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Mapping the role of vaccines in combating AMR in the WHO African region: a scoping review and implications for research and policy

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Abstract

Introduction There is substantive evidence that vaccines play a crucial role in curbing antimicrobial resistance (AMR). This has a potentially high impact in the WHO African Region. However, there is a need for a viable strategy to leverage vaccines in addressing AMR in the region. We conducted a scoping review to map existing evidence on the role of vaccines in combating AMR in the WHO African Region, identify critical knowledge gaps, and propose priority areas for research and policy interventions.

Methods We systematically reviewed the literature to identify studies that have been published in this area, with no date or study design restriction. The search results were screened for eligibility, and data from eligible studies were extracted and synthesised following the PRISMA Extension for Scoping Reviews.

Results A total of 10 studies were included in this review. Seven studies either focused on Africa as a whole or were multi-regional studies that included Africa, with country-specific studies mostly from South Africa and Ethiopia. Four studies focused on pneumococcal conjugate vaccines (PCV), while others examined influenza, rotavirus, respiratory syncytial virus, tuberculosis, and *Klebsiella pneumoniae* vaccines. Five studies estimated the potential impact of vaccines on AMR, focusing on outcomes such as reductions in AMR burden, disease incidence, deaths due to resistant pathogens, and antibiotic consumption. The remaining studies examined economic value and potential role in antimicrobial stewardship programmes. Three studies addressed policy-related issues, including potential barriers and collaboration between AMR and vaccination programmes.

Conclusion This review underscores the need for more country-level studies to build evidence on vaccine impact on AMR, including cost-effectiveness studies. Research priorities should include clinical trials with AMR-related endpoints and evaluation of vaccine impact during new vaccine introductions. Strengthening AMR surveillance systems and

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enhancing collaboration between AMR and vaccination programmes are crucial. The development and review of regulatory frameworks that explicitly address vaccines and AMR may be required.

Keywords Africa, Antimicrobial resistance and vaccines, Vaccination, Research, Policy

Background

Antimicrobial resistance (AMR) occurs when microorganisms, including bacteria, fungi, parasites, and viruses undergo genetic changes that render them resistant to antimicrobial agents, such as antibiotics, which are intended to treat infections [1, 2]. Though AMR is a natural evolutionary process in microorganisms, it has been recognsSed as a major global threat to public health and economic stability [3–5]. While stemming from genetic mutations, the rate of resistance emergence has accelerated dramatically due to selective pressure from widespread antimicrobial use, rendering previously effective drugs ineffective as resistant organisms survive and thrive [6].

In 2021, bacterial AMR was responsible for an estimated 4.71 million deaths globally, including 1.14 million deaths directly attributed to AMR [7]. The outlook is concerning - by 2050, forecasts project that direct deaths from bacterial AMR could reach 1.91 million annually, while indirect AMR deaths could escalate to 8.22 million worldwide [7]. The African region bears a significant proportion of this burden, highlighting the urgency for targeted interventions.

The phenomenon of AMR is not new; its origins date back to the early use of antimicrobials, including penicillin. Multidrug-resistant pathogens were identified as early as the 1950s [6]. Without a robust and multifaceted response, the economic impact of AMR, including losses in productivity and societal disruption, is projected to escalate significantly by 2050 [8]. Similarly, the costs of treating resistant bacterial infections alone are projected to reach $412 billion annually by 2035, with low- and middle-income countries (LMICs), including Africa facing particularly severe impacts due to their already constrained healthcare systems [9].

Vaccines offer a pivotal yet underutilised strategy for combating AMR, mostly playing a complementary role to core interventions such as antimicrobial stewardship efforts. By reducing the incidence of both antibiotic-sensitive and resistant infections, vaccines minimise the need for antibiotics, thereby lowering selective pressure for resistance [6, 10] Vaccination also decreases the inappropriate use of antimicrobials, such as those prescribed for viral infections like influenza, which are often erroneously treated with antibiotics, thus reducing a key driver of resistance development. Furthermore, vaccinated individuals are less likely to experience secondary infections that could require antimicrobial treatment or hospitalization [11].

Recognising the gravity of AMR, global initiatives have emphasised the need for a comprehensive action. The United Nations General Assembly (UNGA) held a high-level meeting on AMR in 2016, during which countries reaffirmed their commitment to national action plans and pledged to leverage new technologies, in addition to vaccines and diagnostics [12]. In September 2024, a subsequent high-level meeting set ambitious targets, including a 10% reduction in the 4.95 million annual deaths associated with bacterial AMR by 2030 [13, 14]. Vaccines could contribute to the achievement of this and other related AMR reduction goals.

Despite the substantial evidence of the critical role vaccines play in mitigating AMR, this potential remains underrecognised [3, 11]. A recent modelling study estimated that vaccines could prevent up to 515,000 AMR-associated deaths annually, with 32% of these lives saved in Africa [11]. While there have been global reviews examining the theoretical impact of vaccines on AMR across multiple pathogens [15] there is a pressing need for region-specific strategies and frameworks to integrate vaccines into AMR mitigation efforts in Africa that address unique contextual factors and implementation challenges.

We conducted this scoping review to systematically map the existing evidence on how vaccines contribute to addressing AMR across the WHO African Region, identify critical knowledge gaps in the current literature, and propose priority areas that require attention from researchers and policymakers.

Given that research exploring vaccines' impact on AMR in Africa is emerging and may potentially involve multiple interconnected factors, a scoping review methodology was chosen over other review types as it allows for a broader examination of available evidence across diverse study designs and outcomes. This approach is particularly suitable for when systematic reviews might be premature or too narrowly focused [16, 17]. This paper will provide insights to guide future research and policy efforts while accounting for the unique contextual factors in the African region.

Methods

This scoping review utilised the Joanna Briggs Institute (JBI) methodology [17, 18] and was reported in alignment with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) [19].

Inclusion and exclusion criteria

Considering the type of information we sought to gather from the literature, no restrictions were applied to study design. We included primary studies, reviews, systematic reviews, policy and technical documents, perspectives, and commentaries. Only studies focusing on vaccines used in humans were considered. Studies not focused on Africa were excluded.

Literature search

A comprehensive search was conducted on PubMed, Web of Science, Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Cochrane Library, and Google Scholar on 30th October 2024 using the search terms presented in the appendix. We also searched reference sections of included studies to identify more eligible studies.

Study selection

After completing the search, all identified records were uploaded into the Rayyan web application for review [20]. Two authors (CIJ and AVM) independently screened the titles and abstracts to identify potentially eligible records. The full texts of these selected records were then assessed by the same authors (CIJ and AVM) against the inclusion and exclusion criteria. Any disagreements were resolved through discussion and mutual agreement.

Data extraction and synthesis

One author (CIJ) extracted data using a pre-tested data extraction tool developed in an Excel spreadsheet, and a second author (AVM) verified the extracted data. The information collected from each record included the first author's last name, year of publication, country/region, study objectives, population, study type, vaccine type, outcome measures, key findings, and identified evidence gaps. The extracted data were systematically organised and presented in a table, while evidence from the data was synthesised narratively.

Ethics statement

Ethics approval was not required for this study, as it was conducted using publicly available literature and records.

Results

Results of the search

Our literature search across the selected databases and grey literature yielded 811 studies. After deduplication, 522 records remained. The titles and abstracts of these articles were screened as a first step, and 14 were identified as potentially eligible. Upon screening the full texts of these 14 articles for eligibility, 10 articles were ultimately included in this review. Figure 1 presents the PRISMA flow diagram, which outlines the study selection process.

Characteristics of included studies

We included 10 studies and they were published between 2015 and 2024 [21–30]. Among these studies, half were global studies, studies on LMICs that included Africa, and studies focusing on Africa as a whole [21, 22, 25, 27, 29]. Six studies focused on countries, including South Africa [23–25, 28], Ethiopia [26], and Zimbabwe [30]. The study designs included reviews and commentaries ($n=4$) [24, 25, 27, 29], document review [29], a mixed-methods study [30], and quantitative studies [21, 23, 26, 31]. Our included studies mostly provided evidence on the direct or indirect impact of vaccines on the burden of AMR. These studies reported on pneumococcal conjugate [24–26, 28] and vaccines against influenza [23], rotavirus [25], respiratory syncytial virus [25], tuberculosis [25], *Klebsiella pneumoniae* [21, 25], typhoid [30] and malaria [31].

Studies examining the direct impact of vaccines on AMR demonstrated substantial benefits across multiple pathogens and populations. For maternal vaccination against *Klebsiella pneumoniae*, a vaccine with 70% efficacy could prevent 399,015 cases and 80,258 neonatal deaths in LMICs [21]. In malaria vaccination, a model across 42 African countries showed that sustained moderate protection (40% efficacy over 10 years) could avert 10.4 resistant cases per 1000 children in high drug resistance scenarios [31]. For influenza vaccination in South Africa, achieving 30% coverage in children under 5 years could prevent 24,000 antibiotic prescriptions annually [25]. Economic impact was demonstrated with pneumococcal vaccination in Ethiopia, where implementation led to reduced AMR development (14.77% for amoxicillin, 0.59% for ceftriaxone), prevented 718,100 antibiotic treatment failures, and averted 9,520 AMR-related deaths, generating substantial cost savings of $32.7 million [26]. One study described the potential role of vaccines in supporting antimicrobial stewardship programmes, demonstrating how vaccination could be integrated into broader AMR control strategies, providing a complementary approach to traditional stewardship efforts [24].

Three studies addressed policy-related issues concerning vaccines and AMR. A 2023 mixed-methods study from Zimbabwe evaluating typhoid conjugate vaccine showed no significant impact on prescribing practices, despite observed decreasing trends in typhoid-related antimicrobial use. Specifically, the typhoid vaccine campaign did not significantly affect overall antimicrobial prescription rates (aRR 1.20, 95% CI 0.70–2.05) or typhoid-specific prescriptions (aRR 0.93, 95% CI 0.44–1.96), with environmental factors and diagnostic limitations identified as persistent drivers of prescribing behavior [30]. Other policy considerations included the inclusion of vaccination in national action plans on AMR [32], and the need for scaling up vaccine production in

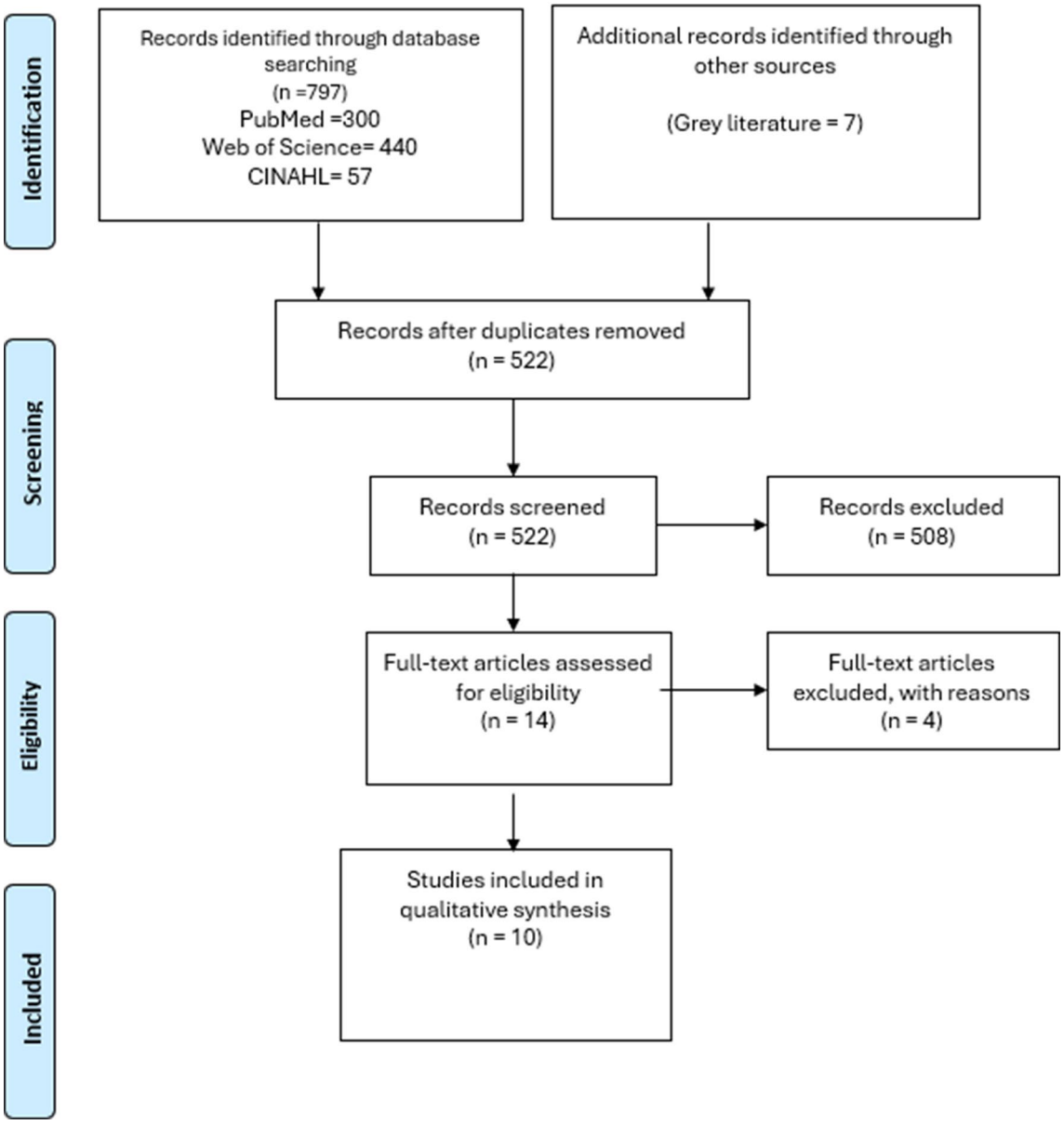

Fig. 1 Overview of the study identification and selection process

the region as a means of fighting AMR [27]. The characteristics and key findings of all included studies are summarised in Table 1.

Discussion

This review sought to consolidate available evidence on the role of vaccines in combating AMR within the African context, identify critical knowledge gaps in the existing literature, and propose evidence-informed priority areas for targeted research and policy interventions in the region.

Studies have demonstrated multiple benefits in reducing AMR, including decreased antibiotic use, reduced disease incidence and mortality, cost savings in healthcare, and fewer treatment failures due to AMR [21, 23, 26, 31]. Maternal vaccination, for example, can potentially reduce neonatal morbidity and mortality associated with AMR pathogens such as *Klebsiella* pneumoniae [21]. In addition, vaccination has been recognized as an essential component of AMR stewardship programmes [3, 15, 24, 33–45] through multiple mechanisms: it optimizes antibiotic use by preventing primary infections that might otherwise trigger inappropriate prescribing; it improves patient outcomes by reducing the risk of secondary bacterial infections requiring antibiotic treatment; and it decreases healthcare costs by preventing hospitalisations and reducing the need for expensive second-line antibiotics.

Table 1 Characteristics of included studies assessing the role of vaccines in Africa

Authors	Year	Country/region	Objectives	Population	Study type	Pathogen/vaccine type	Outcome measured	Key findings	Evidence gaps
Kumar [21]	2023	Low and middle income countries including African countries (Ethiopia, Rwanda, Nigeria, South Africa)	The impact of maternal vaccination	Neonates	Modelling (Bayesian)	*Klebsiella pneumoniae*	Estimates of averted cases and deaths due to neonatal sepsis caused by *Klebsiella pneumonia*	Authors estimated that the hypothetical vaccine with 70% efficacy given to pregnant mothers could prevent 399,015 cases and 80,258 neonatal deaths	-Lack of sufficient data from many countries -Cost effectiveness studies
Hamilton [22]	2022	Africa and specific countries including South Africa, Ghana, Kenya, Senegal and Mali	The impact of malaria vaccination in 42 African countries over a 10-year period was estimated across multiple scenarios, each with varying levels of vaccine efficacy and drug resistance.	Children (1 year olds)	Modelling (compartmental model estimating)	Malaria vaccine	Estimates of cases, drug-resistant cases, and deaths averted	A moderately effective vaccine with sustained long-term protection could prevent more resistant infections and deaths compared to a vaccine that offers high initial protection but declines in efficacy over time.	Need for an effective malaria vaccine
Knight [23]	2018	South Africa	To estimate potential impact of influenza vaccine introduction on reducing antibiotic consumption	Children (less than 5 years); pregnant women, elderly (greater than 65 years)	A mathematical modelling study design—using data to simulate and estimate potential impacts.	Influenza	Vaccine coverage, number of antibiotic prescriptions and antibiotic availability	At 30% coverage the vaccine could avert at least 24,000 antibiotic prescriptions per year if given to children,5 years old.	-Limited evidence linking reduced antibiotic prescribing to actual AMR outcomes, particularly in: -Vaccine impact studies Influenza vaccine trials -Need for outcome measures in vaccine trials including antibiotic usage data, AMR surveillance data, and disease prevention metrics
Brink [24]	2015	South Africa	To discuss the role of vaccination as an adjunct to antimicrobial stewardship programme	Not specific	Commentary	Pneumococcal conjugate vaccines (PCVs)		Vaccination could potentially be part of antimicrobial stewardship programmes	NA
The Global Antibiotic Resistance Partnership–South Africa (GARP-SA) Group collaborator [25]	2024	South Africa	Role of vaccines on AMR, perspectives from South Africa	Not specific	Commentary/Review- describing six studies-from modelling studies and one RCT	*Klebsiella pneumoniae*, Rotavirus, Respiratory syncytial virus, Influenza virus, Tuberculosis, Pneumococcal disease	Disease incidence, antibiotic use, antibiotic prescriptions. Description of barriers and facilitators to the role of vacccines on AMR	Findings showed that Pneumococcal vaccination can lead to cost savings, AMR treatment failures due to AMR in addition to reduced antibiotic use, disease incidence and deaths.	Insufficient electronic patient-level data and local information regarding the health and economic impact of AMR

Table 1 (continued)

Authors	Year	Country/region	Objectives	Population	Study type	Pathogen/vaccine type	Outcome measured	Key findings	Evidence gaps
Ozawa [26]	2021	Ethiopia	To demonstrate the broader economic value of pneumococcal vaccination in controlling the development of AMR in Africa	Children	Modelling-Dynamic Representation of the Economics of AMR (DREAMR)	Pneumococcal conjugate vaccines (PCVs)	Vaccine coverage Cost savings, disease incidence, AMR related deaths, antibiotic use	Findings showed that Pneumococcal vaccination can lead to cost savings, reduced AMR treatment failures, reduced antibiotic use, disease incidence and deaths. Between 2011–2017, PCV vaccination prevented over 718,000 antibiotic treatment failures and 9,500 AMR-related deaths, saving $32.7 million	NA
Akegbe [27]	2023	Africa	To highlight need for Africa to develop its capacity to produce vaccines	NA	Literature review	Not specific	Not applicable	Need for Africa to develop its manufacturing capacity for vaccines that will benefit the region and curb AMR	NA
Javaid [28]	2022	South Africa	An assessment of changes in serotypes of *Streptococcus pneumoniae* before and after the introduction of the PCV13 vaccine cal Sequence Clusters (GPSCs), and antibiotic resistance before and after the introduction of PCV13	Children	cross-sectional study (cross-sectional carriage surveys)	PCV	Resistance rates of pneumococcal isolates	There was an an overall reduction of resistance in pneumococcal carriage isolates. Though there was an increase in penicillin resistance among the non-vaccine types	More studies that include persons living with HIV may be required
van Heuvel [29]	2022	Global including some African countries	Describe countries that included vaccination in their national action plans on AMR	Not applicable	Document review	Not specified	Vaccination as part of strategies for containing AMR	As of 2021, 13 African countries who had national action plans on AMR mentioned vaccination, but not all outlined it detail in the implementation and evaluation plans.	There seems to be low awareness of the potential of vaccines to reduce AMR in countries. Countries planning to update their national action plans should incorporate objectives emphasizing vaccination, with greater attention to specific vaccines of interets for priority action.

Table 1 (continued)

Authors	Year	Country/region	Objectives	Population	Study type	Pathogen/vaccine type	Outcome measured	Key findings	Evidence gaps
Olaru [30]	2023	Zimbabwe	To evaluate whether vaccine use can affect antimicrobial prescribing.	Children	Mixed methods study	Typhoid	Antimicrobial prescribing, including barriers to antimicrobial prescribing	A decreasing trend in the prescription of antimicrobials for typhoid fever was noted; however, the typhoid conjugate vaccine campaign did not influence antimicrobial prescribing practices in this context. Unsafe water sources and inadequate diagnostic services were identified as contributing factors to the persistent disease burden and antibiotic prescriptions.	Missing data on prescription rates from records Lack of electronic record system Longer follow-up periods may be required to more accurately evaluate the impact of vaccination on antimicrobial prescribing practices

Country-level evidence, such as those from South Africa, Zimbabwe, and Ethiopia [25, 26, 30, 46], highlights the importance of localised approaches to leveraging vaccines for AMR mitigation. Further evidence from a more African countries is therefore needed.

The African context presents unique challenges and opportunities that require consideration and tailored strategies. For example, a study has shown that while African countries include vaccination as a strategy in their national AMR action plans as of 2021, detailed implementation and evaluation frameworks are lacking [29]. Context-specific barriers could also hinder the effectiveness of vaccines in reducing AMR. For instance, the study in Zimbabwe revealed that despite a reduction in antimicrobial prescriptions for typhoid fever following the introduction of the typhoid conjugate vaccine (TCV), overall antimicrobial prescribing practices were not significantly influenced due to systemic issues such as unsafe water sources and inadequate diagnostic services [30]. Furthermore, the durability of protection provided by vaccines is crucial in effectively combating AMR. This was demonstrated by a study showing that even moderately effective vaccines with sustained long-term protection could prevent more resistant infections compared to those with declining efficacy [22].

From a research perspective, there is a clear need for clinical trials that incorporate AMR-related outcomes as key endpoints [8, 11]. Future research should expand to include priority vaccines with impact on AMR, such as TCV, Hib vaccines, influenza vaccines, rotavirus vaccines, and measles-containing vaccines [8]. Additionally, priority pathogens identified by the Global Antimicrobial Use and Surveillance System (GLASS) should be considered for inclusion in future research [47] with a focus on vaccines that could have significant impact on AMR.

Economic evidence remains an important aspect in potential research priorities. Economic impact studies and cost-effectiveness studies that quantify the value of vaccines in reducing AMR are essential for guiding policy and investment decisions. For instance, pneumococcal, typhoid, malaria, rotavirus and influenza vaccines have been identified as offering high to moderate economic value relative to AMR [3]. These efforts will necessitate building expertise in both clinical trial design modelling analysis among African researchers, to strengthen the region's capacity for generating high-quality evidence [48].

Furthermore, evaluating the impact of vaccines that have potential impact on AMR should be incorporated during the rollout of new vaccines and existing vaccines. Strengthening AMR and antimicrobial use surveillance systems are equally critical, as they generate the data needed to assess vaccine impact. Enhanced collaboration between AMR initiatives and immunisation programmes

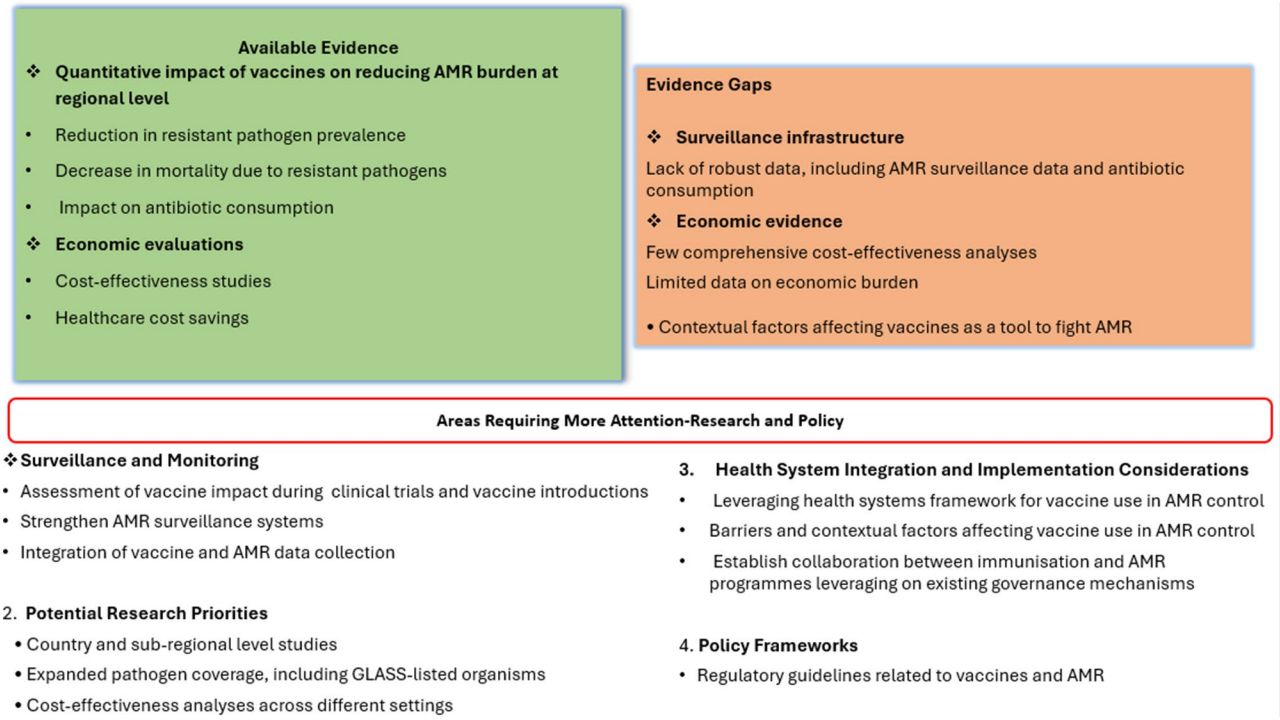

Fig. 2 Overview of Evidence, Gaps, and Priorities for Leveraging Vaccines to Combat AMR in Africa

is essential for raising awareness about the critical role vaccines play in combating AMR.

Beyond their direct role in reducing antimicrobial-resistant infections, vaccines can serve as a key advocacy tool to reinforce AMR mitigation efforts. Strengthening AMR programmes through robust surveillance, improved public awareness, and integrated policy efforts can be leveraged to increase vaccine advocacy, acceptance, and coverage [10]. By highlighting the contribution of vaccines to reducing AMR, public health stakeholders can improve vaccine confidence and uptake, particularly among populations sceptical about immunisation [25]. Incorporating AMR-related messaging into vaccine communication strategies can also enhance public understanding of the broader benefits of immunisation [25], thereby reinforcing a positive cycle where increased vaccination reduces AMR burden and, in turn, strengthens vaccine confidence.

Priority activities include strengthening capacity to implement existing interventions in infection prevention and control (IPC) and water, sanitation, and hygiene (WASH), establishing national and hospital-based antimicrobial stewardship programmes, enhancing surveillance systems, improving coverage of existing vaccines, and scaling up new vaccine introduction. These efforts should include integrating vaccination into antimicrobial stewardship programmes and strengthening regulatory frameworks. One study conducted in Italy provides evidence to show inverse relationships between childhood vaccination coverage and AMR proportions for various pathogens and antimicrobials[49].

Developing tools to accurately estimate vaccine impact on AMR and generating robust evidence for new vaccines targeting priority pathogens remain critical priorities. The success of these initiatives requires strategic coordination between vaccination programmes, AMR prevention and control efforts, and vaccine research and development. By integrating these approaches with existing immunisation programmes, countries can enhance both vaccine coverage and AMR mitigation efforts while maximizing the impact of available resources [8, 11, 50].

Figure 2 summarises the available evidence, key evidence gaps, and areas requiring more attention in terms of evidence generation and policy.

Our study has some limitations. As a scoping review, it was designed to map the available evidence on role of vaccines on AMR in the African region rather than definitively quantify its impact. Another important limitation is that we focused exclusively on human vaccines, excluding animal vaccination interventions which represent a significant component of the One Health approach to AMR control. However, our work provides clear directions for future research and policy development. These could include conducting targeted systematic reviews with more focused questions to quantify specific aspects such as public health impact and economic benefits. Additionally, our findings highlight opportunities for both secondary analyses of existing data and new

primary field studies to address identified evidence gaps. Lastly, in accordance with standard methodology for scoping reviews, quality assessment of included studies was not conducted. While this aligns with scoping review protocols [17], it should be noted when interpreting our findings.

Conclusion

This review confirms that vaccines play a pivotal role in reducing the burden of AMR in Africa. While the evidence is compelling, contextual and systemic challenges must be addressed to maximise their impact. Priority areas for action include strengthening surveillance systems, conducting more country-specific research, and generating robust economic evidence. Clinical trials incorporating AMR-related endpoints and evaluation of priority vaccines are crucial next steps. Also, integrating vaccination into national action plans are critical steps forward. Success will require coordinated efforts across research, policy, and implementation domains to fully harness vaccines as tools in mitigating AMR in Africa.

Appendix

PubMed search strategy 31ST October 2024

S/No	Search terms	Results
#1	(Africa[Title/Abstract] OR African[Title/Abstract] OR Algeria[Title/Abstract] OR Angola[Title/Abstract] OR Benin[Title/Abstract] OR Botswana[Title/Abstract] OR Burkina Faso[Title/Abstract] OR Burundi[Title/Abstract] OR Cameroon[Title/Abstract] OR "Canary Islands"[Title/Abstract] OR "Cape Verde"[Title/Abstract] OR "Central African Republic"[Title/Abstract] OR Chad[Title/Abstract] OR Comoros[Title/Abstract] OR Congo[Title/Abstract] OR "Democratic Republic of Congo"[Title/Abstract] OR Djibouti[Title/Abstract] OR Egypt[Title/Abstract] OR Eritrea[Title/Abstract] OR Eswatini[Title/Abstract] OR Ethiopia[Title/Abstract] OR Gabon[Title/Abstract] OR Gambia[Title/Abstract] OR Ghana[Title/Abstract] OR Guinea[Title/Abstract] OR "Ivory Coast"[Title/Abstract] OR "Cote d'Ivoire"[Title/Abstract] OR Jamahiriya[Title/Abstract] OR Kenya[Title/Abstract] OR Lesotho[Title/Abstract] OR Liberia[Title/Abstract] OR Libya[Title/Abstract] OR Madagascar[Title/Abstract] OR Malawi[Title/Abstract] OR Mali[Title/Abstract] OR Mauritania[Title/Abstract] OR Mauritius[Title/Abstract] OR Mayotte[Title/Abstract] OR Morocco[Title/Abstract] OR Mozambique[Title/Abstract] OR Namibia[Title/Abstract] OR Niger[Title/Abstract] OR Nigeria[Title/Abstract] OR Principe[Title/Abstract] OR Reunion[Title/Abstract] OR Rwanda[Title/Abstract] OR "Sao Tome"[Title/Abstract] OR Senegal[Title/Abstract] OR Seychelles[Title/Abstract] OR "Sierra Leone"[Title/Abstract] OR Somalia[Title/Abstract] OR "St Helena"[Title/Abstract] OR "sub-Saharan Africa"[Title/Abstract] OR Sudan[Title/Abstract] OR Swaziland[Title/Abstract] OR Tanzania[Title/Abstract] OR Togo[Title/Abstract] OR Tunisia[Title/Abstract] OR Uganda[Title/Abstract] OR "Western Sahara"[Title/Abstract] OR Zaire[Title/Abstract] OR Zambia[Title/Abstract] OR Zimbabwe[Title/Abstract])	662,030
#2	Vaccine[Title/Abstract] OR vaccination[Title/Abstract] OR immunization[Title/Abstract] OR immunization[Title/Abstract] OR vaccin*[Title/Abstract]	505,242
#3	"antimicrobial resistance"[Title/Abstract] OR "antibiotic resistance"[Title/Abstract]	96,192
#4	#1 AND #2 AND #3	300

Web of Science (WoS) search strategy (25/10/2024)

S/No	Search terms	Results
#1	(Africa OR African OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cameroon OR "Canary Islands" OR "Cape Verde" OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Democratic Republic of Congo" OR Djibouti OR Egypt OR Eritrea OR Eswatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR "Ivory Coast" OR "Cote d'Ivoire" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR "Sao Tome" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "St Helena" OR "sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR "Western Sahara" OR Zaire OR Zambia OR Zimbabwe)(Topic)	1,371,987
#2	Vaccine OR vaccination OR immunization OR immunization OR vaccin*(Topic)	558,009
#3	"antimicrobial resistance" OR "antibiotic resistance" (Topic)	127,684
#4	#1 AND #2 AND #3	440

CINAHL search strategy

S/No	Search terms	Results
#1	(Africa OR African OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cameroon OR "Canary Islands" OR "Cape Verde" OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Democratic Republic of Congo" OR Djibouti OR Egypt OR Eritrea OR Eswatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR "Ivory Coast" OR "Cote d'Ivoire" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR "Sao Tome" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "St Helena" OR "sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR "Western Sahara" OR Zaire OR Zambia OR Zimbabwe)	179,614
#2	Vaccine OR vaccination OR immunization OR immunization OR vaccin*	105,038
#3	"antimicrobial resistance" OR "antibiotic resistance"	18,774
#4	#1 AND #2 AND #3	57

Abbreviations

AMR	Antimicrobial resistance
CINAHL	Cumulative Index to Nursing and Allied Health Literature
GLASS	Global Antimicrobial Use and Surveillance System
IPC	Infection Prevention and Control
JBI	Johanna Briggs Institute
LMICs	Low-and Middle-Income Countries
PCV	Pneumococcal Conjugate Vaccine
TCV	Typhoid Conjugate Vaccine
UNGA	United Nations General Assembly
WASH	Water Sanitation and Hygiene
WHO	World Health Organization

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Author contributions
Study was conceptualized by CIJ, CSW, LG and AAY; literature screening and data extraction were done by CIJ, AVM; CIJ synthesised the extracted data and wrote the first draft; LG, AVM, WF, DYM, JO, OOO, PdMCK, AAY, KY, CSW provided critical contributions to various sections of the manuscript; all authors read and approved the final version.

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Data availability
The data used for this study were extracted from published articles that are publicly available.

Declarations

Ethics approval and consent to participate
No ethics approval was required since data used for this study were from publicly available data.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests. The authors alone are responsible for the views expressed in this article, which do not necessarily represent the views, decisions, or policies of the institutions with which they are affiliated.

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