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Treatment outcome, and associated factors of measles infection among children admitted to Hiwot Fana Comprehensive Specialized Hospital Harar, eastern Ethiopia

Medical Specialty Research Thesis

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I hereby certify that I have read and evaluated this Thesis entitled **Treatment outcome and associated factors of measles infection among children admitted to Hiwot Fana Comprehensive Specialized Hospital** Prepared under my guidance by **Samuel Adugna**. I recommend that it can be submitted as fulfilling the Thesis requirement.

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As a member of the Board of Examiners of the Medical Specialty Thesis Open Defense Examination, I certify that I have read and evaluated the Thesis prepared by Samuel Adugna and examined the candidate. I recommend that the thesis be accepted as fulfilling the Thesis in partial fulfillment of the requirement for Medical Specialty in Pediatrics and Child Health.

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Acronym and abbreviations

AOR	Adjusted Odds' Ratio
CFR	Case Fatality Rate
CI	Confidence Interval
COR	Crude Odds Ratio
COVID	COrona Virus Disease 2019
CRP	C- Reactive Protein
EPHI	Ethiopian Public Health Institute
ETB	Ethiopian Birr
EPI	Expanded Program on Immunization
FMOH	Federal Ministry Of Health
HFCSH	Hiwot Fana Comprehensive Specialized Hospital
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
IHRERC	Institutional Health Research Ethics Review Committee
MCV	Measles Conjugate Vaccine
OR	Odds Ratio
ORS	Oral Rehydration Salt
PHEM	Public Health Emergency Management
RESOMAL	REhydrating SOlution for MALnourished
RNA	RiboNucleic Acid
SIRS	Systemic Inflammatory Response Syndrome
SPSS	Statistical Package for Social Sciences
ULN	Upper Limit of Normal
USA	United States of America
USD	United States Dollar
WHO	World Health Organization

Abstract

Background: Measles is a highly contagious serious airborne disease caused by a virus that that can lead to severe complications and death. It has a case fatality rate of 3 – 6% and may reach as high as 30% in infants. Measles is one of the most common cause of mortality and morbidity in children of developing countries. Globally in 2023, there was an estimated 107,500 measles deaths, mostly among unvaccinated or under vaccinated children under the age of 5 years. Even though Measles is the leading problem there is no study done on the treatment outcome and associated factors in Hiwot Fana Comprehensive Specialized Hospital.

Objective: Treatment Outcome and associated factors among Measles cases admitted to Hiwot Fana comprehensive Specialized Hospital from July 1, 2020- June 30, 2024. Data will be collected using a data extraction tool from February 15, 2025- February 28 2025.

Methods: Facility-based Retrospective cross-sectional study was performed on 422 children's admitted to at Hiwot Fana Comprehensive Specialized Hospital with the diagnosis of Measles from July 1, 2020 up to June 30 2024. A systematic sampling technique was used to select the participants and data was collected using a semi-structured questionnaire. Data was entered into environmental performance index data 7 and analyzed using the statistical package of social sciences version 27. A bivariable logistic regression analysis was done to select the variables to be entered into the final logistic multivariable analysis. Explanatory variables with p value less than or equal to 0.25 in bivariable logistic regression analysis was entered into the multivariable logistic regression analysis model and association between the independent variables. Every variable with P-values less than 0.05 in the multivariable logistic model was considered as statistically significant.

Result: A total of 422 infants and children with measles infection were included in the study. Of the 422, 28 (6.6%) died with 95% CI (23.9-33.8%). In multivariable analysis, being referred on arrival (AOR= 3.136, 95%CI: 1.007-9.764), requiring IV fluids/ORS/RESOMAL (AOR-6.765 95%CI 1.426-32.095), requiring INO2/CPAP (AOR=15.67 95%CI: 3.741-65.627) and requiring vasopressors (AOR= 14.449 95%CI 1.832-113.988) were factors significantly associated with mortality.

Conclusion: The magnitude of mortality among measles infection in the study area was high. There was statistically significant correlation with being referred, requiring IV fluids/ORS/RESOMAL, INO2/CPAP and vasopressors. Therefore, special attention should be given to measles patients who are referred.

Keywords: Treatment outcome of measles, pediatrics, cross sectional study, eastern Ethiopia

1. INTRODUCTION

1.1 Background

Measles is an acute, highly contagious and serious viral disease, spread by contact with infected respiratory droplets that was breathed by someone with measles (Minta, 2024). It is caused by a single-stranded, enveloped RNA (Ribonucleic acid) virus with 1 serotype(Abbott and Vlasses, 2011). It is an acute viral illness that starts with a prodromal phase, lasting 2 to 4 days, of fever and at least one of the "three Cs" (cough, coryza, and conjunctivitis), followed by characteristic measles rash an erythematous maculopapular exanthem appears first on the face and head and then on the trunk and extremities(WHO, 2017) . In young children less than five years , around 30% of measles infections can lead to complications such as diarrhoea, otitis media, pneumonia, encephalitis, seizures and death (Ferreira-van der Watt, 2014).

World health organization(WHO) recommends in addition to the first routine dose of Measles conjugate vaccine (MCV1), all countries should include a second routine dose of MCV2 in their national vaccination schedules regardless of the level of MCV1 coverage. In countries with ongoing transmission in which the risk of measles mortality among infants remains high, MCV1 should be administered at 9 months of age. These countries should administer the routine dose of MCV2 at age 15–18 months(WHO, 2017).

Since measles vaccine became available in 1963, its widespread use has contributed to the reduction in the global burden of the disease. In 2012, the World Health Assembly endorsed the targets in the Global Vaccine Action Plan (GVAP) of 90% national coverage and 80% for every district or equivalent administrative unit for all vaccines in national programmes by 2020. In 2015, universal coverage for measles immunization (i.e., ≥95%) was also highlighted in the Sustainable Development Goals (SDG) to be implemented in 2016 and achieved by 2030. Also the Immunization Agenda 2030 (IA2030) used absence of measles cases as a benchmark for successful implementation of primary health care(O'Brien et al., 2024). While measles vaccination policies and stages of implementation vary across the countries, as at the end of 2019, 178 countries offered two doses of measles-containing vaccine (i.e., measles, mumps and rubella (MMR) as part of their routine immunization programs as recommended by the WHO towards elimination of measles. Nonetheless, measles vaccination coverage continues to be suboptimal in many countries. In 2019,

the global coverage of the first dose of measles-containing vaccine (MCV1) was 85%, whereas the coverage of the second dose (MCV2) was 71%, with wide variations across the regions and countries. These rates were short of the GVAP targets to eliminate measles in at least five WHO regions by 2020(Ori et al., 2021).

Globally during 2000–2015, the annual reported measles incidence declined by 75% from 146 to 35 cases per million populations. In 2015, there were an estimated 134 200 measles deaths globally, representing a 79% decline since 2000(WHO, 2017).

Ethiopia started routine immunization with measles in 1980, at 9 months of age and started routine MCV 2 on 2019 at the age of 15 months. Also measles catch-up campaigns were conducted for all children less than 15 years old in a phased manner at the beginning of the accelerated control program, and every 2-3 year intervals, supplemental immunization activities were conducted(Nazir et al., 2023).

1.2 Statement of the problem

Despite more than 20 years of immunization efforts, measles still represents one of the major causes of death among children under-five due to vaccine preventable diseases(Trentini et al., 2017). Before the introduction of measles vaccine in 1963 and widespread vaccination, major epidemics occurred approximately every 2 to 3 years and measles caused an estimated 2.6 million deaths each year it is estimated that 30 million cases of measles and more than 2 million deaths occurred globally each year, and that by the age of 15 years, more than 95% of individuals had been infected with measles virus(WHO, 2017).

Globally after introduction of measles vaccination, it averted 57 million deaths between 2000 and 2022. Vaccination decreased some estimated measles deaths from 761 000 in 2000 to 136 000 in 2022. And the causes of death in 2022, was mostly among unvaccinated or under vaccinated children under the age of 5 years (Masresha et al., 2024). The overwhelming majority (more than 95%) of measles deaths occur in countries with low per capita incomes and weak health infrastructure(Feyissa, 2019). In 2022 about 83% of the world's children received one dose of measles vaccine by their first birthday through routine health services -the lowest since 2008 (Masresha et al., 2024).

Measles has particularly impacted the WHO regions of Africa and South-East Asia, which were responsible for 70% of these incident cases and 84% of measles-related deaths. To combat this burden, the WHO African Region established a 2020 measles elimination goal, but it was not met. In 2016, regional coverage with 1 dose of measles-containing vaccine (MCV) was 68%, and 40% of countries met surveillance performance indicators and in 2021, coverage with a first MCV dose remained <95% in all but two countries. After a 2019 global measles resurgence, incidence in 2021 exceeded that in 2017. Surveillance quality declined during 2017–2021, with 62% of countries achieving surveillance performance indicators in 2017 compared with 22% in 2021. Reaching all children with 2 MCV doses and improving surveillance is critical to achieving the renewed 2030 regional measles elimination goal in at least 80% of African countries(Masresha, 2023) .

According to the WHO data published in 2017 the number of measles death in Ethiopia is 25,103 (3.95%), death rate (deaths per 100,000 population) is 15.44, that's about 1 of every 25 deaths in Ethiopia(WHO, 2017). Despite Ethiopia being the first large country to conduct a mass immunization campaign for measles in 2020 following coronavirus disease 2019 (COVID-19) outbreak, there was another outbreak of measles in the country in the year 2022, especially in the eastern parts of the country. Between august 12 2021 and may 1 2023, 16814 laboratory confirmed cases and 182 deaths – with a case fatality ratio of 1.1% have been reported nationally. From 2021, the annual number of confirmed measles cases has increased significantly, from 1953 cases in 2021 to 9291(375% increment) in 2022 and 6933 in May 1, 2023(Minta, 2024). Its recent outbreak in Ethiopia can be linked to poor immunization status, distance from medical institutions, malnutrition, as well as misdiagnosis due to the COVID-19 pandemic and war(Tariku et al., 2023) .

According to a systematic review done by Sbarra and her colleagues they identified 3772 studies for review and found 49 studies showing at least one significant association with mortality for measles for 15 indicators (average household size, educational attainment, first- and second-dose coverage of measles-containing vaccine, HIV prevalence, level of health care available, stunting prevalence, surrounding conflict, travel time to major city or settlement, travel time to nearest health care facility, under-five mortality rate, underweight prevalence, vitamin A deficiency prevalence, vitamin A treatment, and general malnutrition) (Sbarra et al., 2023).

Due to the availability of an inexpensive effective vaccine (approximately 1US$ for 2 doses), measles immunization is one of the most cost effective public health interventions in a wide range

of development setting. In a retrospective cohort study done in Uganda on treatment outcome and cost estimate for managing measles, among 267 reviewed patient charts, 114.5 USD was estimated to treat a child with measles. Human resource (79.33USD, SD4.63) and treatment costs (21.98USD, SD22.77) were the largest expenses (Namugga et al., 2023). A similar study conducted in Keffa Zone of Ethiopia by Aaron Wallace and his colleagues revealed that the economic cost of the measles outbreak and response was 758,869 United States dollars (US$). Household economic cost was US$29.18/case, equal to 6% of the household median annual income. Hence, Improvement in two-dose measles vaccination coverage above 95% would both reduce measles incidence and save considerable outbreak-associated costs to both the health sector and the households (Wallace et al., 2014).

There is a paucity of information regarding the frequency and contributing causes of each measles death cause, particularly how common the disease is in developing nations like Ethiopia and particularly in the study area. The purpose of this study is to close this knowledge gap on measles since the majority of studies conducted in our nation are community-based, and no studies have been done on the disease in hospital settings, where fatality rates are greater. Additionally, it will attempt to examine the above mentioned variables for measles mortality in our configuration. Also the short-term outcomes and factors associated with adverse outcome have not been well established. Therefore, this study topic is specifically chosen to determine short-term outcomes of measles patients receiving care at HFCSH which is a teaching and referral hospital with large volume of clients.

1.3 Significance of the study

Finding the variables linked to unfavorable results will make it easier to decide whether to use aggressive interventional treatment in the settings of Hiwot Fana Comprehensive Specialized Hospital and other outlying healthcare facilities where patients are referred from. The findings of this study will help HFCSH to know the burden of measles and initiates provision of training for the staff and help in future planning accordingly. The results of this study will increase knowledge about the treatment of measles patients and serve as the foundation for improved surveillance and increased immunization efforts by the health bureaus in the Oromia and Harari regions. The results

can also be used for comparison and quality improvement purposes, as well as serving as baseline data for additional research in the field.

1.4 Objectives

1.4.1 General Objectives

Treatment outcomes and associated factors of measles in children admitted to Hiwot Fana comprehensive specialized hospital, Harar Eastern Ethiopia from July 1 2020 to June 30 2024. Data will be collected using a data extraction tool from February 15, 2025- February 28, 2025.

1.4.2 Specific objectives

To assess treatment outcome of measles infection in children

To identify factors associated with adverse outcome of measles treatment

2. LITERATURE REVIEW

2.1 Treatment outcome of measles infection

According to a cross sectional study done in brazil Sao Paulo, of the 15,598 confirmed measles cases in 2019, 52.1% were male (8,123) and 47.9% were female (7,471). The most affected age group was 18–29 years old (39.7%; 6,190), followed by children under five years old (32.8%; 5,124). In relation to race/skin color, a higher share of vaccination was observed among whites (43.7%) as compared to Blacks (36.5%), browns (36.8%), yellows (40.7%) and indigenous people (37.8%) ($p < 0.001$). The risk of hospitalization was higher in children than in the older age group (RI = 2.19; 95%CI: 1.66–2.88), as well as in the unvaccinated as in the vaccinated (RI = 1.59; 95%CI: 1.45–1.75). Of all the confirmed cases 2,039 were hospitalized and 17 progressed to death. And they conclude that in addition to routine vaccination in children, there should be immunization campaigns for young adults (Makarenko et al., 2022).

According to a prospective cross sectional study done In India from January 2021 to December 2021, only 42 children with fever and rash had laboratory confirmed measles IgM positive antibody titer. Out of total, 42.86% of the study participants belonged to 1-4 years age group and 50% were unvaccinated. Males were more affected than females. A total of 31/42 (73.8%) developed complications and the most common complication was pneumonia (38.71%), followed by Upper respiratory tract infection 3 (9.67%), Laryngotracheobronchitis 5 (16.12), Acute otitis media 3 (9.67), Ophthalmic 4 (12.9), Encephalitis 2 (6.45), Gastroenteritis 2 (6.45), Protein-energy malnutrition 26 (83.87), Anemia 28 (90.32), Uncomplicated 14 (45.16). All the patients recovered completely and were discharged from the hospital. And they said since half of the patients are unvaccinated they recommend to improve vaccination (Mehta et al., 2023).

Another retrospective cohort study from march 1 to June 18 2017 in India they identified 75 suspected cases (56% females) for a Konsa village-specific AR of 86% (75/87) among children ≤5 years; the median age was 36 months; CFR was 7% (5/75); all deaths unvaccinated; none received Vitamin A. Coverage for MCV1 was 9.2% (6/65) and Vitamin A 4.6% (3/65). No MCV1 (RR = 7.3, 95% confidence interval [CI] = 1.3–53) and participation in a recent local festival (RR = 5.3, 95% CI = 1.5–18.5) were associated with illness. MCV vaccine efficacy was 100%. Of 17 cases, 13 tested positive for measles. They conclude that this outbreak was likely due to low MCV1 and Vitamin A coverage due to poor health-care access(Dzeyie et al., 2021)

According to Barbara Namugga and his colleague's retrospective cohort study in Uganda from 1st January to 31st December 2018, among 267 reviewed patient charts, the median age was 1.0((IQR 0.75- 2) years. 63 patients (24%) were immunized, 79 (29%) were not immunized, Median length of hospital stay was 4.0 days (IQR3.0–7.0) with Majority (n=207,77%) staying <7 days. 30 patients (11%) died with mortality highest among the unimmunized (n=13,44%) and severe pneumonia (39.5%) was the commonest complication. They recommend to promote uptake of the cheaply available measles vaccine to reduce on incidence of severe disease that requires hospitalization(Namugga et al., 2023).

According to a descriptive analysis of the reported measles cases from January 1 to December 25 of 2022 in Liberia, 8127 cases were included for analysis and the incidence rate was 1.7 to 36.6/10000 population. The median age of the cases was 4 years (interquartile range: 2-8years). Children under five years of age constituted 60% of the cases (4836/8127), and females accounted for 52% (4204/8127) of the cases. Only 1% (84/8127) of the cases had documented evidence of receiving at least one dose of measles-containing vaccine (MCV). The overall cases fatality rate was 1% however CFR of up to 10% were reported in some districts. They recommend for optimal vaccination and for further study to investigate some districts with high CFR(Shobayo et al., 2024).

According to a study done in Nigeria from January 2013 to June 2018, a total of 4935 suspected measles cases with an average annual incidence rate of 15.3 per 100,000 populations and 57 deaths (CFR: 1.15%) were reported. Among the reported cases, 294 (6%;) were laboratory-confirmed, while clinically compatible and epidemiologically-linked cases were 402 (8%) and 3879 (70%), respectively. Of the 4935 measles cases, 2576 (52%) were males, 440 (9%) were under 1 year of age, and 3289 (67%) were between 1 and 4 years. Only 889 (18%) of the measles cases received at least one dose of measles vaccine, 2701 (54.7%) had no history of measles vaccination while 1346 (27.3%) had unknown vaccination status. The fatality of measles in Bauchi State were significantly associated with being under 5 years (AOR = 5.58; 95%CI: 2.19–14.22) and not having at least a dose of MCV (OR = 7.14; 95%CI: 3.70–14.29). And they recommend for improved routine measles surveillance be implemented(Ori et al., 2021).

According to descriptive unmatched 1:2 case control study done in dawro zone Ethiopia from April to May 2023, the overall attack rate of 22.64/10,000 for general population and 104.59/10,000 among under-five children were attributed to the outbreak with a case fatality rate of 2.72%.

Vaccine coverage in the last year and this year were 73.52 and 53.88%, respectively, while vaccine effectiveness in the district was 79%. They concluded that Vaccination coverage was less than what expected to develop herd immunity and recommend on increase vaccine coverage and surveillance and early intervention (Tefera et al., 2024).

According to a study done in woliso hospital from January 1, 2013, to April 9, 2017 a total of 1819 case patients were recorded. Of these, 855 (47.0%) were female and 964 (53.0%) were male; The mean age was 6.0 years (range, 0–65); 1259 case patients (69.2%) were aged ≤ 4 years and 1486 (81.7%) were aged ≤ 10 years. Records obtained during 2016 show that vaccinated admitted cases between 9 months and 5 years of age were 40.6%. The CFR based on hospital admitted cases was 1.98% (36/1819, 95% credible interval (CI) 1.43–2.72). The mean age of fatal cases was 3.3 years (range, 0–30) (Poletti et al., 2018).

2.2 Factors Associated with measles infection

2.2.1 Sociodemographic factors

According to an institution based retrospective study done in USA among the inpatients from measles in the year 2002–2016, 1,018 hospitalizations occurred with estimated incidence of 2.2 per ten million. The majority of patients are being <10 and >40 years (32.0% and 41.3%) and male (56.1%). The most frequent complications were: dehydration (161[15.8%]), hyponatremia (145[14.3%]), pneumonia (127[12.5%]), acute renal failure (106[10.4%]), diarrhea (97[9.5%]), thrombocytopenia (97[9.5%]), conjunctivitis (87[8.5%]), septicemia (84[8.3%]), fever (73[7.2%]), sepsis/SIRS (64[6.3%]), bronchitis (49[4.8%]), pleurisy (38[3.8%]), otitis media (37[3.7%]), and pancytopenia (35[3.4%]). When stratified by race/ethnicity, (white: 50.2%; black: 100.0%; Hispanic: 66.7%; Asian/Pacific Islander: 61.7%). Inpatient mortality was 3.3% (34 deaths) among measles inpatients. The average cost per measles-related hospitalization was $7,438 with total cost from 2002– 2016 of $16,973,795. They recommend that further studies are needed to improve the prevention and management of measles(Chovatiya and Silverberg, 2020).

According to a Descriptive case–control study done in Guradamole, oromia region from March 25 to April 9/2021. 98 cases were identified with an overall attack rate of 12/1000 population and a case fatality rate (CFR) of 7%. The highest attack rate (38/1000 population) and CFR (57%) were among children aged <59 months. Regarding vaccination with MCV of the 94 cases reported about 71 (75.5%) of them were unvaccinated and 24 (24.5%) vaccinated with one dose only. Vaccination

efficacy was calculated to be 82.6%. Being unvaccinated (adjusted odds ratio/AOR=5.66, 95% confidence interval, CI: 1.24–25.81), contact with patient (AOR=3.24, 95%CI: 1.03–10.17), moderate malnutrition (AOR=4.34, 95%CI: 2.14–8.814), distance from health facility (AOR=4.58, 95%CI: 1.39–15.19) and history of travel to affected area (AOR=3.99, 95%CI: 1.31–12.19) were shown significant association with contracting measles infection. Regarding complications, 18 (18.4%), 12 (12.25%), and 8 (8%) cases developed diarrhea, pneumonia, and otitis media, respectively. They recommend conducting vaccination campaigns, interventions to malnutrition, and strengthening routine immunization programs to reduce future measles outbreaks(Tsegaye et al., 2022).

2.2.2 Clinical related factors

According to an institutional based retrospective study done in Italy from January 2016 to august 2017 there were 249 children (median age 14.5 months): 207(83%) children developed a complication and 3(1%) died. Neutropenia was more commonly reported in children with B3 genotype compared with other genotypes (29% vs7.7%, p=0.01). Pancreatitis (AOR 9.19, 95%CI 1.69-50, p=0.01) and encephalitis (aOR 7.02,95%CI 1.05-46.8 p=0.04) were related to severe outcome in multivariable analysis, as well as a CRP (c reactive protein) (aOR 1.1, p=0.028), the increase of which predicted severe outcome (area under the receiver operating characteristic curve 0.67, 95%CI 0.52 to 0.82). CRP values >2mg/dl were related to higher risk of complications (OR 2.0, 95% CI 1.15 to 3.7, p=0.01) or severe outcome (OR 4.13, 95% CI 1.43 to 11.8, p<0.01). they claimed that the risk of severe outcome in measles is independent of age and underlying conditions, but is related to the development of organ complications and may be predicted by CRP value(Vecchio et al., 2020).

According to a retrospective cross sectional study done in Pakistan from 2013 – 2017, there were 307 children admitted 79(26%) were aged <9mths and were excluded. Of the remaining 228 subjects, 109(47.8%) were unvaccinated. Risk factors significantly associated with mortality were being unvaccinated (AOR 7, 95%CI 2.03- 24.01, p=0.011), being stunted (AOR 6.08 95%CI 3.24-14.26, p<0.0001), and encephalitis (AOR 12.22 95%CI 4.33-34.49, p<0.0001) in comparison with pneumonia (P<0.05). A total of 39(17%) children died within 15 days of admission. They conclude that Encephalitis, non-vaccination and undernutrition are significantly associated with measles mortality(Aurangzeb et al., 2021).

According to a cross sectional study done in Somalia from January 2018 to December 2021 in total, 110 participants were enrolled. The median age was 16 [interquartile range (IQR)12–36] years, and 87 (79.1%) were male. All participants presented with fever, typical measles rash, cough and conjunctivitis, and 43 (39.1%) had received the measles vaccine. Overall, 104 (94.6%) participants were admitted with severe respiratory symptoms, and six (5.4%) were admitted due to poor feeding and/or significant dehydration. Overall, all-cause mortality was 1.8% (n=2). The median duration of hospitalization was longer among participants who died compared with those who survived [11(IQR8–14) vs 4(IQR2–6) days; P=0.046]. Unvaccinated participants Were significantly younger than vaccinated participants [36(IQR24–72) vs 12(IQR9–16) months<0.001]. There was a trend towards higher mortality [0/43(0%) vs 2/67(3%); P=0.519] and longer length of hospitalization [3(IQR2–6) vs 4(IQR3–7) days=0.056] among unvaccinated participants compared with vaccinated participants. They recommend on timely vaccination and need of improved care of children and undernourished(Hassan et al., 2023).

Mulugeta and his colleagues had studied epidemiology of measles in Oromia region, Ethiopia, from 2007-2016 and a total of 26,908 measles suspect cases were identified, of which 18,223 (68%) were confirmed. A median age of 6 years (IQ range 0.5-71 years) and 288 deaths were observed. Among the total cases, 29% were unvaccinated and 46% had unknown vaccination status. The highest IR was seen in Guji zone (IR=190/100,000 population) among 1-4 years, with a majority from rural areas. Risk factors associated with death include age <5 years (AOR=1.82, CI: 1.42-2.33), unvaccinated status (AOR=1.44, CI: 1.06-1.95) and inpatient treatment (AOR=2.12, CI: 1.58-2.85). They recommend to improve vaccination rate and consideration of use of MR vaccine(Gutu et al., 2020).

2.2.3 Comorbidities

An institution based retrospective cross sectional study was done on 2018 in Israel from March 2018 to February 2019, of 161 individuals, 86 (53.4%) were <5 years old, 16 (10%) were >5 years but <20 years old, and 59 (36.6%) were >20 years old. Most, 114/135 (85%), were unvaccinated. Immunocompromised state was identified in 12/161 (7.5%) patients, 20/161 (12.4%) had other underlying comorbidities, and four were pregnant. Hypoxemia on admission was a common finding in all age groups. Hepatitis was more common among adults >20 years old (33/59, 59%). Measles-related complications were noted in 95/161 (59%) patients, and included pneumonia/pneumonitis (67/161, 41.6%), which was more common in young (<5 years) children,

diarrhea (18/161, 11.2%), otitis (18/161, 11.2%), and neurological complications (6/161, 3.7%) the latter occurring more frequently in the 5- to 20-year age group. 2 of the 12 Immunocompromised patients died of measles-related complications. They conclude that there is high rate of complications in hospitalized children and recommends on maintaining high measles vaccination coverage(Ben-Chetrit et al., 2020).

2.2.4 Treatment related factors

According to an institutional based case control study done in Romania from January 2016 through June 2018, Ninety-three percent of case-patients and controls had not received a valid dose of a measles-containing vaccine; only 5 % received Vitamin A supplementation once diagnosed with measles. In the univariable analysis, cases were more likely than controls to have had a healthcare-related exposure to measles manifesting as inpatient admission for pneumonia during the 7 to 21 day measles incubation period (OR: 3.0; 95% CI [1.2, 7.2]), to have had a history of malnutrition (OR: 3.4; 95% CI [1.1, 9.9]), and to have had pneumonia as a complication of measles (OR:7.1; 95% CI [2.0–24.8]). In the multivariable analysis, pneumonia as a measles complication remained a risk for death (OR: 7.1; 95% CI [1.4–35.3]). And they concluded that Implementing infection prevention and control practices, ensuring immunization of healthcare workers, and hospitalizing only severe measles cases may minimize the risk of nosocomial measles transmission. Implementing World Health Organization recommendations for Vitamin A supplementation, improving immunization of children to prevent influenza, pneumococcal, and other bacterial respiratory diseases may decrease complications and deaths due to measles in Romania(Donadel et al., 2021).

According to an institutional based cohort study done in Vietnam from January 2017 to December 2019, In total, there were 2, 072 patients, including 1, 297 (62.6%) males and 775 (37.4%) females. The median age was 9 months (interquartile range 7 − 17). 87.3% of cases had not received any measles-containing vaccine (MCV). 30 (1.4%) patients died, with 40% aged less than 9 months. Only 3 among 30 (10%) who died had received at least 1 dose of MCV. Bronchopneumonia was the most common complication, occurring in 1,413 (68.2%) patients. The following characteristics were significantly associated with mortality in the multivariable analysis: age under 9 months and age from 9 months to 5 years, residing 20 to 200 kilometers from Vietnam national childrens hospital (VNCH), and having co-infection with adenovirus or other hospital acquired infections. Age group was also significantly associated with severity in the multivariable analysis. And they

concluded that to prevent future outbreaks and lower measles incidence routine immunization needs to be strengthened, and earlier scheduling of MCV1 needs to be further evaluated(Tran et al., 2023).

2.3 Conceptual framework

There are different factors that contribute to the outcome of patients with measles infection

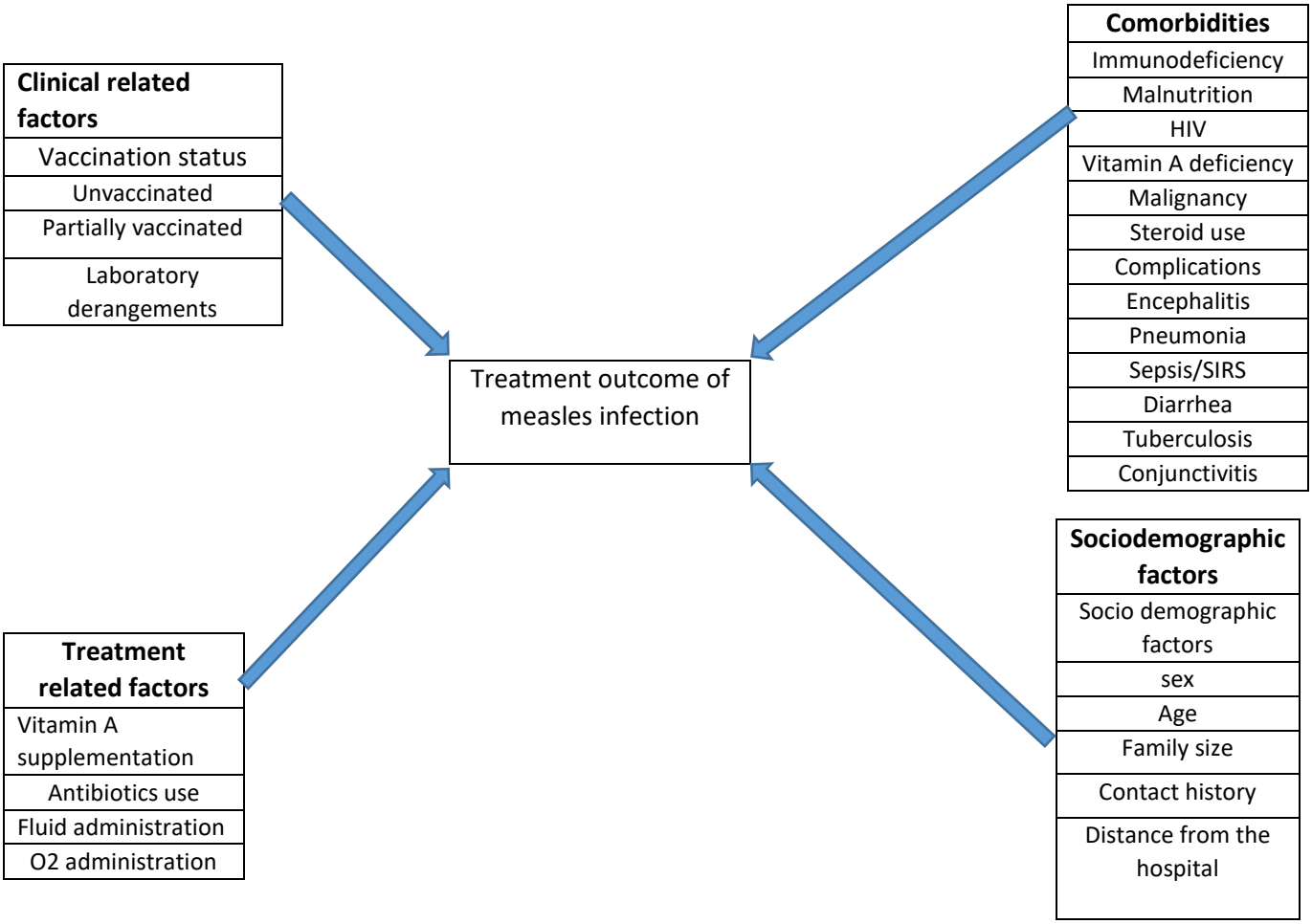

Figure 1: Conceptual frame-work for understanding the Outcome and Associated Factors of Measles infection on study of Treatment Outcome and Associated Factors of measles among infants and children Hospitalized in the HFCSH, Eastern Ethiopia. Constructed by the investigator from different literatures.

3. METHODS AND MATERIALS

3.1 Study area and period

The study was conducted in Harari Regional State, Harar, and eastern Ethiopia. Harar, the capital city of Harari Regional State is located at 526 km east of Addis Ababa. According to a government survey conducted in 2014, Harari Regional State has estimated size of 340Km2 with 19 kebeles with a total population of 240000; consisting of 121000 men and 119000 women. This region is the only one in Ethiopia where the majority of the population (55.4%) lives in an urban area. According to the regional health bureau report, there are two government hospitals (HFCSH & Jugal hospital). HFCSH serves the health services for an estimated six million populations in eastern Ethiopia. Hiwot Fana is a comprehensive specialized hospital established during the Italian Invasion and become a teaching and referral hospital of Haramaya University in 2014. In HFCSH there are four basic wards (pediatric, gynecology, internal medicine and surgical) and in total 15 departments together with different outpatient health care service in each department. There are around 606 registered health professionals in it and it has around 305 beds. Pediatric and Child health department is one of the major units of the hospital and have five main sub-units which include: The pediatric Ward, PICU, NICU, Outpatient units and follow-up clinics. There are 2 subspecialists, 14 pediatricians, 24 residents, 100 nurses and 5 general practitioners currently working in pediatric department with estimated 106 beds. And during the past 5 years there are 7955 admissions.

The study was conducted from February 15 to February 28, 2025.

3.2 study design

Institution based retrospective cross-sectional study was conducted .

3.3 Population

3.3.1 Source population

All infants and children's who were admitted due to measles infection to Hiwot Fana comprehensive specialized hospital from July 1, 2020 to June 30, 2024 will be the source population.

3.3.2 Study population

Selected infants and children's who were admitted to HFCSH with the diagnosis of measles and fulfills the inclusion criteria from July 1, 2020 to June 30, 2024.

3.4. Inclusion and exclusion criteria

3.4.1 Inclusion criteria

All infants and children with age between >=1month and <= 14 years and admitted to HFCSH with the diagnosis of suspected or confirmed measles from July 1, 2020 up to June 30, 2024.

3.4.2 Exclusion criteria

- ✓ All infants and children whose chart is lost or not full (if undocumented inpatient number, age, sex, and illegible handwriting)
- ✓ Infants and children who died without taking any treatment
- ✓ Self-discharged patients

3.5. Sample size determination and sampling technique

3.5.1. Sample size determination

A single population proportion formula was used to calculate the required sample size with the assumption of taking 95% confidence interval (Sbarra et al.), 5% marginal error. The sampling size is calculated by taking p value of (0.5)50% (to get maximum sample size, because no similar previous studies was done, with an additional 10% for non-respondent's cases.

$$n = \frac{(Z\alpha/2)^2 P (1-P)}{d^2}$$

Where n=required sample size,

n= required sample size

Z= the standard normal deviation at 95% confidence interval; =1.96

P= proportion of measles mortality……0.5(50%) to get maximum sample size.

d= margin of error that can be tolerated, 5% (0.05)

1-p = proportion of population that do not possess the character of interest.

$$n = \frac{(1.96)^2 x (0.5) (1-0.5)}{(0.05)^2} = 384$$

Then, the total sample size to assess the treatment outcome and associated factor of measles infection is 384 plus additional 10% for non-respondents will become 422.

3.5.2. Sampling technique and procedure

There were an estimated of 40180 outpatient visits, among them 7955 were inpatient admissions and there were 788 measles patients from July 1, 2020 to June 30, 2024 according to data from HMIS and PHEM. The EOPD and Pediatrics ward registration logbook was used to retrieve the medical record number of those children that had been admitted with measles infection. The medical record numbers was numbered in the order of date of hospital admission to form a sampling frame. Then Systematic sampling technique was employed to pick the charts using a skip interval(k=2), implying that every 2nd chart was chosen until the required sample size was achieved. The first chart was selected randomly.

K= N/n, i.e. 788/422……. = 2, so i take Kth interval of 2 and select study participants every 2nd interval until sample size gets saturated.

3.6. Data collection Method

3.6.1 Data collection tools

Semi structured interviewer administrative questionnaire was developed after reviewing relevant literatures and measles treatment guideline to the problem under study. The questionnaire was prepared with English language. The checklist was designed to obtain information on the main variables sociodemographic, clinical related, treatment related, and comorbidity factors as well as the outcome of the measles patients will be included.

3.6.2 Data collectors and supervisor

Data was collected by 2 interns and 1 resident supervise the process. The data collectors was trained by principal investigator on the purpose of the study, the study procedures, data collection steps, and supervision activities, mainly focused on the responsibilities of data collectors and supervisors, for two days. After, preparation of the necessary equipment and tools data collectors was deployed for work.

3.6.3 Data collection procedures

Pretesting was done on around 5% of the sample size ahead of the actual data collection and appropriate modification was made. Data was collected by assigned interns by first collecting the medical record number (MRN) from the Medical Registration book. Then assigned liaison officers

collect the charts. Followed by the interns using a paper-based checklist to capture the necessary data, then it was checked manually for completeness.

3.7. Variables

3.7.1 Dependent Variable

Treatment outcome of measles infection.

3.7.2. Independent Variables

Sociodemographic factors: patient age, sex, contact history, house hold size, distance to hospital, mode of arrival

Clinical related factors: vaccination status, laboratory derangements, length of hospital stay, duration of illness

Comorbidities factors: immunodeficiency, malnutrition, HIV, vitamin A deficiency, malignancy, steroid use, encephalitis, pneumonia, sepsis/SIRS, diarrhea, conjunctivitis, Tuberculosis

Treatment related factors: vitamin A supplementation, antibiotics use, fluid administration, O2 administration

3.8. Operational Definitions

Clinically compatible measles: A suspected case with fever and maculopapular (non-vesicular) rash and at least one of cough, coryza or conjunctivitis, but no adequate clinical specimen was taken and the case has not been linked epidemiologically to a laboratory-confirmed case of measles or other communicable disease ((Aurangzeb et al., 2021)).

Complications: are illnesses that occur directly due to the virus or the associated illnesses that occur during the clinical course of measles, and they include encephalitis, pneumonia, diarrhea and conjunctivitis(Aurangzeb et al., 2021).

Encephalitis: is considered if there is lethargy, irritability, headache, fits, disorientation or neurological deficits (Aurangzeb et al., 2021).

Pneumonia: defined as the WHO definition in which the presence of cough with tachypnea for age, chest in drawing(Aurangzeb et al., 2021).

Diarrhea: is a passage of 3 or more loose or watery stools in a 24-hr period(Aurangzeb et al., 2021).

Measles treatment outcome: Indicates whether the patient is discharged alive or died at the time of discharge which is collected from the medical record of the patients (Aurangzeb et al., 2021).

Measles recovery: indicates that the patient was alive at time of discharge(Aurangzeb et al., 2021).

Measles related death: death within 15 days of the rash onset, unless death was because of some other disease or non-related cause(Aurangzeb et al., 2021).

Length of stay(LOS): is duration of hospital stay for the treatment and will be classified as <7, 7 to 21 and > 21 days(Aurangzeb et al., 2021).

3.9. Data quality control

To maintain the quality of the data(secondary data) pretest of tool will be conducted at Haramaya General Hospital prior to the actual data collection that is not the part of study area by considering 5% of the total sample size to assess check list for its clarity. Findings and experiences from the pretest were utilized in modifying and reshaping the research data collection tools. A questionnaire that consists of all the variables was developed with English language and used to collect the necessary data from patient card. The data was checked every day for completeness and

consistency before data processing and analysis. Training on the basics of the questionnaire and on how to use it appropriately was given by the principal investigator for two interns for two days.

3.10. Data processing and analysis

The collected data was cleaned, edited and coded on Microsoft Excel sheet. Any errors identified at this time were corrected. The data was then exported into SPSS software (version 27) for further statistical analysis. Based on the nature of variables descriptive statistical analysis were carried to compute frequency, percentage, and mean for independent and dependent variables and data was presented using frequency tables, figures and graphs. Bivariate regression analysis was done, and variables with $p \leq 0.25$ in the bivariate analysis were included in the final model of multivariable logistic regression analysis to control all confounding variables. The direction and strength of statistical association was measured by odds ratio (AOR) along with 95% CI. Finally, in multivariable regression, variables with a P-value less than 0.05 were considered as statistically significant.

3.11. Ethical consideration

Before starting the data collection process, the study protocol was approved by the Haramaya University, College of Health and Medical Sciences Institution Health Research Ethical Review Committee (IHRERC)/191/2022. An official letter of co-operation was submitted to HFSUH and concerned bodies to obtain the co-operation and consent in facilitating the study. Voluntary, written and signed consent was obtained from the hospital head. Informed, voluntary, and signed consent is not required from participants since it is a medical chart review. Participants' confidentiality of information was assured by excluding names and identifiers in the data extraction tool.

3.12. Dissemination of the results

The thesis will be presented to Haramaya University, College of Health and Medical Science School of Medicine. The hard copy will be available in the library of Haramaya University, College of Health and Medical Science for postgraduate students as well as for other concerned readers. Furthermore, it will be presented in an open defense and will be considered for publication in a scientific journal.

4. RESULTS

Sociodemographic factors

Total sample size(n) considered in this study is 422. Among these 52.61%(222)are male and 47.39%(200) are female. The majority of patients are 1-4yrs old accounting (66.1%), then infants(23.7%), then 5-10yrs old(9.24%) and >10yrs (0.95%). Most of the patients are from Oromia region(60.66%) and the remaining from Harari region(39.44%). And when we see their time of presentation (53.55%) were seen on 2012, (34.36%) on 2015, (10.66%) on 2016, (0.71%) on both 2013 and 2014. And the majority of patients acquire the illness at home or in their village accounting 13.51% and 1.9% at the hospital, while the remaining 84.6% are unknown. And their mode of arrival is majority not referred(self) 348 (82.46%) and 74(17.54%) are referral. And the majority of the patients are within 20km of distance 339(80.1%), then 20-200km 82(19.4%) and the remaining 1(0.2%) from >200km.

Table 1. Socio demographic related factors of infants and children admitted with measles infection to HFSUH, Harar, Ethiopia, (n=422)

Variables	Category	Frequency	Percent
Age of the patient	<1yr	100	23.7%
	1-4yrs	279	66.11%
	5-10yrs	39	9.24%
	>10yrs	4	0.95%
Sex of the patient	Male	222	52.61%
	Female	200	47.39%
Family size	Unknown	415	98.34%
	1-5	1	1.18%
	>5	5	0.24%
Region	Oromia	256	60.66%
	Harari	166	39.34%
Place where they acquire the disease	Unknown	357	84.6%
	Home/village	57	13.51%
	Hospital	8	1.9%
Mode of arrival	Not referred	348	82.46%
	Referred	74	17.54%
Place of residence	<20km	339	80.1%
	20-200km	82	19.4%
	>200km	1	0.2%

Clinical related factors

The majority of children are unvaccinated accounting to 213(50.47%), followed by 1 times 80(18.96%), then 2 times 65(15.4%) and remaining are illegible 64(15.17%). And when we see the radiologic findings the majority are not done 313(74.17%), then normal chest x-ray 48(11.37%), bronchopneumonia 42(9.95%), lobar pneumonia 15(3.55%), and interstitial pneumonia 4(0.95%).

Variables	Category	Frequency	Percent

Vaccination status	Not vaccinated	213	50.5%
	Illegible	64	15.2%
	1 times	80	19%
	2 times	22	5.2%
	Unknown	43	10.2%
Chest x-ray finding	Not done	313	74.17%%
	Normal	48	11.37%
	Bronchopneumonia	42	9.95%
	Lobar pneumonia	15	3.55%
	Interstitial pneumonia	4	0.95%

Table 2. Clinical related factors for treatment outcome of infants and children admitted with measles infection to HFSUH, Harar, Ethiopia (n=422)

Comorbid factors

Among the comorbidities the majority patients have no comorbid illnesses 383(90.76%) then followed by infections 30(7.1%), neurological diseases 4(0.9%), genetic 2(0.5%), cardiac 2(0.5%), and endocrine illnesses 1(0.2%). And among secondary causes of immunodeficiency majority have none 223(52.8%), then malnutrition 197(46.7%), then HIV/ AIDS 1(0.2%) and DM(0.2%). And among measles related complications all the admitted patients have complications, with majority have pneumonia 409(96.9%), then diarrhea 294(69.7%), conjunctivitis 143(33.9%), dehydration 121(28.7%), cytopenias 102(24.2%), fungal infections 87(20.62%), croup 59(13.98%), SIRS/Sepsis, bronchiolitis, and acute otitis media each accounted for 9(2.13%), encephalitis 6(1.42%), myocarditis 1(0.24%), hepatitis 1(0.24%), and vitamin A deficiency 1(0.24%).

Table 3. Comorbid related factors for treatment outcome of infants and children admitted with measles infection to HFSUH, Harar, Ethiopia (n=422)

Variables	Category	Frequency	Percent
Comorbid illnesses	None	383	90.76%%
	Infections	30	7.1%
	Neurological diseases	4	0.9%
	Genetic disease	2	0.5%
	Cardiac	2	0.5%
	Endocrine disease	1	0.2%

Immunodeficiency	None	223	52.8%%
	Malnutrition	197	46.7%
	HIV/AIDS	1	0.2%
	DM	1	0.2%
Measles related complications	Pneumonia	409	96.9%
	Diarrhea	294	69.7%
	Conjunctivitis	143	33.9%
	Dehydration	121	28.7%
	Cytopenias	102	24.2%
	Fungal infection	87	20.62%
	Croup	59	13.98%
	SIRS/sepsis	9	2.13%
	Bronchiolitis	9	2.13%
	Acute otitis media	9	2.13%
	Encephalitis	6	1.42%
	Myocarditis	1	0.24%
	Hepatitis	1	0.24%
	Vitamin A deficiency	1	0.24%

Treatment related factors

The majority of childrens admitted took antibiotics 409(96.92%), vitamin A 407(96.45%), analgesic/antipyretics 215(50.95%), INO2/CPAP 173(41%), IV fluids/ORS/RESOMAL 146(34.6%), zinc 104(24.64%), anti fungals 85(20.14%), therapeutic milk/RUTF 64(15.17%), steroids 31(7.35%), nebulized epinephrine 29(6.87%), vasopressors 14(3.32%), anti-seizure medications 9(2.13%), blood products transfusion 2(0.47%).

Table 4. Treatment related factors for treatment outcome of infants and children admitted with measles infection to HFSUH, Harar, Ethiopia (n=422)

Variables	Category	Frequency	Percent
Treatment given	Antibiotics	409	96.92%
	Vitamin A	407	96.45%
	Analgesic/antipyretic	215	50.95%
	INO2/CPAP	173	41%
	Iv fluids/ORS/RESOMAL	146	34.6%
	Zinc	104	24.64%
	Anti fungals	85	20.14%

	Therapeutic milk/RUTF	64	15.17%
	Steroids	31	7.35%
	Nebulized epinephrine	29	6.87%
	Vasopressors	14	3.32%
	Anti-seizure medications	9	2.13%
	Blood products transfusion	2	0.47%

Treatment outcome

Treatment outcome of the study participants are discharged alive and died. Among the total of 422 studied patients 394(93.36%) are discharged alive while 28(6.64%) was died. And the major causes of death are pneumonia accounting 17(4.03%), then SIRS/sepsis 9(2.13%), croup 2(0.47%), and encephalitis 1(0.24%). When we see the duration of stay in the hospital majority 358(84.83%) stayed for 0-7 days, followed by 60(14.22%) stayed for 7-21 days and 4(0.95%) stayed more than 21 days. And the total duration of illness lasts for 7-21 days in the majority 237(56.16%), 0-7 days in 168(39.81%) and in 16(3.79%) patients it lasts for >21 days. Among the died patients most of them died in first 7 days 26(92.86%) while the remaining 2(7.14%) die in 7-21 days of hospital admission.

Variables	Category	Frequency	Percent
Treatment outcome	Discharged alive	394	93.36%
	Died	28	6.64%
Cause of death	Pneumonia	17	4.03%
	SIRS/sepsis	9	2.13%
	Croup	2	0.47%
	Encephalitis	1	0.24%
Duration of hospital stay	0-7 days	358	84.83%
	7-21 days	60	14.22%
	>21 days	4	0.95%
Duration of illness	0-7 days	168	39.81%
	7-21 days	237	56.16%
	>21 days	16	3.79%

Table 5. Treatment outcome of infants and children admitted with measles infection to HFSUH, Harar, Ethiopia (n=422)

Factors associated with treatment outcome

The binary logistic regression analysis shows a p value of <0.25 for the following variables: age of the patient, mode of arrival, vaccination status, distance from the hospital, total duration of illness, presence of comorbidities(like infection and DM), presence of immunodeficiency, presence of complications (like dehydration, conjunctivitis, SIRS/sepsis, fungal infection, and leukopenia), and patients who require iv fluids/ORS/RESOMAL, INO2/CPAP, vasopressors, therapeutic milk/RUTF, anti fungals and steroids. Further analysis of the above variables in the multivariable logistic regression further revealed that mode of arrival(being referred), requiring IV fluids/ORS/RESOMAL, INO2/CPAP/MV, and vasopressors were significant predictors of treatment outcome among measles patients.

Patients with measles infection who are referred are 3 times more likely to die than who are not referred(AOR 3.136; 95%CI :1.007-9.764)). And measles patients who require IV fluids/ORS/RESOMAL, INO2/CPAP and vasopressors have 6 times increased mortality (AOR 6.765;95%CI:1.426-32.095), 15 times increased mortality (AOR 15.67;95%CI:3.741-65.627), and 14 times increased mortality with (AOR 14.449;95%CI: 1.832-113.988) respectively.

Variables	Category	Outcome		COR (95%CI)	p-value	AOR (95% CI)	P-value
		Survived	Died				
Age of the patient	<1yr	93	7	0.226(0.021-2.464)	0.222		
	1-4 yrs	261	18	0.207(0.2-2.091)	0.182		
	5-10yrs	37	2	0.162(0.011-2.349)	0.182		
	>10yrs	3	1				
Mode of arrival	Not referred	329	19				
	Referred	65	9	2.398 (1.039-5.534)	0.04	3.136 (1.007-9.764)	0.049
Distance from the hospital	<20km	319	20				
	20-200km	74	8	1.724(0.731-4.067)	0.213		
	>200km	1	0	0			
Vaccination status	Illegible	59	5				
	Not vaccinated	194	19	1.156(0.414-3.228)	0.783		
	1 times	78	2	0.303(0.057-1.614)	0.162		
	2 times	22	0	0.000	0.998		
	Unknown	41	2	0.576(0.106-3.112)	0.521		
Length of illness	0-7 days	161	7				
	7-21 days	220	17	1.777 (0.72-4.386)	0.212		
	>21 days	12	4	7.667(1.965-29.91)	0.003		
Presence of comorbidities	No	361	21				
	Yes	33	7	3.646(1.443-9.211)	0.006		
Presence of immunodeficiency	No	217	6				
	Yes	177	22	4.495(1.784-11.328)	0.001		
Dehydration	No	285	16				
	Yes	109	12	1.961(0.899-4.279)	0.091		
Conjunctivitis	No	253	26				
	Yes	141	2	0.138(0.032-0.59)	0.008		
SIRS/sepsis	No	388	25				
	Yes	6	3	7.76(1.832-32.874)	0.005		
Fungal infection	No	317	18				

	Yes	77	10	2.287(1.015-5.152)	0.046		
Leukopenia	No	318	27				
	Yes	76	1	0.155(0.021-1.158)	0.069		
Iv fluids/ORS/RESOMAL	No	268	8				
	Yes	126	20	5.317(2.28-12.401)	<0.001	6.765(1.426-32.095)	0.016
INO2/CPAP	No	246	3				
	Yes	148	25	13.851(4.111-46.673)	<0.001	15.67(3.741-65.627)	<0.001
Vasopressors	No	385	23				
	Yes	9	5	9.3(2.882-30.004)	<0.001	14.449(1.832-113.988)	0.011
Therapeutic milk/RUTF	No	341	17				
	Yes	53	11	4.163(1.849-9.375)	<0.001		
Anti-fungal	No	318	19				
	Yes	76	9	1.982(0.863-4.553)	0.107		
Steroids	No	367	24				
	Yes	27	4	2.265(0.733-7.001)	0.155		

AOR- Adjusted odd ratio COR- Crude odd ratio

Table 6. Bivariable and multivariable logistic regression analysis of the factors affecting treatment outcome in measles infection among infants and childrens admitted to HFSUH, Harar, Ethiopia (n=422),

5. DISCUSSION

The purpose of this study was to assess the treatment outcome of measles infection in infants and children admitted Hiwot Fana Specialized University Hospital, Eastern Hararghe, Ethiopia. The outcome was death in 6.6% (95% CI (23.9-33.8%). In this study, mode of arrival, being unvaccinated, having conjunctivitis in and requiring IV fluids/ORS/RESOMAL, INO2/CPAP and vasopressors were factors significantly associated with mortality.

Almost comparable findings regarding to mortality was found in studies done at hospital in Uganda which was 11% (Namugga et al., 2023). However studies conducted in Pakistan (Aurangzeb et.al., 2021)shows a mortality of 17% which was substantially higher. The discrepancy can be due to many of study participants are infants. On the other hand there is considerably lower mortality was seen in studies done in Vietnam (Tran et al., 2023), USA (Chovatiya and Silverberg, 2020), Italy (Vecchio et al., 2020) 1.4%, 3.3% and 1 % respectively, this discrepancy can be due to low socioeconomic status and poor resource in our set up. Also according to a study done in woliso hospital (Poletti et al., 2024) they get a mortality rate of 1.98%, which is lower than this study and can be explained by vast catchment area of our hospital(6 million population vs 521771).

The vast majority of patients in this study died due to pneumonia accounting for 17/28(60.7%). This is comparable to study done in Uganda(Namugga et al., 2023) study which accounts for 39.5. Also vast majority of patients are died with in first 7 days of admission 26/28(93%), which is comparable to the study done in the Pakistan (Aurangzeb et.al., 2021) and Somalia(Hassan et al., 2023) in which 100% of them occurred in the 1st 15 days of admission. .

In the current study measles patient who comes with a referral are 3 times more likely to die than the others who are not referred. This can be explained by complicated nature of their illness and wide range of treatment they required. Also the vast majority of study subjects that are died are unvaccinated 19/28(68%) and illegible 5/28(19%). This is comparable to the studies done in Pakistan(Aurangzeb et al., 2021) which claimed the unvaccination rate of 48% and 66.6% of mortality occurred in unvaccinated children.

In this current study requiring IV fluids/ORS/RESOMAL increases measles mortality by 7 times compared to study participants who didn't require. Similarly patients who require INO2/CPAP increases measles mortality by 16 times compared to others who didn't require oxygenation. This is comparable to a study done in Israel(Ben Chetrit et al., 2020) the most common clinical manifestations was hypoxemia accounting for 43% and a study done in Romania (Donadel et al., 2021) claimed 90% of the cases have pneumonia. This result can be explained by narrower and immature (few in number) alveoli's and air ways in children especially under 5 make them more susceptible to respiratory illness. Also patients requiring vasopressors

are significantly associated with measles mortality. The result showed 14 fold increment in mortality compared to those who don't require vasopressors.

6.STRENGTH AND LIMITATIONS OF THE STUDY

STRENGTH

The study was able to capture the targeted population in the sampling process. It included the past 5 years which can provide an opportunity to assess the existing situation and facilitating actions to improve the survival of measles patients. To my knowledge, this is the one of the few institution based studies conducted in the country and only study done in the eastern region of Ethiopia.

LIMITATIONS

Measles serology was not done to confirm the diagnosis in the hospital. There is therefore a possibility that some diagnoses of measles were actually other viral exanthems like rubella, scarlet fever, varicella and roseola. It was also hard to verify whether all the treatments/investigations documented in the charts were received by the patients. Instead I assumed that they were received since they would ideally be required for management of these cases. The study is a cross-sectional study which can't establish a cause-and-effect relationship. Furthermore, it is retrospective and single facility that limits its generalizability to the broader community. However, in spite of these limitations, i believe my findings are valid and pertinent, in efforts to promote immunization against measles.

7. CONCLUSIONS

The study shows that Measles infection is among the major causes of infant and child mortality in our hospital. It also revealed a significant association of being referred, and requiring IV fluids/ORS/RESOMAL, INO2/CPAP and vasopressors with the Measles-related in hospital mortality. According to this study 50.5% of study participants are unvaccinated, I recommend to improve vaccination efforts and semiannual supplementation of vitamin A to decrease burden of severe complicated measles.

8. RECOMMENDATIONS

For the hospital and health workers

- To manage referred measles patients as early as possible.
- The hospital should avail wide range of medications with affordable price, which are of great significance in the management of severe complicated form of measles patients.
- The hospital also should avail measles serology, which is of great significance to rule out measles mimics.
- Training of medical personnel on management of complicated and intensive care requiring measles patients as well as availing mechanical ventilators for the care of these patients.

For future researchers

- To conduct a prospective study on the short-term and long-term outcome of infants and children admitted with measles infection.
- To conduct research that takes in to account the knowledge, attitude and practice factors that can affect the outcome of infants and children admitted with measles infection.

Stake holders and regional bureaus

- Creating awareness in the community about the need for measles vaccination which ultimately will prevent complicated form of measles infection.
- Also to improve case surveillance and increase immunization coverage by the regional bureaus of Oromia and Harari.

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10. ANNEXES

7.1: Information sheet and informed voluntary consent form for head of hospital

1. Introduction

My name is Dr Samuel Adugna. I am the principal investigator of the study to be conducted in this hospital (Hiwot Fana comprehensive Specialized Hospital). I am a final year pediatric and child health resident at the College of Health and Medical Sciences, Haramaya University. I kindly request you to lend me your attention to explain to you about the study and your institution being selected as the study setting.

2. The study title:

Treatment Outcome and Associated Factors of measles infection among infants and children admitted to Hiwot Fana comprehensive Specialized Hospital, Harar, Eastern Ethiopia.

3. Purpose/aim of the study:

The finding of this study will help to provide information to the professionals in improving the quality of care, improve surveillance and plan intervention programs to prevent mortality in children with measles infection. It will also help as baseline data for HFCSH for further study. Moreover, It is also being conducted for the partial fulfilment of specialty certificate in pediatrics.

4. Procedure and duration:

Medical log book found in the EOPD, and Pediatrics ward was used to retrieve the Medical Record Numbers of infants and childrens admitted with measles infection from January 2020 to January 2024. The charts then was collected from the liaison office. Then using my 24 questions containing questionnaire data was entered in to a checklist from February 15 to February 28th of 2025, and the amount of time to fill 1 questionnaire is 1 hr.

5. Risks and benefits:

The risk of participant in this study is minimum for patients because data was collected from medical card. The benefit will be understanding the burden of measles infection related mortality in our setting and what factors contribute to the poor outcome of the patients so as to conduct more researches and propagate this information to the necessary body.

6. Confidentiality:

The data extracted from the cards was kept confidential. The data abstraction tool was coded with a unique identification number to exclude showing names. The collected information was kept confidential and used only for research purposes. No one except the members of the research team will have access to the information collected. The findings of the study will be generalized for the study population and it will not reflect anything specific of individual patient.

7. Rights:

The hospital has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data collection process.

8. Contact address:

If there are any questions or enquires any times about the study or the procedures, please contact Dr Samuel Adugna, 0920686265 and/ or samueladugna95@gmail.com or the Institutional Health Research Ethics Review Committee (IHRERC) using their office phone number; 02546862011 or P.O.Box 235, Harar, Ethiopia.

9. Declaration of informed voluntary consent:

I have read the information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I am also informed that the hospital has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data collection process in the hospital's premises. Therefore, I declare my voluntary consent on behalf of Hiwot Fana Comprehensive Specialized Hospital management to allow this study to be conducted in our hospital with my signature.

Name and signature of Head of the Hospital: _____Signature: _____ Date:_____

Name and signature of the PI: _____Signature_____ Date: _____

7.2: Data extraction tool

Question no.	Questions	Categories/ response	Skip if any
a. Socio demographic factors			
1	**When was the admission? (dd/mm/yy)**	__/___/____	
	When was the discharge? (dd/mm/yy)	__/___/____	
2	**What is age of the patient?**	□ <1yr □ 1 -4yr □ 5-10yr □ >10yr	
3	**What is the sex of the patient?**	□ M □ F	
4	**Which region did he/she come from?**	□ Harari □ Oromia □ Somali □ other	
5	**Where did he/she come from?**	□ _____Woreda	
6	**What is the house hold size?**	□ unknown □ 1-5 □ >=5	
b. vaccination status			
7	**Is he/she vaccinated for measles?**	□ Illegible □ 1 times □ 2 times □ unknown/not recorded	
c. means of exposure and mode of arrival			
8	**Where did he/she acquire the disease?**	□unknown □ home □ hospital	
9	**What is the mode of arrival?**	□ not referred □ referred	
d. comorbidities			
10	**How many comorbidities does he/she have?**	□ 0-1 □ 2-5 □ >=6	
11	**Which type of comorbidities does he/she have?**	□ None □ DM	

		□ pulmonary disease □ liver Disease □ Cardiac Disease □ neurological disease □ TB □ Genetic disease □ other	
e. immunodeficiency			
12	**Does the patient have any immune impairment?**	□ None □ DM □ Malnutrition □ steroid use □ malignancy □ HIV/AIDS □ others	
13	**If yes to malnutrition which type?**	□ stunting □ wasting □ underweight	
f. duration of illness and length of hospital stay			
14	**How long was the duration of illness at home?**	□ 0-3 □ 4-7 □ >7	
15	**How long did he/she stay at the hospital?**	□ 0-7 days □ 7- 21 days □ >=21 days	
g. measles related complications			
16	**Does the patient have any measles related complications?**	□ pneumonia □ AOM □ croup □ encephalitis □ myocarditis □ diarrhea □ hepatitis □ conjunctivitis □ cytopenia □ SIRS/sepsis □ malnutrition □ Dehydration □ others	
17	**If yes to diarrhea, does he have dehydration?**	□ yes □ no	
18	**If yes to cytopenia, which cell line is affected?**	□ leukopenia □ lymphopenia □ thrombocytopenia	

h. laboratory derangements			
19	**What was the chest x-ray finding?**	□ not done □ Normal □ lobar pneumonia □ interstitial pneumonia	
20	**What was the patients CRP level?**	□ not done □ <2mg/dl □ >=2mg/dl	
21	**What is the level of ALT?**	□ not done □ < 2 x ULN □ >=2 x ULN	
i. treatment given			
22	**What was the treatment given?**	□ none □ IV fluids/ORS/RESOMAL □ Antibiotics □ vitamin A □ Zinc □ Analgesics/ antipyretics □ INO2/CPAP/MV □ other	
j. treatment outcome of the patients			
23	**What was the outcome of the patient?**	□ improved □ died □ self-discharged □ Disappeared	
24	**If yes to died, what was the immediate cause of death?**	□ pneumonia □ croup □ encephalitis □ myocarditis □ diarrhea □ SIRS/sepsis □ others	

7.3: Curriculum Vitae

Personal Information

 Name: Samuel Adugna Lemma

 Sex: male

 Date of birth: May 10, 1991G.C.

 Place of birth: Harar, Ethiopia

 Nationality: Ethiopian

 Marital status: Single

 Personal info: +251920686265

Email: Samueladugna95@gmail.com

Educational Background

 Primary Education: 1-4 Model primary school, 6-8 Yeshimebet primary school, Harar

 Secondary Education: 9-10 Harar technical and vocational college and 11-12 Aboker preparatory secondary School, Harar

 Higher Education: Haramaya University

 Qualification: Doctor of Medicine

Trainings

 Completed a course on national comprehensive HIV prevention, care and treatment training by Haramaya University from august 6 – 18, 2018 Harar, Ethiopia

 Completed a course on CRC (compassionate, respectful and caring) training from September 2019 Harar, Ethiopia

 Completed a course on LEEP(loop electrosurgical procedure) training from February, 2019 Addis Ababa, Ethiopia

CLINICAL ELECTIVES

 Medical Intern Pediatrics (12 weeks), Hiwot Fana Hospital

Surgery (12 weeks) hiwot fana hospital

Internal Medicine (12 weeks) hiwot fana and jegula Hospital

Obs/Gyne (12 weeks) hiwot fana Hospital

 General practitioner at quante primary hospital, Gurage zone from 2016 to 2018 then general practitioner at jegula general hospital

 Facility level member of DTC(drug and therapeutic committee) at jegula hospital from 2019 -2020

LANGUAGE SKILLS

Language Listening Speaking Reading Writing

Amharic	Excellent	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent	Excellent

OTHER COMPETENCIES

- Basic skill in use of Microsoft (Word, Excel, PowerPoint) and internet
- Ability to solve problems in the work environment
- Ability to organize and lead in tasks. Good communication skills in the work place.

REFERENCES

Haramaya university office of registrar

Tel: 25105111399

Fax: 25105114008

Email: HARAMAYA.univ@telecom.net

Certification

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications and my experience. And I am able to undertake the assignment in case of an award. I understand that any mistreatment or misrepresentation described herein may lead to my disqualification.

Dr Samuel Adugna

7.4 APPROVAL SHEET
HARAMAYA UNIVERSITY SCHOOL OF GRADUATE STUDY

Title _____

Submitted by:

_____ _____ _____

Name of student Signature Date

Approved by:

1. _____ _____ _____

Major Advisor Signature Date

2. _____ _____ _____

Co- Advisor Signature Date

3. _____ _____ _____

Research thematic area leader Signature Date

4. _____ _____ _____

Chairman, DGC/ SGC Signature Date

5. _____ _____ _____

PGPD Signature Date