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Investigation of Mixed Outbreak (measles-rubella) in Rural Community Temanggung, Central Java

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Abstrak

Pada tanggal 31 Agustus 2016 terjadi peningkatan kasus dengan gejala demam dan ruam di masyarakat pedesaan Temanggung. Investigasi untuk memastikan kejadian luar biasa dan mengidentifikasi orang, tempat, waktu, faktor risiko, dan tindakan pengendalian. Penelitian ini menggunakan desain studi kasus-kontrol dengan rasio 1:1. Informasi mengenai karakteristik pasien dengan mewawancarai ibu. Mixed outbreak dimulai dari 28 Mei hingga 1 Oktober 2016. Kami menemukan 59 kasus di 3 dusun, gejala yang paling umum adalah demam (94,63%), ruam (88,14%), dan flu (47,46%). Tiga orang terkonfirmasi positif IgM rubella dan dua orang positif IgM campak. Attack rate tertinggi terjadi pada laki-laki (12,65%), usia ≥4 tahun (25%) dan tinggal di Kalitengah (74,57%). Sebanyak 38 kasus (64,41%) belum divaksin dan efektivitas vaksin sebesar 52,17%. Faktor risiko yang berhubungan dengan mixed-outbreak adalah tidak divaksinasi (OR=4.47, 95% CI =1.92-10.47). Mixed outbreak telah dikonfirmasi secara klinis, epidemiologis, dan serologis. Kami melakukan beberapa pengendalian seperti promosi kesehatan dan distribusi vitamin A. Kami juga telah bekerja sama dengan para pemangku kepentingan untuk meningkatkan cakupan vaksinasi campak.

Abstract

On August 31,2016 there were more cases with symptoms of fever and rash in rural community Temanggung. An investigation to confirm the outbreak and identify the person, places, times, risk factors and control measures. It was a case-control study design 1:1 ratio. Information on characteristic patients was obtained by interviewing the mother. A mixed outbreak started from May 28 to October1,2016. We found 59 cases in 3 sub-villages, most common symptoms are fever (94.63%), rash (88.14%), and flu (47.46%). Three were confirmed positive rubella IgM and two were positive measles IgM. The highest attack rates were male (12.65%), ≥4 years old (25%), and in Kalitengah (74.57%). A total of 38 cases (64.41%) had not been vaccinated, and the effectiveness of the vaccine is 52.17%. The risk factors associated with mixed outbreak were unvaccinated (OR=4.47, 95% CI =1.92-10.47). A mixed outbreak has been confirmed clinically, epidemiologically, and serologically. We did some control such as health promotion and vitamin A distribution. We have also worked with stakeholders to increase measles vaccination coverage.

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INTRODUCTION

Measles may be an exceedingly infectious viral contamination caused by measles *morbillivirus*. It remains a noteworthy cause of passing in young children worldwide despite the accessibility of secure and compelling immunization (WHO, 2017a). WHO reports that the disappointment in immunizing children with two dosages of measles-containing antibody (MCV) was the most significant cause of the increase in measles cases and passings between 2016 and 2019 (WHO, 2020). In 2019, CDC and WHO detailed the number of measles cases worldwide, which came to 870,000, the highest number since 1996. The passing toll has come to 207,500, an increment of 50% compared to 2016 (WHO, 2022).

Unvaccinated infants under the age of 12 months have a moderate risk of contracting measles. However, measles complications increase the risk of morbidity and mortality in children (≥1–5 years old). Furthermore, the overall risk for individuals with impaired immune systems is moderate. Since they typically do not exhibit severe illness or consequences, unvaccinated adults and older people (over the age of five) are thought to be at low to moderate risk of contracting measles. Lastly, the population immune to measles has a minimal risk because of the lifetime protection against natural disease or the strong immunity provided by the two-dose vaccination program. (ECDC, 2024).

Rubella is a contagious viral infection usually occurs in children and young adults. The average incubation period for rubella is 14 days, ranging from 12 to 23 days. Symptoms are usually mild, and up to 50% of infections may be asymptomatic or subclinical. In young children, a rash is often the first symptom. A prodrome may last 1-5 days in older children and adults with low-grade fever, malaise, lymphadenopathy, and upper respiratory symptoms preceded by a rash. Rubella infection in pregnant women can cause fetal death or a congenital disability known as congenital rubella syndrome (CRS). CRS covers a wide range of congenital disabilities, such as deafness, eye abnormalities (cataracts, glaucoma, retinopathy, microphthalmia), and congenital heart disease (CDC, 2015; UNICEF, 2022).

The rubella outbreak in Kuyu occurred in children less than 15 years old in rural areas. A community with crowded conditions, large family members or community, diarrhea in the last 14 days, not receiving Vitamin A in the last six months, and contact with people with the symptoms of rubella were the significant factors driving the outbreak (Abdulkadir, 2021). The rubella outbreak usually had multiple intermittent peaks during its course. The attack rate was higher in females in males and higher in 3–5 years than those in 5–8 years children. People who got rubella were vaccinated against measles but unvaccinated against rubella (Dinede, 2019).

The differential diagnosis that most closely resembles rubella is measles. Measles is an infectious disease characterized by red macular patches lasting three or more days and preceded by a fever of 380°C accompanied by one of the symptoms of cough, flu, or red eyes. Measles is more severe if the person is malnourished, vitamin A deficient, immunocompromised, and treatment is delayed (WHO, 2017b). Surveillance sensitivity for measles and rubella remained sub-optimal in several endemic countries, resulting in underreporting and underestimation of the disease burden (Bahl, 2023).

Every year, surveillance activities report more than 11,000 suspected cases of measles, and from the results of confirmation laboratory, 12-39% of them will be measles (lab confirmed), whereas 16-43% are definite rubella. From 2010 to 2015, it is estimated that there were 23,164 measles cases and 30,463 rubella cases (Kemenkes RI, 2017). Elimination of rubella is likely achievable in all countries, but measles elimination is not possible in some countries. The subnational model of measles transmission highlighted inequity in routine coverage as a likely driver ofthe continuity of endemic measles

transmission in a subset of countries (Winter, 2022).

Measles outbreaks can occur when there are five or more clinical cases within four weeks of successive clusters that have been shown to have an epidemiological relationship. The frequency of measles outbreaks in Indonesia in 2016 was 129 cases, with a total of 1,511 cases. Frequency and number of outbreaks Cases of measles outbreaks have increased compared to the previous year (Kemenkes RI, 2016). Based on a situation analysis of communicable diseases, measles is also one of the top five public health problems in some cities in Indonesia (Masruroh, 2022).

Only 60% of measles outbreaks were confirmed by lab testing, although 17% of rubella outbreaks and 18% of mixed epidemics were. In 5% of cases, there was neither rubella nor measles. Dry months saw the majority of cases. Rubella cases were observed at older ages than measles infections. A handful of chosen districts were the source of most outbreak reports. In order to establish a diagnosis and focus on eradicating cases, laboratory diagnosis is crucial for both measles and rubella (Choudhary, 2018).

According to a report by Tretep Medical Center on July 11, 2016, some patients have fever and rash accompanied by cough, flu, and conjunctivitis symptoms. Some even have diarrhea and pneumonia. All patients with this symptom are residents of Bonjor Village, Tretep district. On August 31, 2016, the staff of Tretep Health Center reported that the Temanggung district health department found 37 cases with similar symptoms. Conspicuous signs and symptoms suggest that two diseases with the same symptoms are measles and rubella (Puskemas Temanggung, 2016).

The investigation was conducted on September 2, 2016, to verify the diagnosis, identify the outbreak, describe the outbreaks by person, time, and place, and determine the transmission source, mode of transmission, and take preventive measures.

METHODS

This outbreak investigation uses a descriptive and case-control study design ratio 1:1. We collected the data from August until September 2016 in Tretep. The population consists of residents of Bonjor, district of Tretep. Cases defined as people with fever, rash accompanied by one or more symptoms of cough, flu, conjunctivitis, diarrhea, and pneumonia or test results confirming rubella IgM and measles IgM detected in May-October 2016 and lives in Bonjor village, Tretep district. Control-defined subjects were people without fever or rash accompanied by one or more symptoms of cough, flu-like conjunctivitis, diarrhea, and pneumonia who lived in Bonjor village, Tretep district.

All patients who experienced symptoms of fever and rash accompanied by one or more symptoms of cough, cold, conjunctivitis, diarrhea, and pneumonia were taken as samples. Meanwhile, neighbors of sufferers who were not sick were used as controls.

Information on age, sex, date of onset, place of residence, signs, symptoms, exposure, and vaccination history was collected through interviews with mothers using structured questionnaires. PHC staff collected samples of blood at random from the afflicted population. Laboratory criteria used for diagnosis were antibody titers of at least 4-fold, virus isolation, or the presence of measles or rubella-specific immunoglobin M (IgM) antibodies.

Visits to patients' homes are based on the case address obtained from the Bonjor Village midwife. We also find new cases by visiting homes and asking patients or their families if other patients have similar symptoms. The main symptoms are fever and rash, with one of the symptoms of cough, flu, and conjunctivitis. Interviews with midwives and immunization officers from public health centers (PHCs) were conducted to gather information on vaccination coverage.

Secondary data was taken from visits to the Tretep Community Health Center and Bonjor Village Health Center (Pos Kesehatan

Desa); the patient reported data with fever and rash symptoms accompanied by cough, cold, and conjunctivitis symptoms. Demographic and geographic data were also collected in Bonjor Village and from the Temanggung District Health Service, namely W2 report data and monthly reports.

The dependent variables were disease status, categorized with "cases" and "control". The independent variables included sex, age, contact history, and vaccination. Sex was categorized into female and male. Age was subdivided into three groups ≤4 years, 5-14 years, and 15-19 years. Contact history was derived from the question, "Did you have interaction with the patients before you got sick?" The respondent reported "yes" and "no" contact history. For the vaccination status derived from the question "Did he/she get measles immunization?", respondents reported "yes" and "no".

We presented the descriptive analysis using the proportions of all variables. The attack rate of the cases was calculated according to age, sex group, and place of living using demographic data obtained from health facilities and local authorities. We constructed an epidemic curve to test the dynamics of disease. We also estimate vaccination rates in the population based on interviews with mothers. Then, we used chi-square tests on two variables to see if there was a link between disease status and all variables. We used a significance level of $p<0.05$ for this test. We also conducted a multivariate analysis for variables with a p-value less than 0.25. We employed logistic regression and reported the findings using an odds ratio (OR) and a 95% confidence interval (CI). We constructed models in the multivariate investigation to identify factors that influence mixed (rubella-measles) outbreaks. We determined statistical significance using a significance level of $P<0.05$. We analyzed the data using Stata 13 software. No ethical committee review was indicated, as this epidemiological investigation was conducted purely in the context of a public health response to an outbreak.

RESULT AND DISCUSSION

Through investigation, we found 59 cases with clinical symptoms. Most of the patients had fever (91.53%), rash (88.14%), and flu (47.46%) (Figure 1).

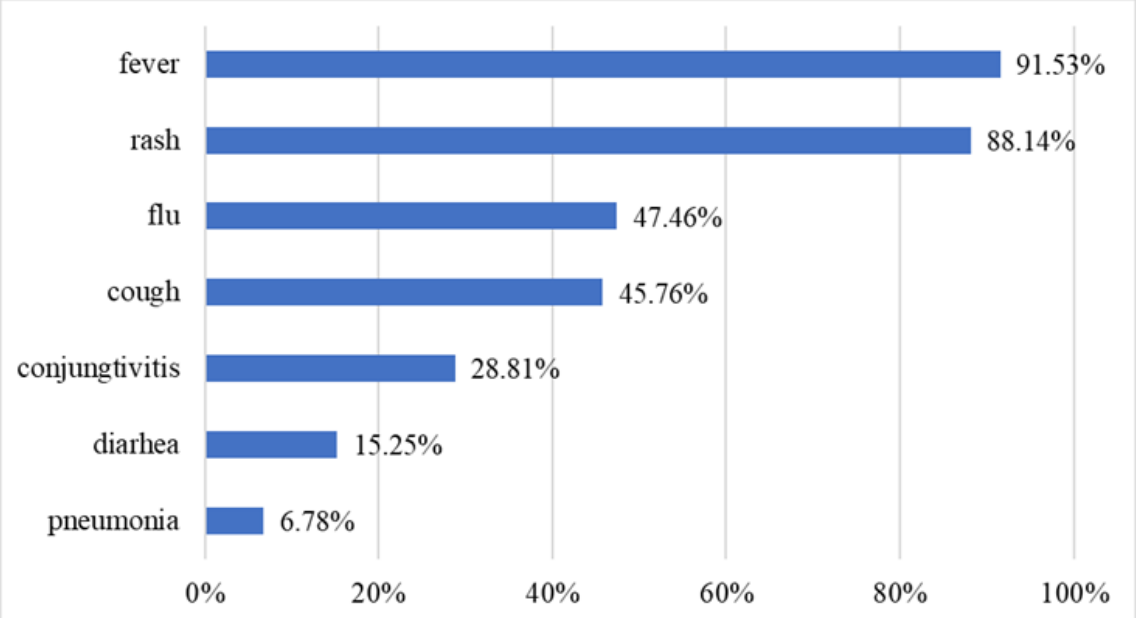

Figure 1. Signs and symptoms (n=59) in mixed outbreak (measles-rubella) in rural community Temanggung District, Central Java, Indonesia, 2016

Table 1. Rubella and Measles Laboratory Examination Results in Bonjor Village, Tretep District, Temanggung, 2016

Identity	Result	
	IgM Measles	IgM Rubella
1	Negative	Positive
2	Negative	Positive
3	Negative	Positive
4	Positive	ND
5	Positive	ND
6	Negative	Negative
7	Negative	Negative

Confirmation of the diagnosis is also done by taking a blood sample. Test results showed that three samples were positive for rubella and two samples were positive for measles (Table 1).

The majority of cases are male (54.24%), aged 4 years or older (62.71%), and live in the sub-village of Kalitengah (74.58%). The highest specific attack rate (AR) was among children ≤ 4 years old (AR=25 per 100 population) and living in the sub-village of Kalitengah (AR=23.78 per 100 population) (Table 2).

According to their mother's information, out of 59 cases identified in the village, 74.58% had contact with other cases before the onset of illness. We also asked about their vaccination status, 64.51% of cases were not vaccinated against measles. Variables significantly associated with outbreaks were people 5-14 years old (OR=0.003; 95% CI=1.45-6.61) and vaccination status (OR=0.0001; 95%CI=1.92-10.47). The results of the case-control study are presented in Table 3.

Table 2. The specific attack rates of mixed outbreak of measles-rubella in rural community in Temanggung District, Central Java, Indonesia, 2016

Variables	Number of cases (n=59)		Total population	Attack Rate (per 100 population)
	n	%		
Sex				
Male	32	54.24	253	12.65
Female	27	45.76	225	12.00
Age Group				
≤4	37	62.71	148	25.00
5-14	21	35.59	187	11.23
15-19	1	1.69	143	0.70
Sub-Village				
Kalitengah	44	74.58	185	23.78
Krajan	11	18.64	209	5.26
Banaran	4	6.78	84	4.76

Table 3. Bivariate analysis of mixed outbreak of measles-rubella in rural community in Temanggung District, Central Java, Indonesia, 2016

Risk factor	Cases (n=59)		Control (n=59)		OR	95% CI	p value
	n	%	n	%			
Sex							
Female	27	45.76	32	54.24	ref		
Male	32	54.24	27	45.76	1.40	0.63-3.08	0.3573
Age group							
≤4	37	62.71	21	35.59	ref		
5-14	21	35.59	37	62.71	3.10	1.45-6.61	0.003**
15-19	1	1.69	1	1.69	1.76	0.10-29.64	0.694
Contact history							
No	15	25.42%	18	30.51%	ref		
Yes	44	74.58%	41	69.49%	1.28	0.53-3.13	0.5383
Vaccination status							
Yes	21	35.59%	42	71.19%	ref		
No	38	64.41%	17	28.81%	4.47	1.92-10.47	0.0001***

In the multivariate analysis, we found that vaccination status (adjOR = 4.47; 95% CI = 1.92-10.47) was related and significant for mixed measles-rubella cases (Table 4).

Table 4. Multivariate analysis of mixed outbreak of measles-rubella in rural community in Temanggung District, Central Java, Indonesia, 2016

Risk factor	Model 1	Model 2
Age group		
<=4	ref	
5-14	1.97 (0.85-4.55)	
15-19	1.47 (0.07-28.55)	
Vaccination Status		
Yes	ref	ref
No	3.49 (1.52-7.99)**	4.47 (2.05-9.70)***
aic	153.66	152.22
bic	164.75	157.76
ll	-72.83	-74.11
r2_p	0.109	0.09

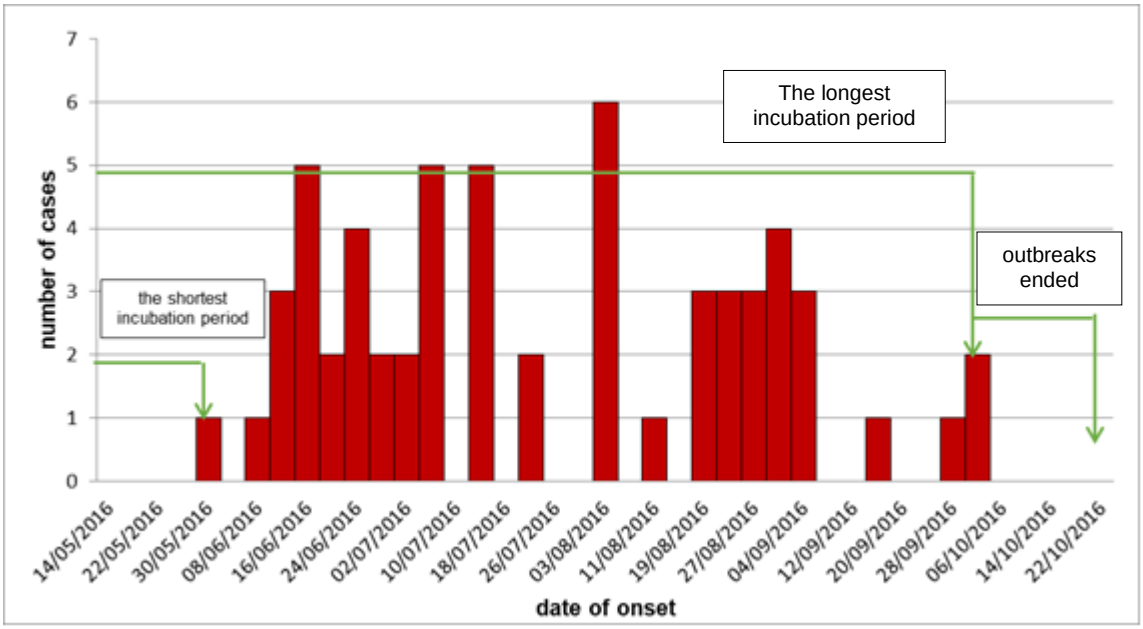

Figure 2. Epidemic Curve of Mixed Outbreak (Measles-Rubella) May 28 - October 1, 2016, in Rural Community, Temanggung District, Central Java

Table 5. Mixed Outbreak Case-Control Data (Rubella and Measles) Based on Immunization Status

Vaccination status	Case	Control	Total
No	38	17	55
Yes	21	42	63
Total	59	59	118

We have identified case cases in the area reported by local community leaders on May 28, 2016, of the village of Bonjor and the highest number of cases reported on October 1, 2016. Then, person-to-person transmission began to occur, and several transmission peaks can be seen from this curve. Epidemic curves show that dynamic epidemics have several cases. The peak of transmission occurred on June 16 (6 cases), July 14 (5 cases), and August 3 (6 cases). The epidemic curve indicated the dynamic outbreak that there were several generations of cases with propagated outbreaks several peaked, and the highest picked around August 3, 2016 (6 cases). The last case occurred on October 1, namely 1 case. The outbreak status is declared to have stopped after passing 2 incubation periods for rubella and measles. No related deaths were reported during the outbreak (CFR=0). (Figure 2).

The vaccination rate in Temanggung in 2016 was around 91%, but in this region, it was between 32.5% and 73% between 2013 and 2015. According to the interview with the mother, the vaccination rate was 35.59 %. At the same time, the effectiveness of the vaccine for people is 52.17% (Table 5).

$$\text{Vaccine efficacy} = \frac{\left(\frac{38}{38+17}\right)\left(\frac{21}{21+42}\right)}{\left(\frac{38}{38+17}\right)} \text{ x } 100\%$$

$$= \frac{(0{,}69-0{,}33)}{0{,}69} \text{ x } 100\% = 52.17\%$$

A mixed measles-rubella outbreak occurred in 3 sub-villages of a rural community in Temanggung in May-October 2016. The seasonality of the suspected measles-rubella outbreak was similar in Maharashtra, India, and is divided into two seasons: February-May and September-December (Vaidya, 2016). From the epidemic curve, we found that the index case was 2 years old, boy-children. These findings confirm the previous reports that children younger than 5 years and those aged 5–15 years old remain the most vulnerable groups to measles and rubella infection, respectively, representing key target groups for catch-up

immunization efforts (Jallow, 2022). The previous study cohort included children aged 8–29 months, which showed that <10 months may still have had persisting maternal antibodies. However, it was found that by 8 months of age, virtually all children had lost their maternal antibodies (Hefele, 2021).

The identification of the mixed measles and rubella epidemic in this community is also based on measles and rubella incidence data over the past 3 years. If an epidemic occurs in an area where IgM is positive for rubella and IgM is positive for measles, the mixed measles and rubella epidemic can be identified (WHO, 2017b). A high prevalence of anti-measles and anti-rubella antibodies was found in unvaccinated children. It indicated widespread circulation of both viruses and possibly underreporting of measles and rubella cases. Longer time since vaccination (>180 days ago) was also associated with higher seroprevalence (Hefele, 2021). In this investigation, we found 3 samples were positive for rubella and 2 for measles. Like measles-rubella in Papua, IgG prevalence rates were 62.6% for measles and 82.0% for rubella. The IgG prevalence for rubella was higher than measles in these groups (Ichimura, 2022).

In terms of AR per person, males (AR=12.6) were higher than females (AR=12), similar to a mixed outbreak in Senegal (Jallow, 2022). This could be because males are more mobile or socially active than females (Nassar, 2021). AR was higher in people younger than four years old (AR=25). This is consistent with another study that found that people aged < 5 years are more affected due to reduced vaccination rates and the accumulation of susceptible populations in < 5 years (Nassar, 2021). In general, children aged 0-6 years and adults aged 26-45 had a higher incidence of the disease than other age groups after 2012. According to the report, the benefits of vaccination were short-lived, and resistance declined after six years of age nine months old, which is why babies are susceptible to measles (Chong, 2018).

A case-control study performed during this outbreak demonstrated using a two-variable analysis that individuals aged 5 to 14 years (OR=3.10; 95% CI=1.45-6.61) and unvaccinated individuals (OR = 4.47; 95% CI = 1.92 -10.47) were independently and significantly associated with mixed outbreaks (measles-rubella). Younger populations account for more confirmed cases, possibly because young adults are in contact with infected surfaces and are exposed to infected airborne droplets more often than other age groups. They tend to underestimate the risk of disease (Yu, 2022). Previous outbreaks in India showed that the majority of both measles (96.9%) and rubella (77.9%) infections were in unvaccinated patients (or those with unknown vaccination status) (Jallow, 2022). This study suggests that young people may be considered a high-risk group for measles and rubella, so multiple vaccinations are needed to prevent the spread and transmission of measles and rubella (Yu, 2022).

Mitigation efforts undertaken by local health workers include treatment, diagnosis confirmation, vitamin A provision, and school counseling (elementary and kindergarten). However, cases continued until October 1, 2016. This was because people were still exposed to the disease in the community and vaccination rates were lower. Vitamin A is effective in treating measles and may reduce morbidity and mortality. Acute measles promotes vitamin A deficiency by depleting vitamin A stores and increasing its use, leading to severe infections. WHO recommends a dose of 200,000 IU of vitamin A once daily for two consecutive days for all children 12 months of age and older with measles, while younger children should receive a low dose (Vemula, 2016).

Depending on the region, cases of rubella and measles have spread to three villages of Bonjor village. Most measles and rubella cases occurred in the sub-village of Kalitengah (23.78%). Kalitengah is the most populous sub-village of Bonjor village. In addition, the educational institutions (kindergarten, primary, and secondary) in Bonjor village are concentrated in the sub-village of Kalitengah.

People with no history of contact with an infected person had a 79% lower risk of contracting measles than those with a history of exposure. In a previous outbreak in schools, most frequent school contacts could increase the likelihood of virus transmission to susceptible hosts, as measles is a highly contagious disease. respiratory airborne transmission (W/Kidan, 2021).

According to interviews with local midwives in this area, vaccination rates in Bonjor village have not reached the target. These outbreaks are mainly seen in densely populated areas and states. The chance of contracting measles is 90% in exposed and unvaccinated people. This cascade can proliferate in tight-knit communities, leading to disease outbreaks (Sanyaolu, 2022). Factors that influence immunization coverage are family support, access information, distance from home to healthcare services, and availability of measles immunization/vaccine (Lestari, 2023). The measles-rubella vaccination coverage is probably due to pre-existing weaknesses in the immunization program. The lowered population immunity likely contributed to the measles outbreak (Rockson, 2024). The measles vaccine is highly effective, and analyses of a large measles outbreak in a German school show that giving more than one dose of the vaccine can prevent infection in 99% of people (Althaus, 2015).

Most measles cases occur in children in school, and a strengthening campaign conducted for teachers and comrades-in-arms-teachers implies sharing knowledge about measles (Liu, 2024). In most daycare centers and schools, measles vaccination is usually mandatory for children. It can be concluded from the statistical data that the measles vaccine provides compelling evidence to reduce the incidence of this disease. Those most at risk, such as college students, healthcare workers, and those who travel frequently, should be vaccinated significantly (Sanyaolu, 2022). Vaccine efficacy in this area was 52.17%; this is one reason for the persisting high incidence of measles and rubella could be the low efficacy of the MR vaccine and the weak response/seroconversion of children to the two components of the vaccine (Hefele, 2021).

Strengthening surveillance for rubella and measles cases was required to diminish the episodes. Efficient observation utilizing the case definition to distinguish suspected cases and conducting efficient research facility testing for moving forward announcing. The contrast in measles and rubella counteracting agent predominance in inoculated children reflects higher immunogenicity of the rubella component of the antibody and/or a more dynamic circulation of the rubella infection (Hefele, 2021). Interaction and cooperation between the government and relevant sectors, such as groups and regional religious authorities, are also required. Therefore, to overcome public reluctance and boost vaccine uptake, policymakers and health authorities should collaborate with influential opinion leaders in the community, especially religious figures (Oktavianus, 2023).

Measles and rubella infection transmission in any nation undermines end in all nations. More grounded bolster and facilitated procedures, all-inclusive, inside locales, and over-transmission squares must be created to complement the person's national endeavors. Endeavors to realize and keep up measles and rubella disposal must be conveyed through significant fortifying of essential well-being care frameworks that successfully convey scheduled immunization. Progressing measles and rubella immunization scope is seen as an imperative marker for advancing toward accomplishing value in inoculation and essential wellbeing care (Moss, 2021).

CONCLUSION

There were 59 cases with symptoms of fever (91.53%), rash (88.14%), flu (47.46%), cough (45.76%), conjunctivitis (28.81%), diarrhea (15.25%) and pneumonia (6.78%).

There has been a mixed outbreak of rubella and measles in Bonjor Village, Tretep District. Laboratory examination results showed that there were three positive samples for rubella and two positive samples for measles. The highest number of attacks occurred in men (12.65%), in the age group ≤4 years (25%), and living in Kalitengah (23.78%). The risk factor associated with mixed outbreaks (rubella and measles) is not receiving measles immunization (OR=4.47, CI=1.92-10.47, p=0.0001). The source of transmission (index case) was a 2-year-old male toddler who fell ill on 28 May 2016. The mode of transmission can be seen from the epidemic spread curve which shows that the source of the outbreak transmission did not originate from a disease. The exposure is single, but from person to person so the spread is faster and more extensive.

Non-vaccination is a risk factor for mixed measles-rubella outbreaks in Temanggung District. A vaccination campaign is needed to increase the number of measles and rubella (MR) vaccines for nine months to <15 years old in the community, involving local stakeholders. Strengthen surveillance systems for forecasting, preparedness, early detection, and response to mixed measles-rubella outbreaks and case management through technical training in outbreak management and surveillance. There may have been a bias in recall regarding vaccinations among children in the area. So, in the future, we need to respond quickly to manage outbreaks.

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