

# The Role of Municipal Water Supply in Diarrhea Prevention in East Africa: A Review

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## ABSTRACT

Diarrhoeal disease remains a leading cause of illness and death among children under five in low- and middle-income regions, including East Africa. Municipal (piped) water supply, when safely managed, reliably available, and microbiologically safe at the point of use, is a central public-health intervention that can reduce exposure to enteric pathogens and lower diarrhoeal incidence. This review synthesizes evidence on how municipal water systems affect diarrhoea outcomes in East Africa, examines the mechanisms by which piped water reduces disease risk, and discusses barriers that limit protective effects (intermittency, contamination, inequitable access, household storage practices, and governance). We summarize findings from global systematic reviews and regional primary studies showing sizeable reductions in diarrhoea associated with improved and safely managed water services, but also emphasize mixed results when systems are intermittent or water quality is poor. Climate variability, urbanization, and aging infrastructure further challenge the delivery of safe municipal water in East African cities and towns. We highlight successful programmatic elements, continuous piped supply, disinfection at source, household connection coverage, leak control, and community engagement, and propose a set of policy, investment, and research priorities tailored to the East African context. Strengthening municipal water systems is necessary but not sufficient for sustained diarrhoea reduction; coordinated action across water, sanitation, hygiene (WASH), health, and urban planning sectors is required. Finally, we identify critical research gaps, including robust impact evaluations of municipal upgrades on health outcomes, cost-effectiveness analyses in East African settings, and operational studies addressing intermittency and equity.

**Keywords:** Municipal water supply, Diarrhoeal disease, East Africa, Water quality, Intermittent supply, Equity.

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## INTRODUCTION

Diarrhoeal diseases remain one of the leading causes of morbidity and mortality globally, with a disproportionate burden in low- and middle-income countries, particularly in East Africa. According to the World Health Organization (WHO), diarrhoea is defined as the passage of three or more loose or liquid stools per day and is commonly caused by bacterial, viral, or parasitic infections. Among these pathogens, *Escherichia coli*, *Salmonella spp.*, *Rotavirus*, and *Giardia lamblia* are frequently implicated in clinical cases [1]. In recent decades, significant progress has been made worldwide in reducing diarrhoeal deaths among children under five, yet in East Africa, diarrhoea continues to account for a substantial fraction of under-five mortality. In Uganda, Kenya, Tanzania, and neighboring countries, diarrhoeal diseases are responsible for approximately 10–15% of all child deaths, highlighting a pressing public-health challenge [2].

The burden of diarrhoea in East Africa is exacerbated by socio-economic inequalities, limited access to clean water, poor sanitation, and inadequate hygiene practices. Vulnerable populations, particularly children under five, pregnant women, and households in low-income urban or rural settings, bear the brunt of these diseases. Unsafe water, inadequate sanitation, and limited health education combine to create an environment where enteric infections thrive [3]. Studies show that households relying on unprotected surface water, open wells, or intermittent municipal water supplies are at a significantly higher risk of diarrhoeal infections than those with consistent access to safe piped water. Additionally, rapid urbanization, population growth, and informal settlements in East African cities have

strained municipal water infrastructure, often resulting in irregular water supply, contamination during transport, and inequitable distribution of services [4].

Access to safe drinking water at or near the household is recognized as a core determinant of diarrhoeal disease risk. Waterborne pathogens are often transmitted through contaminated water and poor hygiene practices, including inadequate handwashing and the use of unsafe water storage containers. Municipal water systems such as public piped networks delivering water to households, shared taps, or communal standpipes have the potential to significantly reduce the incidence of diarrhoeal disease by interrupting the transmission of enteric pathogens [5]. However, the protective impact of these systems is influenced by multiple factors, including water quality, continuity of supply, geographic coverage, household access, and equitable delivery to marginalized populations. Even when piped water is available, intermittent supply and contamination along distribution networks can undermine its protective benefits. Moreover, households that cannot afford connections to municipal water networks or live in informal settlements may remain exposed to unsafe water sources [6].

Despite widespread recognition of the importance of safe water, there remains a gap in comprehensive evidence linking municipal water supply to diarrhoea prevention in East Africa. Previous studies have often focused on either urban or rural settings, and findings are sometimes inconsistent regarding the role of water quality versus quantity, the impact of household water treatment, and the interaction with sanitation and hygiene practices [7]. Additionally, the role of governance, policy, and investment in ensuring equitable and reliable water supply is less explored, yet these factors are critical in sustaining long-term reductions in diarrhoeal disease. Understanding these dynamics is essential for designing interventions that are both effective and contextually appropriate for East African countries, where resources are limited, and public-health needs are high [8].

Diarrhoeal diseases continue to cause significant morbidity and mortality in East Africa, particularly among children under five and other vulnerable populations. Despite the expansion of municipal water infrastructure in urban and peri-urban areas, many households continue to rely on unsafe water sources due to inequitable access, intermittent supply, and compromised water quality. This situation contributes to persistent diarrhoeal outbreaks and hampers progress toward national and global child health targets [9]. Moreover, existing studies provide limited insights into the mechanisms through which municipal water supply mitigates diarrhoeal risk and how these effects are modified by factors such as household socio-economic status, sanitation practices, and urban versus rural settings. Therefore, a comprehensive review of the evidence is needed to inform policies, interventions, and investments that can effectively reduce diarrhoeal disease burden in East Africa [10]. The objectives of this review are focused on understanding the relationship between municipal water supply and diarrhoeal disease prevention in East Africa. Specifically, the review aims to examine the link between municipal water access and reduced diarrhoeal incidence, explore the mechanisms through which water quality and availability influence health outcomes, and identify key factors, such as water coverage, quality, continuity, and household practices that affect the effectiveness of water supply in reducing disease. Additionally, the review seeks to offer evidence-based recommendations for improving municipal water systems to mitigate the burden of diarrhoeal disease in the region. The research questions guide this inquiry by addressing the existing evidence on the relationship between water supply and disease reduction, exploring the mechanisms involved, and identifying factors that enhance or limit effectiveness. Ultimately, this study holds significant value as it synthesizes evidence on municipal water's role in diarrhoeal disease prevention. It also informs context-specific interventions, supports resource allocation for water, sanitation, and hygiene (WASH) programs, and contributes to achieving the Sustainable Development Goals, particularly those related to clean water, sanitation, and good health.

## METHODOLOGY

This narrative review adopts a comprehensive approach by synthesizing a variety of data sources to explore the relationships between water, sanitation, and hygiene (WASH) interventions and diarrhoeal disease outcomes. The review draws on four key sources of information: (1) global systematic reviews and meta-analyses of WASH interventions and their impact on diarrhoea; (2) reports from the WHO/UNICEF Joint Monitoring Programme (JMP) providing insights into regional water coverage and service levels; (3) peer-reviewed primary studies focused on East African countries, including Kenya, Uganda, Tanzania, Ethiopia, Rwanda, Burundi, and South Sudan, which examine the links between water sources, municipal/piped water supplies, and diarrhoea outcomes; and (4) recent studies investigating the influence of climate variability and extreme weather events on diarrhoeal incidence, particularly where municipal water access modifies risk. The electronic sources consulted include databases like PubMed/PMC, WHO, and UNICEF data portals, as well as large review articles up to the year 2024–2025. Although this review provides a broad synthesis of relevant studies, it is not conducted as a systematic review following the PRISMA guidelines, and the citations presented are a selection from a much wider pool of available research. The review aims to offer an integrated view of the current evidence on WASH interventions and diarrhoeal disease, particularly in the context of East Africa.

### **Burden and water coverage in East Africa**

Despite global progress in household water access, substantial gaps remain in safely managed services, especially in East Africa. According to recent reports from the Joint Monitoring Programme (JMP) and UNICEF, although many people in the region gained access to basic water services between 2000 and 2022, a significant portion of the population still lacks access to safely managed piped water at home. This ongoing water access issue contributes directly to the high rates of diarrhoeal diseases, which continue to be a leading cause of child mortality in East Africa [11]. Diarrhoeal diseases are particularly prevalent in areas where households rely on surface water, unprotected wells, or must collect water from distant sources. Surveys conducted at both national and subnational levels consistently show higher rates of diarrhoeal illness in these communities, underscoring the risks posed by inadequate water sources. The lack of safely managed water services not only jeopardizes public health but also limits economic development and hinders the overall quality of life for millions of East Africans. Addressing these gaps in water access and ensuring that all households have access to safely managed piped water is crucial to reducing waterborne diseases and improving the health and well-being of the region's population [12].

### **How municipal water supply reduces diarrhoeal disease: pathways and mechanisms**

Municipal piped water systems play a critical role in reducing diarrhoeal disease transmission by addressing multiple pathways through which waterborne pathogens are spread. One key mechanism is the improvement in microbiological quality at the source. Centralized treatment processes, such as chlorination, significantly reduce pathogen loads before water is distributed to consumers. Additionally, on-premises piped water systems minimize contamination risks associated with manual handling and unsafe transport and storage practices, which are common with water fetched from distant sources [13]. The availability of greater quantities of water also supports improved hygiene behaviors, such as handwashing and safe food preparation, which are essential for interrupting the fecal-oral transmission of pathogens. Moreover, municipal piped water protects against climate-related contamination events, such as floods or droughts, by offering a more reliable and safer water source compared to surface water, which is often contaminated during extreme weather events. However, the public health benefits of municipal water systems are not guaranteed. Intermittent supply, contamination within distribution systems due to biofilms or leaks, and unsafe post-collection storage can undermine the expected health benefits. These issues emphasize the importance of maintaining robust water treatment and distribution systems to fully capitalize on the potential of municipal piped water in reducing diarrhoeal diseases [14].

### **Evidence: global syntheses and relevance to East Africa**

Systematic reviews and meta-analyses consistently demonstrate that access to improved water supplies and household water treatment significantly reduces the risk of diarrhoeal diseases. However, the magnitude of these effects varies depending on several factors, including the context, intervention fidelity, and the specific outcome measures used. A landmark systematic review and meta-regression found that improved water supply is associated with substantial reductions in diarrhoea, with the most significant effects occurring when the water is both of high quality and continuously available [15]. Additionally, point-of-use chlorination and integrated Water, Sanitation, and Hygiene (WASH) interventions have shown protective benefits, though these are contingent on consistent use and adequate coverage. These global findings are consistent with evidence from East Africa, where primary studies report lower diarrhoeal prevalence in households with piped or treated water compared to those relying on unimproved sources. However, many local studies emphasize that piped water is protective only when the supply is continuous and the water is properly treated, highlighting the importance of reliable and high-quality water delivery systems in reducing diarrhoeal disease burden [16].

### **Country- and subregional studies from East Africa**

Studies from East Africa highlight the complexities of water, sanitation, and hygiene (WASH) interventions in addressing diarrhoeal diseases. Research across Uganda, Kenya, and Tanzania revealed that households relying on surface water or unprotected wells had higher diarrhoeal prevalence, with water use and sanitation practices acting as key modifiers. Similarly, in Ethiopia, demographic and surveillance data indicated a clear link between improved water supply and reduced diarrhoeal prevalence; however, issues like intermittent service and inadequate household storage practices hindered the effectiveness of these interventions [17]. A rural study in Tanzania further emphasized the importance of adopting proper water handling and household treatment practices, which were associated with reduced diarrhoea among children under five, even in areas with limited infrastructure. These findings collectively demonstrate that while municipal water supply systems can significantly reduce diarrhoeal incidences, their benefits are often compromised by irregular service, contamination, and unequal access, particularly in informal urban and peri-urban areas. This highlights the need for complementary measures, such as improved household practices and equitable access to safe water, to enhance the impact of water supply interventions.

### **Critical barriers that weaken the protective effect of municipal water**

Municipal water systems face several critical barriers that weaken their protective effect, compromising public health and safety. One key issue is intermittent supply, where disruptions lead to negative pressure events, causing

contaminants to enter the system through leaks and forcing reliance on stored water, which is less safe than continuous supply systems. Distribution-system contamination further exacerbates the problem, as leaky pipes, cross-connections, and biofilms can recontaminate treated water inside the network. In many regions, households collect and store water, especially in areas with intermittent supply or communal taps. Improper storage can reintroduce pathogens, rendering the water unsafe for consumption [18]. Limited household connections, especially in lower-income or informal settlements, also contribute to inequity, as these areas often rely on distant or informal water vendors of uncertain quality. Additionally, aging infrastructure, underfunded utilities, and weak governance lead to poor maintenance, inadequate financing, and insufficient regulation, undermining treatment reliability and water safety. Climate shocks, such as floods and droughts, can damage infrastructure and contaminate sources, further compromising water quality, with centrally treated supplies being vulnerable when overwhelmed by such extreme events.

#### **Programmatic strategies that enhance diarrhoeal prevention via municipal systems**

Programmatic strategies that enhance diarrhoeal prevention through municipal systems involve a multifaceted approach. Ensuring a continuous 24/7 piped water supply, where feasible, is critical, as consistent service offers more health benefits compared to intermittent delivery. Routine maintenance and upgrades, such as chlorination, leak detection, and pressure management, are essential for minimizing contamination risks in both treatment and distribution. Expanding household connections, particularly in low-income areas, and implementing affordable tariffs help reduce reliance on unsafe informal water sources [19]. Additionally, integrating water safety planning (WSPs) ensures systematic risk assessments from source to tap, supported by regular monitoring and corrective actions. Promoting complementary hygiene practices, such as handwashing, safe storage containers, and education to prevent recontamination, is another vital component of diarrhoeal prevention. Climate-resilient designs, including protections for intakes, diversified water sourcing (e.g., combining groundwater and surface water), and planning for extreme weather events, help ensure long-term sustainability. Strengthening governance and financing by securing sustainable utility funding, establishing transparent performance metrics, and involving communities in decision-making enhances the effectiveness and equity of water systems, ensuring broad access to safe water and hygiene practices.

#### **Policy implications and recommendations for East Africa**

Policy implications and recommendations for East Africa emphasize the need for strategic investments and actions to improve water, sanitation, and health outcomes. First, national water strategies should prioritize converting basic water services to safely managed ones, including on-premises, treated, and continuously available water, which can yield significant health and economic returns. Efforts should target informal settlements through subsidized household connections and network upgrades, reducing inequities in water exposure. Regular monitoring of microbial water quality across distribution networks must be mandated and funded, with transparent reporting and rapid response protocols to ensure public safety. To maximize impact, WASH programs should be coordinated with health initiatives, integrating vaccination, nutrition, and diarrhea management alongside water system improvements [20]. Furthermore, climate adaptation should be incorporated into utility planning to safeguard infrastructure from floods and droughts. Finally, supporting operational research and impact evaluations of municipal water system upgrades will help measure health outcomes and inform cost-effective investment strategies. These measures, grounded in evidence from sources such as UNICEF and The Lancet, will help East Africa tackle water-related challenges and improve overall public health.

#### **Research gaps and priority studies**

Research gaps and priority studies in water and sanitation interventions in East Africa present critical opportunities for advancing public health. One key area is the need for causal impact evaluations of municipal water upgrades, such as stepped-wedge or natural experiments, to assess their effectiveness in reducing laboratory-confirmed enteric infections and clinical diarrhea in the region. Additionally, cost-effectiveness analyses comparing centralized municipal upgrades with decentralized household-level interventions in both urban and rural settings are essential for optimizing resource allocation [21]. Operational studies focused on reducing contamination in intermittent water supply networks, such as through pressure management or the establishment of district metered areas, are another important research priority. Furthermore, equity-focused research that tracks the beneficiaries of municipal investments, particularly with respect to gender, socioeconomic status, and informal settlements, is necessary to ensure that vulnerable populations receive the intended benefits. Lastly, climate-health modeling is critical to understanding how improvements in municipal water systems could mitigate vulnerability to climate-driven diarrheal disease spikes, which are becoming more frequent due to climate change. Addressing these gaps will provide valuable insights for improving water security and public health outcomes in East Africa.

#### **CONCLUSION**

In conclusion, municipal water supply plays a crucial role in reducing diarrhoeal disease burden in East Africa, but its impact is dependent on several factors, including water quality, system continuity, and equitable access. While

municipal piped water has been shown to significantly reduce diarrhoeal incidence, challenges such as intermittent supply, contamination in distribution networks, and inadequate household water storage practices can undermine its effectiveness. Additionally, urbanization, climate change, and inequitable access to services further complicate efforts to ensure a reliable water supply for all. The review emphasizes the need for a multi-sectoral approach to strengthen municipal water systems and suggests that improving water infrastructure, increasing household connections, and promoting hygiene practices can enhance public health outcomes. Future research should focus on causal impact evaluations, cost-effectiveness analyses, and operational studies to address the persistent challenges in East African water systems and guide policies for long-term health improvements.

#### REFERENCES

1. Nantege, R., Kajoba, D., Ddamulira, C., Ndoboli, F., Ndungutse, D.: Prevalence and factors associated with diarrheal diseases among children below five years in selected slum settlements in Entebbe municipality, Wakiso district, Uganda. *BMC Pediatr.* 22, 394 (2022). <https://doi.org/10.1186/s12887-022-03448-2>
2. Alum, E. U., Obeagu, E. I., Ugwu, O. P. C. Curbing Diarrhea in Children below five years old: The sub-Saharan African Standpoint. *J. New Medical Innovations and Research.* 2024;5(1); DOI:10.31579/2767-7370/083
3. Merid, M.W., Alem, A.Z., Chilot, D., Belay, D.G., Kibret, A.A., Asratie, M.H., Shibabaw, Y.Y., Aragaw, F.M.: Impact of access to improved water and sanitation on diarrhea reduction among rural under-five children in low and middle-income countries: a propensity score matched analysis. *Tropical Medicine and Health.* 51, 36 (2023). <https://doi.org/10.1186/s41182-023-00525-9>
4. Ugwu, O. P. C., Alum, E. U., Uhama, K. C. (2024). Role of Phytochemical-Rich Foods in Mitigating Diarrhea among Diabetic Patients. *Research Invention Journal of Scientific and Experimental Sciences.* 3(1):45-55.
5. Nabi, M.H., Rupa, F.H., Jahan, I., Hasan, A.B.M.N., Naz, F., Masud, I., Hawlader, M.D.H., Hossian, M.: Water, sanitation, and hygiene (WASH) factors and the incidence of communicable diseases in Urban Bangladesh: Evidence from municipal areas. <https://doi.org/10.1371/journal.pntd.0013329>
6. Uhama, K. C. Ugwu, O. P. C., Alum, E. U., (2024). Phytochemicals and Vitamins as Adjunct Therapies for Diarrhea in Diabetic Patients. *Research Invention Journal of Research in Medical Sciences.* 3(2):27-37.
7. Omuna D., Obaroh I. O., Akiyode O. O., Eniru E. I., Tiyo C. E & Omoding, J. (2024). Impacts of climate change on water security in Uganda: A review. *Int. J. Adv. Multidiscip. Res.* 11(9): 47-60. DOI: <http://dx.doi.org/10.22192/ijamr.2024.11.09.005>
8. Alum EU, Obeagu EI, Ugwu OP. 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.00000000000039578. PMID: 39312342; PMCID: PMC11419503.
9. Auma, B., Musinguzi, M., Ojuka, E., Kigongo, E., Tumwesigye, R., Acup, W., Kabunga, A., Opio, B.: Prevalence of diarrhea and water sanitation and hygiene (WASH) associated factors among children under five years in Lira City Northern Uganda: Community based study. <https://doi.org/10.1371/journal.pone.0305054>
10. Awor P, Wamani H, Bwire G, Jagoe G, Peterson S (2012). Private sector drug shops in integrated community case management of malaria, pneumonia, and diarrhea in children in Uganda. *The American journal of tropical medicine and hygiene*, 87, (5), 92, doi: [10.4269/ajtmh.2012.11-0791](https://doi.org/10.4269/ajtmh.2012.11-0791).
11. 1 in 4 people globally still lack access to safe drinking water – WHO, UNICEF, <https://www.who.int/news/item/26-08-2025-1-in-4-people-globally-still-lack-access-to-safe-drinking-water---who--unicef>
12. Silveira, P., Rebelo, M.T., Salvador, D.: Challenges of Providing Safe Drinking Water in African Rural Communities: A Case Study on the Oio Region, Guinea-Bissau. *Water.* 16, 3621 (2024). <https://doi.org/10.3390/w16243621>
13. Critchley J. A, Ejemot-Nwadiaro R. I, Ehiri J. E, Arikpo D, Meremikwu M. M (2015). Hand washing promotion for preventing diarrhea. *Cochrane Database of Systematic Reviews*, 9, 9. Art. No.: CD004265. DOI: 10.1002.
14. Mohamed, M.H., Sharma, H.R., Ilić, P., Elmi, Y., Adam, A.A.: Assessment of water handling practices in households and related health impacts: a case study in Deyniile District, Mogadishu, Somalia. *BMC Public Health.* 25, 2368 (2025). <https://doi.org/10.1186/s12889-025-23595-2>
15. Humphrey, J.H., Mbuya, M.N.N., Ntozini, R., Moulton, L.H., Stoltzfus, R.J., Tavengwa, N.V., et al.: Independent and combined effects of improved water, sanitation, and hygiene, and improved complementary feeding, on child stunting and anaemia in rural Zimbabwe: a cluster-randomised trial. *The Lancet Global Health.* 7, e132–e147 (2019). [https://doi.org/10.1016/S2214-109X\(18\)30374-7](https://doi.org/10.1016/S2214-109X(18)30374-7)

16. Wolf, J., Hubbard, S., Brauer, M., Ambelu, A., Arnold, B.F., Bain, R., et al.: Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis. *Lancet*. 400, 27–40 (2022). [https://doi.org/10.1016/S0140-6736\(22\)00937-0](https://doi.org/10.1016/S0140-6736(22)00937-0)
17. McClelland, P.H., Kenney, C.T., Palacardo, F., Roberts, N.L.S., Luhende, N., Chua, J., et al.: Improved Water and Waste Management Practices Reduce Diarrhea Risk in Children under Age Five in Rural Tanzania: A Community-Based, Cross-Sectional Analysis. *International Journal of Environmental Research and Public Health*. 19, 4218 (2022). <https://doi.org/10.3390/ijerph19074218>
18. Ogban G. I, Nduso E. M, Iwuafor A. A, Emanghe U. E, Ushie S. N, Ejemot-Nwadiaro R. I (2020). Basic Knowledge of Childhood Diarrhea and Health-seeking Practices of Caregivers of Under-five Children in Calabar-South, Calabar, Nigeria. *Asian Journal of Medicine and Health*, 18, (4), 12–23. <https://doi.org/10.9734/ajmah/2020/v18i430195>.
19. Ercumen, A., Arnold, B.F., Kumpel, E., Burt, Z., Ray, I., Nelson, K., Jr, J.M.C.: Upgrading a Piped Water Supply from Intermittent to Continuous Delivery and Association with Waterborne Illness: A Matched Cohort Study in Urban India. <https://doi.org/10.1371/journal.pmed.1001892>
20. Howard, G.: The future of water and sanitation: global challenges and the need for greater ambition. *AQUA - Water Infrastructure, Ecosystems and Society*. 70, 438–448 (2021). <https://doi.org/10.2166/aqua.2021.127>
21. Kamara, J.K., Galukande, M., Maeda, F., Luboga, S., Renzaho, A.M.N.: Understanding the Challenges of Improving Sanitation and Hygiene Outcomes in a Community Based Intervention: A Cross-Sectional Study in Rural Tanzania. *International Journal of Environmental Research and Public Health*. 14, 602 (2017). <https://doi.org/10.3390/ijerph14060602>

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