



Trends and distribution of zoonotic disease-related mortality, Uganda, 2020–2025

Authors: Justine Wobusobozi^{1*}, Winfred Nakaweesi¹, Richard Migisha¹, Aminah Namwabira¹, Martha Dorcas Nalweyiso¹, Carol Nanziri², Paul Okello¹, Irene Kyamiwine¹, Benon Kwesiga¹

Institutional Affiliations: ¹Uganda Public Health Fellowship Program, Uganda National Institute of Public Health, Kampala, Uganda

²Department 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: Uganda is a recognised zoonotic hotspot and has invested heavily since 2017 in detecting priority zoonoses through the District Health Information Software 2 (DHIS2). Whether that investment has been matched by fewer deaths is unknown, and national totals conceal which pathogens account for the deaths that remain and where they occur. We described zoonotic disease-related deaths reported through DHIS2 in Uganda during 2020–2025, and their distribution by pathogen, health facility level, and region.

Methods: We analyzed all cases and deaths for the nine zoonoses reportable through DHIS2 during 2020–2025, grouped as rabies; anthrax and brucellosis; other zoonoses; and viral haemorrhagic fevers (VHFs). We excluded any facility-condition-year death count that both exceeded 100 deaths and exceeded the total reported for that condition at all other facilities nationally in the same year. We calculated proportional mortality and mortality rate per 100,000 population, and tested annual death counts for monotonic trend using the Mann–Kendall test (Kendall's tau-b).

Results: Of 344,998 zoonotic disease cases reported, 1,894 (0.5%) resulted in death. Annual deaths held between 392 and 460 from 2020 to 2023, then fell by 68% in a single year to 126 in 2024 and to 94 in 2025; because the fall was a step rather than a slope, the trend across all 6 years did not reach significance ($\tau_b = -0.73$, $p = 0.056$). Anthrax and brucellosis, the only category to decline progressively, fell from 283 deaths in 2020 to 16 in 2025 ($\tau_b = -0.87$, $p = 0.017$), whereas rabies showed no evidence of a monotonic trend ($\tau_b = -0.07$, $p = 1.0$) and rose from 10.6% (43/405) to 36% (34/94) of annual deaths. Brucellosis alone caused 680 (36%) of the 1,894 deaths. Health Centre (HC) II–HC IV facilities and private clinics reported 1,713 (90%) of deaths but approximately 272,500 (79%) of cases.

Conclusion: Reported zoonotic deaths fell by 77% over 6 years, but as a single step between 2023 and 2024 rather than a progressive decline, a shape more consistent with a change in reporting than with improving survival. Only the bacterial zoonoses declined progressively; rabies showed no evidence of decline and now accounts for more than a third of a much smaller burden. Nine in ten deaths were reported at the first point of contact rather than at referral hospitals, placing both the diagnostic gap and the opportunity to close it at HC II–HC IV facilities and private clinics. Triangulating these data against medically certified deaths would establish whether the decline is real before it is read as programme success.



Background

Zoonotic diseases account for more than 60% of emerging infectious diseases worldwide and involve over 2—known pathogens transmissible between animals and humans (1). Sub-Saharan Africa carries a disproportionate burden: outbreaks in the region rose by 63% between 2012 and 2022 compared with the previous decade, and such events comprise approximately 33% of all public health emergencies there (2, 3). Uganda is a recognised hotspot, with extensive wildlife-livestock-human interfaces and a livestock-dependent rural economy that includes 14.5 million cattle, 17.4 million goats, 7.1 million pigs, and 57.8 million poultry (4), and experienced recurrent outbreaks of priority zoonoses during 2020-2025, including Ebola disease caused by Sudan virus, Marburg virus disease, Rift valley fever, anthrax and Crimean-Congo haemorrhagic fever (5, 6).

Uganda has invested substantially in the systems that detect these events; the electronic Integrated Disease Surveillance and Response module has been embedded within DHIS2 since 2017 and was scaled nationally during 2020–2022, and the country adopted the 7-1-7 target for rapid detection, notification, and response and the National One Health Platform has institutionalized multisectoral coordination. Whether these investments have translated into fewer deaths has not been described, and aggregate figures conceal both which pathogens account for the deaths that remain and where in the health system they occur, which determines whether the appropriate response is community-level prevention, primary care capacity, or referral-level treatment. We described zoonotic disease-related deaths reported through DHIS2 in Uganda during 2020–2025, and their distribution by pathogen, health facility level, and region, to inform targeted action under the National One Health Strategic Plan, the Third National Development Plan (7) and Sustainable Development Goal 3 (8).

Methods

We conducted a descriptive analysis of routinely collected national DHIS2 surveillance data from public and private health facilities in Uganda during 2020–2025. We included nine reportable zoonotic conditions and grouped them into four categories: rabies; anthrax and brucellosis; other zoonoses; and viral haemorrhagic fevers.

Facility-level information was obtained from the national master facility list, and population denominators from Uganda Bureau of Statistics projections. We screened facility–condition–year records for implausible death counts and excluded 8,973 of 10,867 reported deaths that met predefined inconsistency criteria, retaining 1,894 deaths for analysis.

We calculated proportional mortality, mortality rates per 100,000 population, and deaths as a percentage of reported cases. Annual trends were assessed using the Mann–Kendall test, with $p < 0.05$ considered statistically significant; given the six annual observations, trend results were interpreted cautiously. Data were analyzed in Stata version 17.

The analysis used aggregated routine surveillance data and was conducted with Ministry of Health permission and U.S. CDC non-research determination.

Results

Of 344,998 zoonotic disease cases reported through DHIS2 during 2020–2025, 1,894 (0.5%) resulted in death. Annual deaths were stable across the first four years at 405 in 2020, 460 in



2021, 417 in 2022, and 392 in 2023, then fell by 68% in a single year to 126 in 2024 and to 94 in 2025 (Table 1, Figure 1A). Mean annual deaths were 419 during 2020–2023 and 110 during 2024–2025. Because the series was flat before this step and low afterwards rather than falling progressively, the Mann–Kendall test across all 6 years did not reach significance ($\tau_b = -0.73$, $p = 0.056$), despite a fall of 77% between the first and last year.

Only anthrax and brucellosis declined progressively, from 283 deaths in 2020 to 16 in 2025 ($\tau_b = -0.87$, $p = 0.017$). Each of the other three series contained an interior peak, for which the Mann–Kendall test is not an appropriate summary: other zoonoses peaked at 270 deaths in 2021, rabies at 88 in 2023, and VHFs at 10 in 2022. Because the categories declined at different rates, the composition of mortality shifted (Figure 1B): anthrax and brucellosis accounted for 70% of deaths in 2020 but 17% in 2025, while the rabies share rose from 11% to 36%. Across the whole period, anthrax and brucellosis accounted for 806 deaths (43%) and other zoonoses for 804 (42%), an essentially equal contribution differing by two deaths, with rabies accounting for 267 (14%) and VHFs for 17 (0.9%). Brucellosis alone accounted for 680 deaths (36%), more than anthrax, plague, human African trypanosomiasis, and the VHFs combined.

Deaths were overwhelmingly reported at the lower levels of the health system (Figure 1C). Of 1,894 deaths, private clinics reported 637 (34%), HC III 592 (31.3%), HC II 361 (19%), general hospitals 131 (6.9%), HC IV 123 (6.5%), regional referral hospitals 47 (2.5%), and the national referral hospital 3 (0.2%). Together, HC II–HC IV facilities and private clinics reported 1,713 deaths (90%) but approximately 272,500 (79%) of the 344,998 cases, a concentration present in every year, from 72% of deaths in 2020 to between 92% and 99% thereafter. Geographically, rabies mortality moved from Kampala, which recorded 6.4 deaths per 100,000 population in 2020 and none from 2023 onwards, to Karamoja, which recorded the highest regional rate in 2023 (2.0 per 100,000) and 2025 (1.4) (Figure 2A–C). Anthrax and brucellosis mortality was highest in Karamoja throughout, peaking at 7.8 per 100,000 in 2020, before every region fell below 0.5 per 100,000 by 2025 (Figure 2D–F).

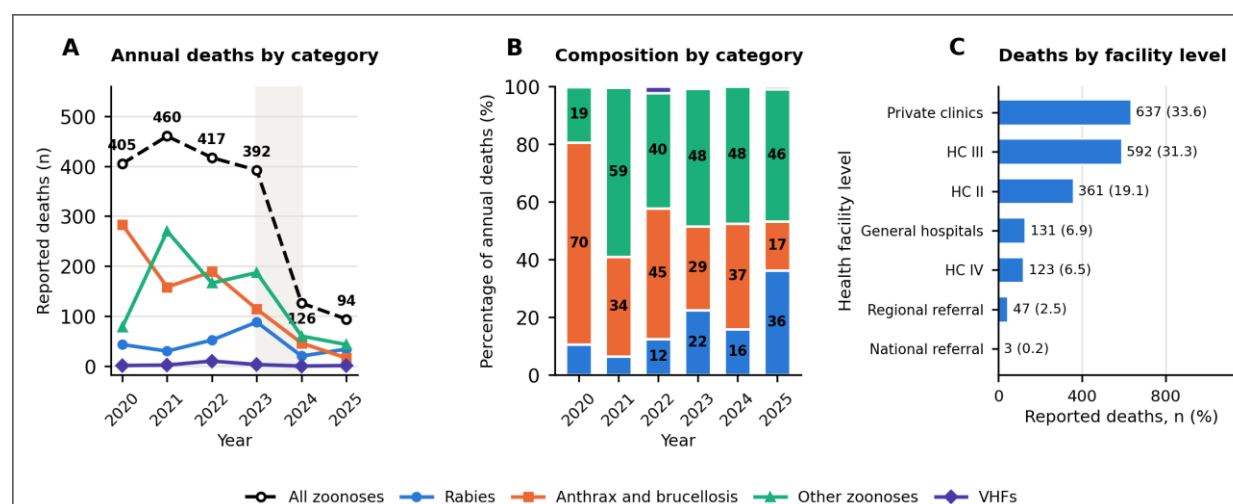


Figure 1: Annual zoonotic disease-related deaths by disease category (A), the percentage composition of those deaths by category (B), and deaths by health facility level (C), Uganda, 2020–2025. Values in panel C are deaths (proportional mortality, %). HC, health centre; VHFs, viral haemorrhagic fevers



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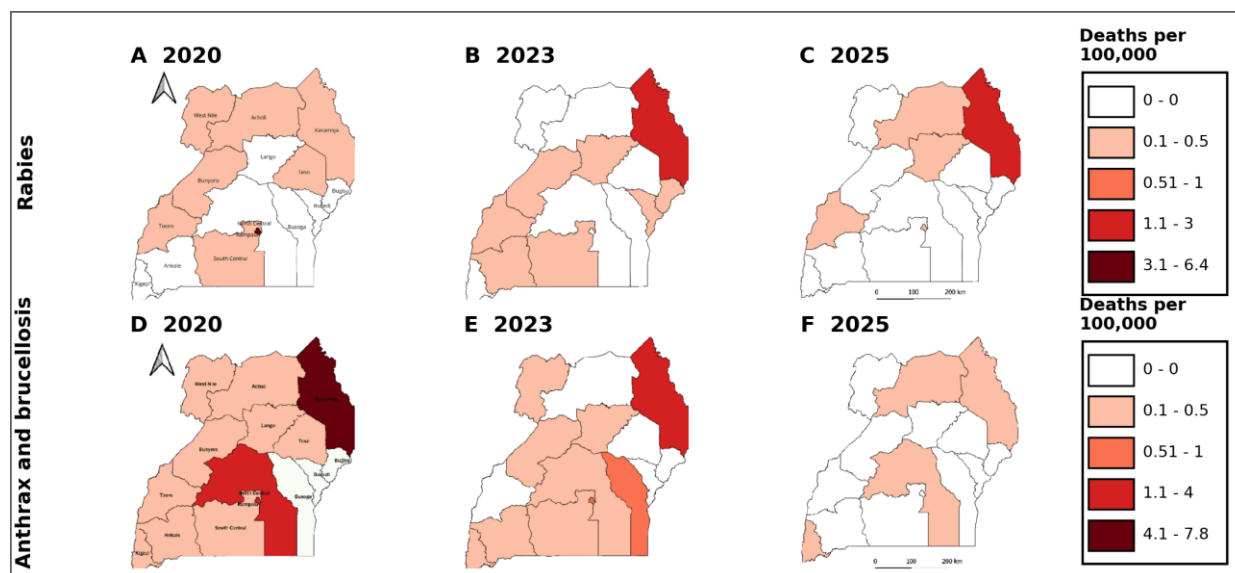


Figure 2: Mortality rate per 100,000 population from rabies (A–C) and from anthrax and brucellosis (D–F), by region, Uganda, 2020, 2023, and 2025

Table 1: Zoonotic disease-related deaths reported through DHIS2, by specific zoonosis, disease category, and year, with Mann–Kendall trend test results, Uganda, 2020–2025

Disease category and specific zoonosis	2020	2021	2022	2023	2024	2025	Total	%	tb	p-value
Rabies (animal bites, suspected)	43	30	52	88	20	34	267	14	−0.07	1.0
Anthrax and brucellosis	283	158	189	114	46	16	806	43	−0.87	0.017
Brucellosis	282	133	125	98	37	5	680	36		
Anthrax	1	25	64	16	9	11	126	6.7		
Other zoonoses	78	270	166	187	60	43	804	42	−0.47	0.27
Influenza-like illness	31	148	92	75	47	10	403	21		
Human influenza, new subtype	16	65	41	32	8	0	162	8.6		
Plague	23	25	8	40	5	25	126	6.7		
Human African trypanosomiasis	8	32	25	40	0	8	113	6.0		
Viral haemorrhagic fevers	1	2	10	3	0	1	17	0.90	−0.14	0.70
Crimean-Congo haemorrhagic fever	1	1	9	3	0	1	15	0.79		
Marburg virus disease	0	1	1	0	0	0	2	0.11		
All zoonoses	405	460	417	392	126	94	1,894	100	−0.73	0.056



%, proportional mortality, calculated as deaths in the group divided by all 1,894 zoonotic deaths; *tb*, Kendall's tau-*b* for the trend in annual deaths, reported for disease categories and for all zoonoses combined; a negative value indicates a declining trend. The rabies, other zoonoses, VHF, and all-zoonoses series each contain an interior peak and are not monotonic, so their non-significant *p*-values indicate that a monotonic trend was not demonstrated rather than that no change occurred.

Discussion

Reported zoonotic mortality in Uganda fell sharply over 6 years, but neither gradually nor uniformly across pathogens. The fall occurred as a discontinuity between 2023 and 2024 rather than as the gradual accumulation expected if strengthened surveillance, diagnosis, and case management were improving survival. Changes in reporting practice, indicator definitions, or reporting completeness can produce exactly this pattern, and the electronic Integrated Disease Surveillance and Response module was itself being scaled and reconfigured over this period (8), so the decline is best read as a decline in reported deaths. Analysis of neonatal sepsis mortality in Uganda over the same years found that only 8.8% of DHIS2-reported deaths were medically certified (9); the same triangulation would show whether the 2024 discontinuity appears in both systems, supporting a true decline, or in DHIS2 alone, pointing to a reporting artefact.

The divergence between pathogens is consistent with the differing reach of available control measures. Anthrax and brucellosis are acquired from livestock and are amenable to animal-sector interventions such as livestock vaccination, safe slaughter, and control of trade in sick animals (10-12). Rabies is prevented instead by timely post-exposure prophylaxis and dog vaccination, which depend on continuous supply and coverage rather than on outbreak response (13, 14); that rabies deaths did not fall while other categories did means it now constitutes a larger share of a smaller burden. Brucellosis, a chronic condition that generates no outbreak response and little programmatic visibility, produced more deaths over the period than anthrax, plague, human African trypanosomiasis, and the VHFs combined, and its mortality burden merits attention proportionate to its ranking among Uganda's priority zoonoses (10).

That nine in ten deaths were reported at HC II–HC IV facilities and private clinics, which handled a smaller share of cases, is the most directly actionable finding, and it was stable in every year. This is compatible with community-acquired infection presenting late to the nearest facility, where diagnostic capacity and referral linkages are weakest (15, 16), although severity-based referral with death before transfer could produce the same pattern. Either way, the level of care at which these deaths are recorded is the level at which they must be averted. Both rabies and bacterial zoonoses persisted longest in Karamoja, consistent with its pastoralist livelihoods, livestock density, and distance from referral care (12, 17).

Study limitations: Passive surveillance under-reports, most at lower-level facilities and in remote districts, so these counts understate the true burden and the concentration of deaths at HC II–HC IV level would be greater still if reporting were complete. Changes in reporting completeness would also alter measured deaths in the absence of any true change, which is why the 2024 discontinuity cannot be attributed to improved survival on these data alone. With



only six annual observations the Mann–Kendall test has low power, so non-significant results are not evidence that no change occurred. The exclusion rule removed 82.6% of raw reported deaths; applying the stated numeric criterion alone leaves 2,123 deaths, a monotonic series and a significant overall trend ($tb=-1.00$, $p=0.003$), but leaves every pathogen-specific finding unchanged. Deaths under the animal bites indicator are suspected rather than laboratory-confirmed rabies, influenza-like illness includes non-zoonotic influenza, and case counts by facility level were available only as rounded percentages.

Conclusion: Zoonotic disease-related deaths reported through DHIS2 fell from 405 in 2020 to 94 in 2025, but as a step change between 2023 and 2024 rather than a progressive decline, and cannot be attributed to improved survival on these data alone. Anthrax and brucellosis accounted for the only progressive decline, while rabies showed no evidence of decline and now represents more than a third of the reported burden. Brucellosis was the single largest cause of zoonotic death, and nine in ten deaths were reported at the first point of contact.

Triangulating DHIS2 zoonotic mortality with medically certified deaths could establish whether the 2023–2024 discontinuity reflects a true decline or a change in reporting, before the trend is used for programme evaluation. Sustained rabies control, through reliable post-exposure prophylaxis stocks at primary care facilities and dog vaccination in regions with persistent mortality, could reduce the one category that has not responded to date, and giving brucellosis programmatic attention proportionate to its mortality burden could address the largest single contributor identified here. Building capacity for early recognition, diagnosis, and referral at HC II–HC IV facilities and private clinics, and adding validation rules that prevent deaths from exceeding cases at the point of data entry, could reduce both the deaths occurring at first contact and the entry errors found in this extract.

Conflict of interest: The authors declare no conflict of interest

Authors' contributions: JW conceptualized the study, led data collection, analysis, and interpretation and wrote the draft article. RM and BK reviewed the draft and made multiple edits for intellectual content. WN, AN, MDN, CN, LB, and ARA reviewed the article for intellectual content and scientific integrity. All authors read and approved the final article.

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