Poor quality data challenges conclusion and decision making: timely analysis of measles confirmed and suspected cases line list in Southern Nations Nationalities and People’s Region, Ethiopia

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Abstract

Background: Measles is one of the leading causes of death among young children even though a safe and cost-effective vaccine is available. Timely analysis of measles surveillance data is crucial for epidemic control and can show disease control program status. Therefore, this study aimed to show vaccination status and delay in seeking health care using surveillance data.

Methods: A retrospective study was carried out in Southern Nations Nationalities and People’s Region (SNNPR), Ethiopia. We reviewed 2132 records from measles surveillance line list data from July 2013 to January 2014. Descriptive statistics were performed using SPSS 20 for Windows.

Results: From a total of 2132 confirmed and suspected measles cases, 1319 (61.9%), had at least one dose of measles containing vaccine; the rest 398 (18.7%) and 415 (19.5%) were unvaccinated and had unknown status respectively. About two fifth, 846 (39.7%), cases visited health facilities within 48 h of onset of clinical signs/symptoms with a median of 2.0 days, IQR (1.0, 3.0).

Conclusion: Majority of the measles cases were vaccinated with at least one dose of measles containing vaccine and vaccination data or vaccine potency at lower level was unclear. Delay in seeking healthcare was noted as only about two fifth of cases visited health facilities within 48 h of clinical manifestation. Vaccination and surveillance data quality and factors associated with delay in seeking health care should be investigated.

Keywords: Surveillance, Vaccination status, Measles, SNNPR, Healthcare seeking

Background

Measles is acute viral illness caused by a virus in the family paramyxovirus, genus Morbillivirus [1, 2]. Though measles is usually a mild or moderately severe illness, it can result in complications such as pneumonia, encephalitis and death. Post infectious encephalitis may occur in approximately one per 1000 reported measles cases. Approximately two to three deaths may occur for every 1000 reported measles cases [1].

Measles is one of the leading causes of death among young children even though a safe and cost-effective vaccine is available [3, 4]. Globally, measles death was 145,700 in 2013 [3] and 114,900 in 2014 [4].

In Ethiopia, estimated measles incidence was 6.52 per 100,000 populations in 2013 and 14.61 in 2014 [5]. In Southern Nations Nationalities and People’s Region (SNNPR), measles was the 6th cause of under-five admission in 2013/14 [6].

Countries in measles mortality reduction phase (areas where measles is endemic) are advised to use the clinical classification scheme until their program meet the low levels of measles incidence (measles incidence to less
than five cases per million population [7]) and access
to proficient measles laboratory that is access to stan-
dardized quality-controlled testing through the WHO
Measles and Rubella Laboratory Network. Laboratory
confirmation may be attempted by sampling approxi-
ately 10 cases per outbreak. When measles is en-
demic, routine monthly reporting of aggregated data
on clinical measles cases is recommended by district,
age group and immunization status; that is only out-
breaks (not each case) are investigated [8].

In SNNPR, before 2015, samples from suspected mea-
sles cases were collected and sent to central (national)
laboratory for confirmation. The occurrence of 3 or
more confirmed cases within one month in a district
was considered an outbreak per national guideline [9].
After outbreak confirmation, appropriate actions (like
vitamin A supplementation, supplementary vaccination
and severe case management) were taken based on sur-
veillance data and risk assessments [9, 10].

Measles surveillance is critical strategy to control
measles outbreak. It helps to detect outbreaks early,
provide trends in transmission, and can provide inci-
dence estimates [11]. So, this study aimed to show
vaccination status and delay in seeking health care
using surveillance data.

Methods
A retrospective study was conducted in SNNPR using
secondary data from measles surveillance line lists in
September 2014. SNNPR is the third largest adminis-
trative region of Ethiopia representing about 20% of the
country’s population (Fig. 1). According to 2007 census,
the regional population was estimated to be 18.9 million
in 2014. It is the most diverse region in the country in
terms of language, culture and ethnic background. From
total population, under 1 year of age was estimated to be
3.19% while less than 5 years constituted 15.6% respect-
vively. Administratively the region is divided into 14 zones,
1 city administration and 4 special woredas (districts) [12].
Woreda, equivalent to district, is administrative structure
in the region with about 100,000 populations.

A total of 2132 sample was selected using simple ran-
dom sampling from suspected and confirmed measles
cases reported to SNNPR health bureau from July 2013
to January 2014. The sample size was calculated using
single population formula assuming proportion of cases
vaccinated \( P = 0.492 \) [13], \( Z_{\alpha/2} = 1.96 \) reliability coeffi-
cient for 95% confidence interval for normal distribu-
tion, margin of error \( d = 0.03 \) and design effect of 2
considering vaccination coverage variability across the
region. Cases selected with incomplete and/or invalid

Fig. 1 Administrative map SNNPR
Case definition
Before 2015, the study region had limited access to proficient measles laboratory and samples from suspected cases were tested at central (national) laboratory to confirm outbreak and the region used the clinical classification scheme. In a district of about 100,000 population, measles outbreak was considered when 3 or more cases were confirmed within a month as per national guideline [9]. Laboratory investigation was done for the first 5–10 cases to confirm an outbreak in each district. After confirming an outbreak, cases that were linked to confirmed cases within a district were considered as epidemiologically confirmed. Cases from districts where rubella outbreak was confirmed were not included in this study since vaccine in the region was measles monovalent (did not include rubella and mumps).

Variables on vaccination status, age, sex, treatment modality (inpatient/outpatient), date of onset of rash, date seen at facilities, diagnosis and outcome (live or dead) were collected using checklist prepared for this purpose. During surveillance, vaccination status was collected using vaccination card, vaccination register and/or history of vaccination by health worker reporting cases.

Data was checked for its completeness and consistency and entered to and analysed using IBM SPSS for Windows version 20. Frequencies, percentiles, median and interquartile were carried out.

Ethical clearance was obtained from Ethical Review Committee of SNNPR Health Bureau. No name of case was mentioned and the data were only used for the above mentioned objectives and kept confidential.

Results
A total of 2132 confirmed and suspected measles cases were selected from cases reported to SNNP regional health bureau from July 2013 to January 2014 and reviewed for vaccination status and delay in seeking health care (time interval from date of clinical signs and symptoms to date seen at health facilities for health care).

From the total 2132 sample, 94 (4.4%) were confirmed by laboratory test while rest were epidemiologically linked. Both sexes were affected equally with male to female sex ratio of 1:1 and more than half, 1204 (56.47%), of cases were between age range of 5–14 years with a median of 8.00 (IQR 3.0, 12.0) (Table 1).

Majority, 1787 (83.8%), of cases were not admitted to health facility or treated in outpatient department. Regarding treatment outcome, only one death was reported. The admission rate in both sex was also nearly equal with sex ratio of (male to females) 1.03 (Table 1).

Table 1 Age, sex and treatment modality of measles confirmed and suspected in SNNPR, Ethiopia, 2014

| Variables          | Treatment modality | Total Number (%) |
|--------------------|--------------------|------------------|
|                    | Inpatient | Outpatient | Number (%) |
| Sex                |            |            |            |
| Female             | 170 (15.9%) | 901 (84.1%) | 1071 (50.2) |
| Male               | 175 (16.5%) | 886 (83.5%) | 1061 (49.8) |
| Age category       |            |            |            |
| < 1                | 53 (18.0%)  | 242 (82.0%) | 295 (13.8)  |
| 1–4                | 79 (18.4%)  | 350 (81.6%) | 429 (20.1)  |
| 5–14               | 163 (13.5%) | 1041 (86.5%) | 1204 (56.5) |
| ≥ 15               | 50 (24.5%)  | 154 (75.5%) | 204 (9.6)   |
| Total              | 345 (16.2%) | 1787 (83.8%) | 2132 (100.0) |

Table 2 Vaccination status of measles confirmed and suspected cases in SNNPR, Ethiopia, 2014

| Variable          | Dose | Unvaccinated | 1 | 2+ | Unknown |
|-------------------|------|--------------|---|----|---------|
| Age(years)        |      |              |---|----|---------|
| < 1               |      | 140 (47.5%)  | 121 (41.0%) | 24 (8.1%) | 10 (3.4%) |
| 1–4               |      | 32 (7.5%)    | 155 (36.1%) | 216 (50.3%) | 26 (6.1%) |
| 5–14              |      | 163 (13.5%)  | 480 (39.9%) | 292 (24.3%) | 269 (22.3%) |
| ≥ 15              |      | 63 (30.9%)   | 28 (13.7%)  | 3 (1.5%)   | 110 (53.9%) |
| Sex               |      |              |---|----|---------|
| Female            |      | 196 (18.3%)  | 384 (35.9%) | 269 (25.1%) | 222 (20.7%) |
| Male              |      | 202 (19.0%)  | 400 (37.7%) | 266 (25.1%) | 193 (18.2%) |
| Treatment modality|      |              |---|----|---------|
| Inpatient         |      | 78 (22.6%)   | 136 (39.4%) | 68 (19.7%)  | 63 (18.3%) |
| Outpatient        |      | 320 (17.9%)  | 648 (36.3%) | 467 (26.1%) | 352 (19.7%) |
| Total             |      | 398 (18.7%)  | 784 (36.8%) | 535 (25.1%) | 415 (19.5%) |
From those who visited health facility within 48 h, 120 (14.2%) were admitted while 225 (17.5%) were admitted from those who visited health facility after 48 h. The median delay time was 2.0 days (IQR 1.0, 3.0) (Table 3).

**Discussion**

About three fifth, 1319 (61.9%), of cases were vaccinated with at least one dose of measles containing vaccine while 398 (18.7%) and 415 (19.5%) cases were unvaccinated and had unknown status respectively. The vaccination schedule for measles in the country is nine months (child is expected to get vaccination before age of 1 year). At community level, routine vaccination of single dose is given. Nationally, mass campaign of measles vaccination as catch-up was conducted from 2002 to 2004 targeting 6 months to 14 years. Following that, from 2005 to 2009, follow-up campaign was conducted targeting 9 months to 4 years. And from 2010 to 2011, another follow-up supplementary immunization activities (SIAs) were conducted in two phases. The first phase (2010) was conducted in SNNPR while second done in other regions that implemented their last follow up SIAs in 2009 [14]. Following increased incidence of measles, measles SIA was integrated with polio campaign and targeted children between 6 months to 15 years of age. In most cases, if there is measles outbreak, supplementary vaccination can be given. In addition, if there is case build (increments of cases over time but below outbreak threshold) and early warning situations of outbreak like malnutrition, supplementary vaccination can be given. So, there is a chance of getting more than one dose and that was why some cases got two and more doses.

Analysis of different measles outbreak surveillance data showed that outbreak can occur in area where there is high vaccination coverage (≥95%) due to accumulation of unvaccinated individuals over time and/or immigrants from low vaccination coverage [15–17]. Most epidemiological analysis of measles surveillance data also showed that the status of more than half of cases was unvaccinated [17–21]. The proportion of vaccinated cases in this study was found to be higher (61.9%) than that of epidemiological analysis of measles surveillance data done in Cameroon [13], Iran [22], Iraq [21] and Italy [18] that showed 49.2%, 20%, 18% and 5.5% of cases were vaccinated respectively. At the time of outbreak, it was concluded that outbreak was due to accumulation of susceptible population. But surveillance data showed that more than half were vaccinated with at least one MCV. This higher vaccination status report could be false report of vaccination or poor efficacy of vaccine at lower level due to different reasons like cold chain failure. Proportion of cases with unknown status was also higher than other epidemiological analysis of measles outbreak [18, 21] which might indicate poor documentation of vaccination data. Ruling out data quality or cold-chain problem thus needs other study.

To control the measles outbreak, timely measles surveillance is one of critical strategies [11]. Prompt recognition, reporting, and investigation of measles is important because the spread of the disease can be limited with early case identification and public health response including vaccination. Regular monitoring of surveillance indicators, including time intervals between diagnosis and reporting and completeness of reporting, may identify specific areas of the surveillance and reporting system that need improvement. The median interval between rash onset and notification of a public health authority is one of surveillance indicators that should be monitored [1]. But, in most cases, the number of reported cases of measles reflects a small proportion of the true number of cases occurring in the community [23]. Many measles cases do not seek health care or, if diagnosed, are not reported [11] while some cases go to traditional healers as seen in Bayelsa, Nigeria [24]. At the time of measles outbreak, surveillance is highly affected by community health seeking behavior and belief, especially mothers [24, 25]. In this study, median (delay time in days) interval between rash onset and case seen in health facilities seeking health care was 2.0 (IQR 1.0, 3.0). About two fifth cases, 846 (39.7%), visited health facilities within 48 h of onset of clinical sign and symptoms (Table 3) which was lower than that of Cameroon

| Variable             | Time interval to visit health facilities |
|----------------------|------------------------------------------|
|                      | Within 48 h | 2–3 days | 4+ days |
| **Age (years)**      |             |          |         |
| < 1                  | 118 (40.0%) | 132 (44.7%) | 45 (15.3%) |
| 1–4                  | 150 (35.0%) | 210 (49.0%) | 69 (16.0%) |
| 5–14                 | 504 (41.9%) | 538 (44.7%) | 162 (13.4%) |
| 15–44                | 74 (36.3%)  | 99 (48.5%)  | 31 (15.2%)  |
| **Vaccination status** |             |          |         |
| Unvaccinated         | 169 (42.5%) | 155 (38.9%) | 74 (18.6%) |
| One dose             | 347 (44.3%) | 364 (46.4%) | 73 (9.3%)  |
| ≥ 2 dose             | 183 (34.2%) | 262 (49.0%) | 90 (16.8%) |
| Unknown              | 147 (35.4%) | 198 (47.7%) | 70 (16.9%) |
| **Sex**              |             |          |         |
| Female               | 433 (40.4%) | 487 (45.5%) | 151 (14.1%) |
| Male                 | 413 (38.9%) | 492 (46.4%) | 156 (14.7%) |
| **Treatment modality** |             |          |         |
| Inpatient            | 120 (34.8%) | 167 (48.4%) | 58 (16.8%) |
| Outpatient           | 726 (40.6%) | 812 (45.5%) | 249 (13.9%) |
| **Total**            | 846 (39.7%) | 979 (45.9%) | 307 (14.4%) |
which reported 48.5% of cases visited within 48 h of onset of clinical signs and symptoms [13]. According to WHO guideline for epidemic preparedness and response to measles outbreaks, measles is one of the most highly communicable diseases in man, with a basic reproductive rate of 17–20. The disease is communicable from slightly before the prodromal period to four days after the appearance of the rash [26]. When cases visit health facilities in time, in addition to counselling on supportive care, vitamin A is given to all cases irrespective of whether it has previously been administered for prophylaxis or given during routine immunization activities since vitamin A minimizes complication (mortality) related to measles [4]. So, cases that delayed in the community were source for disease spread and challenge outbreak control. In addition, cases that stay without care were at risk of complications related to measles. Beyond this, as this study used secondary data, nothing was known about those cases who did not visit health facility which spread the disease and expected to be at risk of developing complications.

This study was limited in assessing reasons for delay as it used secondary data. In addition, the vaccination status was also judged by health worker reporting cases using immunization card, register and/or history.

Conclusions
Majority of the measles cases were vaccinated with at least one dose of measles containing vaccine and vaccination data or vaccine potency at lower level was unclear. Delay in seeking healthcare was noted as only about two fifth of cases visited health facilities within 48 h of clinical manifestation. Vaccination and surveillance data quality and factors associated with delay in seeking health care should be investigated.

Abbreviations
E.F.Y: Ethiopian Fiscal Year; IBM: International Business Machines Corporation; IQR: Interquartile; PHEM: Public Health Emergency Management; SIAs: Supplementary Immunization Activities; SNNP: Southern Nations, Nationalities, and People’s; SNNPR: Southern Nations, Nationalities, and People’s Region; SPSS: Statistical Package for the Social Sciences; WHO: World Health Organization

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Availability of data and materials
Data will not be shared. During ethical review, it was approved only to analyze data for study objectives and stated that it will not be shared except authors analyzing it.

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