Progress and Barriers Define the Journey to Measles Elimination in Africa

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ABSTRACT

Measles remains one of the most contagious and deadly childhood diseases. Africa bears a disproportionate burden of measles, despite more than 50 years of vaccine availability. The objective of this review was to examine recent epidemiological evidence on measles elimination progress and barriers in Africa towards the WHO's 2030 goal and to identify scalable strategies through a holistic analysis of epidemiological, systems, innovation, and socio-cultural aspects. A review of approximately 252 sources (2016-2025) from PubMed and WHO/UNICEF databases using the Boolean strategy was done. The search query used was (measles OR "measles virus") AND (epidemiology OR "vaccination coverage" OR elimination OR outbreaks OR barriers OR innovations) AND (Africa). Sixty-five articles were selected and thematically synthesised to gather evidence via a four-domain framework (epidemiology, health resilience, innovations, and socio-cultural factors). From 2017 to 2021, measles incidence in Africa rose from 69.2 to 81.9 cases per million. Coverage of measles-containing vaccine was 69% and 41% for the first and second doses, respectively, falling far below the 95% herd immunity threshold. Key barriers included weak health systems, vaccine hesitancy, COVID-19 disruptions, and cross-border transmission. Innovations included drone delivery of vaccine, District Health Information System 2/Short Message Service reminders, thermostable microarray patches, and genomic surveillance. Case studies show Rwanda sustained >95% for the first dose of measles-containing vaccine via digital systems, and the Democratic Republic of Congo outbreak in 2018-2020 resulted in 458,000 cases and 8,000 deaths. Integrated strategies, including resilient systems, regional collaboration, domestic funding, and community engagement, are critical to close immunity gaps and achieve WHO's 2030 elimination goal in Africa.

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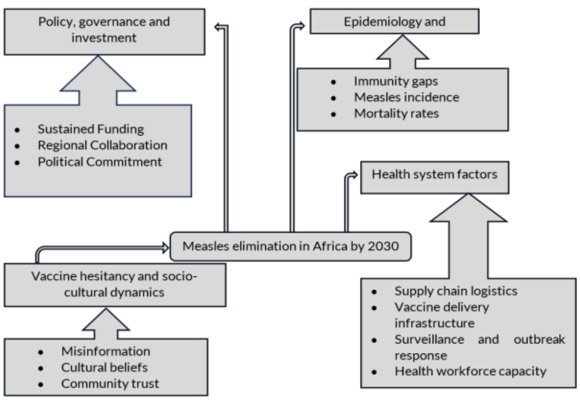
1.0 Introduction

Measles remains one of the most contagious and deadly childhood diseases. This situation has not changed even though a highly effective vaccine has existed for more than fifty years (Gastañaduy *et al.,* 2021). The global basic reproduction number (R0) for measles ranges between 12 and 18 (Guerra *et al.,* 2017). R0 shows how many secondary infections one case can cause in a fully susceptible population. A single infected individual can transmit the virus to up to 18 others if the whole population is unprotected. Measles spreads quickly, making it difficult to eliminate. This creates a major public health challenge worldwide with the greatest impact seen in Africa. In 2022, Africa had over half of the 9 million measles cases reported across the world, and it was associated with about 130,000 deaths (Minta *et al.,* 2023).

Efforts to control measles in Africa are longstanding. In 1974, the World Health Organisation (WHO) launched an Expanded Programme on Immunisation to ensure everyone could access vaccines for major childhood diseases, including (World Health Assembly 27, 1974). The Expanded Programme on Immunisation achieved a notable reduction in global morbidity and mortality from measles (Pan *et al.,* 2021; Wang *et al.,* 2022). By 2001, measles deaths in Africa had dropped by over 90%, mainly because of mass vaccination campaigns led by the Measles Initiative, renamed the Measles & Rubella Initiative in 2012 (Strebel *et al.,* 2024).

Figure 1
Conceptual Framework for Measles Elimination in Africa Developed from Evidence Synthesised in Reviewed Literature



Moreover, the WHO African Region aimed to eliminate measles by 2020 by stopping the spread of the virus in all member states. However, until 2020 outbreaks continued in several high-burden countries. Reasons included ongoing immunity gaps, weak health systems, conflicts, and emerging challenges such as the COVID-19 pandemic (Mboussou *et al.,* 2024; World Health Organisation, 2021). As a result, the elimination target was extended to 2030 under the post-2020 Measles and Rubella Strategic Framework (World Health Organisation, 2020).

The current review bridges these gaps by examining measles epidemiology, elimination barriers, technological advances, and case studies in Africa. It offers insights and strategies to help achieve the WHO 2030 measles elimination goal and improve child survival in Africa. The review uses a framework developed from a synthesis of reviewed literature that connects four key areas: epidemiological dynamics, health system resilience, vaccine delivery innovations, and socio-cultural factors like vaccine hesitancy (Fig. 1).

By linking these areas, the framework provides a clear view for assessing challenges and opportunities for eliminating measles in Africa. The review starts by outlining measles epidemiological patterns and discusses barriers to elimination. Finally, it explores technological and community engagement innovations that show promise for sustainable measles control in Africa.

2.0 Methods

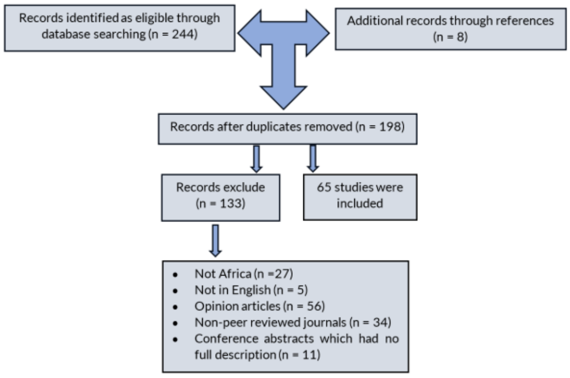
This review focused on evidence of measles elimination in Africa from 2016 to 2025. We conducted a systematic search across PubMed and WHO/UNICEF databases. Search terms combined three categories grouped using the Boolean operators (AND/OR). The first group included measles-related terms (measles OR measles virus), the second included epidemiological and programmatic terms (epidemiology OR vaccination coverage OR elimination OR outbreaks, barriers OR innovations), and the third included a geographic term (Africa). The combined search query applied was (measles OR "measles virus") AND (epidemiology OR "vaccination coverage" OR elimination OR outbreaks OR barriers OR innovations) AND (Africa).

Studies were eligible for inclusion if they were published peer-reviewed articles from 2016 to 2025, focused on measles in Africa, WHO/UNICEF reports, or surveillance data addressing measles incidence, vaccine coverage, elimination barriers, or innovations. Only English-language publications were considered. Exclusion criteria applied to duplicate studies, studies that were published before 2016 (except when used for historical background), conducted outside Africa, or did not report relevant outcomes. Non-English publications without translation were also excluded.

Two reviewers independently assessed study quality using the Cochrane Risk of Bias tool for randomised studies and the Newcastle-Ottawa Scale for observational studies. Evidence strength was graded using the GRADE framework (high, moderate, low, or very low). Disagreements were resolved by consensus between the reviewers.

From a total of 252 sources identified, 65 were selected based on inclusion and exclusion criteria (Fig. 2). Synthesis used thematic analysis organised in a four-domain framework (Fig. 1) that includes epidemiology, health system resilience, innovations, and socio-cultural factors. Terms were operationally defined as immunity gap (< 95% vaccination coverage), vaccine hesitancy (delay or refusal despite availability), and political commitment (sustained government investment and policy prioritisation). Case studies (Rwanda and Botswana = success; Nigeria = hesitancy; Democratic Republic of Congo (DRC) = fragility) were purposively selected to illustrate the governance-innovation spectrum. Pre-2016 references were used to provide historical context only.

Figure 2
A Flow Diagram of Article Selection Process



3.0 Results and Discussion

This review reveals that measles elimination is not just a biomedical or technical challenge. It is embedded in complex socio-political systems in Africa. Immunisation gaps and vaccine hesitancy stem from governance structures, health diplomacy, misinformation dynamics, and community distrust. Political commitment is the key driver that requires coordinated action across policymakers, civil society, and communities. In order to address this challenge, overcoming public health misinformation and the role of conflict in disease outbreaks is important. Strengthening health system resilience, improving communication, and building flexible policy frameworks are also essential. Future research should examine the impact of health governance on vaccine coverage to create better elimination strategies.

3.1 Measles Epidemiology in Africa

Globally, measles cases rose by 20%, from 8.6 million in 2022 to 10.3 million in 2023 (Anderer, 2025). Africa continued to bear a heavy burden due to immunity gaps, low vaccination coverage, and health system weaknesses (Branda *et al.,* 2024). In Africa, measles exhibits recurrent outbreak patterns with geographic and temporal variations. Countries such as DRC, Nigeria, Ethiopia, Somalia, and Chad consistently report high incidence rates.

From 2017-2021, regional cases increased from 69.2 to 81.9 per million population *(Masresha et al.,* 2023). COVID-19 disruptions exacerbated outbreaks in 2022, leaving millions of children unprotected (Nchasi *et al.,* 2022). Children under five years suffered most, comprising the majority of deaths due to their vulnerability and immunisation gaps (Chen *et al.*, 2025; Wolfson *et al.,* 2009). Outbreaks peak during dry seasons when there is high population density that intensifies transmission (Bharti *et al.,* 2011; Ferrari *et al.,* 2010).

From 2000 to 2016, Africa reduced measles deaths by 84% through coordinated vaccination campaigns (Dabbagh *et al.,* 2016). However, coverage fell significantly after 2017, worsened by COVID-19 (Feldman *et al.,* 2021; Masresha *et al.,* 2023; Minta *et al.,* 2023). In 2020, the worst backslide in decades occurred. Approximately 25 million children missed routine doses *(Causey et al.,* 2021; Gupta *et al.,* 2023). By 2022, the average coverage for the first and second doses of measles-containing vaccine (MCV1 and MCV2) was only 69% and 41%, respectively. Both records were far below the 95% herd immunity threshold (Mboussou *et al.,* 2024; World Health Organisation, 2023).

Table 1 summarises cases and incidence in five high-burden countries in Africa (2021-2023). The DRC and Nigeria accounted for 73% of all cases in Africa in 2021 (Masresha et al., 2023) . Somalia and Chad showed persistently high rates, while Ethiopia experienced recurrent outbreaks associated with gaps in vaccination coverage, reflecting weaknesses in their healthcare systems (Paluku *et al.,* 2025; Siad *et al.,* 2025). Fig. 3 presents MCV1/MCV2 trends and highlights immunity gaps driving epidemics, especially in underserved and conflict zones. Cross-border movements and people displacement complicate control, thereby necessitating strengthened regional surveillance and targeted immunisation strategies to achieve the WHO's 2030 measles elimination goal (Mohan *et al.,* 2021).

Table 1
Reported Measles Cases and Incidence Rates per 100,000 Population in Selected High-Burden African Countries, 2021–2023

Country	Number of Cases			Incidence Rates per 100,000 Population		
	2021	2022	2023	2021	2022	2023
DRC	54,300	94,400	48,200	54.9	95.4	48.7
Nigeria	12,200	18,300	15,600	5.6	8.4	7.2
Ethiopia	8,400	11,000	9,500	6.8	8.9	7.7
Somalia	7,000	8,200	7,600	41.2	48.2	44.7
Chad	6,500	7,200	6,900	36.1	40.0	38.3

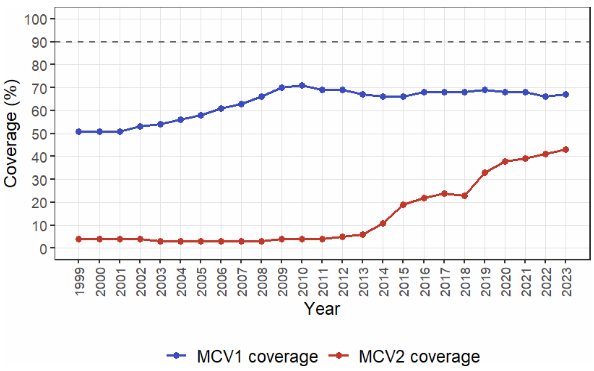
Source: World Health Organisation (WHO); United Nations Children's Fund (UNICEF); and Gavi (2023)

3.2 Barriers to Elimination

Despite a highly effective vaccine, measles elimination in Africa faces barriers that vary by country and region (Moyo *et al.,* 2023; World Health Organisation Africa, 2022). The biggest barrier being suboptimal vaccine coverage, with MCV1 and MCV2 coverage below the 95% threshold for herd immunity (Baptiste *et al.,* 2021; Brownwright *et al.,* 2017; Majekodunmi *et al.,* 2022). Over the years no African country has consistently achieved the 95% MCV coverage (Masresha *et al.,* 2018). Large, populous, and conflict-affected countries like Nigeria and the DRC have major immunity gaps that sustain recurrent outbreak (Ducomble & Gignoux, 2020; Mohan *et al.,* 2021).

A weak health system worsens these challenges. Fragile infrastructure, understaffed and undertrained health workforces, and unreliable cold chains hinder routine immunisation and outbreak responses, especially in rural and conflict-affected areas (Lennon *et al.*, 2017; Li *et al.,* 2019). Differences arise from governance, resources, and security. Furthermore, adoption of innovations like digital surveillance and genomic diagnostics remains limited. Targeted investment in workforce development, supply chains, real-time data, and integration with the broader health systems are essential (Ikhalea *et al.,* 2024; Spencer *et al.,* 2023).

Figure 3
MCV1 and MCV2 Coverage by Year in African Region (Source: 2022 WEUNIC, as Cited in (WHO African Region, 2023)



Additionally, misinformation and vaccine hesitancy contribute to the erosion of public trust in immunisation programmes and undermine vaccination efforts. For instance, reports indicate that vaccine hesitancy in Nigeria negatively impacts measles vaccination uptake (Mashinini *et al.,* 2020). This challenge of misinformation regarding vaccine safety, including unfounded claims that vaccines cause infertility, fuels this challenge. by misinformation regarding vaccine safety, including unfounded claims that vaccines cause infertility. Such misconceptions, often reinforced by religious and cultural beliefs, continue to circulate within some communities (Garett & Young, 2021; Mashinini *et al.,* 2020). Consequently, unvaccinated clusters that are highly susceptible to measles outbreaks rise in both underserved and urban settings (Hooper *et al.,* 2021; Matas *et al.,* 2023; Saçikara *et al.,* 2023). Public health emergencies like COVID-19 disrupted routine immunisation by diverting resources, restricting access, and halting measles campaign efforts (Chen *et al.,* 2025; Durrheim *et al.,* 2021; Wariri *et al.,* 2021). Subsequently, vaccination coverage dropped, triggering outbreaks across Africa (Mohan *et al.,* 2021). Moreover, conflict and climate-related challenges exacerbate shortages of healthcare personnel and vaccines while disrupting transportation and vaccine delivery systems (Shet *et al.,* 2022). Resilient systems are vital for supporting immunisation during these emergencies.

Table 1
Key Barriers Undermining Measles Elimination Efforts in Africa, Impacts and Country Illustrations

Barrier	Impact	Examples
Suboptimal vaccine coverage	Millions of children remain unprotected; herd immunity not achieved	Only Botswana and Cabo Verde reached ≥95% MCV1 in 2021; no country achieved ≥95% for MCV2 (Masresha *et al.,* 2023)
Weak health systems & logistics	Fragile infrastructure, poor cold chain, lack of health workers, delayed outbreak detection	DRC and Somalia report repeated outbreaks due to fragile systems and understaffed facilities (Lennon et al., 2017; Li *et al.,* 2019; Sodjinou *et al.,* 2022)
Misinformation & vaccine hesitancy	Erodes confidence; creates clusters of unvaccinated children and fuels explosive outbreaks	Infertility rumors in Nigeria; cultural objections in urban and rural communities (Garett & Young, 2021; Mashinini *et al.,* 2020)
Public health emergencies (e.g., COVID-19)	Service disruptions, missed campaigns, fear of facilities; 25M children missed vaccines in 2021 globally	Nigeria: >18,000 suspected cases, ~200 deaths in 2022 (Masresha *et al.,* 2023; WHO African Region, 2023) DRC: >148,000 cases in 2021–2022 (Siad *et al.,* 2025)
Cross-border transmission	Susceptible populations move across borders; undermines national programs	Uganda 2022 outbreak: 90% South Sudanese refugees (Amodan et al., 2025) Nigeria 2019 emergencies (Baptiste, Wagai, *et al.,* 2021)
Political will & funding gaps	Reliance on donors; shifting priorities; delayed or underfunded immunisation programs	Fragile commitment in conflict-affected states in DRC and Angola (Cernuschi *et al.,* 2018); underinvestment in cold chain and health workforce in Uganda and Mozambique (Lennon et al., 2017; Zakumumpa *et al.,* 2021)

Cross-border transmission normally involves unvaccinated refugees, displaced persons, and nomads across porous borders (Baptiste *et al.,* 2021; Mengistu *et al.,* 2023). For instance, a 2022 Uganda outbreak was fuelled by cases from South Sudan, where nearly 90% of cases were among South Sudanese refugees in overcrowded settlements (Amodan *et al.,* 2025). Regional collaboration that includes joint campaigns, synchronised surveillance, and border vaccinations is essential.

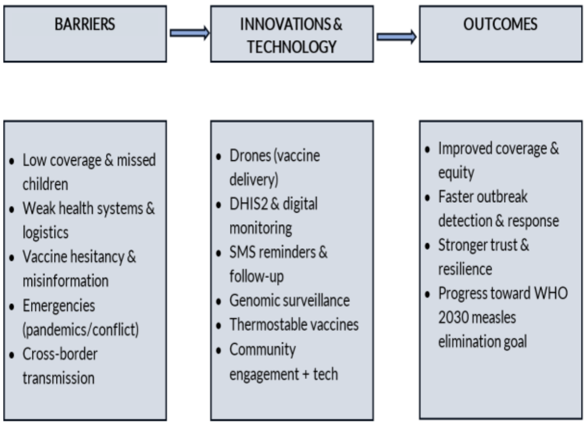
Political will and funding further slow progress. Reliance on unstable donor support, varying commitment, and misalignment with national strategies limit investment in cold chains, training, and surveillance (Cernuschi *et al.,* 2018; Zakumumpa *et al.,* 2021). African countries must increase domestic financing and align resources for sustained efforts.

Table 2 outlines barriers to measles elimination, drawn from WHO/UNICEF data, outbreak reports, and cited analyses. Integrated strategies including resilient systems, community engagement, sustained funding, molecular surveillance and regional collaboration are paramount for achieving the WHO 2030 measles elimination goal in Africa.

3.3 Innovation and Technology in Measles Control

Africa's progress toward measles elimination increasingly depends on the adaptation of innovative technologies. These technologies were initially developed for other infectious diseases such as polio, malaria, COVID-19, and Ebola. Their repurposing is critical to overcoming persistent obstacles in measles control. Figure 4 is developed to illustrate how key innovations link to major barriers. It highlights how each technology addresses a distinct specific barrier to accelerate progress toward elimination.

Figure 4
Link between Barriers, Innovations, and Measles Elimination Outcomes in Africa



3.4 Innovations in Vaccine Delivery

Drone delivery technology, first implemented in Rwanda for blood transport, now facilitates vaccine distribution across the country (Nisingizwe *et al.,* 2022). Drones reduce delivery time and maintain vaccine cold chains in remote areas. They enable access to previously unreachable populations, enhancing equity in vaccine coverage. In Mozambique, vaccine delivery through drones increased vaccine availability by 2% and reduced logistics costs by $0.08 per dose, illustrating the potential impact on measles programmes (Haidari *et al.,* 2016).

Microarray patch vaccines represent another breakthrough in vaccine delivery. Trials showed they are safe, thermostable and more cost-effective than needles and syringes (Baker *et al.,* 2023). These patches can be administered by community health workers or even laypersons during door-to-door campaigns. Wider measles-rubella microarray patch deployment could vaccinate millions more children and significantly reduce measles deaths (Fu *et al.,* 2023; Ko *et al.,* 2024).

3.5 Digital Health and Surveillance

Digital platforms like the District Health Information System 2 (DHIS2) were initially developed for polio and malaria surveillance. Now, they offer real-time immunisation tracking across many African countries (Kinkade *et al.,* 2022). This system facilitates rapid responses to outbreaks by identifying coverage gaps within a short time. Short message service (SMS) reminders have proven effective in raising vaccination completion rates (Eze *et al.,* 2021). Experience in Kenya shows a 10% increase in timely immunisation after SMS interventions (Kagucia *et al.,* 2021). Furthermore, artificial intelligence and geospatial analytics are emerging tools that allow precise prediction of measles outbreaks by analysing population-level data, guiding vaccination efforts to high-risk locations efficiently (Biswas *et al.,* 2023).

3.6 Genomic Surveillance

Genomic surveillance strengthens understanding of measles virus transmission. Tools established during Ebola and COVID-19 responses now support measles control (Branda *et al.,* 2024; Smyth, 2020). Over 30 African countries have now developed next-generation sequencing capabilities (Mboowa *et al.,* 2024). These tools distinguish imported virus strains from locally circulating ones. They also identify transmission sources to enable targeted outbreak control and promote regional data sharing for improved cross-border coordination. The African Pathogen Genomics Initiative exemplifies this collaborative approach (Makoni, 2020). This capability is critical for achieving and verifying measles elimination.

3.7 Community Engagement

Experience from polio eradication highlights the importance of community trust. Campaigns involving religious leaders, media, and door-to-door outreach builds confidence in vaccines (Duru *et al.,* 2019). Digital tools enable real-time monitoring of community reception. In Nigeria, campaigns that combine technology and grassroots mobilisation have contributed to a significant reduction in vaccine hesitancy (Duru *et al.*, 2019). Adapting similar strategies may help in dismissing misinformation and increase vaccine uptake. Both integration of community engagement and technology are critical for sustained measles control.

3.8 Toward Integrated and Sustainable Solutions

No single intervention is sufficient to eliminate measles in Africa. The integration of vaccine delivery innovations, digital health systems, genomics, and community engagement creates a comprehensive approach. Figure 4 summarises a proposed framework for overcoming barriers to measles elimination. The framework emphasises equity, timeliness, sustainability, and effectiveness in measles programmes. Strong political commitment and resilient health systems are necessary to scale and sustain such innovations. The model provided a clear pathway toward measles elimination by 2030, requiring coordinated effort, strategic investment, and continuous evaluation.

3.9 Comparative Case Studies: A Framework for Scaling Innovation in African Measles Elimination

Analysis of African case studies reveals not only isolated successes but also lessons that inform broader measles control strategies. Common facilitators and barriers identified across settings support the development of adaptable programme frameworks suited to diverse contexts. The focus therefore shifts from descriptive accounts to replicable and scalable interventions. Achieving the 2030 measles elimination targets will require decision-makers to integrate effective governance, technological innovation, and community engagement.

Rwanda's implementation of digital health systems, such as DHIS2, exemplifies real-time data for immunisation tracking and outbreak response (Nisingizwe *et al.,* 2022). It enables rapid identification of under-vaccinated areas and targeted outreach. With strong political commitment, Rwanda sustained >95% MCV1 coverage and improved MCV2 uptake amid COVID-19 disruptions (Robson *et al.,* 2020). This demonstrates how digital innovation strengthens resilient health systems.

Botswana has maintained MCV1 coverage ≥95% since 2011 through strong routine immunisation services, effective surveillance, and supplementary immunisation activities (Masresha *et al.,* 2018). These efforts have resulted in low measles incidence (<1 confirmed case per million population in several years) and periods of interrupted transmission, despite disruptions across the continent (Masresha *et al.,* 2023). Strong governance and a well-developed health infrastructure make Botswana a valuable model for African countries working toward measles elimination.

Nigeria reveals vaccine hesitancy and misinformation as key barriers. Despite vaccine availability, rumours and cultural concerns, especially in northern regions, erode trust (Chido-Amajuoyi *et al.,* 2018). Tailored strategies, including leveraging media, religious leaders, and digital follow-up, helped restore confidence (Duru *et al.,* 2019). This approach emphasises addressing sociocultural factors alongside immunisation logistics.

In the DRC, fragile health systems and conflict intensify the persistence of measles in the country. The 2018-2020 outbreak resulted in >458,000 suspected cases and 8,000 deaths, mostly in children under five (Sodjinou *et al.,* 2022). Only 40.7% of confirmed cases were vaccinated (Sodjinou *et al.,* 2022). The outbreak illustrates the interplay of health system gaps, access issues, and socio-political factors, stressing the need for integrated strategies beyond mass campaigns.

3.10 The Road to 2030: Africa's Pathway to Measles Elimination

The African journey towards measles elimination by 2030 is centred on the ambitious goal of achieving and sustaining elimination in at least 80% of member states. Elimination is here defined as reducing measles incidence to fewer than one case per million population with confirmed high-quality surveillance (Masresha *et al.,* 2023; World Health Organisation, 2021). While median MCV1 coverage hangs around 69% and below 45% for MCV2, significant gaps still leave millions of children at risk, especially in underserved and conflict-affected areas.

Supplementary immunisation activities have successfully vaccinated millions annually, but they often face issues related to quality, timing, and inequitable reach. To reach every zero-dose child and ensure no child is left behind, innovative microplanning and integration with routine services are required. Advances in vaccine delivery, which include digital health systems, drone logistics, thermostable vaccines, and genomic surveillance, hold promise but must be integrated with supportive health infrastructure.

Addressing persistent vaccine hesitancy is essential. Community engagement rooted in culturally sensitive dialogue, the empowerment of trusted leaders, and transparent communication can counter misinformation and build confidence, thereby increasing demand for complete immunisation. Moreover, strong governance with sustained political commitment and regional collaboration are vital to overcoming cross-border transmission and ensuring programme resilience. Reliable funding and multisectoral coordination support these governance efforts.

Continuous monitoring, evaluation, and adaptive programme management are essential to ensure that interventions remain responsive to evolving epidemiological and operational challenges. Only through this comprehensive and integrated strategy can Africa achieve the measurable 2030 elimination goal, leading to significant improvements in child survival and public health.

4.0 Conclusion and Recommendations

Achieving measles elimination in Africa demands a strategic, integrated approach that harmonises governance, innovation, and community trust. Sustained political commitment remains mandatory, requiring reliable financing, strengthened health systems, and accountability for uninterrupted immunisation and surveillance.

Technological innovations like digital health systems, drone delivery, thermostable vaccines, and genomic surveillance offer transformative potential but need context-specific adaptation and infrastructure. Equally critical is building community trust through culturally sensitive engagement, transparency, and local leaders countering hesitancy. Integrating mobilisation with tailored technologies fosters vaccine uptake and resilience.

This framework, where governance drives innovation, and community trust ensures sustainability, demands continuous adaptation, flexible implementation, and multi-sector partnerships. Rigorous evaluation of supplementary immunisation activities targeting zero-dose children is essential.

Future research should quantify the determinants of hesitancy, assess novel technologies like microarray patches, and measure programme resilience. Regional collaboration against cross-border transmission and alignment of political will is essential. This roadmap can push Africa toward the WHO 2030 measles elimination goal, reducing child mortality and exemplifying global leadership.

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6.0 Declaration of Conflicting Interests

The authors declare no conflict of interest.

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