

VACCINE DELIVERY RESEARCH DIGEST

UNIVERSITY OF WASHINGTON STRATEGIC ANALYSIS,
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1. [Routine DTP Vaccination Coverage and Herd Immunity Against Pertussis in 2024 Did Not Recover to Pre-COVID-19 Levels Globally and in WHO Regions.](#)

Plans-Rubió P.

Vaccines (Basel). 2026 Mar 27;14(3).

PubMed ID: 41893800

ABSTRACT

Objectives: The study's objective was to assess ten diphtheria-tetanus-pertussis (DTP) vaccination program indicators globally and in World Health Organization (WHO) regions in 2024, and compare the values in 2024 and 2019. **Methods:** Global and regional values for routine DTP vaccination performance indicators were assessed in 2024. Means and percentages in 2024 and 2019 were compared using the t-test and Chi-square test, respectively, considering $p < 0.05$ as statistically significant. High-priority countries for DTP vaccination coverage increase were identified in each WHO region based on the indicators assessed in this study. **Results:** The global mean vaccination coverage for DTP1, DTP3 and three DTP doses were 90.7%, 86.6% and 72.8%, respectively, in 2024. Eight of the ten indicators assessed in this study worsened and two improved globally from 2019 to 2024. The differences between 2019 and 2024 were statistically significant for the three-dose DTP coverage decrease in the European WHO region (88.1% vs. 82.5%, $p < 0.05$), and the decrease in the global percentage of countries with $\geq 90\%$ three-dose coverage (34% vs. 21%, OR = 0.52, 95% CI: 0.33-0.81, $p < 0.005$). This study identified 27 (13.8%) high-priority countries for DTP vaccination coverage increase due to DTP1 coverage lower than 80%; 47 (24.1%) countries due to DTP3 coverage lower than 80%; and 48 (24.6%) countries due to three-dose coverage lower than 60%. **Conclusions:** Global and regional DTP vaccination performance indicators in 2024 did not recover to pre-pandemic levels, although the differences between 2024 and 2019 were statistically significant only for two regional indicators.

WEB: [10.3390/vaccines14030264](https://doi.org/10.3390/vaccines14030264)

IMPACT FACTOR: 3.4

CITED HALF-LIFE: 2.8

START COMMENTARY

Since 2022, pertussis cases have surged globally due to insufficient vaccination coverage, waning immunity over time, and changes in *Bordetella pertussis* which have resulted in reduced vaccine effectiveness. This study evaluates global DTP vaccination coverage, levels of protection against

pertussis, trends from 2019 to 2024, and progress toward global vaccination targets. Using WHO and UNICEF country-specific data, authors assessed coverage of the first (DTP1) and third (DTP3) doses, as well as overall three-dose and zero-dose vaccination rates among one-year-old children.

Findings show that three-dose DTP coverage remained below 90% (72.8%) worldwide in 2024, and vaccine-induced herd immunity was insufficient to prevent transmission. While regions such as Europe, South-East Asia, and the Western Pacific performed relatively well with DTP1 and DTP3 coverage above 90% and protection levels exceeding 80%, the African region lagged significantly, with lower coverage and protection rates with an average of 59.5 coverage. Notably, eight out of ten vaccination indicators worsened between 2019 and 2024, including DTP1 and DTP3 coverage, three-dose coverage, and the proportion of fully vaccinated children. As a result, routine vaccination programs failed to achieve the ~90% immunity threshold needed to stop the spread of pertussis. Contributing factors to this gap include lingering impacts of the COVID-19 pandemic, vaccine hesitancy, limited healthcare resources, and biological factors such as waning immunity and pathogen evolution.

To address these gaps, the study highlights priority countries requiring urgent intervention, particularly those with high numbers of unvaccinated children or low DTP coverage. These include Nigeria, India, Sudan, the Democratic Republic of Congo, Ethiopia, Indonesia, Yemen, Angola, and Pakistan, as well as countries with especially low DTP1 coverage such as Afghanistan, Azerbaijan, Bolivia, Gabon, and Papua New Guinea. Strengthening routine immunization systems in these settings is essential to control pertussis and meet future vaccination goals.

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2. [Aligning health, industry, and innovation through public procurement.](#)

da Fonseca E, Shadlen K.

Eur J Public Health. 2026 Mar 20;36(Supplement_2):ii25-ii29.

PubMed ID: 41859916

ABSTRACT

This article examines how public procurement of pharmaceuticals can serve as a tool to advance both access to medicines and industrial development, in line with the Health in All Policies (HiAP) and Health for All Policies (HfiAP) agendas. We draw on four illustrative, purposefully selected cases—the pneumococcal Advance Market Commitment, emergency procurement of the Ebola vaccine, Operation Warp Speed for the accelerated production of coronavirus disease 2019 (COVID-19) vaccines, and Brazil’s Partnerships for Productive Development. Through configurative analysis, we identify distinct procurement models and assess their contributions to health and industrial objectives. The analysis highlights several procurement models: anticipatory, reactive, emergency-driven, innovation-enabling, and capability-building. These cases demonstrate how procurement can generate co-benefits across Sustainable Development Goals (SDGs) 3 (health) and 9 (industry, innovation, infrastructure), while also revealing implementation gaps and structural constraints. Realizing the potential of procurement as a dual health-industrial tool requires linking it to capability-building, tailoring instruments to local and industrial contexts, and confronting structural asymmetries that limit national ownership. By treating procurement not as an administrative task but as an industrial strategy, governments can better operationalize HiAP/HfiAP and make progress toward more equitable and sustainable health innovation systems.

WEB: [10.1093/eurpub/ckaf245](https://doi.org/10.1093/eurpub/ckaf245)

IMPACT FACTOR: 3.9

CITED HALF-LIFE: 6.7

START COMMENTARY

This study identifies public procurement models and evaluates their contributions to health and industrial objectives to assess the extent to which procurement can generate co-benefits when linked to capacity building. The authors use four illustrative case studies representing anticipatory, reactive, innovation-enabling, and capacity-building procurement models. Among these, the capacity-building model illustrated by Brazil’s Productive Development Partnerships (PDPs), shows the strongest alignment between health and industrial policy.

Brazil’s PDPs illustrate how procurement can be leveraged to transfer technology and develop domestic capabilities. Since the mid-2000s, Brazil’s Ministry of Health has used its purchasing power

within the country's Unified Health System to reshape the pharmaceutical sector. Under this model, the government guarantees five-year procurement contracts for high-cost medicines, conditional on technology transfer from private firms to public laboratories. This approach supports stable access to medicines while strengthening domestic production capacity.

Even where full technology transfer is not achieved, PDPs have led to important co-benefits. Public laboratories have improved infrastructure, adopted Good Manufacturing Practices, and developed in-house regulatory capabilities. These advancements have enabled institutions to handle complex biologics, meet international standards, and engage in long-term industrial partnerships. Being able to produce existing products but adapt manufacturing to local needs is a valuable type of innovation especially for LMICs where there is often limited access to funding and less developed research and development systems. The AstraZeneca–Bio-Manguinhos partnership in Brazil during COVID-19 further illustrates this model by combining short-term access to COVID-19 vaccines through fill-finish production with long-term capability development in drug manufacturing.

These findings show that procurement strategies focused solely on access or emergency response may deliver immediate results but fail to address structural challenges. In contrast, models that integrate technology transfer and capacity building leverage procurement into a strategic tool for sustainable health and industrial development.

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3. [Anticipating tuberculosis vaccine acceptability in Kenya and South Africa: a narrative review of behavioral and social drivers and strategies to optimize acceptability.](#)

Giovanatti A, Shapiro A.

Vaccine. 2026 Mar 17;79:128457.

PubMed ID: 41830693

ABSTRACT

Tuberculosis (TB) remains the leading infectious cause of death worldwide, yet the only vaccine currently available is the pediatric BCG, which has poor effectiveness in preventing TB in adolescents and adults. A TB vaccine for this older age group is projected to prevent 4.6-8.5 million deaths by 2050 and increase gross domestic product by US\$1.6 trillion by 2080, making this a priority investment for global stakeholders. In response to the World Health Organization's End TB Strategy, several TB vaccine candidates are now in phase III clinical trials, many of which target adolescents and adults. However, research on attitudes towards a TB vaccine is limited and urgently needed among these key populations to inform vaccine demand creation, scale up needs, and implementation strategies, particularly given global trends of increased vaccine hesitancy following the introduction of novel COVID-19 vaccines. To address this gap, a literature search was conducted for published studies evaluating socio-behavioral predictors of acceptability of HPV, COVID, and childhood immunizations as proxy indicators since there is a lack of published data on TB vaccine acceptability. We focused our search within Kenya and South Africa between January 2015 and July 2025 to represent high TB burden countries. Findings were supplemented with emerging data from unpublished conference abstracts on TB vaccine attitudes. Significant predictors of vaccine acceptability included higher perceived risk of disease, older age, a sense of collective responsibility, accurate and sufficient knowledge of the vaccine, trust in government or health authorities, and confidence in vaccine safety, side effects, and efficacy. Corresponding strategies to improve TB vaccine acceptability included early and accurate public communication, engagement of community influencers and youth, and use of diverse communication platforms.

WEB: [10.1016/j.vaccine.2026.128457](https://doi.org/10.1016/j.vaccine.2026.128457)

IMPACT FACTOR: 3.5

CITED HALF-LIFE: 8.2

START COMMENTARY

Recent accelerated research has produced several tuberculosis (TB) vaccine candidates targeting adolescents and adults in high-burden settings such as Kenya and South Africa. However, evidence on public acceptance of a novel TB vaccine remains limited. This review draws on insights from

COVID-19, HPV, and childhood vaccination studies to identify potential drivers of TB vaccine acceptability.

Perception of risk among adolescents and young adults emerged as a notable modifiable driver of vaccine acceptance. Complacency toward vaccine-preventable diseases was shown to reduce vaccine acceptance. For example, South African high school students cited “not having the disease” as a primary reason for declining a hypothetical TB vaccine. This is indicative of a gap in knowledge of TB and the role of vaccines, and a consequent sense of invulnerability in young people. The authors suggest addressing these gaps with timely, accessible health education delivered by healthcare workers and public campaigns. Messaging should improve understanding of TB pathophysiology, transmission, and the risks of morbidity and mortality, while also reducing stigma.

Community-based outreach using visual media and art has demonstrated effectiveness in promoting HIV/TB awareness and positive health-seeking behaviors among South African youth. Tailored communication strategies that use relatable language and align vaccination with individual priorities can also counter complacency. For example, in communities affected by high rates of HIV and sexual violence, HPV vaccine uptake improved when messaging emphasized sexual health implications. Similarly, TB vaccine campaigns could highlight TB as a leading cause of death among young people living with HIV to increase perceived relevance.

This review is limited by the scarcity of TB-specific acceptability studies and reliance on evidence from other vaccination contexts. However, its integration of emerging and unpublished data offers a timely and comprehensive perspective. Findings suggest future research should prioritize TB-specific acceptability studies to inform targeted interventions. Lessons from prior vaccination efforts underscore the importance of education, combating misinformation, and building trust to support successful TB vaccine uptake.

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4. [Bridging immunization gaps in Sub-Saharan Africa: a narrative review of microplanning, geospatial, and machine learning approaches to reach zero-dose children and under-immunised children.](#)

Musuka G, Umar A, Dadari I, Moyo E, Mano O, Iradukunda P, et al.

Vaccine. 2026 Mar 10;79:128413.

PubMed ID: 41806761

ABSTRACT

Immunization inequities persist across Sub-Saharan Africa, with significant numbers of zero-dose and under-immunised children contributing to preventable morbidity and mortality. This narrative review critically examines the integration and effectiveness of machine learning, geospatial mapping, and microplanning strategies in identifying and reaching these vulnerable populations. The review's primary objective is to synthesise current evidence on how these innovative approaches are being applied within routine immunization systems to address persistent coverage gaps. A systematic search of peer-reviewed literature and grey sources was conducted, focusing on studies and programmatic reports from 2015 to 2025. The review analyses methodological trends, implementation experiences, and outcome data related to machine learning algorithms for risk profiling, geospatial technologies for mapping and targeting, and microplanning tools for local-level action. Data extraction and thematic synthesis were guided by the WHO framework for immunization equity. Findings demonstrate that machine learning models, utilizing demographic, health system, and mobility data, have enhanced the precision of zero-dose child identification, enabling more targeted outreach interventions. Geospatial mapping has further enabled real-time visualisation of immunization deserts and the spatial distribution of missed communities, supporting resource allocation and deployment of mobile teams. Microplanning, when integrated with digital tools and community engagement, has shown promise in translating high-level data into actionable local strategies, improving follow-up, and reducing missed vaccination opportunities. Despite these advancements, several challenges persist. Data quality and interoperability issues limit the scalability of machine learning and geospatial solutions, particularly in remote or fragile settings. Capacity gaps at the sub-national level, including technical skills and digital infrastructure, impede effective microplanning and data use. Furthermore, the sustainability of these approaches is threatened by fragmented investments and limited integration into national health information systems. Opportunities exist to strengthen the routine immunization system by standardising data collection, investing in workforce training, and fostering cross-sectoral collaboration. The review recommends prioritising the development of interoperable platforms, expanding context-specific pilot projects, and embedding evaluation mechanisms to track impact and equity outcomes. Policymakers are urged to leverage the demonstrated benefits of machine learning.

WEB: [10.1016/j.vaccine.2026.128413](https://doi.org/10.1016/j.vaccine.2026.128413)

IMPACT FACTOR: 3.5

CITED HALF-LIFE: 8.2

START COMMENTARY

This narrative review synthesizes evidence on the use of machine learning for identifying zero-dose and under-immunized children, geospatial mapping to locate underserved populations, and microplanning approaches that integrate data-driven insights with local context. Data-driven microplanning frameworks emerge as particularly impactful for addressing under-immunization. Microplanning that integrates geospatial and population data has significantly improved the identification and reach of missed children. For example, in the Democratic Republic of Congo (DRC), georeferenced microplans developed at health zone and area levels incorporated settlement maps, facility catchment boundaries, and population estimates. These enabled more precise targeting of vaccination efforts, identification of previously missed settlements, and better estimation of vaccine needs which ultimately contributed to increased coverage and reductions in zero-dose prevalence. Context-sensitive approaches emerged as another theme that strengthen microplanning. In the DRC, integrating gender-intentional data collection helped address barriers to care and improved community engagement and service uptake. In fragile settings like Sudan, collaboration with trusted community leaders and NGOs has been critical for reaching underserved populations which underscores the importance of flexible, locally grounded strategies. Findings are limited by potential language bias and reliance on retrospective studies. Moving forward, the authors suggest that success will depend on scaling beyond pilot programs toward systematic integration of digital tools into national systems. Investments in data infrastructure, workforce capacity, and community engagement are essential.

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5. [Recent advances in microneedle technology in transdermal drug delivery systems.](#)

Kushwaha A, Goswami L, Amiryaghoubi N, Kim B.

Expert Opin Drug Deliv. 2026 Mar 11:1-22.

PubMed ID: 41794409

ABSTRACT

INTRODUCTION: Transdermal drug delivery systems (TDDs) offer significant advantages over traditional drug administration routes (oral and parenteral); however, the barrier function of the stratum corneum limits its application to compounds possessing the obligatory physicochemical characteristics. To overcome the limitations of TDD, micro-sized needles can be used. Microneedles (MN), a non-invasive drug delivery system, can disrupt the skin's integrity, generating microchannels that facilitate the efficient infusion of drugs.

AREAS COVERED: The review highlights the designing, (bio)materials utilized, classification, fabrication, optimization, and characterization of microneedles for TDDs application. The application of microneedles for vaccination, sustained transdermal delivery, biologics, targeted drug delivery, cosmetics, and advanced therapeutic applications are explored. The involvement of computational modeling and AI-driven approaches, 3D printing, etc. is included. The critical challenges in microneedle development, e.g., dimensional concerns, safety, adequacy, toxicity, scalability, regulatory, and sustainability, are also covered.

EXPERT OPINION: Developments in the MN technology have extended the potential of the transdermal drug delivery system, holding potential to transform areas like immunization, chronic disease treatment, pain management, and real-time biomonitoring. In the upcoming decade, drug delivery procedures are expected to prioritize people's ease and self-supervision; however, supervisory synchronization, maneuver calibration, and sustained novelty will be indispensable for MNs to develop as a standard of care.

WEB: [10.1080/17425247.2026.2642108](https://doi.org/10.1080/17425247.2026.2642108)

IMPACT FACTOR: 5.4

CITED HALF-LIFE: 8.2

START COMMENTARY

Transdermal drug delivery (TDD) is a growing field that offers a compelling alternative to traditional drug delivery routes such as oral and injectable administration. Among emerging TDD technologies, microneedles (MNs) have gained significant attention due to their ability to enable minimally invasive, painless drug delivery while supporting patient self-administration. This review highlights

recent advances in MN-based systems, along with key challenges related to sustainability, regulation, and large-scale adoption.

Microneedle technology has a wide range of applications, with vaccine delivery being one of the most promising and rapidly developing areas. MN patches enhance vaccine accessibility and effectiveness by targeting the skin, which is rich in antigen-presenting cells. Compared to conventional intramuscular injections which target muscle tissue containing fewer immune cells, MN-based delivery can generate stronger and longer-lasting immune responses. Notably, skin-based vaccination can achieve similar antibody levels using lower antigen doses, offering a dose-sparing advantage. Clinical studies have also demonstrated improved immunogenicity and higher patient acceptance of MN patches. Beyond immunological benefits, MN systems offer logistical advantages including improved thermal stability, reduced reliance on cold-chain storage, elimination of sharps waste, and the potential for self-administration making them particularly valuable for remote or resource-limited settings.

Despite these advantages, several barriers limit widespread adoption. These include the lack of standardized manufacturing practices, quality control systems, and scalable production methods. Transitioning from small-scale fabrication to industrial production requires substantial investment and process optimization. Additionally, traditional sterilization methods such as heat or radiation can compromise microneedle structure or drug integrity. Regulatory concerns regarding long-term safety, dosing precision, and biocompatibility further limit market acceptance. Future progress will depend on advances in material science, including the development of composite and stimuli-responsive MNs that improve mechanical strength and controlled release. Innovations in cost-effective manufacturing and regulatory frameworks to support safe and scalable deployment are equally important.

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6. [The Current Landscape and Future Prospects of Vaccine Manufacturing in Africa: Challenges, Innovations, and Opportunities: A Narrative Review.](#)

Chandipwisa C, Shimilimo A, Uwishema O, Onyeaka H.

Health Sci Rep. 2026 Mar 03;9(3):e71926.

PubMed ID: 41773217

ABSTRACT

BACKGROUND AND AIMS: Africa has significant challenges in meeting its vaccination needs, including inadequate manufacturing capacity, infrastructure deficiencies, a scarcity of experienced personnel, regulatory hurdles, restricted access to technology and intellectual property. This review evaluates African vaccine manufacturing capacity, region-specific limitations, and highlights significant innovations and policy alternatives to promote vaccine autonomy and equitable public health results.

METHODS: A comprehensive narrative evaluation of the literature was done. We obtained prior papers from WHO publications, CDC publications, Google Scholar, Elsevier, PubMed, and EBSCOhost. The assessment examines the current status and future prospects of vaccine manufacturing in Africa, emphasizing obstacles, innovations, and possibilities.

RESULTS: Africa's vaccine manufacturing capacity is constrained by limited production infrastructure, a shortage of skilled personnel, and inadequate technical resources. These challenges are compounded by financial constraints, heavy reliance on donor support, and restricted access to technology transfer. In remote regions, regulatory fragmentation and weak cold chain infrastructure further hinder vaccine distribution. Promising innovations such as mRNA platforms, heat-stable formulations, and microarray patches offer potential breakthroughs, but progress in scaling up manufacturing remains slow despite international partnerships and funding support. To achieve vaccine self-sufficiency, Africa must strengthen its research ecosystem, build a skilled workforce, and expand domestic manufacturing capabilities.

CONCLUSION: Africa's vaccine manufacturing capacity is at an important phase, requiring coordinated efforts to overcome long-standing barriers. Investment in local vaccine facilities, skilled personnel development, and strong regulatory framework are essential. Strengthening international partnerships while fostering local innovations will lead to self-reliance. Emphasis on One Health approaches can enhance disease surveillance and control. Adequate funding and political will are indispensable for sustained progress.

WEB: [10.1002/hsr2.71926](https://doi.org/10.1002/hsr2.71926)

IMPACT FACTOR: 2.1

CITED HALF-LIFE: 2.0

START COMMENTARY

This review examines the state of vaccine manufacturing in Africa, highlighting challenges, key innovations, and policy opportunities to advance vaccine independence and public health outcomes, based on a narrative analysis of peer-reviewed literature and institutional reports. Despite significant progress in immunization coverage over the past decade, disparities in vaccine access persist across Africa. In response, the Vaccine Innovation Prioritization Strategy (VIPS), launched in 2018 and identified technologies with the potential to help overcome barriers to immunization. These include microarray patches, heat-stable and controlled-temperature chain liquid vaccines, and barcoding on primary packaging. While this initiative has provided a framework for prioritizing new vaccine technologies, challenges remain in facilitating their development and adoption in LMICs.

Africa's vaccine manufacturing capacity is uneven across regions. Although several countries have vaccine manufacturing facilities, only a few facilities such as Afrigen in South Africa and VACSERA in Egypt are involved in all stages of production, including research and development, drug substance manufacturing, and fill-and-finish processes. In contrast, several countries, including Algeria, Ethiopia, and Tunisia, are restricted to fill-and-finish operations only or the manufacturing of only specific vaccines. Other countries, like Kenya and Botswana, rely primarily on partnership-oriented initiatives. This imbalance reflects the broader structural challenge of the absence of comprehensive vaccine manufacturing ecosystems across much of sub-Saharan Africa. To achieve the African Union's target of producing 60% of vaccines locally by 2040, substantial investment is needed upstream in infrastructure, workforce development, and regulatory systems. Findings suggest strengthening these areas is needed to ensure local manufacturing goals and to achieve equitable vaccine access across the continent.

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7. [Preparing for Tuberculosis Vaccine M72/AS01E Implementation: A Global Demand Forecast and Key Influential Factors.](#)

Kallenberg J, Milea D, Breuer T, Philippot A.

Infect Dis Ther. 2026 Mar 23.

PubMed ID: 4173934841866440

ABSTRACT

INTRODUCTION: Tuberculosis (TB) affects over 10 million people worldwide annually, is difficult to treat, and is a major cause of death. The M72/AS01E candidate vaccine is the first vaccine in over 100 years with the potential to protect adolescents/adults. To prepare for the introduction of the vaccine and ensure adequate manufacturing capacity, global vaccine demand must be carefully estimated in advance.

METHODS: A global demand forecasting model was developed that considered demand factors such as TB burden, external funding, anticipated interest, and country vaccine adoption capabilities, which determined assumptions for the timing and implementation approach of vaccine introduction. Assuming initial M72/AS01E regulatory approval in 2029, demand for routine vaccination and catch-up campaigns was forecasted through to 2045.

RESULTS: Adoption of M72/AS01E was projected to begin in South Africa in 2029, expanding to 89 countries by 2039. In the base-case forecast, demand reached a steady state of around 56 million doses per year by 2036, and decreased to around 43 million doses per year following licensure of another global TB vaccine, assumed in 2037. Seven countries accounted for 61% of demand, and approximately half of all demand was from Gavi-eligible countries (Gavi, the Vaccine Alliance). In scenario analyses, demand increased by 43% (peaking at 79 million in 2036), assuming higher efficacy and more available funding, and decreased by 34%, assuming narrower, delayed policy recommendations and less available funding. Key drivers of global demand included adoption timing, target population, and coverage.

CONCLUSIONS: M72/AS01E has the potential to reduce the TB burden worldwide. Successful vaccine introduction requires early and coordinated planning, with detailed demand forecasting refined over time. The model will be updated as new data and country implementation plans emerge. To avoid access delays, continued collaboration among key stakeholders, including vaccine suppliers, and early visibility on policy recommendations and domestic and donor funding availability will be critical in the coming years.

WEB: [10.1007/s40121-026-01319-2](https://doi.org/10.1007/s40121-026-01319-2)

IMPACT FACTOR: 5.3

CITED HALF-LIFE: 3.2

START COMMENTARY

This study aims to estimate future global demand for the candidate tuberculosis vaccine M72/AS01E to inform supply planning and implementation. The authors developed a forecasting model that integrates country-level data on TB burden, population demographics, immunization capacity, and funding eligibility. Assumptions on vaccine introduction timing, target populations (e.g., adolescents and high-risk groups), and coverage were informed by prior vaccine implementations such as HPV vaccination. Demand was projected from 2029 through 2045 under base-case, upside, and downside scenarios. Notably, the model shows annual global demand could reach approximately 56 million doses by 2036 in the base-case, with seven countries accounting for most of the demand, and about half of all demand was from lower-income countries supported by Gavi. Limitations of this study include reliance on assumptions due to limited empirical data, particularly regarding country adoption decisions. Uncertainty in key countries such as India and China further affects projections. Strengths of the study include its comprehensive global scope and use of scenario analyses to capture uncertainty. The findings underscore the importance of early coordination among manufacturers, policymakers, and funders to avoid delays in access. This study provides a valuable framework for anticipating demand and guiding global TB vaccine preparedness.

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8. [From campaign to continuity: stakeholders' recommendations for integrating HPV vaccination into Nigeria's healthcare system.](#)

Akpen C, Uwatt E, Dauda M, Ngobua S, Kubura D, Sampson S, et al.

BMC Health Serv Res. 2026 Mar 28;26(1).

PubMed ID: 41709189

ABSTRACT

BACKGROUND: For Human Papillomavirus (HPV) vaccination to be delivered effectively, countries must transition from campaign-based introduction to integration within the routine immunization schedule. While existing literature provides insights into the effectiveness of HPV campaigns and barriers to initial vaccine acceptance, there is a dearth of stakeholder-informed implementation research around the transition from campaign to routine delivery. This study aimed to explore the experiences and perspectives of key stakeholders involved in the HPV vaccine campaign in Nigeria to generate stakeholder-driven recommendations for the effective and sustainable integration of the vaccine into the country's routine immunization schedule and strengthen national capacity for introducing and sustaining future new vaccines.

METHODS: This study adopted a qualitative, exploratory research design. The research was conducted across nine Nigerian states, representing five of the six geopolitical zones. Participants were purposively sampled, encompassing 140 stakeholders (30 Key Informant Interviews, 110 In-depth Interviews). Data were collected using semi-structured interview guides, audio-recorded, transcribed verbatim, and thematically analysed.

RESULTS: Stakeholder recommendations emphasize that effectively integrating the HPV vaccine into routine immunization in Nigeria demands a multi-pronged strategy. This includes comprehensive strategies for awareness, engagement, and mobilization; continuous workforce training and motivation; robust data systems and reporting; effective management of misinformation; and intensification campaign. Additionally, early and thorough planning, fostering government ownership, optimizing operational logistics, ensuring consistent funding, and maintaining vaccine availability are critical. These insights provide valuable, transferable lessons for the introduction and sustained implementation of future vaccines.

CONCLUSION: The transition of the Human Papillomavirus (HPV) vaccine from a campaign-driven approach to routine immunization in Nigeria represents a critical juncture, offering both significant challenges and unparalleled opportunities to strengthen the national health system. Policy priorities should include institutionalizing periodic intensification programs, strengthening community engagement, standardizing immunization data systems, securing sustainable financing, and enhancing primary healthcare infrastructure. By addressing these priorities, Nigeria can achieve

equitable HPV vaccine coverage and strengthen its capacity for future vaccine initiatives, ensuring a lasting public health impact.

CLINICAL TRIAL NUMBER: Not applicable.

SUPPLEMENTARY INFORMATION: The online version contains supplementary material available at [10.1186/s12913-026-14225-7](https://doi.org/10.1186/s12913-026-14225-7).

WEB: [10.1186/s12913-026-14225-7](https://doi.org/10.1186/s12913-026-14225-7)

IMPACT FACTOR: 3.0

CITED HALF-LIFE: 5.6

START COMMENTARY

This study explores experiences and perspectives of stakeholders involved in Nigeria's HPV vaccination campaign to inform recommendations for integrating the vaccine into the routine immunization schedule. The authors use a qualitative, exploratory design across nine Nigerian states among stakeholders involved in planning, vaccine delivery, and community mobilization.

Stakeholder interviews revealed key themes and potential strategies to effectively integrate the HPV vaccine into Nigeria's routine immunization schedule. The most emphasized theme focused on bolstering comprehensive communication and engagement. Stakeholders stated that continuous communication, strong community engagement, and active mobilization are essential. Strategies include consistent advocacy, use of local languages, leveraging schools as access points, and collaboration with community leaders and external sectors such as education. Misinformation was identified as a major barrier to this strategy, with recommendations to engage trusted figures such as parents, traditional and religious leaders, influencers, and Civil Society Organizations to build trust and counter vaccine hesitancy in the community. Another key theme is training and workforce motivation. Stakeholders emphasized ongoing training programs to provide health workers with necessary skills for vaccine administration, cold chain management, and community education. Stakeholders highlighted that trainings should also reinforce the permanent integration of HPV vaccination into routine immunization schedules to support a long term and sustainable approach while addressing challenges such as understaffing and low motivation. The importance of strengthening data systems and reporting was also highlighted. Weak data management due to limited training, outdated tools, and poor use of existing systems undermines program effectiveness. Recommended solutions include continuous staff training, updated tools, stronger accountability systems, and improved data awareness among health workers.

A limitation of this study is that findings are based on stakeholder perceptions rather than direct observation, which may introduce bias. Policy implications include institutionalizing periodic

intensification campaigns, strengthening community engagement, ensuring sustainable financing, improving data systems, and investing in primary healthcare infrastructure.

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9. [Examining Artificial Intelligence Chatbots' Responses in Providing Human Papillomavirus Vaccine Information for Young Adults: Qualitative Content Analysis.](#)

Laily A, Schwab-Reese L, Davish M, Cahue E, LaRoche K, Rodriguez N, et al.

JMIR Public Health Surveill. 2026 Feb 18;12:e79720.

PubMed ID: 41707197

ABSTRACT

BACKGROUND: The growing use of artificial intelligence (AI) chatbots for seeking health-related information is concerning, as they were not originally developed for delivering medical guidance. The quality of AI chatbots' responses relies heavily on their training data and is often limited in medical contexts due to their lack of specific training data in medical literature. Findings on the quality of AI chatbot responses related to health are mixed. Some studies showed the quality surpassed physicians' responses, while others revealed occasional major errors and low readability. This study addresses a critical gap by examining the performance of various AI chatbots in a complex, misinformation-rich environment.

OBJECTIVE: This study examined AI chatbots' responses to human papillomavirus (HPV)-related questions by analyzing structure, linguistic features, information accuracy and currency, and vaccination stance.

METHODS: We conducted a qualitative content analysis following the approach outlined by Schreier to examine 4 selected AI chatbots' (ChatGPT 4, Claude 3.7 Sonnet, DeepSeek V3, and Docus [General AI Doctor]) responses to HPV vaccine questions. These questions, simulated by young adults, were adapted from items on the Vaccine Conspiracy Beliefs Scale and Google Trends. The selection criteria for AI chatbots included popularity, accessibility, countries of origin, response update methods, and intended use. Two researchers, simulating a 22-year-old man or woman, collected 8 conversations between February 22 and 28, 2025. We used a deductive approach to develop initial code groups, then an inductive approach to generate codes. The responses were analyzed based on a comprehensive codebook, with codes examining response structure, linguistic features, information accuracy and currency, and vaccination stance. We also assessed readability using the Flesch-Kincaid Grade Level and Reading Ease Score.

RESULTS: All AI chatbots cited evidence-based sources from reputable health organizations. We found no fabricated information or inaccuracies in numerical data. For complex questions, all AI chatbots appropriately deferred to health care professionals' suggestions. All AI chatbots maintained a neutral or provaccine stance, corresponding with scientific consensus. The mean and range of response lengths varied [word count; ChatGPT: 436.4 (218-954); Claude: 188.0 (138-255); DeepSeek: 510.0 (325-735); and Docus: 159.4 (61-200)], as did readability [Flesch-Kincaid Grade

Level; ChatGPT: 10.7 (6.0-14.9); Claude: 13.2 (7.7-17.8); DeepSeek: 11.3 (7.0-14.7); and Docus: 12.2 (8.9-15.5); and Flesch-Kincaid Reading Ease Score; ChatGPT: 46.8 (25.4-72.2); Claude: 32.5 (6.3-67.3); DeepSeek: 43.7 (22.8-67.4); and Docus: 40.5 (19.6-58.2)]. ChatGPT and Claude offered personalized responses, while DeepSeek and Docus lacked this. Occasionally, some responses included broken or irrelevant links and medical jargon.

CONCLUSIONS: Amidst an online environment saturated with misinformation, AI chatbots have the potential to serve as an alternative source of accurate HPV-related information to conventional online platforms (websites and social media). Improvements in readability, personalization, and link accuracy are still needed. Furthermore, we recommend that users treat AI chatbots as complements, not replacements, to health care professionals' guidance on clinical settings.

WEB: [10.2196/79720](https://doi.org/10.2196/79720)

IMPACT FACTOR: 3.9

CITED HALF-LIFE: 3.3

START COMMENTARY

In recent years, there has been growing reliance on internet-based artificial intelligence (AI) chatbots for accessing health-related information. Tools like ChatGPT are increasingly used to support personal health decision-making, despite not being designed for clinical purposes. This study aimed to examine how four AI chatbots respond to HPV vaccine questions using language representative of young adults. The authors performed a qualitative content analysis to evaluate general-purpose and health-specific chatbots, focusing on response structure, personalization, tone, and information accuracy.

Findings showed variation in user-centered communication. ChatGPT and Claude incorporated personal details such as age and offered tailored guidance (e.g., providing vaccine schedules for a 22-year-old), while DeepSeek and Docus provided more general responses. All chatbots demonstrated some level of emotional validation, though Docus used minimal affirming language compared to the more detailed and empathetic responses from other chatbots. In terms of accuracy, all chatbots cited credible sources, including organizations like the WHO and CDC along with peer-reviewed journals. No fabricated information was identified. However, some chatbots included broken links and occasionally irrelevant sources which may reduce trust among users. Notably, all chatbots maintained a neutral or supportive stance toward HPV vaccination.

The study is limited by its short data collection period combined with the rapid evolution of AI systems. Strengths include the use of multiple chatbots and a qualitative approach that reflects real-world user interactions. These findings show that AI chatbots have promise as accessible sources of accurate health information. However, improvements in readability, personalization, and source

reliability may be needed. The findings also highlight the importance of AI health literacy, which encourages users to critically evaluate AI-generated information and not use these tools as a replacement for professional medical advice.

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10. [The invasive non-typhoidal Salmonella vaccine landscape: Innovations and challenges ahead.](#)

Revie N, Guo M, Mullin A, Excler J, Wilder-Smith A, MacLennan C, et al.

Vaccine. 2026 Mar 16;76:128339.

PubMed ID: 41702319

ABSTRACT

Invasive non-typhoidal Salmonella disease represents a major public health challenge, particularly in sub-Saharan Africa, where it is a leading cause of community-acquired bloodstream infections. Despite its significant morbidity and mortality, no licensed vaccines exist. Recognizing this unmet need, multiple global health initiatives and targeted investments have advanced iNTS vaccine development. These efforts have advanced several promising candidates employing diverse platform technologies, including the first iNTS vaccine candidate to enter clinical trials in more than 15 years in 2019. To date, three additional candidates have entered clinical development—two progressing through Phase 2 trials and one currently in a Phase 1/2 study—while many more remain in preclinical development. Several candidates also incorporate antigens targeting Salmonella Typhi or Salmonella Paratyphi A alongside iNTS components to broaden coverage and expand market potential. Despite this progress, scientific, regulatory and commercial challenges persist. In response, global health organizations have intensified efforts to support vaccine development, clarify regulatory pathways and foster engagement with key decision-makers, including through the development of Preferred Product Characteristics and a Full Value of Vaccines Assessment. These coordinated efforts mark a significant step toward enabling and accelerating iNTS vaccine development, ultimately aiming to prevent iNTS disease and its associated health burden.

WEB: [10.1016/j.vaccine.2026.128339](https://doi.org/10.1016/j.vaccine.2026.128339)

IMPACT FACTOR: 3.5

CITED HALF-LIFE: 8.2

START COMMENTARY

Despite major progress in vaccines against S. Typhi, development of vaccines for invasive non-typhoidal Salmonella (iNTS) has lagged. However, increasing partnerships and clinical trials indicate increased momentum toward iNTS vaccine development. The current pipeline includes several promising candidates in preclinical and early clinical stages. Current candidates use diverse platforms such as glycoconjugates, Generalized Modules for Membrane Antigens (GMMAs), and Multiple Antigen Presenting Systems (MAPS). These diverse approaches may help increase the likelihood of successfully developing a new and effective iNTS vaccine. Key candidates include a trivalent glycoconjugate vaccine (targeting S. Typhimurium, S. Enteritidis, and S. Typhi) developed

by the University of Maryland and Bharat Biotech, a bivalent and trivalent GMMa vaccine from GSK, and MAPS-based vaccines from Boston Children's Hospital that includes quadrivalent formulations that also target *S. Typhi* and *S. Paratyphi A*.

Despite these advances, no iNTS vaccine has reached late-stage clinical trials or approval. Remaining challenges include limited data on disease burden, uncertainty in clinical development strategies, the need for large efficacy trials, and the lack of well-defined correlates of protection. iNTS disease continues to cause significant morbidity and mortality, particularly in sub-Saharan Africa. Although no vaccines are currently available, early-stage candidates show promise for reducing disease burden and potentially lowering antibiotic use. Some models also suggest that a moderately effective vaccine could substantially reduce antibiotic consumption. Ongoing global initiatives and funding efforts aim to accelerate development and ensure affordability to support vaccine deployment in high-need regions.

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Additional Articles of Interest

- 1 From Estimated Targets to Verified Coverage: Implementation of a Community Health Worker-Based Tracking Intervention to Address Denominator Inaccuracies in High-Risk Urban Settings of Balochistan, Pakistan. [{Full Article}](#)
- 2 Cost-Effectiveness of Infant Pneumococcal Conjugate Vaccination Strategies in Vietnam: A Stepwise Economic Evaluation. [{Full Article}](#)
- 3 Strengthening the Immunization System Through Private Provider Engagement to Improve Vaccine Uptake in Urban Settlements of Karachi, Pakistan: A Before-After Study. [{Full Article}](#)
- 4 Globalizing digital immunization systems for the sustainable development goals: a perspective. [{Full Article}](#)
- 5 Maternal and child healthcare coverage and trends: refugee vs. non-refugee districts in Uganda. [{Full Article}](#)
- 6 Strengthening measles immunity in Thailand: Rationale for a third vaccine dose to avert outbreaks. [{Full Article}](#)
- 7 Provincial stratification and equity-weighted cost-effectiveness of malaria vaccines in Zambia under climate variability. [{Full Article}](#)
- 8 Gavi's Zero-Dose Learning Hubs: Enhanced Approach for Evidence Generation and Use from Local to Global. [{Full Article}](#)
- 9 Recent advances in microneedle technology in transdermal drug delivery systems. [{Full Article}](#)
- 10 Catalysing vaccines research, development and manufacturing in Nigeria: a qualitative exploration of industry stakeholders' knowledge, perceptions and experience. [{Full Article}](#)
- 11 Typhoid knowledge, prevention practices, and vaccine awareness in high-risk communities of Lilongwe, Malawi. [{Full Article}](#)
- 12 Mpox vaccination uptake and acceptance in the Democratic Republic of Congo: a systematic review and meta-analysis. [{Full Article}](#)
- 13 Knowledge, attitudes and factors associated with the awareness of caregivers of under-five children regarding the malaria vaccine in the Tiko Health District, Cameroon: A community-based cross-sectional study. [{Full Article}](#)
- 14 Improving emergency preparedness of subnational vaccine stores in Ukraine: co-creation and implementation of on-site functional simulation exercises. [{Full Article}](#)
- 15 Leveraging community insights and navigating logistical challenges: a case study of the 2024 polio vaccination campaign in Gaza, State of Palestine. [{Full Article}](#)
- 16 The power of powerful others: health locus of control and vaccination behavior in rural Namibian pastoralists. [{Full Article}](#)
- 17 Caregivers' qualitative insights on trust, resilience and vaccination attitudes shaping child health in conflict-affected Northeast Nigeria. [{Full Article}](#)

- 18 Determinants of Mpox vaccine uptake and hesitancy among healthcare workers in Port Harcourt, Nigeria. [{Full Article}](#)
- 19 Community Perceptions and Attitudes Toward Vaccination in Madagascar. [{Full Article}](#)
- 20 Knowledge and attitude toward monkeypox (mpox) among healthcare providers in Sub-Saharan Africa: a systematic review and meta-analysis. [{Full Article}](#)
- 21 Economic impact of a maternal Klebsiella pneumoniae vaccine: estimates for 107 low- and middle-income countries. [{Full Article}](#)
- 22 Decision-making considerations for single-dose HPV vaccination, including drivers of schedule adoption or switch: insights from immunisation stakeholders in 19 low-income and middle-income countries. [{Full Article}](#)
- 23 Cervical cancer elimination in India: Repurposing diagnostics, vaccination, and accelerating policy for the 2030 target. [{Full Article}](#)
- 24 Oral cholera vaccine uptake, acceptance and confidence among residents of a high-risk township in Zambia: key insights for future vaccination programs. [{Full Article}](#)

Appendix

The literature search for the April 2026 Vaccine Delivery Research Digest was conducted on March 27, 2026. We searched English language articles indexed by the US National Library of Medicine and published between February 15, 2026 and March 14, 2026. The search resulted in 520 items.

SEARCH TERMS

(((((“vaccine”[tiab] OR “vaccines”[tiab] OR “vaccination”[tiab] OR “immunization”[tiab] OR “immunisation”[tiab] OR “vaccines”[MeSH Terms] OR (“vaccination”[MeSH Terms] OR “immunization”[MeSH Terms])) AND (“logistics”[tiab] OR “supply”[tiab] OR “supply chain”[tiab] OR “implementation”[tiab] OR “expenditures”[tiab] OR “financing”[tiab] OR “economics”[tiab] OR “Cost effectiveness”[tiab] OR “coverage”[tiab] OR “attitudes”[tiab] OR “belief”[tiab] OR “beliefs”[tiab] OR “refusal”[tiab] OR “Procurement”[tiab] OR “timeliness”[tiab] OR “systems”[tiab])) OR “vaccine delivery”[tiab] OR “vaccination refusal”[MeSH Terms] OR “immunization programs”[MeSH Terms] OR “zero dose”[tiab] OR “unvaccinated children”[tiab] OR “gavi”[tiab]) NOT (“in vitro”[tiab] OR “immune response”[tiab] OR “gene”[tiab] OR “chemistry”[tiab] OR “genotox”[tiab] OR “sequencing”[tiab] OR “nanoparticle”[tiab] OR “bacteriophage”[tiab] OR “exome”[tiab] OR “exogenous”[tiab] OR “electropor*”[tiab] OR “systems biology”[tiab] OR “animal model”[tiab] OR “cattle”[tiab] OR “sheep”[tiab] OR “goat”[tiab] OR “rat”[tiab] OR “pig”[tiab] OR “mice”[tiab] OR “mouse”[tiab] OR “murine”[tiab] OR “porcine”[tiab] OR “ovine”[tiab] OR “rodent”[tiab] OR “fish”[tiab])) AND “English”[Language] AND 2026/02/15:2026/03/14[Date - Publication]