Epidemiology of Measles in Bale Zone Southeast Ethiopia: Analysis of Surveillance Data from 2013 to 2019

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Abstract

Background: Measles remains causes of vaccine preventable deaths in children worldwide. Measles is under the list of weekly reportable diseases in Ethiopia; however, reported cases represent only a small proportion of the expected cases due to weak measles case-based surveillance implementation. This study was aimed to analyze seven years measles surveillance data of Bale zone in order to indicate measles epidemiology and surveillance related gaps.

Methods: Cross-sectional study was conducted from May 25-June 25/2019. Study population was all measles cases reported to Bale Zone Health Office from 2013 to 2019. Data were abstracted from seven years measles line list and case-based report by the investigator using data abstraction check list. The data were entered and analyzed using Microsoft excel, and presented in tables and graphs.

Result: Overall, 4241 measles cases were reported from 2013 to 2019. Mean age of the cases were 7.15 and 2147 (50.6%) were males. The most affected age group were children under 4 years of age. The analysis indicated that the case fatality rate was 3.07/1000 population. From the total cases reported 248 (5.8%) were measles IgM confirmed. The highest prevalence rate of 141/100,000 populations was reported in 2019. Unvaccinated cases and cases with unknown vaccination status were 890 (21%) and 731(17.2%) respectively. The highest numbers of cases were reported from Ginir and Gololcha districts. Measles cases increase in autumn season of the year and reaches peak in May.

Conclusion: Measles is a major cause of morbidity and mortality in Bale zone due to poor immunization coverage. Its case fatality is also high excluding community deaths. From all districts included Ginir reported the highest number of cases. Improving vaccination coverage, early preparedness for annual epidemic cycle and strengthening measles case-based surveillance are important interventions to reduce measles morbidity and mortality.

Introduction

Measles is one of the most contagious diseases for humans caused by a virus in the family paramyxovirus, genus Morbillivirus. The incubation period for measles is 10–14 from exposure to symptom onset. Measles characterized by fever, malaise, cough, coryza, and conjunctivitis, followed by a maculopapular rash (1). Complications of measles are most common among children younger than 5 years of age and 30% of reported measles cases result in complications such as pneumonia, diarrhea and encephalitis, and death (2).

Measles resulted in 90,000 and 110 000 deaths annually, in 2016 and 2017 respectively. In high income regions of the world, measles causes death 1 in 5000 cases, but greater than 1 in 100 may reach 25% will die in developing countries (7). Measles is still a common and often fatal disease in developing countries (2). In 2013, 171,178 cases were reported from Africa region of world health organization WHO (10) and resulted in high attack rates among children less than one year. Measles is the leading cause of blindness in African children (2). According to a WHO report, measles still remains a public health priority disease and is associated with high morbidity and mortality. Most of the associated deaths occur in children aged five years and younger. It is a leading cause of vaccine preventable death and endemic in low vaccine coverage countries. Measles follows a seasonal pattern, with increasing incidence in the dry season, i.e. from reported November to May (6) and in Ethiopia reach peak during the late-early part of the year (December to February) (11).

Measles is still one of the major causes of death and sickness of children in Ethiopia and outbreak reported annually (11)(3). Ethiopia is committed to achieve the elimination of measles by 2020 and measles incidence in Ethiopia is 50 cases/1,000,000 per year, which is above the national set targets for measles elimination by 2020 <1/1,000,000 per year in 2017 (5). Case-fatality rate is between 3% and 6%; In certain high-risk populations, case-fatality rates as high as 30% have been reported in infants aged less than 1 year of age in Ethiopia (3). According to measles surveillance data analysis of 2012-2016 conducted in Oromia regional state of Ethiopia 26908 cases and 288 deaths were reported (12).

The risk factors for measles is inadequate vaccination, Malnourished, children with vitamin A deficiency and immunodeficiency due to HIV or AIDS, leukemia, alkyl ting agents, or corticosteroid therapy, regardless of immunization status and children who travel to areas where measles is endemic or contact with travelers to endemic areas are at high risk of (3).

As a result of the existence of highly effective measles vaccine (4) four million measles related deaths are averted from 2012-2014 (5). Measles vaccine is a live attenuated virus vaccine and two doses recommended by world health organization to provide protection from measles (13). According to WHO-AFRO region of 2015 status of the measles elimination in the African Region, Ethiopia is among the eleven countries with major challenges, large population, insecurity, and high incidence of measles, frequent outbreaks and leadership gaps (13).

According to WHO Ethiopia is among the six countries with the most unvaccinated infants of (1.1million) in 2017 (24). Ethiopia is among the nations with low measles containing vaccine (MCV1) coverage and MCV2 was given by supplementary immunization activities until recent time. To get extra immunity the government launched measles vaccine second dose (MCV2) vaccination into the routine immunization program in the second year of life in February 2019. Measles antibodies develop in approximately in 95% of children vaccinated at 9-12 months of age and 98% of children vaccinated at 15 months of age (2) (17).

According to WHO, measles surveillance is a key element to achieving elimination goal (8). The objectives of measles surveillances are detecting, identify, investigate, and manage outbreaks identifying geographic areas and age groups at high-risk and Evaluate vaccination strategies in order to improve measles control (3). In Ethiopia measles, case-based surveillance is part of the national public health emergency management (PHEM) system.

Case-based measles surveillance was initiated in Ethiopia in 2003. Measles is one of the weekly reportable diseases in Ethiopia and the number of reported cases represents only a small proportion of the expected cases. Measles case usually comes to health facilities often after they develop complication. As a result, they are diagnosed as the complication rather than measles, which is one of the reasons for under reporting of measles cases (11). And the aim of this study was to analyze seven years (2013-2019) measles surveillance data of Bale zone by person, place and time. The analysis includes vaccination status, laboratory confirmation and case fatality rate among cases.

Methods And Materials

Study area

Bale zone is among twenty-one administrative zones of Oromia regional state. It is located in the Southeastern part of Oromia and is situated between 5°11´03´´N to 8°09´27´´North latitudes and 38°12 ´04´´E to 42°12´47´´East longitudes with an altitude ranges from 300 to 4377 meters above sea level. Bale is bordered by Somali Region on the South and Guji zone on the West, West Arsi Zone on the North, Arsi Zone on the Northeast, West Hararghe and East Hararghe on the East. Robe, the capital of the zone is situated at 430km from Addis Ababa. Bale zone have 18 districts and two city administrations. About 383 health posts, 83 health centers and four hospitals are found in the zone. The total population projected for 2019 was 1,963,416.

Study design and period

Cross-sectional study was conducted to analyze measles surveillance report (2013-2019) from 25/5/2019-25/6/2019.

Source and the study population

All peoples in Bale zone during the study period were the source population, while all confirmed, epidemiologically linked and clinically compatible measles cases reported to Bale zone from 2013-2019 were the study population.

Inclusion and exclusion criteria

Complete line lists and case-based reports of measles recorded in the database of Bale zone public health emergency management (PHEM) from 2013 to 2019 was included.

Line lists and case-based reports registered prior to January 2013 and after December 2019 as well as line lists with incomplete data elements were excluded.

Sample size and sampling procedure

All 4,241 measles cases reported to Bale zone PHEM department from 2013 to 2019 were taken.

Data collection procedure and analysis

Secondary data of measles from 2013-2019 was abstracted by using a format developed for this purpose. Data were collected from line list, case based and Weekly integrated disease surveillance and report (IDSR) report. The data were abstracted by the investigator in terms of person, place, time, case classification, vaccination status and final outcome. The abstracted data were entered and analyzed using Microsoft Excel, Pivot software. Arch JIS version 10.1 software was used to locate area and spot map of cases. Descriptive statistics median, standard deviation and percentages were used to analyze measles surveillance data during 2013-2019. The prevalence, case fatality and vaccination status were also calculated. The data were also described by person, place and time. The results were presented in tables, graphs and figures.

Operational definition

Suspected measles case

Any person with fever and maculopapular generalized rash and cough, coryza or conjunctivitis OR any person in whom a clinician suspects measles.

Confirmed measles case

A laboratory confirmed (positive measles IgM antibody) or epidemiologically linked to confirmed cases.

Epidemiologically linked case

A suspected measles case living in the same or in adjacent district 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 death

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

Discarded

A suspected measles case that has been completely investigated, including the collection of adequate blood specimen (5 ml), but lacks serologic evidence of recent measles virus infection (that is, IgM negative).

Clinical /compatible

A suspected measles case that has not had a blood specimen taken for serologic confirmation, and cannot be epidemiologically linked to a laboratory-confirmed case.

Ethical Issues

Official letter was written from Jimma university school of Public Health and presented to Bale Zonal health office. A permission letter was obtained from Bale Zone PHEM department before seven years zonal Measles data was accessed to carry out this analysis. The privacy of the data was maintained to use it only for our study purpose confidentially.

Result

Measles case distribution by age, sex and place

A total of, 4241 measles cases were reported from 475 health facilities and twenty districts to Bale Zone Health office from 2013-2019. From a total cases reported, 51% were males and 49% were females. Mean age of cases were 7.15 years and standard deviation were 8.95 years. Age group of 1-4 years were 40%, followed by 5-15 which were 30% (Table 1).

Table 1 Measles cases reported in Bale from 2013 to 2019 by age categories and sex, Bale Zone Health Office, May 25-June 25/2019.

Age	Sex					
	Male		Female		Total	
	No	%	No	%	No	%
<1	235	5.5	268	6.3	503	11.9
1_4	759	17.9	923	21.8	1682	39.7
5_15	771	18.2	502	11.8	1260	29.7
16-35	303	7.1	333	7.9	649	15.3
36_49	74	1.7	52	1.2	126	3.0
>50	5	0.1	16	0.4	21	0.5
Total	**2147**	**50.6**	**2094**	**49.4**	**4241**	**100**

From a total reported measles cases 2,147 (50.6%) were males and 2,094 (49.4%) were females. Female to male ratio was 1:1.04. Sex specific prevalence rate was calculated and the highest prevalence rate was among male with 2.27/1000 slight lower among females 2.2/1000 population. The trend shows that almost distribution of cases was equal among both sexes with slight difference in 2013, 2015 and 2019 as shown in figure 1.

Measles age specific prevalence by time

Prevalence was high in under one year's children during 2013-1019 with the highest PR 30/1000 reported in 2019. The second most affected age group was 1-4 age categories the highest PR 4.29/1000 in 2019. The prevalence rate was low among greater than 15 years with highest PR of 0.73/1000 observed in 2019 (Table 2).

Table 2 Age specific prevalence/10,000 population of measles in Bale zone from 2013 to 2019, Bale Zone Health Office, May 25 - June 25/2019.

	Prevalence Rate (PR)/1000 in age groups					
Years	**< 1**	**1_4**	**5_15**	**16-35**	**36-49**	**<50**
2013	1.17	0.31	0.09	0.08	0.03	0.02
2014	2.96	0.31	0.09	0.13	0.00	0.00
2015	5.31	0.42	0.22	0.09	0.03	0.03
2016	6.36	0.35	0.12	0.02	0.02	0.02
2017	3.47	0.21	0.06	0.01	0.00	0.00
2018	2.34	0.33	0.13	0.10	0.01	0.01
2019	29.80	4.29	1.32	0.73	0.01	0.01
Total	**51.41**	**6.21**	**2.04**	**1.16**	**0.10**	**0.10**

Prevalence of measles by place

From a total of 4,241 measles cases reported from 2013-2019 years, the highest proportion of measles prevalence were reported from Ginir district (77/10000 population) followed by Gololcha (45.4/10000 population) and Lega Hidha (38.4/10000 population). The lowest proportions of measles prevalence were reported from Guradhamole and Gasara, with a prevalence of 0.6/10000 and 0.9/10000 population respectively as shown in (Figure 2).

Geographical distribution of measles

Regarding measles cases by place of residence, the highest number of cases were reported from rural areas of the zone 3,642 (85.8%) cases; while only 599 (14.1%) measles cases were reported from urban areas.

Trend of measles by month

The highest number of measles cases were reported during autumn (June 1344 (31.6%), May 934 (22%) and April 545 (12%)). From the season of the year it reaches peak level in May and lower number of cases were reported in summer season (October, November and September) as shown in Figure 4.

Trend of measles prevalence by time

From 2013-2019 the highest suspected measles cases prevalence rates were seen in 2019 and 2015 accounted for 141 per 100,000 and 21 per 100,000 populations respectively. While remarkable decrement of suspected measles cases was reported in year 2017 which was 7.2/ 100000 and in 2013 which was 11.4 /100000 populations (Figure 5).

Measles final case classifications

From a total of 4241 measles cases reported during the study period only 248 (5.8%) cases were confirmed by laboratory for measles IgM and 3,060 (72.1%) were epidemiologically linked to confirmed measles cases. About 497 (11.3%) of the cases were reported as clinically compatible with measles case as shown in Figure 6.

Measles laboratory result

During 2013-2019, 993 serum samples were sent to Ethiopian Public Health Institute (EPHI) central laboratory for confirmation, and about 248 (24.9%) of the samples tested were positive for measles IgM and 375 (37.7%) of samples were discarded (Figure 7).

Inpatient and outpatient cases

From 2013-2019 period, 582 (13.2%) measles cases were admitted in inpatient and 3659 (86.2%) suspected measles cases were treated as an outpatient. The overall admission rate from the treated measles cases were 16 %.

Measles case fatality rate

From all measles suspected cases that were reported from all districts of the zone, the crude case fatality rate (CFR) was 3.07/1000 population and the highest numbers, 9 (69.2 %) of measles related deaths were reported from Ginir district.

Case fatality by sex and age

Fatality was high among females than males with crude case fatality rate (CCFR) of 3.3/1000 among females and 2.8/1000 among males respectively. Measles age specific fatality rate (ASFR) was calculated and highest case fatality rate (4/1000 population) were observed among children less than one year's age.

Trend of measles CF by year

Regarding the trend of measles mortality, the greatest case fatality was occurred during 2015, which was 5.4/1000, and in 2014 which was 4.4/1000 populations. Measles related death were not reported in 2013, 2017 and 2018 years (Figure 9).

Vaccination status

Out of the total measles case reported, 2620 (62%) were vaccinated, and from which 1480 (34.4%), 1032 (24.3%) and 108 (2.5%) have received a single, two and three doses of measles containing vaccine (MCV) respectively. There were 890 (21%) case patients with no vaccination history and 731 (17.2%) of the case patients with unknown vaccination status (Table 3).

Table 3 Table showing vaccination status of measles cases by sex from 2013-2019 in Bale Zones, May 25 -June 25 /2019.

Vaccination status of reported cases	Sex		Total	Percent
	Male	Female		
Vaccinated	1296	1323	2619	61.8
Unvaccinated	484	406	890	21.0
Unknown	369	363	732	17.3
Total	**2149**	**2092**	**4241**	**100**

Vaccination status by place

Regarding unknown vaccination status, 390 (53.4%) were from Ginir and 107 (14.6%) of unknown vaccination status were from Gololcha. Vaccinated cases were also highest in Ginir, Gololcha and Sewena, which were 981 (37.4%), 400 (15.3) and 213(8.1%) respectively. The proportions of zero doses were 443 (50 %) from Ginir, 88 (10%) from Dawe Serer and 82 (9.2%) from Lega hida. Ginir woreda reported highest number of both vaccinated and zero dose cases.

Vaccination status by time

Concerning vaccination status of measles cases, from a total of 890 unvaccinated cases the highest percentage of unvaccinated cases were reported in 2019 and 2014, with 73.3% and 9% respectively. Regarding those who have vaccination history, the highest percentage of measles case with single dose and two doses of MCV were reported in 2019 and 2015 with 67.9%, 68% and 7.2% and 14% respectively. Lower proportion of cases with single dose and two doses were reported in 2014, 2% single dose and 1.5% of two doses. Forty-one percent of measles cases with unknown vaccination statuses were reported in 2019 which is relatively high.

Measles Data Type

From 4241 total suspected measles cases, 903 (21%) of the cases were reported by case based and 3312 (64.9%) were by line list.

Discussion

From a total cases reported the highest measles cases were observed among all age categories. This finding is in line with the study conducted in Guji zone which shows all age groups, even older than 15 years are affected (20) and national measles surveillance data analysis finding of the age group 1 to 4 years was the most affected population by measles from all other age categories (21). This is because of malnutrition and inadequate vaccination status.

From 2013-2019 the highest measles prevalence rates were seen in 2015 and 2019 accounted for 21 per 100,000 and 141 per 100,000 populations respectively. The study finding is higher compared to study conducted in Nigeria the incidence was estimated at 19/100,000 population/year (22) and in Ethiopia the incidence was more than 2/100,000 populations/year for five years (21). The deference is possibly due to high accumulation of susceptible person and outbreak occurs frequently in the zone.

During 2013-2019, 993 a serum sample was sent to Ethiopian Public Health Institute (EPHI) for confirmation of cases and about 25%) were measles IgM positive, 38% were discarded and 14% were negative for measles IgM. This finding is in line with study conducted in south Ethiopia and Oromia region finding 31.3% (23) and 36% of samples were positive for measles IgM respectively (13). The finding is greater than national confirmed cases in 2008 and 2009, which were only   10.7 and 9.1% were confirmed respectively (21). These might be because measles is still prevalent in the zone. In other word this finding indicates improvement and strength of measles surveillance system of the zone.

From 2013-2019 periods 13% measles cases were admitted and 86% suspected measles cases were treated as an outpatient level. The overall admission rates from the cases were 16%. The admitted cases were lower as compared to study conducted in Addis Ababa among 1787 measles cases; 84% were outpatient visits while the rest 16% were inpatient (17). This might be due to limited resources among patients and inadequacy of admission rooms of health facilities in the study area.

The analysis revealed that case fatality rate was 3.07/1000 population and high among children less than 1-year followed by 5-15 years. Fatality was high among females than males with CCFR of 3.3/1000 among females and 2.8/1000 among males respectively. The fatality of the zone was low as compared to study in Niger with CRF of 9.7% and highest CFR was among infants 15.7% (23). The current expected Case-fatality rate in Ethiopia is between 3% and 6%; however, in certain high-risk populations, case-fatality rate reach 30% in infants aged less than 1 year of age in Ethiopia (3). This is because CFR of measles decrease with increasing age and fatal in under five aged children due to poor nutritional and vitamin A supplementation in the zone.

Out of the total cases of patients 62% of cases were vaccinated. There were 21% case patients with no vaccination history and 17% of the case patients had unknown vaccination status. This finding were greater compared to study conducted in Ethiopia 22% were received at least one dose of measles containing vaccine (MCV) while 24% were not vaccinated and the rest 54% vaccination status were not known (17). The study finding is lower than the study conducted in Oromia region 29% measles cases were not vaccinated and 46% of cases were unknown for vaccination status (12). It is also lower than the study conducted in Guji zone, 77% of measles cases were unvaccinated (19) .

The analysis indicates that from all suspected measles cases reported, 27% of suspected measles cases were reported by case based, while 73% were reported by line list; from which the majority 72% was reported in 2019 because of outbreak. There were no reported measles cases by line list during 2018 and 2017 year. This shows there is sensitivity of the surveillance system and case notification is good. Measles case-based surveillance is part of the national PHEM system and a key component of the measles control program. It is a system whereby every suspected measles case should be detected, reported and undergo laboratory investigation (20).

Regarding seasonal pattern of measles, the highest number of measles cases were reported during June 32%, May 22% and July 12% season of the year and low number of cases were reported in October, November and September 2%, 0.97% and 2.3% of cases respectively. Cases reach peak level in June. The finding were contrary with the finding of study conducted in Ethiopia, there was a trend of increment of cases in January, February and March (20). This is due to about 60% of the zone climate were characterized by long persistent dry season (kola).

Limitation of the study

The study does not include the analysis of sample collected for laboratory by place and time, because the line list and case based was not complete. Vitamin A Supplemented for case patients were not included. Because deaths in the community were not reported and case fatality was underestimated. Time lines and completeness was not included because of incomplete data.

Strength of the study

The study tried to address all measles cases data by type and all variables. It included 2019 data, because five districts of the zone were attacked by outbreak. To analyze all related variables of the study, measles case-based report and line lists were used.

Conclusion

Generally, measles cases reported indicated a very high crude case fatality. The highest percentage of cases was seen in males. Despite the presence of effective vaccination, less than four years of age children are the most affected population. The highest numbers of cases were reported from Ginir and Gololcha while G/dhamole and Gasara reported low number of cases. Most of samples examined for measles showed measles IgM positive. High proportions of study population were not vaccinated, which indicates a significant number of susceptible people are in the community. The highest number of them reported in single year, 2019. Only few measles cases were admitted and 3659 (86.2%) Almost all suspected measles cases were treated as an outpatient, and only few cases were admitted inpatient. The cyclic pattern shows increase of cases in April to June.

Recommendation

Surveillance system needs to be strengthened to notify and identify cases early in the community. Health facilities and health offices of the districts in the zone have to investigated and report measles death in the community. Samples collected for Laboratory confirmation should be improved in terms of quality and quantity by facilities. Routine immunization program had better be strengthened by health posts and facilities in the zone. Even though different prevention strategies exist to expand measles immunization coverage, the measles cases increase from 2013 to 2019. This raises the question on the service quality and health providers need to focus on quality improvement of immunization services. The support of the zone has to be strengthened in early preparedness and supplementary immunization activities before April to overcome changes in seasonal patterns of measles cases. The possible cause of measles in Ginir district should be further investigated.

Declarations

Competing of interest: No conflict of interest

Funding: None

Contribution

GT conceptualized the study and methodology, collected all data, performed data analysis and wrote the original draft and the manuscript. YG and SB contributed to the conceptualization of the study and methodology reviewed and edited the manuscript. GG, NA and GM contributed reviewed and edited the manuscript. All authors read and approved the final manuscript.

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Figures

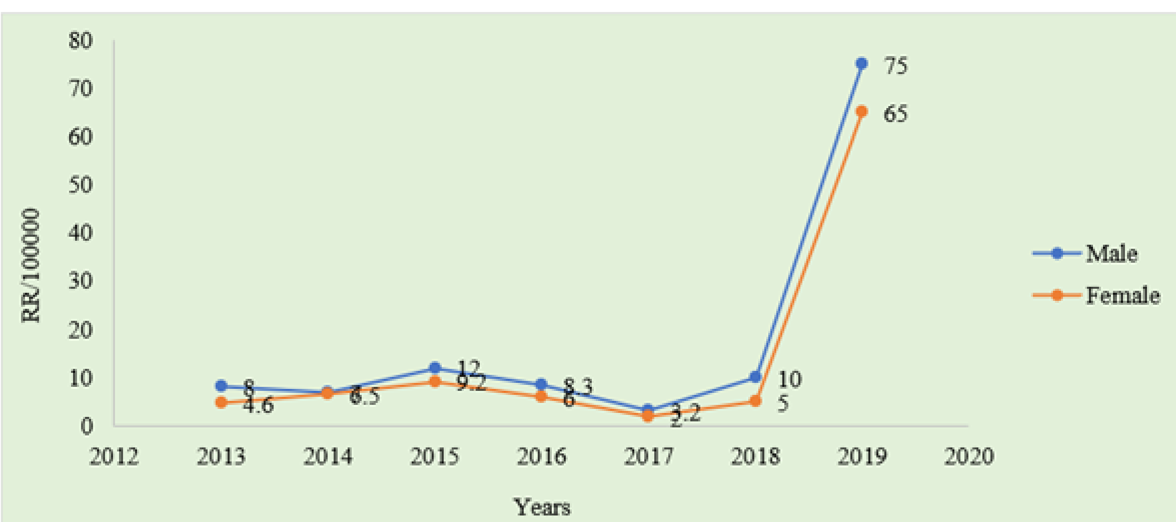

Figure 1

Measles case trend by sex in Bale zone from 2013 to 2019, Bale Zone Health Office, May 25 -June 25 /2019.

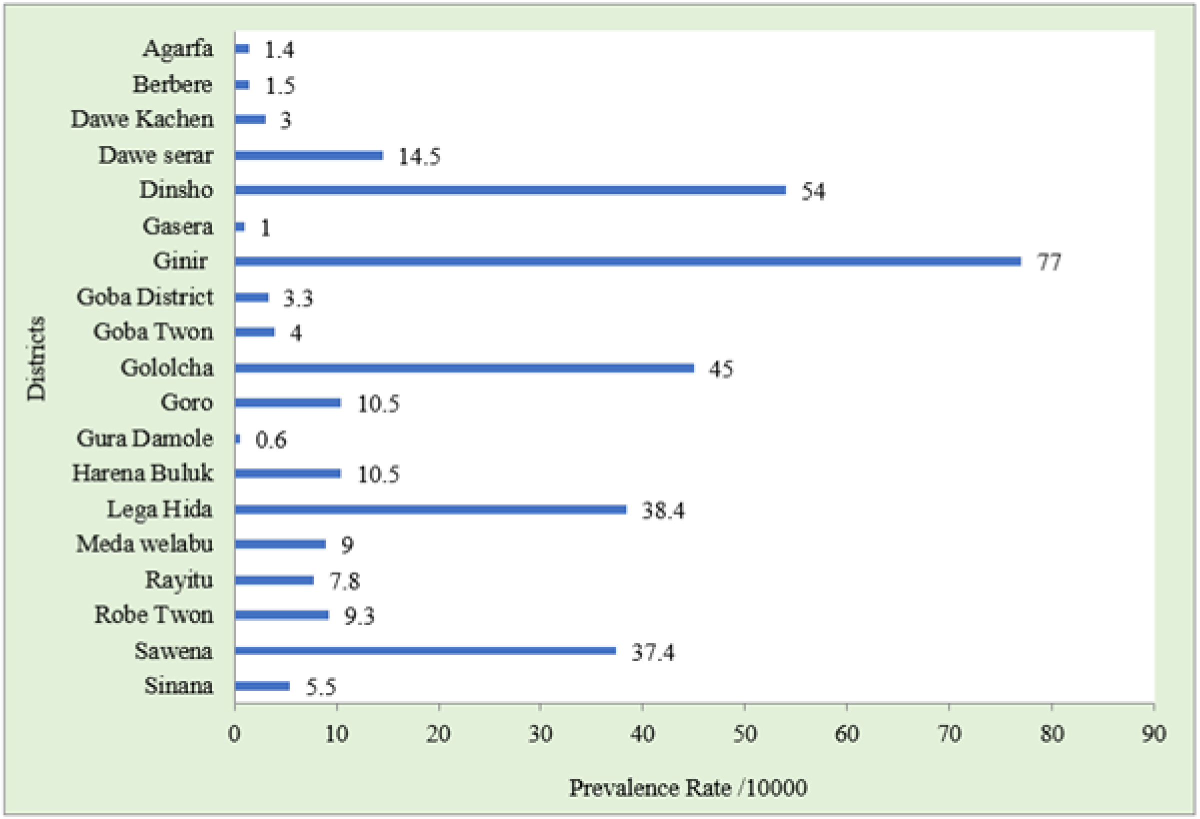

Figure 2

Measles case distribution by prevalence rate per 10000 populations in Bale zone from 2013 to 2019, Bale Zone Health Office, May 25 - June 25 /2019.

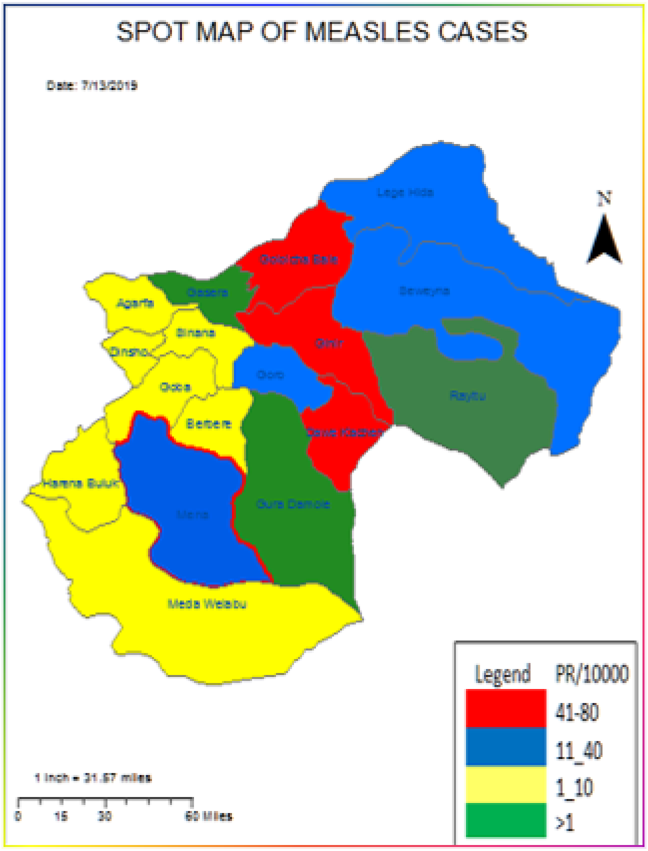

Figure 3

Distribution of measles cases by prevalence rate per 10000 populations in 2013-2019 in districts of Bale zone, Bale Zone Health Office, May 25 -June 25 /2019. The spot map shows the distribution of measles cases with prevalence rate per 10000 populations during 2013-2019 in the districts of Bale zone.

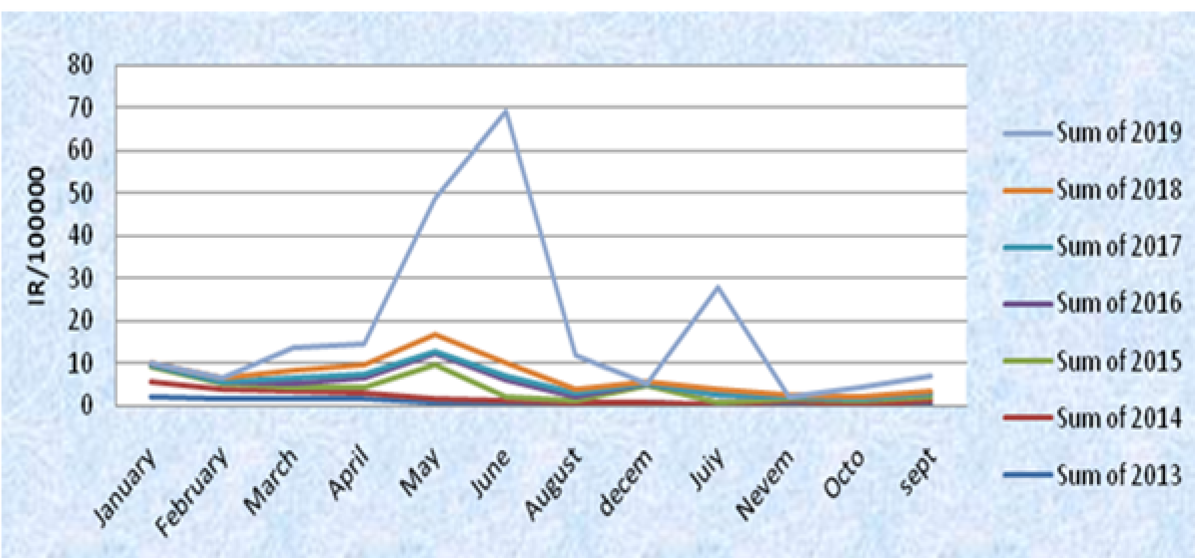

Figure 4

Cyclic patterns of measles cases in Bale zone from 2013 to 2019, Bale Zone Health Office, May 25 -June 25 /2019.

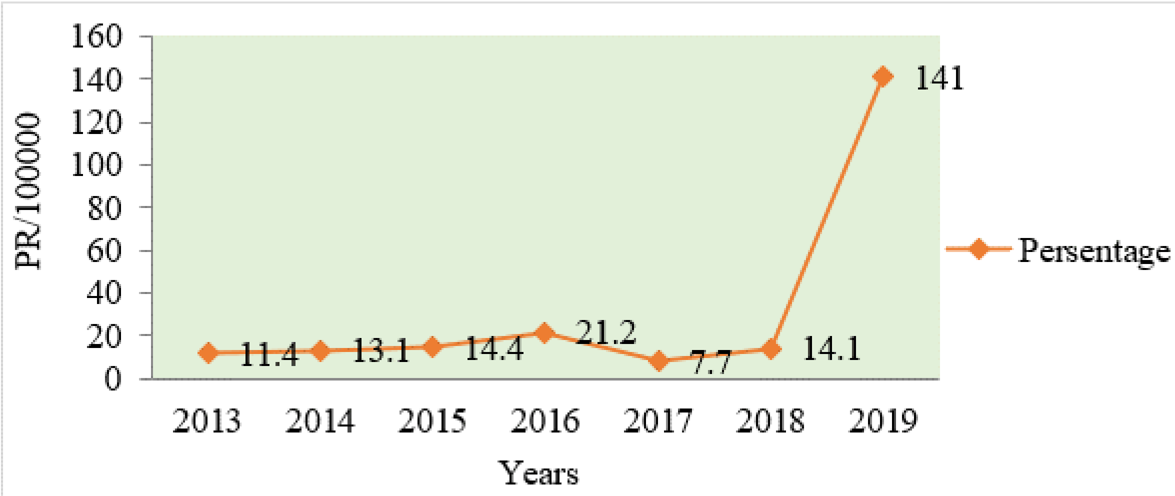

Figure 5

Trend of measles prevalence by year from 2013-2019 in Bale zone, Bale Zone Health Office, May 25 -June 25 /2019.

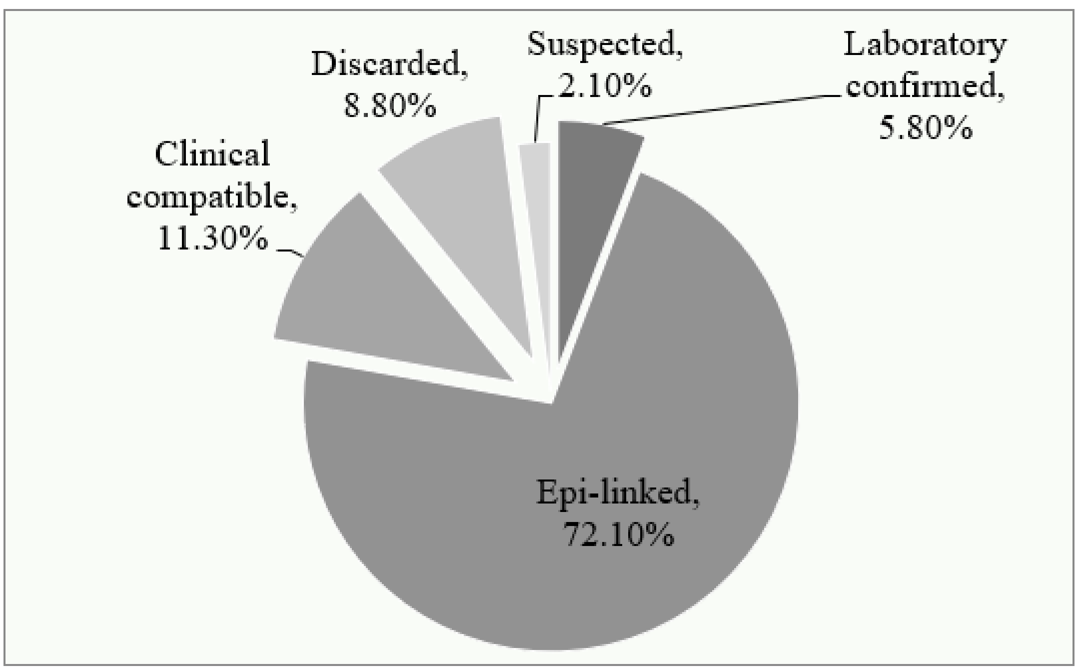

Figure 6

Final case classification of measles cases 2013-2019 in Bale Zone, Bale Zone Health Office, May 25 -June 25 /2019.

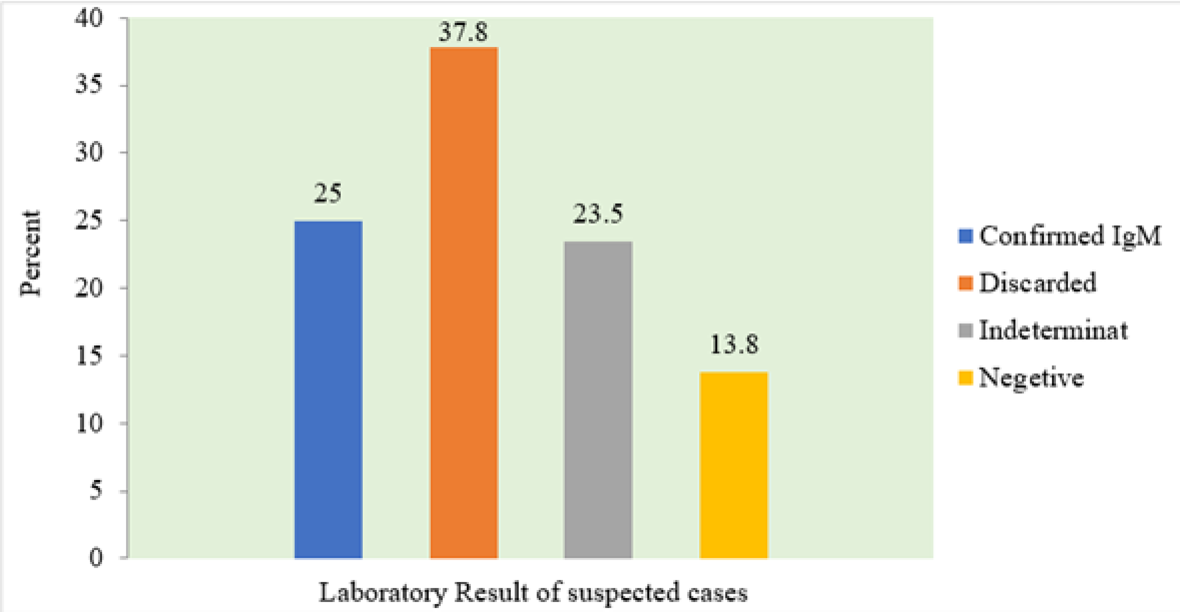

Figure 7

Percentage of samples tested and laboratory result 2013 -2019 in Bale Zone, Bale Zone Health Office, May 25 -June 25 /2019.

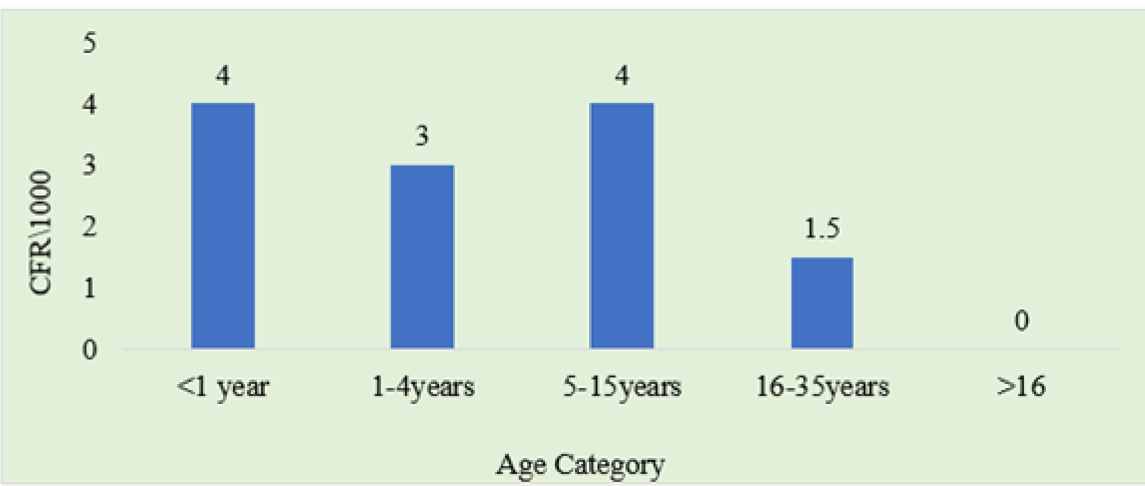

Figure 8

Measles case fatality by age group 2019-2013, Bale Zone Health Office, May 25 -June 25 /2019.

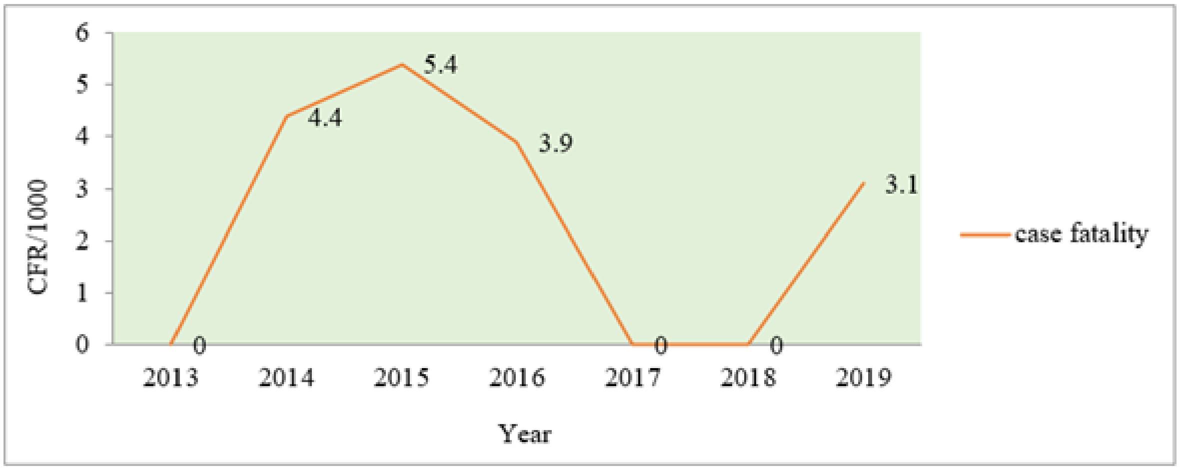

Figure 9

Measles trend of case fatality from 2013-2019 in Bale zone, May 25 -June 25 /2019.

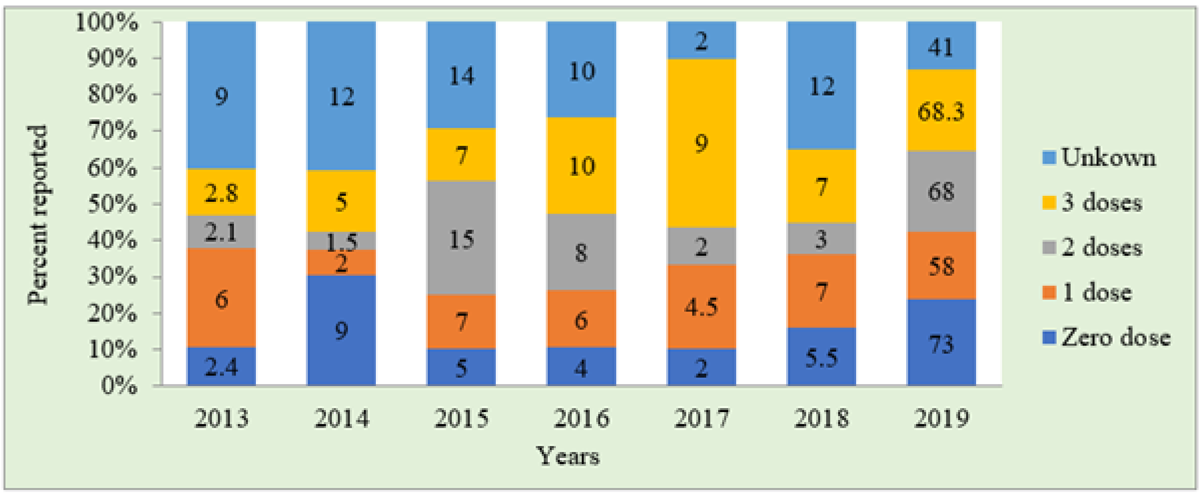

Figure 10

Trend of vaccination status among reported cases of Measles from 2013-2019 in Bale zone, May 25 - June 25 /2019.