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## RESEARCH ARTICLES

# Measles Outbreak Investigation in Nomadic Population Nasirabad, Balochistan, Pakistan February 2018

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### Abstract

**Introduction:** On 14 February 2018, the District Health Officer of Nasirabad reported 16 suspected measles cases from the nomadic population of Dera Murad Jamali to the disease surveillance and response unit of Quetta and requested an investigation. A FELTP fellow was deputed by the Director of General Health Services, Balochistan to investigate the outbreak, evaluate risk factors and recommend control measures.

**Methodology:** A purposive sampling technique was adopted and a case control study was planned and conducted. Case was defined as “acute onset of generalized maculopapular rash and fever with cough or coryza or conjunctivitis from 29 January to 20 February 2018 in a resident of Dera Murad Jamali”. Active case searches along with interviews were conducted through a semi structured questionnaire. Demographic, socioeconomic, clinical and epidemiological information was collected along with assessment of routine immunization. Five blood samples were sent for serology.

**Results:** A total of 49 cases (AR= 0.17%), including five deaths (CFR=10.2%), were identified. Males, 61% (n=30), were more affected. The median age was three years (age range=1-10 years). The age-group 0-4 years, 69% (n=34), was most affected. The median age group of controls were four years (age range 1-11 years). Of the cases, 71% were unimmunized for any routine antigen while 32% of controls were unimmunized. Pneumonia, 42.8% (n=21), and diarrhea, 38.7% (n=19), were the most common complications. All five samples were positive for measles IgM. Significant statistical association was found between nomadic populations having zero routine doses of measles containing vaccines (MCV1) (OR 2.85; CI 1.83 – 4.42; p value <0.0021) and developing measles.

**Conclusion:** Nomadic populations with low immunization was a probable cause of outbreak, resulting in the rapid spread of measles amongst susceptible individuals in the community. Laboratory tests confirmed the outbreak. As a control measure, measles mop-up vaccinations and six health education sessions were suggested and carried out. It was also recommended that proper outreach microplanning and regular pulse immunization should be adopted in future.

**Key words:** Measles, outbreak, immunization, expanded program on immunization, nomadic population

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### Introduction

Measles, a vaccine-preventable disease, is extremely contagious given that it can be spread via airborne transmission.<sup>1</sup> A susceptible person who has face-to-face contact with an infected person has a 90% likelihood of developing the disease.<sup>2</sup> Measles is still common in many parts of the world, particularly in countries with developing economies. Approximately 20 million cases are estimated to occur globally each year, with 89,780 deaths from measles in 2016 – mostly children under the age of 5 years, despite the availability of a safe and effective vaccine.<sup>3</sup>

Measles is caused by a virus of the paramyxovirus family and it is contracted through direct contact and through the air. Measles is a human disease and is not known to occur in animals.<sup>4</sup> Accelerated immunization activities have had a major impact on

reducing measles deaths. From 2000 to 2016, vaccination against measles prevented 20.4 million deaths. Global measles deaths have decreased by 84% from an estimated 550,100 in 2000 to 89,780 in 2016.<sup>5</sup>

The measles vaccination is highly effective, safe and relatively cost-effective<sup>6</sup>, and has interrupted measles transmission in most parts of the world,<sup>7</sup> although high-risk areas remain in Africa and southern Asia. Population susceptibility to measles is dependent on the uptake of Measles 1 and Measles 2, vaccine effectiveness, immunity as a result of prior infection and protection by maternal antibodies in infants. Therefore, using these factors, it is possible to estimate population susceptibility to measles using a well-defined formula.<sup>8</sup>

The Eastern Mediterranean Region has made substantial progress towards achieving measles elimination and reducing the burden of Measles disease. By 2008, measles deaths had decreased to 7000 deaths from 96,000 in 2000 - a reduction of 93%. The number of confirmed measles cases decreased from about 88,000 in 1998 to 11,295 in 2011<sup>9</sup>. The World Health Organization (WHO)-UNICEF Global Immunization Vision and Strategy (GIVS) achieved a reduction in measles deaths by 90% in 2010 compared to the year 2000<sup>9; 10</sup>. During the period 1998–2010, reported measles cases in the Region decreased by 77%, from 89,478 cases in 1998 to 10,072 in 2010. However, during 2011–2013, regional progress slowed and the number of reported measles cases increased more than 2-fold to reach 20,884 cases in 2013, with the occurrence of large outbreaks in several countries. Around 90% of the reported measles cases during the period 2011–2013 were from 5 countries: Afghanistan, Pakistan, Somalia, Sudan and Yemen. With this resurgence of measles in some countries, the EMR’s target of measles elimination by 2015 is not likely to be achieved.

In Pakistan, the Expanded Program on Immunization was started in 1978, in which initially six vaccines were included, namely childhood tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus and measles containing vaccine-1 (MCV-1), while measles containing vaccine-2 (MCV-2) was added in 2009. The World Health Organization’s statistics give more than 24,000 measles cases with 300 deaths in Pakistan in the year 2017<sup>11</sup>, out of which 93 were from Balochistan<sup>5; 12</sup>. The estimated MCV1 coverage in Pakistan increased from 57% in 2000 to 76% in 2017, and the estimated MCV2 coverage increased from 30% in 2009 to 45% in 2017, while Balochistan remained the lowest in the country coverage with MCV1 from 17% in 2009 to 33% in 2017 and MCV2 from 8% in 2009 to 34% in 2017<sup>11</sup>. The MCV-1 coverage of the district was 22% in 2009 to 43% in 2017 and MCV-2 coverage from 19% in 2009 to 39% in 2017. The expanded program of immunization schedule in the country is given in table below (Table 1).

**Table 1: Routine Immunization Schedule in Pakistan**

Age of Child	Vaccination
At Birth	OPV 0, BCG
6 Weeks	OPV 1, PENTA 1, PCV 1, Rota Virus 1
10 Weeks	OPV 2, PENTA 2, PCV 2, Rota Virus 2
14 Weeks	OPV 3, PENTA 3, PCV 3, IPV
9 Months	Measles 1 (MCV-1)
15 Months	Measles 2 (MCV-2)

**Source:** Expanded Program of Immunization Pakistan<sup>13</sup>

## Background

This study was the account of the measles outbreak in Nasirabad district in 2018. Nasirabad district is situated at South East of the Balochistan province of Pakistan. The bordering districts are Sibi, Kachhi, Jhal Magsi, Jaffarabad and Sohbat pur. The Population is highly mobile with seasonal migration for agriculture purposes. Pat Feeder Canal, a tributary from Sindh River serves the purpose of agriculture. According to censuses 2017, the district has a population of 490,538 with an area of 3,387 km<sup>2</sup> comprising of three Tehsils and 33 union councils.<sup>14</sup>

On 16 February 2018, the District Health officer (DHO) of Nasirabad reported 16 suspected measles cases from the nomadic population of Dera Murad Jamali town to provincial disease surveillance and response unit Quetta and requested for an investigation. A FELTP

(Field Epidemiology and laboratory Training Program) fellow was deputed by Director General Health Services (DGHS) Balochistan on 17 February to investigate the outbreak, evaluate risk factors and recommend control measures.

## Research Question

H<sub>0</sub>: There is no association between nomadic populations having zero routine immunizations (measles containing vaccine) and the development of a measles outbreak.

H<sub>1</sub>: There is an association between nomadic populations having zero routine immunizations (measles containing vaccine) and the development of a measles outbreak

## Methods and Materials

A purposive sampling technique was adopted and a case control study was planned and conducted. Matched pairs for age and sex controls (1:2) were taken. Case was defined as “acute onset of generalized maculopapular rash and fever with one of the following: cough or coryza or conjunctivitis between 29 January to 20 February 2018 in a resident of nomadic population in Dera Murad Jamali town”. Controls were selected against the cases from the same community. To understand the outbreak and the perspective of the community, a combined meeting session with district administration and community members in the area was conducted. Hospital records were reviewed and house to house surveys were conducted using a pre structured questionnaire. Information on socio-demographics, clinical signs and symptoms, vaccination status, risk factors and disease outcome were collected and analyzed. Vaccination status (MCV-1 “measles containing vaccine 1” and MCV-2 “measles containing vaccine 2”) along with other antigens was verified based on respondents’ recall and vaccination card. Apart from active case finding, verbal autopsy was carried out by visiting the addresses of deceased children. The data was entered, cleaned and coded. The descriptive statistics were calculated, tables/graphs were generated and inferential statistics were calculated using Epi Info 7.0 version. The odds of getting disease in Measles 1 versus no measles 1 and Measles 2 versus no measles 2 were calculated. All significance was reported at confidence interval of 95% and p-value less than 0.05. The risk factors were coded as 0= No and 1= Yes. Community members from nomadic populations who contracted measles were included in the study and controls from same nomadic community who have not contracted measles while

community outside nomadic population were excluded. Due to confined nomadic community and lab constraint only five samples were collected for Immunoglobulin M (IgM) serology.

## Results

A total of 49 cases (overall AR= 0.17%) including five deaths (Case Fatality Rate=10.2%) were identified. Sixty percent (n=33) of cases from the total were detected through the active search in community. The median age of the cases was three years with an age range one to ten years, while the median age group of controls were four years with an age range one to eleven years. Among the cases, 61% (n=30) were males and 46% (n=19) were females, while out of 98 controls, 67% (n=66) were males while 33% (n=32) were females. During active case finding, majority 69% (n=34) of cases found were among the age group 0 to 4 years, followed by 23% (n=11) from 5 to 9 years of age, and 8% (n=4) from 10 to 14 years of age (Table 2).

**Table 2:** Attack rates with Specific Age group (n=49)

Age Groups (Years)	Cases (n=49)	Percentage (%)	Total population of that Age Group	Attack Rates/1000 Pop
0-4	34	69	4305	7.9
5-9	11	23	4519	2.4
10-14	4	8	3532	1.1

The routine vaccination assessment survey revealed that among the cases, 71% (n=35) of children were unimmunized for any routine antigen and 29% (n=14) were partially immunized. In controls, 32% (n=31) were unimmunized for any routine immunization. From the cases 4% (n=2) were vaccinated for MCV1 and none of the cases were vaccinated for MCV2. In controls, 34% (n=33) were vaccinated for MCV1, while 17% (n=17) were vaccinated for MCV2. In cases, out of the total none have the EPI card, while in controls 40% (n=39) verified

through EPI card while 60% (n=59) responded on recall history. Seventy three percent (n=36) of respondents responded that a vaccinator did not visit their homes to vaccinate their children, 16% (n=8) were unaware about the routine vaccinations, and 10% (n=5) were having misconceptions and misbeliefs regarding routine immunization. The laboratory results showed that out of five blood samples all were positive for measles IgM antibodies.

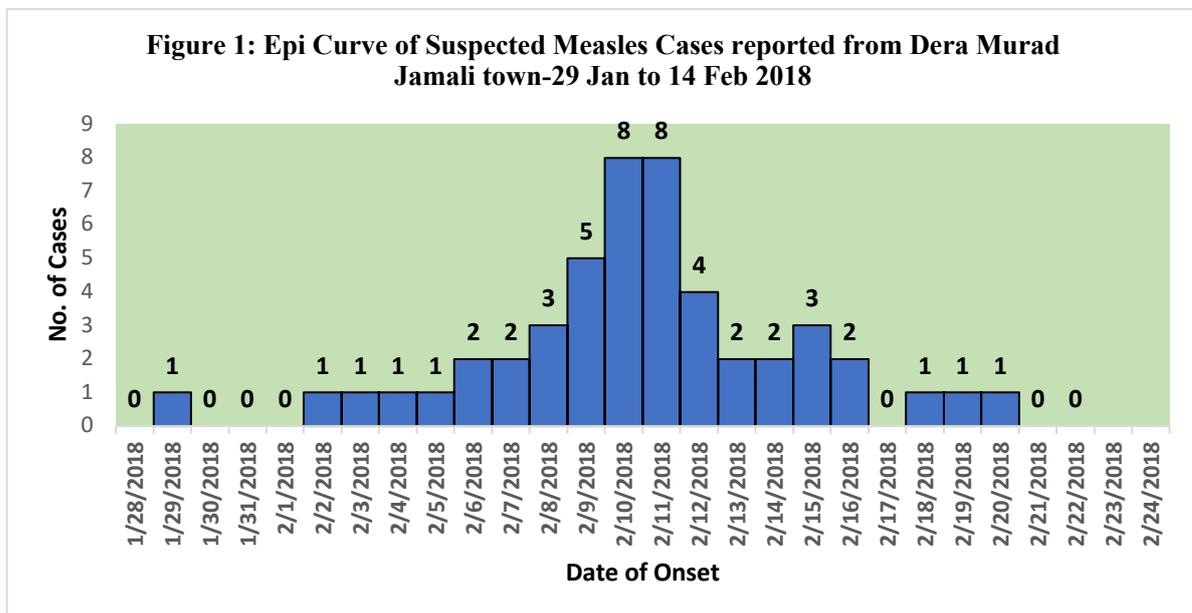
On bivariate analysis, a significant statistical association was found between the nomadic population

having zero routine immunization and the development of measles (Table-3).

<b>Table 3: Risk Factors Association</b>			
<b>Risk factor</b>	<b>OR</b>	<b>95% CL</b>	<b>P value</b>
<b>Nomadic Population</b>	2.85	1.83-4.42	<0.0021
<b>Mother's Education</b>	0.92	0.72-1.97	<0.0401
<b>Measles 1</b>	0.045	0.0010-0.0099	<0.0051
<b>Measles 2</b>	0.00033	0.00081-0.00213	<0.0041

The epidemiological curve below shows the distribution of suspected measles cases reported with respect to the onset of symptoms. The first case was reported on 29 January 2018, where the person came from the village Doda pur district Jacobabad of the Sindh province with his family two weeks before where measles was already endemic. After that, the cases started reporting and the peak was observed on 10 and 11

February. After that, there were a decline in cases, with the last case reported on 20 February 2018 after control measures (Figure 1).



Out of the total 49 cases, 35% (n=17) had signs and symptoms of pneumonia, including three out of the five deceased, while 49% (n=22) of the cases had signs and symptoms of diarrhea, including all of the five deceased.

**Discussion**

Pakistan had experienced an increased number of measles outbreaks with high morbidity and mortality in the year 2017-18. The outbreak started in Sindh riverine

belt which also affected bordering district Jaffarabad and Naseerabad of Balochistan Province.<sup>15</sup> This study was conducted in district Naseerabad. Deadly measles outbreaks had occurred in countries that experienced or were recovering from any disaster, war or conflict.<sup>16</sup> The results of the study showed that majority of measles cases 71% (n=35) were unimmunized. Studies suggested that measles transmission can be interrupted when the herd immunity level is raised to 95%.<sup>17</sup> Measles

outbreaks and epidemics can arise in communities where immunization coverage is low. The results of this study showed that routine immunization coverage in measles cases was about 29% (n=14) which is consistent with the Pakistan Health and Demographic Survey (PDHS) 2017-18 report, where it states that RI coverage is just 29% in Balochistan.<sup>18</sup> However, other multiple factors such as flood, malnutrition, illiteracy, and high risk susceptible populations, i.e. internally displaced persons (IDPs), may have played an aggregating role for the outbreak.<sup>19</sup> This study is also consistent with another study conducted in Karachi showing MCV-2 coverage being 12%.<sup>20</sup> In this study, Pneumonia and diarrhea complications were prevalent in measles cases, resulting in hospitalization and leading to the deaths of five children. Studies revealed that children having malnutrition are expected to experience more frequent severe measles infections due to weak immune system response.<sup>21; 22; 23</sup> This study showed that the cause of death was developing complications like diarrhea and pneumonia, which correlated with another study in which pneumonia and diarrhea were more common because measles virus causes profound and transient immunosuppression leading to increased susceptible secondary viral and bacterial infections.<sup>24; 25; 26</sup> The recovery from measles complications in developing countries is very poor. The mortality rate in our study is 10.2% (n=5), which is not consistent with evidence from other studies conducted in developing countries.<sup>27</sup> This study also revealed same reasons for non-immunization as other studies conducted in South East Asia. The reasons were parents' unawareness about routine vaccinations, vaccinators not visiting to vaccinate the children and parents having misbeliefs regarding routine immunization.<sup>16; 23</sup> This negligence on part of the parents is in turn due to many reasons like the lack of awareness about the importance of vaccination and inaccessibility to the vaccination centers. Another worrisome situation arose when parents from some religious communities in Sindh refused to vaccinate their children stating that it is no disease and it is a test of faith as some soul had entered the children and would exit the body after sometime.<sup>28</sup> Majority of measles cases were under four years of age, with a mean age of three years, while a study conducted by Queen Sirikit reported a mean age of 2 years.<sup>29</sup> In this study, measles had affected male children more, while different studies have shown the same and alternate results for the sex ratio.<sup>25</sup>

## Conclusion

This measles outbreak investigation in district Naseerabad revealed that majority of measles cases were from nomadic populations and out of the total cases 71% (n=35) were unimmunized. It is also depicted in study that susceptible high risk populations with low routine immunization were at greater risk of developing measles with a higher mortality rate. Moreover other risk factors like low socioeconomic status, illiteracy and poor health infrastructure to deliver also played aggravating roles for measles infection. The results showed that unavailability

of vaccinators and unawareness about the importance of routine immunizations among the parents of affected children were the main causes of such outbreaks. This situation brings attention to boost social mobilization activities for routine immunization. The index case was identified as being from a nomadic population and having had a travel history to Jacobabad Sindh.

Certain recommendations and control measures were made including measles campaigns and mop-up vaccinations in affected towns and bordering union councils especially targeting high risk mobile group populations, the launch of a health awareness and education campaign involving the Lady Health Workers and other health staff, and strengthening of measles case surveillance system in the district. Strengthening routine immunization by increasing coverage to more than 95%, using strategies like outreach, regular pulse immunization, follow up measles SIAs and defaulter tracking is of utmost importance and should be adopted. It was also recommended to address issues related to management, human resource involving district PPHI (People's Primary Health Care Initiative), ensuring timely supply of vaccines and proper cold chain maintenance. Strong surveillance was recommended for measles and other vaccine preventable diseases to prevent future outbreaks in the district.

## Public Health Impact of this Outbreak Investigation

District administration took serious notice and the local health department carried out a mop up of the entire district for measles vaccinations with a special focus on high risk group populations. The measles outbreak taught a lesson and lead to capacity building of community health workers and health staff to manage measles outbreaks. Local health authorities were sensitized to do risk assessment for public health emergencies. The provincial government was approached for the allocation of resources to carry out regular outreach/mobile activities for routine immunization.

## Competing Interests

The authors declare no competing interests.

## Author's Contribution

ZA conceived and designed the study and collected the data, analyzed the data and analyzed the results. AS and EA supervised and helped in preparing, editing and finalizing the manuscript for publication. QA and SS supported and searched literature and refined methodology.

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