OPEN ACCESS Freely available online

Journal of Infectious Diseases and Diagnosis

Research Article

Epidemiology of Measles in West Arsi Zone, Oromia Region, Ethiopia: 2011-2015

Tesfaye Solomon[1*], Mamo Nigatu[2], Birhanu Areda[3]

[1]Epidemiology Department, Ethiopian Public Health Institute, Addis Ababa, Jimma University, Jimma, Ethiopia;[2]Epidemiology Department, Jimma University, Jimma, Ethiopia;[3]West Arsi Zonal Health Department, Shashemene, Ethiopia

ABSTRACT

Background: Measles is a leading vaccine-preventable childhood disease, which has been designated for elimination. Despite the success of measles control, measles is still responsible for 145,700 deaths worldwide each year, with many of the outbreaks in developing countries including Ethiopia. We analyzed to characterize the epidemiology of measles and recommend better prevention and control strategies in West Arsi Zone, Ethiopia.

Methods: Data from 2011–2015 from the Public Health Emergency Management Unit of the West Arsi Zonal Health Department database were obtained using a semi-standard checklist. We analyzed and described the data by person, place, and time.

Results: We identified 1735 cases of measles between 2011-2015. The annual average measles incidence rate during 2011-2014 was 3.4/100,000 while the incidence rate in 2015 was 14/100,000. During 2011-2015, most of the cases occurred in children age less than 15 years old (87%), and 33 % were under five. Measles cases were reported every month, and March had the highest number of cases (24%). The districts with the highest incidence rates of measles had high routine measles vaccination coverage's. The proportion of districts with an annual detection rate for non-measles febrile rash was 67% both in 2014 and 2015 which was below the national target (>80%).

Conclusions: Measles outbreaks in children in 2015 in an area with high routine vaccination coverage were identified. We recommended improving the surveillance system, vaccine cold chain management, and supplement measles vaccination targeting children less than 15 years old in all districts and it should be implemented before the start of the dry season (at the beginning of January).

Keywords: Epidemiology; Measles; Surveillance; West arsi; Ethiopia

ABBREVIATIONS

IgM (Immunoglobin M); MCV (Measles Containing Vaccine); PHEM (Public Health Emergency Management); SIA (Supplementary Immunization Activities); WHO (World Health Organization)

INTRODUCTION

Measles is a highly contagious viral disease caused by the measles virus and transmitted through direct contact and the air, and then the virus infects the mucous membranes and then spreads throughout the body. It is characterized by a prodromal of fever, cough, coryza, and conjunctivitis, followed by a maculopapular rash. Measles can result in complications such as pneumonia, encephalitis, and death, if not treated [1].

Member states of the World Health Organization (WHO) African region including Ethiopia have set goals for measles elimination by 2020. In the Horn of Africa, measles remains endemic with periodic outbreaks despite efforts to achieve elimination goals [2]. WHO recommends two-dose Measles Containing Vaccines (MCV) for all children and emphasizes on-time delivery of the first dose at age 9 months in countries with

Correspondence to: Tesfaye Solomon, Epidemiology Department, Ethiopian Public Health Institute, Addis Ababa, Jimma University, Jimma, Ethiopia, Tel/Fax: +251-920117147; E-mail: abdiikoo50@gmail.com

Received: August 03, 2021; **Accepted:** August 17, 2021; **Published:** August 24, 2021

Citation: Solomon T, Nigatu M, Areda B (2021) Epidemiology of Measles in West Arsi Zone, Oromia Region, Ethiopia: 2011-2015. J Infect Dis Diagn. 6: 160.

ongoing measles virus transmission [3]. In Ethiopia, MCV1 is provided in the routine childhood vaccination schedule at age of 9 months and the second dose of MCV is provided through periodic supplemental immunization activities (SIAs) [4].

Measles surveillance is part of the national Public Health Emergency Management (PHEM) system and it includes investigation of suspected measles cases along with the collection of blood specimens at first contact with the health worker, but within 28 days of rash onset for laboratory confirmatory (Immunoglobin M or IgM testing). Suspected measles cases would be confirmed based on the laboratory findings, the presence of epidemiological linkages, or based on clinical criteria [1,5,6].

Measles is one of the leading causes of death among young children even though a safe and effective vaccine is available. Approximately two to three deaths may occur for every 1,000 reported measles cases [1]. In 2013, WHO reported that there were 145,700 measles deaths globally, and more than 95% of these deaths occur in low-income countries with weak health infrastructures. Measles vaccination resulted in a 75% drop in measles deaths between 2000 and 2013 worldwide. Measles vaccination prevented an estimated 15.6 million deaths during 2000-2013 [7].

The WHO has attributed the significant rise in measles cases in many countries to not enough children have received the measles vaccination, especially those who are between the ages of 10 and 19. The measles vaccine not only protects the individual who has received it but also helps to protect the whole population because once 95% of the population is immunized, the disease dies out [7].

Despite substantial progress and the dramatic reduction in estimated measles mortality from 354,900 annual deaths in 2000 to 41,400 in 2012 in African Region [8], outbreaks of measles continued to occur. From 2011 to 2013, large measles outbreaks occurred in Angola, Burkina Faso, Chad, the Democratic Republic of Congo, Ethiopia, Nigeria, and Zambia. Outbreak investigation activities done in these countries indicated that the principal factors contributing to the occurrence of the outbreaks included the accumulation of susceptible older children and adolescents and the gaps in reaching all children with two doses of measles vaccine at national and sub-national levels [9].

A study conducted in Nigeria showed that 13809 (51%) of suspected measles cases from 2006-2009 were laboratory confirmed [10]. Children aged 1-4 years were the most commonly affected (57%) followed by children aged less than 9 months (24%). In other studies, most of the measles cases occurred in children age less than 15 years [6].

Ethiopia had the highest number of suspected and confirmed measles cases in Africa in 2014. There were 16,028 suspected measles cases and of these 14,100 (88%) were confirmed cases. This represents a steep increase in the data for 2013 when there were 6,137 confirmed measles cases in Ethiopia [7].

In Ethiopia, the expected case-fatality rate is between 3% and 6%; the highest case-fatality rate occurs in infants 6 to 11 months of age, with malnourished infants at the greatest risk. These rates may underestimate the true lethality of measles because of incomplete reporting of outcomes of measles illness. In certain high-risk populations, case-fatality rates as high as 30% have been reported in infants aged less than 1 year of age [1].

From January to April 2015, a total of 2,190 suspected measles cases have been reported in 61 separate outbreaks in Ethiopia. Of these, 929 (42.4%) have been positively confirmed. The majority of the cases were reported in the districts of Nejo and Nole, West Wellega zone in the Oromia Region, and the district of Kola Tembien, Central Tigray Zone in the Tigray Region. Children under 5 years of age made up 28% of the cases, whereas those over 15 years of age represented 33% of the measles cases [7].

In countries where the main objective is to completely interrupt measles transmission, detailed analysis of surveillance data is important to obtain clues that guide appropriate control strategies and achieve measles pre-elimination. This study was aimed to assess the epidemiology of measles in the West Arsi Zone and provide information for health managers to take appropriate intervention by determining age and risk groups to be targeted for vaccination.

METHODS

Study setting

The study was conducted in the West Arsi Zone, Oromia Regional State, which is located 250 km from Addis Ababa (capital city) to the south of Ethiopia. Projected from the 2007 census, the West Arsi Zone has a total population of 245,0413 in 2016, of whom 78,903 are infants less than 1 year, 323,700 are children 1-4 years, 764,039 are children 5-14 years and 1,283,771 are adults greater than or equal to 15 years. The zone has 15 districts of which two are urban. Before 2014, there were only 13 districts in the zone and since then two districts have been added; namely Arsi Negelle Town and Bishan Guracha [11].

Study design, period and population

A descriptive cross-sectional study was conducted. All measles cases in the West Arsi Zone, from 2011-2015 were the study populations. All measles cases registered on the aggregated measles database of West Arsi Zonal Health Department, PHEM unit from 2011- 2015 were the study units.

Data collection tool and techniques

Data from January 2011-December 2015 from the database were obtained using a semi-standard checklist on Microsoft excels. In the database, all suspected measles cases were filled in from all districts of West Arsi Zone and reported to Oromia Regional Health Bureau, and sent to Ethiopian Public Health Institute for laboratory confirmation.

Study variables and data quality assurance

The database was checked for the variables it contains before the beginning of data collection and it includes the following variables: age, date of rash onset, vaccination status, conditions of the specimen, laboratory result, and final classification of the case.

Data analysis

We analyzed all measles cases registered from 2011-2015 and described them by person, place, and time using a pivot table on Microsoft Excel. Data were checked for completeness, and missing values were cleaned before data analysis.

Operational definitions of keywords based on National Measles outbreak investigation and response Guideline in Ethiopia [1]

Suspected measles case

i. Any person with generalized maculopapular rash and fever plus one of the following: cough or coryza or conjunctivitis or

ii. Any person in whom a clinician suspects measles.

Suspected outbreak of measles: An occurrence of 5 or more reported suspected cases of measles in a health facility or district in one month.

Confirmed outbreak of measles: is defined as 3 or more measles IgM positive cases in a kebele, health facility, or district in one month.

Laboratory confirmed: A suspected measles case that is investigated, including the collection of blood specimen has serological confirmation of recent measles virus infection (measles IgM positive) and had not received measles vaccination in the 30 days preceding the specimen collection.

Confirmed by epidemiological linkage: A suspected measles case that has not had a specimen taken for serologic confirmation and is linked (in place, person, and time) to lab-confirmed cases where there is a likelihood of transmission; onset of rash of the two cases being within 30 days of each other.

Discarded/ not measles: A suspected measles case that has been completely investigated, including the collection of the adequate blood specimen, and lacks serologic evidence of recent measles virus infection (IgM negative) or is considered to have IgM positivity due to measles vaccination within the 30 days preceding the collection of a specimen.

Compatible measles: A suspected measles case that has not had a blood specimen taken for serologic confirmation and is not linked epidemiologically to any lab-confirmed case of measles. Suspected measles cases that have no definite proof of recent infection (measles IgM test indeterminate repeatedly) may also be classified as compatible.

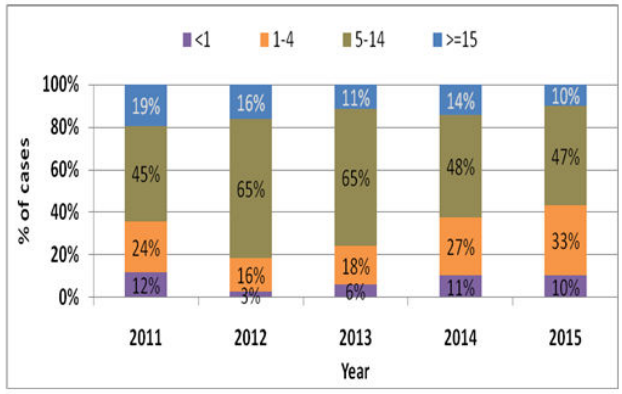

Figure 1: Trend of measles cases by age category in west arsi zone, oromia regional state, ethiopia, 2011-2015.

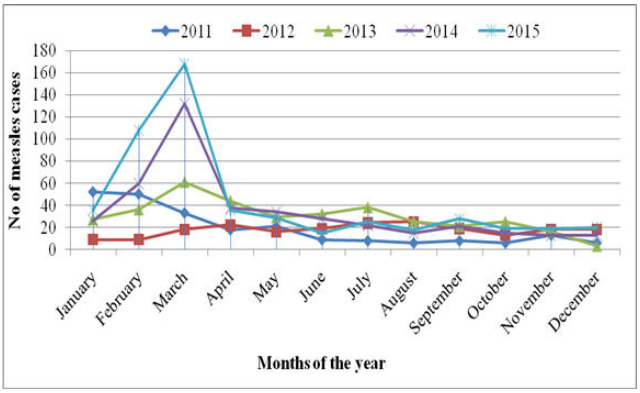

Figure 2: Trend of measles cases by months in West Arsi Zone, Oromia Regional State, Ethiopia, 2011-2015.

RESULTS

A total of 1,735 measles cases included in the study. Of these, 1,387 (80%) were recorded by case-based and 348 (20%) were registered by line list. The majority (30%) of the cases occurred in 2015 followed by 417 (24%) cases in 2014.

During 2011-2015, most of the cases occurred in children age less than 15 years old (87%), and 33% were under five. Laboratory specimen was collected from 1399 cases and 93% were considered as an adequate sample. Among the total cases, 302 (17%) were confirmed by the laboratory, 349 (20%) were epidemiologically linked to laboratory-confirmed cases, 973 (56%) were discarded and 111 (6%) were compatible cases. Confirmed measles cases were 8 (4%) in 2012 and 339 (65%) in 2015 among the total cases in each year.

Of the total cases, 146 (8.4%) had missing values for the age variable. The age of laboratory-confirmed cases ranged from two months to 36 years old. Among those 1,589 measles cases fully documented for age, 846 (53.2%) were children 5-14 years of age, while 397 (25.0%), 134 (8.4%), and 212 (13%) were children 1-4 years, children less than 1 year and adults >15 years old respectively (Figure 1).

Concerning vaccination status, 374 (22%) of the cases were unvaccinated and 989 (57%) of the cases had an unknown

status for measles vaccination. Of 651 total confirmed cases, 225 (35%) were unvaccinated and 298(46%) had unknown measles vaccination status.

The administrative routine measles vaccine coverage for eligible children was 100% except in 2012 which was 95%. The number of children susceptible to measles was 563 (1%) in 2011 and 11637 (15%) in 2015 among those vaccine eligible in each year. Totally within five years cumulative of 24,750 children's were susceptible to measles in the zone. These included unvaccinated surviving infants and 15% of children from those vaccinated due to lack of sero-conversion at nine months of age with MCV1.

Thirteen out of fifteen districts in the zone reported measles cases. There were no reported cases from Arsi Negelle Town and Bishan Guracha districts. Among the total cases within five years, more than half (52.2%) of the cases were recorded in three districts; namely Shashemene, Kore, and Seraro accounting for 382(22.0%), 336 (19.4%), and 197(11.4%) cases respectively. Districts with the highest measles incidence rates were Wondo (115/100,000) in 2015, Kore (72/100,000) in 2013, and Shashemene (54/100,000) in 2011.

Measles cases were reported every month, and March had the highest number of cases (24%). A high proportion of the cases, 1215 (70%), developed the disease from January through June in five years. A small proportion of the cases, 60 (3.0%) were recorded in December (Figure 2).

Based on the national measles guideline definition for the outbreak, there were 33 laboratory confirmed outbreaks of measles in districts of the West Arsi Zone. Five districts namely: Shashemene, Arsi Negelle, Dodola, Gedeb Assasa and Kore accounted for 63.6% of the outbreak. The largest outbreak, 14 (42%), was occurred in 2015 and affected 10 (67%) districts of the West Arsi Zone. The annual average measles incidence rate during 2011-2014 was 3.4/100,000 while the incidence rate in 2015 was 14/100,000 (Figure 3).

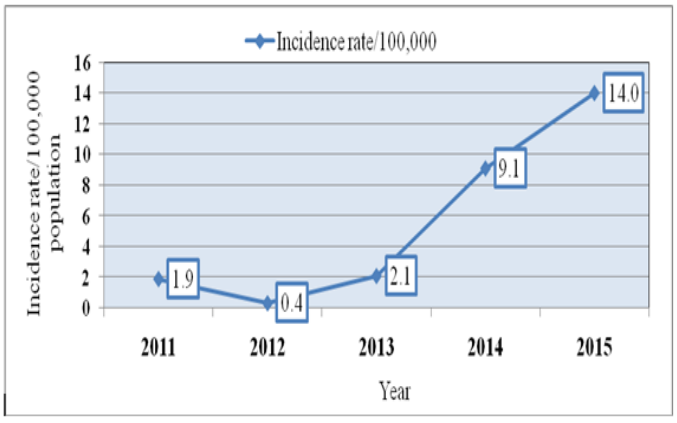

Figure 3: Trend of Measles incidence rate in West Arsi Zone, Oromia Regional State, Ethiopia, 2011-2015

During 2011-2015, the most frequently affected districts include Shashemene which attacked five times; and Kore, Arsi Negele, Dodola, and Gedeb Asesa each were attacked four times. There were no SIAs done in 2014 and 2015. Regarding the seasonal variation of the outbreak, the highest proportion, 9 (27.3%), occurred in January followed by February 7(21.2%) and September 4 (12.1%).

Surveillance indicators

The proportion of districts detected two and more cases of non-measles febrile rash per 100,000 populations in a year (annual detection rate for non-measles febrile rash) were 8(62%) in both 2011 and 2012, 10(92%) in 2013 and 10(67%) both in 2014 and 2015. The proportion of districts investigated greater than two suspected cases of measles with blood specimen per 100,000 populations per year (annualized rate of investigation) were 8 (62%) both in 2011 and 2012, 11 (85%), 11(73%), and 12(80%) from 2013 to 2015 respectively. There were no measles cases reported and investigated cases from Arsi Nagele Town and Bishan Guracha districts in 2014 and 2015.

The adequacy rate of specimen collected for laboratory test was 92%, 100%, 80%, and 87% from 2012 up to 2015 respectively and it was 69% in 2011.

DISCUSSION

This study showed that there was an occurrence of measles cases in every year almost every month despite administrative measles vaccination coverage was 95% in 2012 and 100% in other years during 2011-2015. Among 651 confirmed cases, 225 (35%) were unvaccinated and 298 (46%) had unknown vaccination status. This finding was not similar to other studies that showed an increase in the percentage of measles routine immunization coverage decreases the occurrence of the disease [12-14]. This might be due to problems related to vaccine efficacy, reporting problems, or parents/caregivers may not differentiate or remember what type of vaccine the child received or not; or there was inadequate information given to the community from the health providers during the vaccination.

However, all children who are vaccinated for measles could not develop immunity for lifelong, because only 85% of children can develop immunity within a good condition of the vaccine [1]. Most (87%) of the cases occurred in children less than 15 years old and 33% were under-five children. This highlights the fact that children less than 15 years of age remain a risky population for contracting measles in the West Arsi Zone and they need to be targeted for interventions like during SIAs.

There were a cumulative of 24,750 children susceptible for measles among those eligible for vaccination from 2011 to 2015. Most 14 (42%) of the measles outbreaks happened in 2015 when there were no SIAs. This finding is similar to other studies that revealed accumulation of susceptible individuals in the community and the nonexistence of a second opportunity for vaccine leads to the occurrence of the disease [15,16].

The finding of this study indicates that the majority of the cases (87%) were below the age of 15 years and 53% were children

between 5-14 years old. This finding is similar to a study conducted in Zimbabwe that describes most affected age groups are the under 15 years with 53.4% of them being children between the ages of 5 – 14 were noted in other African countries in which an average of 50% of cases occur in children aged 5 - 14 years [7,17]. The finding of this study is also similar to other previous studies which indicated that as measles vaccine coverage increases, or population density decreases, the age distribution shifts towards older children. As vaccination coverage, and thus population immunity, increases further, the age distribution of cases might shift into adolescence and adulthood [7,12,15]. This study showed that adults 15 years and above accounts for 13% of the cases. This finding is not similar to the WHO report that showed those over 15 years of age represented 33% of the measles cases in Ethiopia [7]. This might indicate more adults were being vaccinated in the zone during SIAs before their fifteens.

Regarding the seasonal pattern of the cases, measles cases were reported every month, and March had the highest number of cases (24%). This result is similar to a previous study conducted in Sub-Saharan countries that revealed an occurrence of measles disease was related to the dry season [16].

The proportion of districts with an annual detection rate for the non-measles febrile rash of more than 2 cases per 100,000 populations was 10 (92%) in 2013. However, it was below 80% in each year during 2011-2015. This was below the nationally recommended target of >80% [1] and and indicates that the case-based surveillance system in most districts of the West Arsi Zone was weak except in 2013.

The proportions of districts that have reported >1 case of measles (IgM+ve) from whom blood specimens have been collected per 100,000 populations were above the national target of above 80% from 2012 to 2015. The districts with the highest incidence rates were Wondo (115/100,000) in 2015; Kore (72/100,000) in 2013 and Shashemene (54/100,000) in 2011. Despite these routine measles vaccination coverage in these districts were 100% and children less than 15 years were the most affected. This might be due to problems related to vaccine potency, under planning of the eligible population, over-reporting problems, or improved surveillance system. Furthermore, the study is necessary to identify the determinant factors.

Limitation

The surveillance data had missing information on important variables (i.e. sex, the outcome of illness) which made a meaningful review of some of these records difficult. A significant proportion 146 (8.4%) of data has incomplete documentation for age variable, this makes a significant proportion of cases to be missed out of the analysis concerning age.

CONCLUSION

This study revealed that the measles incidence rate in the zone was 14.0/100,000 in 2015. We identified measles outbreaks with the highest attack rates in districts with high immunization coverage. Most of the cases had unknown vaccination status or unvaccinated at all. March had the highest number of measles cases (24%) and the majority (56.7%) of the cases occurred from January to April. The annual detection rate for non-measles febrile rash was below the nationally recommended target of >80% except in 2013.

Ethics approval, consent to participate and consent for publication

Letter of ethical clearance was obtained from the Ethics Committee of Jimma University, and officially submitted to West Arsi Zone Health Department. The ethics committee approved the procedure for data collection by replacing the name of patients on the database with codes for confidentiality reasons. The Ethics committee approved that the finding of the study could publish since identifying images or clinical details of participants that compromise anonymity was not applicable.

RECOMMENDATIONS

We recommended the zone should improve the surveillance system, vaccine cold chain management, and supplement measles vaccination targeting children less than 15 years old in all districts and it should be implemented before the start of the dry season i.e. at the beginning of January. Evaluating the effectiveness of measles control and prevention strategies should be beneficial for interventions in the zone. A further study is needed to determine the risk factors contributing to the occurrence of the outbreaks.

AVAILABILITY OF DATA AND MATERIALS

The data supporting our findings are found at, kept in confidentiality, and stored at the corresponding author in soft copies.

COMPETING INTERESTS

The authors declared they have no competing interests.

FUNDING

The authors declared no fund has been received.

AUTHORS' CONTRIBUTIONS

TS conceived the study, developed the proposal, carried out data collection, and conducted the analysis, and involved in reviewing the manuscript. BA participated in reviewing the proposal, reviewing the analysis, and participated in final study document development. MN provided general guidance in overall study progress and participated in drafting and reviewing the manuscript. All authors read and approved the final manuscript.

ACKNOWLEDGEMENTS

Our deep gratitude goes to staff of West Arsi Zonal Health Department; especially those working on the Public Health Emergency Management Unit for their cooperation. We would like to acknowledge Mr. Tsegaye Tewalde and Mr. Tamirat Shiferawu for giving us their constructive comments.

We want to express our heartfelt thanks to the research square for posting an earlier version of the manuscript as a preprint for comments of the scientific community and the manuscript has been presented as a preprint in "Epidemiology of Measles in West Arsi Zone, Oromia Region, Ethiopia: 2011-2015" according to the following link: https://www.researchsquare.com/article/rs-549158/v2

REFERENCES

1. Geremew TT, Gezie LD, Abejie AN. Geographical variation and associated factors of childhood measles vaccination in Ethiopia: a spatial and multilevel analysis. BMC Public Health. 2019;19(1): 1-5.
2. Robert T Perry, Alya J Dabbagh, Marta Gacic-Dobo, Jodi L Liu. Progress in global measles control, 2000-2010. MMWR. Morbidity and mortality weekly report. 2012;3;61(4):73-8.
3. Kebede A, Ahmed H, Masresha BG, Perry RT, Burton A, Spiegel P, et al. Measles-Horn of Africa, 2010-2011. Morbidity and Mortality Weekly Report. 2012;61(34):678-84.
4. The Sphere Project. Humanitarian charter and minimum standards in humanitarian response 2016.
5. Masresha B, Fall A, Luce R, Eshetu M, Kaiser R, Dosseh A, et al. Measles elimination in the WHO African Region: Progress and challenges.
6. WHO, WHO AFRO's Accelerated Measles Control Initiative: Target age for supplemental immunization. 2001.
7. Akalu HB. Review on measles situation in Ethiopia; past and present. Journal of Tropical Diseases and Public Health. 2015;23.
8. Perry RT, Gacic-Dobo M, Dabbagh A, Mulders MN, Strebel PM, Okwo-Bele JM, et al. Global control and regional elimination of measles, 2000–2012. MMWR. Morbidity and mortality weekly report. 2014;63(5):103.
9. Shibeshi ME, Masresha BG, Smit SB, Biellik RJ, Nicholson JL, Muitherero C, et al. Measles resurgence in southern Africa: challenges to measles elimination. Vaccine. 2014;1;32(16): 1798-807.
10. Deiner MS, Fathy C, Kim J, Niemeyer K, Ramirez D, Ackley SF, et al. Facebook and Twitter vaccine sentiment in response to measles outbreaks. Health informatics journal. 2019;25(3):1116-32.
11. West Arsi Zonal Health Department, West Arsi Zone Profile report. 2016.
12. Mitiku K, Bedada T, Masresha B, Kegne W, Nafo-Traoré F, Tesfaye N, et al. The epidemiology of rubella disease in Ethiopia: data from the measles case-based surveillance system. The Journal of infectious diseases. 2011;1;204(suppl_1):S239-42.
13. World Health Organization. Measles outbreaks and progress towards meeting measles pre-elimination goals: WHO African Region, 2009-2010. Weekly Epidemiological Record=Relevé épidémiologique hebdomadaire. 2011;86(14):129-36.
14. Mandomando I, Naniche D, Pasetti MF, Cuberos L, Sanz S, Vallès X, et al. Assessment of the epidemiology and burden of measles in Southern Mozambique. The American journal of tropical medicine and hygiene. 2011;1;85(1):146.
15. Szpringer M. Observation of permanent teeth adjacent to teeth damaged by trauma. Czasopismo stomatologiczne. 1975 Nov; 28(11):1045-9.
16. Ferrari MJ, Grais RF, Bharti N, Conlan AJ, Bjørnstad ON, Wolfson LJ, et. al. The dynamics of measles in sub-Saharan Africa. Nature. 2008;451(7179):679-84.
17. Choto R, Chadambuka A, Shambira G, Gombe N, Tshimanga M, Midzi S, et al. Trends in performance of the National Measles Case-Based Surveillance System, Ministry of Health and Child Welfare, Zimbabwe (1999-2008). Pan African Medical Journal. 2012;11(1).