INOSR APPLIED SCIENCES 14(2):45-49, 2026 ©INOSR PUBLICATIONS

International Network Organization for Scientific Research ISSN: 2705-165X
https://doi.org/10.59298/INOSRAS/2025/14.2.4549 INOSR14.2.00.000

Evaluating the Economic Impact of Typhoid Vaccination Strategies in Uganda: A Cost-Effectiveness Analysis

Kamanzi Ntakirutimana G.

School of Natural and Applied Sciences Kampala International University Uganda

ABSTRACT

Typhoid fever remains a significant public health concern in Uganda, affecting both rural and urban populations, particularly children and young adults. Despite advances in water, sanitation, and hygiene (WASH) interventions, outbreaks continue to occur, placing a heavy burden on the healthcare system and the national economy. This review evaluates the economic impact of typhoid vaccination strategies in Uganda, focusing on cost-effectiveness compared to traditional treatment approaches. It synthesizes existing data on the direct and indirect costs associated with typhoid fever, such as medical expenses, productivity losses, and long-term disability, while analyzing the financial benefits of introducing and scaling up mass vaccination campaigns using Typbar-TCV and related vaccines. The findings suggest that vaccination programs, though initially costly, yield substantial economic and health benefits over time through reduced disease incidence, improved productivity, and lowered healthcare expenditures. The review concludes that integrating typhoid vaccination into national immunization programs represents a cost-effective and sustainable strategy to enhance public health outcomes and economic resilience in Uganda.

Keywords: Typhoid fever, Uganda, cost-effectiveness, vaccination, economic impact, health policy, productivity loss, Typbar-TCV

INTRODUCTION

Typhoid fever, a systemic infection caused by *Salmonella enterica* serovar Typhi, remains a major public health challenge in low- and middle-income countries (LMICs), including Uganda. The disease is primarily transmitted through ingestion of food or water contaminated with fecal matter, which reflects the broader challenges of inadequate sanitation, poor hygiene practices, and limited access to safe drinking water that characterize many LMIC settings [1]. Globally, typhoid fever is estimated to affect over 9 million people annually, resulting in approximately 110,000 deaths, with sub-Saharan Africa accounting for a substantial proportion of the disease burden. The morbidity and mortality associated with typhoid fever are particularly pronounced among vulnerable populations, including children under 15 years, who are at higher risk of severe complications and death [2].

In Uganda, the epidemiology of typhoid fever reveals a concerning pattern of recurrent outbreaks, particularly in urban centers such as Kampala, Wakiso, Jinja, and other densely populated districts. These outbreaks often follow periods of heavy rainfall and flooding, which compromise water quality and sanitation systems, thereby facilitating the transmission of the pathogen. The persistence of typhoid in Uganda underscores systemic gaps in water, sanitation, and hygiene (WASH) infrastructure, coupled with challenges in public health surveillance and timely outbreak detection [3]. Moreover, urban informal settlements, characterized by overcrowding and limited access to municipal services, serve as hotspots for typhoid transmission, exacerbating the vulnerability of already marginalized communities.

The economic consequences of typhoid fever are multidimensional, affecting both households and the broader health system. Direct medical costs include expenditures on diagnostic testing, antibiotic treatment, hospitalization, and follow-up care, which can strain limited healthcare budgets. Indirect costs, which are often overlooked, include lost productivity due to illness, school absenteeism among children, and long-term impacts on human capital development [4]. For families living in poverty, the financial burden of typhoid treatment may be catastrophic,

forcing households to divert resources from essential needs such as food, education, and housing. At the national level, recurrent outbreaks impose costs on health systems through emergency response measures, outbreak investigation, and public health campaigns, highlighting the importance of cost-effective preventive interventions [5].

One promising strategy to address the persistent burden of typhoid is the introduction of typhoid conjugate vaccines (TCVs), such as Typbar-TCV. These vaccines have demonstrated high immunogenicity, long-lasting protection, and suitability for use in children as young as six months, making them particularly relevant for endemic settings like Uganda. Vaccination campaigns have the potential to substantially reduce disease incidence, alleviate the economic burden on households and health systems, and contribute to broader public health goals [6], including the Sustainable Development Goal (SDG) of universal health coverage and access to safe water and sanitation. However, the implementation of vaccination programs requires careful consideration of cost-effectiveness, logistical feasibility, and integration with existing health services.

Despite the clear benefits of typhoid vaccination, there is limited empirical evidence in Uganda on the economic impact of large-scale immunization programs compared to conventional treatment-focused approaches. While clinical management remains essential for reducing morbidity and mortality among affected individuals, preventive strategies such as vaccination offer a more sustainable approach by interrupting transmission and preventing future cases. Understanding the cost-effectiveness of typhoid vaccination is therefore critical for policymakers and health planners who must allocate scarce resources efficiently while maximizing public health outcomes [7].

In Uganda, recurrent typhoid outbreaks continue to represent a significant public health challenge, particularly for vulnerable populations such as children, urban dwellers, and communities with insufficient access to water, sanitation, and hygiene (WASH) infrastructure. While current management relies heavily on treatment, which remains reactive, the inability to implement widespread preventive measures leaves communities susceptible to repeated outbreaks. The financial burden of a treatment-focused approach is substantial, encompassing both direct medical costs and indirect societal costs, such as loss of productivity and school absenteeism. However, limited data exist on the long-term economic advantages of preventive strategies, particularly the introduction of typhoid conjugate vaccines. This gap in evidence creates challenges for policymakers, who struggle to make informed decisions on resource allocation and prioritization for typhoid control efforts. The primary objective of this study is to assess the economic impact of typhoid vaccination strategies, with specific objectives including evaluating healthcare costs, analyzing indirect costs, and assessing the cost-effectiveness of typhoid conjugate vaccines compared to treatment-based approaches. By answering key research questions regarding the direct and indirect costs of typhoid fever, as well as the cost-effectiveness of vaccines, this study provides essential evidence to inform policy decisions. The findings aim to guide resource allocation for typhoid prevention, ensuring a more sustainable, cost-effective approach to disease control in Uganda.

Economic Impact of Typhoid Fever

The economic impact of typhoid fever is multifaceted, involving both direct and indirect costs that burden households and national economies. Direct healthcare costs include expenses related to diagnostic testing, antibiotic therapy, and hospitalization for severe cases, with treatment costs ranging between USD 30 and USD 100 per case in Uganda, depending on disease severity and healthcare facility. This financial strain accumulates, with national healthcare expenditures for typhoid potentially reaching millions of dollars annually [8]. Recurrent outbreaks only worsen the situation, diverting resources away from other pressing public health concerns. Indirectly, typhoid's economic consequences extend beyond direct healthcare expenses. Illness and caregiving responsibilities result in substantial productivity losses, particularly among working adults and parents of school-age children. Additionally, recurrent infections can lead to long-term health complications, including chronic fatigue, which further reduces the earning capacity of individuals. School absenteeism among infected children hampers their educational progress, perpetuating cycles of poverty and poor health. On a broader societal scale, typhoid outbreaks can disrupt community activities, discourage tourism, and impose significant sanitation intervention costs. Families affected by typhoid often face catastrophic health expenditures, leading to asset depletion or indebtedness [9]. Given these far-reaching economic consequences, investing in preventive measures, such as vaccination programs, could not only reduce the health burden but also deliver substantial economic returns at both the household and national levels.

Typhoid Vaccination Strategies

Typhoid vaccination strategies have evolved significantly over the years, with various types of vaccines being developed to combat the disease. Historically, the main vaccines used were whole-cell and Vi polysaccharide vaccines. While these vaccines proved effective in providing protection, they had notable limitations. One major issue was that the immunity they provided was relatively short-lived, and they were not suitable for children under the age of two. The introduction of typhoid conjugate vaccines (TCVs), particularly Typbar-TCV, represented a significant advancement in typhoid prevention [10]. These vaccines offer better immunogenicity, provide longer-lasting protection, and are now included in routine immunization schedules for young children, making them a key tool in

preventing typhoid globally. In Uganda, the potential introduction of TCVs has garnered attention, especially in light of recommendations from the World Health Organization (WHO). The success of TCV rollouts in countries such as Zimbabwe, Pakistan, and Malawi has provided valuable evidence of their effectiveness and feasibility. Pilot studies in Uganda have indicated high acceptance rates for the vaccine and demonstrated its compatibility with the country's existing immunization infrastructure. Despite these promising results, the financial cost of implementing nationwide TCV vaccination remains a significant barrier [11]. Therefore, conducting comprehensive cost-effectiveness analyses is essential to ensure that the benefits of vaccination outweigh the financial investment required for its widespread adoption.

Cost-Effectiveness Analysis

Cost-Effectiveness Analysis is a crucial aspect when evaluating the long-term impact of vaccination versus treatment strategies, particularly in sub-Saharan Africa, where typhoid fever remains a significant public health challenge. Economic modeling studies consistently demonstrate that the introduction of Typhoid Conjugate Vaccines (TCVs) is cost-effective, particularly in areas with moderate to high typhoid incidence [12]. Vaccination not only reduces the disease burden but also decreases antibiotic consumption, thus mitigating the development of Antimicrobial Resistance (AMR). When compared to the ongoing costs associated with treatment campaigns, hospitalizations, and emergency outbreak control measures, vaccination proves to be a more sustainable and financially sound investment. In Uganda, the cost-effectiveness of vaccination can be quantified by the cost per Disability-Adjusted Life Year (DALY) averted. Preliminary economic projections indicate that mass vaccination campaigns could save approximately USD 300–500 per DALY, which is well within the World Health Organization's recommended threshold for cost-effective health interventions in low-income countries [13].

In addition to immediate healthcare savings, vaccination offers substantial long-term economic benefits. It plays a pivotal role in preserving workforce productivity by reducing absenteeism due to illness, thereby promoting economic stability. Furthermore, reduced antibiotic use contributes to lower healthcare costs associated with treating resistant infections [14]. Vaccination programs also bring positive spillover effects, such as strengthening overall health systems, improving disease surveillance, and bolstering cold-chain infrastructure, all of which contribute to the broader effectiveness of other immunization programs, making the investment even more beneficial in the long run.

Challenges in Implementation

The implementation of typhoid vaccination in Uganda, despite being economically advantageous, encounters several significant barriers that impede its widespread adoption. One of the foremost challenges is the issue of *funding constraints*. Uganda's limited national health budget, coupled with competing priorities, often results in delays in vaccine procurement and distribution, affecting timely rollouts. Additionally, infrastructure limitations present a serious hurdle, as the country struggles with weak cold-chain systems necessary to maintain vaccine potency and limited healthcare access in rural areas, leaving underserved populations vulnerable [15]. Another critical issue is *public perception and awareness*, where vaccine hesitancy fueled by misinformation and a low perception of risk in certain communities leads to reluctance towards vaccination. The lack of clear, localized communication strategies further exacerbates this problem. Moreover, *data gaps* in both epidemiological and economic research hinder the development of precise cost-benefit models, making it difficult to assess the full impact of vaccination programs and secure adequate funding. To overcome these obstacles, a coordinated, multi-sectoral approach is required. Collaboration between government bodies, international health organizations, and local communities is essential to address these barriers, ensuring that typhoid vaccination becomes a sustainable and accessible intervention for all Ugandans [16].

Policy Implications and Recommendations

To maximize the economic benefits of typhoid vaccination in Uganda, several key policy actions should be taken. First, integrating the Typhoid Conjugate Vaccine (TCV) into the National Immunization Schedule is crucial, with an emphasis on targeting high-burden districts where the incidence of typhoid is highest. This would ensure that the most vulnerable populations are protected, reducing the overall disease burden [17]. Second, Uganda should leverage international support from organizations such as Gavi, WHO, and UNICEF to subsidize the procurement of vaccines, which would ease the financial burden on the government and make vaccines more accessible. Third, strengthening surveillance systems is essential to monitor the impact of vaccination programs over time. This would allow for the continuous assessment of vaccine effectiveness and cost-effectiveness, enabling informed policy decisions. Fourth, promoting public awareness campaigns is vital to ensure community acceptance of the vaccine. These campaigns should address misconceptions and provide clear information on the safety and benefits of vaccination. Finally, a multi-sectoral approach that links vaccination efforts with water, sanitation, and hygiene (WASH) initiatives is necessary for comprehensive typhoid control [18]. By improving hygiene practices and access to clean water, the risk of typhoid outbreaks can be further reduced, complementing vaccination efforts and enhancing overall public health outcomes.

CONCLUSION

In conclusion, typhoid fever remains a significant health and economic burden in Uganda, with substantial direct and indirect costs affecting both individuals and the broader economy. The evidence presented in this review highlights the cost-effectiveness of introducing Typhoid Conjugate Vaccines (TCVs), which offer long-term benefits by reducing disease incidence and improving overall productivity. While the initial investment in vaccination campaigns may be high, the returns in terms of healthcare savings, reduced absenteeism, and improved workforce participation far outweigh the costs. Integrating TCVs into Uganda's National Immunization Schedule, coupled with strong surveillance systems and public awareness campaigns, can maximize the benefits of vaccination. Furthermore, combining vaccination efforts with improvements in water, sanitation, and hygiene (WASH) will enhance the overall effectiveness of disease control measures. By adopting a multi-sectoral approach and securing international support, Uganda can implement a sustainable, cost-effective strategy to combat typhoid, ultimately leading to better health outcomes, economic growth, and enhanced public health resilience.

REFERENCES

1. Bhandari, J., Thada, P.K., Hashmi, M.F., DeVos, E.: Typhoid Fever. In: StatPearls. StatPearls Publishing, Treasure Island (FL) (2025)
2. Li, T., Qiang, N., Bao, Y., Li, Y., Zhao, S., Chong, K.C., et al.: Global burden of enteric infections related foodborne diseases, 1990–2021: findings from the Global Burden of Disease Study 2021. Sci One Health. 3, 100075 (2024). https://doi.org/10.1016/j.soh.2024.100075
3. Agwu E (2011). Distribution of Community acquired typhoid fever among febrile patients attending clinics in Bushenyi, Uganda: case study of the year 2005. *Journal of Medical Microbiology and Diagnosis*, *1*, *(101)*, *1-4.*
4. Kaljee, L.M., Pach, A., Garrett, D., Bajracharya, D., Karki, K., Khan, I.: Social and Economic Burden Associated With Typhoid Fever in Kathmandu and Surrounding Areas: A Qualitative Study. J Infect Dis. 218, S243–S249 (2018). https://doi.org/10.1093/infdis/jix122
5. F, L., C, S., R, W., H, C., J, M., P, N., P, P., Pd, P., F, D., C, P., Ma, G., N, B.-Z.: Estimating the economic burden of typhoid in children and adults in Blantyre, Malawi: A costing cohort study. PubMed. (2022)
6. Vashishtha, V.M., Kumar, P.: Typhoid conjugate vaccines: is a single dose enough for durable protection? Expert Review of Vaccines. 24, 194–205 (2025). https://doi.org/10.1080/14760584.2025.2476525
7. Nakisuyi J, Bernis M, Ndamira A, Kayini V, Mulumba R, Theophilus P, Agwu E, Lule H., (2023). Prevalence and factors associated with malaria, typhoid, and co-infection among febrile children aged six months to twelve years at kampala international university teaching … Heliyon, 9, (9), e19588.
8. Limani, F., Smith, C., Wachepa, R., Chafuwa, H., Meiring, J., Noah, P., et al: Estimating the economic burden of typhoid in children and adults in Blantyre, Malawi: A costing cohort study. https://doi.org/10.1371/journal.pone.0277419
9. Emerson, N.D., Distelberg, B., Morrell, H.E.R., Williams-Reade, J., Tapanes, D., Montgomery, S.: Quality of Life and School Absenteeism in Children With Chronic Illness. J Sch Nurs. 32, 258–266 (2016). https://doi.org/10.1177/1059840515615401
10. Marathe, S.A., Lahiri, A., Negi, V.D., Chakravortty, D.: Typhoid fever & vaccine development: a partially answered question. Indian J Med Res. 135, 161–169 (2012)
11. Majidulla, A., Gerste, A.K., Baidya, A., Georgewill, O., Muralidharan, K.K., Dare, D.J., et al.: Adolescent vaccine introductions scoping review: A decade of insights from low- and middle-income countries (2013–2023). Vaccine: X. 25, 100657 (2025). https://doi.org/10.1016/j.jvacx.2025.100657
12. Kim, C.L., Cruz Espinoza, L.M., Vannice, K.S., Tadesse, B.T., Owusu-Dabo, E., Rakotozandrindrainy, R., Jani, I.V., Teferi, M., Bassiahi Soura, A., Lunguya, O., Steele, A.D., Marks, F.: The Burden of Typhoid Fever in Sub-Saharan Africa: A Perspective. Res Rep Trop Med. 13, 1–9 (2022). https://doi.org/10.2147/RRTM.S282461
13. Kananura, R.M., de Broucker, G., Ssebagereka, A., Mutebi, A., Kiracho, E.E., Patenaude, B.: Coverage and distributional benefit–cost of rotavirus vaccine in Uganda: an analysis of routine health facility aggregated data. Cost Effectiveness and Resource Allocation. 22, 85 (2024). https://doi.org/10.1186/s12962-024-00586-5
14. Alum, E. U., Uti, D. E., Agah, V. M., Orji, O. U., Ezeani, N. N., Ugwu, O. P.C, et al. (2023). Physico-chemical and Bacteriological Analysis of Water used for Drinking and other Domestic Purposes in Amaozara Ozizza, Afikpo North, Ebonyi State, Nigeria. *Nigerian Journal of Biochemistry and Molecular Biology*, 38(1), 1-8. https://doi.org/10.2659/njbmb.2023.151.
15. Obeagu, E.I., Ugwu, O.P. Enhancing quality water, good sanitation, and proper hygiene is the panacea to diarrhea control and the attainment of some related sustainable development goals: A review. Medicine (Baltimore). 2024 Sep 20;103(38):e39578. doi: 10.1097/MD.0000000000039578

16. El-Jardali, F., Fadlallah, R., Daher, N.: Multi-sectoral collaborations in selected countries of the Eastern Mediterranean region: assessment, enablers and missed opportunities from the COVID-19 pandemic response. Health Res Policy Syst. 22, 14 (2024). https://doi.org/10.1186/s12961-023-01098-z
17. Carter, A.S., Steele, D., John, J., Saha, S., Laurens, M.B., Minta, A.A., et al: Advancing typhoid conjugate vaccine implementation in Asia: Regional policy priorities. Vaccine. 66, 127848 (2025). https://doi.org/10.1016/j.vaccine.2025.127848
18. Vanderslott, S., Joynes-Burgess, K., Kadambari, S., O'Dwyer, E., Alidu, L., Vandrevala, T.: Examining the role of community champions to promote vaccine uptake in under-served communities in the United Kingdom: Lessons from the COVID-19 pandemic. SSM - Qualitative Research in Health. 5, 100436 (2024). https://doi.org/10.1016/j.ssmqr.2024.100436

CITE AS: Kamanzi Ntakirutimana G. (2026). Evaluating the Economic Impact of Typhoid Vaccination Strategies in Uganda: A Cost-Effectiveness Analysis. INOSR APPLIED SCIENCES 14(2):45-49. https://doi.org/10.59298/INOSRAS/2025/14.2.4549