



The Role of Vaccines in Mitigating Antimicrobial Resistance in Uganda

Key message:

Antimicrobial resistance (AMR) threatens the effectiveness of both current and future antimicrobial therapies and further exacerbates the burden of infectious diseases. Vaccines can prevent infections in the first place and reduce the need for antimicrobial use, simultaneously addressing key drivers of AMR. It is critical to leverage vaccines and immunization programs to fight AMR in Uganda.

The Burden of Infectious Diseases and Antimicrobial Resistance in Uganda:

- Uganda, with a population of 48.5 million in 2023, faces a significant burden of communicable diseases. Malaria, human immunodeficiency virus (HIV), tuberculosis (TB), and diarrheal diseases, such as rotavirus, contribute to high mortality and morbidity rates (Table 1) (World Bank n.d-a, 2023).
- In 2021, of the 47,821 deaths due to bacterial infections in Uganda, 26,839 were associated with AMR, while over 5,616 were directly attributable to AMR. Key AMR pathogens include *Klebsiella pneumoniae*, *Streptococcus pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, and *Salmonella typhi* (IHME, University of Oxford. n.d.; Naghavi et al. 2024).
- AMR-related deaths in Uganda surpass those from respiratory infections, tuberculosis, cardiovascular diseases, HIV/acquired immunodeficiency syndrome (AIDS), sexually transmitted infections, neglected tropical diseases, malaria, and cancers (IHME, University of Oxford. n.d.).
- The AMR problem is particularly concerning in low-resource settings due to weak healthcare systems, poor diagnostics, substandard antimicrobials, and inadequate water, sanitation, and hygiene (WASH) infrastructure. Only 30.9 percent of Ugandans have access to basic handwashing facilities, and even fewer have access to basic sanitation services (Vekemans et al. 2023; World Bank n.d-b,c).
- Inadequate WASH infrastructure promotes the spread of resistant bacteria, such as *E. coli* and *Shigella spp.*, increasing the burden of diarrheal diseases (IHME 2024).
- AMR complicates treatment by increasing reliance on second- and third-line antibiotics and raising health care costs. In 2021, Uganda's healthcare expenditures accounted for 4.67 percent of the country's gross domestic product (GDP), with over 50 percent of expenses being out-of-pocket (IHME n.d-b; WHO n.d-b).

Table 1. Mortality Rates for Common Infectious Pathogens in Uganda

Causative pathogen(s)	Disease	Number of deaths	Year
Rotavirus	Diarrheal diseases (in children under 5 years of age)	10,637	2019
<i>Streptococcus pneumoniae</i>	LRTIs	3,794	2021
<i>M. tuberculosis</i>	Tuberculosis	11,819	2021
<i>Plasmodium spp.</i>	Malaria	15,945	2023
HIV	AIDS	20,000	2023

LRTIs: Lower Respiratory Tract infections; HIV: Human Immunodeficiency Virus; AIDS: Acquired Immunodeficiency Syndrome

Source: WHO (2024), IHME (2021), IHME, University of Oxford (n.d.), UNAIDS (2023), GAVI (2018)

Immunization and AMR Strategies

Vaccines play a crucial role in reducing the burden of infectious diseases and slowing the emergence of AMR. They reduce the incidence and transmission of infections and the need for treatment, indirectly tackling a critical driver of AMR: the overuse and misuse of antibiotics.

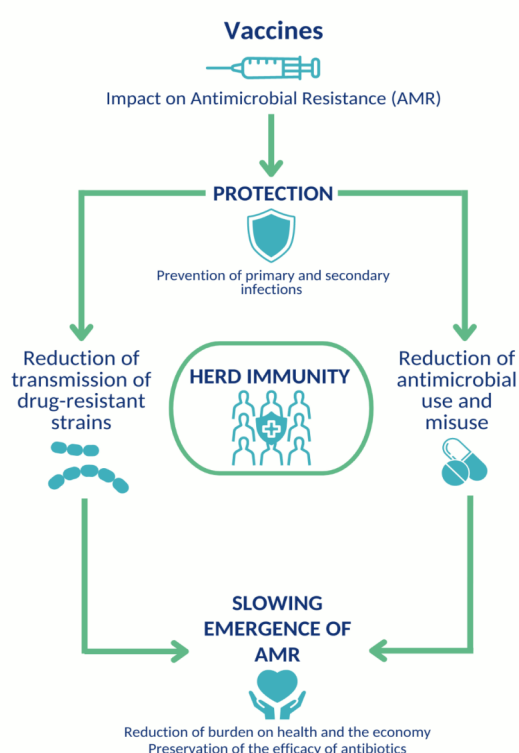


Figure 2: The Role of Vaccines in Addressing AMR

Source: Kalanxhi et al. 2023

Uganda's national childhood immunization program includes nine vaccines that protect against tuberculosis, poliomyelitis, whooping cough (pertussis), diphtheria, tetanus, measles, hepatitis B, *Haemophilus influenza B*, cancer of the cervix, and pneumococcal infections (Ministry of Health, Government of Uganda, 2012). These vaccines are part of the Expanded Program on Immunization, which targets approximately two million children each year (GAVI 2023).

Despite significant progress, further improvements are needed to ensure that vaccines reach the target population and maintain subnational coverage across regions. For example, although all districts have achieved more than 50 percent coverage of the second dose of the rotavirus vaccine and the third dose of the pneumococcal conjugate vaccine (PCV), many are still below the international target of 90 percent.

In addition to limited financial resources and challenges in service delivery, vaccine uptake is hindered by poverty, low literacy rates, sociocultural and religious beliefs, inadequate information on vaccinations, and restricted access to health care (Jammeh et al. 2022; Malande et al. 2019).

These obstacles must be addressed through coordinated efforts by governments, policymakers, health care providers, and civil society organizations to enhance vaccine coverage and immunize the population against common vaccine-preventable diseases.

The Potential of Vaccines in Curbing AMR in Uganda

Vaccines can reduce the health and economic burden of AMR. Modeling estimates suggest that the pneumococcal conjugate vaccine (PCV) in Uganda can prevent approximately 80 percent of antibiotic-treated cases of acute respiratory infections in children under five. Additionally, the **rotavirus vaccine (RotaC)** can avert 56 percent of antibiotic-treated cases of diarrhea in children under two years (Lewnard et al. 2020).

An important vaccine not included in Uganda's national immunization schedule is the **typhoid conjugate vaccine (TCV)**. It is projected that over 10 years, a TCV campaign could avert 75.2 percent of cases and 71 percent of deaths from fluoroquinolone-nonsusceptible typhoid fever and 75.9 percent of cases and 73.1 percent of deaths from multidrug-resistant (MDR) typhoid fever in Uganda (Birger et al. 2022).

Highlighting the potential of the newly introduced malaria vaccine, projections show that routine **childhood malaria vaccines** with 40 percent efficacy over 10 years could avert 611.13 cases and 1.56 deaths per 1,000 children (Hamilton et al. 2023). Additionally, preliminary research from One Health Trust (2024) suggests that the malaria vaccine could prevent 68,000–153,000 cases of catastrophic healthcare expenditure over 3–10 years, saving up to US\$115.7 million in societal costs and up to US\$14.7 million in monetized disability-adjusted life years. A pilot program for the newly approved RTS, S/AS01 malaria vaccine in Ghana, Kenya, and Malawi also supports these projections. A campaign involving more than 800,000 children between 2019 and 2021 led to a 30 percent reduction in severe malaria cases (WHO n.d.-c). The R21/matrix-M malaria vaccine was incorporated into Uganda's national immunization schedule in April 2025 (WHO Regional Office for Africa 2025). By reducing malaria cases and reliance on antimalarial drugs and antibiotics, vaccines play a critical role in combating antimalarial resistance and minimizing antibiotic use.

Recommendations for Leveraging Vaccination to Address AMR

To fully harness the benefits of vaccines, it is essential to optimize and increase coverage rates, ensure appropriate vaccine regulatory mechanisms, and strengthen healthcare provision and access. The following recommendations can help inform policy decisions to improve vaccination and immunization practices and mitigate the growing threat of AMR.

1. Maintain high coverage of all available vaccines:

Increasing coverage of childhood vaccines, such as PCV, rotavirus, Bacillus Calmette-Guérin, measles-containing, and hexavalent (DPT-Hib-HepB) vaccines, would help reduce antimicrobial use associated with infectious diseases and the incidence of resistant infections in Uganda.

2. Expedite the rollout of approved vaccines:

The Ministry of Health should accelerate the rollout of approved vaccines to reduce the overuse of antibiotics and alleviate the health and economic burden of infectious diseases.

3. Enhance collaborations: Boosting collaborative initiatives between authorities working on AMR and immunization could foster alignment of national strategies to incorporate vaccination-specific targets and objectives in the national action plan for AMR.

4. Develop and implement a comprehensive

communication strategy: Comprehensive communication strategies aimed at healthcare professionals and the community can combat misinformation and enhance awareness about AMR and the role of vaccines in reducing the additional health and economic burden from hard-to-treat infections.

Acknowledgements

This publication was prepared by the Global Antibiotic Resistance Partnership – Uganda.

GARP Technical Work Group members:

Prof. Denis Byarugaba, Makerere University (Chair); Dr. Sabrina Kitaka, Makerere University; Dr. Freddy Kitutu, Makerere University; Dr. Josephine Bwogi, Ministry of Health; Dr. Emmanuel Isingoma, Ministry of Agriculture; Dr. Susan Nabadda Ndidde, National Health Laboratory and Diagnostics Services, Ministry of Health; Dr. Immaculate Ampaire, UNEPI Human Health; Dr. Stella Nanyonga, Pharmaceutical Society of Uganda; Dr. Charlotte Muheki, Healthnet Consult; David Walusimbi, National Drug Authority; Ms. Celia Nalwadda, Uganda National Academy of Sciences (GARP Coordinator)

One Health Trust:

Dr. Oluoma Agiri, Dr. Erta Kalanxhi, Ms. Simran More, Mr. Harry Street, Mr. Felix Bahati, Mr. Rishiraj Bhagawati, Dr. Samantha Serrano

References

- Birger, R., M. Antillón, and J. Bilcke, et al. 2022. Estimating the Effect of Vaccination on Antimicrobial-Resistant Typhoid Fever in 73 Countries Supported by GAVI: A Mathematical Modelling Study. *Lancet Infectious Diseases* 22(5): 679–91.
- GAVI. 2023. Uganda Zero-Dose Landscape. <https://zdlh.gavi.org/country-profiles/uganda> (accessed August 8, 2024).
- Griffin, M. Pamela, Yuan Yuan, and Therese Takas, et al. 2020. Single-Dose Nirsevimab for Prevention of RSV in Preterm Infants. *New England Journal of Medicine* 383(5): 415–25.
- Hamilton, A., F. Hagpanah, and M. Hasso-Agopsowicz, et al. 2023. Modeling of Malaria Vaccine Effectiveness on Disease Burden and Drug Resistance in 42 African Countries. *Communications Medicine* 3(1): 144.
- Naghavi, M., Vollset, S. E., Ikuta, K. S., Swetschinski, L. R., Gray, A. P., Wool, E. E., Robles Aguilar, G., et al. 2024. Global burden of bacterial antimicrobial resistance 1990–2021: A systematic analysis with forecasts to 2050. *The Lancet* 404 (10459): 1199–1226. [https://doi.org/10.1016/S0140-6736\(24\)01867-1](https://doi.org/10.1016/S0140-6736(24)01867-1).
- IHME. n.d-b. Uganda. <https://www.healthdata.org/research-analysis/health-by-location/profiles/uganda#main-content> (accessed February 13, 2024).
- IHME. 2021. GBD Results <https://vizhub.healthdata.org/gbd-results/> (accessed February 25, 2025).
- IHME. 2024. GBD Compare | Institute for Health Metrics and Evaluation. <https://www.healthdata.org/data-tools-practices/interactive-visuals/gbd-compare> (accessed May 2, 2024).
- IHME, University of Oxford. n.d. MICROBE. <https://vizhub.healthdata.org/microbe> (accessed March 24, 2025).
- Jammeh, A., M. Muhoozi, A. Kulane, and D. Kajungu. 2023. Comparing Full Immunisation Status of Children (0–23 Months) Between Slums of Kampala City and the Rural Setting of Iganga District in Uganda: A Cross-Sectional Study. *BMC Health Services Research* 23(1): 856.
- Kalanxhi, E., Roberts N., Miller L., Bahati F., and Laxminarayan R. 2023. The Value of Vaccines to Mitigate Antimicrobial Resistance — Evidence from Low- and Middle-Income Countries. Washington, DC. <https://onehealthtrust.org/publications/reports/the-value-of-vaccines-to-mitigate-antimicrobial-resistance-evidence-from-low-and-middle-income-countries/> (accessed November 24, 2023).
- Lewnard, J.A., N.C. Lo, N. Arinaminpathy, I. Frost, and R. Laxminarayan. 2020. Childhood Vaccines and Antibiotic Use in Low- and Middle-Income Countries. *Nature* 581 (7806): 94–9.
- Malande, O.O., D. Munube, and R.N. Afaayo, et al. 2019. Barriers to Effective Uptake and Provision of Immunization in a Rural District in Uganda. *PLOS ONE* 14(2): e0212270.
- Ministry of Health, Government of Uganda. 2012. Uganda National Expanded Programme on Immunization Multi-Year Plan. https://extranet.who.int/countryplanningcycles/sites/default/files/planning_cycle_repository/uganda/uganda_epi_cmyip_2012-2016.pdf. (accessed April 28, 2025).
- GAVI. 2018. Gavi Supports Rotavirus Vaccine Introduction in Uganda. <https://www.who.int/news/item/06-10-2021-who-recommends-groundbreaking-malaria-vaccine-for-children-at-risk> (accessed April 28, 2025).
- UNAIDS. 2023. Uganda Country Factsheets 2023. <https://www.unaids.org/en/regionscountries/countries/uganda> (accessed March 22, 2025).
- Vekemans, J., M. Hasso-Agopsowicz, and G. Kang, et al. 2021. Leveraging Vaccines to Reduce Antibiotic Use and Prevent Antimicrobial Resistance: A World Health Organization Action Framework. *Clinical Infectious Diseases* 73(4): e1011–7.
- WHO. n.d.-b. Datadot. Data: Uganda. <https://data.who.int/countries/800> (accessed July 28, 2024).
- WHO. n.d.-c. WHO Recommends Groundbreaking Malaria Vaccine for Children at Risk. <https://www.who.int/news/item/06-10-2021-who-recommends-groundbreaking-malaria-vaccine-for-children-at-risk> (accessed April 24, 2024).
- WHO. 2024. World Malaria Report. <https://www.who.int/publications/i/item/9789240104440> (accessed March 24, 2025).
- WHO Regional Office for Africa. 2025. Uganda's Bold Step towards a Healthier Future through Malaria Vaccine Roll-out. <https://www.afro.who.int/countries/uganda/news/ugandas-bold-step-towards-healthier-future-through-malaria-vaccine-roll-out>. (accessed April 2, 2025).
- World Bank. n.d.-a. World Bank Open Data—Cause of Death, by Communicable Diseases and Maternal, Prenatal and Nutrition Conditions. <https://data.worldbank.org> (accessed July 28, 2024).
- World Bank. n.d.-b. World Bank Open Data. World Bank Open Data—People with Basic Handwashing Facilities Including Soap and Water. <https://data.worldbank.org> (accessed July 28, 2024).
- World Bank. n.d.-c. World Bank Open Data—People Using Safely Managed Sanitation Services. <https://data.worldbank.org> (accessed July 28, 2024).
- World Bank. 2023. World Bank Open Data—Population. <https://data.worldbank.org> (accessed July 28, 2024).