ORIGINAL ARTICLE

Who Would Get Measles in Petaling District? A Trend Analysis of Measles Outbreak From 2014-2018

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ABSTRACT

Introduction: Measles outbreaks are endemic in Southeast Asia. A possible reason for such outbreaks is low vaccine coverage. In Malaysia, there is a lack of studies on measles outbreaks. The urban district of Petaling in Selangor, Peninsular Malaysia, reported a high number of outbreaks in 2014–2018. Thus, we analysed the trend of measles outbreaks and identify the common characteristics of measles cases in Petaling District. **Methods:** This was a cross-sectional study using secondary data from the Petaling District Health Office online surveillance system. Data from 2014 until 2018 from the e-Measles and eWabak systems were extracted, and the trend and common characteristics of measles cases were analysed. **Results:** A total of 48 outbreaks involving 124 cases were reported during the period investigated. The outbreaks showed an increasing trend from 2.1% in 2014 to 37.5% in 2016, and decreased slightly from 29.2% in 2017 to 27.1% in 2018. The common characteristics were age 1 to <7 years (50.8%), female sex (55.6%), Malay ethnicity (89.5%), Malaysian citizenship (95.2%) and being unvaccinated (55.6%). Of the cases, 63.7% were admitted to hospital, and siblings were the common source of infection (75.8%). Most cases occurred at home (75.8%). Most of the children who were infected at home were unvaccinated (60.6%). **Conclusion:** Unvaccinated children aged 1 to <7 years are at highest risk of contracting measles and spreading it to their siblings. Thus, awareness of the importance of vaccination needs to be emphasized to their parents to prevent related issues such as vaccine hesitancy.

Keywords: Measles outbreak, Children, Unvaccinated

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INTRODUCTION

Measles is a highly infectious disease caused by a paramyxovirus of the genus Morbillivirus, and is transmitted through aerosol or droplet (1). After an incubation period of 8–12 days, an individual infected with the measles virus will develop a fever and maculopapular rash, and cough or coryza or conjunctivitis (2). Confirmed measles cases are defined as laboratory-confirmed cases or cases epidemiologically linked with laboratory-confirmed cases (3, 4). Measles may cause complications such as diarrhoea, pneumonia, meningitis or encephalitis, which require hospitalisation and are associated with risk of mortality, especially among children (5, 6). However, it can be prevented by the measles vaccine, commonly given as the measles-mumps-rubella (MMR) combination vaccine (1, 2).

A measles outbreak is defined as two or more confirmed measles cases that are epidemiologically linked (7). In Europe, a large outbreak of measles had occurred in the Netherlands in 1999, involving 2961 cases and three deaths, followed by a large measles outbreak in Dublin in July 2000 (8). In the United States, there were 15 outbreaks, which accounted for 79% (227 cases) of total cases in January to May 2014 (9), and five measles outbreaks that accounted 70% of total cases in the same period in 2015 (10). A large measles outbreak had also occurred in South Africa, spanning 2 years, i.e. from 2003 until 2005, and involved 1676 laboratory-confirmed cases (11). In 2009 until 2011, there were another 195 measles outbreaks in South Africa, which involved 18,431 cases (12, 13). Meanwhile, in the Southeast Asian region, a total of 2530 laboratory-confirmed measles outbreaks were reported in 2003 until 2013 (14). In Malaysia, measles was endemic before the monovalent measles vaccine was introduced in 1982 (15). After the introduction of the vaccine, measles incidence showed a reducing trend [65.2 cases per 100,000 population in 1982 (15) to 22.3 cases

per 100,000 population in 2004 (15) to 6.1 cases per 1,000,000 population in 2013 (16)].

The World Health Organization (WHO) had recommended the Global Vaccine Action Plan in 2012 with the goal of eliminating measles in four WHO regions by 2015 and in five regions by 2020 (17). In conjunction with the WHO Measles Elimination Programme, the Ministry of Health Malaysia (MOH) initiated an enhanced laboratory-confirmed measles case-based surveillance and MMR vaccine coverage programme in the community (15). The two doses of vaccination against measles virus were introduced in the Malaysia Expanded Immunization Program (EIP) in 2004. However, scattered measles outbreaks continue to occur throughout the country despite the good immunisation coverage reported (15). According to Hagan et al. (2018), measles incidence in Malaysia had increased from 2013 at 6.1 cases per 1,000,000 population to 52.1 cases per 1,000,000 population in 2017 (18). The possible reason for the measles outbreaks is reduced MMR vaccine coverage, which occurred more in urban areas (19, 20). However, studies on situational analysis of measles outbreaks and the common characteristics of measles cases, especially in urban areas in Malaysia, remain inadequate. Most published reports and situational analysis have focused on the number of measles cases and their incidence only. Petaling is an urban district in Selangor, Peninsular Malaysia. The district has reported a high number of measles outbreaks from 2014 until 2018. Thus, the present study is aimed at analysing the trend of measles outbreaks in Petaling District and identifying the common characteristics.

MATERIALS AND METHODS

Study design

This was a cross-sectional study based on secondary measles outbreak data from the measles surveillance system, involving 48 outbreaks with a total of 124 measles cases between 1 January 2014 until 31 December 2018 in the Petaling Health District. Of these cases, there were 69 female children and 55 male children aged 3 months to 9 years. The data were extracted from the online surveillance systems e-Measles and eWabak, which include cases from government and private clinics and hospitals.

Case definition

A measles outbreak is defined as when ≥2 laboratory-confirmed cases or epidemiologically linked cases are reported. In the present study, people who had received one or two doses of measles vaccine were considered vaccinated; those who had not received any measles vaccination, who were not qualified for vaccination due to age or who had unknown vaccination status were considered unvaccinated. The place of infection was categorised as follows: 1) school, when the measles outbreak occurred among children from the same school; 2) childcare, when the outbreak occurred among children who went to the same childcare centre; 3) home, where the outbreak occurred among siblings; and 4) public area, when measles transmission occurred among children who played together in the same housing area. The inclusion criteria for this study were: 1) ≥2 laboratory-confirmed measles cases; 2) ≥2 epidemiologically linked cases; and 3) measles outbreaks that occurred between 1 January 2014 until 31 December 2018. The exclusion criteria for this study were: 1) sporadic measles cases; 2) incomplete measles outbreak data.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 21.0 (IBM SPSS 21). The graphs were created using Microsoft Excel 2017. In this study, we performed descriptive analysis for: 1) trend of measles outbreaks; 2) socio-demographics; 3) characteristics of measles outbreaks; 4) place of infection and vaccination status of measles outbreaks; and 5) vaccination status and ethnicity of cases. The statistical significance was set at $p<0{\cdot}05$.

RESULTS

Based on measles outbreaks notifications in e-Measles and eWabak between 1 January 2014 until 31 December 2018, 48 outbreaks were reported, involving 124 (14.6%) cases. We extracted all 48 measles outbreaks for analysis. The trend of measles outbreak showed a 35.4% increase between 2014 until 2016 and decreased slightly (10.4%) from 2017 to 2018 (Fig. 1).

The incidence of measles outbreaks was high in children aged 1 to <7 years (50.8%), females (55.6%), Malaysians (95.2%) and Malays (89.5%) (Table I). Most measles outbreaks were laboratory-confirmed cases (94.4%) (Table II). The incidence of measles outbreaks was also high among unvaccinated children (55.6%) (Table II), where most cases occurred at home (75.8%) (Table II). A high number of cases were hospitalised (63.7%) (Table II), and measles outbreaks that occurred at home were highest among unvaccinated children (60.6%) (Table

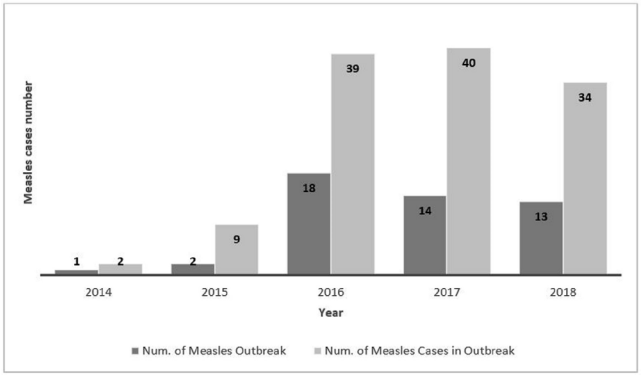

Figure 1: Trend of measles cases and outbreaks in Petaling District from 2014 until 2018

Table I: Socio-demographic characteristics of children with measles in Petaling District by year

	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	Total n (%)
Age						
< 9 months old	0 (0)	0 (0)	4 (10.3)	2 (5)	4 (11.8)	10 (8.1)
9 months - < 1 y.o	0 (0)	5 (55.6)	8 (20.5)	4 (10)	4 (11.8)	21 (16.9)
1 y.o to < 7 y.o	2 (100)	2 (22.2)	20 (51.3)	24 (60)	15 (44.1)	63 (50.8)
7 y.o and above	0 (0)	2 (22.2)	7 (17.9)	10 (25)	11 (32.4)	30 (24.2)
Gender						
Male	1 (50)	6 (66.7)	21 (53.8)	11 (27.5)	16 (47.1)	55 (44.4)
Female	1 (50)	3 (33.3)	18 (46.2)	29 (72.5)	18 (52.9)	69 (55.6)
Citizenship						
Malaysian	2 (100)	9 (100)	36 (92.3)	40 (100)	31(91.2)	118 (95.2)
Non-Malaysian	0 (0)	0 (0)	3 (7.7)	0 (0)	3 (8.8)	6 (4.8)
Race						
Malay	2 (100)	9 (100)	31 (79.5)	40 (100)	29 (85.3)	111 (89.5)
Chinese	0 (0)	0 (0)	2 (5.1)	0 (0)	0 (0)	2 (1.6)
Indian	0 (0)	0 (0)	3 (7.7)	0 (0)	2 (5.9)	5 (4.0)
Others	0 (0)	0 (0)	3 (7.7)	0 (0)	3 (8.8)	6 (4.8)

Table II: Characteristics of measles outbreak cases in Petaling District by year

	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	Total n (%)
Type of measles cases						
Confirmed						
Lab confirmed	2 (100)	8 (88.9)	37 (94.9)	36 (90)	34 (100)	117 (94.4)
Epid linked	0 (0)	1 (11.1)	2 (5.1)	4 (10)	0 (0)	7 (5.6)
Vaccination status						
Yes	2 (100)	4 (44.4)	8 (20.5)	13 (32.5)	2 (5.9)	29 (23.4)
No						
Unvaccinated	0 (0)	3 (33.3)	23 (59)	17 (42.5)	26 (76.5)	69 (55.6)
Unqualified	0 (0)	2 (22.2)	7 (17.9)	3 (7.5)	4 (11.8)	16 (12.9)
Unknown	0 (0)	0 (0)	1 (2.6)	7 (17.5)	2 (5.9)	10 (8.1)
Place of infection						
School	0 (0)	6 (66.7)	6 (15.4)	3 (7.5)	0 (0)	15 (12.1)
Childcare	0 (0)	0 (0)	5 (12.8)	0 (0)	8 (23.5)	13 (10.5)
Home	2 (100)	3 (33.3)	26 (66.7)	37 (92.5)	26 (76.5)	94 (75.8)
Public area	0 (0)	0 (0)	2 (5.1)	0 (0)	0 (0)	2 (1.6)
Admission status						
Hospitalised	1 (50)	9 (100)	21 (53.8)	33 (82.5)	15 (44.1)	79 (63.7)
Not hospitalised	1 (50)	0 (0)	18 (46.2)	7 (17.5)	19 (55.9)	45 (36.3)

III). The majority of the unvaccinated children were of Malay ethnicity (85.5%) (Table IV).

DISCUSSION

Malaysia implemented the National Immunisation Programme (NIP) in 1982 (one dose) and 2004 (two doses), thus the incidence rate of measles was reduced from 65.2 cases per 100,000 population in 1982 (15) to 6.1 cases per 1,000,000 population in 2013 (16). This was also recorded in Petaling, where measles outbreak cases were reduced from 2014 to 2018. However, this reduction still has not achieved the target of the Malaysia elimination programme, as scattered outbreaks continue to occur in the country, despite the high reported vaccination coverage (>95%) for both the Malaysia EIP and supplementary immunization activities (SIAs), which have been implemented in a timely manner (21). Here, our findings show that the age group most affected age 1 to <7 years (50.8%). Adults in Malaysia are less affected by measles due to the implementation of the measles immunisation programme in 1982. This

Table III: Place of infection and vaccination status of the children infected with measles in Petaling District

	Place of infection				Total, n (%)
	School	Childcare	Home	Neighbour	
Vaccination status					
Yes	5 (33.3)	3 (23.1)	20 (21.3)	1 (50)	29 (23.4)
No					
Unvaccinated	6 (40)	5 (38.5)	57 (60.6)	1 (50)	69 (55.6)
Unqualified	4 (26.7)	4 (30.8)	8 (8.5)	0 (0)	16 (12.9)
Unknown	0 (0)	1 (7.7)	9 (9.6)	0 (0)	10 (8.1)

Table IV: Vaccination status according to ethnicity of the children infected with measles in Petaling District

	Ethnicity				Total, n (%)
	Malay	Chinese	Indian	Others	
Vaccination status					
Yes	27 (93.1)	0 (0)	2 (6.9)	0 (0)	29 (100)
No					
Unvaccinated	59 (85.5)	2 (2.9)	3 (4.3)	5 (7.2)	69 (100)
Unqualified	16 (100)	0 (0)	0 (0)	0 (0)	16 (100)
Unknown	9 (90)	0 (0)	0 (0)	1 (10)	10 (100)

finding is similar to that of a measles outbreak report in Kalimantan, Indonesia, in 2014, which involved 23 children aged 6 months to 11 years, with a median age of 41 months (22). This is contrary to the findings of others, where the measles outbreaks involved older children. For example, a measles outbreak in Germany in 2010 mostly involved older children aged 11–15 years (23), and a measles outbreak in Singapore in 2011 involved children aged 8–16 years (24).

In terms of ethnicity, we found that the majority of children infected with measles were Malay (89.5%) and the majority of unvaccinated children were also Malay (85.5%). The reason for this is unknown, given the inadequate data on the reason for not receiving vaccination. Some studies have also indicated that measles outbreaks are common among certain ethnicities or types of community. For example, most measles outbreaks have occurred in orthodox Protestant communities in the Netherlands (25) and in orthodox Jewish communities in Israel (26), which do not believe in vaccination due to the strong emphasis placed on religious belief, prayer and mysticism (25, 26). Similarly, a qualitative study performed to understand measles vaccination hesitancy in Sudan reported that most parents from the Ansar Al-Sunna group refused vaccination because they believed that vaccination is a Jewish conspiracy against the Muslim brotherhood, there were issues regarding the halal status of vaccines, and the parents' religious beliefs that only God can protect their children from diseases (27).

In the present study, more than half of the measles outbreak cases involved unvaccinated children. Some studies have reported similar findings. In the report on the measles outbreak in a public hospital in Singapore from 2–20 August 2011, none of the 14 children involved had been vaccinated against measles (24). A situational analysis of a measles outbreak in the Netherlands also showed that more than 90% of measles outbreaks occurred in the unvaccinated population (25). We are unable to suggest an explanation for the children not receiving measles immunisation in Petaling District, as the related data are unavailable. However, other studies in Spain (28), Germany (23) and Greece (29) have revealed that measles outbreaks that occurred in these countries in 2010 mostly involved unvaccinated children whose parents refused measles vaccination (23, 28, 29). In Malaysia, Kusnin (2017) showed that the trend for vaccine refusal has slowly increased starting from 2013 (21). Elsewhere, Lim et al. showed that the main reason for vaccine refusals in Kinta, Perak, was preference for alternative treatment, the assumption that vaccines have no effect, and doubt regarding the contents of a vaccine (30).

The data from the present study also show that 63.7% of the measles outbreak cases were hospitalised, and additional 36.3% of cases consulted an outpatient department. However, we did not analyse the level of severity and the reason for hospital admission, as the data contained insufficient information. In a study done in Japan, most children with measles were admitted to the hospital for pneumonia, followed by encephalitis, intestinal complications, conjunctivitis and otitis media (5). In Pakistan, children with measles developed complications such as pneumonia, encephalitis and diarrhoea with dehydration, which required hospitalisation (6).

We also found that 75.8% of the disease transmission occurred at home. Of this, the majority (60.6%) were

unvaccinated. This indicates that the outbreak cases that occurred at home were among siblings who were unvaccinated. A similar finding was also reported in measles outbreaks in Germany in 2010 (23). However, a study in the Netherlands showed higher attack rates of measles outbreaks among school students as compared to household members (25). The possible reason for measles outbreaks being common among siblings at home is that transmission occurs from person to person via airborne droplets (31). The measles virus is highly infectious and easily spread, with high virulence. A child exposed to an infected person with measles in closed areas such as at home has a higher risk of contracting the disease, as there are many opportunities for contact between infected and susceptible people (32, 33).

Strength and limitations

The limitations of this study were insufficient data on parents' socio-demographics and the severity of each case in the surveillance system. Moreover, the reason the children did not receive their vaccinations is not fully explained. Improvement of the surveillance system is required via the addition of more information such as parents' sociodemographic data, namely, their education level, household income, occupation and reasons for not vaccinating their children. Besides that, measles outbreaks investigations need to be strengthened to determine the severity of each case. This will provide more information for planning on prevention and control. The strength of the study is that it is the first study using big-data analyses on the trend of measles outbreaks in Petaling District involving 5-year data, and we studied the common characteristics of the measles outbreaks. Our findings will provide initial information for devising interventions for preventing measles outbreaks in Petaling District.

Recommendations

Measles is still endemic in Petaling District, where unvaccinated preschool-age children, particularly Malay children, are contracting measles infection. Thus, awareness campaigns via a transdisciplinary approach involving the Malaysian Ministry of Health, Ministry of Education, all religious centres, political leaders and non-governmental organizations (NGOs) need to be strengthened, especially towards parents with unvaccinated children. The provision of sufficient information on the safety and positive health effects of MMR vaccination would encourage parents to have their children receive the MMR vaccination, which might prevent measles transmission among their children at home. Besides that, measles SIA for children aged 1–15 years in low-coverage areas with 3-yearly mopping-up campaign needs to be conducted continuously. This would increase herd immunity in the community, which would protect other children against measles infection. Lastly, more studies are recommended to further explore the root cause of measles outbreaks by improving the measles outbreak investigations and surveillance system data in Petaling District.

CONCLUSION

Unvaccinated children of pre-schooling age in Petaling District are prone to measles infection. Parental education, continuous coverage of SIAs and improving surveillance system data are recommended to resolve the endemic problem in the district.

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