PEDIATRIC INFECTIOUS DISEASE SOCIETY OF THE PHILIPPINES

# PIDSP JOURNAL

Vol 16, No. 1
January-June 2015



Vol.16 No.1
January-June 2015

Pediatric Infectious Diseases Society of the Philippines Journal
Vol 16 No.1 pp. 28-35 Jan – Jun 2015
Gonzales AM, Tubera DL, Serna P. Measles and Vaccination Coverage

ORIGINAL ARTICLE

# POPULATION-BASED STUDY OF MEASLES AND VACCINATION COVERAGE IN BAGUIO CITY, PHILIPPINES

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The authors declare that the data presented are original material and have not been previously published, accepted or considered for publication elsewhere; that the manuscript has been approved by all the authors, who have met the requirements for authorship.

## ABSTRACT

Measles continues to be a major childhood illness in Baguio City considering that the Philippines is in the elimination phase due to continuous transmission among susceptible population. Despite a high percentage of anti-measles vaccination coverage, outbreaks have been reported.

**Objective:** The goal of this study is to describe the epidemiology of measles cases during 2010-2012 and relate it to the outbreak response immunization (ORI) and supplemental immunization activities (SIA) of Health Services Office.

**Methods:** It is a cross sectional design utilizing data from Philippine Integrated Disease Surveillance and Response (PIDSR) of the City Epidemiology and Surveillance Unit and reports from the Expanded Program on Immunization of the Field Health Service Information System of Baguio City. Simple descriptive statistical analysis utilizing frequency and percentage distribution was used to characterize the measles cases according to age, sex, case final classification and vaccination status.

**Results:** During the 3-year, period, there were 457 total suspected measles cases with history of fever, generalized rash, and either cough, coryza or conjunctivitis. Outbreak started in February 2010 and reached 97 suspected cases and eventually decreased after the ORI by March to April 2010. The mean age of the cases is 11.81±10.64 years old, 10.28 are aged from 0-8 months. Of this total, 105 (22.98%) were clinically confirmed, 66 (14.44%) were laboratory confirmed positive for anti-measles IgM antibodies, 27, (5.91%) were epidemiologically linked to confirmed cases and 295, (56.67%) discarded non-measles cases. Among 171 laboratory and clinically confirmed cases, 33 (19.30%) did not received measles vaccination, 40 (23.40%) received 1 dose and 54.40% has unknown immunization status.

**Conclusion:** There were observed cases of measles that are out of age target of the immunization program which necessitates public health action. There is a need to revisit immunization programs and policies to address out of target cases.

## KEYWORDS:

*measles immunization, supplemental immunization activity, outbreak response immunization*

## INTRODUCTION

Measles is one of the leading causes of death among young children[1] even though a safe and cost-effective anti-measles vaccine is available[2]. Measles surveillance performance has consistently improved over the past several years. This increases the ability of the country to monitor progress towards elimination and rapidly detect and respond to measles virus transmission. Measles vaccination coverage is one of three indicators for achieving Millennium Development Goal 4 – to reduce by 2/3, between 1990 and 2015, the under-five mortality rate[3]. Outbreak response immunization (ORI) and Supplemental immunization activity (SIA) as Department of Health guidelines in times of confirmed cases in the area has an impact in measles morbidity and mortality, however, measles transmission is continuous among susceptible people and outbreak has still been reported. Despite ongoing immunization efforts and campaigns against its elimination, measles epidemics still take a terrible toll on the lives of the children because of its highly infectious nature.

The Western Pacific Region including the Philippines has made great progress towards its goal of measles elimination by 2012, having reduced incidence to 12 cases per million population in 2011. Best practices in measles prevention and control have been observed in countries like Ethiopia and Americas which ensures immunization coverage and providing a second opportunity for measles vaccination for all children, establishing measles case-based surveillance, and improving case management [4,5]. In the Philippines, a total of 1,499 cases were reported from 2012 that is lower compared to previous year which is 6,555 cases[6]. The Department of Health closely monitors progress towards interruption of endemic transmission of both diseases through enhanced surveillance and epidemic intelligence. During 2011, measles immunization coverage using the measles-rubella (MR) vaccine was close to the 95% elimination threshold, with 84% for 9 months to 9 years old.

The goal of this study is to describe the epidemiology of measles cases during 2010-2012 and relate this to the outbreak response immunization (ORI) and supplemental immunization activity (SIA) of Health Services Office.

## MATERIALS AND METHODS

This is a cross sectional study utilizing data from Philippine Integrated Disease Surveillance and Response (PIDSR) of the City Epidemiology and Surveillance Unit of Baguio City from 2010-2012. Routine vaccination coverage and status were gathered from the data of Expanded Immunization Program of the Field Health Service Information System of the Health Services Office.

### *Case Definition*

The study population consisted of all suspected measles cases who were classified according to the standard case definition of the Philippine Integrated Disease Surveillance and Response (PIDSR) from health centers and hospitals in Baguio City notified within 24 hours regardless of age with signs and symptoms of fever (T>38˚C) or hot to touch; generalized non-vesicular rash of ≥3 days duration and at least one of the following: cough, coryza, or conjunctivitis who sought consult from January 2010 – December 2012 (5).

1. **Laboratory-confirmed case:** suspected case with at least one of the following: positive serologic test result for anti-measles IgM antibodies, fourfold rise in anti-IgM antibodies in acute and convalescent serum, isolation of measles virus, dot immunobinding assay and polymerase chain reaction testing for measles nucleic acid.
2. **Epidemiologically-linked**: suspected measles case who was not discarded and

who had contact with another epidemiologically-linked case or a laboratory confirmed case 7-21 days before onset of rash and the other epidemiologically-linked or laboratory confirmed case was infectious at the time of contact (i.e., contact was 4 days before to 4 days after rash onset in the other epidemiologically-linked or laboratory confirmed case).

3. **Clinically-confirmed:** a suspected measles case, that, for any reason, is not completely investigated (e.g. death before investigation, no blood sample) or has equivocal laboratory test results.
4. **Discarded cases**: non-measles cases which has adequate specimen that is not serologically confirmed or is confirmed positive for other diseases such as dengue and rubella.

***Data Analysis***

Simple descriptive statistical analysis was performed using Epi Info version 7 software (CDC, Atlanta, GA). Frequency and percentage distribution were used to characterize the measles cases according to age, sex, case final classification and vaccination status. Measles incidence was compared to the coverage of the routine measles vaccination, outbreak response immunization (ORI) and supplemental immunization activity (SIA) using epidemiologic curve.

**RESULTS**

The study aimed to describe the clinic-epidemiologic profile of measles cases in Baguio City for the period of 2010-2012. This study showed

**Table 1. Demographic Characteristics of Suspected Measles Cases (n= 457) in Baguio City**

| Variables | Frequency | Percentage |
|---|---|---|
| **Sex** | | |
| Male | 214 | 46.83% |
| Female | 243 | 53.17% |
| **Age (mean + SD)** | 11.81±10.64 | |
| 0-6 months | 24 | 5.25% |
| 7-8 months | 23 | 5.03% |
| 9-11 months | 20 | 4.38% |
| 1-5 years | 106 | 23.19% |
| 6-12 years | 91 | 19.91% |
| 13-19 years | 98 | 21.44% |
| 20 above | 95 | 20.79% |
| **Case Classification** | | |
| Clinically-Confirmed | 105 | 22.98% |
| Epidemiologically-Confirmed | 27 | 5.91% |
| Laboratory-Confirmed | 66 | 14.44% |
| Discarded | 259 | 56.67% |
| **Vaccination Status** | | |
| Vaccinated | 193 | 42.23% |
| Unvaccinated | 81 | 17.72% |
| Unknown vaccination status | 183 | 40.04% |

showed that during the 3-year period, there were 457 total suspected measles cases with history of fever, generalized rash, and either cough, coryza or conjunctivitis, reported in the PIDSR of the City Epidemiology and Surveillance Unit of Baguio City. The mean age of the cases is 11.81±10.64 years, 10.28%, most of the measles cases are ages 1-5 years (23.19%), however measles infection is also present to ages 0-6 months (5.25%) and 7-8 months (5.03%). Out of the total cases, 105 (22.98%) were clinically confirmed, 66 (14.44%) were laboratory

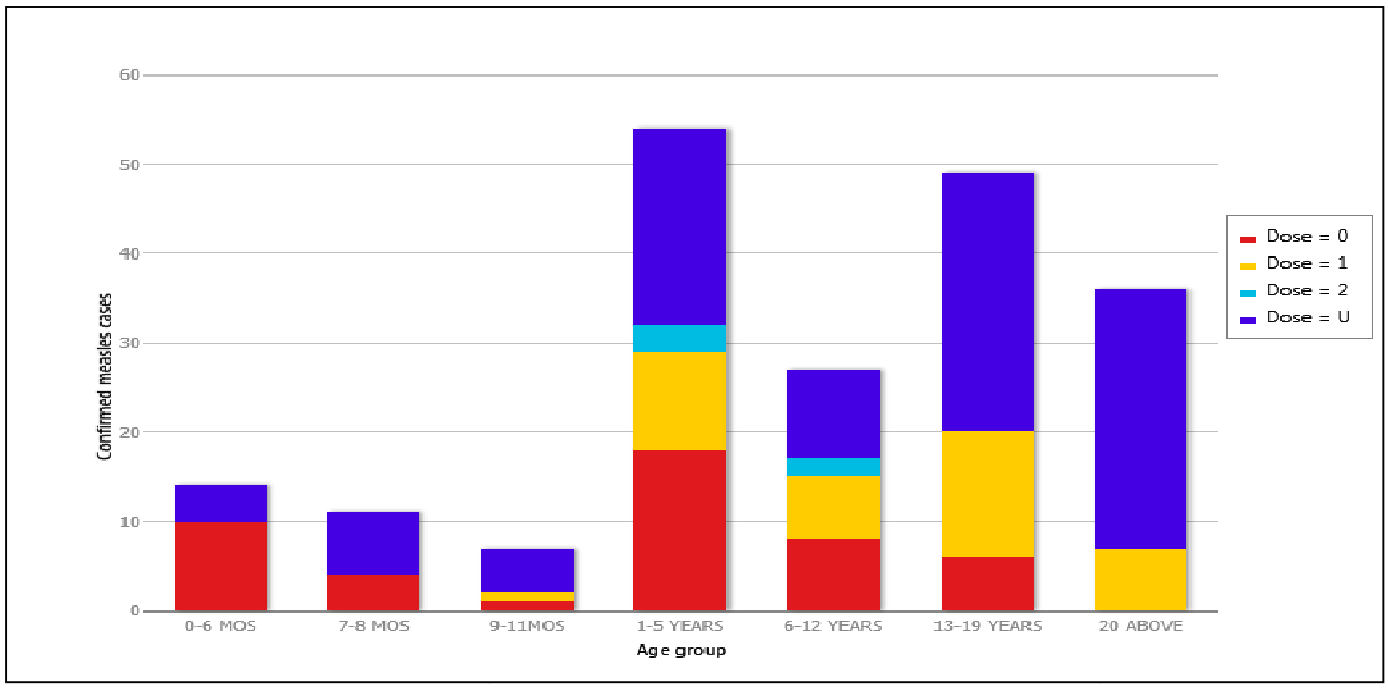


**Figure 1 Age specific incidence of confirmed measles cases, Baguio City, 2010-2012**

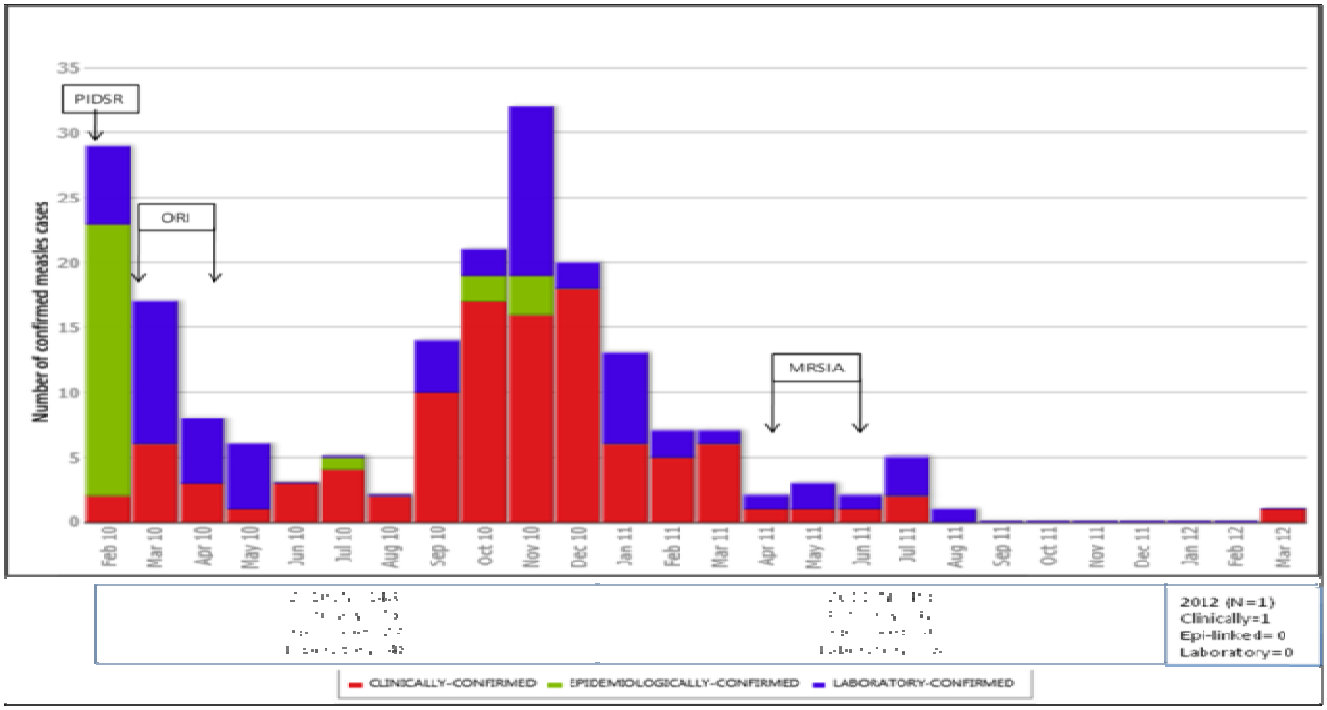


**Figure 2. Confirmed Measles Cases by month of onset, Baguio City, 2010-2012**

confirmed, and 27 (5.91%) were epidemiologically linked cases. However, 259, (56.67%) were discarded. Most cases had measles vaccination (42.23%), nevertheless some cases were unvaccinated (17.72%). (Table 1).

Among the 457 suspected measles cases, 198 (43.33%) were confirmed cases (Figure 1). Out of the confirmed cases, 7.07% were aged 0-6 months and 5.56% were ages 7-8, and most of the confirmed measles cases belongs to 1-5 age group (27.27%). Most confirmed cases were ages 1-5 years (27.72%) and measles vaccination status were unvaccinated (18, 33.33%) and has unknown vaccinated status (22, 40.74%), (11, 20.27%) received a dose of measles vaccine and (3, 5.56%) received more than 1 dose of measles vaccine. Among 171 laboratory and clinically confirmed cases 19.30% did not received measles vaccination, 23.40% received 1 dose and 54.40% has unknown immunization status.

The results showed that the cases of the measles cases is progressing with a total of 29 confirmed laboratory (n=6), clinical (n=2) and epidemiological-linked (n=21) cases on February 2010 due to institutionalization of PIDSR that intensify and improved infectious disease surveillance. (Figure 2). After the initiation of ORI which was conducted from March through April 2010 that achieved 72.84% coverage and reduction of measles cases was observed. Another measles outbreak was observed from September 2010 and reached its peak during November 2010. A late immune response from supplemental immunization program (SIA) which was initiated on April through June 2011 attained 72% vaccination coverage is considered and still 3 confirmed cases (6-8 months old) were reported.

Table 2 showed the cumulative measles immunization coverage of Baguio City from 2010 which achieved the highest coverage of 99.56% which can be responsible for the decreased cases started December 2010 through 2012 which coverage decline to 95.35% but still reached the goal of World Health Organization-Western Pacific Region of 95% measles vaccination coverage.

**Table 2. Measles Immunization Coverage of Baguio City, 2010-2012**

| Year | Target Population | Vaccinated | | | | Total Coverage |
|---|---|---|---|---|---|---|
| | | Health Centers | | Under Five Clinics | | |
| | | Frequency | Percentage | Frequency | Percentage | |
| **2010** | 8,011 | 4,066 | 50.76% | 3,910 | 48.81% | 99.57% |
| **2011** | 8,980 | 5,103 | 56.83% | 3,459 | 38.52% | 95.35% |
| **2012** | 9,142 | 3,745 | 40.96% | 4,972 | 54.39% | 95.35% |

## DISCUSSION

The description the epidemiology of measles cases during 2010-2012 was related to the ORI and SIA of Baguio City Health Department. Despite the Philippines in measles elimination phase, it continues to be a major childhood illness in Baguio City due to continuous transmission among susceptible population. Despite a high percentage of anti-measles vaccination, outbreaks have been reported.

In this study, confirmed cases was observed to the children ages 0-6 months that are supposedly protected by maternal antibodies and ages 7-8 months that are still not in the coverage of immunization program for measles. Incomplete immunization can put children at greater risk of acquiring an ailment. A high proportion of cases were aged 8 months and below, those not eligible to receive the first dose of routine measles vaccine from the expanded program for immunization (EPI) in Philippines. In populations where measles epidemics are relatively frequent, infants less than 9 months of age are usually protected by measles specific antibodies transferred through the placenta by mothers who were either exposed to natural measles or immunized against measles[7]. Placental transferred antibodies usually provide protection for infants in the early months of life, as these

antibodies tend to diminish below protective levels between 4 and 8 months after birth. Breast milk may also contain measles-specific antibodies, which may provide additional protection for the infant against early exposure when placental transferred antibodies have diminished below protective levels[8], however measles cases was observed to ages below 8 months old. Children of mothers vaccinated against measles have lower concentration of maternal antibodies and lose protection by maternal antibodies at an early age than children of mothers that increases the risk of disease transmission in highly vaccinated population [9].

In many developing nations, including several Asian countries, national childhood immunization coverage remained low until recently. There has been a steady increase in routine measles coverage from 71% to 82% globally between 2000 and 2009, and from 56% to 73% in the 47 countries with the greatest burden of measles deaths[10].

Measles immunization campaigns can serve to rapidly increase demand for measles immunization, while targeting hard-to-reach people with additional interventions capable of reducing mortality in children under five years old. As such, measles remains a major preventable cause of childhood death in developing countries. The increased vaccine coverage resulted in a mortality decline of around 78% between 2000 and 2008 or to 164,000 deaths worldwide by 2008[11]. Individuals who recover from the virus are immune for the rest of their lives. This means that epidemics are self-limiting and due to the attrition of susceptible, subsequent epidemics can occur (in the absence of migration) only after a new group of susceptible are born into the population[12]. However, Baguio City increases its risk to an impending epidemic as a result of migration and movement of population. Baguio's average annual population growth rate was 2.81% [13]. As such, measles requires a large host population at least 250,000 people to become endemic or occur at regular intervals [14]. That is to say, the high infectivity of measles means that a small percentage of susceptible individuals are sufficient to maintain viral circulation in populations of a few hundred thousand. However, as mentioned above, even with a high level of population immunity, the highly infectious nature of measles means that a small percentage of susceptible are enough to maintain viral circulation.

Many of previous studies on measles vaccination have focused on the accumulative uptake rate for a certain age. However, relying on the overall vaccination coverage may be crude, which may mask the substantial delays in vaccination and subsequent lack of immunity. Hence, there could be a measles outbreak in the highly vaccinated population which was attributed to vaccine failure resulted from individuals being vaccinated outside the recommended period [15], since the primary cause for the epidemic was failure to provide vaccines on schedule[16,17]. The most common cause of vaccine failure in routine uses of vaccine might be due to transportation from manufacturer to distributor, then to department offices, failure of electricity especially in developing countries, failure of refrigerator, storage in deep freezer, exposure of sunlight, ignoring the use of ice box, cooler or thermos and using the translucent membrane vaccine containers permitting the sunlight exposure[18].

The study has certain limitations. First, the study did not explore health system factors and community factors which might have provided some clues on the program factors which may have significant association with uptake of vaccinations. Secondly, we may have underestimated the number of cases as not all possible measles cases will seek medical advice. Third, our estimates of vaccination coverage

were based on the administrative data, which depend on the validity of the numerator or denominators, and therefore can only provide a relative imprecise estimation of the vaccination coverage.

## CONCLUSION

The findings indicate that the supplementary immunization activity (SIA) and outbreak immunization response (ORI) conducted during the course of an outbreak may reduce total case numbers. In this study the PIDSR case definition of measles of rash, fever and either cough, coryza or conjunctivitis cannot be sensitive symptoms of measles infection as there more discarded cases seen compared to confirmed positive. Wide outbreak affecting wide age range highlights that Baguio City remains vulnerable to a large measles outbreak.

## RECOMMENDATIONS

The data indicate that there is a substantial immunity gap in this group, possibly due to weakening maternal antibodies in the setting when immunity is from vaccination not natural infection[19] that desires further study and analysis.

Efforts to maintain high routine measles vaccination coverage should be emphasized and strengthen the vaccination coverage if below 95%. Specific intervention such as immunization awareness day and knowledge, attitude and practices (KAP) survey should be held to reach unvaccinated children and those who did not develop protective immune response; thus lessening the number of susceptible individuals. Furthermore, efforts to include measles vaccine dose at six months for infants at high risk should be strengthened. However, the decision to conduct the campaign should be based on a comprehensive risk-benefit assessment including assessment of the potential for epidemic spread and cost of the intervention.

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