MINISTRY OF HEALTH UGANDA

UNIPH

PUBLIC HEALTH Bulletin

Volume 11 Issue 1| January–March, 2026

UGANDA PUBLIC HEALTH BULLETIN

January–March, 2026

Dear Reader,

We take great pleasure in welcoming you to Issue 1 Volume 11 of the Uganda Public Health Bulletin.

We aim to inform the district, national, and global stakeholders on disease outbreak investigations, public health surveillance, and interventions undertaken in detecting, preventing, and responding to public health events in Uganda.

In this issue, we present a variety of articles including: Comparison of Medically Certified and DHIS2-Reported Neonatal Sepsis Mortality in Uganda, 2020–2025; Trends and Distribution of Snakebite Incidence, Uganda, 2020–2024: Analysis of District Health Information Software Surveillance Data; Temporal and Spatial Comparison of Malaria Incidence Between Urban and Rural Areas in Uganda, 2020–2024; Clustered deaths linked to severe malaria and poor health-seeking behavior in Mid-Western Uganda, June–September 2025; Measles outbreak investigation in Kumi District, Uganda, May–July 2025, Measles Recurrence in a Refugee-Hosting Setting: An Outbreak Investigation in Kamwenge District, Uganda, 2025; Factors associated with zero-dose status among children aged 12–23 months, Uganda, August to September, 2024; Imported cholera outbreak in Adjumani District, Uganda, June–July 2025; Cholera outbreak following cross-border introduction and consumption of untreated River Nile water, Moyo District, Uganda, June–July 2025; Measles outbreak investigation in Akwon and Muntu sub-counties, Amolatar District, Uganda, November 2025–February 2026; and Investigation of Anthrax Outbreak in Kazo District, March 2025.

Should you have any questions or require additional information related to articles in this bulletin please contact us on: annealupo@uniph.go.ug, akyomugisha@uniph.go.ug, mutegekim@uniph.go.ug, nakaweesavivian@uniph.go.ug lbulage@uniph.go.ug

Thank you

Inside

Comparison of Medically Certified and DHIS2-Reported Neonatal Sepsis Mortality in Uganda, 2020–2025

Sharon Namasambi[*1], Richard Migisha[1], Irene Kyamwine[1], Collins Ankunda[2], Winfred Nakaweesi[1], Pauline Achom[1], Benon Kwesiga[1], Fred Nsubuga[3]

Institutional affiliation: [1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda, [2]Department of Pharmacology, Makerere University, Kampala, Uganda, [3]Uganda National Expanded Program on Immunisation, Ministry of Health, Kampala, Uganda

Correspondence*: Tel: +256 772 511 067, Email: nabsharon@uniph.go.ug

Summary

Background: In Uganda, neonatal deaths are routinely reported through District Health Information Software 2 (DHIS2); however, the extent of formal medical certification using International Classification of Diseases, 10th Revision (ICD-10) within the Medical Certification of Cause of Death–Civil Registration and Vital Statistics system (MCCOD-CRVS) platform remains poorly described. Assessing the concordance between MCCOD-certified deaths and DHIS2-reported data is essential to strengthen mortality surveillance, improve data quality, and inform targeted interventions to reduce preventable neonatal mortality. We compared NS-related deaths reported in DHIS2 with those medically certified in the MCCOD-CRVS system to quantify concordance between the two platforms and identify gaps to strengthen vital statistics systems.

Methods: We conducted a national-level descriptive analysis using DHIS2 data from 2020–2025. All facility-reported NS deaths during this period were identified and cross-referenced with Uganda's MCCOD-CRVS system to determine the proportion that received formal ICD-10 medical certification. The proportion of medically certified deaths was calculated annually, and monotonic trends in annual proportions were assessed using the Mann-Kendall test.

Results: A total of 6,427 neonatal sepsis–related deaths were reported in DHIS2 from 2020–2025, of which 564 (8.8%) were medically certified in the MCCOD-CRVS system. Certification increased significantly over time from 0.1% in 2020 to 26.2% in 2025 (τ_b=0.87, p=0.02), while no significant trend was observed in total reported deaths (τ_b=0.20, p=0.71). Certified deaths were highly concentrated in regional and national referral hospitals (89.5%), with minimal contributions from lower-level facilities.

Conclusion: Substantial discordance persists between DHIS2-reported and MCCOD-CRVS–certified neonatal sepsis deaths in Uganda, with overall certification remaining low despite recent gains. The concentration of certification in higher-level facilities highlights gaps across the health system. Strengthening and decentralising medical certification, alongside improved integration of routine surveillance with CRVS systems, is essential to enhance mortality data quality and better inform efforts to reduce preventable neonatal deaths.

Background

Accurate and complete cause-of-death data are essential for tracking progress toward Sustainable Development Goal (SDG) 3.2, which aims to end preventable neonatal deaths by 2030. High-quality mortality data enable countries to monitor trends, prioritize interventions, and allocate resources effectively. However, in many low- and middle-income countries, including Uganda, weaknesses in civil registration and vital statistics (CRVS) systems and incomplete medical certification of deaths limit the availability of reliable cause-of-death information(1–3).These gaps undermine the ability to accurately quantify disease burden and evaluate the impact of newborn health interventions.

In Uganda, neonatal deaths are routinely reported through the District Health Information Software 2 (DHIS2), that captures aggregated facility-based data. While DHIS2 provides timely and broad coverage, cause-of-death attribution is often based on clinical judgment and may be affected by diagnostic uncertainty and inconsistent reporting (4).In contrast, the Medical Certification of Cause of Death–Civil Registration and Vital Statistics (MCCOD-CRVS) system applies standardized International Classification of Diseases, 10th Revision (ICD-10) coding and is considered the gold standard for assigning underlying causes of death (2,5). Despite this, MCCOD coverage in Uganda remains limited, and the extent of concordance between MCCOD-certified deaths and DHIS2-reported mortality has not been well determined. We compared NS-related deaths reported in DHIS2 with those medically certified in the MCCOD-CRVS system to quantify concordance between the two platforms and identify gaps to strengthen vital statistics systems.

Continued from page 2

Methods

We conducted a descriptive trend analysis of routinely collected facility-based surveillance data to compare neonatal sepsis (NS) deaths reported in Uganda's District Health Information Software 2 (DHIS2) with medically certified NS deaths captured in the Medical Certification of Cause of Death–Civil Registration and Vital Statistics (MCCOD-CRVS) system from 2020 to 2025. The analysis included all public and private health facilities reporting to DHIS2 at Health Centre III level and above across Uganda's districts. The study population comprised all facility-based neonatal deaths (0–28 days) attributed to sepsis in DHIS2 and those medically certified with ICD-10 code KA60 (neonatal sepsis) in the MCCOD-CRVS system over the same period.

Data were extracted from monthly inpatient reports (HMIS Form 108-ND01b) submitted to DHIS2 and from MCCOD-CRVS records. We summarized the annual and overall number of NS deaths reported in each system for 2020–2025. The proportion of DHIS2-reported deaths that were medically certified in MCCOD-CRVS was calculated for each year; and was compared across health facility levels. Temporal trends in certification were assessed using the Mann–Kendall trend test to evaluate changes in the proportion of DHIS2-reported deaths captured in MCCOD-CRVS over time. Permission to access HMIS data was obtained from the Ministry of Health Resource Centre. The activity was classified by the U.S. Centers for Disease Control and Prevention (CDC), Center for Global Health, as non-research, as it was conducted to support public health practice and data use for decision-making.

Results

Trends in DHIS2 reported and MCCOD-certified deaths, 2020–2025

A total of 6,427 neonatal sepsis (NS)-related deaths were reported in DHIS2 between 2020 and 2025, of which 564 (8.8%) were medically certified using the Medical Certificate of Cause of Death (MCCOD). Cause of death certification increased significantly over time, from 0.1% (1/858) in 2020 to 26.2% (194/740) in 2025; (τ_b=0.87, p=0.02), demonstrating a strong upward trend in certification. In contrast, there was no significant monotonic trend in total DHIS2-reported deaths over time (τ_b=0.20, p=0.71) (Figure 1).

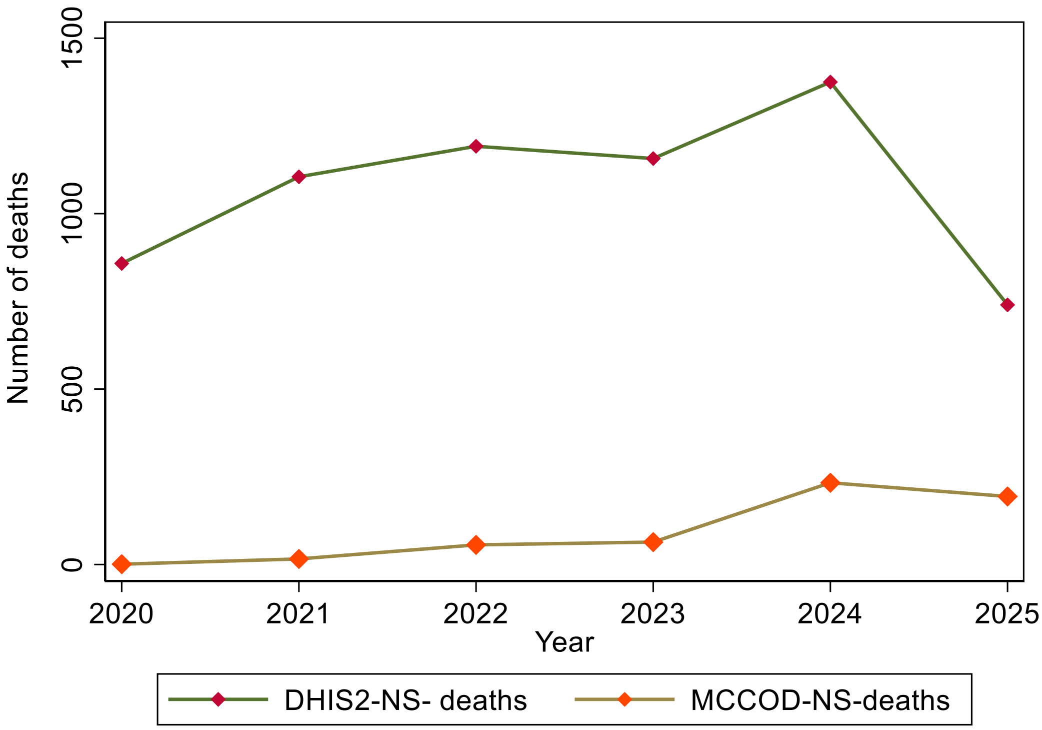


Figure 1: Trends in DHIS2 reported and MCCOD-certified deaths, 2020–2025

Continues to page 4

Continued from page 3

Distribution of certified Neonatal sepsis deaths across health facility levels in Uganda, 2020-2025
Medical certification of neonatal sepsis (NS) deaths was highly concentrated at higher-level health facilities. Of the 564 certified deaths, 89.5% (505) occurred in regional and national referral hospitals (RRH/NRH), followed by general hospitals (8.9%), Health Centre IVs (1.2%), and Health Centre IIIs (0.4%). Across the study period, RRH/NRH facilities consistently accounted for the majority of certifications each year, contributing over 80% annually, while certification at lower-level facilities remained minimal throughout the period (Figure 2).

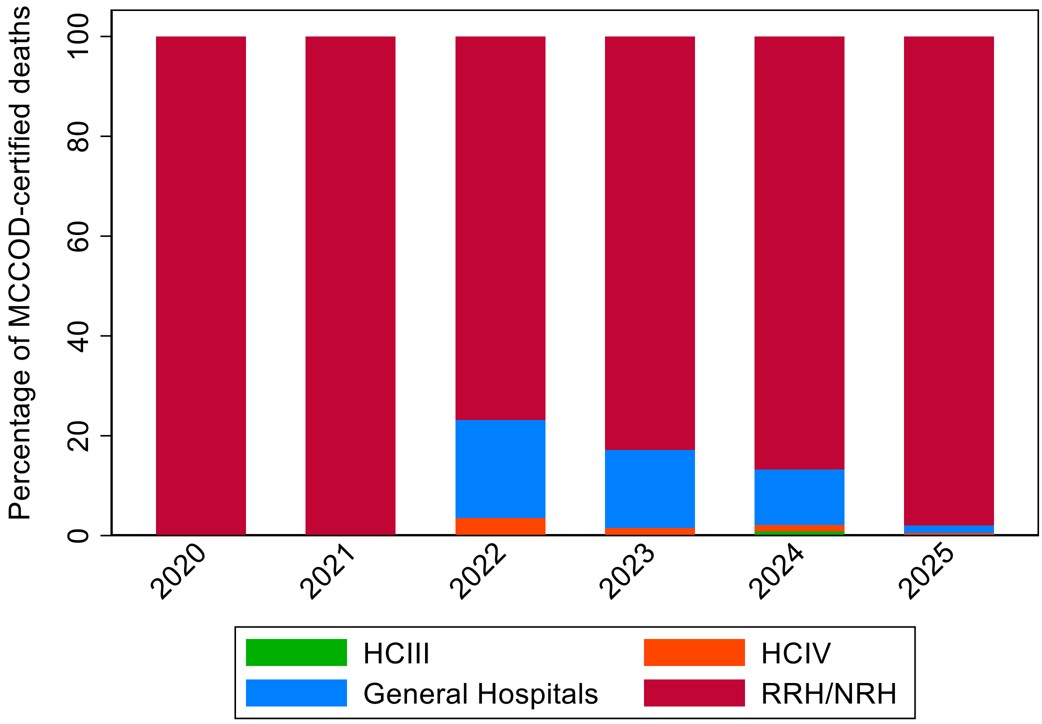


Figure 2: Distribution of medically certified neonatal sepsis deaths across health facility levels in Uganda, 2020-2025

Discussion

Our analysis reveals a substantial gap between DHIS2-reported neonatal sepsis (NS) deaths and medically certified deaths in Uganda's MCCOD-CRVS system. Over the six-year period, only 8.8% of NS-related deaths reported in DHIS2 were formally certified using ICD-10 processes; medical certification increased from 0.1% in 2020 to 26.2% in 2025; and nearly 80% of certified deaths occurred in referral hospitals.

The persistent under certification observed in our study aligns with broader evidence from sub-Saharan Africa, where discrepancies between routine health information systems and civil registration data are well documented (6,7). Although medical certification improved markedly over the study period, the overall low concordance limits the ability to validate DHIS2-reported deaths and accurately assess the true population-level burden of neonatal sepsis.

The discordance between DHIS2 and MCCOD-CRVS may reflect inherent differences in how deaths are captured and classified in these two systems. Routine health management information systems (HMIS) like DHIS2 often rely on syndromic or clinical diagnoses recorded by frontline health workers without formal medical certification or standardized ICD-10 coding (4,8). In contrast, CRVS systems require structured cause-of-death certification following WHO guidelines, which includes completing medical certificates of cause of death and applying ICD coding by trained personnel (9).
Studies from Kenya, Tanzania, and Ethiopia have similarly documented substantial discrepancies between HMIS mortality data and medically certified deaths.
For instance, a Kenyan study found that only 15% of neonatal deaths reported in HMIS were medically certified, comparable to our 8.8% finding(10,11).

Continued from page 4

The concentration of certified deaths in higher-level facilities is consistent with international literature showing that referral and tertiary hospitals are more likely to have staff trained in MCCOD and better adherence to ICD coding practices(12,13)
In our study, nearly 80% of certified deaths occurred in referral hospitals, reflecting both greater case severity at these levels and enhanced capacity for formal death certification. This hierarchical pattern has been observed across multiple sub-Saharan African countries, where certification rates rise with facility level but remain inadequate overall, undermining national mortality surveillance(14)

The marked improvement in medical certification from 0.1% in 2020 to 26.2% in 2025 suggests that Uganda's investments in strengthening CRVS systems, including training health workers on MCCOD, expanding access to certification tools, and integrating MCCOD modules into DHIS2, are yielding measurable results(15).
Similar improvements have been documented in countries that prioritized CRVS strengthening as part of national health information system reforms, such as Rwanda and South Africa(16,17). However, the persistence of a large certification gap indicates that substantial barriers remain, including limited human resources, competing clinical priorities, and insufficient supervision and quality assurance mechanisms at facility level

In summary, our findings emphasise the critical need to bridge the gap between routine surveillance and formal certification systems. Without reliable, standardised cause-of-death data, policy-making and resource allocation for newborn health remain inadequately informed, potentially undermining interventions aimed at reducing preventable neonatal mortality. Enhancing concordance between DHIS2 and MCCOD-CRVS data will improve the accuracy of neonatal mortality estimates, inform targeted interventions, and ultimately support Uganda's efforts to meet SDG 3.2.

Study limitations: The study relied on aggregated routine surveillance data, limiting the ability to assess individual-level agreement between DHIS2 and MCCOD-CRVS records. However, this was mitigated by using national-level data over a six-year period and applying trend analysis to provide robust insights into patterns of concordance between the two systems.

Conclusion
Substantial discordance exists between DHIS2-reported and MCCOD-CRVS certified neonatal sepsis deaths in Uganda, with persistently low certification despite recent improvements. The marked concentration of certification in higher-level facilities highlights critical gaps at lower-level facilities, highlighting the need to decentralise and strengthen medical certification practices. Enhancing integration between routine surveillance and CRVS systems, alongside targeted capacity building at facility level, is essential to improve mortality data quality and guide interventions to reduce preventable neonatal deaths.

Conflict of Interests: The authors declare no conflict of interests.
Author Contributions: SN conceptualized, led data collection, analysis and report writing. WN and PA supported data collection and review of draft report. RM, CA and IK supported technical review of data analysis, and report writing. SN, CA, and RM contributed to writing and reviewing the bulletin article to ensure scientific rigor and intellectual content. All authors reviewed and approved the final bulletin for submission.
Acknowledgements: We acknowledge the Ministry of Health Division of Health Information for granting access to the data used in this study. We also thank the Ministry of Health Reproductive Health Department and the Uganda Public Health Fellowship Program for their valuable technical support.

References
World Health Organisation. Covering every birth and death: improving civil registration and vital statistics (CRVS) [Internet]. 2014 [cited 2026 Mar 27]. Available from: https://iris.who.int/items/501ecdd3-4c30-4b37-a8ee-af5df864d475
2. World Health Organisation. Civil registration and vital statistics [Internet]. 2025 [cited 2026 Mar 27]. Available from: https://www.who.int/news-room/fact-sheets/detail/civil-registration-and-vital-statistics

Continues to page 6

Continued from page 5
3. AbouZahr C, de Savigny D, Mikkelsen L, Setel PW, Lozano R, Nichols E, et al. Civil registration and vital statistics: progress in the data revolution for counting and accountability. Lancet Lond Engl. 2015 Oct 3;386(10001):1373–85. doi:10.1016/S0140-6736(15)60173-8 PubMed PMID: 25971224; PubMed Central PMCID: PMC7753937.
4. Iburg KM, Mikkelsen L, Adair T, Lopez AD. Are cause of death data fit for purpose? evidence from 20 countries at different levels of socio-economic development. PLOS ONE. 2020 Aug 24;15 (8):e0237539. doi:10.1371/journal.pone.0237539
5. World Health Organisation. International Classification of Diseases (ICD) [Internet]. 2024 [cited 2026 Mar 27]. Available from: https://www.who.int/standards/classifications/classification-of-diseases
6. Mikkelsen L, Phillips DE, AbouZahr C, Setel PW, Savigny D de, Lozano R, et al. A global assessment of civil registration and vital statistics systems: monitoring data quality and progress. The Lancet. 2015 Oct 3;386(10001):1395–406. doi:10.1016/S0140-6736(15)60171-4 PubMed PMID: 25971218.
7. Setel PW, Macfarlane SB, Szreter S, Mikkelsen L, Jha P, Stout S, et al. A scandal of invisibility: making everyone count by counting everyone. The Lancet. 2007 Nov 3;370(9598):1569–77. doi:10.1016/S0140-6736(07)61307-5 PubMed PMID: 17992727.
8. Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health - The Lancet [Internet]. [cited 2026 Mar 27]. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)30104-1/abstract
9. World Health Organisation. Medical certification of cause of death : instructions for physicians on use of international form of medical certificate of cause of death [Internet]. 2016 [cited 2026 Mar 27]. Available from: https://iris.who.int/items/59fc64df-14ed-44f2-a115-a1137c3a998f
10. Shabani J, Salim N, Bohne C, Day LT, Kumalija C, Makuwani AM, et al. Neonatal indicator data in Tanzania District Health Information System: evaluation of availability and quality of selected newborn indicators, 2015-2022. BMC Pediatr. 2025 Jan 23;23(Suppl 2):658. doi:10.1186/s12887-025-05417-x PubMed PMID: 39849367; PubMed Central PMCID: PMC11755859.
11. Irimu G, Aluvaala J, Malla L, Omoke S, Ogero M, Mbevi G, et al. Neonatal mortality in Kenyan hospitals: a multisite, retrospective, cohort study. BMJ Glob Health. 2021 May 31;6:e004475. doi:10.1136/bmjgh-2020-004475
12. Mahapatra P, Shibuya K, Lopez AD, Coullare F, Notzon FC, Rao C, et al. Civil registration systems and vital statistics: successes and missed opportunities. The Lancet. 2007 Nov 10;370 (9599):1653–63. doi:10.1016/S0140-6736(07)61308-7 PubMed PMID: 18029006.
13. Kazonga E, Mwinga DKK. Strengthening of Civil Registration and Vital Statistics System for Enhanced Public Health Information in Zambia.
14. Ye Y, Wamukoya M, Ezeh A, Emina JBO, Sankoh O. Health and demographic surveillance systems: a step towards full civil registration and vital statistics system in sub-Sahara Africa? BMC Public Health. 2012 Sep 5;12(1):741. doi:10.1186/1471-2458-12-741
15. Ministry of Health. National Mortality Surveillance Roadmap 2024_25 - 2027_28 edited [Internet]. 2024. Available from: https://library.health.go.ug/sites/default/files/resources/National%20Mortality%20Surveillance%20Roadmap%202024-2028.pdf
16. Yokobori Y, Matsuura J, Obara H, Sugiura Y, Kitamura T, Moyo C, et al. Rapid assessment of the civil registration and vital statistics performance of health facilities in the five districts of Zambia: A cross-sectional study. Heliyon. 2021 Nov 11;7(11): e08367. doi: 10.1016/j. heliyon.2021.e08367 PubMed PMID: 34825083; PubMed Central PMCID: PMC8605283.
17. Dorrington R, Bradshaw D, Laubscher R, Nannan N. RAPID MORTALITY SURVEILLANCE REPORT 2019 & 2020 .

Continued from page 6

Trends and Distribution of Snakebite Incidence, Uganda, 2020–2024: Analysis of District Health Information Software Surveillance Data

Authors: Martha Dorcas Nalweyiso[1*], Justine Wobusobozi[1], Aminah Namwabira[1], Patricia Eyu[1], Richard Migisha[1], Benon Kwesiga[1], Emmanuel Obuya[2], Fred Isaasi[2], David Were Oguttu[3], Charles Kennedy Kissa[3]

Institutional affiliations:[1]Uganda National Institute of Public Health, Kampala, Uganda, [2]Department of Integrated Epidemiology, Surveillance and Public Health Emergencies, Ministry of Health, Kampala, Uganda, [3]Department of Environmental Health, Ministry of Health, Kampala, Uganda

Correspondence*: Tel: +256785832362, Email: nmartha@uniph.go.ug

Summary

Background: Snakebites remain a neglected public health challenge in Uganda, with an annual incidence of 101/1,000,000 population. Snakebites have been prioritised in Uganda's Neglected Tropical Diseases Master Plan, 2023-2027, which aligns with WHO's target to reduce snakebite mortality and disability by 50% by 2030. We described trends and distribution of snakebite cases in Uganda, 2020–2024, to inform control efforts.

Methods: We analysed snakebite cases reported through the District Health Information Software (DHIS2) from January 2020 to December 2024 across 146 districts. We calculated annual incidence rates per 1,000,000 population stratified by age, sex, year, and district, using Uganda Bureau of Statistics (UBOS) population projections. Temporal trends were assessed using the Mann–Kendall test. Spatial distribution of snakebites was assessed using QGIS. We correlated annual district-level rainfall data from the Uganda National Meteorological Authority with snakebite incidence using the Spearman correlation coefficient.

Results: From 2020-2024, 50,011 snakebite cases were reported, yielding a mean incidence of 250/1,000,000 population. Adults aged ≥20 years had the highest incidence (320/1,000,000). Females had a slightly higher incidence (250/1,000,000) than males (240/1,000,000). A significant temporal trend in snakebite incidence was observed among females (p=0.02). Incidence declined between 2020 and 2022, with no significant overall upward trend (p=0.22).

West Nile and Acholi regions consistently reported snakebite incidence risks exceeding 1,000/1,000,000 with Moyo District among the highest annually. Rainfall showed a weak negative correlation with snakebite incidence, significant only in 2022 ($\rho=-0.22$, p=0.01).

Conclusion: Snakebites mostly affected adults and females, with West Nile and Acholi regions reporting the highest incidences. No significant temporal trend was observed over five years. We recommend enhancing community awareness in high-burden regions and supporting locally produced antivenom tailored to Uganda's snake species.

Background

Snakebites are recognised by the World Health Organisation (WHO) as a top-priority neglected tropical disease (NTD) with a particularly high burden in rural, low-and middle-income (LMICs) countries, and represent a major global public health challenge (1, 2). Sub-Saharan Africa is especially affected, and annual estimates indicate 421,000 to 500,000 snakebites occur, resulting in up to 32,000 deaths, leaving survivors with permanent disabilities and socio-economic consequences (3, 4).

In Uganda, Snakebite Envenoming (SBE) is a significant public health threat, especially within the agricultural sector, where nearly 70% of the population is employed. Farming activities frequently expose individuals to snake habitats, increasing the risk of snakebites (5, 6).

Continues to page 8

Continued from page 7

The estimated national incidence is at 10.1 cases per million people annually, with higher rates reported in certain districts such as Gulu and Nakapiripirit (7). Uganda's biodiversity includes more than 200 snake species whose bites can cause illness, disability, and death in humans (8, 9).

Despite the high burden of snakebites, Uganda's healthcare response is limited. Critical shortages of antivenom mean that only 4% of health facilities have the treatment (7, 10). This challenge is exacerbated by knowledge gaps among healthcare practitioners (HCPs), resulting in delayed or suboptimal care (11, 12). Consequently, snakebite victims seek help from traditional healers first, influenced by accessibility, affordability, and cultural beliefs (13-16). Ethnobotanical studies in Uganda have identified over 77 plant species used as folk remedies for snakebites, alongside harmful practices, such as applying tourniquets, black stones, or coins to bite wounds (14, 17).

In response, the Ugandan Ministry of Health has added SBE to the national list of neglected tropical diseases and drafted a strategic plan for prevention and management (18). However, implementation is challenged by a lack of detailed, up-to-date information on the epidemiology and spatial distribution of cases, as well as the interplay between community behaviours and the formal health system. Environmental factors, especially rainfall and temperature, influence snakebite incidence, but these relationships vary by region and are not fully understood in Uganda (19, 20).

In Uganda, snakebite cases are routinely reported monthly by health workers through the District Health Information Software version 2 (DHIS2); however, gaps remain in understanding the true magnitude and spatial distribution of cases. We analysed DHIS2 data to examine trends and the distribution of snakebites in Uganda, 2020-2024.

Methods

This study employed a descriptive design, utilising DHIS2 and rainfall data from the Uganda National Meteorological Authority (UNMA), covering the period from January 2020 to December 2024. Snakebite cases were defined as injuries resulting from snake bites, with or without clinical signs of envenomation, as reported by health facilities. Study variables included year of reporting, district, number of snakebite cases, age group, sex, and population estimates. Rainfall data consisted of annual totals aggregated at the district level to align with snakebite surveillance data.

Descriptive analyses were conducted by person (age group, sex), place (district), and time (year). Snakebite incidence rates were calculated using reported cases as the numerator and district-level population projections from the Uganda Bureau of Statistics (UBOS) as the denominator, stratified by age group and sex.

Temporal trends were analysed using annual variations in case counts and incidence rates, visualised with line graphs, and assessed using the Mann–Kendall trend. Spatial analysis was performed in Quantum GIS to generate district-level choropleth maps of incidence. The relationship between annual rainfall and snakebite incidence was examined using Spearman's rank correlation, with statistical significance set at $p<0.05$. All statistical analyses were conducted using Stata version 17.

The study used routine surveillance data from health facilities in DHIS2, which were aggregated without individual patient identifiers. However, we obtained administrative clearance to use the data from the Uganda Ministry of Health. The US Centers for Disease Control and Prevention (CDC) also determined that this activity was not human subject research and that its primary intent was public health practice or disease control. This activity was reviewed by CDC and conducted in accordance with applicable federal law and CDC policy. §§See e.g., 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241 (d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

Continues to page 9

Continued from page 8

Results

Person characteristics of snakebite cases, Uganda, 2020-2024

A total of 50,011 snakebite cases were reported between 2020-2024. Of these, 2,385(4.8%) were children <5 years, 4,750(9.5%) aged 5-9 years, 13,680(27.4%) aged 10-19 years, and 29,196(58.4%) aged ≥20 years. Females accounted for 27,474(54.9%) of all cases. The highest proportion of cases was reported in 2024 (10,802,21.6%), followed by 2020 (10,737,21.5%), while the lowest number was registered in 2022 (9,088,18.2%). The mean incidence among females was 245/1,000,000 compared to 208/1,000,000 among males. A statistically significant temporal trend was observed among females (p=0.02) (Figure 1).

Incidence varied across age groups, with adults aged ≥20 years recording the highest incidence throughout the study period. There were no statistically significant temporal trends observed across any age category. Incidence declined from 259/1,000,000 in 2020 to 200/1,000,000 in 2023, then increased to 230/1,000,000 in 2024. Despite these fluctuations, no statistically significant temporal trend was observed over the study period (p = 0.2) (Figure 2).

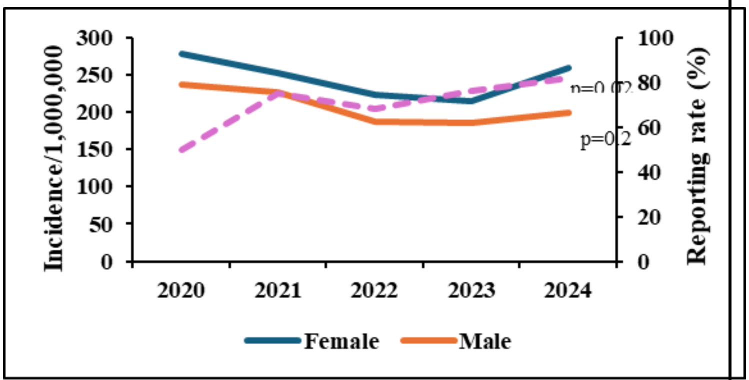
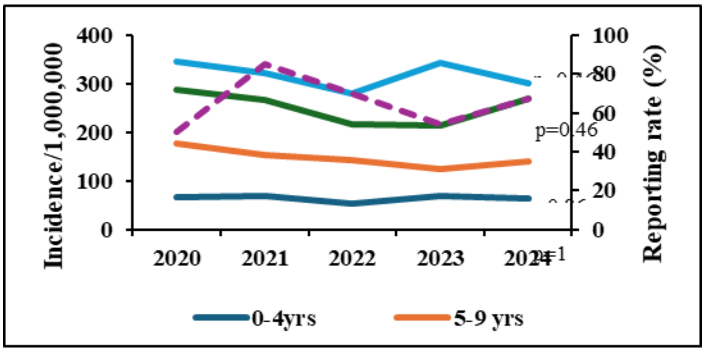
	

Figure 1: Incidence trend of snakebite incidence by sex, Uganda 2020-2024	**Figure 2: Incidence trend of snakebite incidence by age group, Uganda, 2020-2024**

Spatial distribution of snakebite incidence in Uganda 2020-2024

The national incidence was 250/1,000,000 population, with the proportion of affected districts reporting fluctuating between 14% and 21% over the study period (2020-2024). Mean annual district-level incidence ranged from 20 to 30/1,000,000 population and statistical testing showed no significant trend across years. The burden was consistently concentrated in Northern Uganda with Lamwo, Obongi, Moyo, Kitgum, and Pakwach districts recording risk exceeding 1,000/1,000,000 population, while Luwero District in Central Uganda emerged as a notable new hotspot in 2024 [Figure 3].

Continues to page 10

Continued from page 9

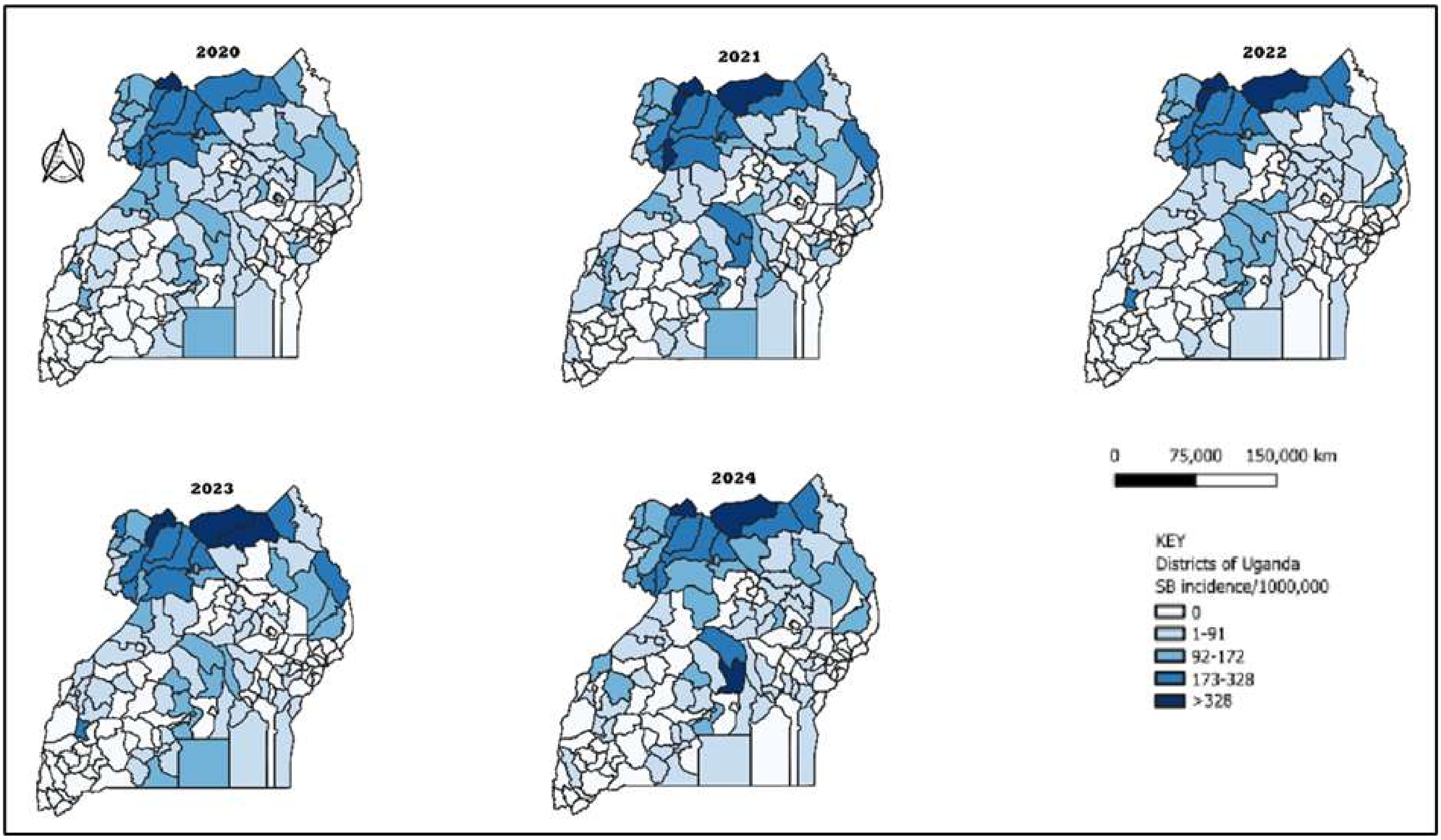


Figure 3: Spatial distribution of snakebite incidence, Uganda,2020-2024

Table 1: Correlation between rainfall (mm) and annual snakebite incidence, Uganda, 2020-2024

Year	Outcome	Number of districts (n)	Spearman's ρ	p-value
2020	snakebite incidence	146	−0.03	0.72
2021			−0.11	0.17
2022			−0.22	0.01
2023			−0.10	0.21
2024			−0.06	0.49

Spearman's rank correlation analysis examining the association between annual rainfall and snakebite incidence across districts showed evidence of a statistically significant correlation only in 2022. In that year, a weak negative correlation was observed (ρ=−0.22, p=0.01). In contrast, no evidence of a statistically significant correlation between annual rainfall and snakebite incidence was observed in 2020 (ρ=−0.03, p = 0.72), 2021 (ρ=−0.11, p=0.17), 2023 (ρ=−0.10, p=0.21), or 2024 (ρ=−0.06, p=0.49).

Discussion

Our study showed a higher incidence of snakebites among adult females and in Northern region, largely reflecting occupational exposure in agricultural activities (11, 21). While adults bear the greatest burden, cases among children and adolescents indicate additional risks during play and farm tasks, underscoring the need for community-wide education. and availability of pediatric antivenom in essential drug supplies (22). The higher incidence among females differs from patterns reported in many other regions, where males are more affected (6).

Continued from page 10

In Uganda, this may be explained by women's prominent involvement in agriculture and possible differences in health-seeking behaviours (23).

Snakebite incidence declined after 2020 but increased between 2023-2024, indicating temporal variation. The incidence in 2020 may be linked to heightened surveillance and behavioral changes during the COVID-19 pandemic (24). The subsequent decline in 2022–2023 may reflect shifts in reporting, health system performance, or exposure patterns. The rise of cases in 2024 suggests a combination of surveillance practices, environmental factors, and population exposure (25). Similar rainfall-associated increases in snakebite incidences have been documented in Africa and Asia (25, 26).

Snakebite incidence remains concentrated in Northern Uganda particularly in West Nile and Acholi with parts of the central region in Luwero District. The high burden is likely driven by the presence venomous species combined with intense agricultural activity that increases human exposure (27). The emergence of Luwero District suggests shifting risk patterns, possibly due to land-use changes, population expansion, and improved reporting.

Annual rainfall showed no consistent association with snakebite incidence across the study period. Only in 2022 was a weak negative correlation observed; in other years, no significant relationship was found. This suggests that rainfall alone does not explain differences in snakebite burden, which are likely shaped by additional factors such as agricultural practices, land use, and human exposure patterns (25, 28). Aggregated annual data may also obscure important seasonal effects relevant to snakebite risk (25, 29, 30).

Study limitations: We relied on DHIS2 routine surveillance data, which may underestimate the burden of snakebites due to underreporting and inconsistent reporting across districts and over time. The data also lacked detailed clinical information (snake species, envenomation severity, outcomes, time to treatment), limiting in-depth analysis.

Conclusion

Snakebites remain a major public-health concern in Uganda, with incidence rates exceeding 100/1,000,000 between 2020-2024, disproportionately affecting adults, females and children. The Northern region bears the highest burden with emerging hotspots Luwero District. We recommend enhancing community awareness in high-burden regions and supporting locally produced antivenom tailored to Uganda's snake species.

Conflict of interest: The authors declare that they have no conflict of interest.

Authors' contributions

MDN participated in the conception, design, analysis, and interpretation of the study and wrote the draft bulletin. JW, AN, PE, RM, BK, RM, DK, EO, FI, DWO, and CKK reviewed the report and the drafts of the bulletin for intellectual content and made multiple edits to the draft bulletin; BK, RM, and ARA reviewed the final bulletin to ensure intellectual content and scientific integrity. All authors read and approved the final bulletin.

Acknowledgement: We thank the staff of the Uganda Public Health Fellowship Program and Uganda Public Health Emergency Operations Centre for the technical support and guidance offered during this work. We also thank the US-CDC for supporting the activities of the Uganda Public Health Fellowship Program under which this work was done.

Continues to page 12

Continued from page11

Reference

1. Williams DJ, Faiz MA, Abela-Ridder B, Ainsworth S, Bulfone TC, Nickerson AD, et al. Strategy for a globally coordinated response to a priority neglected tropical disease: Snakebite envenoming. PLoS neglected tropical diseases. 2019;13(2):e0007059.
2. World Health Organisation. Snakebite envenoming 2023 [Available from: https://www.who.int/news-room/fact-sheets/detail/snakebite-envenoming.
3. Chippaux JP. Snake-bites: appraisal of the global situation. Bulletin of the World Health organization. 1998;76(5):515.
4. Kasturiratne A, Wickremasinghe AR, De Silva N, Gunawardena NK, Pathmeswaran A, Premaratna R, et al. The global burden of snakebite: a literature analysis and modelling based on regional estimates of envenoming and deaths. PLoS medicine. 2008;5(11):e218.
5. Uganda K. Uganda Bureau of Statistics. Kampala, Uganda and Calverton. 2016.
6. Ooms GI, van Oirschot J, Waldmann B, von Bernus S, van Den Ham HA, Mantel-Teeuwisse AK, et al. The current state of snakebite care in Kenya, Uganda, and Zambia: healthcare workers' perspectives and knowledge, and health facilities' treatment capacity. The American Journal of Tropical Medicine and Hygiene. 2020;104(2):774.
7. Ddamulira J, Kasasa S, Kizito S. The Burden of Snakebite and Snakebite Envenoming in Uganda: A Community Survey and Facility Audit. Kampala, Uganda: Makerere University. 2021.
8. The Surgery. Poisonous snakes in Uganda 2025 [Available from: https://thesurgeryuganda.org/poisonous-snakes-in-uganda/.
9. Rentokil U. Types of snakes in Uganda 2025 [Available from: https://www.rentokil.co.ug/snakes/species/.
10. Health Action International. Snakebite project in Uganda, Fact Sheet 2019 [Available from: https://nru.uncst.go.ug/server/api/core/bitstreams/7fa55c67-adfa-4e1f-9650-a5dacf1acf15/content.
11. Wafula ST, Mugume IB, Namakula LN, Nalugya A, Naggayi V, Walekhwa AW, et al. Healthcare practitioners' knowledge of snakebite management and associated factors in high-burden, low-resource settings in Uganda. Transactions of The Royal Society of Tropical Medicine and Hygiene. 2023;117(8):569-79.
12. Tusabe J, Muhoozi M, Kajungu D, Mukose A, Kasasa S, Sebina Kibira SP. Knowledge, perceptions and healthcare practices of communities for management of snakebites in Kamuli District, Eastern Uganda. Transactions of The Royal Society of Tropical Medicine and Hygiene. 2025;119(4):418-31.
13. Steinhorst J, Aglanu LM, Ravensbergen SJ, Dari CD, Abass KM, Mireku SO, et al. 'The medicine is not for sale': practices of traditional healers in snakebite envenoming in Ghana. PLOS Neglected Tropical Diseases. 2021;15(4):e0009298.
14. Schioldann E, Mahmood MA, Kyaw MM, Halliday D, Thwin KT, Chit NN, et al. Why snakebite patients in Myanmar seek traditional healers despite availability of biomedical care at hospitals? Community perspectives on reasons. PLoS neglected tropical diseases. 2018;12(2):e0006299.
15. Omara T, Kagoya S, Openy A, Omute T, Ssebulime S, Kiplagat KM, et al. Antivenin plants used for treatment of snakebites in Uganda: ethnobotanical reports and pharmacological evidences. Tropical Medicine and Health. 2020;48(1):6.
16. The Daily Monitor. How to get rid of snakebites 2015 [Available from: https://www.monitor.co.ug/uganda/magazines/healthy-living/using-nature-to-get-rid-of-snakes-and-their-venom-1622448.
17. Adu-Gyamfi S. Spiritual and indigenous healing practices among the Asante people of Ghana: A testimonial from twenty-first century practitioners and recipients in Kumase. Journal of Basic and Applied Research International. 2016;12(1):39-50.
18. HEPS Uganda. Uganda Reviews Snakebite Prevention and Management Strategy 2023 [Available from: https://www.heps.or.ug/uganda-reviews-snakebite-prevention-and-management-strategy/.
19. Bravo-Vega C, Santos-Vega M, Cordovez JM. Disentangling snakebite dynamics in Colombia: How does rainfall and temperature drive snakebite temporal patterns? PLoS Negl Trop Dis. 2022;16(3):e0010270.
20. Gutiérrez JD, Bravo-Vega C, Cordovez JM. Causal inference unveils how forest coverage mitigates excess snakebite cases during rainfall seasons in Colombia. Sci Rep. 2025;15(1):32401.
21. Nanyonga SM, Matafwali SK, Kibira D, Kitutu FE. Treatment and treatment outcomes of snakebite envenoming in Uganda: a retrospective analysis. Transactions of The Royal Society of Tropical Medicine and Hygiene. 2025;119(7):796-803.

Continues to page 13

Continued from page 12

22. Moos B, Williams D, Bolon I, Mupfasoni D, Abela-Ridder B, de Castaneda RR. A scoping review of current practices on community engagement in rural East Africa: Recommendations for snakebite envenoming. Toxicon: X. 2021;11:100073.
23. Aglanu LM, Amuasi JH, Prokesh E, Beyuo A, Dari CD, Ravensbergen SJ, et al. Community members and healthcare workers' priorities for the control and prevention of snakebite envenoming in Ghana. PLOS Neglected Tropical Diseases. 2023;17(7):e0011504.
24. Musoke D, Nalinya S, Lubega GB, Deane K, Ekirapa-Kiracho E, McCoy D. The impact of the COVID-19 lockdown on social and economic welfare in Uganda. Archives of Public Health. 2024;82(1):117.
25. Bravo-Vega C, Santos-Vega M, Cordovez JM. Disentangling snakebite dynamics in Colombia: how does rainfall and temperature drive snakebite temporal patterns? PLOS Neglected Tropical Diseases. 2022;16(3):e0010270.
26. Bhaumik S, Beri D, Jagnoor J. The impact of climate change on the burden of snakebite: evidence synthesis and implications for primary healthcare. Journal of Family Medicine and Primary Care. 2022;11(10):6147-58.
27. Warrell DA, Williams DJ. Clinical aspects of snakebite envenoming and its treatment in low-resource settings. The Lancet. 2023;401(10385):1382-98.
28. Mugasha R, Kwiringira A, Ntono V, Nakiire L, Ayebazibwe I, Kyozira C, et al. Enhancing functionality and scaling up of the electronic Integrated Diseases Surveillance and Response system in Uganda, 2020-2023: Description of the journey, challenges, and lessons learned.
29. Landry M, D'Souza R, Moss S, Chang HH, Ebelt S, Wilson L, et al. The association between ambient temperature and snakebite in Georgia, USA: a case-crossover study. GeoHealth. 2023;7(7):e2022GH000781.
30. Ediriweera DS, Kasthuriratne A, Pathmeswaran A, Gunawardene NK, Jayamanne SF, Murray K, et al. Evaluating spatiotemporal dynamics of snakebite in Sri Lanka: Monthly incidence mapping from a national representative survey sample. PLoS neglected tropical diseases. 2021;15 (6):e0009447.

Temporal and Spatial Comparison of Malaria Incidence Between Urban and Rural Areas in Uganda, 2020–2024

Authors: Maria Nakabuye[1], Michael Mutegeki[1], Charity Mutesi[1], Ronald Elly Kimuli[2], Gerald Rukundo[2], Benon Kwesiga[1], Richard Migisha[1]
Institutional affiliations:[1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda, [2]Ministry of Health, Kampala, Uganda
Correspondence*: Tel: +256 706233470, Email: nakabuyemaria.mn@uniph.go.ug

Summary
Background: Although malaria has traditionally affected rural populations, recent evidence indicates increasing transmission in rapidly growing urban areas of sub-Saharan Africa. We compared the spatial and temporal distributions of malaria incidence in urban and rural Uganda to inform targeted interventions.
Methods: We analyzed monthly District Health Information Software-2 (DHIS2) malaria data (2020–2024) for 10 cities and their corresponding districts in Uganda. Urban areas were city divisions and district town councils. Rural areas were sub-counties from the districts corresponding to each selected city. To calculate annual malaria incidence per 1,000 population, we abstracted monthly data of malaria confirmed outpatient cases from DHIS2 as the numerator and population data was obtained from Uganda Bureau of Statistics as the denominator. A linear regression model with a year × setting interaction term assessed differences in incidence trends between rural and urban settings.
Results: Malaria incidence trend differed significantly between settings (interaction p=0.047) with rural setting showing a higher incidence. Rural incidence declined (p-value=0.02) from 318 (573,115/1,800,600) to 254 (460,619/1,814,024) while urban incidence decreased from 249 (606,421/2,434,300) to 198 (544,457/2,744,443) per 1,000 population though not significantly. We observed spatial variation, with rural areas such as Gulu (mean incidence of 810 per 1,000 population) and Lira districts (281 per 1,000 population) showing high burden, and persistent urban hotspots like Soroti City, which recorded a mean incidence of 949 per 1,000 population.

Continues to page 14

Continued from page 13

Conclusion: Rural Uganda continues to carry a higher burden and experienced a more significant decline than urban areas. Localized urban hotspots exist. Uganda should sustain vector control and case management in rural areas while implementing targeted surveillance-driven interventions in urban hotspots focused on hotspot identification, improved housing and drainage of breeding sites.

Background

Uganda is among the countries with the highest malaria burden globally. Malaria remains endemic throughout the country and is a leading cause of morbidity and mortality, accounting for approximately 30-40% of outpatient visits(1).

Global malaria control and elimination strategies emphasize the scale-up of key interventions such as insecticide-treated nets, indoor residual spraying, malaria chemoprevention, and prompt diagnosis and treatment alongside strengthened malaria surveillance systems to guide targeted interventions. In Uganda, these interventions have contributed to reductions in malaria burden in several parts of the country, however, their implementation has largely focused on high-transmission rural districts where malaria burden has historically been greatest (1).

Historically, malaria has been considered a disease that disproportionately affects rural populations, particularly those with limited access to healthcare, preventive measures, and adequate housing (2). However, malaria risk is closely linked to socio-economic conditions such as poverty, housing quality, and access to healthcare, which may affect vulnerable populations in both rural and urban settings (3-6).

In some contexts, urban malaria remains a substantive threat, with incidence rates that are higher than those reported in rural areas. One systematic review noted that prevalence estimates in urban areas ranged from as low as 0.06% to as high as 58%, with many studies reporting 10 and 30% (7). Factors such as unplanned urban growth, informal settlements, poor drainage, standing water from construction activities, and migration from high-transmission rural areas may sustain or even increase malaria transmission in these environments (8-10). We determined the burden and compared incidence trends of malaria in rural versus urban settings in Uganda from 2020 to 2024.

Methods

This was a descriptive study of monthly, routinely collected malaria surveillance data submitted into District Health Information Software-2 (DHIS2) by health facilities in Uganda cities and their respective districts using malaria confirmed outpatient cases recorded in the Health Management Information System (HMIS)-105 from 2020 to 2024.

We stratified study locations into urban and rural areas in accordance with the classification framework of Uganda Bureau of Statistics (UBOS). Urban areas were defined as city divisions for all Ugandan cities (except Kampala City since it doesn't have a corresponding district) and district town councils within the districts corresponding to each selected city. For comparison, rural areas were defined as sub-counties within the same districts corresponding to each selected city. For each district, rural malaria incidence was computed using data from all sub-counties excluding the city divisions and town councils classified under the urban category. We compared data of 10 cities and their corresponding districts. Cities included; Lira, Gulu, Soroti, Fort portal, Masaka, Mbarara, Hoima, Arua, Mbale and Jinja. The corresponding districts were; Lira, Gulu, Soroti, Kabarole, Masaka, Mbarara, Hoima, Arua, Mbale and Jinja.

We abstracted monthly data of confirmed outpatient malarias from DHIS-2 at division, sub-county, and town council level. Population data to calculate incidence was obtained from UBOS from 2020 to2024. We calculated annual malaria incidence using the malaria confirmed outpatient cases as the numerator and the respective population estimates as the denominator, per 1000 population. Line graphs were used to visualize temporal trends of malaria incidence across both urban and rural areas and these were disaggregated by sex and age. Age was categorized into age categories <5 years and ≥5 years. The seasonal Mann-Kendall test was used to test for significance of trends in malaria incidence. We used linear regression to test whether malaria incidence trends differed between urban and rural areas. We drew choropleth maps using Quantum Geographic Information System (QGIS) to show the spatial distribution of annual malaria incidence across the Ugandan cities corresponding dis-

Continues to page 15

Continued from page 14

Results

Between 2020 and 2024, a total of 3,698,997 malaria cases were reported in urban areas and 2,542,090 malaria cases in rural areas. In urban settings, malaria incidence declined (p-value=0.34) from 249 per 1,000 population (606,421/2,434,300) in 2020 to 198 per 1,000 population (544,457/2,744,443) in 2024. In rural settings, malaria incidence reduced (p-value=0.02) from 318 per 1,000 population (573,115/1,800,600) to 254 (460,619/1,814,024) per 1,000 population between 2020–2024 (Figure 1). The trend in malaria incidence differed between rural and urban areas since the interaction between year and setting was statistically significant (p=0.047).

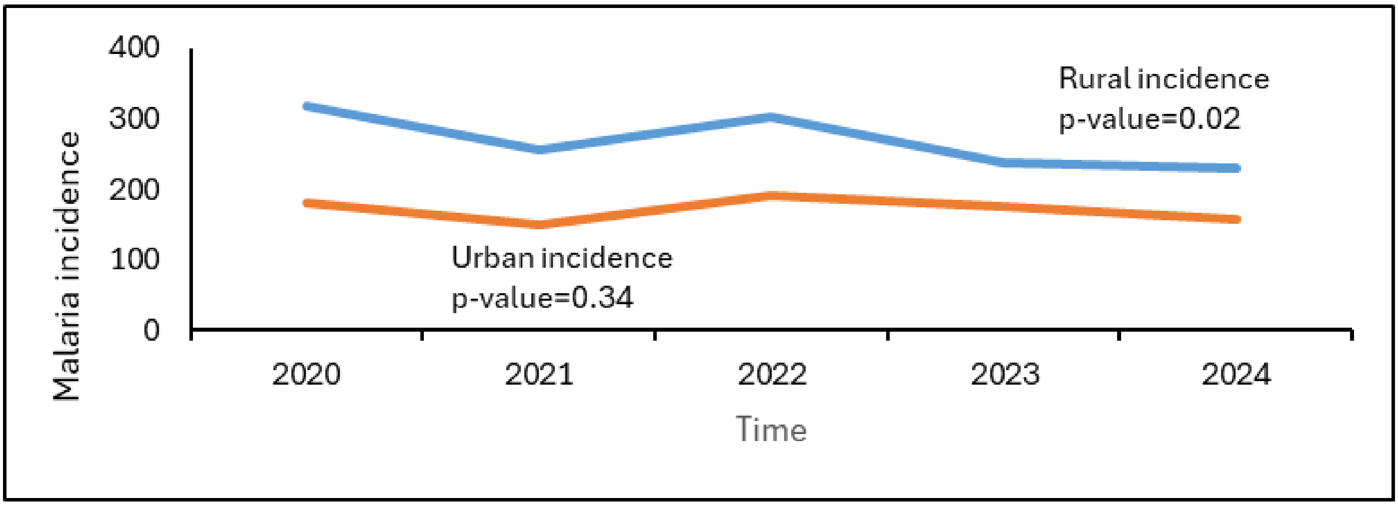


Figure 1. Temporal distribution of rural and urban malaria incidence in Uganda 2020–2024

Both males and females demonstrated declining trends in rural and urban areas. Although incidence remained consistently higher among males and females from rural areas compared to their urban counterparts, rural populations experienced a statistically significant malaria incidence decline, with females showing a reduction from 393 (357,944/911,800) to 306 (292,302/955,290), p=0.02 and males from 242 (215,171/888,800) to 196 (168,317/858,734), p=0.01 (Figure 2).

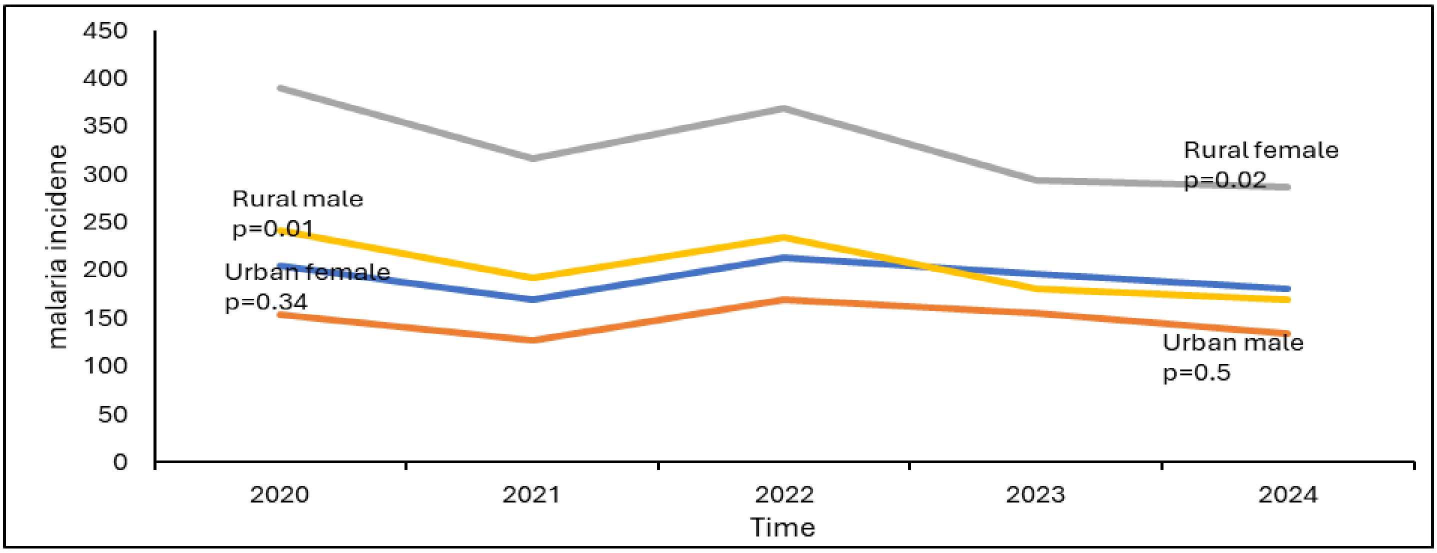


Figure 2: Temporal distribution of rural and urban incidence disaggregated by sex, Uganda, 2020–2024

Malaria incidence declined over time in both children <5 years and individuals aged ≥5 years across rural and urban areas. Although incidence remained consistently higher in rural populations compared to their urban counterparts, the decline in rural areas was statistically significant, with reductions observed among <5 years from 433 (129,450/298,900) to 303 (91,301/301,128), p=0.02 and individuals ≥5 years 295 (443,665/1,501,700) to 244 (369,318/1,512,896), p=0.02 (Figure 3).

Continues to page 16

Continued from page 15

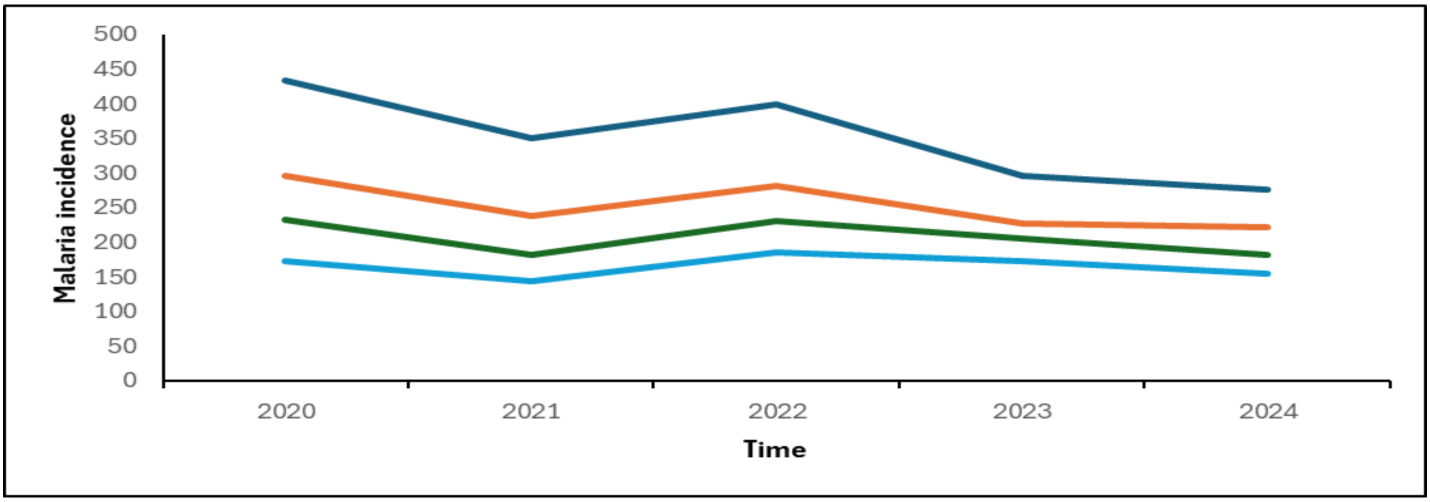


Figure 3: Temporal distribution of rural and urban incidence disaggregated by age, Uganda, 2020–2024

Over the study period, Gulu District, Soroti City, and Lira District consistently reported the highest malaria incidence. In most settings, urban areas exhibited lower incidence than their corresponding districts, including Gulu, Lira, Mbale, Jinja, and Fort Portal cities. Arua, Hoima, Masaka, and Mbarara cities showed incidence comparable to their respective districts. Soroti City consistently experienced higher malaria incidence than its corresponding district throughout the study period (Figure 4).

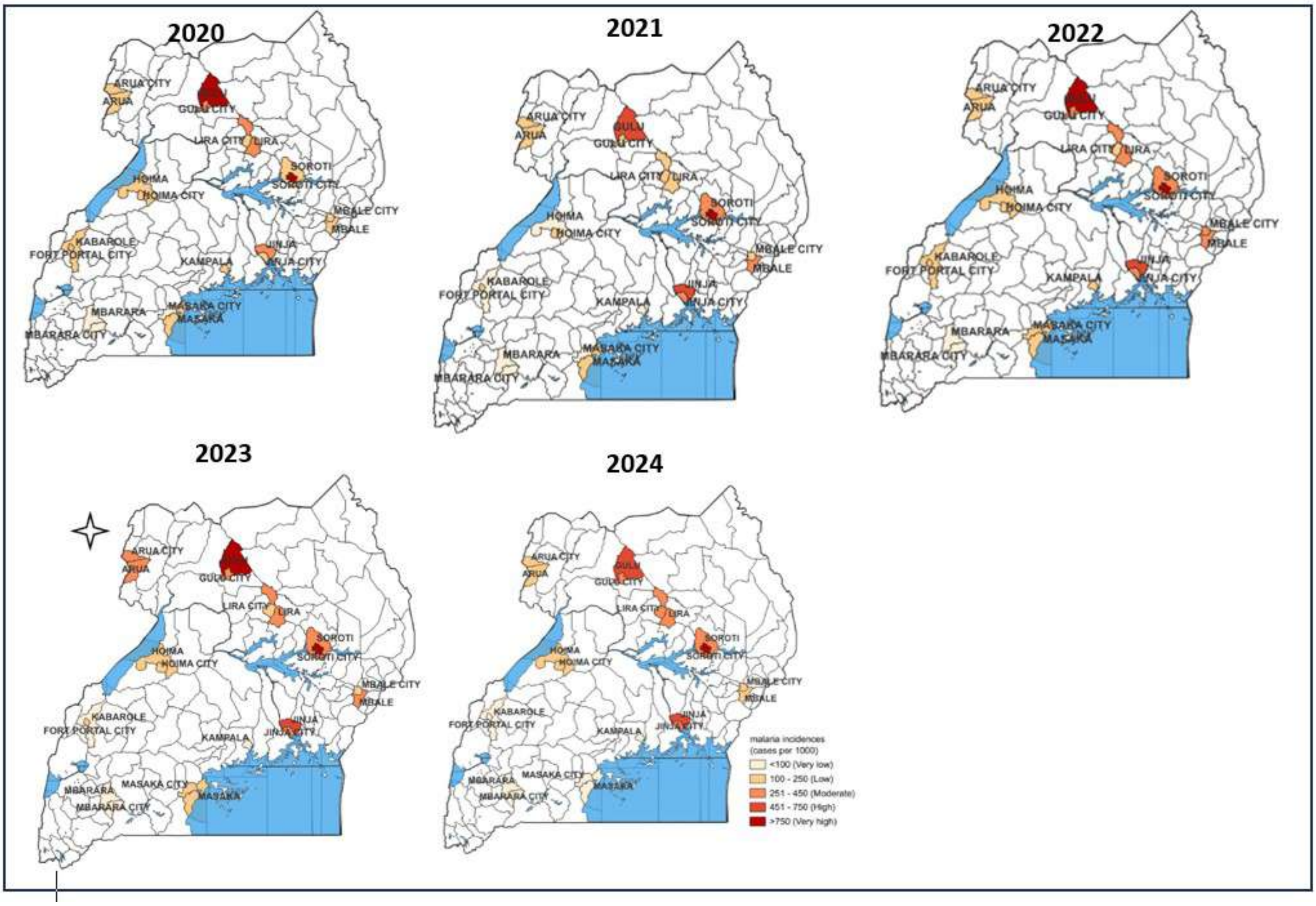


Figure 4: Spatial distribution of malaria incidence by cities and respective districts, Uganda, 2020–2024

Continues to page 17

Continued from page 16

Discussion

Malaria incidence in Uganda declined between 2020 and 2024 in both urban and rural areas, the declines may reflect intensified vector control and case management interventions in high-burden districts, including indoor residue spraying in targeted districts, long-lasting insecticide nets distribution cycles, and improved diagnostic access. The rural burden remained higher than urban areas throughout the study period. Previous studies have reported rural environments to present with greater ecological suitability for malaria transmission due to factors such as extensive vegetation, agricultural activities, and greater availability of mosquito breeding sites (11, 12).

Sex-disaggregated patterns showed comparable trends among males and females, with both sexes experiencing higher incidence in rural areas. Across both urban and rural areas, females recorded a consistently higher malaria incidence than males. Studies suggest that women are generally more likely than men to seek health care services. Age-disaggregated results are consistent with existing literature indicating that children under five were more affected by malaria due to their limited immunity (5). This trend persisted in both urban and rural areas highlighting the need for sustained pediatric-focused malaria prevention and case management interventions.

Spatial analysis revealed that certain rural districts, such as Gulu and Lira, consistently recorded high incidence, while some cities, notably Soroti, emerged as an urban hotspot with incidence surpassing that of its corresponding district.

Study limitations

We used routine DHIS2 surveillance data, which are subject to some limitations including data incompleteness that may affect the validity and interpretation of the findings.

Conclusion

Rural areas consistently experienced a higher malaria incidence compared to urban areas across age and sex groups. However, important heterogeneity exists, with urban hotspots such as Soroti City and high-burden rural districts including Gulu District sustaining elevated transmission. Children under five years and females were more affected in both settings. Malaria incidence declined in both urban and rural areas of Uganda between 2020 and 2024, with rural areas continuing to experience a higher burden, malaria control efforts should prioritize sustaining and strengthening core interventions in high-transmission rural areas. At the same time, targeted strategies should be implemented in identified urban hotspots, such as Soroti City, to address localized drivers of transmission. These strategies may include intensified surveillance, focal vector control, and environmental management targeting urban-specific risk factors such as informal settlements, urban agriculture, and peri-urban mosquito breeding sites. Additionally, interventions should prioritize vulnerable populations, particularly children under five years and females, who were disproportionately affected in both settings.

Conflict of interest: The authors declared no conflict of interest.

Authors' contribution: All authors contributed to the write-up and review of the bulletin article. MN drafted the initial version of the article. MN, MM, and CM participated in the data collection and data analysis. RM, BK supervised the data collection and reviewed the draft bulletin article for substantial intellectual content. All authors read and approved the final bulletin article.

Acknowledgements

We appreciate the Ministry of Health Division of Health Information for giving us access the data upon which our results are based.

References

1. Health Mo. Malaria Reduction and Elimination Strategic Plan 2021-2025. 2023 [
2. G. KA. Socio-Economic Determinants and Malaria Risk: Assessing the Impact of Poverty, Housing Conditions, and Healthcare Accessibility in High-Incidence Regions. 2024.
3. Tatem AJ, Gething PW, Smith DL, Hay SI. Urbanization and the global malaria recession. Malaria Journal. 2013;12(1):133.

Continues to page 18

Continued from page 17

4. Wilson MI Fau - Krogstad DJ, Krogstad Dj Fau - Arinaitwe E, Arinaitwe E Fau - Arevalo-Herrera M, Arevalo-Herrera M Fau - Chery L, Chery L Fau - Ferreira MU, Ferreira Mu Fau - Ndiaye D, et al. Urban Malaria: Understanding its Epidemiology, Ecology, and Transmission Across Seven Diverse ICEMR Network Sites. 2007(1476-1645 (Electronic)).
5. Hay SI, Guerra CA, Tatem AJ, Atkinson PM, Snow RW. Urbanization, malaria transmission and disease burden in Africa. Nature Reviews Microbiology. 2005;3(1):81-90.
6. Omumbo JA, Guerra Ca Fau - Hay SI, Hay Si Fau - Snow RW, Snow RW. The influence of urbanisation on measures of Plasmodium falciparum infection prevalence in East Africa. 2005(0001-706X (Print)).
7. Merga H, Degefa T, Birhanu Z, Tadele A, Lee MC, Yan G, et al. Urban malaria in sub-Saharan Africa: a scoping review of epidemiologic studies. 2025(1475-2875 (Electronic)).
8. Merga H, Degefa T, Birhanu Z, Tadele A, Lee M-C, Yan G, et al. Urban malaria in sub-Saharan Africa: a scoping review of epidemiologic studies. Malaria Journal. 2025;24(1):131.
9. Merga H, Degefa T, Birhanu Z, Lee M-C, Yan G, Yewhalaw D. Urban malaria and population mobility in sub-Saharan Africa: systematic review and meta-analysis. Malaria Journal. 2025;24(1):264.
10. Martens P, & Hall, L. Malaria on the Move: Human Population Movement and Malaria Transmission. . Emerging Infectious Diseases. 2000.
11. Villena OC, Arab A, Lippi CA, Ryan SJ, Johnson LR. Influence of environmental, geographic, socio-demographic, and epidemiological factors on presence of malaria at the community level in two continents. Scientific Reports. 2024;14(1):16734.
12. Dear NF, Kadangwe C, Mzilahowa T, Bauleni A, Mathanga DP, Duster C, et al. Household-level and surrounding peri-domestic environmental characteristics associated with malaria vectors Anopheles arabiensis and Anopheles funestus along an urban–rural continuum in Blantyre, Malawi. Malaria Journal. 2018;17(1):229

Continues to page 19

Continued from page 18

Clustered deaths linked to severe malaria and poor health-seeking behavior in Mid-Western Uganda, June–September 2025

Authors: Michael Mutegeki[1]*, Nasif Matovu[1], Aman Denise Kyomugisha[1], Florence Nambaziira[1], Vivian Nakaweesa[1], Peter Chris Kawungezi[2], Atek Kagirita[3], Benon Kwesiga[1], Richard Migisha[1]
Institutional affiliations: [1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda, [2]Mubende Regional Referral Hospital, Mubende, Uganda, [3]Department of Integrated Epidemiology, Surveillance and Public Health Emergencies, Ministry of Health, Kampala, Uganda
Correspondence*: Tel:+256787882985, Email: mutegekim@uniph.go.ug

Summary
Background: Uganda remains one of the top 3 countries most affected by malaria with a nationwide prevalence of 19% and endemicity in over 95% of the districts. In August 2025, clusters of rapidly progressing deaths were reported in Mubende, Kakumiro, and Kyankwanzi districts in mid-western Uganda. We investigated to determine the cause, magnitude, contributing factors, to recommend public health measures to prevent more related deaths.
Methods: A suspected case was defined as an acute onset of ≥2 symptoms (fever, headache, dizziness, abdominal pain, vomiting, or weakness) in a resident of the affected sub-counties (Kibijjo, Kisala, Butoloogo and Southern Division) from June 1–September 5, 2025. Cases were identified through healthcare facility records review and active case search with house-to-house searches assisted by local leaders. We interviewed cases on demographics, symptoms, exposures, and health-seeking behavior. Samples (blood, urine, stool) were picked and tested for infectious and toxicological causes. We also analyzed malaria surveillance data. We summarized alive cases and deaths using descriptive epidemiology (proportions and attack rates by age group, sex and sub-county).
Results: We identified 57 cases from 46 households. Thirteen (23%) died, with 8/13 (62%) dying within 24 hours of symptom onset. The majority of cases were children aged 6–18 years (38/57,65%). One-third (15/46) of households had ≥1 case. Kisala Sub-county was the most affected with an attack rate of 409 cases per 100,000 population. Out of the total cases, 40/57 (70%) first sought care at drug shops/clinics and 12/57 (21%) self-medicated. Of 1,304 records reviewed, malaria was the leading diagnosis with 716 cases (55%) and a test positivity rate of 57%. *Plasmodium falciparum* was detected in 14/22 (64%) of the tested samples. Malaria surveillance data of the affected region showed case counts consistently exceeded the epidemic threshold from week 1–27 of 2025, confirming a malaria upsurge. All cases tested negative for viral hemorrhagic fevers and toxicological agents.
Conclusion: The clustered deaths were caused by severe malaria, exacerbated by poor health-seeking behaviors. We recommended enhancing community-based mortality surveillance, risk communication and test-and-treat approaches to reduce transmission and prevent more related deaths.

Background
Uganda remains one of the top 3 countries most affected by malaria (1) with a nationwide prevalence of approximately 19% and endemic in over 95% of the districts in the country. Unexplained clustered deaths represent a major public health concern due to their potential to signal emerging infectious diseases, outbreaks of unknown pathogens, environmental or toxicological exposures(2). Such events can rapidly overwhelm local health systems, create fear within communities, and pose significant threats to national health security if not promptly investigated(3).

Globally clustered deaths have been associated with various causes, including infectious diseases such as viral hemorrhagic fevers, severe malaria, bacterial meningitis, or anthrax; exposure to toxins such as pesticides or contaminated food; or sociocultural practices that facilitate rapid transmission of pathogens(4). In addition, clusters of unexplained deaths are associated with delayed detection of novel pathogens, as seen with Ebola virus disease (EVD) (5) and Covid-19, underscoring the need for timely and systematic investigation.

Continues to page 20

Continued from page 19

On August 7, 2025, the Mubende District Surveillance Focal Person (DSFP) reported a cluster of unexplained deaths to the Mubende Regional Public Health Emergency Operations Centre (RPHEOC). The deaths occurred within a short time frame and were characterized as an acute illness with high fatality, raising suspicion of a possible outbreak or exposure to a common risk factor. Preliminary verification by the RPHEOC confirmed additional clusters of deaths in neighboring Kyankwanzi and Kakumiro districts. We investigated to establish the cause of the clustered deaths, assess the magnitude of the illness, identify factors contributing to the deaths, and recommend evidence-based interventions to prevent further spread and improve preparedness for similar future events.

Methods

We investigated in Mubende, Kyankwanzi, and Kakumiro districts in mid-Western Uganda. This districts had experienced an EVD outbreak in 2022. These districts are characterized by scattered rural settlements, subsistence farming, and limited access to health services.

We defined a suspected case as; an acute onset of ≥2 of the following symptoms; headache, general body weakness, fever, dizziness, vomiting, and abdominal pain in a resident of the affected sub-counties (Kibijjo, Kisala, Butoloogo and Southern Division) of Kyankwanzi, Mubende, and Kakumiro districts from June 1, 2025 to September 5, 2025.

We reviewed symptoms from the preliminary reports and then used a structured case investigation form to conduct active case search. We conducted a house to house search starting with households that had reported deaths since June 1, 2025 and then included all their neighborhood households that had cases. We interviewed all alive cases and caretakers of cases who had passed on demographics, symptoms onset, health seeking behaviors, and outcomes.

We reviewed records (outpatient and inpatient registers) of selected high volume health facilities serving the affected sub-counties covering the June 1 to September 5, 2025.

We analyzed malaria data from District Health Information System 2 (DHIS2) for the affected districts and constructed malaria surveillance channels. We also assessed the trend of inpatient malaria cases from January to July 2025 using the
Mann–Kendall trend test.

We collected a total of 86 samples from 44 alive case-patients. They were analyzed for malaria parasites, metagenomics sequencing, pathogen discovery and for viral hemorrhagic fever/arbovirus using Polymerase Chain Reaction (PCR) and toxicology tests done.

We entered all collected data into a standardized Kobo Collect questionnaire. We conducted descriptive epidemiology on the identified cases.

We conducted the investigation in response to a public health emergency as part of the National Rapid Response Team of the Ministry of Health in Uganda as non-research. Verbal informed consent was obtained from cases or caretakers as proxy for minors or cases that had died prior to the start of each interview.

Results

Descriptive epidemiology

We identified a total of 57 cases. 13/57 had died yielding an overall case fatality rate of 23% with 8/13 (62%) dying within the first 24 hours of symptom onset. Children and adolescents aged 6–18 years were the most affected with attack rates 10 times higher than that of adults >18 years. Kisala was the most affected sub-county (Table 1).

Continues to page 21

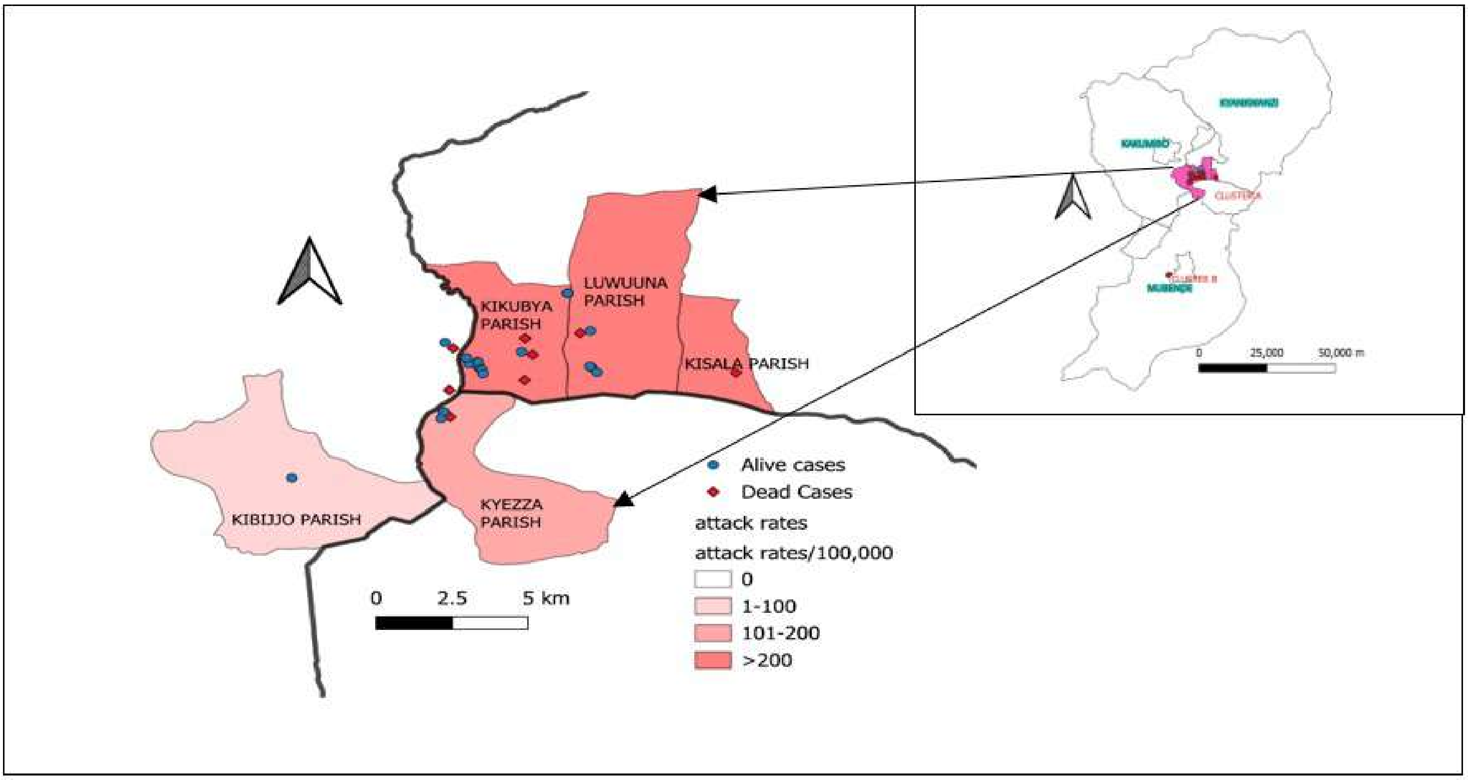
Continued from page 20

Table 1: Attack rates by sex, age and Sub-counties during Clustered deaths investigation in Mubende region, June–August 2025

Characteristics	Cases	Percentage (%)	Population	Attack rate (per 100,000)
Sex				
Male	23	40.4	590,964	3.9
Female	34	59.6	637,659	5.3
Age group (Years)				
0-5	15	26	206,451	7.8
6 -13	23	41	258,724	8.9
13-18	15	26	200,527	7.5
≥ 18	4	7	613,618	0.7
Sub-counties				
Butoloogo	15	26	32,307	46
Kibijo	1	2	30,525	3.3
Kisala	38	67	9,284	409
Southern Division	3	5	42,789	7.0

We identified two clusters A and B with cluster A having 95% (54/57) of cases (Figure 1)

Figure 1: Clusters A and B with location of cases, Mubende region, June–August 2025



Continues to page 22

Continued from page 21

Cases were uniformly distributed over the three months (not clustered in time) (Figure 2).

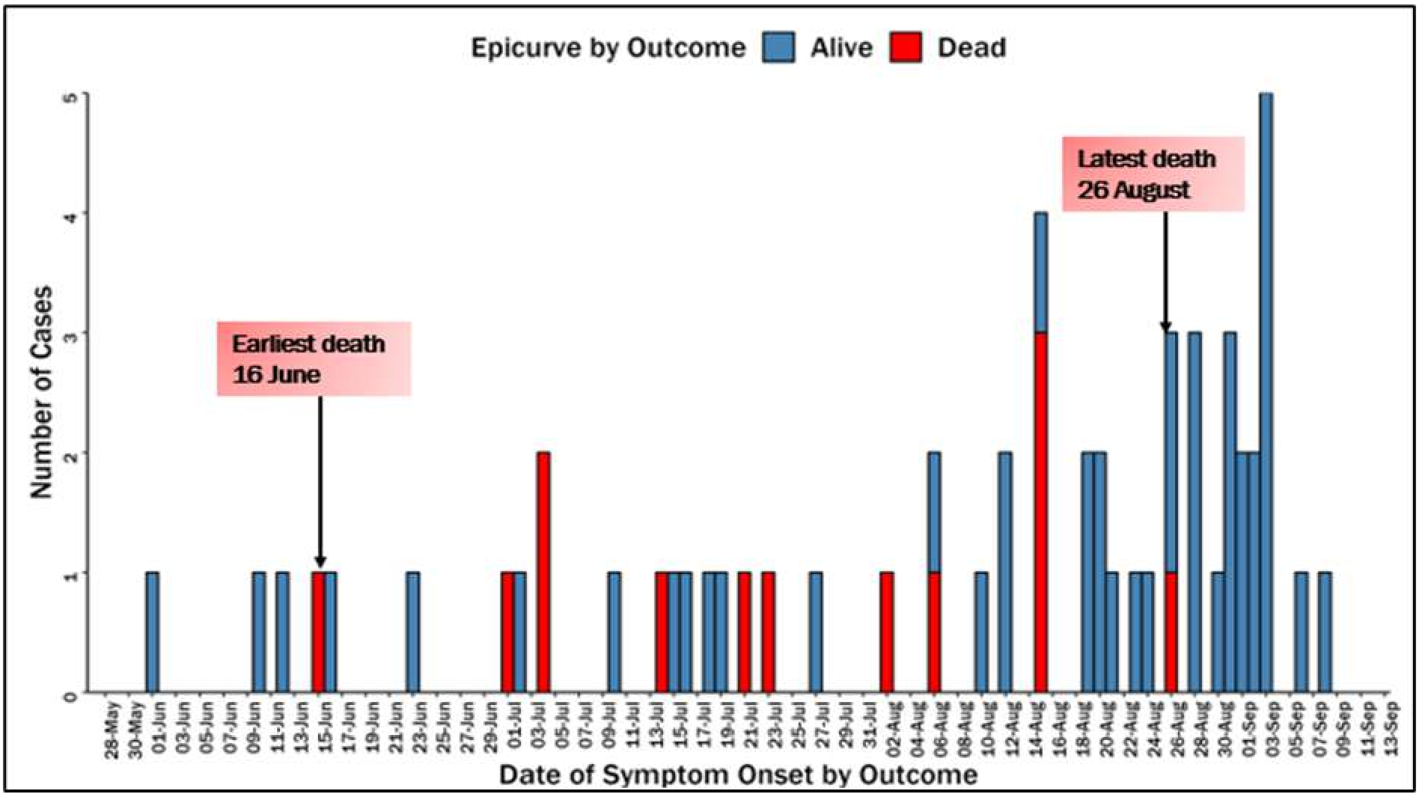


Figure 2: Epidemiological curve stratified by outcome, Mubende Region, June–August 2025

Health seeking behaviors

We found 28/57 (67%) cases sought care first from a private clinic and 13/57 (24%) of cases opted for self-medication at home. Further analysis revealed that over half of the cases, 32/57 (56%) sought medical attention more than 24 hours after symptom onset.

Records review results

We reviewed a total of 1,304 patient records from 5 high volume health facilities in the affected districts. Malaria was the most common diagnosis 717/1,304 (55%) with an overall test positivity rate of 57%.

Results from analysis of District Health Information System 2 data for the affected districts

From the DHIS2 analysis, weekly surveillance data for Mubende District revealed that the number of malaria cases remained persistently above the upper limit of the normal malaria threshold for most weeks of the year (Figure 3). For Kakumiro and Kyankwanzi districts, the cases were within the normal malaria channels.

Continues to page 23

Continued from page 22

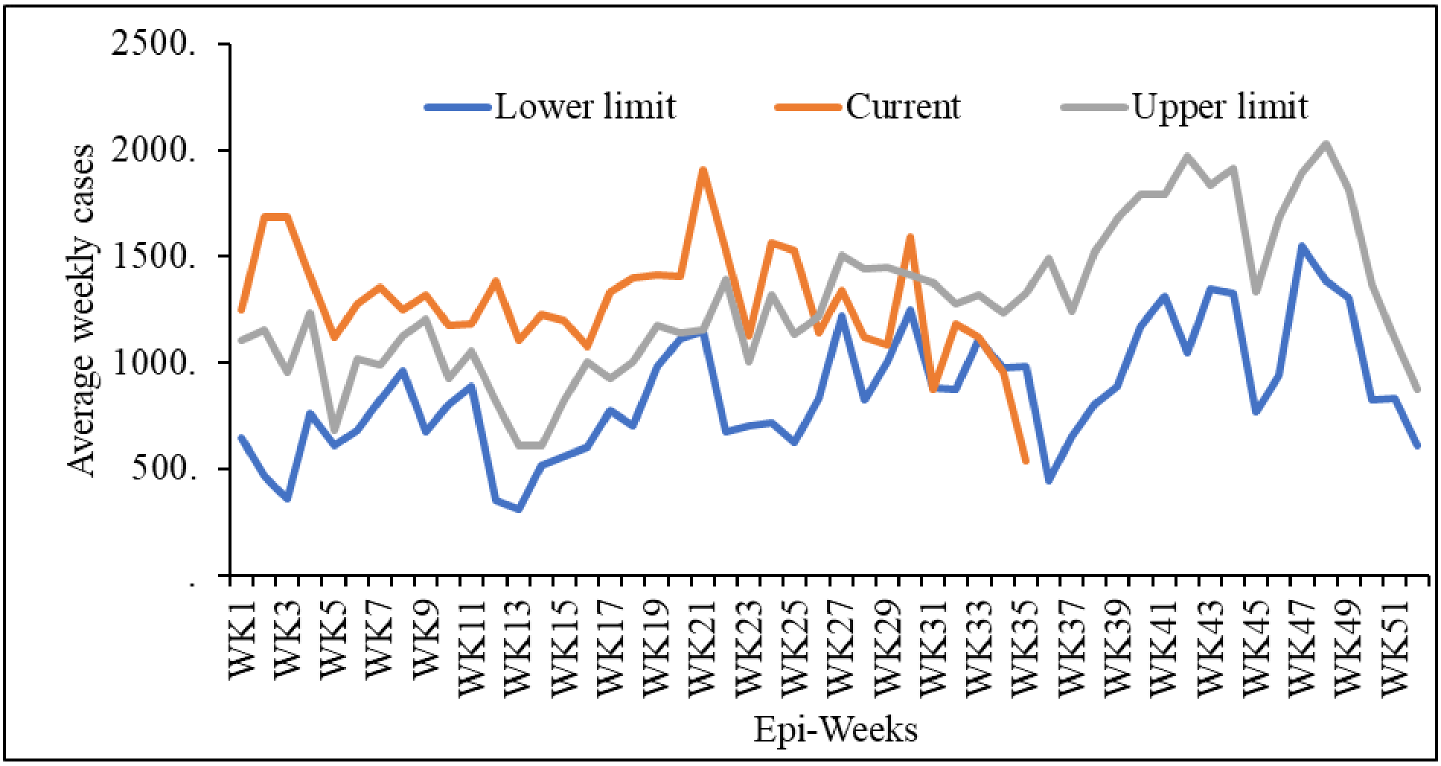


Figure 3: Malaria surveillance channel for Mubende District, January–August 2025

Additionally, analysis of inpatient malaria admissions also demonstrated a progressive increase across two of the three affected districts from January to July 2025. A statistically significant upward trend was observed for Mubende (p=0.007), whereas the changes in Kakumiro and Kyankwanzi were not statistically significant (Figure 4).

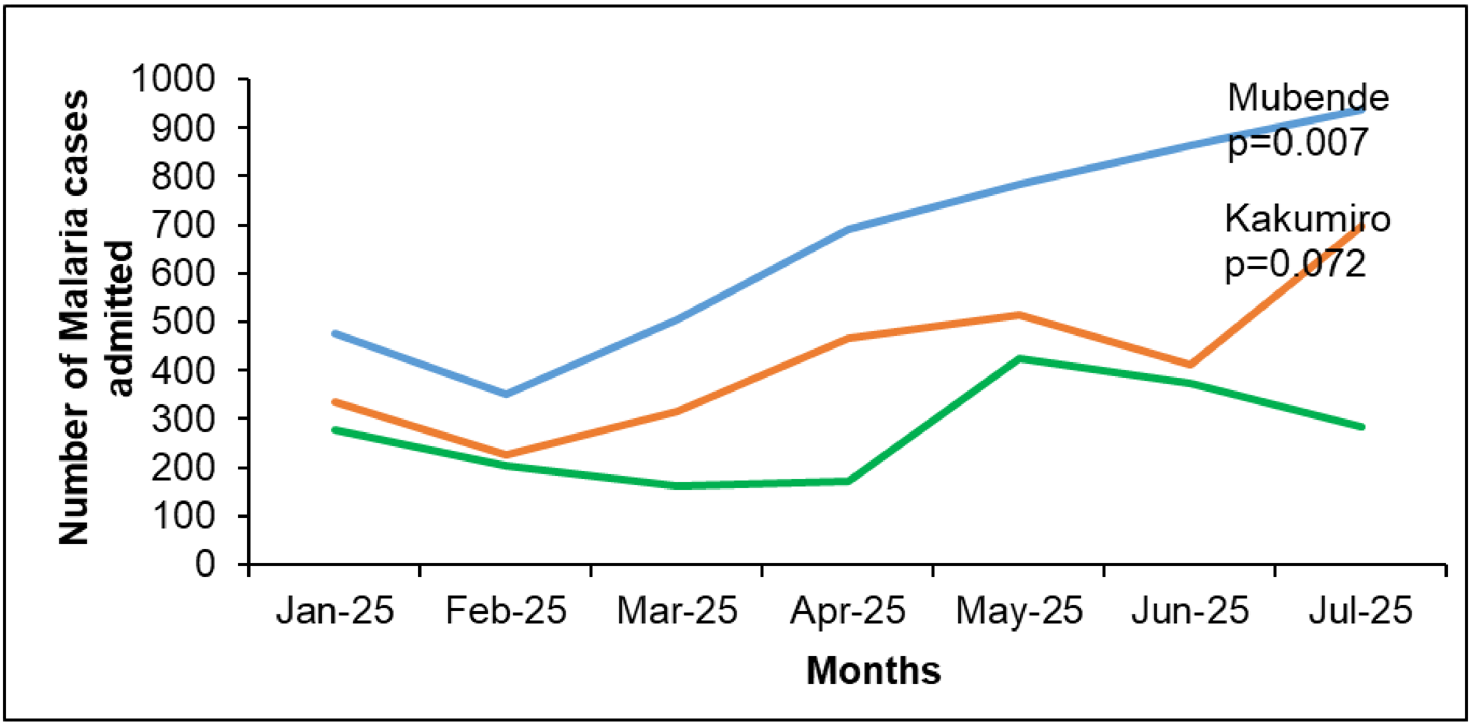


Figure 4: Trends of Malaria inpatient admissions in the three affected districts, January–July 2025

Continues to page 24

Continued from page 23

Laboratory investigations

Out of the 22 samples tested by PCR, 14/22 (64%) were positive for *Plasmodium falciparum* with 7/14 (50%) having high parasitemia. All samples tested negative for viral hemorrhagic fevers and arboviruses. Toxicological analysis similarly tested negative for heavy metals and there was no bacterial growth from blood and stool cultures.

Discussion

The investigation revealed that the clustered deaths in Mubende, Kyankwanzi, and Kakumiro districts were due to severe malaria, against a backdrop of poor health-seeking behavior. Most deaths occurred within 24 hours of illness onset is consistent with previous literature documenting the rapid progression of severe Plasmodium falciparum malaria, particularly if untreated (6).

Children below 18 years were most affected. This aligns with known malaria epidemiology, where children are most vulnerable due to low acquired immunity (7).

The epidemiological curve indicated sustained transmission from June to August 2025.This temporal pattern is consistent with seasonal malaria transmission in mid-western Uganda, where peaks coincide with the rainy season (8).

The investigation revealed delayed and inappropriate health-seeking behaviors greatly contributing to the high fatality rate. Such delays increase the risk of severe malaria and death. This is consistent with other studies done in Uganda about delayed time to seek healthcare (9).

The laboratory results strongly support malaria as the etiology, with 64% PCR positivity for P. falciparum and confirmation of high parasitemia in several cases. Importantly, the exclusion of VHFs, bacterial infections, and toxic exposures strengthens the attribution of clustered deaths to malaria. This contrasts with some previous unexplained death clusters in Uganda that were later linked to zoonotic or toxicological etiologies reinforcing the importance of comprehensive differential testing (10).

Study limitations

During this investigation, we were unable to obtain biological samples from the deceased cases because they had already been buried by the time the team arrived. This could have introduced a misclassification bias since we relied on caregiver reports to reconstruct the course of illness. Additionally, the investigation relied on ability of the participant to recall, introducing potential recall bias regarding onset of symptoms, care-seeking behavior, and exposures. Despite these limitations, the investigation provides critical insights into the pattern, context, and possible drivers of the clustered deaths and offers evidence to inform targeted public-health action.

Conclusion

Our results demonstrate that clustered deaths in Mubende, Kakumiro, and Kyankwanzi districts were most plausibly attributable to severe malaria among school-aged children, exacerbated by poor health seeking behavior.

Public health actions

We identified and treated all symptomatic cases in the community and initiated VHT-led follow-up and referral of severe cases. Additionally, we held district-led community dialogues and health education to address myths and cultural barriers. Through the district Health Teams, we quantified and redistributed Long Lasting Insecticidal Nets to the affected Sub-counties.

Recommendations

We recommended enhancing community-based mortality surveillance and risk communication to easily identify severe cases. Using the test-and-treat approaches could prevent related deaths.

Conflict of interest

The authors declare that they had no conflict of interests.

Authors' contributions

MM, NM, ADK, FN, VN Conceived and designed the study, acquired, analyzed, interpreted the data and wrote the first draft of the manuscript. PCK and AK were the team leads of the investigation. RM, BK, provided technical supervision and Bulletin review.

Continues to page 25

Continued from page 24

Acknowledgements
We would like to appreciate the Uganda Public Health Fellowship Program for the technical support provided during the preparation and conducting the investigation. We appreciate the Uganda Ministry of Health (MoH), National Malaria Elimination Division, Mubende Regional Emergency Operation Centre, Mubende, Kakumiro and Kyankwanzi District health teams for supporting the outbreak response efforts.

References

1. Venkatesan P. The 2023 WHO World malaria report. The Lancet Microbe. 2024 Mar;5(3): e214. doi:10.1016/S2666-5247(24)00016-8
2. Hajjeh RA, Relman D, Cieslak PR, Sofair AN, Passaro D, Flood J, et al. Surveillance for Unexplained Deaths and Critical Illnesses. Emerg Infect Dis. 2002 Feb;8(2):145–53. doi:10.3201/eid0802.010165
3. Wartenberg D. Investigating Disease Clusters: Why, When and How? Journal of the Royal Statistical Society Series A: Statistics in Society. 2001 Jan 1;164(1):13–22. doi:10.1111/1467-985X.00181
4. Guthmann JP, Bonnet M, Ahoua L, Dantoine F, Balkan S, Van Herp M, et al. Death Rates from Malaria Epidemics, Burundi and Ethiopia. Emerg Infect Dis. 2007 Jan;13(1):140–3. doi:10.3201/eid1301.060546
5. Curran KG, Gibson, JJ, MD, Marke, D, MD, Caulker V, et al. Cluster of Ebola Virus Disease Linked to a Single Funeral — Moyamba District, Sierra Leone, 2014. MMWR Morb Mortal Wkly Rep. 2016 Mar 4;65(8):202–5. doi:10.15585/mmwr.mm6508a2
6. Yap XZ, McCall MBB, Sauerwein RW. Fast and fierce versus slow and smooth: Heterogeneity in immune responses to *Plasmodium* in the controlled human malaria infection model. Immunological Reviews. 2020 Jan;293(1):253–69. doi:10.1111/imr.12811
7. Doolan DL, Dobaño C, Baird JK. Acquired Immunity to Malaria. Clin Microbiol Rev. 2009 Jan;22(1):13–36. doi:10.1128/CMR.00025-08
8. Kigozi SP, Kigozi RN, Sebuguzi CM, Cano J, Rutazaana D, Opigo J, et al. Spatial-temporal patterns of malaria incidence in Uganda using HMIS data from 2015 to 2019. BMC Public Health. 2020 Dec;20(1):1913. doi:10.1186/s12889-020-10007-w
9. Rutebemberwa E, Kallander K, Tomson G, Peterson S, Pariyo G. Determinants of delay in care-seeking for febrile children in eastern Uganda. Tropical Med Int Health. 2009 Apr;14(4):472–9. doi:10.1111/j.1365-3156.2009.02237.x
10. Bbosa N, Ssemwanga D, Weiss SL, Kalungi S, Mawanda A, Ssentudde R, et al. Identification of Anthrax as the Cause of a Cluster of Unexplained Deaths, Uganda, 2023: The Role of Metagenomic Next-Generation Sequencing and Postmortem Specimens. The American Journal of Tropical Medicine and Hygiene. 2025 Apr 2;112(4):835–9. doi:10.4269/ajtmh.24-0489

Continues to page 26

Continued from page 25

Measles outbreak investigation in Kumi District, Uganda, May–July 2025

Authors: Aman D. Kyomugisha[1*], Paul E. Okello[1], Yasiini Nuwamanya[2], Sharon Namasambi[1], Deborah Aujo[1], Vianney J. Kigongo[1], Benon Kwesiga[1], Richard Migisha[1]
Institutional Affiliations: [1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Ministry of Health, Kampala, Uganda
[2]Uganda National Expanded Program on Immunization, Ministry of Health, Kampala, Uganda.
Correspondence*: Tel:+256759803507, **Email:** akyomugisha@uniph.go.ug

Summary
Background: In July 2025, Kumi District in Eastern Uganda reported a Measles outbreak among children admitted in high-volume healthcare facilities. We investigated to determine the scope of the outbreak, identify risk factors for transmission, and recommend evidence-based control measures.
Methods: A suspect case was acute onset of fever and maculopapular rash with ≥1 of cough, coryza, or conjunctivitis in a Kumi District resident from 1 May–31 July 2025. A confirmed case was suspected case with a positive measles-specific IgM test. We reviewed health facility records and conducted community case searches. We conducted descriptive epidemiology, environmental assessment, and an age-matched case-control study (1:2) to identify risk factors for transmission. Vaccine coverage and effectiveness were estimated for the first Measles vaccine dose (MR1).
Results: We identified 177 cases, including 6 (3%) confirmed and 2 (1.1%) deaths. Among the cases, 104 (61%) were vaccinated with one dose. Children aged 6–8 months (AR=41/10,000), males (AR=7/10,000) and Northern Division (AR=76/10,000) were most affected. Poor isolation and triage practices were observed in high-volume healthcare facilities. Visiting healthcare facilities (aOR=20, 95% CI:5.9–70), playing around neighbouring homes (aOR=5, 95% CI:1.2–21), and attending religious gatherings increased odds of infection (aOR=1.9, 95% CI:1.03–3.5). Vaccination with ≥1 dose was protective (aOR=0.35, 95% CI:0.16-0.77). Vaccine coverage among controls was 73% for MR1 and 13% for MR2. Vaccine effectiveness for MR1 was 65% (95% CI:23–84).
Conclusion: Suboptimal vaccine coverage and poor isolation and triage practices in healthcare facilities fuelled transmission of measles in this outbreak. We recommended mass vaccination to increase vaccination coverage and refresher trainings for health workers emphasizing effective infection prevention and control.

Introduction

Measles is a highly infectious disease caused by Measles virus and has an incubation period ranging from 7–21 days. Measles presents with fever, maculopapular skin rash, coryza, cough and conjunctivitis ((1)). It is transmitted from person to person through respiratory droplets or direct contact.

Measles is a leading cause of deaths globally, with more than 95% of the deaths occurring in developing countries and its case fatality is usually between 0.1% in developed settings to 30% in refugee settings (1–3). Measles vaccination has been found to be effective in preventing Measles transmission and 82 countries have been able to achieve Measles elimination (4). Measles vaccination is 93% effective at preventing Measles after 1 dose of vaccine and approximately 97% effective after 2 doses (5). Measles vaccination coverage of over 95% for both doses should be attained in order to achieve HERD immunity ad therefore prevent community transmission (1).

On 1 July, 2025, the Kumi District Health Officer received an alert from the in-charge of Kumi HC IV. They had noticed an influx of suspected Measles cases on the paediatrics in-patient ward at Kumi HCIV. Blood samples tested positive for Measles antibodies and this confirmed an outbreak. We investigated to determine the scope of the Measles outbreak, identify risk factors for transmission and recommend evidence-based control measures in Kumi District.

Methods

Kumi District is situated in Eastern Uganda, forming part of the Teso Sub-region. It is bordered by Katakwi in the North, Bukedea in the East, Ngora in the West and Pallisa in the South. Kumi District has a population of 286,992; which is largely rural across the 14 sub-counties and 4 town councils; with the district headquarters in Southern Division. Prior to Kumi declaring an outbreak, 6 other districts within Teso Sub-region had reported measles outbreaks including; Bukedea, Serere, Kaberamaido, Kalaki, Amuria, and Kapelebyong.

Continues to page 27

Continued from page 26

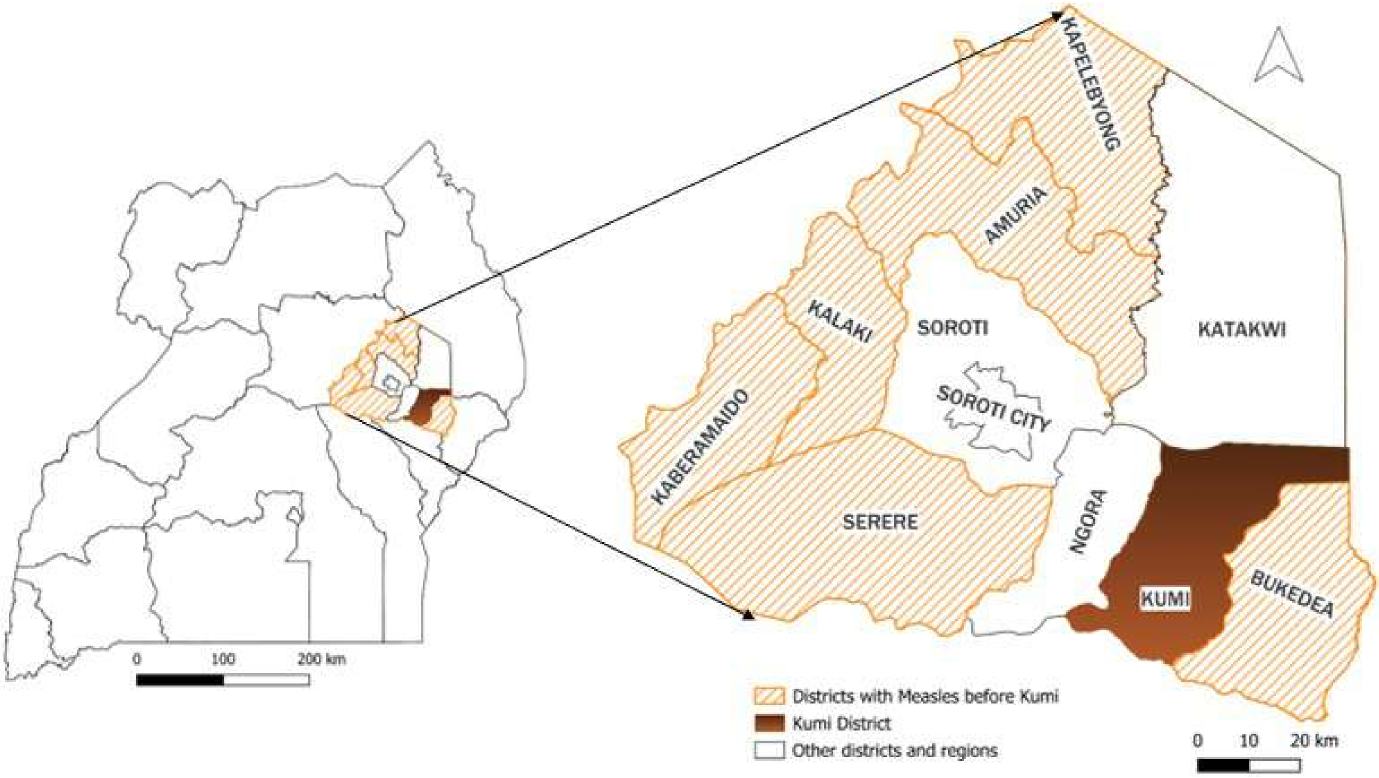


Figure 1: Location of Kumi District within Uganda and a zoomed-out map of Teso sub-region showing measles-affected neighbouring districts, 2025

We defined a suspected Measles case as acute onset of fever and maculopapular rash, with at least one of the following symptoms: cough, runny nose (coryza) or conjunctivitis in a resident of Kumi District from 1 May, 2025 to 31 July, 2025.
A confirmed case was defined as a suspected case that had tested positive for IgM Measles-specific antibody test.

We line listed suspected measles cases by reviewing records at 3 high volume healthcare facilities. We conducted active case search in healthcare facilities and communities.

We conducted descriptive epidemiology of the identified cases. We then visited the Measles isolation ward at Kumi HC IV to observe triage and isolation practices. We also observed interactions of children in the community.

We conducted 56 hypothesis generating hypotheses to identify potential exposure factors that could have occurred within a 21-day period prior to onset of symptoms. The exposures of interest included not being vaccinated, visiting a health facility, receiving a visitor from another district, visiting a communal water collection point, travelling to another district and attending a religious gathering or burial. We also discussed with the district health team about potential exposures.

We conducted a 1:2 age-matched case control study in Northern Division, the most affected sub-county, to test the hypotheses that were generated. We interviewed 105 cases and 210 controls. Controls were selected randomly from neighbourhood households which had no case from 1 May 2025 to 31 July 2025.

We assumed that the controls are representative of the general population and estimated vaccine coverage amongst the controls with the following formula;

$$\text{Vaccine coverage } (\%) = \frac{\text{number of controls vaccinated}}{\text{total number of eligible controls}} \times 100$$

Continues to page 28

Continued from page 27

We estimated vaccine effectiveness for MR1 vaccine with the following formula;

$$\text{Vaccine effectiveness } (\%) = 1 - aOR \times 100$$

Where aOR is the adjusted odd ratio of receipt of one vaccination dose.

The outbreak investigation was conducted in response to a public health emergency on behalf of the National Rapid Response Team of the Ministry of Health in Uganda. Kumi District Health Office and Chief Administrative Office granted local approval to investigate. The Office of the Associate Director for Science at the US Centres for Disease Control and Prevention (CDC) Uganda determined that this investigation was non-research and that its primary intent was public health practice or disease control. Verbal informed consent was obtained from participants or guardians as proxy for minors prior to the start of each interview.

Results

Descriptive epidemiology

Between 1 May 2025 and 31 July 2025, we identified 177 cases of which 6 (3%) were confirmed and 2 (1%) died. The majority of cases (105, 70%) had received ≥1 dose of MR vaccine. Children aged 6 -8 months (AR=41/10,000) and those aged 9-59 months (AR=24/10,000) were the most affected. Males (AR=7/10,000) were slightly more affected than females (6/10,000). The most affected sub-counties were Northern Division (AR=76/10,000) and Ogooma sub-county (AR=10/10,000) (Figure 2). In addition to fever and rash, the majority (>80%) also presented with cough and coryza.

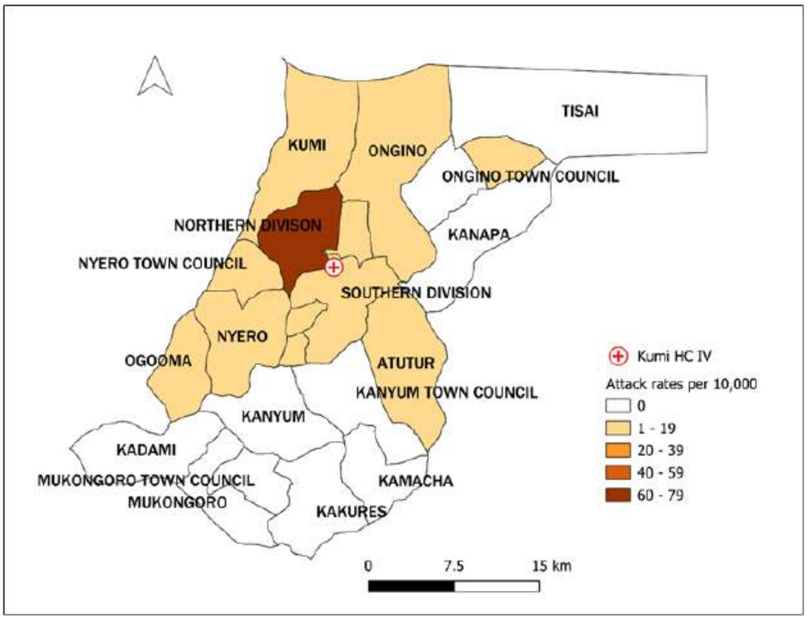


Figure 2: Attack rates by sub-county during a measles outbreak in Kumi district, Eastern Uganda, May-July 2025

The epidemic curve (Figure 3) shows a protracted outbreak from May–July 2025. The outbreak started with sporadic cases linked to attendance of religious gatherings that had symptomatic children followed by clusters related to symptomatic visitors from affected neighbouring districts and then widespread community transmission propagated by hospital exposure in high volume healthcare facilities. There was a mass vaccination campaign in response to widespread community transmission.

Environmental assessment findings

At Kumi HC IV, we observed that suspected measles patients were mixed with other patients within the inpatient ward during drug dispensing and there was unrestricted access to the isolation ward which also served as a walkway to public toilets. In the community, symptomatic children were playing freely with healthy children.

Hypothesis generation findings

Of the 56 hypothesis generating interviews conducted, 68% had received at least one dose of Measles vaccine.

Continues to page 29

Continued from page 28

We hypothesized that attending religious or social gatherings (66%), visiting a health facility (32%) and not being vaccinated (32%) during the exposure period were potentially associated with an increased risk of measles transmission.

Case-control investigation findings

Among those interviewed, 215 (68%) of respondents had history of receiving ≥1 MR vaccination. Vaccination (aOR=0.4, 95%CI=0.2–0.8), visiting a health facility during the exposure period (aOR=20, 95%CI=5.7–71), playing around neighbouring homes during the exposure period (aOR=5.7, 95% CI=1.4–24) and attending a religious gathering during the exposure period (aOR=1.9, 95%CI=1.03–3.5) were significantly associated with measles transmission in Kumi District (Table 1).

Vaccine coverage and effectiveness

The estimated vaccine coverage of 73% among controls who had history of receiving ≥1 MR vaccine dose. The estimated vaccine effectiveness was 65% (95%CI=23-84).

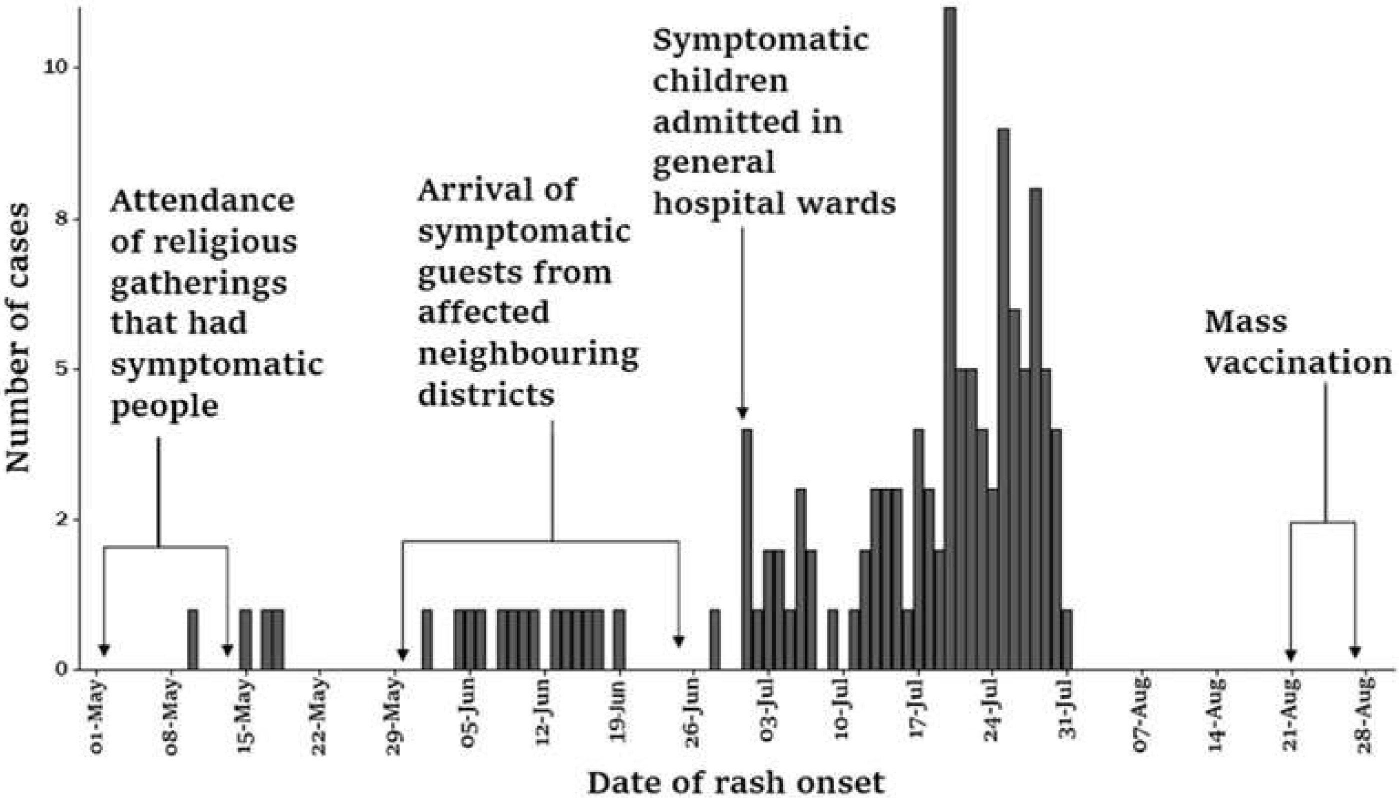


Figure 3: Distribution of measles cases by date of earliest rash onset, Kumi District, May-July 2025

Continues to page 30

Continued from page 29

Table 1: Risk factors for Measles transmission in Kumi District, May-July 2025

Exposures	Cases n (%)	Controls n (%)	cOR (95% CI)	aOR (95% CI)
Vaccination				
No	43 (41)	57 (27)	Ref	Ref
Yes	62 (59)	153 (73)	0.3 (0.2–0.7)	0.4 (0.2–0.8)
Visited health facility in exposure in exposure period				
No	272 (86)	199 (95)	Ref	Ref
Yes	43(14)	11 (5)	18 (5.43–59)	20 (5.7–71)
Play area in exposure period				
At home	91 (87)	202 (96)	Ref	Ref
Away from home	14 (13)	8 (4)	5.8 (1.9–18)	5.7 (1.4–24)
Attended social gatherings in exposure period				
None	35 (34)	110 (52)	Ref	Ref
Burials	6 (6)	1 (0.5)	15.2 (1.8–128)	2.9 (0.2–33)
Religious	57 (56)	87 (41)	2 (1.2–3.3)	1.9 (1.03–3.5)
Multiple	4 (4)	12 (5.7)	1 (0.3–3.3)	0.8 (0.2–3.3)

cOR – Crude Odds Ratio
aOR – Adjusted Odds Ratio

Discussion

This investigation confirmed a protracted measles outbreak in Kumi District driven by significant immunity gaps and high-risk social and clinical exposures. Between May–July 2025, children aged 6-59 months were most affected. Key drivers of transmission included suboptimal vaccine coverage and effectiveness alongside intense exposure at healthcare facilities, within community through play and at religious gatherings.

Children below the age of vaccination were vulnerable due to early waning of maternal antibodies as suggested in some studies (6)Vaccination was protective; however, the estimated coverage among controls was below the ≥95% threshold required for herd immunity (7–9). These findings suggest that the population remained highly vulnerable due to high numbers of unvaccinated children. The accumulation of susceptible individuals contributed to the magnitude and duration of the outbreak (3,4).

Health facility exposure emerged as the dominant transmission pathway. Environmental assessments revealed gaps in infection prevention and control with mixing of suspected measles patients with other patients and ineffective isolation. These findings highlight high-volume healthcare facilities as amplification points as reported in other studies (10–13).

Social interactions played a significant role in propagating the virus as symptomatic children interacted freely at religious and neighbourhood gatherings as reported in other studies in Uganda (14).

Study limitations

Not all suspected cases were laboratory confirmed, which may have resulted in misclassification. Vaccination status was partly based on caregiver recall when vaccination cards were unavailable, introducing potential reporting inaccuracies. Exposure histories were collected retrospectively and may have been affected by recall bias. The analytical study was conducted in the most affected sub-county, which may limit generalizability to the entire district.

Conclusion

We confirmed a propagated measles outbreak that was amplified by gaps in infection prevention and control in health facilities, as well as by community interactions in areas with suboptimal immunization coverage.

Continues to page 31

Continued from page 30

Public health actions
Following the dissemination of our findings, a district-wide mass measles vaccination campaign was conducted on 21–25 August 2025 following this investigation.

Recommendations
District health authorities could provide refresher training to strengthen infection prevention and control practices in paediatric wards. Targeted mop-up vaccination activities could increase MR1 and MR2 coverage in affected communities. Health facilities could strengthen triage, isolation, and patient-flow systems, while surveillance teams could enhance early detection and rapid response to prevent similar outbreaks.

Conflict of interest
The authors declare that they had no conflict of interest.

Authors' contribution
KDA conceived, designed, analyzed, interpreted the study and wrote the draft bulletin. KDA, PO, SN, DA conducted the investigation and contributed to report writing, VJK reviewed the draft bulletin. YN, BK, RM reviewed the bulletin to ensure intellectual content.

Acknowledgments
The authors convey their gratitude to the Ministry of Health through Uganda National Expanded Program for Immunization (UNEPI) for the technical support provided, Kumi District leadership for the approvals and leading this investigation in the district. We also thank the staff at Kumi Health Centre IV, health inspectors and Village Health Teams for the assistance in identifying and interviewing cases and controls.

References
1. Do LAH, Mulholland K. Measles 2025. New England Journal of Medicine. 2025 Jun 25. doi:10.1056/NEJMRA2504516
2. Measles [Internet]. [cited 2025 Aug 22]. Available from: https://www.who.int/news-room/fact-sheets/detail/measles
3. Measles vaccines WHO Position Paper – April 2017 [Internet]. Available from: http://www.who.int/wer
4. Minta AA, Ferrari M, Antoni S, Lambert B, Sayi TS, Hsu CH, et al. Progress Toward Measles Elimination — Worldwide, 2000–2023. MMWR Morb Mortal Wkly Rep. 2024 Nov 14;73(45):1036–42. doi:10.15585/MMWR.MM7345A4 PubMed PMID: 39541251.
5. Questions About Measles | Measles (Rubeola) | CDC [Internet]. [cited 2025 Oct 9]. Available from: https://www.cdc.gov/measles/about/questions.html
6. Waaijenborg S, Hahné SJM, Mollema L, Smits GP, Berbers GAM, Van Der Klis FRM, et al. Waning of Maternal Antibodies Against Measles, Mumps, Rubella, and Varicella in Communities With Contrasting Vaccination Coverage. J Infect Dis. 2013 Jul 1;208(1):10. doi:10.1093/INFDIS/JIT143 PubMed PMID: 23661802.
7. Okiror Okello E, Migisha R, Ampaire I, Nsubuga F, Nalwanga J, Kwizera P, et al. Measles outbreak investigation in Kakumiro District, Uganda, February–May 2024. Discover public health. 2025 Dec 1;22(1). doi:10.1186/s12982-025-00446-4
8. Oduoye MO, Zuhair V, Marbell A, Olatunji GD, Khan AA, Farooq A, et al. The recent measles outbreak in South African Region is due to low vaccination coverage. What should we do to mitigate it? New Microbes New Infect. 2023 Sep 1;54:101164. doi:10.1016/J.NMNI.2023.101164 PubMed PMID: 37455850.
9. Bello IM, Akpan GU, Teshager HF, Jepkorir LE, Girma MB. Factors influencing recurrent measles outbreak in Ethiopia among under-five children: a systematic review. PAMJ-OH 2024; 15:7. 2024 Oct 11;15(7). doi:10.11604/PAMJ-OH.2024.15.7.43800
10. Biribawa C, Atuhairwe JA, Bulage L, Okethwangu DO, Kwesiga B, Ario AR, et al. Measles outbreak amplified in a pediatric ward: Lyantonde District, Uganda, August 2017. BMC Infect Dis. 2020 Jun 5;20(1):1–8. doi:10.1186/S12879-020-05120-5/FIGURES/3 PubMed PMID: 32503450

Continues to page 32

Continued from page 31

11. Torner N, Ferràs J, Curto L, Rebull J, Sol J, Costa J, et al. Measles outbreak related to healthcare transmission. Vacunas. 2021 Jan 1;22(1):20–7. doi:10.1016/J.VACUN.2020.08.002
12. Mfitundinda E, Migisha R, Mary Namusisi A, Wenani D, Kwesiga B, Ayeerwot R, et al. Investigation of a cross□border measles outbreak in Moroto District, northeastern Uganda, March–September, 2024 [Internet]. Vol. 22. 123AD;22:267. doi:10.1186/s12982-025-00581-y
13. Nsubuga F, Bulage L, Ampeire I, Matovu JKB, Kasasa S, Tanifum P, et al. Factors contributing to measles transmission during an outbreak in Kamwenge District, Western Uganda, April to August 2015. BMC Infect Dis. 2018 Jan 8;18(1):1–7. doi:10.1186/S12879-017-2941-4/TABLES/5 PubMed PMID: 29310585.
14. Measles outbreak Investigation in Terego District, Uganda, May- June, 2024. - UNIPH [Internet]. [cited 2025 Dec 10]. Available from: https://uniph.go.ug/measles-outbreak-investigation-in-terego-district-uganda-may-june-2024/

Measles Recurrence in a Refugee-Hosting Setting: An Outbreak Investigation in Kamwenge District, Uganda, 2025

Authors: Nasif Matovu[1]*, Aman D.Kyomugisha[1], Deborah Aujo[1], Yasiini Nuwamanya[1], Richard Migisha[1], Benon Kwesiga[1], Fred Nsubuga[2]
Institutional affiliations: [1]Uganda Public Health Fellowship Program, Ministry of Health, Kampala, Uganda, [2]Uganda National Expanded Program on Immunisation, Ministry of Health, Kampala, Uganda
Correspondence*: Tel: +256774755494, Email: matovan5@uniph.go.ug

Summary
Background: Measles remains a major cause of vaccine-preventable morbidity in Uganda, with 61/146 districts reporting a confirmed measles outbreak between January and October 2025, despite the availability of an effective Measles-Rubella (MR) vaccine. On 24 June 2025, Kamwenge, a refugee-hosting district, reported three confirmed measles cases. This was the 3rd measles outbreak in two years. We investigated to determine outbreak magnitude, identify risk factors, estimate vaccine effectiveness (VE), and vaccine coverage (VC), and recommend control prevention measures.
Methods: We defined a suspected case as acute onset of fever and generalized maculopapular rash plus ≥ 1of cough, coryza, or conjunctivitis in a Kamwenge resident during 1 April–7 July 2025; a confirmed case was a suspected case with measles IgM-positive. We identified cases through health facility records and community case search. We also conducted environmental assessments. We described cases by person, place, and time. Vaccination status was verified by the child\s health card or caregiver recall. Attack rates (AR) were calculated based on district population projections. We conducted a 1:3 age-and subcounty-matched case-control study and used conditional logistic regression to generate adjusted odds ratios (aOR). VE was calculated as $(1–OR_{M-H})$ ×100. We calculated VC as the proportion of vaccinated controls.
Results: We identified 109 cases (3 confirmed, 106 suspected); no deaths, 48.6% (53/109) were refugees. Overall AR was 3.2/10,000, highest among children 9-17 months (31/10,000) and refugees (13.2/10,000). Inadequate triage and delayed isolation were observed. Visiting places of worship significantly increased odds of infection (aOR=9.9, 95% CI:3.2-30.1) while receiving one MR dose reduced odds (aOR=0.11, CI:0.03-0.48), with greater protection for two doses (aOR=0.04, CI:0.01-0.29). VE for MR1 was 92% (CI: 76-98) and 96% (CI:80-99) for MR2. VC was 67% for MR1 and 36% for MR2 among children ≥9 months.
Conclusion: The outbreak was associated with suboptimal MR coverage, mass gatherings, and inadequate triage. A mass vaccination campaign (6-59 months) and strengthened isolation of febrile rash cases were implemented.

Continues to page 33

Continued from page 32

Background

The measles virus causes a severe systemic illness (1). Transmission of Measles is dependent on person-to-person spread through respiratory droplets or direct contact (2). Measles has an incubation period of approximately 10-14 days, a basic reproductive number (R_0) ranging from 12 to 18, making it one of the most contagious human diseases, with a case fatality rate of 1-3% in low-resource settings (3). Furthermore, measles virus infection diminishes preexisting antibodies that offer protection from other pathogens (4). Measles is re-emerging in several developed countries despite having an effective vaccine for decades. This resurgence is due to insufficient vaccination coverage in certain subpopulations, the anti-vaccination movement, and increased human mobility across borders(5). In Uganda, recurrent measles outbreaks continue to occur due to suboptimal routine immunization coverage, delayed supplemental immunization activities, and immunity gaps in refugee-hosting and hard-to-reach populations(6-8).

On June 24, 2025, Uganda's Ministry of Health reported a measles outbreak in Kamwenge District, with three of five samples testing positive for measles-specific IgM antibodies. The district has faced ongoing outbreaks due to low immunization rates, immunity gaps, and challenges in accessing refugee and hard-to-reach populations, raising concerns about local transmission and preparedness(6-8). We assessed the outbreak's scope, response timeliness, transmission risk factors, vaccine effectiveness, coverage, and recommended control measures.

Methods

The measles outbreak occurred in Kamwenge, a district in Western Uganda with a population of 337,167, including 39,929 refugees across 17 sub-counties. Kamwenge has a history of measles outbreaks, including one in February 2025, where 75% of case-patients had never received any Measles-Rubella vaccinations. The outbreak lasted from April to July 2025, affecting select sub-counties.

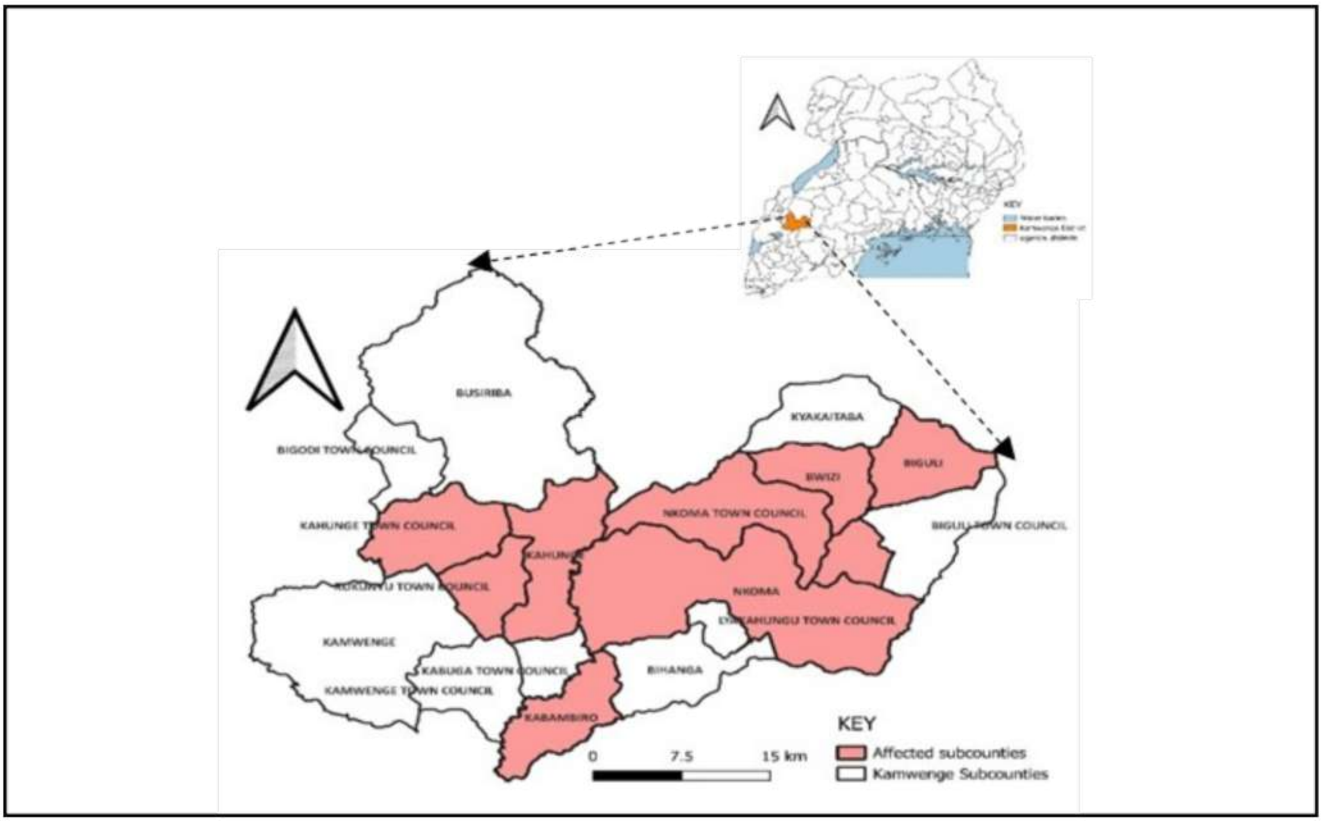


Figure 1: Measles-affected sub-counties in Kamwenge District, April to July 2025

Continues to page 34

Continued from page 33

We conducted descriptive epidemiology to understand the distribution of cases by person, place, and time

We conducted an environmental assessment to identify factors that facilitated measles transmission at Rwamwanja Health Center IV, the main measles treatment unit, and within affected communities to identify transmission risks, such as crowded settings, including schools and places of worship.

We conducted thirty-one hypothesis-generating interviews with parents or guardians of case-patients to assess exposures during the three weeks before symptom onset.
We conducted an age-matched case-control study in a ratio of 1: 3 controls to test the generated hypotheses, with controls selected from children without signs and symptoms suggestive of measles. Vaccination status was confirmed through cards or caregiver recall.
We estimated vaccine effectiveness using the formula VE = (1 - ORM-H), while the vaccine coverage was estimated using the proportion of eligible vaccinated respondents among the control group.

Whole blood samples were collected from suspected case-patients for measles IgM antibody testing using enzyme-linked immunosorbent assay (ELISA) kits.

This outbreak investigation was conducted as a public health response and classified as non-research. Approval was obtained from the Ministry of Health (MoH). The investigation was also approved by the US CDC and conducted in accordance with the applicable US federal laws, and permission was granted by the Kamwenge District Health Office. Verbal informed consent was obtained from respondents, and confidentiality was maintained throughout the investigation.

Results

Descriptive epidemiology

We recorded 109 measles cases, including three confirmed and 106 suspected. Seventy-nine percent (86/109) had fully recovered, with no deaths. Fifty-three percent were refugees, with an overall attack rate (AR) of 3.2/10,000, affecting females more (AR 3.7/10,000) than males (AR 2.8/10,000). The most affected age group was 9-17 months AR (30.8/10,000), followed by 18-59 months AR (7.7/10,000). Refugees had a higher AR of 13.3/10,000 compared to nationals at AR (1.9/10,000). All cases reported fever and maculopapular rash, with many also experiencing coryza (71%), cough (61%), and conjunctivitis (54)

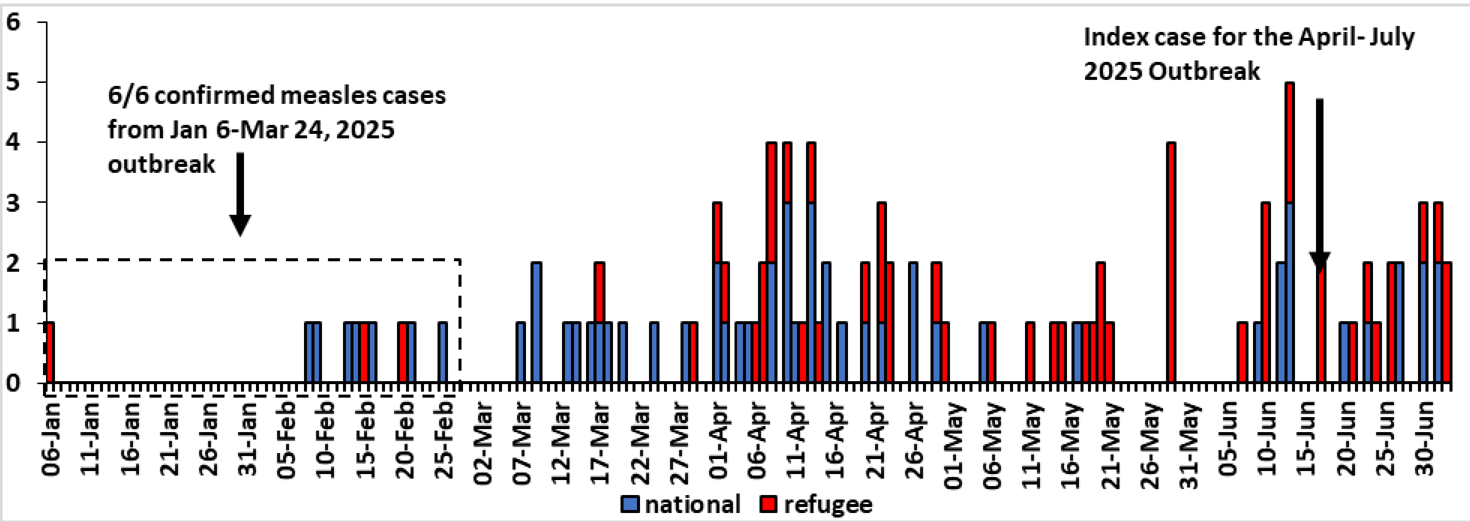


Figure 2: Distribution of measles cases by date of rash onset, in Kamwenge district, April– July, 2025

Continues to page 35

Continued from page 34

The index case for the April-July outbreak developed a rash on the 17th of June 2025. However, following active case search, we identified suspected cases dating as far back as 6th January (Figure 2).

The overall attack rate was 3.2/10,000 with subcounties of Nkoma Katalyeba Town Council (AR:12/10,000), Biguli subcounty (AR:8/10,000) reporting the highest attack rates (Figure 3).

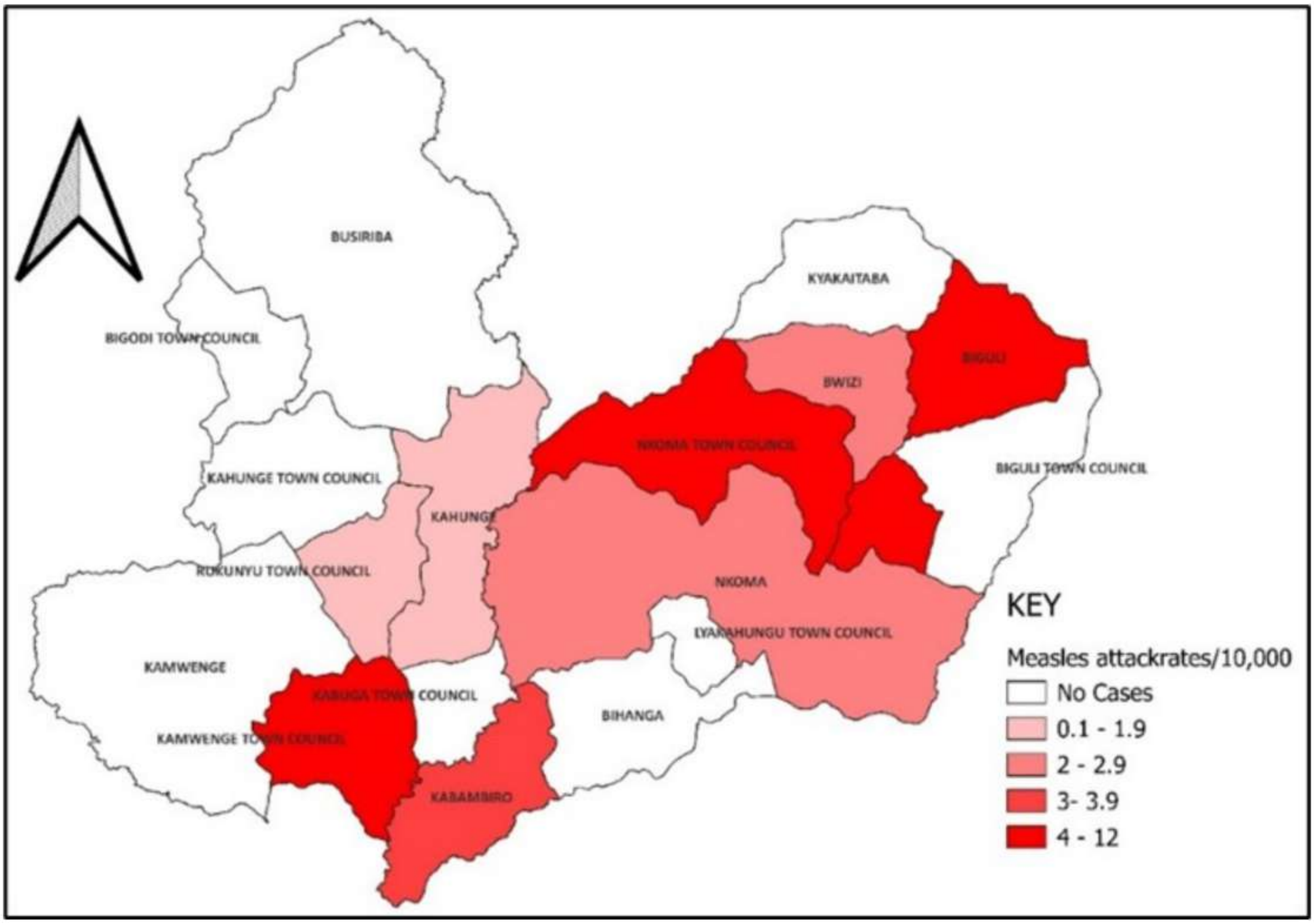


Figure 3: Attack rate by sub-county, per 10,000 persons in Kamwenge District, April to July 2025

Environmental assessment findings

The assessment found that measles patients were mixed with other pediatric cases at Rwamwanja HCIV and Biguli HC III. There were no functional isolation areas and inadequate triage processes. Large gatherings in Nkoma Katalyeba, combined with a lack of awareness about measles transmission, contributed to the spread of the infection.

Hypothesis generation findings

Table 1: Summary of the risk factors for Measles transmission in Kamwenge District

Risk factor	Percentage %
Attending a social gathering	79%
Attending a place of worship	66%
Attending school within 3 weeks before falling sick	53%
Not vaccinated against measles	46%
Visiting a water collection point	39%
Playing away from home	32%
Attending a health facility	25%

Continues to page 36

Continued from page 35

The potential risk factors for measles transmission included attending social gatherings (especially places of worship), going to school, and being unvaccinated (Table 1).

Case-control study findings

Children who received at least one dose of the measles-rubella (MR) vaccine had 89% lower odds of contracting measles (aOR 0.11; 95% CI 0.032-0.48), and those with at least two doses experienced a 96% reduction in risk (aOR 0.04; 95% CI 0.01-0.29). Additionally, visiting a place of worship three weeks before symptom onset increased the odds of measles infection by 10-fold (aOR 9.5; 95% CI 3.6 -25) (Table 2)

Table 2: Risk factors for measles transmission, Kamwenge, April– July, 2025

*We also assessed the relationship between becoming a case and the visiting a water collection point, school attendance, playing away from home, history of travel away from home and visiting a health facility before developing a rash and these were not significant.

Measles vaccine effectiveness

In the case-control analysis, 50% (32/64) of cases had received one dose of the measles vaccine, which was 93% effective against infection (ORMH 0.07; 95% CI=0.02-0.23).

Risk factor*	Number (%Exposed)		cOR (95%CI)	aOR (95%CI)
	Cases n (%)	Controls n (%)		
One Measles-Rubella vaccine dose				
Received	32(50)	97(86)	0.08(0.22-0.29)	0.11(0.03-0.48)
Did not receive	32(50)	16(14)	Ref	
Two Measles-Rubella vaccine doses				
Received	9(22)	54(77)	0.04(0.01-0.21)	0.04(0.01-0.29)
Did not receive	32(78)	16(23)	Ref	
Attending a place of worship				
Attended	40(55)	30(18)	9.9(3.9-25)	9.5(3.6-25)
Did not attend	33(45)	137(82)		

Continues to page 37

Continued from page 36

Overall, the vaccine effectiveness for one dose was estimated at 93% (95% CI=77-98), while those who received a second dose had even higher effectiveness at 95% (95% CI=78-99).

Measles vaccination coverage

Sixty-seven percent (105/156) of controls aged at least 9 months received at least one dose of the measles vaccine. Vaccination coverage was highest among children aged 9-17 months. Nationals had a higher coverage at 71%, while refugees were at 66%. The coverage for the second dose of MR2 was lower at 36%, with nationals only at 8% compared to refugees at 49%.

Discussion

Low immunization coverage and high-risk social mixing contributed to the April–July 2025 measles outbreak in Kamwenge District, consistent with patterns observed in Uganda and across the African Region. Recent outbreaks in districts such as Terego and Kakumiro have similarly highlighted persistent gaps, particularly among displaced populations where MR2 uptake remains low and susceptible populations accumulate over time(6-8). The higher attack rates observed among refugees in this investigation further underscore the vulnerability of displaced populations when routine immunization services are inconsistently accessed.

Crowded indoor gatherings, particularly religious congregations, likely amplified transmission. Evidence from outbreak investigations indicates that even small declines in vaccination rates can trigger rapid outbreaks in these settings,   due to intense social mixing(10). In this study, unvaccinated children attending places of worship had significantly higher odds of measles infection, consistent with previous Ugandan outbreak investigations identifying crowded social environments as key drivers of transmission. (11, 12).

Vaccination provided strong protection, with vaccine effectiveness estimated at 93% for one dose and 95% for two doses, consistent with field investigations and controlled trials (13). However, coverage remained suboptimal, with MR1 coverage at 67% and MR2 coverage at 36%, both below the ≥95% threshold required to interrupt transmission. Lower MR2 coverage and higher attack rates among refugee populations highlight the need for targeted strategies to improve completion of the two-dose schedule.

Health-facility factors also contributed to transmission. Mixing suspected measles cases with other patients and the absence of functional triage at Rwamwanja HC IV likely facilitated nosocomial transmission, as observed in other Ugandan measles investigations. (8) Strengthening infection prevention measures, including effective triage, isolation areas, and improved outpatient patient flow, is essential during outbreaks.

Globally, measles is considered a key indicator of immunization program performance, and WHO recommends achieving and sustaining≥95% coverage with two doses of measles- containing vaccine. Global strategies, including the Measles & Rubella Strategic Framework and Immunization Agenda 2030, emphasize closing immunity gaps through strengthened routine immunizations, targeted supplemental activities (SIAs), and strategies for underserved populations(14, 15). The findings from Kamwenge Support these priorities

Study limitations

Vaccination status partly relied on caregiver recall, where cards were unavailable, which may introduce recall bias.   Coverage estimates based on controls from affected sub-counties, which might not reflect the entire district, and the small number of laboratory samples tested may have underestimated confirmed cases.

Continues to page 38

Continued from page 37

Public health actions
A mass vaccination campaign targeting all children aged 6 to 59 months was conducted in all sub-counties. Active case finding was intensified in health facilities and communities, and triage and temporary holding areas were set up in outpatient departments. Social mobilization and risk communication efforts were also enhanced.

Conclusion
The outbreak was driven by immunity gaps from low MR1 and MR2 coverage, amplified by high-risk social mixing and gaps in infection prevention in health facilities. High vaccine effectiveness indicates that programmatic weakness in vaccination delivery, rather than vaccine failure were the primary driver.

Recommendations
Routine immunization should be strengthened to achieve and sustain ≥95% MR1 and MR2 coverage through targeted outreach and defaulter tracking. SIAs should prioritize refugee settlements and underserved communities. Health facilities should improve triage, isolation, and infection prevention practices, while community-based surveillance and engagement with religious and community leaders should be intensified to support vaccination uptake and outbreak control.

Conflict of interest: The authors declare that they have no conflict of interest

Author's contributions
NM, KDA, and AD designed the study and contributed to the data collection and analysis. NM led the writing of the bulletin. NM YN, AD participated in bulletin writing and review to ensure scientific integrity and intellectual content. All the authors contributed to the final draft of the bulletin

Acknowledgements
We appreciate the management of Kamwenge District Local Government and Rwamwanja HC IV for their stewardship, and the community for their participation in this investigation. We also thank the Ministry of Health, Uganda, National Expanded Program for Immunisation (UNEPI) for their technical support. We are grateful to the Global Alliance for Vaccines and Immunisation (GAVI) and the US CDC for funding this investigation.

References

1. Griffin DE, Ward BJ, Esolen LM. Pathogenesis Of Measles Virus Infection: An Hypothesis For Altered Immune Responses. The Journal of Infectious Diseases. 1994;170(Supplement_1):S24-S31.
2. Bester JC. Measles and Measles Vaccination: A Review. JAMA Pediatrics. 2016;170(12):1209-15.
3. Organisation WH. Measles Fact Sheet Genever: WHO; 2023 [cited 2025 04/10/2025]. Available from: https://www.who.int/news-room/fact-sheets/detail/measles.
4. Mina MJ, Kula T, Leng Y, Li M, de Vries RD, Knip M, et al. Measles virus infection diminishes preexisting antibodies that offer protection from other pathogens. Science. 2019;366(6465):599-606.
5. Rota JS, Hickman CJ, Sowers SB, Rota PA, Mercader S, Bellini WJ. Two Case Studies of Modified Measles in Vaccinated Physicians Exposed to Primary Measles Cases: High Risk of Infection But Low Risk of Transmission. The Journal of Infectious Diseases. 2011;204(suppl_1):S559-S63.
6. Okiror Okello E, Migisha R, Ampaire I, Nsubuga F, Nalwanga J, Kwizera P, et al. Measles outbreak investigation in Kakumiro District, Uganda, February–May 2024. Discover Public Health. 2025;22(1):1-10.

Continues to page 39

Continued from page 38

7. Namusisi AM, Nuwamanya Y, Migisha R, Atugonza R, Immaculate A, Nsubuga F, et al. Measles outbreak Investigation in Terego District, Uganda, May-June, 2024.
8. Kizito SN, Simbwa B, Thomas K, Akuguzibwe R, Sembatya I, Nsubuga E, et al. Measles outbreak propagated by visiting a health facility, in a refugee hosting community, Kiryandongo District, Western Uganda, August 2022–May 2023.
9. Nsubuga F, Bulage L, Ampeire I, Matovu JK, Kasasa S, Tanifum P, et al. Factors contributing to measles transmission during an outbreak in Kamwenge District, Western Uganda, April to August 2015. BMC infectious diseases. 2018;18(1):21.
10. Measles, Initiative R. Perspective: The risks of measles in religious communities. Retrieved October. 2013;30:2013.
11. Namulondo E, Ssemanda I, Komugisha M, Nuwamanya Y, Nsubuga EJ, Wako S, et al. Measles Outbreak in a Refugee Settlement, Kiryandongo District, Uganda, July–October 2023. 2024.
12. Majwala RK, Nakiire L, Kadobera D, Ario AR, Kusiima J, Atuhairwe JA, et al. Measles outbreak propagated by children congregating at water collection points in Mayuge District, eastern Uganda, July–October, 2016. BMC infectious diseases. 2018;18(1):412.
13. CDC. Measles Vaccination 2025 [cited 2025 24/08/2025]. Available from: https://www.cdc.gov/measles/vaccines/index.html.
14. WHO. Immunization Agenda 2030 2020 [cited 2025 27092025]. Available from: https://www.who.int/publications/m/item/immunization-agenda-2030-a-global-strategy-to-leave-no-one-behind.
15. WHO. Measles Outbreak Toolkit 2022 [cited 2025 01102025]. Available from: https://www.who.int/emergencies/outbreak-toolkit/disease-outbreak-toolboxes/measles-outbreak-toolbox.

Continues to page 40

Continued from page 39

Temporal trends and Distribution of measles outbreaks in Uganda, 2020-2025

Sharon Namasambi[*1], Richard Migisha[1], Godfrey Biroma[2], Deogratius Katongole[2], Nasif Matovu[1], Benon Kwesiga[1], Yasiini Nuwamanya[2], Fred Nsubuga[2]

Institutional affiliation: [1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda, [2]Uganda National Expanded Program on Immunization, Ministry of Health, Kampala, Uganda

Correspondence*: Tel: +256 772 511 067, Email: nabsharon@uniph.go.ug

Summary

Background: The World Health Organization (WHO) recommends ≥95% coverage with two doses of measles–rubella (MR) vaccine to interrupt transmission. However, by 2023, WHO/United Nations Children's Fund (UNICEF) estimates of national immunization coverage (WUENIC) estimates showed Uganda among countries with MR2 coverage (≤50%) below this target, leaving many children susceptible to measles infection. We described temporal and spatial trends in measles outbreaks to identify persistent high-risk areas and programmatic gaps; to inform targeted outbreak control measures.

Methods: We conducted a descriptive analysis of national measles surveillance and immunization data from January 2020 to December 2025. Data sources included outbreak reports from the National Expanded Program on Immunization, and aggregate MR1/MR2 administrative coverage from District Health Information Software 2. Outbreaks were defined as ≥3 IgM-positive cases within 30 days.We summarised case counts using descriptive statistics, calculated annual percentage changes, and assessed temporal trends with Mann–Kendall tests.

Results: From 2020–2025, 3,192 measles cases were reported, 93% (2,970) of whom had received 1 MR dose, while none had received the full two-dose schedule. Cases increased from 48 (1.5%) in 2021 to 1,967 (61.6%) in 2025, though the trend was not statistically significant (τ_b=0.733, p=0.060). Overall, 115/146 (78.8%) districts reported ≥1 outbreak, peaking in 2025 (46 districts, 31.5%). MR1 coverage averaged at 92%, while MR2 improved to 64% by 2025 (τ_b=0.95, p=0.04).

Conclusion: Measles outbreaks persisted during the study period, driven by suboptimal vaccine coverage and resulting immunity gaps among vulnerable populations. Strengthening the second-year-of-life platform and integrating MR2 with co-administered vaccines are essential to close immunity gaps and prevent recurrent outbreaks.

Background

Measles is a highly contagious viral disease transmitted via respiratory droplets, characterized by fever, cough, coryza, conjunctivitis, and a maculopapular rash (1–3). Despite the availability of an effective vaccine for over five decades, measles remains a major global public health concern, particularly in settings with suboptimal immunization coverage (4–6). Achieving ≥95% coverage with two doses of measles–rubella vaccine (MR) is essential for herd immunity and interruption of transmission (7).

Between 2020 and 2025, measles control efforts were undermined by the COVID-19 pandemic, which disrupted routine immunization services worldwide. In 2020 alone, an estimated 22.7 million children missed routine vaccinations; a 19.5% increase from 2019 (8,9), creating what the World Health Organization described as a “perfect storm” for measles outbreaks (10).

Uganda reflects these global challenges. Coverage for first dose of measles-rubella vaccine (MR1) has remained below the 95% elimination threshold, averaging 90% through 2023–2024, while MR2, introduced in 2022, remains suboptimal at approximately 50% coverage by 2024(11). These gaps sustain a large pool of susceptible children, enabling recurrent outbreaks despite localised improvements in MR1 uptake. Additional drivers include cold chain limitations, inequitable access to services in hard-to-reach areas, and delays in outbreak detection (12–15). To inform targeted outbreak control interventions, we analysed temporal and spatial trends in measles outbreaks and assessed immunisation coverage to identify persistent high-risk areas and programmatic gaps.

Methods

We conducted a national descriptive analysis of measles surveillance and immunization data from January 2020 to December 2025 across all 146 districts in Uganda.

Continues to page 41

Continued from page 40

Data were triangulated from three sources: (1) case-based records of laboratory-confirmed (IgM-positive) measles cases from the Uganda Virus Research Institute (UVRI); (2) Uganda National Expanded Programme on Immunization (UNEPI) surveillance reports to verify outbreak districts and supplement case data; and (3) aggregate MR1 and MR2 administrative coverage from DHIS2.

A measles outbreak was defined per Uganda's National Technical Guidelines for Integrated Disease Surveillance and Response (3rd Edition) and WHO measles surveillance guidelines as ≥3 laboratory-confirmed (IgM-positive) measles cases within 30 days in the same district or sub-district (16,17).

We summarized cases using descriptive statistics. Annual percentage changes (APCs) were estimated using log-linear regression, and temporal trends assessed using the Mann–Kendall test. Geographic patterns were mapped in QGIS 3.42.1. Coverage of first (MR1) and second dose (MR2) of measles rubella vaccine was compared across outbreak districts to identify high-risk areas.

Permission to analyse the data was obtained from the Uganda Ministry of Health (MoH). In addition, a non-research determination clearance was granted by the U.S. Centers for Disease Control and Prevention (CDC). The investigation was conducted in accordance with applicable U.S. federal regulations governing public health surveillance and data protection (see, for example, *45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.*). Further authorization was obtained from the Uganda National Expanded Programme on Immunization (UNEPI) for access to vaccination and surveillance data. As this analysis involved routine program and surveillance data and posed no more than minimal risk to participants, written informed consent was not required. All data were anonymized before analysis, and strict measures were implemented to maintain privacy, confidentiality, and data security throughout the data abstraction and analysis process.

Results

National burden and temporal trends of measles cases, 2020–2025

Between 2020 and 2025, Uganda reported 3,192 measles cases, of which 2,970 (93%) had received 1 MR dose, while none had received the full two-dose schedule Annual cases varied markedly, from 48 (1.5%) in 2021 to 1,967 (61.6%) in 2025. Although an overall upward trend was observed (τ_b=0.73, p=0.060), it was not statistically significant (Figure 1). Year-to-year changes were highly variable, with sharp increases in 2024 (APC=+334%) and 2025 (APC=+152%) following a decline in 2021 (APC=−68%) (Figure 1).

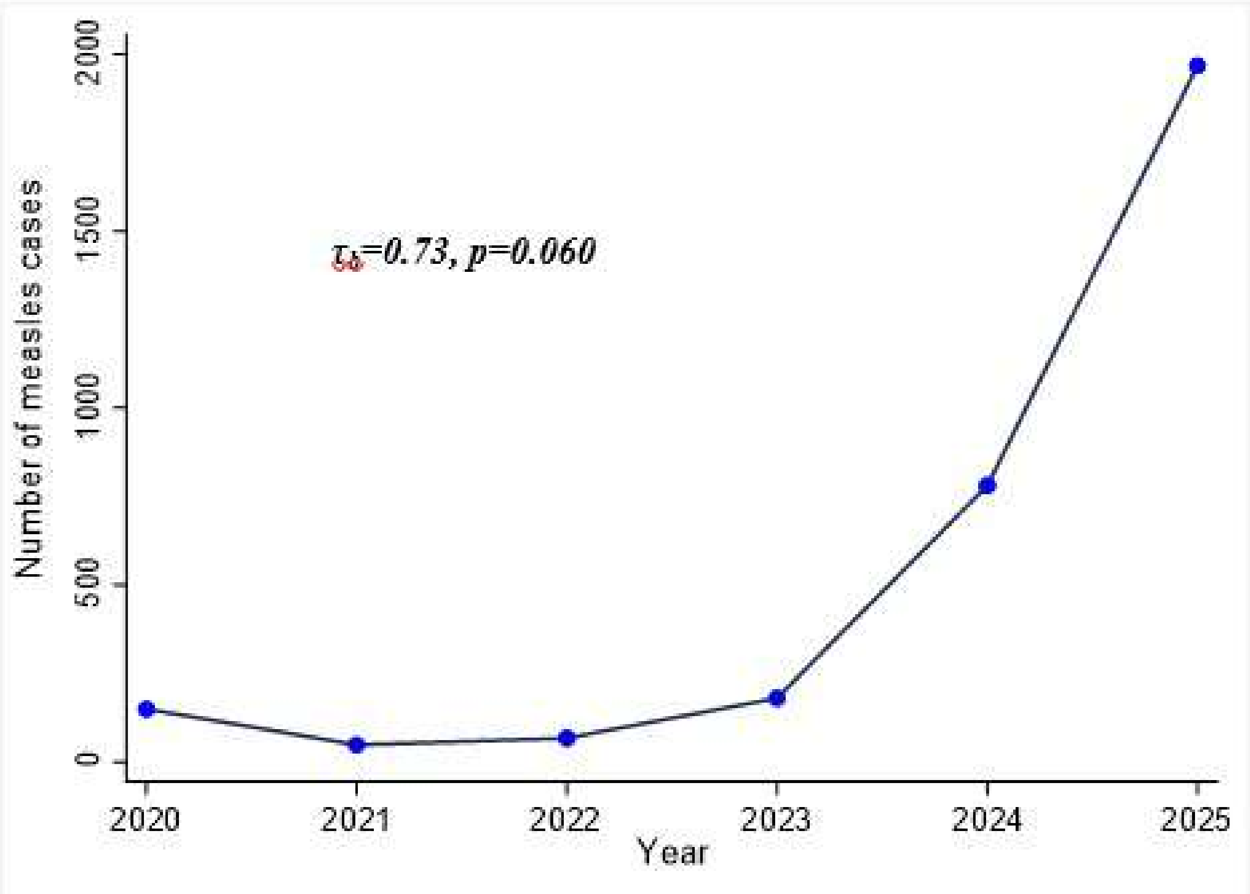


Figure 1: Trends of measles cases, Uganda, 2020–2025

Continues to page 42

Continued from page 41

Spatial distribution and trends confirmed measles outbreaks across districts, Uganda, 2020–2025

Overall, 115/146 (78.8%) districts reported ≥1 confirmed outbreak. The number of affected districts fluctuated widely, from 13 (8.9%) in 2020 to a low of 1 (0.7%) in 2021–2022, before rising sharply to 45 (30.8%) in 2024 and 46 (31.5%) in 2025 (τ_b=0.55, p=0.181). Twenty-two districts experienced recurrent outbreaks, including Buvuma, Isingiro, Jinja, Kamwenge, Kiryandongo, Mbale, Manafwa, Kikuube, Butaleja, Kakumiro, Mpigi, Moroto, Napak, Nakaseke, Kanungu, Namutumba, Lamwo, Kampala, Koboko, Madi-Okollo, Yumbe, and Sembabule during the study period (Figure 2).

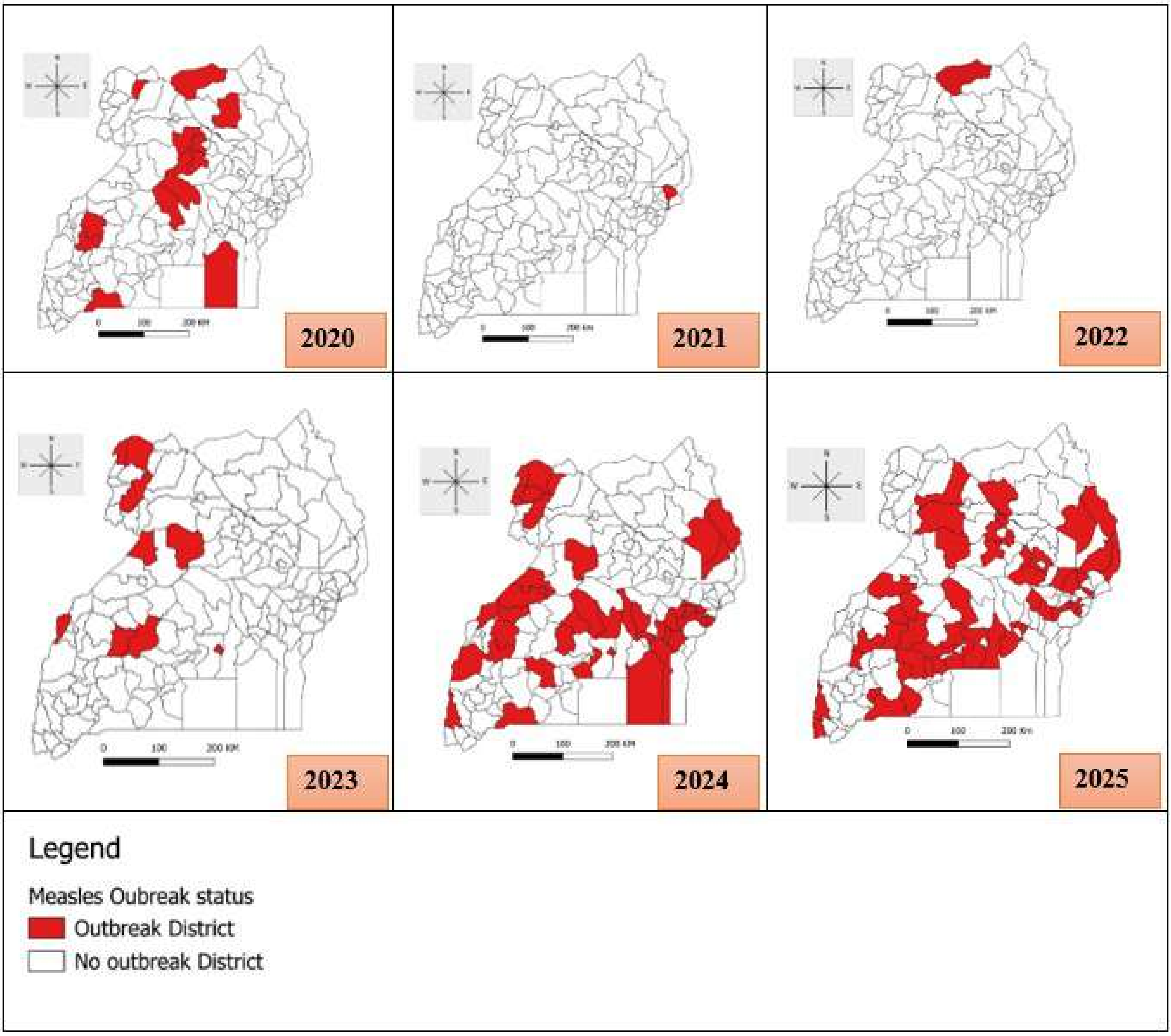


Figure 2: Spatial distribution of confirmed measles outbreaks in Uganda, 2020-2025

Figure 2: Spatial distribution of confirmed measles outbreaks in Uganda, 2020-2025

Spatial overlay of Measles-Rubella vaccination coverage by outbreak districts, Uganda, 2020–2025

Over the six-year period, MR1 coverage averaged at 92%, while MR2 coverage, introduced in 2022, statistically increased from low baseline (22%) to 64% by 2025 (τ_b=0.95, p=0.04). Spatial overlay analysis showed that outbreaks occurred across all coverage categories, including districts with MR1 coverage ≥95% (Figure 3).

Continues to page 43

Continued from page 42

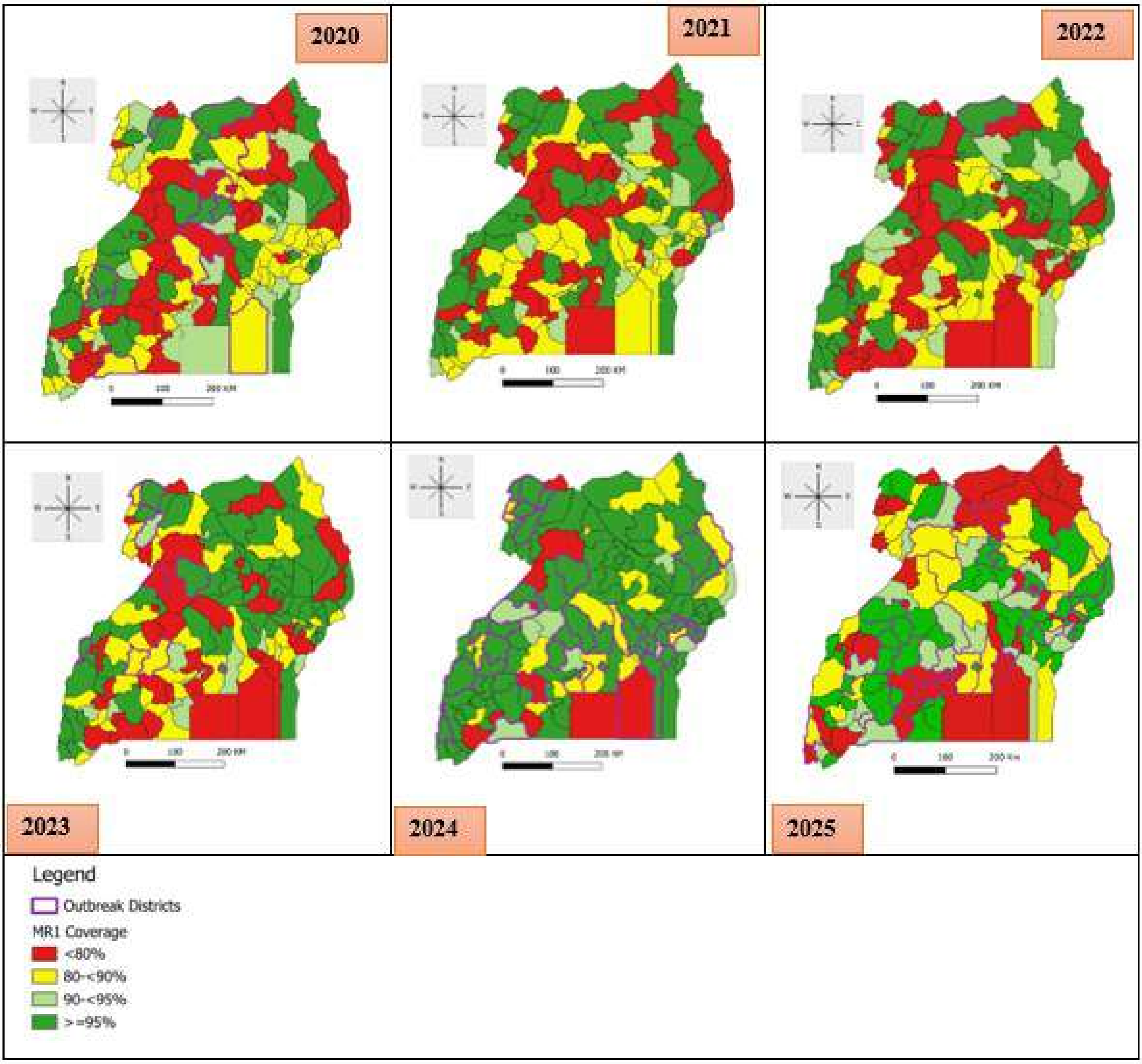


Figure 3: Spatial overlay of measles-rubella 1 coverage and confirmed measles outbreaks, Uganda, 2020–2025

Discussion

Our analysis demonstrates persistent measles transmission in Uganda from 2020 to 2025, marked by a 40-fold increase in cases, spread to 78.8% of districts, and ongoing immunity gaps driven by suboptimal vaccination coverage. The rise from a single outbreak-affected district in 2021 to 46 districts in 2025 suggests sustained local transmission rather than isolated importations. This pattern aligns with global post-COVID-19 trends, where disruptions in routine immunization created susceptible cohorts, resulting in explosive outbreaks upon measles reintroduction (8,9,18).

That 93% of cases had received at least one MR dose may seem paradoxical but reflects the limitations of a single-dose schedule. With 5–10% primary vaccine failure and ~5% secondary failure due to waning immunity (19–22), 10–15% of children remain susceptible even in a population with 92% MR1 coverage. This highlights the critical role of routine MR2 in addressing primary vaccine failures and boosting immunity, a strategy proven effective in global measles elimination efforts (23).

Continues to page 44

Continued from page 43

Outbreaks in districts reporting ≥95% MR1 coverage can be explained by two factors: (1) administrative coverage often overestimates true immunity due to inaccurate denominators, inflating coverage by 10–20% (24); and (2) 5–10% of vaccinated children fail to develop protective immunity (19,20). Although MR2 coverage improved to 64% by 2025, systemic challenges remain.

Study limitations: Administrative coverage data from DHIS2 may not reflect true immunity due to inaccurate denominators, unregistered children, or incomplete reporting. We focused on temporal trends and relative changes rather than absolute coverage, reducing sensitivity to systematic errors.

Conclusion

Measles persisted in Uganda from 2020 to 2025 due to suboptimal vaccine coverage, leaving many children vulnerable. Strengthening the second-year-of-life platform by integrating MR2 with routine child health services, along with targeted follow-up, could close immunity gaps, achieve ≥95% MR coverage, and advance measles elimination efforts in Uganda.

Conflicts of interest: The authors declared no conflicts of interest.

Acknowledgements: We acknowledge the Uganda National Expanded Programme on Immunization, Uganda Virus Research Institute, and Ministry of Health Division of Health Information for data access and technical support. We thank district health teams for their commitment to measles surveillance and outbreak response.

Author contributions: SN conceptualized the study and led data collection, analysis, and writing. RM, and BK, provided technical supervision and Bulletin review. GB, DK, NM, MDN, YN, and FN supported data analysis, and report writing. All authors approved the final version.

References

1. Jalal MA, Halboot KM, Lami SA, Gumar EA, al-Delphi MHK, Lami F, et al. Epidemiological trends and clinical characteristics of measles in Iraq (2023–2024): a retrospective cross-sectional study. BMC Infect Dis. 2025 Apr 9;25(1):487. doi:10.1186/s12879-025-10904-8
2. Kulsoom S, Soomro S, Junejo S, Anjum M, Waseem H, Akram M. Clinical Presentation, Complications and Outcome of Measles in Pediatric Population at Tertiary Care Hospital: Measles in Pediatric Population. Pak J Health Sci. 2023 Mar 31;50–3. doi:10.54393/pjhs.v4i03.624
3. CDC. Measles (Rubeola) [Internet]. 2025 [cited 2025 Nov 8]. Measles (Rubeola). Available from: https://www.cdc.gov/measles/index.html
4. Measles [Internet]. [cited 2025 Nov 8]. Available from: https://www.who.int/news-room/fact-sheets/detail/measles
5. Minta AA, Ferrari M, Antoni S, Lambert B, Sayi TS, Hsu CH, et al. Progress Toward Measles Elimination — Worldwide, 2000–2023. Vol. 73. 2024;73(45).
6. Minta AA, Ferrari M, Antoni S, Portnoy A, Sbarra A, Lambert B, et al. Progress Toward Measles Elimination — Worldwide, 2000–2022. Morb Mortal Wkly Rep. 2023 Nov 17;72(46):1262–8. doi:10.15585/mmwr.mm7246a3 PubMed PMID: 37971951; PubMed Central PMCID: PMC10684353.
7. Do LAH, Mulholland K. Measles 2025. N Engl J Med. 0(0). doi:10.1056/NEJMra2504516
8. Packham A, Taylor AE, Karangwa MP, Sherry E, Muvunyi C, Green CA. Measles Vaccine Coverage and Disease Outbreaks: A Systematic Review of the Early Impact of COVID-19 in Low and Lower-Middle Income Countries. Int J Public Health. 2024 Apr 25;69:1606997. doi:10.3389/ijph.2024.1606997
9. World Health Organisation. Progresses and Challenges with Sustaining and Advancing Immunization Coverage During the COVID-19 Pandemic [Internet]. 2023 [cited 2025 Nov 8]. Available from: https://www.who.int/publications/i/item/progresses-and-challenges-with-sustaining-and-advancing-immunization-coverage-during-the-covid-19-pandemic
10. UNICEF and WHO warn of perfect storm of conditions for measles outbreaks, affecting children [Internet]. [cited 2025 Nov 8]. Available from: https://www.who.int/news/item/27-04-2022-unicef-and-who-warn-of--perfect-storm--of-conditions-for-measles-outbreaks--affecting-children

Continues to page 45

Continued from page 44

11. WHO/UNICEF estimates of national immunization coverage [Internet]. [cited 2026 Feb 13]. Available from: https://www.who.int/teams/immunization-vaccines-and-biologicals/immunization-analysis-and-insights/global-monitoring/immunization-coverage/who-unicef-estimates-of-national-immunization-coverage
12. Nsubuga EJ, Morukileng J, Namayanja J, Kadobera D, Nsubuga F, Kyamwine IB, et al. Measles outbreak in Semuto Subcounty, Nakaseke District, Uganda, June–August 2021. IJID Reg. 2022 Dec;5:44–50. doi:10.1016/j.ijregi.2022.08.017
13. Okiror EO, Ampaire I, Nsubuga F, Kwizera P, Okello PE, Migisha R, et al. Measles outbreak with children below the recommended age for first dose of measles vaccine most affected in Kakumiro District, February–May 2024. Vol. 9. 2024;9(3).
14. Mfitundinda E, Migisha R, Namusisi AM, Wenani D, Kwesiga B, Ayeerwot R, et al. Investigation of a cross-border measles outbreak in Moroto District, northeastern Uganda, March–September, 2024. Discov Public Health. 2025 May 16;22(1):267. doi:10.1186/s12982-025-00581-y
15. Namusisi AM, Nuwamanya Y, Migisha R, Atugonza R, Immaculate A, Nsubuga F, et al. Measles outbreak Investigation in Terego District, Uganda, May- June, 2024. Vol. 9. 2024;9(3).
16. World Health Organization WH. Measles outbreak guide. World Health Organization; 2022. 96 p.
17. Ministry of Health. Uganda 3rd IDSR Tech Guideline_PrintVersion_10Sep2021.pd [Document] [Internet]. Ministry of Health; 2021. Available from: https://www.afro.who.int/sites/default/files/2021-09/2_Uganda%203rd%20IDSR%20Tech%20Guideline_PrintVersion_10Sep2021.pdf
18. Cardoso Pinto AM, Ranasinghe L, Dodd PJ, Budhathoki SS, Seddon JA, Whittaker E. Disruptions to routine childhood vaccinations in low-and middle-income countries during the COVID-19 pandemic: A systematic review. Front Pediatr. 2022;10:979769.
19. Hickman CJ, Hyde TB, Sowers SB, Mercader S, McGrew M, Williams NJ, et al. Laboratory Characterization of Measles Virus Infection in Previously Vaccinated and Unvaccinated Individuals. J Infect Dis. 2011 Jul 1;204(suppl_1):S549–58. doi:10.1093/infdis/jir106
20. Kontio M, Jokinen S, Paunio M, Peltola H, Davidkin I. Waning Antibody Levels and Avidity: Implications for MMR Vaccine-Induced Protection. J Infect Dis. 2012 Nov 15;206(10):1542–8. doi:10.1093/infdis/jis568
21. Patel MK, Dumolard L, Nedelec Y, Sodha SV, Steulet C, Gacic-Dobo M, et al. Progress Toward Regional Measles Elimination — Worldwide, 2000–2018. Morb Mortal Wkly Rep. 2019 Dec 6;68(48):1105–11. doi:10.15585/mmwr.mm6848a1 PubMed PMID: 31805033; PubMed Central PMCID: PMC6897527.
22. Weldegebriel GG, Gasasira A, Harvey P, Masresha B, Goodson JL, Pate MA, et al. Measles Resurgence Following a Nationwide Measles Vaccination Campaign in Nigeria, 2005–2008. J Infect Dis. 2011 Jul 1;204(suppl_1):S226–31. doi:10.1093/infdis/jir136
23. World Health Organization. Measles vaccines: WHO position paper, April 2017 – Recommendations. Vaccine. 2019 Jan 7;37(2):219–22. doi:10.1016/j.vaccine.2017.07.066
24. Wariri O, Edem B, Nkereuwem E, Nkereuwem OO, Umeh G, Clark E, et al. Tracking coverage, dropout and multidimensional equity gaps in immunisation systems in West Africa, 2000–2017. BMJ Glob Health. 2019 Sep 6;4(5). doi:10.1136/bmjgh-2019-001713 PubMed PMID: 10.1136/bmjgh-2019-001713.

Continues to page 46

Continued from page 45

Factors associated with zero-dose status among children aged 12–23 months, Uganda, August to September, 2024

Authors: Pauline Achom[1]*, Sharon Namasambi[1], Nasif Matovu[1], Vianney John Kigongo[1], Brian Bonventure Kawere[3], Daniel Kiiza[3], Ivan Segawa[3], Maureen Kesande[3], Duncan Matovu[3], Paddy Mutungi Tukamuhebwa[3], Micheal Baganizi[4], Immaculate Ampaire[4], Fred Nsubuga[4], Emmanuel Okiror Okello[1], Emmanuel Mfitundinda[1], Annet Mary Namusisi[1] Deogratious Migadde[2], Yasiini Nuwamanya[1], Simon Peter Kibira[5], Deogratious Munube[5], Benon Kwesiga[1], and Richard Migisha[1]

Institutional Affiliation: [1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda, [2] Ministry of Health, Kampala, Uganda, [3]Global Health Security Department, Infectious Disease Institute, Makerere University,
Kampala, Uganda, [4]Uganda Expanded Program on Immunization, Ministry of Health Uganda, Kampala, Uganda, [5]College of Health Sciences, Makerere University, Kampala, Uganda

Correspondence*: Tel: +256785253791, Email: achompauline@uniph.go.ug

Summary

Background: GAVI defines zero-dose children as those who have not received Diphtheria-Pertusis-Tetanus1 (DPT1), which represents a gap in immunization programs and a marker of inequity in access to essential health services. In Uganda, DPT1 coverage exceeds 90%. However, there are regional variations due to health system factors, leaving pockets of unvaccinated children and posing an increased risk of outbreaks. We determined the prevalence and factors associated with zero-dose status among children aged 12–23 months in Uganda.

Methods: We conducted a cross-sectional household survey in all 15 regions of Uganda. We sampled 2,254 children aged 12–23 months using multi-stage cluster sampling. Data were collected through caregiver interviews using a standard questionnaire and review of vaccination cards. Weighted prevalence estimates were calculated. Multivariable logistic regression was applied to assess factors associated with zero-dose status among the children.

Results: The overall prevalence of zero-dose status was 9.1%. The highest zero-dose prevalence was observed in South Central (17%) and Bunyoro (17%), while the lowest was in Acholi (3.9%) and Kigezi (2%). The factors significantly associated with zero-dose status included absence of information on the next appointment (aOR=18; 95% CI=8.5–38), lack of trust in vaccines (aOR=7.1; 95% CI=1.5–34), having above secondary education (aOR=6.6; 95% CI=1.5–28), and unfavorable family norms (aOR=3.5; 95% CI=1.7–6.9).

Conclusion: Despite overall high national coverage, nearly 1 in 10 Ugandan children aged 12–23 months remain unvaccinated with DPT1, with substantial regional disparities. Zero-dose status is driven by a combination of caregiver characteristics, social norms, and systemic barriers. We recommend strengthening community engagement by leveraging VHTs and local leaders to create awareness and reminders on next appointments through media platforms. Promoting the use of immunization champions to build caregiver trust in vaccines and celebrating positive societal practices on immunization to achieve equitable coverage.

Background

Immunization, preventing 2.5 million child deaths worldwide annually, is one of the most successful public health interventions. (1). It is key in attainment of the United Nations Sustainable Development Goal 3.2, which aims to reduce under-five mortality to less than 25/1000 live births by 2030 (1, 2). The diphtheria-tetanus-pertussis (DPT) containing vaccine plays a critical role in protecting children against three life-threatening but preventable diseases (3). These are *Diphtheria, Tetanus,* and **Pertussis** (4). Without DPT vaccination, these diseases pose a significant risk of child morbidity and mortality. The World Health Organization (WHO) defines zero-dose children as those who have not received even a single dose of the DPT vaccine by the age of 12 months (5).

Zero-dose status in children aged 12–23 months is influenced by various factors, including maternal education, access to healthcare facilities, and place of delivery (6). Additionally, community-related challenges such as vaccine hesitancy, misinformation, lack of awareness, and cultural beliefs also contribute to non-immunization (7). These missed vaccinations not only put individual children at risk but also weaken herd immunity, leading to potential outbreaks of vaccine-preventable diseases (7). Although Uganda has adopted several strategies to improve immunization coverage, the persistence of zero-dose children suggests that systemic and contextual barriers remain inadequately addressed.

Continues to page 47

Continued from page 46

We determined the prevalence and identified the factors associated with zero-dose status among children aged 12–23 months in Uganda.

Methods

We conducted a community-based cross-sectional household survey suitable for country-wide data collection for immunization coverage at one point in time. The study was conducted in **Uganda**, with an estimated population of approximately 46 million people as of 2024 (8). In Uganda, immunization services are organized and provided under the Uganda National Expanded Program on Immunization (UNEPI), an arm of the Ministry of Health, through a decentralized health system. Children receive vaccines through static (health facility-based) sites or outreaches organized by health workers in the communities.

We included 2,254 children aged 12–23 months in the survey who were expected to have received DPT1 according to Uganda's national immunization schedule by the Ministry of Health. Eligible participants were children and their caregivers who had lived together for at least six months, with prioritization being given to primary caregivers, especially mothers. We excluded caregivers with mental illness.

We determined the sample size using the World Health Organization Vaccination Coverage Cluster Survey Reference Manual to allow regional-level estimates across 15 regions. A multistage cluster sampling design was applied, where one district per region was randomly selected (with Kampala purposively included).

The outcome was having received no dose of DPT1 (zero-dose) (Yes/No). Independent variables included child characteristics, caregiver socio-demographics, health facility factors, and behavioral and social drivers of vaccination. Data were collected through face-to-face interviews using a pre-tested electronic questionnaire adapted from the WHO manual. We cleaned and analyzed data in Stata 17 using sampling weights. We conducted weighted descriptive statistics, bivariable analysis, and multivariable logistic regression, with statistical significance set at $p<0.05$. We only included variables with $p<0.2$ into the multivariate analysis and subsequently using backward elimination approach. We obtained ethical approval from the Ministry of Health and the Centers for Disease Control and Prevention, and verbal informed consent was secured from participants.

Results

Descriptive epidemiology

A total of 2,254 children were evaluated through their caregivers. Most 53% (1,152) of children were aged 12–17 months, with a median age of 17 months, with females being slightly more 52% (1,152) than males. Most caregivers were aged 25–39 years, 58% (1,237), with a median age of 28 years. Caregivers were mostly female, 95% (2,107), and were living in rural areas, 68% (1,819)

Prevalence of Zero-dose status among children aged 12–23 months in Uganda, August to September, 2024 by region

Among children aged 12–23 months in Uganda, the national prevalence of zero-dose status was 9.1%. The highest prevalence was from Bunyoro (17%) and South Central (17%), followed by Tooro (12%) and Busoga (12%) regions. The lowest prevalence was from Acholi (4%) and Kigezi (2%).

Factors associated with Zero-dose status among children aged 12–23 months in Uganda, 2024

In multivariable analysis, children aged 18–23 months had significantly lower odds of being zero-dose, with an 80% reduction compared to children aged 12–17 months. Caregivers with education above secondary level had significantly about seven times more odds of having a zero-dose child than others. Lack of information about the next vaccination appointment had 18 times higher odds of having a zero-dose child compared to having information. Furthermore, distrust in vaccine-related information was associated with 7 times higher odds of zero-dose status compared to those who trusted vaccine information. Unfavorable family support was also significantly associated with zero-dose status, with 3.5 times higher odds among caregivers with support compared to those without (Table 1).

Continues to page 48

Continued from page 47

Table 1: Factors associated with Zero-dose among children aged 12–23 months in Uganda, August to September, 2024

Variable	Zero-dose (%)			
	Yes	No	cOR(95%CI)	aOR(95%CI)
Age of the child				
12-17 months	13	87	Ref	
18-23 months	4	96	0.29(0.19–0.45)	0.20(0.12–0.32)
Education of the care-giver				
No education	9.5	90.5	Ref	
Primary	11	89	1.1(0.63–2.1)	2.2(0.83–5.6)
Secondary	6	94	0.62(0.3–1.3)	1.6(0.56–4.4)
Above secondary	8	92	0.80(0.26–2.5)	6.6(1.5–28)
Relationship to child				
Mother	8	92	Ref	
Father	10	90	1.30(0.6–2.8)	0.8(0.34–1.9)
Grandparent	26	74	4(2.4–6.7)	3.8(1.8–8.3)
Other	24	76	3.7(0.91–15)	2.6 (0.52–13)
Next appointment information				
Yes	7	93	Ref	
No	53	47	16.(9.6–26)	18(8.5–38)
Trust in vaccines				
Yes	1	99	Ref	
No	9	91	12(3.6–37)	7.1(1.5–34)
Favorable family norms				
Yes	7.98	92.02	Ref	
No	25	75	3.9(2.2–6.9)	3.5(1.7–6.9)

Discussion

The study found a national prevalence of zero-dose to be 9.1% and factors associated with zero-dose status to be lack of appointment information, distrust in vaccine information, having education above secondary level, and unfavourable family support. We found a national prevalence of zero-dose status at 9.1%, which is relatively low compared to that found in a study in Nigeria, which reported a zero-dose prevalence of 24% in 2021 (9), and a multi-country analysis by WHO and UNICEF in 2022 that found zero-dose exceeding 10% in several sub-Saharan African countries (10). The prevalence of zero-dose status in this study was lower than that in a study done in Togo by Mangbassim et al., reporting 27% among children aged 12-23 months (11). The comparatively lower prevalence in Uganda may be attributed to the country's longstanding Uganda National Expanded Program on Immunization (UNEPI), supported by government and development partners through strategies such as Reaching Every District (RED) and Reaching Every Child (REC) approaches (12). This prevalence is higher than the national DPT1 prevalence reported in the 2022 Uganda Demographic and Health Survey (UDHS), which indicated missed DPT1 of approximately 4% (13).

Continues to page 49

Continued from page 48

The findings in this study are consistent with those by Wiysonge et al, who found that non-receipt of DPT1 was associated with maternal education, rural residence, and limited access to health services in sub-Saharan Africa (6). The findings in this study were in line with those from a study conducted in Cameroon by Nchinjoh et al showed that younger children had higher odds of being unvaccinated compared to older ones(14). These findings are also in line with previous studies conducted in sub-Saharan Africa and globally. Furthermore, this study found that unfavorable family norms and competing caregiver responsibilities influence immunization status. These findings are consistent with research from India and Kenya, which showed that household decision-making dynamics and gender roles can hinder mothers from prioritizing or accessing health services for their children, especially in male-dominated or resource-limited households (15, 16). The findings in this study were also consistent with those found in another study where uneducated mothers had a lower risk of having zero-dose children (17). These factors remain a growing challenge to the immunization programs in Africa.

Study limitations: Recall bias, particularly when child health cards were unavailable, may have led to an underestimation of the prevalence. Social desirability bias might have influenced caregivers' responses regarding their child's immunization status.

Conclusion

We found a zero-dose prevalence of 9.1%, driven by a combination of socio-demographic, behavioral, and social factors. We recommend strengthening community engagement by leveraging VHTs and local leaders to create awareness about the importance of vaccination and conducting VHT-led outreaches. Creation of appointment-reminder systems through media platforms like barazas and radios. Promoting trust-building communication by use of immunization champions to build caregiver trust in vaccines. We also recommend addressing unsupportive family norms by encouraging families to support caregivers in vaccination of children, and celebrating positive societal practices on immunization are essential strategies to reach and immunize zero-dose children in Uganda.

Conflict of interest: The authors declare no conflict of interest

Author contribution: PA participated in the conception, design, data collection, analysis, and interpretation of the survey and wrote the draft manuscript. SN, NM, VK, BBK, DK, DM, DM, IS, MK, PMT, IA, FN, EOO, EM, AMN, SPK, DM, LB, and YN reviewed the report and the drafts of the manuscript and made several improvements to it. BK, RM, and ARA reviewed the final manuscript to ensure. Authors read and approved the final draft.

Acknowledgements: We thank all mentors and supervisors from Uganda Expanded Program on Immunization (UNEPI) and the Reproductive and Child Health Division from the Ministry of Health, the Uganda Public Health Fellowship Program, the Infectious Diseases Institute (IDI), and Makerere University for their support during this study. We also acknowledge the US CDC for supporting the activities of the Uganda Public Health Fellowship Program, under which this work was conducted.

References

1. Abdullahi MF, Stewart Williams J, Sahlèn K-G, Bile K, Kinsman J. Factors contributing to the uptake of childhood vaccination in Galkayo District, Puntland, Somalia. Global health action. 2020;13(1):1803543.
2. Rainey JJ, Watkins M, Ryman TK, Sandhu P, Bo A, Banerjee K. Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: findings from a systematic review of the published literature, 1999–2009. Vaccine. 2011;29(46):8215-21.
3. Liang JL. Prevention of pertussis, tetanus, and diphtheria with vaccines in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recommendations and reports. 2018;67.
4. Ogden SA, Ludlow JT, Alsayouri K. Diphtheria tetanus pertussis (DTaP) vaccine. 2019.
5. Gavi. Reaching zero dose children. 2025.
6. Wiysonge CS, Uthman OA, Ndumbe PM, Hussey GD. Individual and contextual factors associated with low childhood immunisation coverage in sub-Saharan Africa: a multilevel analysis. PloS one. 2012;7(5):e37905.

Continues to page 50

Continued from page 49

7. Brown DW, Burton A, Gacic-Dobo M, Karimov RI, Vandelaer J, Okwo-Bele JM. A mid-term assessment of progress towards the immunization coverage goal of the Global Immunization Vision and Strategy (GIVS). BMC Public Health. 2011;11(1):806.
8. UBOS. NATIONAL POPULATION AND HOUSING CENSUS 2024. FINAL REPORT. 2024.
9. Olufadewa I, Adesina M, Oladele R, Shonubi A, Bamidele D, Obigwe E. Trends and predictors of full immunization coverage in Nigeria. Discover Public Health. 2024;21(1):151.
10. WHO. Status of immunization coverage in Africa as of the end of 2022. 2023.
11. Mangbassim NT, Kpozehouen A, Saizonou JZ, Gaffan N. Prevalence and factors associated with "zero-dose" in children 12 to 23 months in Togo. Cent Afr J Public Health. 2023;9:12.
12. Kiwanuka D. Vaccine forecasting and service delivery in Uganda health sector; a case of Uganda National Expanded Programme on Immunization (UNEPI): University of Kisubi; 2022.
13. Statistics UE. Uganda Bureau of Statistics. Energy. 2022;95(13.6):14.5.
14. Nchinjoh SC, Saidu Y, Agbor VN, Mbanga CM, Jude Muteh N, Njoh AA, et al. Factors Associated with zero-dose childhood vaccination status in a remote fishing community in Cameroon: a cross-sectional analytical study. Vaccines. 2022;10(12):2052.
15. Srivastava S, Fledderjohann J, Upadhyay AK. Explaining socioeconomic inequalities in immunisation coverage in India: new insights from the fourth National Family Health Survey (2015–16). BMC pediatrics. 2020;20(1):295.
16. Maina LC, Karanja S, Kombich J. Immunization coverage and its determinants among children aged 12-23 months in a peri-urban area of Kenya. Pan African Medical Journal. 2013;14(1).
17. Mehmood M, Setayesh H, Siddiqi DA, Siddique M, Iftikhar S, Soundardjee R, et al. Prevalence, geographical distribution, and factors associated with pentavalent vaccine zero dose status among children in Sindh, Pakistan: analysis of data from the 2017 and 2018 birth cohorts enrolled in the provincial electronic immunisation registry. BMJ Open. 2022;12(5):e058985.

Continues to page 51

Continued from page 50

Imported cholera outbreak in Adjumani District, Uganda, June–July 2025

Authors: Justine Wobusobozi[1]*, Martha Dorcas Nalweyiso[1], Patrick Pithua[1], Paul Edward Okello[1], Benon Kwesiga[1], Richard Migisha[1], Paul Olony[2], Bonny Kintu[3], and Godfrey Bwire[3]
Institutional affiliations: [1]Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda
[2]Adjumani District Local Government, Adjumani, Uganda
[3]Department of Integrated Epidemiology, Surveillance and Public Health Emergencies, Ministry of Health, Kampala, Uganda
Correspondence*: Tel: +256 772 041876, Email: justinewobusobozi@uniph.go.ug

Summary
Background: On 24 June 2025, a cholera outbreak was confirmed in Egge Village, Dzaipi Sub-county, Adjumani District. We investigated to determine the source, magnitude, and risk factors associated with the outbreak to inform control and prevention measures.
Methods: We defined a suspected case as the onset of watery diarrhoea and dehydration or death from acute watery diarrhea in a resident (aged ≥2years) of Dzaipi, Arinyapi and Pakele sub-counties, Adjumani District from 1 May to 10 July 2025. A confirmed case was a suspected case with a positive stool culture for *Vibrio cholerae*. We reviewed health facility records and conducted active case search in the community with the help of local leaders. We conducted descriptive epidemiology and environmental assessment to generate a hypothesis. We conducted an unmatched case-control study and identified risk factors using logistic regression.
Results: We identified 19 cases (4 confirmed and 15 probable) with an attack rate (AR) of 6.4/100,000 and a case fatality rate of 4.3% (1/19). The median age was 38 (IQR: 2-78 years). Males (AR=0.04/100,000) and females (AR=0.09/100,000) were similarly affected. Ajugopi parish was the most affected parish with 15 cases (AR=2.6/100,000). The primary case developed acute watery diarrhoea on 2 June 2025 immediately after returning from the Elegu border point and shared a meal and drinking water at Nyumanzi Reception Centre with the index case (the primary case later died before testing). We observed latrines with compromised sub-structures, open defecation and confirmed faecal contamination of a borehole located 200 metres from a latrine. Drinking untreated borehole water was significantly associated with cholera infection (aOR=5.2; 95% CI: 1.6–17.0). Latrine use (aOR=0.2, 95% CI: 0.05–0.9) and water treatment (aOR=0.2, 95% CI: 0.02–1.4) were protective.
Conclusion: The outbreak was likely imported from South Sudan and amplified by consumption of water from a contaminated borehole in a refugee-hosting community. We recommended boiling or treating water, strengthened border screening, construction of recommended pit latrines and an oral cholera vaccine (OCV) campaign.

Background

Cholera, caused by the bacterium *Vibrio cholerae*, is characterized by profuse rice-water diarrhea and is primarily transmitted through consumption of water or food contaminated with fecal matter (1). The disease has a short incubation period, ranging from a few hours to five days, with most infected individuals being asymptomatic carriers capable of spreading the infection (2).

Uganda is a cholera-endemic and a priority country for elimination efforts under the Global Task Force on Cholera Control. Hotspots include border districts, refugee-hosting areas, lakeshore communities, and urban slums (3). Adjumani District, located in Northern Uganda, is a key cholera hotspot due to its proximity to South Sudan and its role as a host to over 200,000 refugees, primarily in settlements like Nyumanzi (4). The district's population of approximately 300,590 faces increased cholera risk from cross-border movement and limited access to safe water and sanitation in refugee settlements. Between 2018 and 2021, Uganda implemented Oral Cholera Vaccination (OCV) campaigns in several high-risk districts, administering two doses 14 days apart to individuals aged 2 years and older, offering up to 80% protection for three years. Despite these efforts, cholera outbreaks persist in Uganda's endemic districts (5). On 24 June, 2025, the District Health Officer notified Ministry of Health of a confirmed cholera outbreak in Adjumani District. We determined the source of the outbreak, its magnitude, and risk factors to inform control and prevention measures.

Continues to page 52

Continued from page 51

On 24 June, 2025, the District Health Officer notified Ministry of Health of a confirmed cholera outbreak in Adjumani District. We determined the source of the outbreak, its magnitude, and risk factors to inform control and prevention measures.

Methods

Adjumani District is located in the West-Nile region of Northern Uganda, bordering South Sudan. The district has a population of 297,894 of which 84,349 are refugees primarily from South Sudan and Sudan residing in settlements like Nyumanzi in Egge village and other 11 settlements (Ayilo 1, Ayilo 2, Baratuku, Boroli, Elema, Mirieyi, Mungula 1, Mungula 2, Nyumanzi Settlement, Olua 1, Olua 2, and Pagirinya). Nyumanzi is the largest refugee settlement in the district with a population of 24,281.

We defined a suspected case as onset of acute watery diarrhoea and dehydration or death from acute watery diarrhea from 1 May to 10 July, 2025 in a resident of Adjumani District aged ≥2 years. A probable case was a suspected case with positive RDT test for *V. Cholerae*. A confirmed case was a suspected or probable case with positive culture for *V. Cholerae* from a stool sample. Cases were identified through health facility records review and active case search in the community with the help of local leaders to create a line list. We conducted a descriptive analysis of the cases.

We collected stool samples from 22 cases to confirm the Cholera diagnosis. We also collected 3 water samples from different water sources within most affected community including 3 boreholes for bacteriological culture identification of *V. cholerae.*

We assessed hygiene conditions at drinking-water and household-water sources including human activities and human waste disposal practices likely leading to water contamination.

We interviewed 19 cases using a case investigation form to generate hypotheses likely associated with this outbreak. We explored the following factors: sources of household water, water treatment practices, food sources, contact with an individual with loose diarrhea, travel history to and from areas with cholera and hand hygiene. We conducted an unmatched case-control study to test the hypothesis, in which we interviewed 19 cases and 76 controls. We defined a control as a resident of Egge village, aged ≥2 years with no history of acute watery diarrhea from 1 May to 10 July, 2025.

This investigation was in response to a cholera outbreak following a directive from Ministry of Health of to investigate this outbreak. The Office of the Associate Director for Science at the Center for Disease Control and Prevention (CDC) Uganda determined that this research did not involve human subject research and that its primary intent was public health practice or disease control. Verbal informed consent was obtained from participants or, if the interviewee was a minor, guardians before the start of each interview.

Results

Descriptive epidemiology

We identified 19 cases (4 confirmed, 15 probable) with an attack rate (AR) of 6.4/100,000. There was 1 death; case fatality rate of (CFR=4.3%). The median age was 38 (IQR: 2-78 years). Females (AR= 0.09/1,000) were slightly more affected than males (AR= 0.04/1,000). Dzaipi was the most affected sub-county with an attack rate of 8.4/10,000. The majority of the cases 84% (16) drank untreated borehole water and none of them received OCV.

Continues to page 53

Continued from page 52

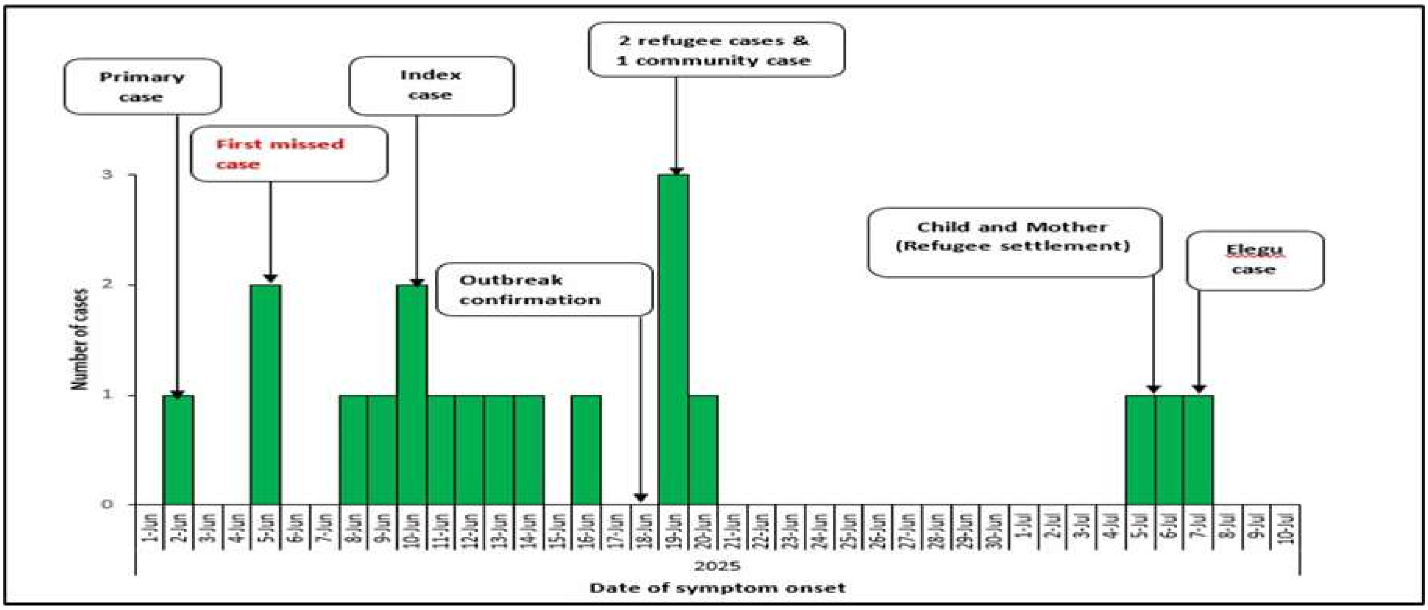


Figure 2: Distribution of cases over time during the cholera outbreak, Adjumani District, Uganda, June–July, 2025

The epidemic curve shows a propagated outbreak with point-source introduction followed by person-to-person and waterborne spread. The primary case was a female resident of Egge village who developed acute watery diarrhoea on 2 June 2025 immediately after returning from the Elegu border point with South Sudan, where a large cholera outbreak was ongoing (75,196 cases and 1,383 deaths reported by June 2025) (6). On 2 June 2025, the primary case, in the symptomatic "wet stage" of cholera with acute watery diarrhoea, shared a meal and water likely contaminated with *Vibrio cholerae* with the first missed case (MN), at Nyumanzi Reception Centre in Dzaipi Sub-County, enabling direct faecal-oral transmission (4). The primary case later died before stool sample collection and testing.

This was followed by MN on 5 June 2025. Two caregivers who had direct contact with MN and likely ingested contaminated water or had inadequate hand hygiene after contact developed symptoms on 8 and 9 June. The index case presented on 10 June 2025, triggering the official notification. Cases continued at 1–2 per day, peaking at three cases on 19 June. No cases were recorded from 21 June to 4 July 2025. A small resurgence occurred on 5 July with two recently arrived refugees from South Sudan (a mother and child) in Nyumanzi settlement, plus an isolated case on 1 July, a health worker who had attended to several cases presenting with acute watery diarrhea and also sought care at Elegu, indicating possible ongoing importation or low-level transmission.

Environmental findings

We found that most of the residents of Egge village collect water for all domestic use from boreholes nearest to their residences. Residents were also seen drinking water directly from the boreholes. We also noted pieces of fecal matter around one borehole in Egge village. The contaminated borehole is located about 200 meters away from a latrine at Nyumanzi HC III.

Hypothesis generation

Out of 19 cases, 16 (84%) depended on borehole water for domestic use, 11 (58%) did not have a pit latrine at home and only 8 (42%) had travelled outside Adjumani District within two weeks before the onset of the disease. Based on the results of the descriptive analysis, we hypothesized that the outbreak was likely imported from South Sudan and amplified by consumption of water from a contaminated borehole in a refugee-hosting community.

Case-control study results

Compared to other primary water sources, drinking untreated water from a borehole in Egge village, Dzaipi sub-county were 5 times more likely to develop acute watery diarrhea relatable to cholera (aOR=5.2, 95% CI: 1.6-17.0). The odds of getting cholera were reduced by using a latrine in a home (aOR=0.2, 95% CI: 0.05-0.9) and treatment of water by any means (aOR=0.2, 95% CI: 0.02-1.4). (Table 1)

Continues to page 54

Continued from page 53

able 1: Risk factors for cholera among residents of Adjumani District, June–July 2025

Exposure		Cases n (%)	Controls n (%)	cOR (95% CI)	aOR (95% CI)
Source of water for domestic use	Others (tap water, treated water)	4 (21%)	54 (72%)	Ref	Ref
	Untreated borehole water	15 (79%)	21 (28%)	9.7 (2.9–32)	5.2 (1.6–17)
Drinking untreated water	Treated (boiled, filtered, chlorinated)	4 (21%)	44 (58%)	Ref	Ref
	Untreated	15 (79%)	32 (42%)	5.2 (1.6–17)	4.2 (1.4–12.9)
Contact with a diarrhea case	No	7 (37%)	58 (76%)	Ref	Ref
	Yes	12 (63%)	18 (24%)	4.7 (1.7–12)	4.1 (1.4–12)

CI: confidence interval, cOR: crude odds ratio, aOR: adjusted odds ratio
No handwashing after latrine use, recent travel to endemic areas and overcrowding were assessed in the multivariable model but were not statistically significant

Discussion

This cholera outbreak was likely imported from South Sudan and amplified by a contaminated borehole in Egge village. South Sudan had experienced a cholera outbreak since October 2024(7). The primary case introduced the infection following cross-border travel from Elegu, with initial transmission occurring through shared contaminated food and water at the overcrowded Nyumanzi Reception Centre in Dzaipi Sub-County. This transmission mode is prevalent in overcrowded refugee settings, where limited access to safe food and water heightens contamination risks (8).

Additional cases included two refugees who arrived from South Sudan already infected and an Elegu health worker who sought care while symptomatic, emphasizing the role of cross-border movement in introducing cholera to Adjumani, a district hosting 84,349 refugees among its 297,894 residents [5,7]. This pattern of disease importation is consistent with outbreaks in other Ugandan border districts, such as Lamwo, where population mobility drives cholera spread (9). These dynamics underscore the challenges of managing infectious diseases in humanitarian settings, where ongoing displacement complicates surveillance and response efforts. Sustained cross-border health coordination and investments in safe food and water provision are essential to prevent recurrent outbreaks in refugee-hosting regions (10). The concentration of cases in Dzaipi Sub- County, a refugee-dense area, highlights how displacement amplifies transmission through shared resources (11).

Study limitation

Given the outbreak context, incomplete case ascertainment may have occurred due to population movement in and out of the settlement, potentially leading to underestimation of the true burden.

Conclusion

The cholera outbreak in Adjumani District, spanning June to July 2025, originated from importation of *Vibrio cholerae* from South Sudan, subsequently amplified by a contaminated water-source in Egge village, Dzaipi sub-county. The outbreak highlights how easily diseases can spread across border areas.

Public health actions

To stop the propagation of the outbreak, we conducted health education on cholera prevention and use of safe water for domestic use. We educated residents of the affected sub-counties especially those in the refugee settlements and encouraged them to use chlorine releasing tablets that had been provided, to make water safe for consumption and to utilize the prophylactic treatment that had been provided by health care workers. Health care workers were trained on Infection Prevention and Control practices (IPC) and case management.

Continues to page 55

Continued from page 54

Recommendations
To prevent future cholera outbreaks in Adjumani District, we recommend that the Government of Uganda, in partnership with local authorities, provide safe drinking water through regular borehole chlorination and monitoring in Egge village and similar refugee-hosting areas. In the long term, the Adjumani District Local Government, in collaboration with the Ministry of Health, Medical Teams International, and other partners, expand latrine availability with improved pit designs and handwashing facilities in Dzaipi Sub-County to reduce faecal contamination and strengthen community health resilience.

Additionally, the Ministry of Health, with support from the World Health Organization (WHO) and UNICEF, initiate a district-wide oral cholera vaccine (OCV) campaign targeting refugees and vulnerable host communities to address the absence of prior vaccination and provide up to 80% protection for three years, as demonstrated in previous Ugandan campaigns.

Conflict of interest
The authors declare that they have no conflict of interest.
Authors' contributions
WJ and MN designed the study and contributed to data collection and analysis. PP and PO also contributed to the study design and data collection. WJ led the writing of the bulletin. PP, PEO, RM, BK, and ARA participated in the writing of the bulletin and review to ensure scientific integrity. All authors contributed to the final draft of the bulletin.
Acknowledgments
The authors would like to thank the Adjumani District Health Team, Nyumanzi HC III administration and staff, and the refugee settlement and reception administration and staff as well as community members of Adjumani District for their support in active case search and line listing of cases during this investigation.

References
1. World Health Organization. Cholera 2024 [Available from: https://www.who.int/news-room/fact-sheets/detail/cholera.
2. Azman AS, Rudolph KE, Cummings DA, Lessler J. The incubation period of cholera: a systematic review. Journal of Infection. 2013;66(5):432-8.
3. Bwire G. Identifying cholera "hotspots" in Uganda: An analysis of cholera surveillance data from 2011 to 2016. PLoS Negl Trop Dis. 2017;11(12).
4. Bwire G. Refugee Settlements and Cholera Risks in Uganda, 2016–2019. Am J Trop Med Hyg. 2021;104(4):1225–31.
5. Bwire G. Development of a Scorecard to Monitor Progress toward National Cholera Elimination: Its Application in Uganda. Am J Trop Med Hyg. 2023;108(5).
6. Organization WH. Mpox: multi-country external situation report no. 57. Geneva World Health Organization. 2025.
7. World Health Organization. Multi-country outbreak of cholera, external situation report #27: World Health Organization; 2025 [Available from: https://www.who.int/publications/m/item/multi-country-outbreak-of-cholera--external-situation-report--27--17-june-2025.
8. Legros D. Global cholera epidemiology: opportunities to reduce the burden of cholera by 2030. The Journal of infectious diseases. 2018;218(suppl_3):S137-S40.
9. Bwire G, Malimbo M, Makumbi I, Kagirita A, Wamala JF, Kalyebi P, et al. Cholera surveillance in Uganda: an analysis of notifications for the years 2007–2011. The Journal of infectious diseases. 2013;208(suppl_1):S78-S85.
10. Ssemanda I, Kibwika B, Namusoosa R, Kwesiga B, Bulage L, Migisha R, Ario AR. Evaluation of response to a cholera outbreak in January 2024 using the 7–1–7 timeliness metrics: a case study of Elegu Point of Entry, Uganda. BMC Public Health. 2024;24(1):3370.
11. Shannon K, Hast M, Azman AS, Legros D, McKay H, Lessler J. Cholera prevention and control in refugee settings: successes and continued challenges. PLoS neglected tropical diseases. 2019;13(6):e0007347.

Continues to page 56

Continued from page 55

Cholera outbreak following cross-border introduction and consumption of untreated River Nile water, Moyo District, Uganda, June–July 2025

Authors: Martha Dorcas Nalweyiso[1*], Justine Wobusobozi[1], Aminah Namwabira[1], Patricia Eyu[1], Richard Migisha[1], Benon Kwesiga[1], Bonny Kintu[2], Godfrey Bwire[2]
Institutional affiliations:[1]Uganda National Institute of Public Health, Kampala, Uganda
[2]Department of Integrated Epidemiology, Surveillance and Public Health Emergencies, Ministry of Health, Kampala, Uganda
Correspondence*: Tel: +256785832362, Email: nmartha@uniph.go.ug

Summary
Background: Cholera is endemic in Uganda, with periodic outbreaks occurring naturally. On June 12, 2025, Uganda's Ministry of Health was notified of a cholera outbreak in Dufile Sub-county, Moyo District. We investigated to determine the source and magnitude of the outbreak and recommend evidence-based control measures.
Methods: We defined a suspected case as onset of watery diarrhoea in a resident of Moyo District aged ≥2 years with *Vibrio cholerae* O1 or O139 detected by a rapid diagnostic test (RDT) from June 5–July 8, 2025. A confirmed case was a suspected case with *Vibrio cholerae* O1 or O139 isolated by stool culture. Cases were identified by active case search and records review at health facilities. We conducted descriptive epidemiology and environmental assessments. We then calculated attack rates (ARs) by sex and subcounty.
Results: We identified 17 confirmed cases with no deaths. Nine cases (53%) were female, with a median age of 27 years (range:5–57). Attack rates (AR) were similar among females (1.4/10,000) and males (1.3/10,000). Dufile Sub-county accounted for 12(71%) cases and had the highest AR (10.4/10,000). The index case had travelled to Nimule, South Sudan, for trade during an ongoing outbreak. He reported drinking untreated River Nile water at the Fula section of the river in South Sudan on June 5, 2025, and developed symptoms the next day. He was transported from South Sudan to Dufile HC IV, which likely facilitated the introduction of cholera in the community. Most (14,82%) of the case-patients also reported consuming untreated water from the Fula section of the River Nile, a common water collection point.
Conclusion: The outbreak was linked to cross-border transmission, which introduced cholera into Moyo District via the index case. Ongoing community transmission was driven by consumption of untreated River Nile water and limited access to safe water sources. We recommend strengthening cross-border surveillance through enhanced screening at points of entry and improving access to safe water.

Background
Cholera is characterised by profuse watery diarrhoea and is caused by the bacterium *Vibrio cholerae* (1). It is transmitted through the consumption of food and water contaminated with faeces (1). It has a short incubation period of hours to 5 days, with most persons being asymptomatic, capable of transmitting infection to communities with inadequate safe water, sanitation and hygiene (2, 3). Clusters of cholera cases are common due to either contamination of the communal water source or contamination of the environment by a case (4).

Most of the global burden of cholera is seen in developing countries and areas with poor sanitation. Globally, it is estimated that 1.3 to 4 million cases and 22,000 to 143,000 deaths occur annually (5). In response, the Global Task Force on cholera set targets to reduce cholera deaths by 90% and eliminate transmission in at least 20 countries by 2030 (6). Key prevention strategies include oral vaccination in hotspots, improving water quality, sanitation and hygiene (7).

Uganda is among the cholera-endemic countries targeted for elimination by the Global Task Force for cholera (6). Uganda experiences an estimated annual incidence of 23 cases per 100,000 population, equivalent to 11,000 reported cases. Notably, 81% of these cases occur in a relatively small number of districts, accounting for only 24% of the country's population (8). High-risk districts include those hosting fishing communities, slum dwellers, refugee settlements and those at the border (9).

Moyo is a cholera-prone district since it has never received the Oral Cholera Vaccine (OCV). The district is located in Northern Uganda along the border with South Sudan. Being a border District, Moyo has a porous border, which facilitates the transboundary movement of people, contributing to the spread of infections (9).

Continues to page 57

Continued from page 56

Moyo District last experienced a cholera outbreak in August 2014 in Metu and Dufile sub-counties, and recorded four (4) deaths (10).

On June 12, 2025, the Ministry of Health was notified of a confirmed cholera case in Moyo District. We investigated to determine the source and magnitude of the outbreak to recommend evidence-based control interventions.

Methods

The outbreak occurred in Moyo District, West Nile Region, Northern Uganda. The district is bordered by South Sudan to the North with frequent cholera outbreaks. The district has 10 sub-counties, with a total population of 120,900. The district is bordered by mountains and forests that form a natural boundary with South Sudan. We defined a suspected case as onset of watery diarrhoea in a resident of Moyo District (aged $\geq$2 years) from June 5–July 8, 2025. A confirmed case was a suspected case with *Vibrio cholerae* O1 or O139 confirmed by stool culture. Cases were identified through a review of medical records and active case search at health facilities.

We conducted a descriptive analysis of the cases identified from June 5–July 8, 2025, by age, sex, clinical presentation, place of residence, and possible exposures. We calculated frequencies, percentages, and attack rates by place (subcounty) and sex using the 2024 population estimates for Moyo District and the Uganda Bureau of Statistics (UBOS). An epidemic curve was used to describe the distribution of cases by the date of symptom (diarrheal) onset.

We used a case investigation form to collect information on potential exposures from randomly selected case patients. Exposures included sources of household water, contact with an individual with profuse watery diarrhoea, and travel from an area with known cholera occurrence.

Based on the hypothesis-generating interviews, consumption of untreated water and travel from South Sudan with known cholera occurrence were suspected to be the possible source of infection in this outbreak. Using a standardised environmental assessment checklist, we planned to inspect key water-collection points along the River Nile identified by case-patients. However, this was unsuccessful because the border area was inaccessible. The terrain leading to the identified sites was impassable, limiting our ability to reach and assess the suspected water-collection points along the river.

This investigation was in response to a cholera outbreak under the directive of the Ugandan Ministry of Health. The Office of the Associate Director for Science at the Center for Disease Control and Prevention (CDC), Uganda, determined that this research did not involve human subjects and that its primary intent was public health practice or disease control. Verbal informed consent was obtained from participants or, if the interviewee was a minor, from the guardian before the start of each interview.

Results

We identified 17 confirmed cholera cases of *Vibrio cholerae,* serotype 01 and 0139 ogawa with no deaths. The median age was 27 years (range: 5–57), and females accounted for 9 (53%) of cases. All cases presented with acute watery diarrhoea; other symptoms included abdominal pain (14,83%), vomiting (13,76%), and nausea (11,64%). Both males and females were similarly affected (attack rate: 1.4/10,000 vs.1.3/10,000). Most case-patients had primary education (12,71%), followed by ordinary level (3,18%), and no formal education (2, 12%). The main occupations were farming (5,29%), fishing (5,29%), students (4,24%), casual labourers (2,12%), and fishmongers (1,6%).

Three (3) out of 10 sub-counties were affected. Dufile Sub-county had the highest attack rate of 10.4/10,000 population, followed by Otce Town Council (1.2/10,000) and Metu Sub-county (0.5/10,000) (Figure 1). These three (3) sub-counties border South Sudan, and most cases had visited the Fula fishing site in Nimule, South Sudan, to participate in fishing activities.

Continues to page 58

Continued from page 57

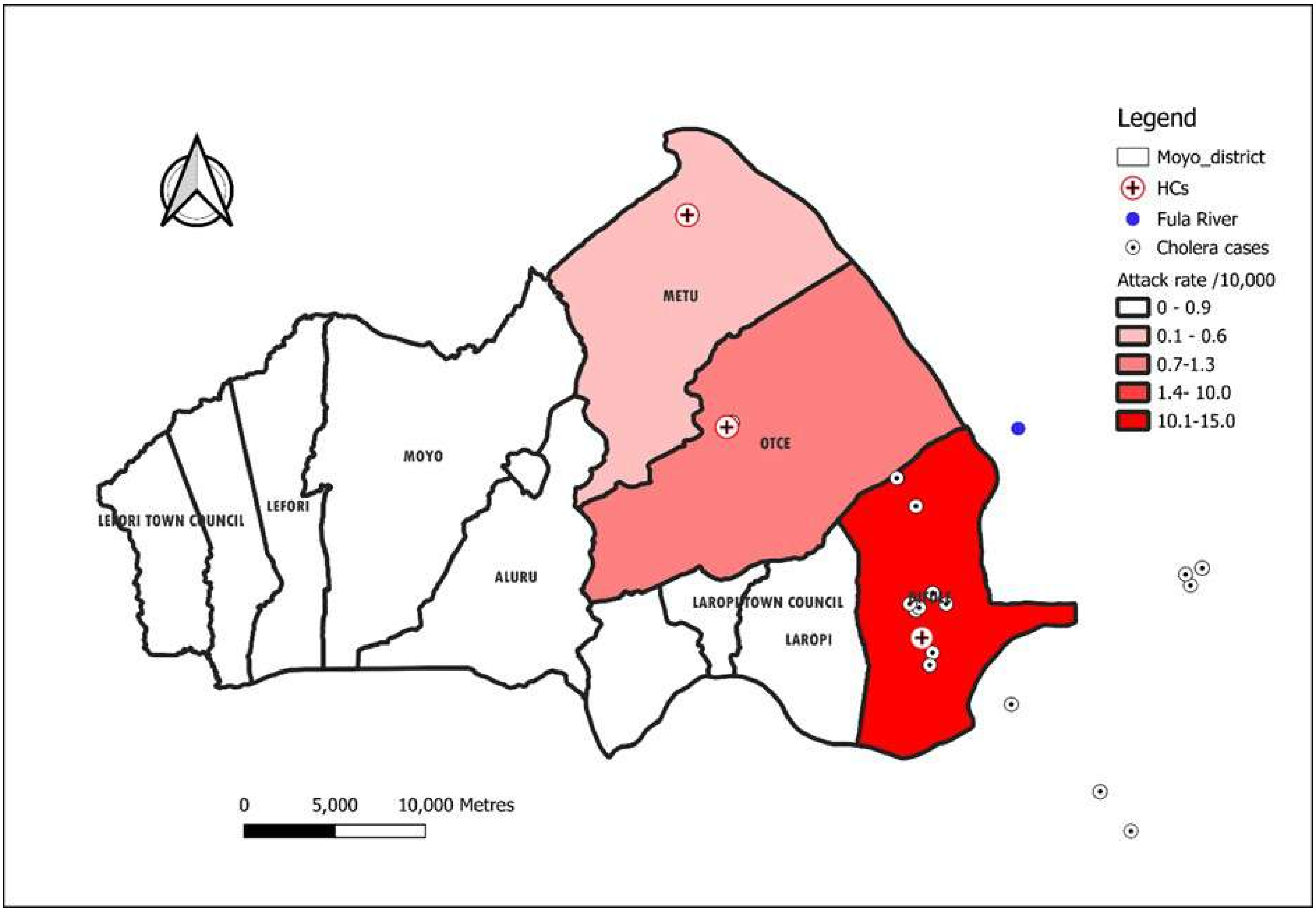


Figure 1: Distribution of cholera cases among the three most affected sub-counties during a cholera outbreak in Moyo District, Uganda, June-July 2025

Distribution of cases

The index case, M.G. (27-year-old fisherman), visited the South Sudanese part of the camp and drank untreated water from the Fula section of River Nile on June 5, 2025, and developed symptoms (abdominal pain, loose stools, vomiting) on June 6, tested RDT-positive and stool culture-confirmed for cholera by June 12. On the same day (June 5, 2025), a fishmonger (K.J.) also travelled to the same camp to sell fish and drank contaminated water from the River Nile. Several people carried K.J from South Sudan, who was in a wet state, of whom five shared bread and drinking water, fell sick and were admitted at Dufile HC IV. The second cluster of cases was reported eighteen (18) days later, where M.E washed a mango in the Fula River and ate it. The other cases visited relatives in Sudan, leading to another cluster of the outbreak. Overall, the Moyo District experienced a point-source outbreak with clusters propagated by two cases (Figure 2).

Continues to page 59

Continued from page 58

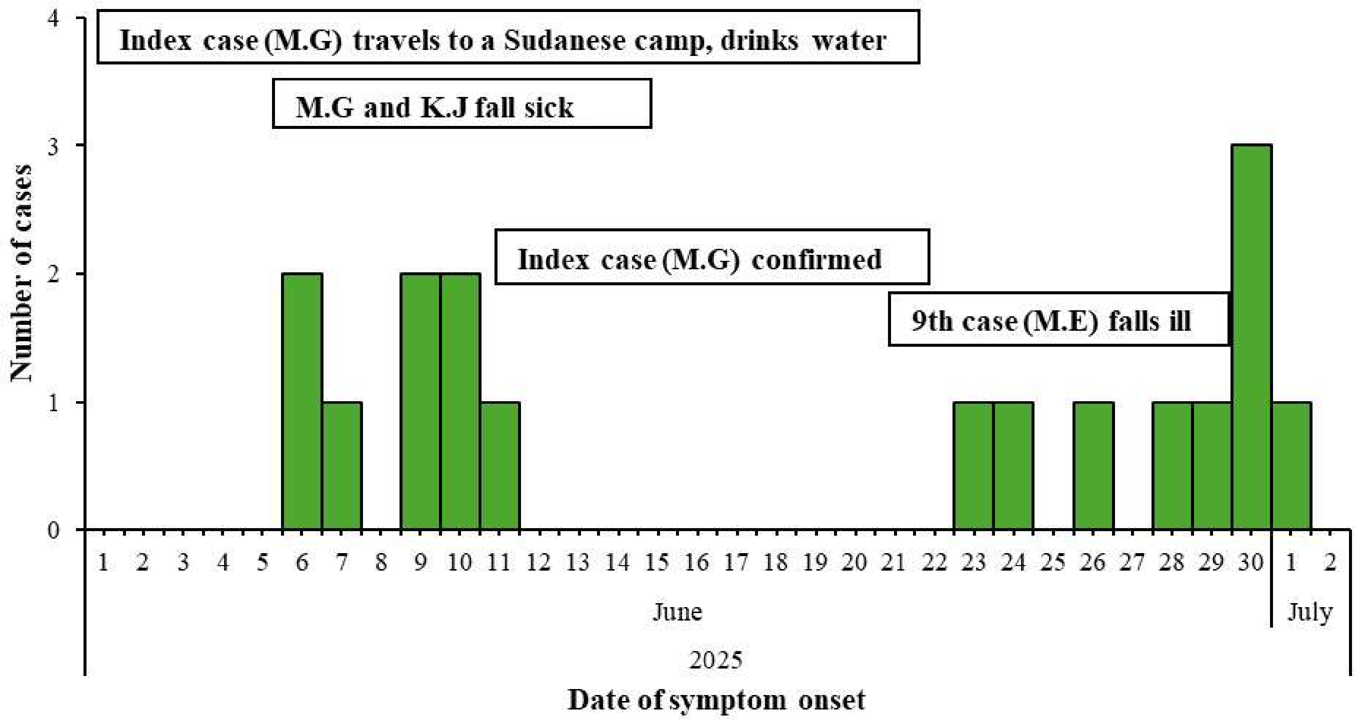


Figure 2: Distribution of symptom onset over time during a cholera outbreak in Moyo District, Uganda, June–July 2025

Environmental assessment findings

Based on the inaccessibility of the Fula section of the River Nile, water samples were not collected. However, South Sudan already had an ongoing outbreak. It was noted that residents of Dufile, Otce, and Metu Sub-counties which border South Sudan use River water for bathing and washing clothes. Water for domestic use is also drawn from the same water source.

Hypothesis generation findings

Of the 17 case patients, 11 (65%) used river water for domestic purposes (bathing, cooking), 12 (71%) had contact with someone with profuse watery diarrhoea, 14 (82%) travelled from an area with known cholera occurrence, and 14 (82%) drank untreated water (Table 1). Based on the descriptive epidemiology and findings from hypothesis-generating interviews, we hypothesised that recent travel from a cholera-affected area, drinking untreated river water, using river water for domestic use and contact with a person with cholera (or profuse watery diarrhoea) were likely risk factors for this outbreak.

Table 1: Exposures among cholera case-patients, Moyo District, Uganda, June–July 2025

Exposure (N=17)	n	(%)
River water* is the main source of water for domestic use	11	65
Contact with an individual with profuse watery diarrhoea	12	71
Travel from an area with known cholera occurrence.	14	82
Drink untreated water	14	82
Wash hands with soap after visiting the toilet	14	82

*Water was fetched from a section of the River Nile locally referred to as ‘Fula' due to the rapids.

Continues to page 60

Continued from page 59

Discussion

Our investigation confirmed a cholera outbreak in Dufile Sub-county, Moyo District, likely due to the importation of *Vibrio cholerae* from a cholera-affected fishing camp in South Sudan. The location of Moyo District at the Uganda-South Sudan border, combined with frequent cross-border fishing activities at the Fula section, heightened cholera vulnerability, particularly given South Sudan's ongoing epidemic lasting two years (11). Although Moyo District had not experienced an outbreak in over 10 years despite persistent cross-border movements, the active South Sudan epidemic facilitated disease importation, with the index case acquiring cholera through consumption of contaminated water. Fishing interactions between Ugandans and South Sudanese at the Fula section amplified transmission risks, consistent with previous findings that cross-border population movements are a key driver of cholera in border districts (12, 13).

Females were more affected, with a slightly higher attack rate than males, likely reflecting their roles in water collection, food preparation, and laundry which increase exposure to contaminated water sources. Similar gender disparities have been observed in cholera-endemic settings, where women's domestic responsibilities heighten risk (14, 15). Despite late detection, no deaths were reported, likely due to the prompt response of Cholera Treatment Units (CTU) staff, early administration of oral rehydration solution (ORS) and intravenous (IV) fluids and the index case seeking care quickly, enabling timely sample collection, diagnosis and effective treatment.

Most cases were linked to the consumption of untreated river water despite the availability of boreholes and piped treated water, suggesting persistent behavioural or access barriers, a challenge commonly observed in cholera outbreaks, consumption of contaminated water has been found to be a risk factor for outbreaks (8, 15-18).This outbreak underscores the need for enhanced cross-border surveillance, stronger community awareness of the risks posed by untreated river water and consistent access to safe water sources to prevent future outbreaks.

Study limitations

We were unable to access the Fula section of the River Nile due to inaccessibility and since all cases were linked and had similar exposures, a case-control study to assess risk factors could not be conducted.

Conclusion

Our investigation suggests that the outbreak was likely initiated through the importation of cholera following travel to a cholera-affected area in South Sudan, supported by the high proportion of case-patients reporting recent travel. Subsequent transmission likely occurred locally through consumption of untreated river water and close contact with infected individuals. The clustering of cases among fishermen, fishmongers, and their contacts indicates occupational and social exposures that facilitated both environmental and person-to-person transmission.

Public health actions

To stop the propagation of the outbreak, we conducted health education on cholera prevention and the use of safe water use. We educated residents and encouraged them to use chlorine-releasing tablets provided to make the water safe for consumption. Health care workers were trained in Infection Prevention and Control (IPC) practices and case management, and in the local preparation of Oral Rehydration Salts (ORS).

Recommendations

We recommend intensifying door-to-door safe water messaging in Dufile Sub-county and riverine parishes, emphasising water boiling and installing warning signage at water access points near Fula. In addition, cross-border surveillance could be intensified to enhance early detection of cases, facilitate timely information sharing, and strengthen coordinated response efforts between neighbouring districts.

Conflict of interest

The authors declare that they have no conflict of interest.

Authors' contributions

MDN, JW and AN designed the study and contributed to data collection and analysis. PE, BK and GB also contributed to the study design and data collection. MDN led the writing of the bulletin. RM, and BK participated in writing the bulletin and in its review to ensure scientific integrity. All authors contributed to the final draft of the bulletin.

Continues to page 61

Continued from page 60

Acknowledgments
The authors would like to thank the Moyo District Health Team and the health workers at Dufile HC IV, Metu HC III, and Otce HC III for their support with medical record review and active case search. We also acknowledge the Health Assistants and Village Health Teams (VHTs) for their invaluable assistance with active case-finding and line listing of cases during this investigation.

References

1. WHO. Cholera Fact Sheet. 2024.
2. Azman AS, Rudolph KE, Cummings DA, Lessler J. The incubation period of cholera: a systematic review. Journal of Infection. 2013;66(5):432-8.
3. Bwire G, Orach CG, Aceng FL, Arianitwe SE, Matseketse D, Tumusherure E, et al. Refugee settlements and cholera risks in Uganda, 2016–2019. The American Journal of Tropical Medicine and Hygiene. 2021;104(4):1225.
4. Almagro-Moreno S, Taylor RK. Cholera: environmental reservoirs and impact on disease transmission. Microbiology spectrum. 2013;1(2):10.1128/microbiolspec. oh-0003-2012.
5. Control GTFoC. Ending cholera: a global roadmap to 2030. World Health Organization Geneva, Switzerland; 2017.
6. Force GT. <ending-cholera-a-global-roadmap-to-2030 (1).pdf>. 2017.
7. Buliva E, Elnossery S, Okwarah P, Tayyab M, Brennan R, Abubakar A. Cholera prevention, control strategies, challenges and World Health Organization initiatives in the Eastern Mediterranean Region: A narrative review. Heliyon. 2023;9(5).
8. Monje F, Ario AR, Musewa A, Bainomugisha K, Mirembe BB, Aliddeki DM, et al. A prolonged cholera outbreak caused by drinking contaminated stream water, Kyangwali refugee settlement, Hoima District, Western Uganda: 2018. Infectious Diseases of Poverty. 2020;9(1):154.
9. Health Mo. Final Cholera Guidelines. May, 2025.
10. Abubakar A, Bwire G, Azman AS, Bouhenia M, Deng LL, Wamala JF, et al. Cholera epidemic in South Sudan and Uganda and need for international collaboration in cholera control. Emerging infectious diseases. 2018;24(5):883.
11. World Health Organisation. South Sudan declares cholera outbreak in Renk, Upper Nile State 2024 [Available from: https://www.afro.who.int/countries/south-sudan/news/south-sudan-declares-cholera-outbreak-renk-upper-nile-state.
12. Bompangue D, Giraudoux P, Piarroux M, Mutombo G, Shamavu R, Sudre B, et al. Cholera epidemics, war and disasters around Goma and Lake Kivu: an eight-year survey. PLoS neglected tropical diseases. 2009;3(5):e436.
13. Piarroux R, Barrais R, Faucher B, Haus R, Piarroux M, Gaudart J, et al. Understanding the cholera epidemic, Haiti. Emerging infectious diseases. 2011;17(7):1161.
14. Ali M, Nelson AR, Lopez AL, Sack DA. Updated global burden of cholera in endemic countries. PLoS neglected tropical diseases. 2015;9(6):e0003832.
15. Okello PE, Bulage L, Riolexus AA, Kadobera D, Kwesiga B, Kajumbula H, et al. A cholera outbreak caused by drinking contaminated river water, Bulambuli District, Eastern Uganda, March 2016. BMC infectious diseases. 2019;19(1):516.
16. Kamukama A, Nuwamanya Y, Namulondo E, Baliruno LN, Kyamwine IB, Nansikombi HT, et al. Cholera outbreak associated with drinking contaminated river water in Kayunga District, Uganda, June-August 2023. BMC Infectious Diseases. 2025;25(1):848.
17. Rek J, Orit D, Waako S, Kwesiga B, Migisha R, Bulage L, et al. Cholera outbreak associated with drinking contaminated lake shore water, Namayingo District, Uganda, July–August 2023.
18. Swerdlow DL, Greene K, Tauxe R, Wells J, Bean N, Ries A, et al. Waterborne transmission of epidemic cholera in Trujillo, Peru: lessons for a continent at risk. The Lancet. 1992;340(8810):28-32.

Continues to page 62

Continued from page 61

Measles outbreak investigation in Akwon and Muntu sub-counties, Amolatar District, Uganda, November 2025–February 2026

Author and Institutional affiliation: Martha Dorcas Nalweyiso, Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Tel: +256 785832362, Email: nmartha@uniph.go.ug

A measles outbreak was confirmed in Amolatar District, Uganda, on February 6, 2026, following laboratory confirmation by the Uganda Virus Research Institute. A total of 120 cases were identified (5 confirmed, 29 probable, 86 suspected), predominantly affecting children aged 9–17 months, who recorded the highest attack rate at 360/100,000 population. Females accounted for 63% of cases, and Akwon Subcounty bore the greatest burden with an attack rate of 690/100,000. The epidemic curve revealed persistent low-level transmission from November 2025, with peaks in November and January, and a surge following a large social gathering a burial on January 31, 2026 which served as a key amplification event.

The outbreak was primarily driven by low measles-rubella (MR) vaccination coverage, with 52% of cases unvaccinated and only 19 children having received both recommended MR doses. Three subcounties lacked vaccinating health facilities, limiting immunisation access. Cultural and religious beliefs particularly among a Seventh-day Adventist subgroup further hindered vaccine uptake and delayed health-seeking. Gaps in surveillance, including an initial false-negative laboratory result in November 2025, contributed to delayed confirmation and response, allowing transmission to persist and expand across the district.

Fellows (In brown jackets), Village Health Team member (in red T-shirt) and family members of a suspected case,verifying the line list during a measles outbreak investigation in Adyangoket village, Akwon Subcounty, Moyo District.

Continues to page 63

Continued from page 62

Investigation of Anthrax Outbreak in Kazo District, March 2025

Author: Winfred Nakaweesi[1], [1] Uganda Public Health Fellowship Program, Field Epidemiology Track, Email: wnakaweesi@uniph.go.ug | Tel: +256 774 572807

On January 22, 2026, the Kazo District Health Team notified the Ministry of Health of a cluster of suspected human anthrax cases following reports of sudden livestock deaths in multiple sub-counties. The National Rapid Response Team (NRRT) from the Uganda Public Health Fellowship Program was deployed and set out to, determine the magnitude of the outbreak, characterize cases by person, place, and time, identify potential exposures, assess outbreak response using 717 time-lines and recommend evidence-based control measures in Kazo District. We conducted active case finding, health facility records reviews, laboratory testing, and environmental assessments.

A total of 135 cases (121 suspected and 14 confirmed) were identified between December 2025 and March 2026, with an overall attack rate of 65 per 100,000 population and a case fatality rate of 4%. The majority of cases (97%) presented with cutaneous anthrax, and males and persons aged ≥15 years were the most affected. All sub-counties reported cases, with Kazo Town Council and Kyam-pangara Sub-county experiencing the highest attack rates.

Epidemiological, laboratory, and environmental findings indicated that the outbreak was associated with handling and consumption of meat from animals that died suddenly. Cases were clustered around farms where livestock deaths occurred, and unsafe practices such as on-site butchering and shallow burial of carcasses were common. Laboratory testing confirmed Bacillus anthracis in both human and animal samples. In response, district authorities, supported by national teams, imple-mented control measures including community sensitization, promotion of safe carcass disposal, strengthening of surveillance, and livestock vaccination. These interventions aimed to interrupt trans-mission, prevent further human infections, and reduce the risk of future outbreaks in this high-risk cattle corridor setting.

Group photo of Winfred Nakaweesi, Dr Aminah Namwabira, Dr Pauline Achom, Dr Patrick Kwizera (fellows wearing rapid response jackets) with Kazo District Health Team including the district health officer, resident district commissioner, district veterinary officer and district surveillance focal person taken after the district entry meeting and debrief.

Continues to page 64

Continued from page 63

Public Health Commemoration Days –April-June 2026

Authors: Anne Loy Alupo[1]*, Aman Denise Kyomugisha[1], Michael Mutegeki[1], Vivian Nakaweesa[2]
Institutional affiliation: [1]Uganda Public Health Fellowship Program – Field Epidemiology Track, Uganda National Institute of Public Health, Kampala, Uganda; [2]Uganda Public Health Fellowship Program – Laboratory Leadership Track, Uganda National Institute of Public Health, Kampala, Uganda
Correspondence: *Tel: +256788372187, Email: annealupo@uniph.go.ug

Global public health awareness days aim to increase visibility, awareness and understanding of specific diseases or health conditions among the general public. They are key in highlighting the importance of healthy lifestyles and well-being among the general population. Each year, various organizations and communities around the world actively participate in promoting and supporting World Health Days.

World Malaria Day, April 25, 2026

Celebrated annually on April 25th, World Malaria Day highlights the global effort to combat and ultimately eliminate malaria. While significant progress has been made, with 47 countries certified malaria-free and billions of cases averted since 2000, the global situation has recently stalled, with an estimated 610,000 deaths reported in 2024. This plateau is attributed to biological challenges such as drug and insecticide resistance, as well as systemic issues like a critical funding gap. Despite these obstacles, advancements in science, including the rollout of malaria vaccines in 25 countries and the distribution of next-generation mosquito nets, offer renewed possibilities for eradication. Addressing the ongoing threat requires sustained funding, strengthened country leadership, accelerated innovation, and empowered communities to ensure that effective tools and treatments reach those in need. This year’s theme is "Driven to End Malaria: Now We Can. Now We Must".