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Supporting surveillance and response priorities for the 2026 DRC Ebola Bundibugyo outbreak — Tshopo cohort

Population movements from the Tshopo health zones, based on privacy-secure analysis of mobile operator data from Vodacom Congo (DRC)

RAPID RELEASE

Analysis period: Daily mobility through 8 June 2026
Publication date: 17 July 2026

1. Population Mobility — Tshopo Cohort

Key Observations

This rapid release maps population movements from three health zones in Kisangani (Tshopo Province) using anonymised mobile operator data. Top recipient zones are ranked in Table 1 and mapped in Figure 2.

Our previous report (29 Jun 2026) highlighted Kisangani as a city with no confirmed cases but at relatively high risk. Given Kisangani's importance as a mobility hub in DRC it is of particular importance for the outbreak. Shortly after our report was released the first case was registered in Kisangani and, as of 13 July, there are now 4 confirmed cases in Tshopo province[2].

This rapid report uses mobility data from the follow-up period ending 8 June, prior to the first confirmed cases in Tshopo. Mobility patterns are generally stable between months and these results are therefore expected to be representative of more recent movement patterns.

This report highlights the high connectivity of Kisangani; especially to Kinshasa and to other population areas along the Congo river, as well as other provinces in the North and North-East of DRC (Ituri, Maniema, Nord-Kivu, Bas-Uele, Haut-Uele). The analysis also indicates notable connectivity with selected population centres in the South of DRC, in particular Lubumbashi, Haut-Katanga. Overall connection to the South is less pronounced.

The high mobility visible on the Congo river and ports along the river should be considered in surveillance, especially if the outbreak in Kisangani grows. This includes settlements bordering the Republic of Congo (Congo-Brazzaville) along the Congo river which may carry a risk of cross-border spread of the outbreak. In relation to movement towards borders we also note Bondo HZ in Bas-Uele ranked as #35, which has border crossings into the Central African Republic.

Excluding provinces with confirmed cases, health zones in Maniema (Lubutu, #7), Mongala (Yamaluka, #11), Bas-Uele (Buta, #12), and Kinshasa (Gombe, #16) are in the top 20 most connected to Kisangani and should also be considered for prioritisation. Of the top 50 health zones identified in this report, 15 are in Kinshasa province, further emphasising the risk of spread to the most populous city and province.

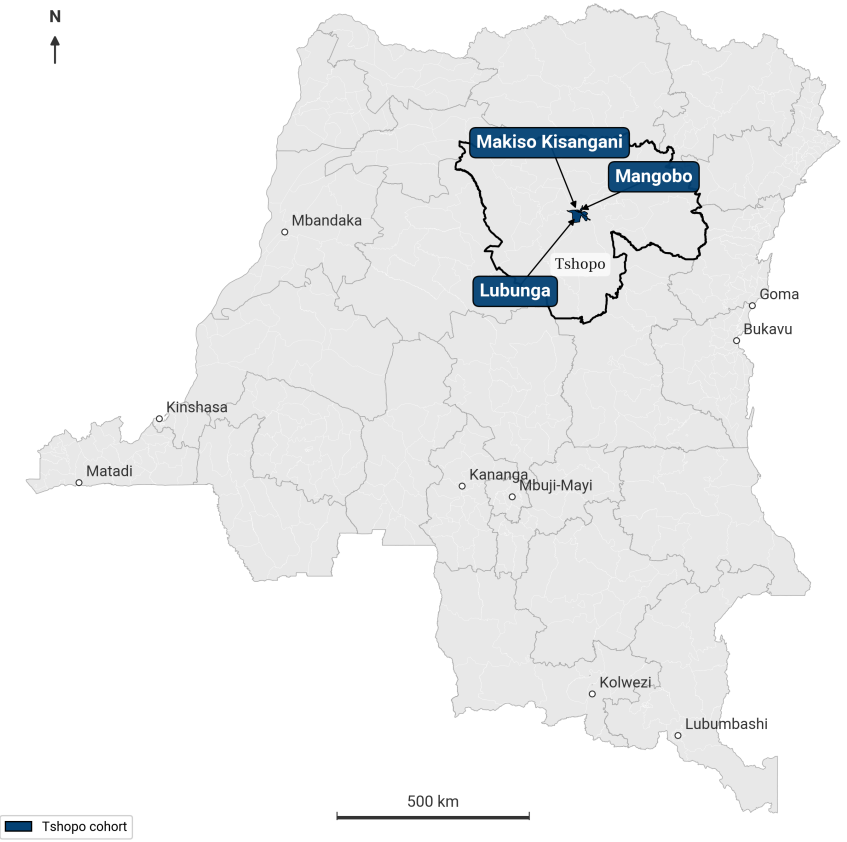


Figure 1. Location of the Tshopo cohort within the Democratic Republic of Congo. *The Tshopo cohort origin zones (Lubunga, Makiso Kisangani and Mangobo) are shown in blue. The province of Tshopo is outlined in black.*

Privacy note

The analysis runs on anonymised Call Detail Records (CDR), metadata records of mobile phone activity held inside Vodacom Congo (DRC)'s secure environment. No individual-level data leaves Vodacom Congo (DRC)'s premises. All results are aggregated to health-zone level. The cohort is defined only by presence in the origin health zones during 4 May 2026–17 May 2026; no other personal attributes are used.

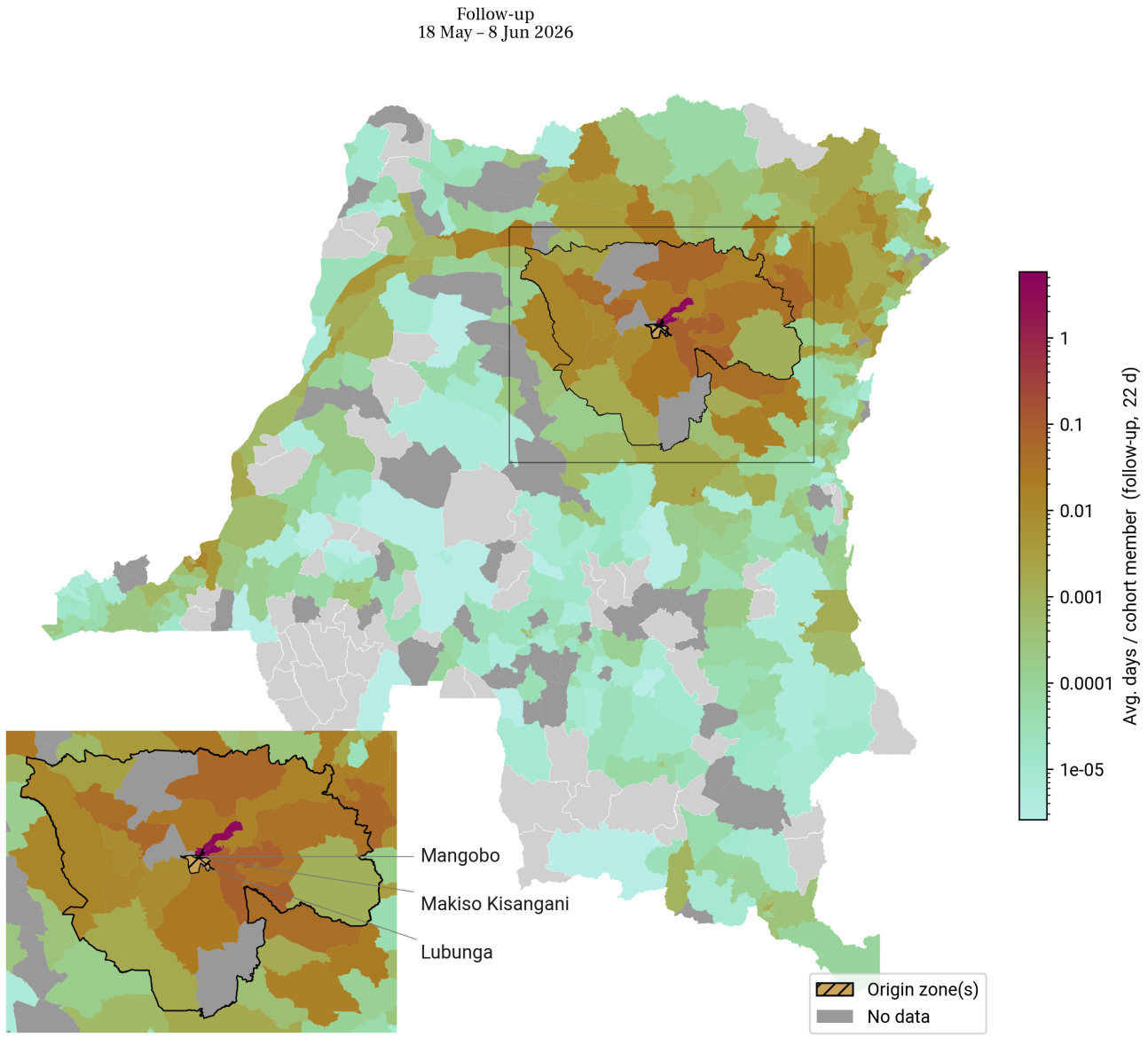


Figure 2. Subscriber-day presence during the follow-up period: Tshopo cohort. *Average subscriber-days per cohort member in each health zone during 18 May 2026–8 June 2026, among subscribers present in Lubunga, Makiso Kisangani, Mangobo during 4 May 2026–17 May 2026 (colour log scale; darker shades indicate higher presence intensity). The metric captures overall intensity of presence: a zone visited briefly by many cohort members scores similarly to one where fewer members spent more time. Health zones with no recorded presence are light grey; zones excluded for data-quality reasons are dark grey. Hatching identifies origin health zones. Inset: northeast DRC. Table 1 lists the ranked values.*

Table 1 — Top 90 Recipient Health Zones (Tshopo Cohort)

Average subscriber-days per cohort member in each health zone during the follow-up period (18 May 2026–8 June 2026), among subscribers present in Lubunga, Makiso Kisangani, Mangobo during 4 May 2026–17 May 2026. Each row is a health zone with at least one recorded cohort member during the follow-up period, ranked highest to lowest. Origin zones and health zones excluded for data-quality reasons are not shown (see Section 2). Values are the same as those mapped in Figure 2. **Red highlight covering the full row:** at least one confirmed case as of 13 Jul 2026[1,2,3]. Health zones in the same province have the same colour shading.

Rank	Province	Health Zone	Avg. days / cohort member (follow-up, 18 May-8 Jun 2026)
1	Tshopo	Kabondo	5.80e+00
2	Tshopo	Tshopo	3.55e+00
3	Tshopo	Wanierukula	7.96e-02
4	Tshopo	Isangi	5.97e-02
5	Tshopo	Banalia	5.75e-02
6	Ituri	Nia Nia	5.59e-02
7	Maniema	Lubutu	4.20e-02
8	Tshopo	Basoko	4.19e-02
9	Ituri	Bunia	3.61e-02
10	Tshopo	Bafwasende	3.28e-02
11	Mongala	Yamaluka	2.67e-02
12	Bas-Uele	Buta	2.65e-02
13	Tshopo	Bengamisa	2.59e-02
14	Tshopo	Yakusu	2.53e-02
15	Tshopo	Ubundu	2.48e-02
16	Kinshasa	Gombe	2.25e-02
17	Nord-Kivu	Walikale	2.17e-02
18	Haut-Uele	Isiro	2.15e-02
19	Nord-Kivu	Katwa	2.09e-02
20	Ituri	Rwampara	1.78e-02
21	Haut-Uele	Wamba	1.73e-02
22	Maniema	Kindu	1.68e-02
23	Ituri	Mambasa	1.68e-02
24	Kinshasa	Limete	1.66e-02
25	Maniema	Punia	1.64e-02
26	Nord-Kivu	Butembo	1.63e-02
27	Tshopo	Bafwagbogbo	1.52e-02
28	Mongala	Lisala	1.51e-02
29	Kinshasa	Binza Ozone	1.45e-02
30	Kinshasa	Nsele	1.44e-02
31	Kinshasa	Lingwala	1.36e-02
32	Tshopo	Yahuma	1.35e-02
33	Tshuapa	Djolu	1.29e-02
34	Nord-Kivu	Beni	1.26e-02
35	Bas-Uele	Bondo	1.20e-02
36	Kinshasa	Kokolo	1.17e-02
37	Kinshasa	Kinshasa	1.16e-02
38	Tshopo	Yahisuli	1.16e-02
39	Haut-Uele	Watsa	1.16e-02
40	Kinshasa	Kasa Vubu	1.06e-02
41	Kinshasa	Kalamu 1	1.01e-02
42	Kinshasa	Lemba	8.95e-03
43	Kinshasa	Kintambo	8.77e-03
44	Tshopo	Yabaondo	8.67e-03
45	Tshopo	Yaleko	8.66e-03
46	Kinshasa	Barumbu	7.37e-03
47	Kinshasa	Binza Meteo	6.94e-03
48	Kinshasa	Bandalungwa	6.37e-03
49	Ituri	Mandima	6.31e-03
50	Kinshasa	Masina 1	6.18e-03
51	Kinshasa	Kingabwa	5.61e-03
52	Nord-Kivu	Mutwanga	5.34e-03
53	Kinshasa	Mont Ngafula 2	5.19e-03
54	Kinshasa	Selembao	5.06e-03
55	Equateur	Makanza	5.06e-03
56	Kinshasa	Maluku 1	4.89e-03
57	Haut-Uele	Gombari	4.86e-03
58	Kinshasa	Matete	4.62e-03
59	Kinshasa	Mont Ngafula 1	4.61e-03
60	Ituri	Mahagi	4.36e-03
61	Ituri	Komanda	4.14e-03
62	Kinshasa	Ndjili	3.79e-03
63	Kinshasa	Ngiri Ngiri	3.64e-03
64	Equateur	Wangata	3.63e-03
65	Equateur	Mbandaka	3.55e-03
66	Bas-Uele	Aketi	3.50e-03
67	Bas-Uele	Likati	3.45e-03
68	Kinshasa	Masina 2	3.39e-03
69	Kinshasa	Kikimi	3.24e-03
70	Nord-Kivu	Musienene	3.19e-03
71	Kinshasa	Kalamu 2	3.07e-03
72	Ituri	Mongbwalu	3.04e-03
73	Ituri	Aru	2.95e-03
74	Maniema	Alunguli	2.80e-03
75	Tshopo	Yalimbongo	2.77e-03
76	Ituri	Lita	2.68e-03
77	Ituri	Ariwara	2.47e-03
78	Nord-Kivu	Mabalako	2.42e-03
79	Nord-Kivu	Kalunguta	2.42e-03
80	Nord-Kivu	Oicha	2.40e-03
81	Haut-Katanga	Lubumbashi	2.39e-03
82	Kinshasa	Makala	2.29e-03
83	Haut-Uele	Dungu	2.21e-03
84	Nord-Kivu	Karisimbi	2.20e-03
85	Equateur	Bolenge	2.18e-03
86	Kinshasa	Police	2.18e-03
87	Ituri	Lolwa	2.04e-03
88	Maindombe	Bolobo	2.01e-03
89	Haut-Uele	Makoro	1.92e-03
90	Kinshasa	Kingasani	1.92e-03

2. Methods

2.1 Input Data

The analysis uses three types of daily-level Call Detail Records (CDR) provided by Vodacom: voice calls, SMS, and mobile data sessions (MDS). CDRs are transactional records generated automatically by a mobile network operator for each communication event made or received by a subscriber. Each record contains a timestamp, an anonymised subscriber identifier, and the identifier of the cell tower that handled the event, which provides an approximate geographic location. CDRs do not capture the content of communications.

The geographic reference unit is the health zone (*zone de santé*). Data on confirmed cases used to contextualise the mobility rankings derive from WHO DON608 and the INRB-UMIE epidemic dashboard[1,2,3].

2.2 Methods for Cohort and Analysis

Step 1 — Cohort Selection

Reference period: 4 May 2026 – 17 May 2026 · Minimum active days: 2

The **Tshopo cohort** comprises all subscribers active on at least 2 distinct days in any of the three origin health zones (Lubunga, Makiso Kisangani and Mangobo) during the reference period (4 May 2026–17 May 2026). CDR files across all three event types (voice calls, SMS, MDS) were scanned for each origin zone; subscribers recorded there were tagged and pooled, with deduplication applied across zones and CDR types to form a single cohort.

Step 2 — CDR Extraction

Look-back: 12 Apr 2026 – 3 May 2026 · Follow-up: 18 May 2026 – 8 June 2026

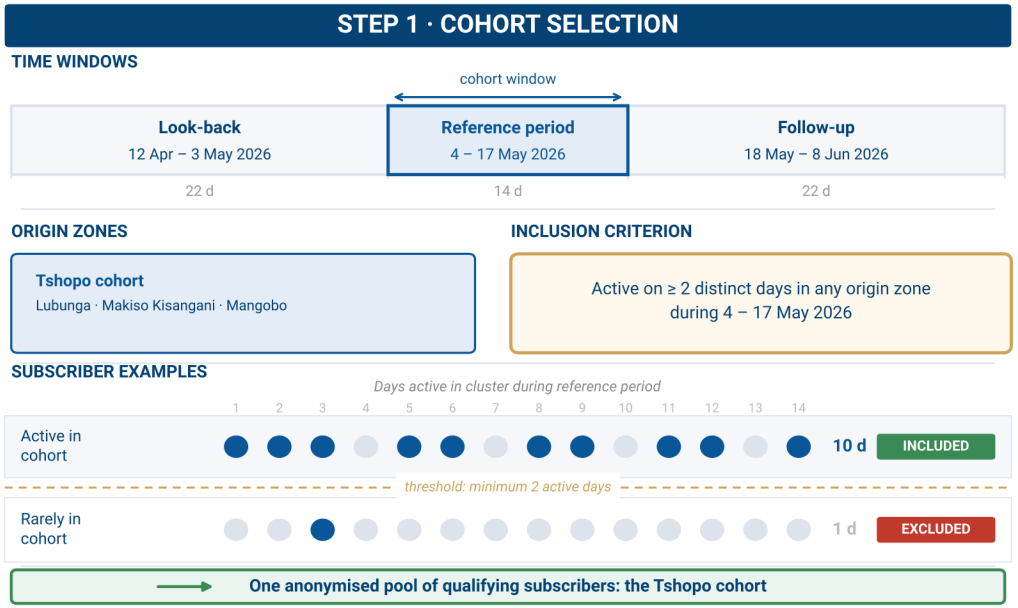
Two analysis windows are extracted: a **look-back** window (12 Apr 2026–3 May 2026), showing where the cohort spent time before the reference period, and a **follow-up** window (18 May 2026–8 June 2026), showing presence afterwards. All CDR files within each window were scanned across all three event types; only records belonging to cohort members were retained, preserving the hashed subscriber identifier, cell tower identifier, and timestamp.

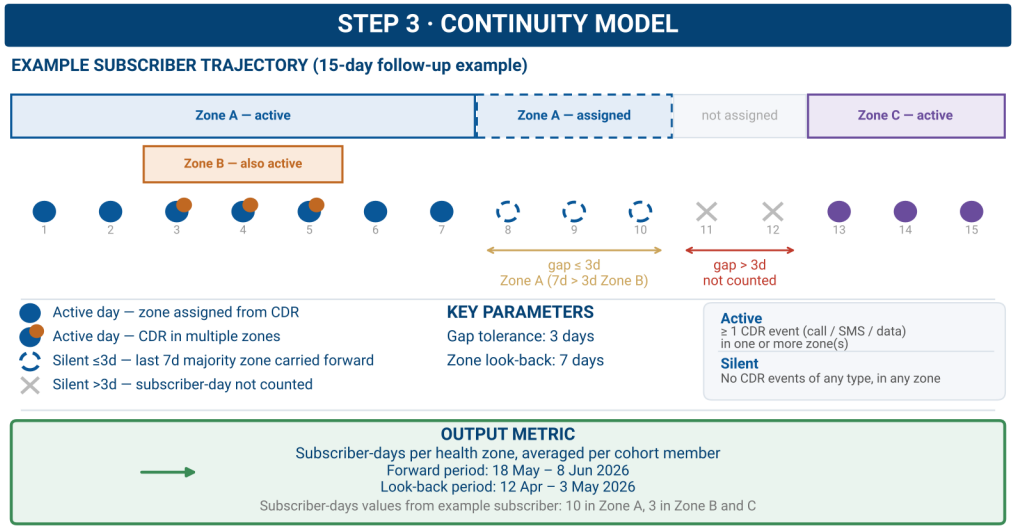
Step 3 — Continuity Model

Gap tolerance: 3 days · Location look-back: 7 days

While CDRs frequently capture multiple events per day for active subscribers, some users experience periods of reduced or absent activity (whether temporarily or persistently), leaving gaps in their location record. A continuity model is applied to estimate presence during these unobserved days. If a subscriber was last detected in health zone Z, they are credited as present in zone Z for each subsequent unobserved day, up to a maximum of 3 consecutive undetected days. Beyond this threshold, no further credit is assigned until the next detection.

More information on CDR analysis methods: www.flowgeek.org





3. Caveats

3.1 Limitations

Sixty-six out of five hundred and nineteen health zones are excluded from the study for data-quality reasons. No reliable data is available for these zones: they are entirely absent from all rankings, not merely low-ranking. Some of these lie near the origin health zones of the cohort. They should not be overlooked when using this data to guide surveillance prioritisation.

Ebola spreads across the geography through travel. However, contact patterns between infectious and susceptible individuals determine whether new individuals become infected. This means that the movements of people, as estimated in this report, are an important but far from the only predictor of the spatial spread of the epidemic.

While Flowminder's monthly population mobility reports for DRC estimate population movement through integration of survey data to adjust for biases in phone ownership, local market shares and other factors, these estimates are based only on Vodacom's subscribers. Vodacom is a leading operator in Tshopo and across the main outbreak-affected provinces.

Areas outside the top-ranked health zones should also be considered at risk. The randomness and multifactorial nature of infectious disease spread means that lower-ranked zones cannot be discounted.

Due to resource and technical constraints, data after 8 June 2026 has not been fully quality assured; 8 June 2026 is therefore the end date of the analysis period covered by this report. This predates the first confirmed cases in Tshopo; however, mobility patterns are generally stable between months and these results are therefore expected to be representative of more recent movement patterns.

Beyond the aggregate analysis provided here, regular or daily data releases would enable finer tracking of how travel patterns evolve over the course of the epidemic. Should dedicated resources become available, we aim to provide such releases to directly inform evolving surveillance priorities.

3.2 Mobile Data and Infectious Disease Spread

The first validation study using mobile operator data to predict infectious disease spread was conducted for the cholera epidemic in Haiti[4]. The approach has since been validated for multiple pathogens, including dengue[5] and COVID-19[6].

3.3 Health Zones Excluded from the Study

Health zones excluded from all rankings due to insufficient data quality. These zones are data-absent, not zero-flow — no reliable data is available for them, and they receive no rank in the analysis. They should not be overlooked in surveillance planning.

Province	Health Zone
Equateur	Djombo
Equateur	Iboko
Equateur	Ntondo
Haut-Katanga	Kowe
Haut-Katanga	Mufunga Sampwe
Haut-Lomami	Butumba
Haut-Lomami	Lwamba
Ituri	Jiba
Ituri	Linga
Ituri	Mangala
Kasaï	Bulape
Kasaï	Kitangwa
Kasaï	Ndjoko Mpunda
Kasaï Central	Bilomba
Kasaï Central	Bobozo
Kasaï Central	Bunkonde
Kasaï Central	Dibaya
Kasaï Central	Kalomba
Kasaï Central	Lubondaie
Kasaï Central	Masuika
Kasaï Central	Mutoto
Kasaï Central	Tshibala
Kasaï Central	Yangala
Kasaï Oriental	Cilundu
Kasaï Oriental	Mpokolo
Kasaï Oriental	Mukumbi
Kongo Central	Kimvula
Kongo Central	Luozi
Kongo Central	Mangembo
Kwilu	Kimputu
Kwilu	Moanza

Province	Health Zone
Kwilu	Mungindu
Lomami	Kamiji
Lomami	Lubao
Lomami	Ludimbi Lukula
Lomami	NGandajika
Lomami	Tshofa
Lualaba	Lualaba
Maindombe	Mimia
Maindombe	Pendjwa
Mongala	Bongandanga
Mongala	Bumba
Mongala	Yamongili
Nord-Kivu	Rwanguba
Nord-Kivu	Vuhovi
Nord-Ubangi	Abuzi
Nord-Ubangi	Bili
Nord-Ubangi	Businga
Nord-Ubangi	Wasolo
Sankuru	Omendjadi
Sankuru	Tshudi Loto
Sud-Kivu	Minembwe
Sud-Kivu	Mwenga
Sud-Ubangi	Bominenge
Sud-Ubangi	Mawuya
Sud-Ubangi	Mbaya
Tshopo	Basali
Tshopo	Lowa
Tshopo	Yakusu
Tshuapa	Bokungu
Tshuapa	Mompono
Tshuapa	Yalifafu

4. Citations

[1] Institut National de Santé Publique (INSP-RDC). *Rapport de Situation de la 17ème Épidémie de la Maladie à Virus Ebola/RDC. SitRep N°042/MVB_25/06/2026.* 26 juin 2026. Available at: insp.cd/sitrep-n042-mvb_25-06-2026

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[5] Wesolowski A, et al. Impact of Human Mobility on the Emergence of Dengue Epidemics in Pakistan. *Proceedings of the National Academy of Sciences* 112(38):11887–11892 (2015).

[6] Chang S, et al. Mobility network models of COVID-19 explain inequities and inform reopening. *Nature* 589, 82–87 (2021).

How to Cite This Report?

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Partnership — Vodacom & Flowminder

Since 2018, Vodacom Congo (DRC) and the Flowminder Foundation have been collaborating to put anonymised mobile data at the service of development and humanitarian action in the Democratic Republic of Congo. This partnership combines operator metadata (CDRs) provided by Vodacom Congo with Flowminder's analytical expertise in big data, in strict compliance with subscriber privacy. Together, the two organisations have produced mobility indicators to support the government's response to COVID-19, estimate population displacement following the eruption of Mount Nyiragongo in 2021, and strengthen routine immunisation planning for the Expanded Programme on Immunization (EPI). This collaboration illustrates how the Congolese private sector, national health authorities, and technical partners can combine their strengths to produce timely, evidence-based insights for the benefit of the people of the DRC. The analyses are carried out on de-identified mobile data. No individual-level data leaves Vodacom's secure premises.

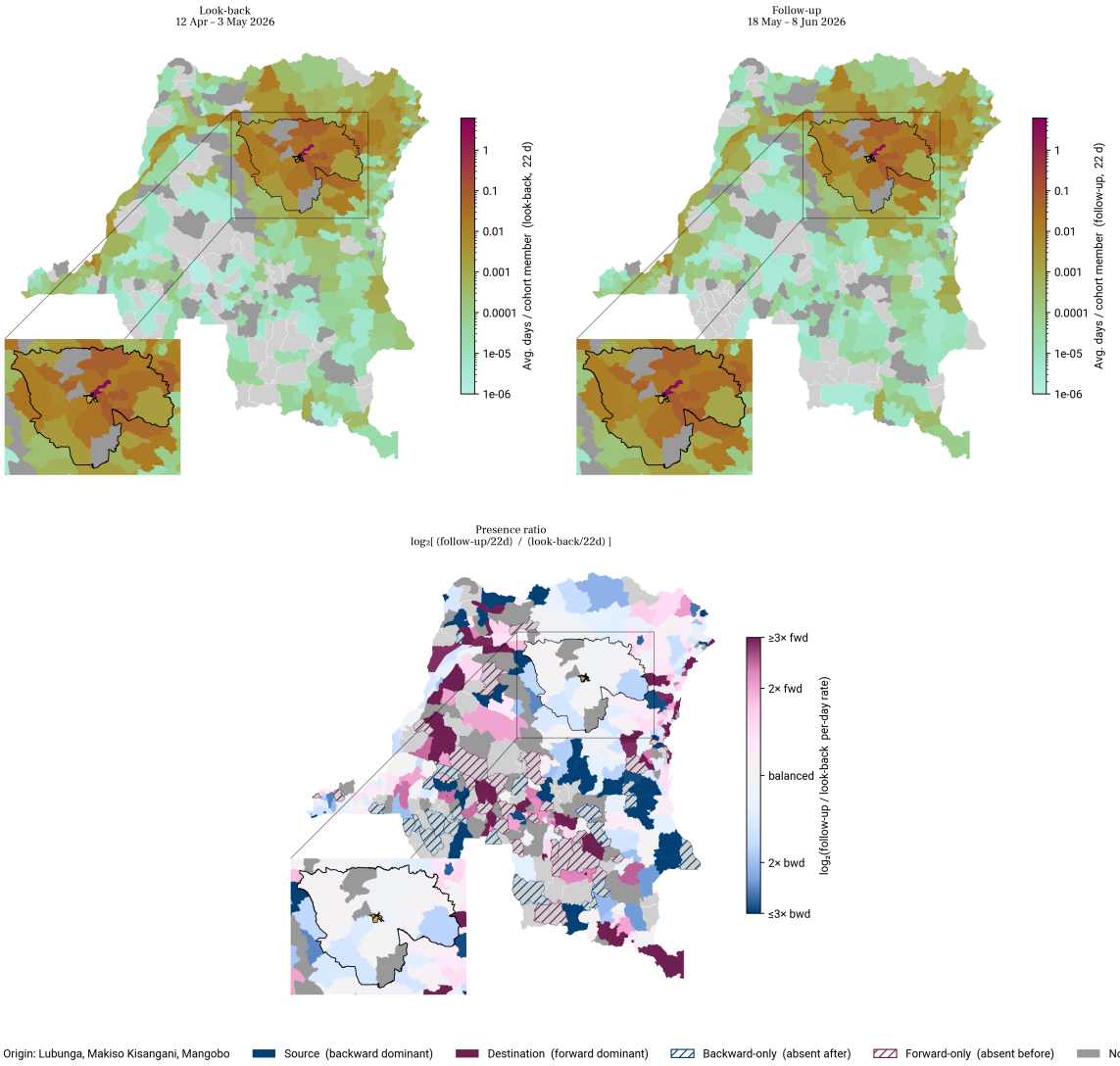
Annex

The following annex provides a three-panel summary map for the Tshopo cohort (Lubunga, Makiso Kisangani and Mangobo): a look-back window (12 Apr 2026–3 May 2026), showing where the cohort spent time before the reference period; a follow-up window (18 May 2026–8 June 2026), showing presence afterwards; and the relative change between the two.

The top-left panel (look-back) shows the intensity of cohort member presence across health zones before the cohort selection period, providing a baseline that can be compared directly with the top-right panel (follow-up) to assess whether presence patterns shifted between the two windows. This is useful for understanding the geographic reach of the cohort both before and after the reference period.

Under normal conditions, past and future presence intensity tend to be similar, since mobility is largely driven by stable factors: economic ties, family connections and established routes. The bottom panel (relative change, $\log_2$ ratio of follow-up to look-back presence) makes this comparison explicit: zones with markedly imbalanced ratios indicate a specific push or pull. Higher follow-up presence suggests the zone attracted more of the cohort during this period than usual, and vice versa. The causes of such imbalances can be many, including the current epidemic, although a direct causal link cannot be established from mobility data alone. Where the two panels are broadly similar, this indicates that the cohort's presence patterns were at least consistent across the two periods.

Annex — Tshopo Cohort: Three-Panel Summary Map



Annex. Subscriber-day presence across DRC for the Tshopo cohort: look-back, follow-up and relative-change panels. *Among subscribers present in Lubunga, Makiso Kisangani, Mangobo during 4 May 2026–17 May 2026.* ***(Top left)*** *Average subscriber-days per cohort member during the look-back period (12 Apr 2026–3 May 2026).* ***(Top right)*** *Average subscriber-days per cohort member during the follow-up period (18 May 2026–8 June 2026). Both panels use a log colour scale; health zones with no recorded presence are light grey, and zones excluded for data-quality reasons are dark grey. The metric captures overall intensity of presence: a zone visited briefly by many cohort members scores similarly to one where fewer members spent more time. Days between detections are estimated using a continuity model (see Section 2).* ***(Bottom)*** *Presence ratio: $\log_2$(follow-up rate / look-back rate), where rate is average subscriber-days per cohort member per day. Purple tones indicate zones with higher relative presence during follow-up; blue tones indicate zones more heavily present during look-back. Values are clipped at $\pm\log_2(3)$. Hatching: origin health zones (gold); zones present only during look-back (blue); zones present only during follow-up (red). Insets: northeast DRC.*

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Authors

This report was produced by the **Flowminder Foundation**, a non-profit organisation specialising in the analysis of mobile phone, geospatial and survey data for humanitarian and development purposes.

This report was written by Romain Goldenberg and Linus Bengtsson, with contributions from Daniel Power, Thomas Smallwood, Joachim Jellinek, Chris Brooks and Apphia Yuma.

Romain Goldenberg led and produced the analysis, created the charts and co-authored the report. Linus Bengtsson interpreted the charts and mobility statistics, and co-authored the report. Daniel Power and Thomas Smallwood co-authored the report. Joachim Jellinek and Chris Brooks produced the aggregates derived from pseudonymised call detail records. Apphia Yuma provided support and oversight for the analysis and the project.

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