# Magnitude and Trends of Measles in North West of Tigray Region, Ethiopia - A Four-year Surveillance Data Analysis, 2012-2015

*Guteta Degefa[1,&], Kidanu Gebremeriam[2], Tsitsi Juru[3], Ruth Jackson[4]*

[1]Ethiopian Field Epidemiology and Laboratory Training Program, [2]Mekelle University School of Public Health, [3]University of Zimbabwe, Department of Community Medicine, [4]School of Humanities and Social Sciences, Deakin University, Geelong, Australia

**KEYWORDS**
Surveillance data analysis, Measles, Tigray region, Ethiopia

## ABSTRACT

**Introduction:** Globally, measles is the leading cause of morbidity and mortality despite the availability of safe and effective vaccine. In Ethiopia, measles remains a disease of public health importance with an annual incidence of 12.5 to 18 per 100,000 populations. This study aimed at identifying the magnitude and trends of measles in the Northwest zone of Tigray region. **Methods:** We conducted a descriptive surveillance data analysis from 2012-2015 in the Northwest zone of Tigray region. We reviewed line list records and Health Information Management System reports. A suspected measles case was defined as any person with fever, rash, cough and either conjunctivitis or coryza. Laboratory confirmed cases had measles-specific IgM antibodies, and epidemiologically confirmed cases were those linked to a laboratory-confirmed case. We collected data by a standardized checklist, and analyzed it using Epi-info 7.1.5 and Microsoft Excel worksheet. We presented the analyzed data using frequencies, proportions, median and range. **Results:** We identified 757 measles cases with an annual incidence of 39 and 16 per 100,000 in 2012; 77 and 67 per 100,000 in 2015 in the <5 and >15-year-old respectively. Among these cases, 380(62%) were unvaccinated. Among <5 children, 27(3.6%) were <9-month infant ineligible for routine measles vaccination. Measles occurrence had a cyclical pattern from November to April, with high peaks from February to April. **Conclusion:** Children <5 years and adults aged ≥ 15 years were more affected in a cyclical occurrence of measles. Routine and supplementary immunization activities for more affected age groups including at-risk adults, and early preparedness before November may limit occurrence and spread of measles.

**[&]CORRESPONDING AUTHOR**
Guteta Degefa, Ethiopian Field Epidemiology and Labolatory Training Program, Addis Ababa, Ethiopia degefaguteta95@gmail.com

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## Introduction

Measles is an acute, highly contagious viral disease caused by the measles virus. The virus is transmitted primarily through respiratory droplets or airborne spray to mucous membranes in the upper respiratory tract. Symptoms usually appear after 10 to 12 days of infection, initially resembling a cold with a runny nose, cough and a slight fever. The eyes become red and sensitive to light [**2**,**3**].

Despite the availability of a safe and effective vaccine, measles remains one of the leading causes of death. Measles vaccination resulted in 84% drop in measles deaths between 2000 and 2016 worldwide [**4**]. In 2016, there were 89,780 measles deaths globally, about 246 deaths every day or 10 deaths every hour [**5**]. Four-fifths of these deaths are estimated to have occurred among children <5 years of age [**6**]. In Africa about 28,000 measles-related deaths are still occurring each year although routine measles vaccination was established during the 1970s and 1980s [**7**].

Ethiopia is working towards measles elimination by 2020 through static and outreach immunization programs. The current routine immunization schedules recommend a dose of measles vaccination at 9 months of age [**3**,**8**,**9**]. In 2004, following surveillance guidelines from the World Health Organization African Regional Office (AFRO), Ethiopia established a surveillance system of measles [**3**,**4**]. The overall goal of the measles surveillance system is to detect, report and control epidemics of measles as early as possible, and to strengthen the capacity for emergency response to the epidemics of measles [**3**,**10**]. Reporting of measles cases or suspects is immediate when using the case-based reporting system which has been place since 2003 and is supplemented by laboratory confirmation for suspected cases. The flow of information is as shown in **Figure 1**[**11**]. However, measles remains one of the main public health problems with an annual incidence of 12.5 to 18 per 100,000 population [**12**,**13**]. Measles outbreaks are reported each year and have become one of the main public health problems in North West zone of Tigray regional state. As a disease targeted for elimination, measles surveillance data analysis is crucial to guide intervention and control activities. This surveillance data analysis is aimed to determine the trends, magnitude and distribution of measles to improve the future interventions against the disease in the North West zone of Tigray regional state.

## Methods

### Study Area

We conducted our study in North West zone (an administrative structure that reports to region) woredas (an administrative unit equivalent to a district that report to the zone) of Tigray regional state (Northern part of Ethiopia). The zone has six woredas and is located at the northwestern part of Tigray regional state where an estimated 926,648 people reside [**14**]. The average annual coverage of measles vaccination in the zone between 2012 and 2015 was above 95%. The completeness (percentage of all expected data reports that were actually submitted to the public health surveillance system) and Timeliness (Interval between the identification of suspected measles cases by the reporting health facilities, reporting to responsible public health agency and the response to the cases) of the zone were 97.6% and 89.6% respectively.

### Study Design

We conducted a descriptive secondary surveillance data analysis from mid-February 2016 to March 2016 in the North West zone of Tigray regional state.

### Source Population

We included all confirmed, suspected and epidemiologically-linked measles cases and deaths reported through; Health Management Information System (HMIS), weekly Public Health Emergency Management (PHEM) reports, and registered on the line list of all North West zone woredas of Tigray regional state from 2012-2015.

### Measles Case Definitions

Detection of measles cases in Ethiopia is done according to the national measles guidelines developed in 2012 by the Ethiopian Public Health Training Institute that specify the case definition of measles as follows.

Suspected measles case: Any person with generalized maculopapular rash and fever plus one of the following: a cough or coryza (a runny nose) or

conjunctivitis (red eyes) or any person in whom a clinician suspects measles.

Confirmed measles case: A suspected case with laboratory confirmation (positive IgM antibody) or epidemiologically-linked to confirmed cases during an outbreak.

Epidemiologically-linked case: A suspected measles case that has not had a specimen taken for serologic confirmation and is linked (in place, person and time) to a laboratory-confirmed case; i.e., living in the same or in an adjacent woreda with a laboratory-confirmed case where there is a likelihood of transmission; onset of rash of the two cases being within 30 days of each other.

Measles-related death: Any death from an illness that occurs in a confirmed case or an epidemiologically linked case of measles within one month of the onset of rash.

Measles Epidemics: Five suspected measles cases in one month or three confirmed measles cases in one month.

### Data Processing and Analysis

We collected 4-year surveillance data (2012-2015) using data abstraction checklist from HMIS, measles line list and PHEM weekly reports. We reviewed, cleaned, cross checked the collected data (weekly and monthly reports with line lists of the zone) and entered it into a designed Epi info 7.1.0.6 and Microsoft Excel worksheet 2007 for analysis. The analyzed and organized data was presented using frequencies, proportions, median and range.

### Permission and Ethical Consideration

We obtained ethical clearance from the Institutional Review Board of Mekelle University. We also obtained a formal letter from Tigray Regional Health Bureau to the woredas of the zone to get all necessary support from the woredas. We obtained legal permission from all woredas to use all available data.

## Results

### Measles Morbidity and Mortality Analysis by Person

From 2012 to 2015, 757 measles cases, 6 deaths and 21 episodes of measles outbreaks were reported in the zone. More than half, 390 (52%) of the cases were male. The median age of the cases was 20 years (Range: 3 months to 58 years). Among the cases, 290(38%) were children <5 years of age while adults >15 years age group contributed 422(55.7%) to the total number of cases (**Table 1**).

The annual incidence of measles cases was 39.3 for children <5 years old, 7.9 for 5-14 years old and 16.0 per 100,000 population for adults >15 years of age in 2012. In 2015 the annual incidence of measles cases was 77.3 and 66.9 per 100,000 for children <5 years old and adults >15 years of age respectively. During the 4-year period, the average incidence was 161.4 and 102 per 100,000 populations in children <5 years and adults >15 years of age respectively. The mortality related to measles was 21 and 7 per 1000 population in 2012 and 2015 respectively (**Table 2**).

### Measles Morbidity Analysis by Time

From the total of 757 measles cases, 448 cases of measles reported in 2015 and only 35 cases were reported in 2014 (**Figure 2**). During the 4-year period, cases of measles occurred with a seasonal variation from WHO week 46 to 17 (mid-November to April of the following year) and a peak of infection during WHO week 10 to 17 (late February to mid-April) (**Figure 3**).

### Measles Morbidity Analysis by Place

During the 4-year period, around half of measles cases 372(49.2%) were reported from Tselemty and Asgeda Tsimbila woreda while Shiraro town 22(2.9%), Endassilassie town 29(3.8% and Tahtay Koraro woreda 30(4%) contributed less than 5 percent of cases during the analysis period (**Table 3**).

## Discussion

In our 4-year secondary data analysis of the measles data from Tigray, we found that the number of measles cases has been increasing in North West

Zone of Tigray regional state, despite efforts being made to control measles through the implementation of measles surveillance system and achieving high (>95%) measles immunization coverage.

In our study, we found a high measles incidence in <5-year-old children and adult >15 years age category. High measles incidence in <5 and adults >15 years age group was also reported in another study done in the Amhara region and the southern part of Ethiopia [**13**,**15**]. High incidence identified in <5 years age groups may be due to waning maternal antibody to protect young infant that may contribute to increasing the number of cases in these age group [**16**]. In adults, better health-seeking behavior, change in the epidemiology of measles or accumulation of susceptible populations within these age groups may also result in high measles incidence [**12**,**17**].

High measles case fatality was reported in <5 years old age group and adults >15 years age category. The identified case fatality rate was below the expected case-fatality rate in Ethiopia, which is between 3% and 6%, but was higher in adults contrary to the highest case-fatality rate expected to occur in infants [**3**,**18**]. This may be because measles can coexist with several comorbid conditions that can cause death; attribution to any cause is somewhat arbitrary, rendering specific accounting difficult in <5 children [**19**]. Variation in reporting and underreporting measles cases in some areas, incomplete reporting of outcomes of measles cases or improvement in the management of measles cases in health facilities may also result in these variations [**3**,**20**].

During the 4-year period, around half of measles cases were reported from Tselemty and Asgeda Tsimbila woredas. These may be due to high population movement in these woredas for gold mining, or availability of refugee camps in Asgeda Tsimbila woreda, that may result in an outbreak of measles that contributed to an increment in the number of cases in these woredas.

The occurrence of measles has a cyclical pattern from November to April. This cyclical occurrence of measles was also reported by the study done on measles, mumps and rubella that indicated that, measles increases generally in winter and spring [**13**,**21**,**22**]. This may be due to high population movement in spring and winter for gold mining in the study area, or dry environmental conditions favorable for transmission of measles.

This study had some limitations. Some variables sought on the line list of measles were incomplete (sample taking for confirmation, laboratory results), making the meaningful review of these variables difficult, therefore, we excluded these variables from the analysis.

## Conclusion

The trend of measles has been on the rise mostly affecting children <5 years old and adult >15 years of age. The mortality related to measles was also higher in children <5 years and adults >15 years. The analysis indicated that measles cases had repeatedly occurred with a cyclical pattern during the analysis period. Therefore, we recommend routine and supplementary immunization activities for more affected age groups, including adults >15 years of age and early preparedness before November to limit the occurrence and spread of the disease. Further research should be conducted to understand why children <5 and adults >15 years are more affected than 5-14 years age group, a high number of measles cases cyclically reported from November to April and an ineligible infant affected than expected.

### What is known about this topic

- A number of measles cases had been reported in different parts of Ethiopia and become a public health concern despite the availability of safe and effective vaccine.
- Measles is one of the epidemic prone diseases of the 20 priority diseases tracked by Public Health Emergency Management (PHEM) surveillance system in Ethiopia.

### What this study adds

- This surveillance data analysis will help to see the trends, burden, and distribution of the measles and evaluate the effectiveness of measles control program.
- The findings from this study may have a contribution to the improvement of the health status of community in the study area in particular and the country in general by

providing new information regarding the magnitude and trends of measles. This in turn used as a platform from which to develop context-specific strategies to decrease the morbidity and mortality related to measles.

## Competing interests

The authors declare no competing interest.

## Authors´ contributions

All authors contributed to the development of the manuscript.

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## Tables and figures

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**Table 1:** Proportion of measles cases by sex and age category North-West zone, Tigray regional state, 2012-2015

| **Age category** | **Sex** | | | |
|---|---|---|---|---|
| | **Male** | **Female** | **Number** | **%** |
| < 5 years | 246 | 44 | 290 | 38.3 |
| 5-14 years | 27 | 18 | 45 | 6.0 |
| ≥ 15 years | 117 | 305 | 422 | 55.7 |
| Total | 390 | 367 | 757 | 100 |

**Table 2:** Age-specific incidence and case fatality rate of measles cases in North West zone, Tigray regional state, 2012-2015

| Year | Age category | Population | Cases | Proportion (%) | Incidence/100,000 | Death | Case fatality/1000 |
|---|---|---|---|---|---|---|---|
| 2012 | <5 years | 122,225 | 48 | 34.3 | 39.3 | 0 | 0.0 |
| | 5-14 years | 277,373 | 22 | 15.7 | 7.9 | 0 | 0.0 |
| | ≥15 years | 438,134 | 70 | 50.0 | 16.0 | 3 | 43 |
| | Sub Total | 837,732 | 140 | 100.0 | 16.7 | 3 | 21 |
| 2013 | <5 years | 125,347 | 36 | 26.9 | 28.7 | 0 | 0.0 |
| | 5-14 years | 284,457 | 29 | 21.6 | 10.2 | 0 | 0.0 |
| | ≥15 years | 449,324 | 69 | 51.5 | 15.3 | 0 | 0.0 |
| | Sub Total | 859,127 | 134 | 100.0 | 15.6 | 0 | 0.0 |
| 2014 | <5 years | 128,548 | 19 | 54.3 | 14.8 | 0 | 0.0 |
| | 5-14 years | 291,722 | 7 | 20.0 | 2.4 | 0 | 0.0 |
| | ≥15 years | 460,799 | 9 | 25.7 | 2.0 | 0 | 0.0 |
| | Sub Total | 881,069 | 35 | 100.0 | 4.0 | 0 | 0.0 |
| 2015 | <5 years | 131,831 | 102 | 22.8 | 77.3 | 1 | 10 |
| | 5-14 years | 299,173 | 30 | 6.7 | 10.0 | 0 | 0 |
| | ≥15 years | 472,568 | 316 | 70.5 | 66.9 | 2 | 6 |
| | Sub Total | 903,572 | 448 | 100.0 | 94.8 | 3 | 7 |
| Average | <5 years | 126,988 | 205 | 27.0 | 161.4 | 1 | 5 |
| | 5-14 years | 288,181 | 88 | 11.6 | 30.5 | 0 | 0.0 |
| | ≥15 years | 455,206 | 464 | 61.3 | 102.0 | 5 | 11 |
| | Total | 870,375 | 757 | 100.0 | 87.0 | 6 | 8 |

**Table 3:** Total measles cases by woreda North-West zone, Tigray regional state, 2012-2015

| Woreda | Number of cases by year | | | | Total |
|---|---|---|---|---|---|
| | 2012 | 2013 | 2014 | 2015 | |
| | No (%) | No (%) | No (%) | No (%) | No (%) |
| **Tselemty** | 62(44.3) | 13(9.7) | 6(17.1) | 113(25.2) | 194(25.7) |
| **Asgeda Tsimbila** | 36(25.7) | 62(46.3) | 15(42.8) | 65(14.5) | 178(23.5) |
| **Laelay Adeayabo** | 15(10.7) | 8(5.9) | 3(8.5) | 97(21.6) | 123(16.2) |
| **Medebay Zana** | 3(2.1) | 15(11.2) | 5(14.3) | 75(16.7) | 98(12.9) |
| **Tahtay Adeayabo** | 6(4.3) | 29(21.6) | 1(2.8) | 47(10.5) | 83(11.0) |
| **Tahtay Koraro** | 6(4.3) | 2(1.5) | 2(5.7) | 20(4.4) | 30(4.0) |
| **Endassilassie Town** | 12(8.5) | 5(3.7) | 3(8.5) | 9(2.0) | 29(3.8) |
| **Shiraro Town** | 0(0.0) | 0(0.0) | 0(0.0) | 22(4.9) | 22(2.9) |
| **Total** | 140(100.0) | 134(100.0) | 35(100.0) | 448(100.0) | 757(100.0) |

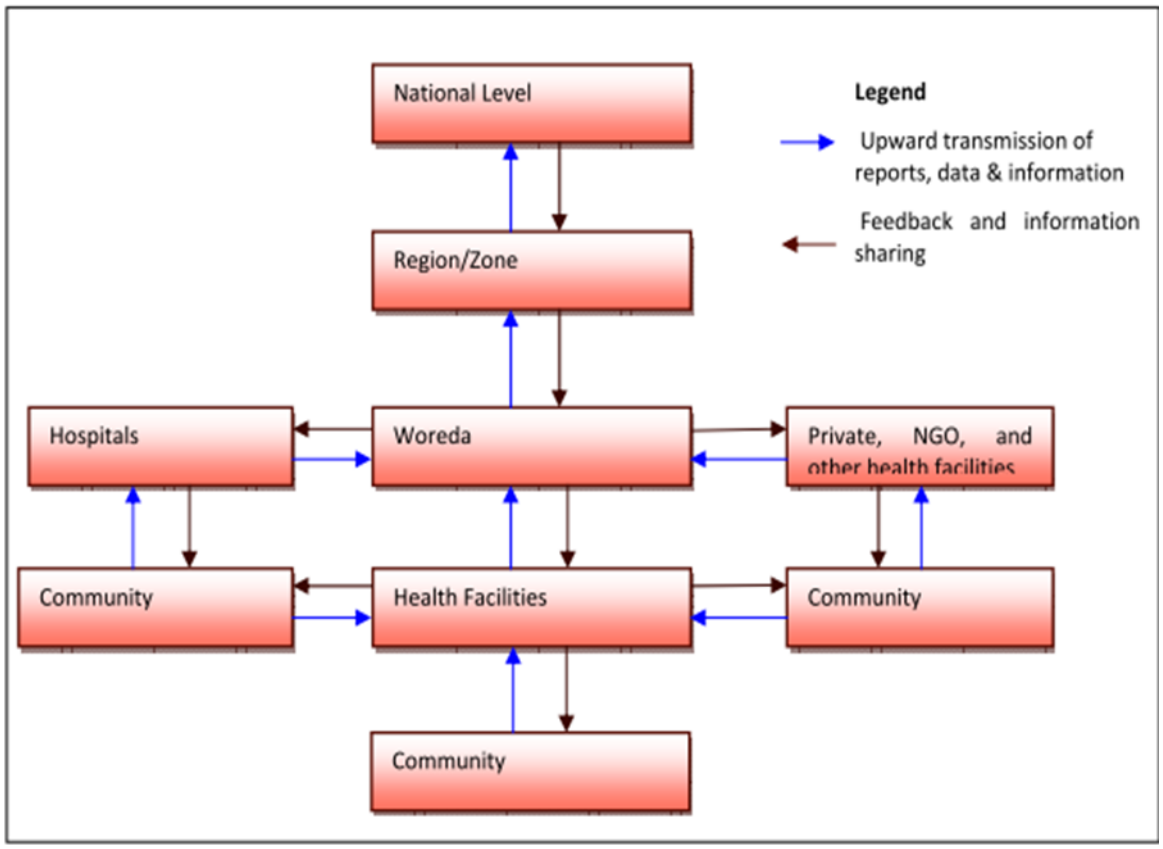


**Figure 1:** The formal and informal flow of measles surveillance data and information throughout a health system in Ethiopia

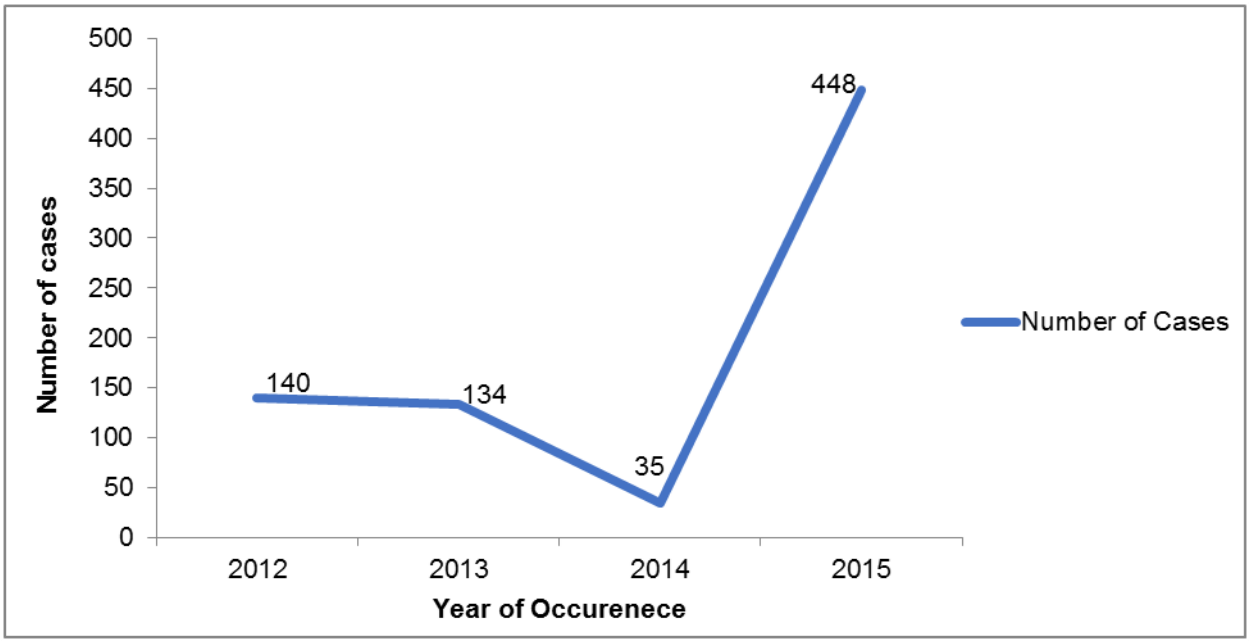


**Figure 2:** Trends of measles by year from total number of cases, North West Zone, Tigray regional state, 2012-2015

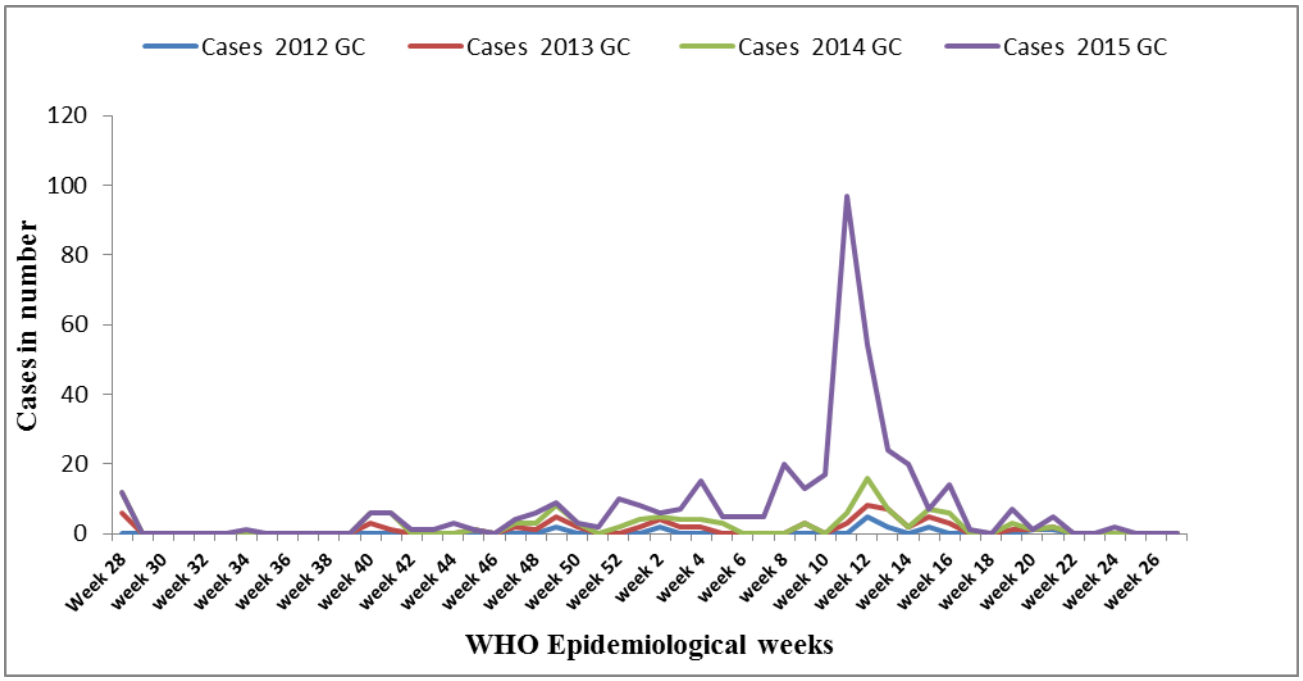


**Figure 3:** Trends of measles cases by week North-West zone, Tigray regional state, 2012-2015