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Prevalence of Measles and Associated Healthcare System Factors in Chasefu District, Eastern Province, Zambia

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Abstract

Measles remains a major public health concern despite the availability of an effective vaccine. In Zambia, outbreaks continue to occur due to gaps in immunisation coverage, surveillance systems, and healthcare service delivery. Chasefu District has experienced recurrent measles cases despite ongoing routine immunisation programmes. This study assessed the prevalence of measles and healthcare system factors associated with its outbreak in Chasefu District, Eastern Province, Zambia. A convergent parallel mixed methods study design was employed in this study. Quantitative data were collected using structured questionnaires administered to 73 healthcare workers and through review of health facility records from 2024 to 2025. Qualitative data were purposively collected through key informant interviews. Quantitative data were analysed using descriptive statistics and multiple linear regression in SPSS version 28, while qualitative data were analysed thematically. Forty-nine percent (49%) of respondents reported measles outbreaks in their facilities, while 51% reported no outbreaks. Lusuntha Rural Health Centre recorded the highest number of cases. Multiple linear regression analysis showed that vaccine availability and the presence of a functional vaccine refrigerator were significant predictors of measles occurrence. Qualitative findings revealed challenges related to vaccine stock-outs, inadequate staffing, long distances to health facilities, poor community uptake of immunisation services, and gaps in surveillance activities. Measles outbreaks in Chasefu District are influenced by healthcare system factors including vaccine availability, cold chain functionality, accessibility of services, and surveillance capacity. Strengthening routine immunisation services, improving cold chain management, and enhancing community outreach programmes are essential for reducing measles transmission.

Keywords: Measles; Immunization; Vaccination; Disease Outbreaks; Public Health Surveillance; Zambia

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Introduction

Measles is a highly contagious viral disease caused by the measles virus, a member of the genus Morbillivirus [1]. It is primarily transmitted from person to person through respiratory droplets released when an infected person coughs or sneezes. The disease commonly affects children and is characterised by high fever, cough, runny nose, red and watery eyes, and a distinctive red rash that usually begins on the face before spreading to the rest of the body [2, 3].

Despite the availability of a safe and cost-effective vaccine, measles continues to cause substantial morbidity and mortality worldwide. Recent global trends indicate a resurgence of the disease, with 260,465 cases reported in 2023 and 395,521 laboratory-confirmed cases in 2024, while 16,147 cases were recorded within the first two months of 2025 alone [4, 5].

Africa from other regions remains disproportionately affected, accounting for a substantial share of global measles cases because of persistent immunity gaps, recurrent outbreaks, and suboptimal routine immunisation coverage [3, 6, 7]. Studies from countries such as Nigeria, the Democratic Republic of the Congo, and Ethiopia show continued transmission linked to low first-dose Measles-Containing Vaccine (MCV1) coverage, delayed supplementary immunisation activities, and weak surveillance systems [8-11]. In the Democratic Republic of the Congo, large and prolonged outbreaks have been associated with chronically low vaccination coverage, rapid population growth, and health system constraints [12], while Nigeria continues to report high case numbers because of inequities in access to immunisation services, insecurity in some regions, and gaps in routine and supplementary immunisation activities [13]. Similarly, Ethiopia has experienced periodic outbreaks driven by immunity gaps among unvaccinated and under-vaccinated populations, as well

as marked regional variation in vaccination coverage [9, 14]. Overall, this resurgence threatens progress towards measles elimination and highlights persistent health system challenges in the African Region [3, 10].

In Zambia, measles outbreaks have continued to occur despite ongoing immunisation efforts; for instance, between January 2020 and August 2023, more than 3,429 cases were reported, including over 420 confirmed cases and 37 deaths in 2022, particularly in underserved and hard-to-reach areas [15]. These outbreaks suggest gaps in routine immunisation, surveillance, and access to health services, indicating that measles control efforts may be stagnating [16]. At the district level, Chasefu district reported 90 suspected measles cases between 2024 and 2025, across multiple health facility catchment areas. Although no measles-related deaths were recorded, the continued occurrence of these cases indicates ongoing possible transmission and raises concerns about the effectiveness of routine immunisation services, outreach activities, disease surveillance, vaccine availability, defaulter tracing, and other health system functions. Persistent outbreaks may increase the risk of morbidity among children under five years of age, place additional pressure on limited healthcare resources, and undermine national measles elimination efforts. There is limited data on the prevalence of measles and the specific healthcare system factors associated with outbreaks in Chasefu District. Without such evidence, interventions may fail to address the underlying drivers of continued measles transmission at the district level. Therefore, this study sought to determine the prevalence of measles and examine the associated healthcare system factors in Chasefu District, Eastern Province, Zambia.

Methods and Materials

Study design

The study employed a convergent parallel mixed methods design, where quantitative and qualitative data were collected simultaneously, analysed separately, and integrated during interpretation. This approach was selected to provide a comprehensive understanding of measles outbreaks in Chasefu District by combining statistical evidence with contextual insights.

Study setting

The study was conducted in Chasefu District, Eastern Province, Zambia [17]. The district comprises rural and semi-rural communities and has several public health facilities that provide preventive and curative services, including routine immunisation services. The study included all health facilities in the district that provided measles vaccination services.

Study population

The study population comprised healthcare workers in Chasefu district who had been stationed in the facility for at least six months and were directly involved in immunisation service delivery and disease surveillance activities. This included facility in-charges, nurses, clinical officers, environmental health technologists, community health assistants, and other personnel working in health posts and rural health centres that provided measles vaccination services. At the time of the study, 89 healthcare workers met the eligibility criteria and constituted the target population (N) from which the sample was drawn.

Sampling techniques

A census sampling technique was used to include all 18 health facilities in Chasefu district. This ensured complete coverage of all service delivery points, regardless of whether they had reported measles cases or outbreaks. For healthcare workers, purposive sampling was used to identify those directly involved in immunisation services and disease surveillance, while simple random sampling was applied to the eligible list of healthcare workers to select study participants and reduce selection bias.

Sample size determination

The sample size for the study was determined using Slovin's formula, $[n=N/(1+Ne^2)]$ since the population was known. The sample size was estimated at 72 health workers from those involved in immunisation services, and *e* was the margin of error of 0.05 at a 95% confidence interval.

Data collection procedure

Data were collected using a structured questionnaire and secondary data extracted from health facility registers, district surveillance records, and the Electronic Integrated Disease Surveillance and Response (eIDSR) system for January 2024 to December 2025. These tools were used to obtain information on cases and health system factors associated with the outbreak. The questionnaire was developed and administered in English to trained health workers. To ensure validity, data were collected using a structured extraction tool aligned with Ministry of Health measles surveillance and immunisation indicators. The tool was reviewed for content validity, and only complete HMIS records, measles line lists, and immunisation registers for the study period were included. Reliability was strengthened by using a standardised data collection procedure.

Data processing and analysis

Quantitative data were checked for completeness and consistency, entered into Microsoft Excel for cleaning and coding, and exported to SPSS version 28 for analysis. Both descriptive (measures of central tendency) and inferential statistics (regression analysis) were used to assess associations between measles outbreaks and health system factors. Qualitative data were transcribed verbatim and analysed thematically, with findings presented narratively and supported by direct quotations.

Results

Demographic profile

A total of 73 health workers participated in the study, with a 100% response rate. The respondents were slightly more male (52%) than female, and most were nurses (25%). Ages ranged from 24 to 53 years, with a mean age of 34 years, and experience varied widely, with the largest proportion having more than six years of work experience (Table 1).

Prevalence of measles cases from 2024 to 2025

The study noted that 49% (95% CI: 39.2-60.5%) of respondents reported the occurrence of measles outbreaks in their health facilities between 2024 and 2025, while 51% reported none (Table 2). Overall, 90 cases of measles were recorded across the district, with Lusuntha RHC reporting the highest number (50 cases) and Malandula RHC the lowest (1 case); no cases were reported in 10 other facilities (Figure 1).

Relationship between selected health care system factors and measles cases

The study findings using multiple linear regression analysis

Table 1: Demographic profile of Health workers.

Variable	Mean	SD	Minimum	Maximum
Age	33.6	7.6	24	53
Variable			**Frequency (n=73)**	**Percent (%)**
Sex				
Male			35	48.0
Female			38	52.0
Occupation				
Environmental Health Technologist			10	14.0
Community Health Assistant			10	14.0
Public Health Nurse			4	5.0
Midwife			14	19.0
Nurse			18	25.0
Clinical Officer			5	7.0
General Health Worker			12	16.0
Years of Experience				
<1 year			2	3.0
2-3 years			23	32.0
4-6 years			19	26.0
>6 years			29	39.0
Total			73	100.0

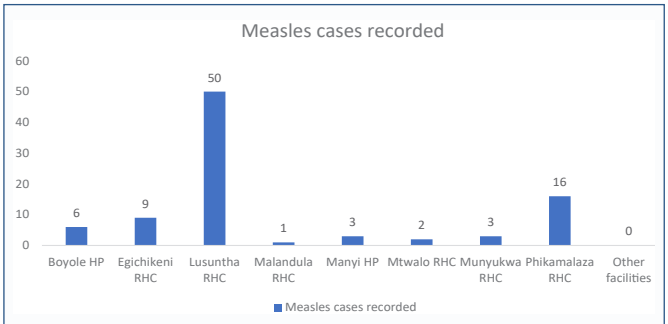

Figure 1: Distribution of measles cases across the district.

identified three health system factors that were significantly associated with measles cases recorded at health facilities (Table 3). Facilities without measles vaccine availability during the previous three years were associated with significantly higher measles cases than facilities where vaccines were available (β=0.761, p=0.006). Vaccine refrigerator functionality was also significantly associated with measles cases (β=−0.741, p=0.013), although the inverse direction of the association should be interpreted cautiously in light of the variable coding and potential facility-level differences. Caregivers' distance to the health facility was significantly associated with measles cases (β=−0.503, p=0.011). The availability and updating of temperature monitoring charts (p=0.188) and the BCG-to-measles dropout rate (p=0.201) were not significantly associated with measles cases.

Healthcare workers' perceptions of health system factors contributing to measles outbreaks

The study identified four major themes describing healthcare workers' perceptions of health system factors contributing to measles outbreaks in Chasefu district, including immunisation coverage and uptake, socio-cultural and community barriers, health system and resource constraints, and disease surveillance and service delivery

Table 2: Prevalence of measles cases from 2024 to 2025.

Variable	Frequency	Percent (%)	95% CI	
			CI (Lower)	CI (Upper)
Measles outbreak recorded in the Facility				
Yes	36	49	38.2	60.5
No	37	51	39.5	61.8
Total	73	100.0		

effectiveness.

Theme 1: Immunisation coverage and uptake

This theme comprised two sub-themes: low immunisation coverage and missed vaccination opportunities. Healthcare workers perceived inadequate routine immunisation coverage as a major contributor to measles outbreaks. Participants also reported that missed vaccination due to inconsistent follow-up of children who missed scheduled vaccinations increased the number of susceptible children within communities. As one participant stated:

"We still record measles cases mainly in areas where routine immunisation coverage is low, and children are not fully vaccinated." (Health Worker 4).

Theme 2: Socio-cultural and community barriers

Participants identified religious beliefs, cultural misconceptions, and limited caregiver awareness as barriers to childhood vaccination. The study noted these as key sub-themes, and respondents perceived them to contribute to delayed or missed immunisation among eligible children.

"Some caregivers refuse vaccines because of religious beliefs and misconceptions about immunisation." (Health Worker 6).

"Many caregivers do not understand the importance of completing all vaccine doses on time." (Health Worker 4).

Theme 3: Health system and resource constraints

Healthcare workers described transport limitations and inadequate staffing as key challenges affecting outreach services, routine immunisation activities, and case detection, especially in remote communities. Transport and logistical challenges and inadequate staffing were key sub-themes for this theme.

"We struggle to reach remote areas because transport for outreach activities is often not available." (Health Worker 13).

"The shortage of staff forces us to multitask, which affects the quality and efficiency of immunisation services." (Health Worker 1).

Theme 4: Disease surveillance and service delivery effectiveness

The study found that effective disease surveillance systems and outreach services were significant sub-themes. Participants acknowledged that routine disease surveillance systems and outreach immunisation services supported early case detection and improved vaccination coverage in hard-to-reach communities, although these services were constrained by limited resources.

"Outreach services have helped us reach children in hard-to-reach areas who would otherwise miss vaccination." (Health Worker 6).

"Many caregivers do not understand the importance of completing all vaccine doses on time." (Health Worker 10).

Table 3: Multiple Linear Regression analysis (Coefficients).

Coefficients									
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	14.161	2.135		6.632	0.000	9.800	18.521		
	Measles vaccine availability in the last 3 years	2.702	.912	0.761	2.964	0.006	0.840	4.564	0.266	3.754
	Vaccine refrigerator available and functional?	-5.679	2.140	-0.741	-2.653	0.013	-10.049	-1.308	0.225	4.442
	The temperature monitoring chart is available and updated	-1.626	1.208	-0.267	-1.346	0.188	-4.093	0.841	0.446	2.245
	Caregivers' distance to the facility	-2.440	0.899	-0.503	-2.716	0.011	-4.276	-0.605	0.511	1.958
	Percentage of Dropout Rate (BCG to Measles)	-0.003	0.002	-.242	-1.308	0.201	-0.006	0.001	0.510	1.960

a. Dependent Variable: Measles cases recorded in the facility

Note: B = Unstandardized regression coefficient; β = Standardised regression coefficient; SE = Standard Error; CI = Confidence Interval; VIF = Variance Inflation Factor. Variables were coded as Yes = 1 and No = 2, unless otherwise stated. Variables with $p<0.05$ were considered statistically significant.

Discussion

The study sought to determine the prevalence of measles and healthcare system factors associated with measles occurrence in Chasefu district. The current study findings indicate that measles remains a public health concern within the district despite ongoing immunisation activities. The study found that measles outbreaks occurred in Chasefu district between 2024 and 2025, with 49.3% of respondents reporting outbreaks in their facilities and 50.7% reporting none. Although slightly more facilities reported no outbreaks, the affected facilities still indicate continued transmission and immunity gaps within the district. This pattern is consistent with global reports of measles resurgence despite vaccination efforts, with increased cases reported across WHO regions between 2023 and 2025 due to immunity gaps and disruptions in immunisation systems [4, 5, 18]. The implication is that routine immunisation alone may not be sufficient in settings with uneven coverage, suggesting that gaps in follow-up and outreach services may contribute to persistent immunity gaps. Similar patterns have been reported in African countries such as Nigeria, Ethiopia, and Kenya, where recurrent outbreaks continue to occur because of incomplete vaccination coverage and weak surveillance systems. The findings also align with evidence from Ghana, Tanzania, and Malawi showing cyclical measles outbreaks every 2-5 years, driven by persistent immunity gaps and weaknesses in routine immunisation systems [11]. In Zambia, comparable trends have been documented, with outbreaks between 2020 and 2023 highlighting gaps in vaccination coverage, outreach services, and surveillance, particularly in rural and hard-to-reach districts [15, 16]. These comparisons suggest that the problem in Chasefu is not isolated, but part of a broader pattern of system-level vulnerability in settings where coverage is uneven and hard-to-reach communities are less well served. The distribution of cases across facilities further suggests that measles burden was uneven. Facilities with higher case numbers may reflect localised outbreaks associated with low immunisation uptake, stock-outs, weak cold chain systems, or poor access to services. These findings suggest that outbreak prevention should be targeted rather than uniform across the district, with priority given to facilities and catchment areas showing repeated case clustering or weaker service performance.

The current study found that measles cases were influenced by health system factors, particularly vaccine availability, cold chain functionality, and caregiver access to health facilities. The regression model indicated 47.4% of the variation in measles cases, suggesting that health system conditions accounted for a substantial part of the outbreak pattern, although other unmeasured factors likely contributed as well. Vaccine availability in the previous three years was significantly associated with measles cases, reinforcing evidence that stock interruptions and low coverage increase outbreak risk. Minta [19] reports that no region has yet achieved the 95% two-dose coverage required for elimination, with major gaps persisting in low-income settings because of supply and coverage disruptions. This denotes that uninterrupted vaccine supply and stronger microplanning should be treated as core outbreak-prevention measures, not routine administrative tasks. Cold chain functionality was also significantly associated with measles cases. Although this finding reinforces the importance of maintaining vaccine potency through effective cold-chain systems, the direction of the observed association should be interpreted cautiously. Differences in facility workload, catchment population size or reporting performance may partly explain this relationship. This finding is consistent with Baptiste [6], who showed that strengthened immunisation systems, including cold chain improvements, contributed to an 86% reduction in measles cases in the WHO African Region between 2000 and 2017. This comparison suggests that investments in temperature control, equipment maintenance, and monitoring can translate into meaningful gains in measles prevention. Caregiver distance to health facilities was another important predictor, supporting findings from Ghana where access barriers affected immunisation uptake despite relatively high MR1 and MR2 coverage [20]. This implies that access barriers remain important even when services exist on paper, which makes outreach, community-based delivery, and transport support essential in rural districts. In contrast, dropout rates and temperature monitoring chart availability were not significant in this study. This differs from Hayman [21], who emphasised the role of incomplete vaccination schedules in sustaining susceptibility and outbreaks. The

interpretation of these findings is not that dropout and monitoring are unimportant, but that their effect may be indirect or masked by stronger determinants such as access and supply. Overall, the study findings suggest that measles occurrence in Chasefu district was closely linked to service availability, cold chain reliability, and physical access to care, pointing to practical areas where programme strengthening could reduce transmission.

This study discovered that healthcare workers viewed measles outbreaks as the result of interacting health system and community factors. Four main themes emerged: missed immunisation opportunities, socio-cultural and community barriers, resource and logistics constraints, and weaknesses in surveillance and outreach services. Respondents repeatedly linked outbreaks to incomplete vaccination schedules and weak defaulter tracing, which is consistent with global evidence that missed vaccination opportunities remain a major driver of measles transmission even where immunisation programmes are in place [10, 22]. The practical application is that defaulter tracing, appointment follow-up, and contact tracking should be strengthened as part of routine immunisation delivery rather than only during outbreak response. Healthcare workers also pointed to religious beliefs, misconceptions, and limited awareness as barriers to vaccine uptake. Similar findings have been reported in Zambia and other African settings, where vaccine hesitancy remains a persistent challenge [16, 21]. In this study, community attitudes were described as a major obstacle, but these attitudes were often shaped by weak communication and inconsistent follow-up from the health system itself. This indicates that addressing measles outbreaks requires more than correcting misinformation; it also requires clearer communication, sustained community engagement, and trusted local delivery channels. Resource constraints were another recurring concern; staffing shortages, transport limitations, and vaccine supply interruptions were said to affect both routine and outreach immunisation services. These findings are consistent with regional evidence showing that weak logistics systems, cold chain failures, and workforce shortages reduce immunisation performance [10, 23]. This highlights that outbreak control depends not only on coverage targets, but also on the operational capacity to reach communities consistently. Health workers also noted that surveillance systems were useful for early detection, but delays in reporting and difficulty reaching hard-to-access communities limited outbreak response. This aligns with findings from Ghana and Kenya, where weak surveillance feedback mechanisms contribute to delayed response [23]. This suggests that surveillance should be linked more closely to rapid feedback, local verification, and response capacity at the facility level. Outreach services were regarded as important for improving coverage, but their impact was reduced by transport and financial constraints. Overall, our study findings suggest that measles control in Chasefu district is limited not by the absence of systems, but by weaknesses in how those systems function in practice.

Study Limitations

The study had some limitations: reliance on self-reported information from healthcare workers and routine facility records, both of which may be affected by reporting inaccuracies. In addition, the qualitative component captured only healthcare workers' perspectives. These limitations were managed through standardised data collection procedures, cross-checking of records, and triangulation of quantitative and qualitative findings, thereby enhancing the credibility of the study findings.

Conclusion

This study found that measles outbreaks remain a public health concern in Chasefu district and are associated with both healthcare system and community-level factors. Vaccine availability, cold-chain functionality, and caregiver access to health facilities were significantly associated with measles occurrence, while missed vaccination opportunities, low immunisation coverage, socio-cultural barriers, and operational constraints affecting routine immunisation, outreach services, and disease surveillance were identified as key contributors to continued transmission. These findings suggest that improving the performance of existing immunisation and surveillance systems, while strengthening community engagement and access to vaccination services, is essential for reducing measles transmission and supporting progress towards measles elimination in rural settings.

Recommendations

To support these efforts, the following recommendations are proposed to strengthen measles prevention and control:

1. The Ministry of Health and Chasefu District Health Office should strengthen routine immunisation systems by ensuring uninterrupted vaccine availability, maintaining effective cold-chain management, and optimising defaulter tracing to reduce missed vaccination opportunities and sustain high vaccination coverage.

2. Chasefu District Health Office should strengthen health system capacity by improving transport and logistical support for outreach activities, ensuring adequate healthcare worker staffing and expanding access to immunisation services in hard-to-reach communities where geographical barriers limit vaccination services.

3. Health facilities should enhance community engagement through continuous health education, risk communication, and collaboration with community and religious leaders to address misconceptions, improve caregiver awareness, and promote timely completion of childhood immunisation schedules.

4. District Health Office should bolster disease surveillance processes through accurate data documentation, timely reporting, active case detection, and rapid outbreak response to support evidence-based planning and measles control.

5. Future studies should evaluate the effectiveness of outreach immunisation and defaulter-tracing strategies in improving vaccination coverage in rural communities.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Ethics Approval

Ethical approval for this study was granted by the Lusaka Apex

Medical University Bio-medical Research Ethics Committee (FWA 00029892, IRB: 00001131, Ref: LAMUBREC No. 08020/07/04/2026). Additionally, permission was sought from the Chasefu District Health Office (DHO) and from all participating healthcare facilities. Informed consent was also solicited in writing from all participants, and strict measures were taken to ensure the confidentiality and privacy of the collected data.

Data Availability

The datasets supporting the current study are available from the corresponding author upon reasonable request.

Authors' Contributions

LM & CM conceptualised the study, methodology and interpretation of results. CM provided supervision, formal analysis, developed, proofread and approved the final manuscript.

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