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Marked Geographic Heterogeneity in Ebola Virus Disease Case Fatality During the 17th Outbreak in the Democratic Republic of the Congo, 2026: a Health Zone Level Funnel Plot Analysis

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Abstract

Background

The Ebola case fatality ratio (CFR) classically varies by geographic and operational context, but this heterogeneity has rarely been formally quantified sub-nationally in real time during an active outbreak.

Methods

From 142 situation reports (SitReps) (May 18 to October 3, 2026), we extracted confirmed cases/deaths for 64 health zones, calculated CFR with 95% Wilson confidence intervals, tested heterogeneity by chi-square, and visualised it by Spiegelhalter funnel plot, excluding a block of 493 unallocated Ituri deaths from zone/province analyses ; sensitivity analyses tested four alternative ways of handling these deaths.

Results

Zone-summed CFR ranged from 33.3% (South Kivu) to 58.5% (North Kivu, 95% CI 56.1–60.8), via 38.3% in Ituri (95% CI 37.1–39.5); heterogeneity was highly significant (x^2= 227.1, df = 6, p < 0.001) and persisted within Ituri (13 zones, x^2 = 193.5, df = 12, p < 0.001). The funnel plot flagged five zones above the 99.8% control limit (Komanda and Nia-Nia in Ituri; Beni, Butembo and Katwa in North Kivu) and five Ituri zones below it. The Ituri–North Kivu gap narrowed from ~ 29 points (late August) to 20.2 points (October 3), a real but modest convergence driven by North Kivu's decline. When the 493 unallocated deaths were added to Ituri, the gap on October 3 was 12.6 points, and the convergence remained driven by North Kivu.

Conclusions

Case fatality shows robust, persisting geographic heterogeneity at two scales, with a real but limited inter-provincial convergence since September, warranting targeted investigation of treatment-capacity and care-seeking determinants.

1. Background

During the Ebola virus disease (EVD), the case-fatality ratio (CFR) is one of the markers that is examined the most rigorously. In most cases, it is an unsaid measurement of the quality and availability of the response, and its purpose is to determine the clinical severity of the outbreak. It is not a biological constant that the case fatality rate (CFR) is determined by; rather, it is the result of the interaction between virological factors (Ebolavirus species, viral load), individual characteristics (age,

comorbidities), and operational factors (delay from symptom onset to treatment center entry, level of supportive care, geographical and security accessibility to treatment) [1, 2].

In light of the fact that these factors vary from one location to another, it is reasonable to anticipate that the CFR will likewise vary geographically. Through the utilization of a specific outlier detection analysis, Garske et al. (2013–2016 West African epidemic with 28,616 cases and 11,310 deaths) were able to demonstrate that the case fatality ratio (CFR) varies significantly by district and treatment center, as well as by age and epidemic phase (Garske et al., 2013–2016 West African epidemic with 28,616 cases and 11,310 deaths). As a result of their investigation, they discovered that eight districts and three treatment institutions had CFRs that were significantly distinctive from the average [1]. The authors acknowledge that this study has a methodological disadvantage, which is that the aggregate data do not provide them to determine whether this is the consequence of variations in reporting and case detection methodologies or whether it is the result of actual inequalities in survival.

On may 15, 2026, the Democratic Republic of the Congo declared the seventeenth outbreak of Ebola Virus Disease, which was ascribed to Bundibugyo ebolavirus (BDBV) [3, 4]. This outbreak had an influence on seven provinces and sixty-four health zones as of the third of October, 2026 which results in a cumulative national case fatality rate of 48% [4,5…]. As was demonstrated during the tenth epidemic (2018–2020) in the same region (Ituri-North Kivu), a cumulative CFR of 66% concealed critical local disparities that resulted from unequal access to treatment facilities and varying levels of community distrust by region. This was evidenced by the fact that a national average could obscure significant variability among transmission hotspots.

During an active outbreak, individual data are rarely available outside the response, whereas cumulative counts of cases and deaths by health zone are published regularly in situation reports. Funnel plots, developped by Spieghalter [8], assess whether differences between units exceed those expected from chance alone given their size, using only aggregated numerators and denominators. To our knowledge, this approach has not yet been used to monitor Ebola case fatality in real time.

Our research is restricted to health zone aggregated data, which is given daily in response Sitreps. This is in contrast to the findings of Garske et al., who used data at the individual level to make adjustments for age and other characteristics [1]. As a result, we made use of the funnel-plot technique that was developed by Spiegelhalter for the purpose of evaluating the performance of institutions (pediatric cardiac surgery, in vitro fertilization) [8]. This technique distinguishes genuine inter-unit variation from sampling variability associated with sample size, thereby removing the requirement for data at the individual level. It is especially important to take this approach during an active outbreak because the only data that can be used to guide the operational response is the data that has been accumulated in real time.

The objective of this research is to (i) measure the variability of CFR across provinces and health zones during the 17th EVD epidemic as of October 3, 2026 (ii) conduct statistical analyses to determine if this

variability exceeds what would be anticipated by random chance, and (iii) outline if temporal progression from May to September 2026, particularly focusing on the stability of this disparity over time.

2. Methods

2.1 Study design and setting

We conducted a retrospective ecological analysis utilizing consolidated surveillance data from the 17th EVD outbreak in the DRC. The health zone, defined as the fundamental operational component of the Congolese healthcare system encompassing a general referral hospital and a network of health institutions, served as the analytical unit. Health zones were categorized by province to facilitate regional comparisons. The research comprised two interrelated analyzes: (i) a cross-sectional examination of cumulative case fatality rates by health zone and province as of October 3, 2026 (SitRep 142); and (ii) a longitudinal assessment of repeated cross-sections, wherein the cumulative provincial CFR was recalibrated from each subsequent SitRep between June 4 and October 3, 2026 to delineate the temporal progression of disparities among provinces.

The DRC Ministry of Public Health announced the epidemic on May 15, 2026, which was attributed to Bundibugyo ebolavirus. The epicenter was located in the Ituri province. The epidemic subsequently disseminated to North Kivu and five other provinces; Haut-Uélé, Tshopo, Bas-Uélé, South Kivu, and Sud-Ubangi. As of October 3, 2026, at least one verified case has been documented in 64 health zones across these seven provinces. Patients received care in Ebola treatment centers (ETCs), which expanded their capacity during the outbreak, particularly in North Kivu with the establishment of an ETC in Matanda on 21 September 2026.

The study population comprised all laboratory-verified EVD cases and confirmed fatalities documented in the SitReps, while suspected and probable cases were omitted. The cross-sectional study encompassed all health zones that had a minimum of one confirmed case as of October 3, 2026 (n = 64). Analyzes of disparities among health zones in Ituri were limited to the 13 zones exhibiting a minimum of 50 confirmed cases to guaranty adequately reliable figures. The research utilized solely aggregated anonymous data derived from government records, without any interaction with patients.

2.2 Data source

A consolidated database was generated from the 142 situation reports (SitReps) that were released jointly by INSP and COUSP-DRC during the dates of 18 May and 3 October 2026 [4]. The data were extracted from this database. This research makes use of the 121 SitReps that report confirmed cases and deaths by health zone, beginning with SitRep 021 (4 June 2026) and ending with SitRep 142 (3 October of the same year).

There was a single disruption that occurred during this health-zone breakdown operation. This provincial summary was the only information that was provided by SitReps 084–086 (6 to 8 August 2026), which

were issued immediately after the reporting was moved to TFPE17. It was with SitRep 088 (10 August 2026) that zone-level reporting was restarted, and it continued without interruption until the conclusion of the assessment period.

In the "to be broken down" row, several of the confirmed deaths that occurred in Ituri were reported as not yet being broken down to a health zone. This information was obtained from SitRep 088. This number experienced a steady ascent until it reached a plateau of 493 deaths beginning with SitRep 128 (19 September 2026) and continuing forth. In the last iteration of this research, this row was included in Ituri's statistics over time in an inconsistent manner: its deaths were added to the numerator without equivalent cases being put in the denominator. Because of this, Ituri's apparent CFR was mechanically inflated in the latter portion of the period where it was measured. In this version, the row is eliminated from all CFR calculations that are performed at the zone and province level within the dataset; nevertheless, it is still included in the totals for the entire country.

2.3 Definitions

Confirmed case

A confirmed case was any EVD case reported as laboratory-confirmed in the SitReps, in accordance with the national case definition. Probable and suspected cases were not included.

Confirmed death

A confirmed death was any death among confirmed cases, as reported in the SitReps.

Unit of analysis

The health zone, the operational unit of the DRC health system, was the primary unit of analysis. Health-zone data were aggregated by province for inter-provincial comparisons. As of 3 October 2026, 64 health zones in seven provinces had reported at least one confirmed case.

Reference date

Cross-sectional measures were computed at 3 October 2026 (SitRep 142), using cumulative counts since the start of the outbreak. For the temporal analysis, the same measures were computed for each of the 121 SitReps with health-zone data.

Case fatality ratio (CFR)

The primary outcome was the cumulative CFR, defined for each health zone as cumulative confirmed deaths divided by cumulative confirmed cases, expressed as a percentage. Counts were taken from the health-zone table of each SitRep; CFRs reported in the narrative text of the SitReps were used to verify the calculations. Provincial CFRs were calculated in the same way, from zone-summed deaths and cases.

Unallocated deaths

As of 3 October 2026, 493 confirmed deaths (12.0% of the national total) were reported in Ituri as a provincial category not assigned to any health zone. Because these deaths cannot be matched to a health-zone denominator, they were excluded from zone- and province-level CFRs but retained in the national cumulative total (4114 deaths). This rule was applied identically to every SitRep in the study period. Their corresponding cases are already counted in the zone totals; alternative ways of handling these deaths were tested in sensitivity analyses.

2.4 Data Analysis

Data management and descriptive analyses were performed in Stata 18. Funnel plots and figures were produced in Python using Python 3 (with pandas, scipy.stats, and matplotlib).

2.4.1 Cross-sectional analysis (Oct 3, 2026)

CFR was determined by dividing deaths by cases for each health zone with comprehensive data (total confirmed cases and fatalities, n = 64 zones, omitting Ituri's "to be broken down" category).

The Wilson approach was employed to construct 95% confidence intervals, demonstrating greater robustness than the normal approximation for small sample sizes (9). A subsequent assessment categorized regions by province, employing same methods for calculating confidence intervals. Heterogeneity was assessed across the seven provinces through a chi-square test of independence applied to the province x outcome (death/survival) contingency table, while a similar analysis was confined to Ituri health zones with at least 50 cumulative confirmed cases each (13 zones as October 3, 2026, consistent with the prior month) to evaluate intra-provincial heterogeneity independent of the provincial effect.

2.4.2 Funnel plot

Following Spiegelhalter [8], we plotted the observed CFR of each of the 64 health zones (y-axis) against its cumulative number of confirmed cases (x-axis, logarithmic scale). The target value was the pooled CFR of deaths allocated to a health zone (p_0=3621/8544 = 42.4%), so that the reference value and the zone level points are computed from the same deaths. Control limits at 95% and 99.8% were calculated using the normal approximation to the binomial distribution:

limit = $p_0 \pm z \cdot \sqrt{[p_0(1 - p_0)/n]}$, where n is the cumulative number of confirmed cases in the health zone, with z = 1.96 (95%) and z = 3.09 (99.8%). A zone lying outside the 95% limits suggests possible true heterogeneity; a zone outside the 99.8% limits indicates a strong statistical signal, consistent with the Shewhart control-chart framework [8].

2.4.3 Temporal evolution

For every one of the 121 SitReps containing health zone specifics, the total confirmed cases and fatalities were aggregated by province, consistently disregarding Ituri's "to be broken down" row (even on dates prior to SitRep 088, as this row, featuring zero values, has no effect), in order to reconstruct a provincial CFR time series, adhering to a convention that remained unchanged over time, for the period of June 4 to October 3, 2026, with particular emphasis on comparing Ituri (the epicenter) and North Kivu (the second most affected province). This analysis was performed for each of the 121 SitReps that included health zone details: cumulative confirmed cases and deaths.

2.4.4 Analyzes of the sensitivity

The 493 deaths that have not been assigned are those that are confirmed cases that have already been counted in the health-zone case totals. The national case count (8544) is equal to the sum of the zone counts; however, the national death count (4114) is approximately 493 times higher than the zone sum. In the Ituri zones where they happened, excluding them therefore results in an underestimate of the CFR; however, the zone in which each death occurred is unclear. We performed the primary analyzes under four different situations in order to determine the extent to which this decision influenced our findings. All 493 deaths were added to Ituri at the provincial level only in scenario S1, but the data at the zone level remained unaltered. In scenario S2, they were dispersed across the Ituri health zones in proportion to the number of confirmed cases in each zone, and in scenario S3, they were redistributed in proportion to the number of deaths that were allocated to each zone. Scenario S4 was an adversarial allocation, which meant that fatalities were assigned one at a time to whichever Ituri zone had at least fifty instances that could reduce the intra-Ituri chi-square statistic the greatest. This provided the most conservative test of heterogeneity within Ituri that could possibly be performed. The control boundaries for the funnel plot were centered on the pooled CFR, which included all deaths [48.2%], in both S2 and S3. We applied scenario S1 to each SitRep based on the number of unallocated deaths that were reported on that date (ranging from 59 in SitRep 088 to 493 from SitRep 128 onwards). This was done for the time series.

3. Results

3.1 Inter-provincial heterogeneity

As of October 3, 2026, the 64 health zones with complete data totalled 8544 confirmed cases and 3621 deaths (pooled CFR 42.4%). Adding the 493 unallocated Ituri deaths gives 4114 deaths (CFR 48.2%), exactly matching the official national total (Table 1).

The zone-summed provincial CFRs ranged from 33.3% in South Kivu (3 cases, insufficient for reliable estimation, 95% CI 6.1–79.2) to 58.5% in North Kivu (1696 cases, 95% CI 56.1–60.8), with Ituri at 38.3% (6427 cases, 95% CI 37.1–39.5; excluding the 493 unallocated deaths; 45.9% when they are included), 41.5% in Haut-Uélé (357 cases), 32.7% in Tshopo (49 cases), 40.0% in Bas-Uélé (10 cases), and 50.0% in Sud-Ubangi (2 cases). CFR showed substantial variability between provinces (x^2=227.1, df = 6, $p < 0.001$), mainly because of the persistent gap between Ituri and North Kivu, the only two provinces with enough cases for reliable estimates (Fig. 1).

3.2 Intra-provincial heterogeneity: the case of Ituri

The variability was not confined to comparisons across provinces. In Ituri, CFR across the 13 health zones with at least 50 confirmed cases varied from 22.5% in Bambu (n = 204) to 61.1% in Komanda (n = 175), with intermediate values in Bunia (32.6%, n = 1769, the zone with the highest volume), Nyankunde (28.5%, n = 130), Rwampara (34.0%, n = 1112), Fataki (37.3%, n = 83), Mongbwalu (47.2%, n = 707), Nizi (35.9%, n = 786), Nia-Nia (56.1%, n = 310), Lita (50.2%, n = 291), Mangala (42.7%, n = 365), Tchomia (32.9%, n = 76), and Mandima (47.7%, n = 176) (Table 2). This variation within Ituri was highly significant (x^2=193.5; df = 12; p < 0.001), indicating that much of the the variation in CFR cannot be explained by provincial differences alone and may reflect more local factors, such as health zone referral systems or the timming of each zone's involvement in the outbreak.

Table 1
Confirmed cases, deaths, and CFR by province with 95% Wilson CI, 64 health zones, SitRep 142 (October 3, 2026)

Province	Confirmed cases	Deaths	Health zones	CFR % (95% Wilson CI)
Ituri	6427	2459	28	38.3 (37.1–39.5)
North Kivu	1696	992	17	58.5 (56.1–60.8)
Haut-Uélé	357	148	7	41.5 (36.5–46.6)
Tshopo	49	16	7	32.7 (21.2–46.6)
Bas-Uélé	10	4	3	40.0 (16.8–68.7)
South Kivu	3	1	1	33.3 (6.1–79.2)
Sud-Ubangi	2	1	1	50.0 (9.5–90.5)
National total	8544	4114	64	48.2

Chi-square test of independence (province × outcome): x^2=227.1; df = 6; p < 0.001.

Note

the province-level sum (8544 cases/3621 deaths) excludes the 493 unallocated Ituri deaths; the "National total" row reflects the official cumulative total once this block is reinstated (8544/4114, CFR 48.2%).

Table 2
Health zones with ≥ 50 cumulative confirmed cases, ranked by volume, SitRep 142 (October 3, 2026)

Province	Health zone	Confirmed cases	Deaths	CFR (%)
Ituri	Bunia	1769	577	32.6
Ituri	Rwampara	1112	378	34.0
Ituri	Nizi	786	282	35.9
Ituri	Mongbwalu	707	334	47.2
North Kivu	Katwa	594	367	61.8
North Kivu	Beni	385	256	66.5
Ituri	Mangala	365	156	42.7
Ituri	Nia-Nia	310	174	56.1
Ituri	Lita	291	146	50.2
North Kivu	Butembo	275	176	64.0
Ituri	Bambu	204	46	22.5
Ituri	Mandima	176	84	47.7
Ituri	Komanda	175	107	61.1
Ituri	Nyankunde	130	37	28.5
North Kivu	Musienene	128	68	53.1
Haut-Uélé	Wamba	114	42	36.8
Haut-Uélé	Isiro	102	44	43.1
Haut-Uélé	Pawa	90	40	44.4
Ituri	Fataki	83	31	37.3
Ituri	Tchomia	76	25	32.9
North Kivu	Kalunguta	60	21	35.0

Intra-Ituri chi-square test (13 zones ≥ 50 cases): $x^2=193.5$; df = 12; $p < 0.001$.

3.3 Funnel plot: distinguishing signal from sampling noise

The funnel plot (Fig. 2), which is centered on the pooled CFR of zone-allocated deaths (42.4%), that the observed variability in a number of high-volume zones cannot be explained only by sampling variance. There are five zones that are located above the upper 99.8% control level. These zones are located in Ituri and are referred to as Komanda (n = 175, CFR 61.1%) and Nia-Nia (n = 310, 56.1%). Additionally, in

North Kivu, Beni (n = 385, 66.5%), Butembo (n = 275, 64.0%), and Katwa (n = 594, 61.8%). Bambu (n = 204, 22.5%), Nyankunde (n = 130, 28.5%), Bunia (n = 1769, 32.6%), Rwampara (n = 1112, 34.0%), and Nizi (n = 786, 35.9%) are the five zones that fall below the lower 99.8% standard. All of these zones are located in Ituri. As a whole, fifteen of the sixty-four zones were found to be outside the 95% boundaries, when only roughly three would be expected based just on chance. As anticipated, regions with a low number of cases (n < 10) exhibited a large dispersion (CFR 0–100%), but they stayed within the control limits, which is in line with the variability observed in the sampling process.

Case fatality ratio by health zone

3.4 Temporal stability of the Ituri – North Kivu gap

A considerable variation in the case fatality ratio (CFR) existed between Ituri and North Kivu across the 121 SitReps assessed, whereas unallocated deaths were systematically disregarded from the provincial numerators (Fig. 3). The division between the two provinces widened incrementally between 4 June and mid-July 2026. From mid-July to late August, the statistics held steady at roughly 20 to 29 percentage points, with the two paths not intersecting: Ituri's CFR maintained at 39% to 43%, while North Kivu's soared to 65% to 71% (for example, 39.0% versus 68.0% on 25 August 2026, indicating a 29.0-point difference). In early September 2026, a deliberate but unwavering convergence initiated. This change was influenced by a decline in North Kivu (from 68.0% on 25 August to 58.5% on 3 October), whereas Ituri's CFR either stabilized or marginally decreased (from 39.0% to 38.3%). This diminished the difference from 29.0 to 20.2 percentage points during a span of five weeks. In this timeframe, the count of accumulated cases consistently escalated in both provinces, which compresses the confidence intervals, suggesting that this convergence is unlikely to be a random coincidence. The North Kivu-induced change is inconsistent with a purely rigid structural determinant and implies the presence of developing, province-specific factors, such as the increase in treatment-center capacity or modifications in case management. Nevertheless, the decline in the cumulative CFR could also be partly ascribed to the recent rise in instances with outcomes that are now uncertain (right-censoring). The total data provided does not clarify these explanations.

Cumulative case fatality, Ituri vs North Kivu, 4 June to 3 October 2026

3.5. Sensitivity analyses of unallocated deaths

Table 3 summarises the sensitivity analyses at October 3, 2026. Heterogeneity between provinces remained highly significant in evry scenario, and North Kivu kept the highest CFR among provinces with sufficient data. Adding the 493 unallocated deaths raised Ituri’s CFR from 38.3% to 45.9% and narrowed the Ituri North Kivu gap on October 3 from 20.2 to 12.6 percentage points; the true gap therefore lies between these two values. Heterogeneity between Ituri healt zones persisted in all scenarios, including the adversarial allocation designed to reduce it as much as possible (x2 = 34.0, df = 12. P < 0.001). in the funnel plot, the five zones above the upper 99.8% limit in the main analysis remained above it in both

redistribution scenarios, and Lita and Mongbwalu were added. Bambu, Bunia and Rwampara remained below the lower 99.8% limit, whereas Nizi and Nyankunde no longer did. Over time, including the unallocated deaths raised Ituri's CFR from 39.0% to 44.9% on August 25 and from 38.3% to 45.9% on October 3, but in both analyses Ituri's CFR changed by about one point after late August. The convergence after August 25 was therefore unallocated deaths were excluded, and from 23.1 to 12.6 points when they were included.

Table 3
Sensitivity analyses for the 493 unallocated Ituri deaths, SitRep 142 (October 3, 2026)

Scenario	Ituri CFR, %	Ituri–North Kivu gap, points	x^2 between provinces (df = 6)	x^2 within Ituri (df = 12)
Main analysis: unallocated deaths excluded	38.3	20.2	227.1	193.5
S1: added to Ituri, province level only	45.9	12.6	97.0	193.5
S2: distributed by zone cases	45.9	12.6	97.0	182.5
S3: distributed by zone deaths	45.9	12.6	97.0	266.2
S4: adversarial allocation	45.9	12.6	97.0	34.0

All chi-square tests: $p < 0.001$. Zone-level data are unchanged in S1, so zone-level results are those of the main analysis. Deaths assigned one at a time to the Ituri zone (≥ 50 cases) that most reduced the intra-Ituri chi-square statistic; this scenario tests heterogeneity within Ituri only.

4. Discussion

To our knowledge, this is the first study to quantify geographic differences in case fatality during the DRC's 17th EVD outbreak. These differences were large and very unlikely to be due to chance, both between provinces and between health zones within Ituri. The Ituri–North Kivu gap was also stable for several weeks. It stayed at around 20–29 percentage points between the middle of July and the end of August 2026, then narrowed by about a third, to 20.2 points by October 3, 2026 (38.3% in Ituri versus 58.5% in North Kivu, zone-summed). This convergence is real but modest, and it came almost entirely from a decline in North Kivu. The 493 deaths not allocated to a health zone do not change this picture: when they were added to Ituri, the gap on October 3 was smaller (12.6 instead of 20.2 points), but Ituri's CFR remained almost flat after late August and the convergence was still driven by North Kivu. A gap of this size is comparable to the disparities that Garske et al. reported between the most extreme districts of the 2013–2016 West African epidemic [1]. Because their analysis relied on a single cross-section at the end of the outbreak, it could not show how such disparities evolve over time, and its weighted mean CFR of 62.9% masked substantial local heterogeneity, of which age explained an important but not

exclusive share [1]. During the tenth epidemic in the DRC (2018–2020), a general CFR of 66% hid marked local differences linked to unequal access to treatment centers and varying levels of community distrust [6, 7], which is consistent with our findings.

Several explanations, which are not mutually exclusive, could account for this gap, although aggregate data cannot tell them apart. The first is delay in seeking care. North Kivu was affected later, through spread from Ituri, and longer delays before supportive care are consistently linked to higher mortality. In Uganda, outbreak-level CFR increased with each additional day of delay before specimen collection [10], and in the DRC, each additional day between symptom onset and hospital admission was associated with an 11% higher risk of death [11]. The second is treatment capacity. As the epicenter, Ituri had more time to set up its treatment centers and received international support earlier. Facilities in North Kivu, despite their experience of the tenth outbreak, may have been less prepared for this resurgence. Several SitReps reported critical bed occupancy in North Kivu, reaching 152.6% of nominal capacity in mid-September 2026, until a new ETC opened in Matanda on September 21, 2026. The decline in North Kivu's CFR coincides with this expansion. This makes capacity a plausible explanation, but our data cannot prove it. Third, differential under-notification of milder cases in North Kivu cannot be excluded; this would raise the apparent CFR without any true difference in clinical severity, a limitation also acknowledged by Garske et al. [1]. Finally, part of the recent decrease in North Kivu may simply reflect new cases for which the outcome was not yet known at the time of reporting.

The differences between health zones within Ituri have, to our knowledge, not been reported for this epidemic, and they matter for the response. Among the 13 zones with at least 50 confirmed cases, CFR ranged from 22.5% in Bambu to 61.1% in Komanda. Situation reports usually present data by province, and this level of aggregation hides much of the variation. The health zone is a more useful level for directing resources such as treatment-centre reinforcement, staff training or the decongestion of saturated facilities. The funnel plot shows where to start: in Ituri, Komanda and Nia-Nia had a CFR well above what chance alone would explain given their number of cases, as did Beni, Butembo and Katwa in North Kivu, whereas Bambu, Nyankunde, Bunia, Rwampara and Nizi were well below it.

The funnel plot, borrowed from the literature on institutional health performance [8], is well suited to an outbreak in progress. It relies only on the cumulative data published in real time and does not require the individual-level data that Garske et al. analysed retrospectively for West Africa [1]. Response coordination teams could therefore produce it themselves at regular intervals. This depends, however, on SitReps continuing to report data by health zone. This level of detail was briefly interrupted in early August 2026 (SitReps 084–086) and has been published without interruption since SitRep 088 [4].

This study has several strengths. It covers all health zones that reported confirmed cases over four months of an ongoing outbreak, using a near-continuous series of consecutive situation reports. It also concerns Bundibugyo virus, for which case-fatality data are scarce.

This study also has several limitations. First, as in the study by Garske et al. [1], only health-zone aggregated data were available, which prevented adjustment for age, sex, care-seeking delay or

comorbidities, all recognized determinants of individual CFR [1, 2]. The observed heterogeneity may therefore reflect, in part or in whole, differences in age structure or clinical case mix rather than differences in quality of care. Second, the crude CFR does not correct for delays in reporting clinical outcomes: cases still under treatment on October 3, 2026 could not yet be counted as deaths, which underestimates the true CFR in recently affected zones. Because this bias depends on when each zone was affected, it may explain part of the differences between earlier and more recently affected zones. Third, differences between zones in how a confirmed case was defined in practice, or in the detection of paucisymptomatic cases, particularly where diagnostic capacity was limited, could inflate the apparent CFR without any real difference in clinical severity. Fourth, the convergence between Ituri and North Kivu since early September 2026 may partly reflect better reconciliation of community deaths by health zone rather than a real change in clinical severity or quality of care; only data disaggregated by place of death (ETC versus community) could resolve this. Fifth, 493 confirmed deaths in Ituri (12.0% of all deaths) had not been assigned to a health zone. Excluding them underestimates CFR in the Ituri zones concerned and widens the apparent Ituri–North Kivu gap; sensitivity analyses showed that our main conclusions were unchanged, but the size of the gap on October 3 (12.6 to 20.2 points) depends on how these deaths are handled. Finally, the most detailed cross-sectional analysis (Tables 1–2, Figs. 1–2) is limited to October 3, 2026; whether the convergence continues can only be assessed if data at this level of detail continue to be published.

5. Conclusion

The DRC's 17th EVD outbreak shows marked and statistically robust geographic differences in case fatality, both between provinces and between health zones within Ituri. The gap between Ituri and North Kivu is not fixed: it narrowed from about 29 percentage points in late August to 20.2 points by October 3, 2026 (12.6 points when unallocated deaths were attributed to Ituri), almost entirely because of a decline in North Kivu. The available data cannot establish the causes. However, both the persistent differences within Ituri and the recent change in North Kivu justify a targeted look at operational factors such as treatment-centre capacity, care-seeking delays and the quality of data reconciliation. They also underline the need to keep publishing data by health zone, the only level at which these differences, and how they change, can be detected and followed in real time.

Abbreviations

BDBV
Bundibugyo ebolavirus
CFR
case fatality ratio
CI
confidence interval
COUSP
Centre des Opérations d'Urgence de Santé Publique (Public Health Emergency Operations Centre)

DPS
Division Provinciale de la Santé (Provincial Health Division)
DRC
Democratic Republic of the Congo
ETC
Ebola treatment center
EVD
Ebola virus disease
INSP
Institut National de Santé Publique (National Institute of Public Health)
SitRep
situation report
TFPE17
Task Force Présidentielle Ebola 17 (Presidential Ebola Task Force).

Declarations

Ethics approval and consent to participate

Only aggregated secondary data that was readily available to the public was utilized in the research project. These data were taken from 142 epidemiological status reports that were published by the Institut National de Santé Publique (INSP) of the Democratic Republic of the Congo. There was no intervention, no recruitment of participants, and no access to individual records or information that may be used to identify personally identifiable information. Following the examination of the study protocol by the Ethics Committee of the Kinshasa School of Public Health, University of Kinshasa (Comité d'Éthique de l'École de Santé Publique, Université de Kinshasa), the protocol was granted an exemption from the need for ethical review (reference number: ESP/CE/133B/2026; 20 October 2026).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

TK and EM conceived the study and designed its methodology. TK built the consolidated database from the situation reports, performed the statistical analyses, produced the figures and wrote the first draft of the manuscript. JL independently re-extracted and cross-checked the case and death counts against the source situation reports and verified the database. SM facilitated access to the surveillance data, checked their consistency with national reporting and contributed to the interpretation of the findings in the context of the response. BK reviewed the statistical approach, independently reproduced the main analyses (chi-square tests, funnel plot and sensitivity analyses) and contributed to the interpretation of the results. EM supervised the study, contributed to the interpretation of the findings and critically revised the manuscript for important intellectual content. All authors critically reviewed the manuscript, read and approved the final version, and agree to be accountable for all aspects of the work.

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Data Availability

The situation reports analysed in this study were published by the National Institute of Public Health (INSP), the Public Health Emergency Operations Centre (COUSP-DRC) and the Presidential Ebola Task Force of the Democratic Republic of the Congo, and are publicly available at https://insp.cd/category/sitrep/. The consolidated database derived from these reports and the analysis code are available from the corresponding author on reasonable request.

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Figures

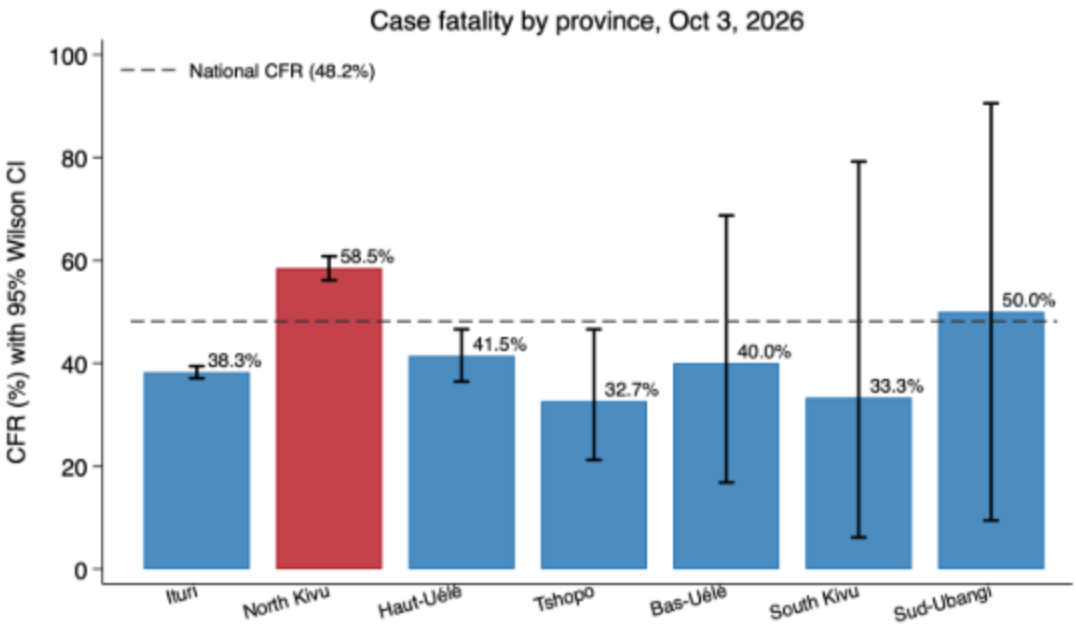
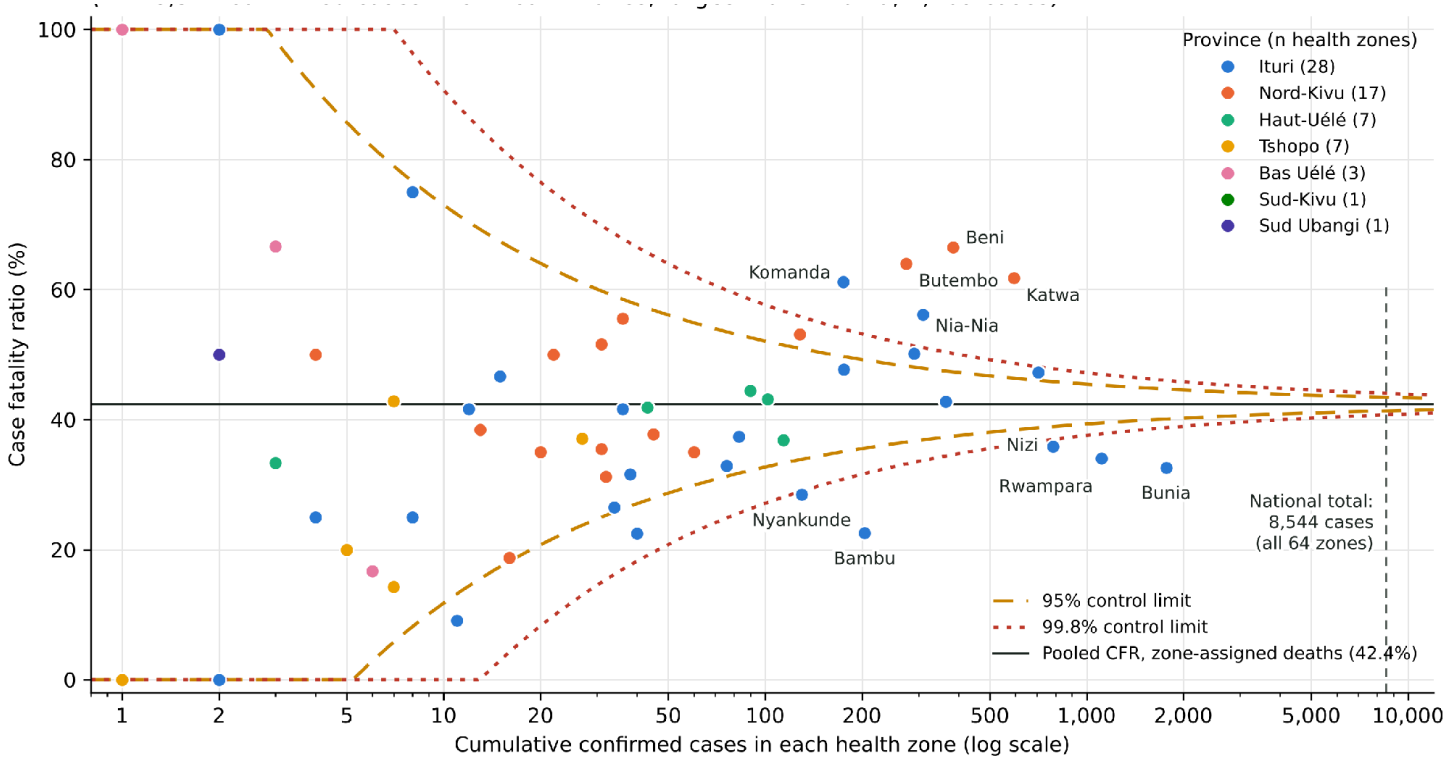


Figure 1

CFR by province with 95% confidence intervals (Wilson method), 64 health zones, SitRep 142 (Oct 3, 2026), excluding unallocated Ituri deaths.



Each point is one health zone; the x-axis shows that zone's own case count, not the national total. 3,621 deaths assigned to a zone.
Binomial control limits (normal approximation) around the pooled CFR. Labelled zones lie outside the 99.8% limit.
Excluded: 493 deaths in Ituri not yet assigned to a health zone. The national CFR reported in SitRep 142 is 48.2% (4,114/8,544), including these unassigned deaths.
Source: EVD situation report No. 142 (MVE-BDBV), 3 October 2026.

Figure 2

Funnel plot of CFR by health zone against cumulative confirmed-case volume, with 95% and 99.8% control limits around the pooled CFR of zone allocated deaths (42.4%) (Spiegelhalter method (8)), 64 health zones, SitRep 142 (Oct 3, 2026), excluding unallocated Ituri deaths.

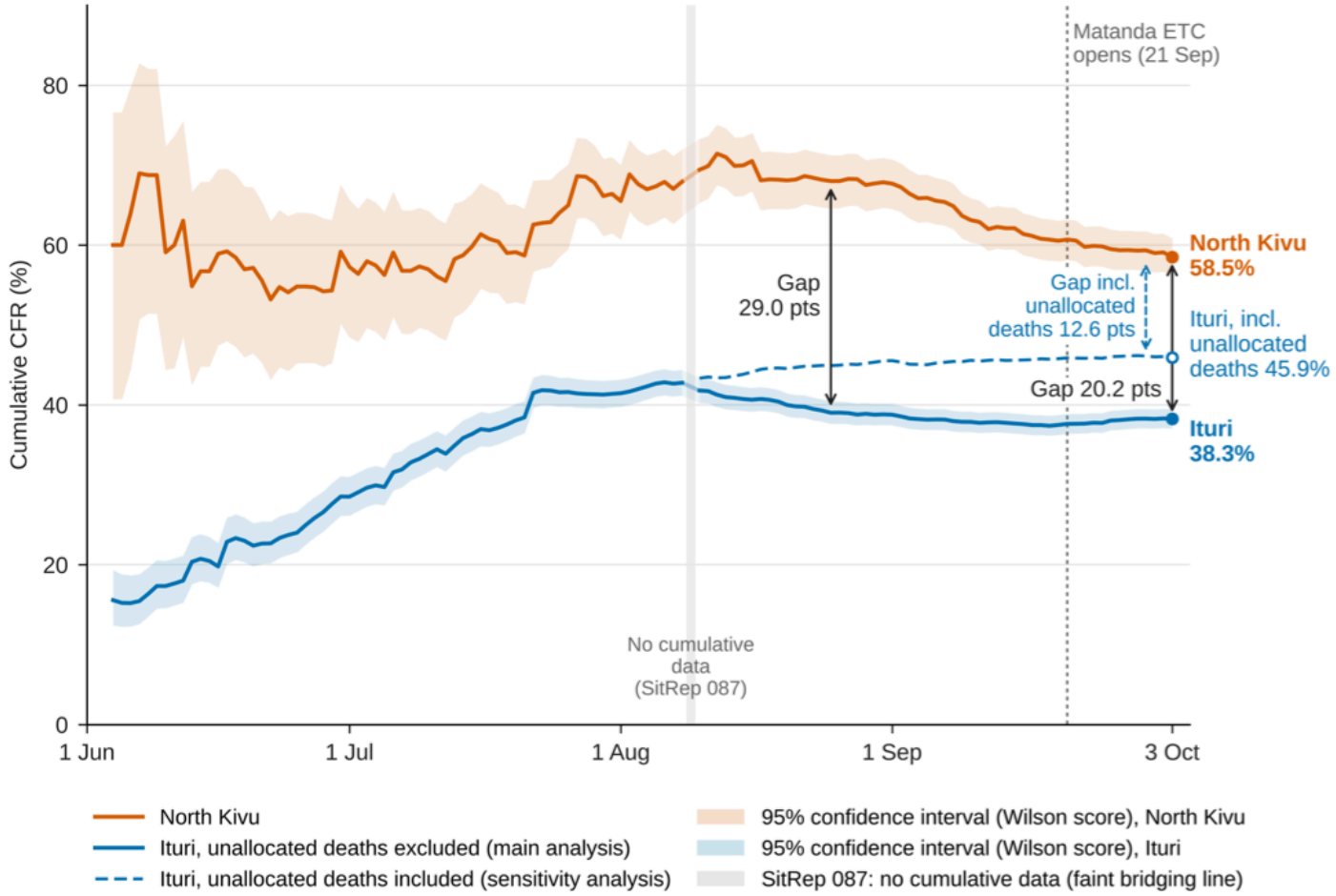


Figure 3

Comparative evolution of cumulative CFR between Ituri and North Kivu, Jun 4–Oct 3, 2026 (health zones aggregated by province, 121 SitReps, unallocated Ituri deaths excluded under a convention applied consistently throughout).