



Changing patterns of drug-resistant tuberculosis notifications in Uganda: findings from routine surveillance, 2015–2024

Authors: Deborah Aujo^{1*}, Richard Migisha¹, Benon Kwesiga¹, Geoffrey Amanywa², Rose Amolo², Henry Luzze²

Institutional affiliations: ¹Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda, ²National Tuberculosis and Leprosy Program, Ministry of Health, Kampala, Uganda

Correspondence*: Tel: 0702983574 Email: deborah.aujo@uniph.go.ug

Summary

Background: Drug-resistant tuberculosis (DR-TB) remains an important challenge for tuberculosis control in Uganda. We analysed national DR-TB surveillance data from 2015–2024 to describe temporal trends in DR-TB case-notifications and geographic patterns that could inform programming.

Methods: We analysed confirmed rifampicin-resistant tuberculosis (RR-TB), multidrug-resistant tuberculosis (MDR-TB), and extensively drug-resistant tuberculosis (XDR-TB) cases reported through the District Health Information Software 2 (DHIS2) between 2015 and 2024. We assessed trends using the Mann–Kendall test and examined geographic clustering using Local Indicators of Spatial Association.

Results: We identified 5,294 DR-TB cases, including 4,050 (76%) RR-TB, 1,184 (22%) MDR-TB, and 60 (1%) XDR-TB cases. National case-notification rates increased from 0.36 per 100,000 population in 2015 to 1.11 per 100,000 in 2024, with a decline during 2020–2021. Notifications increased significantly among new patients ($p=0.012$), while the increase among previously treated patients was not significant ($p=0.15$). District-level analysis, restricted to 2022–2024, showed marked geographic variation. Kampala, Wakiso, and Mukono demonstrated persistent high-high spatial clustering, while Kotido, Karenga, Moroto, and Nabilatuk showed recurrent but non-persistent clustering.

Conclusion: These findings indicate geographic differences in DR-TB notification patterns and highlight the value of using routine surveillance data to guide targeted case finding, diagnostic services, and surveillance strengthening.

Background

Uganda remains among countries with a high tuberculosis (TB) burden, with drug-resistant TB (DR-TB) posing additional challenges for diagnosis, treatment, and prevention. Uganda is also among the countries identified by the World Health Organization (WHO) as having a high burden of multidrug-resistant or rifampicin-resistant TB (MDR/RR-TB). The WHO estimates indicate that approximately 2,000 people develop MDR/RR-TB in Uganda annually yet in 2023 only 1,200 cases were registered nationally, illustrating the gap between the estimated burden and the number detected through routine notification systems[1]. Expansion of molecular testing, drug-susceptibility testing, and decentralized DR-TB services has increased opportunities to identify resistant disease [1-3].



Routine surveillance data can provide more than national counts. Examining notification patterns over time and across geographic areas can identify locations where DR-TB is repeatedly detected and where additional public-health attention may be warranted. We described changes in case-notification rates and identified geographic patterns, Uganda, 2015–2024, to inform TB programming.

Methods

We conducted a retrospective analysis of routinely reported DR-TB surveillance data from all National Tuberculosis and Leprosy Program-affiliated DR-TB sites in Uganda between 2015 and 2024. We used cases recorded in DHIS2 and analysed them according to the resistance category recorded in the database: rifampicin-resistant TB (RR-TB), multidrug-resistant TB (MDR-TB), or extensively drug-resistant TB (XDR-TB).

We calculated annual DR-TB case-notification rates per 100,000 population using mid-year population estimates. We assessed trends using the Mann–Kendall test, and estimated annual change using Sen's slope.

We assessed geographic patterns at regional and district levels. At regional level, we summarised DR-TB notifications for 2015–2024. Because consistent district-of-residence information was available only from 2022 onward, district-level analyses were restricted to 2022–2024. We applied Empirical Bayes smoothing to reduce instability in rates from sparsely populated districts, and used Local Indicators of Spatial Association (LISA) to identify spatial clustering.

We sought permission to use the routinely generated program data from the Uganda Ministry of Health, the National Tuberculosis and Leprosy Program. In addition, The US Centers for Disease Control and Prevention (CDC) provided the non-research determination (NRD) for non-human subjects. In This activity was reviewed by the US CDC and was conducted consistent 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.

Results

Trends in drug-resistant tuberculosis case-notifications, Uganda, 2015–2024

Between 2015 and 2024, 5,294 DR-TB cases were reported. Rifampicin resistant-TB accounted for 4,050 (76%) cases, MDR-TB for 1,184 (22%), and XDR-TB for 60 (1%). Among the 2,806 cases with individual-level information, 1,886 (67%) were male and the median age was 39 years (IQR 28–50). Overall, 1,842 (66%) reported cases were HIV-positive.

National DR-TB case-notification rates increased from 0.36 per 100,000 population in 2015 to 1.11 per 100,000 in 2024 (Figure 1). Notifications increased during 2015–2019,



declined during 2020–2021, and subsequently increased again.

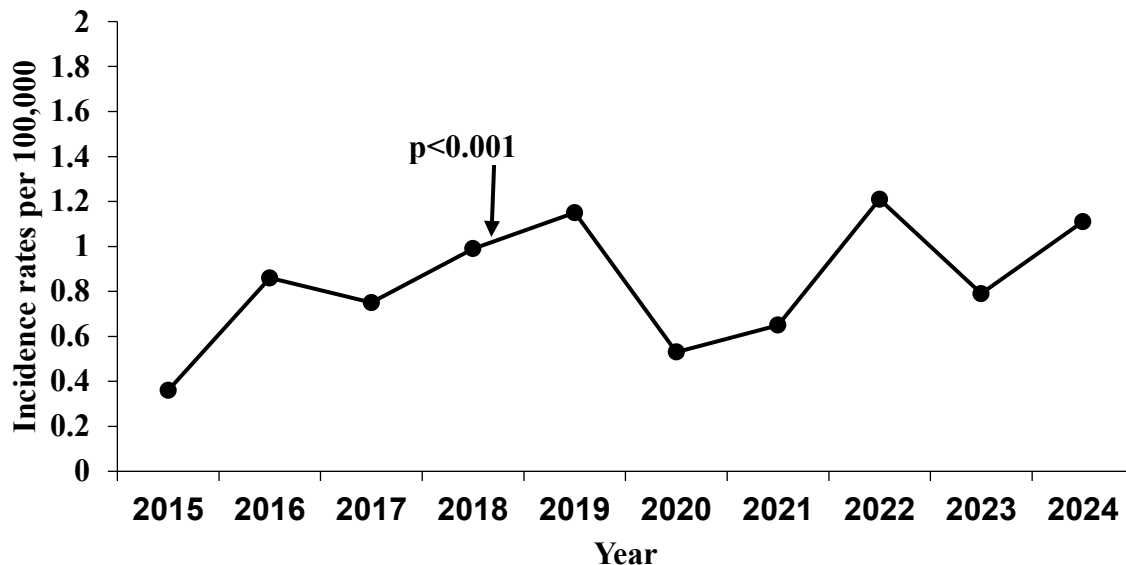


Figure 1: Trends in case-notifications of drug resistance tuberculosis, Uganda, 2015-2024

When categorized by treatment history, notifications increased among both new and previously treated patients. The increase among new patients was statistically significant (Sen's slope 43; 95% CI=11.4–102; $p=0.012$), whereas the increase among previously treated patients was not statistically significant (Sen's slope 15 cases per year; 95% CI =3.8–40.3; $p=0.152$) (Figure

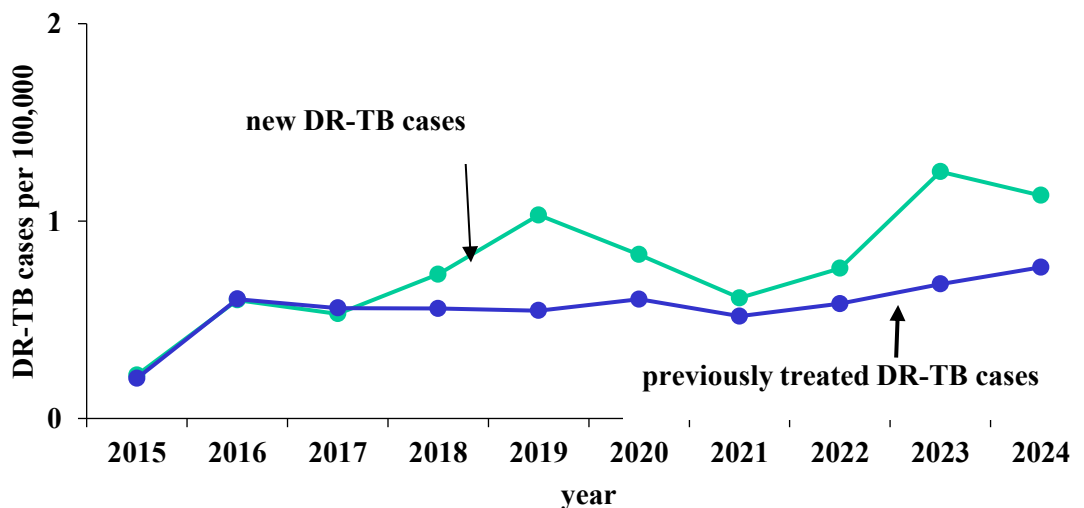


Figure 2: Trends in drug resistant tuberculosis cases among new cases and previously treated cases, Uganda, 2015-2024



Geographic pattern drug resistant-tuberculosis case notifications, Uganda, 2022–2024

Geographic analysis showed substantial variation in DR-TB case-notification rates. At regional level, higher notification rates were repeatedly observed in Kampala, Lango, and Karamoja (Figure 3).

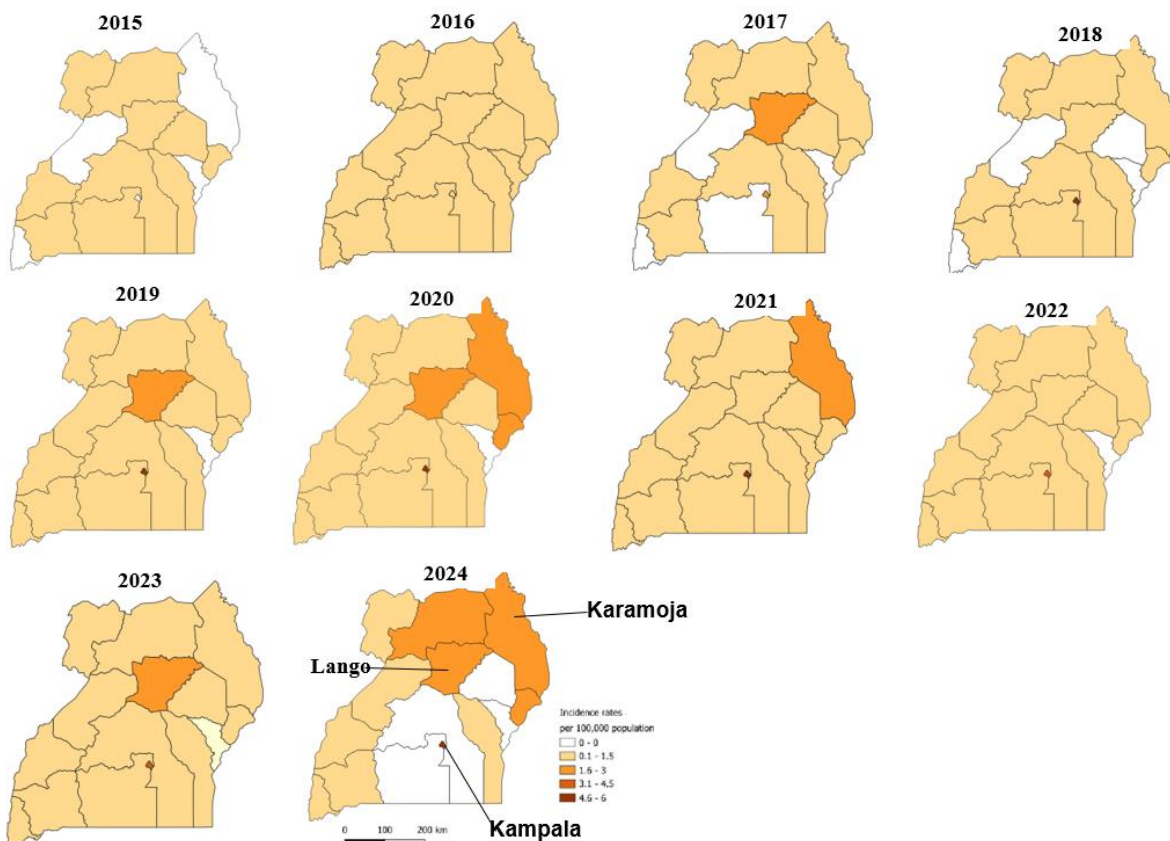


Figure 3: Rifampicin resistant/multidrug resistant tuberculosis case-notifications per 100,000 population, Uganda 2015–2024

At district-level, Kampala, Wakiso, and Mukono had elevated notifications across multiple quarters. Karenga, Kotido, Moroto, and Nabilatuk also frequently appeared in higher notification categories. After smoothing, LISA identified persistent high-high clustering in Kampala, Wakiso, and Mukono. Kotido, Karenga, Moroto, and Nabilatuk demonstrated recurrent but non-persistent clustering.

Discussion

Drug-resistant tuberculosis notifications in Uganda increased overall between 2015 and 2024, with a decline during 2020–2021 followed by renewed increases. Notifications increased significantly among new patients, while the increase among previously



treated patients was not statistically significant. Geographic patterns also varied across the country, with persistent high-high clustering observed in Kampala, Wakiso, and Mukono and recurrent but non-persistent clustering observed in several districts of Karamoja.

The increase in notifications among new patients is also important for the TB programme. Surveillance data cannot determine whether this pattern represents community transmission, increased detection, reactivation, or other factors. Nevertheless, it supports maintaining attention to early detection and contact investigation in addition to management of patients with previous TB treatment.

The reduction in notifications during 2020–2021, followed by recovery illustrates how surveillance can be affected by disruptions in health services [4, 5].

The geographic concentration of notifications should be interpreted in relation to the availability and use of diagnostic and treatment services. Previous studies in Uganda have documented geographic differences in TB burden and access to health services [6, 7]. However, the present analysis did not include measures of diagnostic access, testing coverage, or service availability, so we cannot determine whether areas with higher notifications had better access to DR-TB diagnosis and treatment. Higher notification rates may reflect differences in underlying burden, detection, diagnostic access, reporting, or a combination of these factors. Conversely, lower notification rates should not automatically be interpreted as evidence of lower DR-TB burden where diagnosis or reporting may be limited.

Study limitations: This analysis used routinely reported surveillance data, may be affected by incomplete reporting, reporting delays, which could underestimate notifications in districts with weaker reporting systems. Differences in access to diagnostic services and changes in surveillance coverage over time may also have resulted in fewer cases being detected in some areas, potentially exaggerating or reducing apparent geographic difference. District-level geographic analysis was limited to 2022–2024 because consistently available information on district of residence was not available for earlier years. Individual-level variables were also incomplete for some notified cases. In addition, the analysis was descriptive and ecological; therefore, observed temporal or geographic patterns cannot be used to establish causal relationships or determine whether increases in notifications represent changes in underlying DR-TB transmission.

Conclusion: Drug resistant tuberculosis case-notifications in Uganda increased overall from 2015 to 2024 with a significant increase among new patients and substantial geographic variation in notification patterns. Persistent high clustering was observed in Kampala, Wakiso, and Mukono, while several districts in Karamoja showed recurrent but non-persistent clustering. These findings demonstrate the value of routine surveillance for identifying geographic and temporal signals that can inform program planning. Strengthening geographically targeted case-finding, expanding timely drug-resistance testing, integrating DR-TB and HIV services, and improving surveillance in



underserved districts may be important for reducing inequities and accelerating progress toward TB control.

Acknowledgements: We acknowledge the Ministry of Health for granting permission to access the National Tuberculosis and Leprosy Program. We also thank the United States Centers for Disease Control and Prevention (US CDC) for supporting the Uganda Public Health Fellowship Program activities.

Author contributions: DA took lead in conceptualizing the study idea, data collection, data analysis, bulletin article writing and editing. RM, BK, GA, RA supervised the investigation, and reviewed the bulletin article. All the authors read and approved the final article.

Conflict of interests: The authors declare no competing interests.

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