Line list format was printed and given for Burayu Health Center even though only 10 cases were registered. Any new information was shared on daily basis between EPHI,

Oromia Regional Health Bureau and Addis Ababa City Administration PHEM unit. PHEM Officers from national to woreda level, clinicians and laboratory experts from Burayu and Selam health center and Burayu town Health Extension Workers (HEWs), were participated in the outbreak response process.

Most of the data were collected from students who didn't remember some variables and late notification cause recall bias. These limitations reduced the data quality and completeness. Total number of students by age group was not available, so that, age specific attack rates was not calculated. Since Ethiopia doesn't have customized standard case definition for rubella, WHO outbreak definition for European regions was used.

6. Conclusion

Although the index case and source of infection was not identified, most probably the outbreak was driven by contact at school and sharing of common transportation service then spread to the community (family) through school children. Late case identification and notification cause late investigation and control after the disease was expanded. Provision of health education at school and community increase people's awareness on rubella that contribute to control the outbreak.

All level health departments should work closely with the school to have timely notification of any public health risk and unusual health events happened in a school. The Ministry of Health-Ethiopia need to consider an assessment on the burden rubella disease in the country to include it among the 21 prioritized diseases under surveillance and to consider inclusion of vaccination in the country's infant vaccination program. Finally, all level health departments should strengthen surveillance, proper case management and health education on rubella.

7. Limitations

Most of the data were collected from students at the school, who did not remember some variables such as exact onset date of their illness. This might affect the data quality and completeness. The first notification about the event was also delayed and many students was affected, even recovered, that causes recall bias. Some of the data collectors were not checked for completeness, causing some missed variables in the analysis.

Total number of students by age group was not available, so that, age specific attack rates was not calculated in all classified age groups. Since we (Ethiopia) have no customized standard case definition for rubella, WHO outbreak definition for European regions was used.

Competing Interests

The authors declare that they have no competing interests.

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