



Outbreak, Surveillance and Investigation Reports

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Epidemiology of a Mumps Outbreak and Effect of Measles, Mumps and Rubella Vaccination in Nan Province, Thailand, June to December 2010

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Abstract

In early September 2010, a nurse in Pua District Hospital observed an unusual increase in number of mumps cases and an outbreak investigation was conducted on 5 Oct 2010. This study described epidemiological characteristics of the outbreak as well as secondary attack rates and outcome of MMR vaccination campaign conducted during the outbreak. We reviewed medical records at Pua District Hospital and interviewed the cases' family members, classmates and teachers. A clinical case was a person with acute parotitis or acute lymphadenitis at preauricular, submandibular or submental area with onset of illness from 1 Jun to 31 Dec 2010. A confirmed case was a clinical case who tested positive for mumps viral IgM by enzyme-linked immunosorbent assay (ELISA), mumps virus by polymerase chain reaction (PCR) or virus isolation. During the investigation period, we also conducted a single mass measles, mumps and rubella (MMR) vaccination campaign, targeting children aged 1-6 years in 10 sub-districts. From 1 Jun to 13 Oct 2010, 129 clinical cases (attack rate = 0.2%) were found in 11 out of 12 sub-districts. Of which, 70.4% were less than six years old children. Among 10 laboratory confirmed cases, six were positive for mumps IgM by ELISA and four positive for mumps virus by PCR, with one case revealed as genotype J. Secondary attack rate among 1-6 years old children was 31.4%. Attack rate among children aged 1-6 years during the pre-vaccination campaign period was 289.4 per 10,000 populations and decreased to 54.3 per 10,000 after the campaign. This investigation supported the Ministry of Public Health to change from using monovalent measles vaccine to MMR vaccine for 9-month old children in June 2010.

Keywords: mumps outbreak, MMR vaccination, Pua District, Thailand

Introduction

Mumps is a contagious viral disease caused by mumps virus (genus Rubulavirus, family Paramyxoviridae). Prodromal symptoms include fever, headache, muscle ache, tiredness and loss of appetite followed by swelling of salivary glands. Complications include encephalitis, orchitis, oophoritis and deafness. The virus has low infectivity and is spread by airborne, droplet or direct contact with saliva of an infected person. Incubation period is 16-18 days (range 12-25 days).¹

Mumps is a vaccine preventable disease, but continues to be endemic in many regions of the world. In 2012, only 120 (62%) out of 194 World Health Organization (WHO) member countries around the

world included mumps vaccine in their immunization program.² In Thailand, health officials required to report anyone with mumps through the national disease surveillance system. Most reported cases were children and young adults (Figure 1).

Expanded program on immunization (EPI) in Thailand was commenced in 1980. Monovalent measles vaccine was introduced in 1984 for children at nine months of age. In 1997, measles, mumps and rubella (MMR) vaccine containing the Jeryl Lynn strain was introduced to Grade one students. In June 2010, the monovalent measles vaccine was changed to MMR vaccine (Urabe strain) for children at nine months of age.³ It induces immunity in more than 90% of recipients, which is long-lasting and may be lifelong.⁴

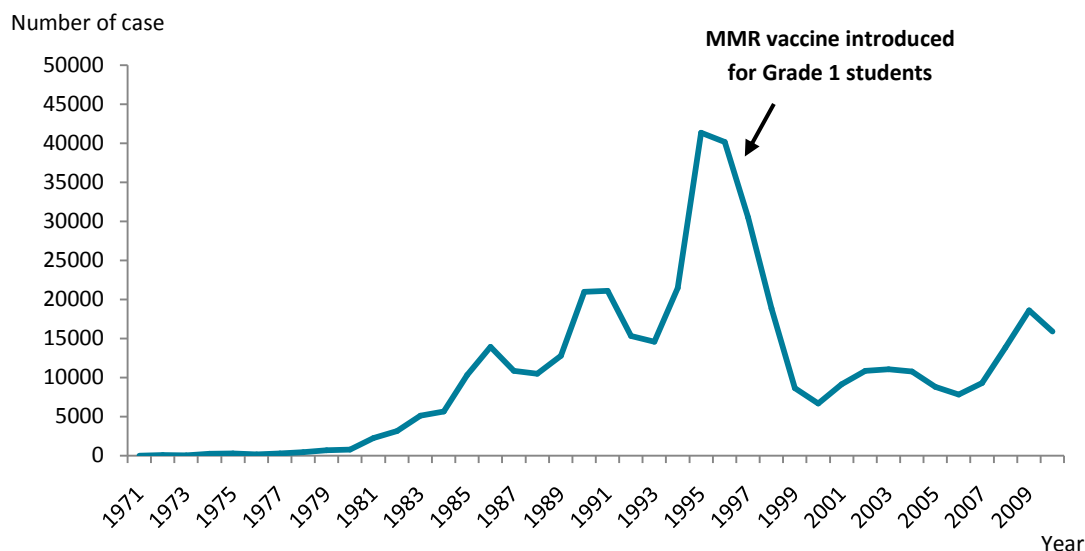


Figure 1. Number of reported mumps cases by year in Thailand, 1971-2010

No mumps outbreak was reported in Pua District during 2004 to 2010. However, in early September 2010, a nurse in out-patient department of Pua District Hospital observed an unusual increase in number of mumps cases and alerted epidemiologist in the hospital. The Bureau of Epidemiology (BOE) received the notification on 1 Oct 2010. Due to unusual rise in number of mumps cases, an outbreak investigation was conducted. This report described epidemiological characteristics of the mumps outbreak in Pua District, including secondary attack rate within households and outcome of implementing a mass MMR vaccination campaign during the outbreak.

Methods

Study Population

Nan Province in northern Thailand composes of 15 districts, including Pua District which is further divided into 12 sub-districts. Pua District is considered to be a rural district and in 2010, had a population of 64,318 in 657 km² (97.9 persons per km²). Average population per sub-district was 5,360 (range 2,775-7,569). Main occupation of residents was agriculture.⁵ Two of the poorest villages in Thailand situated in Pua District. Average annual income in these two villages was 442 and 648 Baht.⁶

Case Finding and Surveillance

The study period was from 1 Jun through 31 Dec 2010. We reviewed medical records from 1 Jun to 13 Oct 2010 in Pua District Hospital and five health centers, which included patients diagnosed with mumps cases (ICD-10 codes of B260 and B269) and patients with clinical history compatible with mumps: swelling of salivary gland (K112), epididymo-orchitis

(N45) and acute lymphadenitis (L040). Active case finding was conducted by interviewing the cases' family members, classmates and teachers who had onset of illness from 1 Jun to 13 Oct 2010. We also surveyed two villages that had the highest number of reported mumps cases. Moreover, we interviewed cases, physicians and public health workers.

A clinical case was defined as a person who lived in Pua District with onset of illness from 1 Jun to 31 Dec 2010 and had acute swelling at preauricular, submandibular or submental areas; or was diagnosed as mumps or acute lymphadenitis at preauricular, submandibular or submental areas; or had a complication due to mumps. A confirmed case was defined as a clinical case that met at least one of the following criteria: positive for mumps virus by polymerase chain reaction (PCR) or viral isolation, or positive for mumps virus immunoglobulin M (IgM) antibody by enzyme-linked immunosorbent assay (ELISA).

Buccal swabs for PCR and viral isolation were collected from cases within seven days from onset of illness. Single serum specimens for mumps IgM antibody were collected from cases within 8-30 days after onset. All specimens were tested at the Thai National Institute of Health (NIH).

In addition, we reviewed the national database of reported mumps cases from Pua District during 2005 to 2009 to understand the epidemiology of mumps in this area. The team, including officers from BOE, local district health office and provincial health office, also conducted passive surveillance from 1 Jun to 31 Dec 2010. When cases went to hospital or health centers and were diagnosed as mumps, epidemiologist reported the cases by a computer program.

Secondary Attack Rate in Households and Effectiveness of Mumps Vaccine

We surveyed 265 out of 382 households in two villages with the highest number of reported cases to describe transmission in the households and assess effectiveness of mumps vaccine. We interviewed at least one member per household about history of mumps, clinical presentation and vaccination history of all family members. Households with at least one mumps case were included in the study.

A primary case was a clinical or confirmed case who had the earliest onset in each household. A co-primary case was a clinical or confirmed case with onset date of less than seven days after the primary case. A secondary case was a clinical or confirmed case who had an onset date of 7-30 days after the primary case. Household contacts included any household member who were not primary or co-primary cases. We calculated secondary attack rate by the following equation: (number of secondary cases / number of household contacts) x 100.

For calculating effectiveness of mumps vaccine in the households, we limited our analyses to household contacts who aged 1-20 years without history of mumps before 1 Jun 2010. The age range was chosen based on eligibility for routine mumps vaccination in Thailand and reliability of vaccination history. Vaccine effectiveness (VE) was assessed using the equation: $VE = [(SAR_U - SAR_V) / SAR_U] \times 100\%$, where SAR_U is secondary attack rate among unvaccinated contacts and SAR_V is secondary attack rate among vaccinated contacts. We used Epi Info software (version 3.5.3) for statistical analyses.⁷

MMR Vaccine Intervention

During the investigation period, the Ministry of Public Health conducted a single mass MMR vaccination campaign for children aged 1-6 years without history of mumps or MMR vaccination and lived in one of 10 sub-districts (Pa Klang, Pua, Sathan, Woranakhon, Chai Watthana, Sila Phet, Sila Laeng, Chedi Chai, Ngaeng and Uan Sub-districts). We calculated age-specific attack rates for the period before (12 Sep to 11 Oct 2010) and after (7 Nov to 31 Dec 2010) the mass MMR vaccination.

Data Analysis

We described quantitative and qualitative findings using median and range for quantitative variables, and proportion and ratio for qualitative variables. VE was calculated in point and 95% confidence interval estimation.

Results

Study Population

In addition to passive surveillance, we conducted active case finding and assessed secondary attack rates in two villages: Village 3 in Pa Klang Sub-district (749 people in 143 households) and Village 1 in Pua Sub-district (435 people in 122 households). People in Village 3 belonged to hill tribes. Average number of family members in Village 3 was five, with 16.2% of population aged 1-6 years. Village 1 was an urban area, with average number of family members of four and 6.2% of population as 1-6 years of age.

In Pua District, attack rates of mumps were approximately 5-10 during 2003-2009 and rose over the baseline since May 2010 (Figure 2).

The index case had onset on 5 Jun 2010 and number of cases gradually increased from August to September, which showed a propagated source and most of the cases were children (Figure 3). From 1 Jun through 13 Oct 2010, 129 clinical cases and 10 laboratory confirmed cases (attack rate two per 1,000) were reported. Of which, 124 cases were reported from passive surveillance and 15 cases were identified from active case finding. Male and female ratio was 1.2:1. Median age was 6 years (interquartile range 4-10.5 years). Majority of the cases were 1-6 years old (70.4%) followed by those of at least 20 years (19.3%), 7-12 years (8.1%) and 13-19 years (2.2%). Most of the cases had swollen salivary glands (91.0%) and fever (64.0%). One orchitis case was reported, but no encephalitis or fatality.

Case Finding and Surveillance

Cases were reported from 11 out of 12 sub-districts in Pua District. Sub-districts with the highest attack rates were Pa Klang (5.8 per 1,000), Pua (4.2 per 1,000), Sathan (3.0 per 1,000), Worranakhon (2.7 per 1,000) and Sila Laeng (1.6 per 1,000). Furthermore, MMR vaccine coverage among Grade one students in these five sub-districts was more than 95% in 2009 and pre-vaccination period of 2010 (Table 1).

Laboratory specimens were collected from 20 cases (11 buccal swabs and nine single sera). PCR results were tested positive for four specimens (36.4%) and one revealed as genotype J (wild type). Viral isolation was not possible as none of the specimens showed any growth. Single serum for mumps IgM antibody was positive by ELISA in six (66.7%) out of nine specimens.

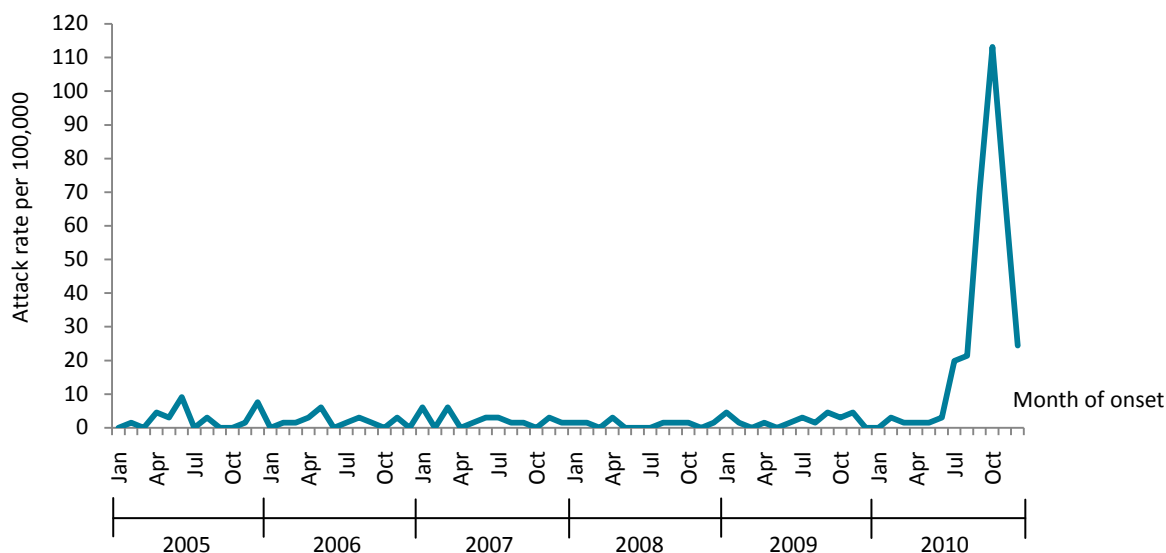


Figure 2. Attack rate of mumps per 100,000 populations by month of onset in Pua District, Nan Province, Thailand, 2005-2010

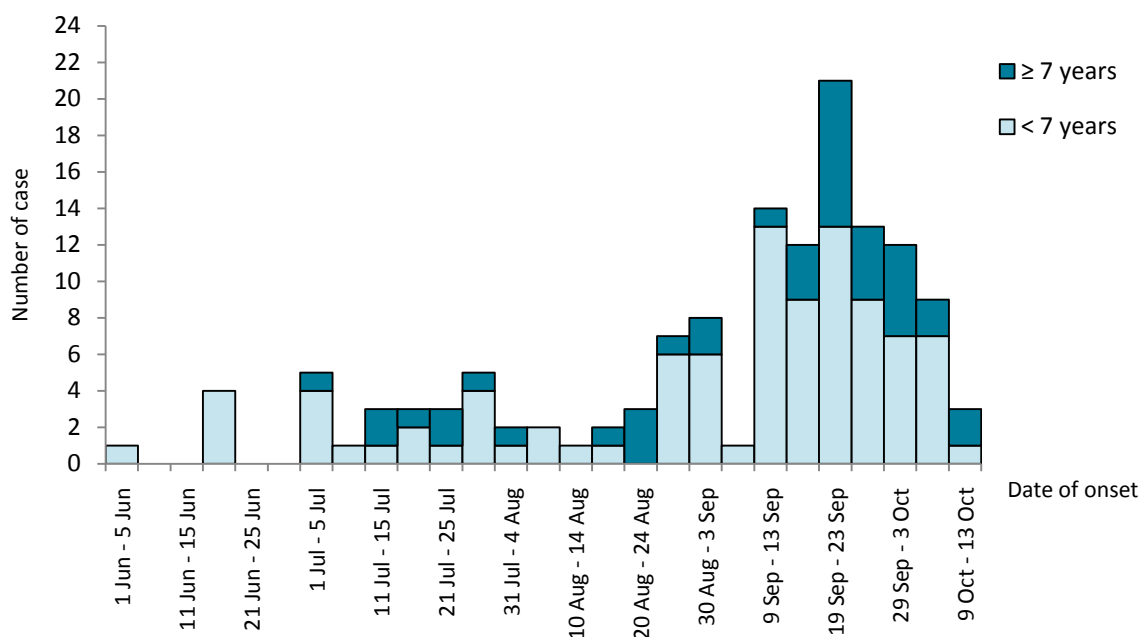


Figure 3. Number of mumps cases by date of onset and age group in Pua District, Nan Province, Thailand, 1 Jun to 13 Oct 2010 (n=136)

Secondary Attack Rate in Households and Effectiveness of MMR Vaccine

Of 265 households surveyed, 57 households had at least one mumps case. Among 364 members in 57 households, there were 57 primary cases, two co-primary cases and 305 contacts.

Total 22 secondary cases were identified with secondary attack rate of 7.2%. Most secondary cases were aged 1-6 years (50.0%) and 7-12 years (27.3%). Secondary attack rate was the highest among 1-6 years (31.4%) followed by those aged 7-12 years (14.6%). Though Village 1 had no secondary case, Village 3 had secondary attack rate of 8.2% (Table 2).

Among 128 contacts aged 1-20 years in both villages, 89 (69.5%) had received one dose of MMR vaccination and 39 (30.5%) were unvaccinated before 1 Jun 2010. There were five cases among vaccinated contacts (5.6%) and 12 cases among unvaccinated contacts (30.8%). VE was 82% (95% CI= 52-93%).

MMR Vaccine Intervention

A single mass MMR vaccination was conducted for 1-6 years old children in 10 sub-districts from 12-17 Oct 2010 as children in that age group had the highest attack rate. Of total 2,979 children, 2,364 children (79.4%) received the MMR vaccination while 615 children did not receive the vaccine because they were

Table 1. Number of clinical and confirmed mumps cases, and MMR vaccine coverage of 5 sub-districts with the highest attack rates in Pua District, Nan Province, Thailand, 1 Jun to 13 Oct 2010

Rank	Sub-district	Number of case	Total population	Attack rate (per 1,000)	Percent of MMR vaccine coverage among Grade 1 students	
					2009	2010
1.	Pa Klang	43	7,421	5.8	95	100
2.	Pua	32	7,569	4.2	100	100
3.	Sathan	19	6,173	3.0	96	100
4.	Woranakhon	17	6,110	2.7	100	100
5.	Sila Laeng	8	4,865	1.6	97	100

Table 2. Epidemiologic characteristics of primary cases and secondary attack rates within households in Village 3, Pa Klang Sub-district and Village 1, Pua Sub-district of Pua District, Nan Province, Thailand, 1 Jun to 31 Oct 2010

Characteristic	Number of primary case	Number of household member	Attack rate of secondary case (%)
Total	57	305	22 (7.2)
Age group (year)			
<1	0	12	0
1-6	46	35	11 (31.4)
7-12	9	41	6 (14.6)
13-19	2	48	1 (2.1)
>20	0	169	4 (2.4)
Gender			
Male	33	150	12 (7.5)
Female	24	155	10 (6.5)
Village			
Village 3	47	269	22 (8.2)
Village 1	10	36	0

absent during the intervention period. After 21 days of mass vaccination, five children who received the vaccine and seven children who did not receive the vaccine developed mumps.

Attack rate of 1-6 years old children during pre-vaccination period (12 Sep to 11 Oct 2010) was 289.4 per 10,000 populations and attack rate during post-vaccination period (7 Nov to 31 Dec 2010) was 54.3 per 10,000 populations. This indicated a decline after the mass vaccination. However, attack rates of other age groups which were not targeted in the mass vaccination did not decline obviously (Figure 4).

Discussion

The 2-3 months delay in reporting of this outbreak might be due to lack of awareness on diagnosis of mumps among public health workers. Epidemiologists did not know about rise in number of mumps cases until a nurse in Pua Hospital alerted

them and hence, triggered relevant control measures. Provincial or district health officers should train public health workers to identify, detect and report clinical mumps cases, and implement control measures in time to prevent further spread. Immediate and thorough investigation and response were imperative in preventing secondary cases of mumps.⁸ In addition, epidemiologists in district level should have awareness to detect unusual surge in notifiable diseases and report to provincial level.

Only small numbers of specimens were tested because asymptomatic cases could not be identified. About 20% of people infected with mumps virus could be asymptomatic.⁹ Although secondary attack rate within households in this outbreak (31% of 1-6 years old age group) did not deviate from that of the other outbreaks (31% in less than 15 years old children)¹⁰, mumps virus can be spread even seven days before

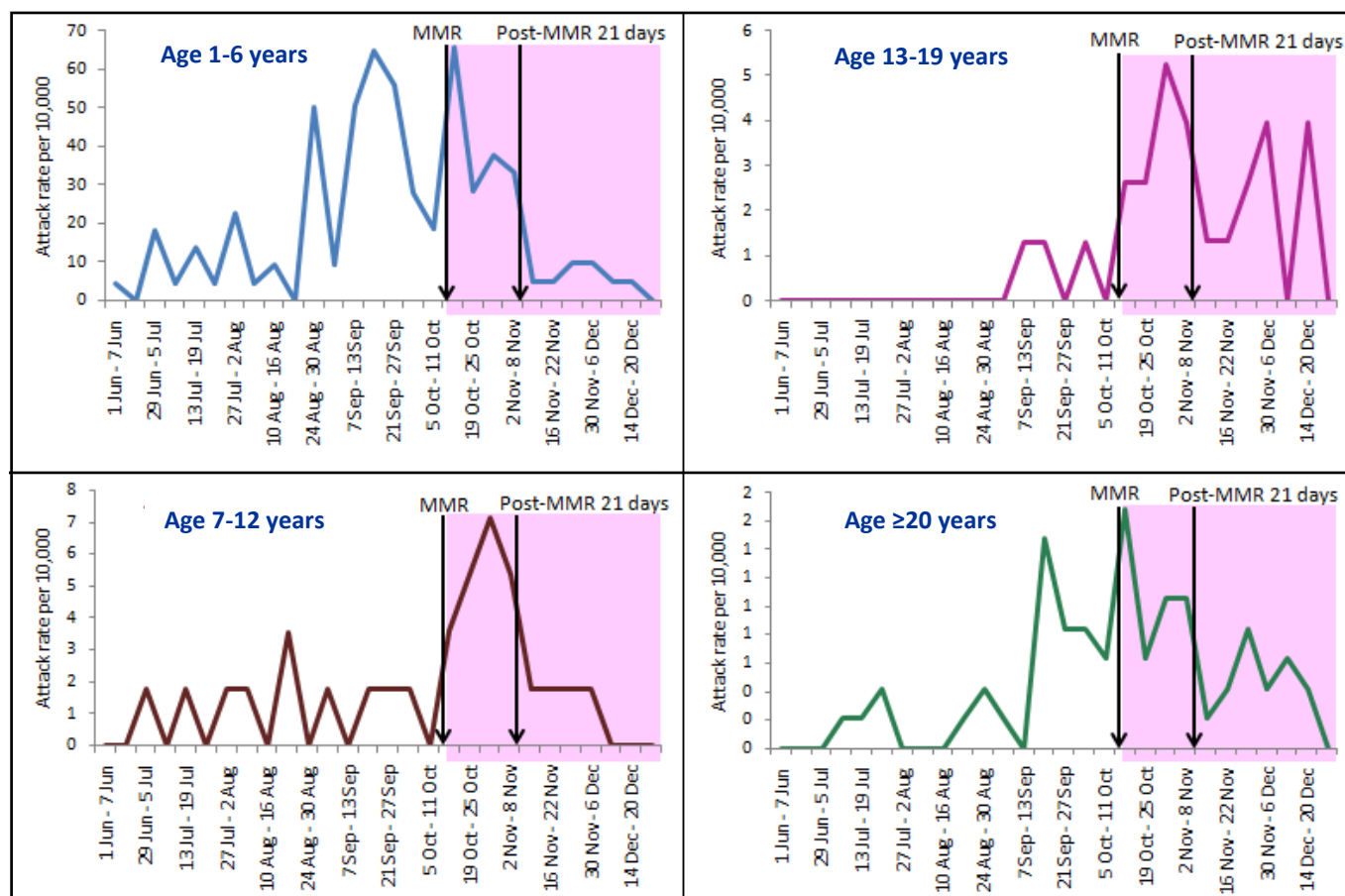


Figure 4. Attack rates of mumps cases by age group and date of onset in Pua District, Nan Province, Thailand, 1 Jun to 31 Dec 2010 (n=236)

onset of symptoms. Most cases were young children who played closely with others and made it difficult to isolate ill children from well children. Perhaps quarantine should be introduced as a control measure. People at risk in the family and neighbors should be protected by personal protection. Village 1 had no secondary case because their families had small number of children compared with 1-4 children per family in Village 3.

One dose of MMR vaccine had been estimated to be 73-91% effective in preventing clinical mumps.¹¹ During this outbreak, the vaccine performed as expected.

Unvaccinated 1-6 years old children had the highest attack rate. People aged 7-20 years might have received MMR vaccination from EPI program in Thailand as the MMR vaccine has been providing for Grade one students since 1997. The attack rate of 1-6 years old age group decreased 81.2% after 21 days of the mass MMR vaccination. This decline was more apparent than attack rates of other age groups which were not included in the mass vaccination.

Four specimens were tested positive by PCR and one specimen resulted to be genotype J (wild type). The Thai NIH reported genotype J had been identified in

Thailand: Bangkok in 2007,¹² Phangnga¹³ and Phayao Provinces in 2008 and Phitsanulok Province in 2010 (data from Thai NIH, unpublished report).

Limitations

Active case finding in community was conducted in only two villages. Lab confirmation was not possible for all clinical cases. In addition, specimen transportation which took more than 24 hours might result negative for mumps virus culture. We identified genotype in only one positive specimen because of limited budget.

Estimation of VE might be biased because obtaining vaccination status was only based on their recall. Nevertheless, the study population was limited to 1-20 years old contacts who had more reliable vaccination history because of school vaccination program since 1997 which had achieved over 95% vaccine coverage during 2009-2010.

Conclusion

This was the largest mumps outbreak in Nan Province since 2003. Majority of cases were in 1-6 years age group that was not included in EPI program. Attack rate of 1-6 years old might have decreased due to the mass MMR vaccination

campaign during the outbreak. The secondary attack rate was similar to a previous study. Children may require their first dose of MMR vaccination prior to Grade one (seven years of age). This investigation confirmed the great benefit of replacing monovalent measles vaccine with MMR at nine months old children in June 2010.

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Suggested Citation

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