Importation risk and preparedness priorities across Africa in the 2026 Bundibugyo Ebola outbreak

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ABSTRACT

The ongoing 2026 Bundibugyo Ebola outbreak in the Democratic Republic of the Congo and Uganda raises concerns about regional dissemination across Africa. Anticipating where imported infections are most likely to occur, and whether recipient countries are prepared to detect and contain them, is essential for prioritizing surveillance and response. We developed an integrated spatial framework combining high-resolution epidemic and population data, air and land mobility, geographical accessibility, conflict-adjusted travel times to estimate the risk of Ebola importation across African countries. We contextualized importation risk using different national readiness indicators. We quantified overall, air-mediated, and land-mediated importation risk under the current epidemic situation and evaluated outbreak amplification scenarios in major regional hubs. Importation risk was highly concentrated geographically, with neighbouring countries accounting for 85% of the estimated continental risk. However, high-risk destinations extended beyond the immediate neighbours, whereas some neighbouring countries remained at low risk, reflecting the complementary roles of land and air mobility in shaping regional dissemination. South Sudan, Rwanda, Kenya, Tanzania, Zambia, Ethiopia,

Burundi, Angola, South Africa, the Central African Republic, and Nigeria were estimated at high risk, but differed markedly in healthcare system capacity and emergency preparedness and response. Readiness gaps were largest in South Sudan, Burundi, and the Central African Republic. Botswana, Burkina Faso, Cameroon, Chad, and Ghana emerged as a second tier of preparedness priorities, combining intermediate-high importation risk with low readiness. Under outbreak amplification scenarios, the highest-risk countries remained largely stable, but additional countries entered the high-risk group and continental importation pressure increased substantially, highlighting the need for dynamic preparedness planning. Integrating high-resolution epidemiological data with complementary land and air mobility provides a refined geography of regional risk and preparedness across Africa, supporting better targeted surveillance, preparedness investments, and international support while allowing priorities to be rapidly updated as outbreaks evolve.

INTRODUCTION

The ongoing Bundibugyo Ebola virus disease outbreak in eastern Democratic Republic of the Congo (DRC) and Uganda has substantial potential for regional spread. Importations into other African countries, particularly where preparedness and response capacities are limited, could turn the outbreak into a broader public health emergency. As of 4 July 2026, the outbreak - previously declared a Public Health Emergency of International Concern (PHEIC)[1] - has reached 1,561 confirmed cases across the provinces of Ituri, North Kivu, and South Kivu in eastern DRC, and 20 confirmed cases in Uganda[2]. Several factors increase the risk of further dissemination. The virus is spreading in both urban centers and remote rural settings, where response efforts face distinct operational challenges[3,4]. Ongoing armed conflicts hamper surveillance and healthcare delivery, while the outbreak epicenter lies close to highly porous international borders characterised by intense movements driven by trade, mining, and population displacement[3,4]. There, informal crossings outside official points of entry further complicate surveillance and compromise border control measures[4].

Regional spread is facilitated by the combination of prolonged incubation, extensive cross-border mobility, and, potentially, air transportation. During the incubation period, infected individuals may travel undetected, seeding infections into neighbouring countries or more distant destinations, as shown by the case reported in France on June 24[2]. Evidence from past Ebola epidemics also shows that international dissemination can occur despite border screening and reductions in travel[5,6]. During the 2014–2016 West Africa epidemic, imported cases were reported in seven countries outside the source region[6], including three in Africa. Additional international exportations may therefore occur if the epidemic expands.

Preventing regional amplification requires not only rapid control at the outbreak source but also preparedness in receiving countries to detect and contain imported infections before sustained local transmission becomes established. In the absence of licensed vaccines and specific treatments against Bundibugyo virus, early detection and implementation of core public health measures remain the cornerstone of outbreak control[7].

Anticipating where importations are most likely to occur remains challenging. Previous modeling studies have estimated the regional[8,9] and international[10–12] spread of Ebola Bundibugyo, but have simplified mobility within Africa by relying on air mobility flows or restricting the analysis to a limited set of neighboring countries. Regional dissemination across the continent, however, is dominated by complex patterns of air and land mobility, and heterogeneous geographical accessibility, which are not adequately captured by air mobility alone. At the same time, African countries differ substantially in healthcare capacity, surveillance systems, available medical supplies, emergency preparedness and operational

response capabilities, as well as risk communication[13,14,4]. Integrating these complementary dimensions is essential for actionable preparedness.

We developed an integrated analytical framework to estimate the risk of Ebola Bundibugyo dissemination in Africa in relation to national readiness, by combining epidemiological and high-resolution spatial population data, commercial air transportation, land mobility, geographical accessibility, conflict-adjusted travel-times, and different readiness scores. We further investigated how the geography of risk would change under different epidemic amplification scenarios. By contextualizing importation risk with national readiness, our framework provides operational evidence to support regional preparedness, surveillance prioritization, and international coordination for the current outbreak.

METHODS

We assessed the risk for regional spread of Ebola virus disease for the 2026 Bundibugyo outbreak in eastern Democratic Republic of the Congo (DRC) and Uganda using a high-resolution multi-layer framework integrating epidemiological, mobility, population, accessibility, capacity, and response data. The analysis focused on the affected health districts in DRC and affected ADM3 units in Uganda and evaluated the epidemic activity of these areas and their connectivity to the rest of Africa through both air and land mobility flows, accounting for travel time, conflicts, length of incubation period, and proximity to transportation hubs (**Fig. 1**).

Cumulative confirmed cases were obtained from the Institut National de Santé Publique (INSP) of the DRC in the daily situation report number 51 published on 5 July 2026[15], and by the Ministry of Health of Uganda on the update of the same date[16] (**Fig. 1a**). To account for geographically heterogeneous reporting rates, we used the proportion of alerts investigated among reported alerts in each DRC province, averaged over the two weeks preceding 5 July 2026, relative to 100% reporting in Uganda[15]. We explored alternative values in the sensitivity analysis. Population data were obtained from the 2024 health-zone population projections produced by the DRC Information Management Working Group and disseminated by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) through the Humanitarian Data Exchange Platform[17]. For Uganda, population estimates at administrative levels 0–3 were obtained from the United Nations Population Fund[18] (UNFPA), based on Uganda Bureau of Statistics data. These datasets were used to compute cumulative attack rates in affected areas and to account for differences in local epidemic intensity across source locations when estimating their relative contribution to international exportation risk.

International mobility in Africa was characterized through complementary air and land mobility. Air mobility was derived from the International Air Transport Association (IATA) data on origin–

destination passenger flows between any pair of commercial airports and accounting for connections at intermediate airports (**Fig. 1c**). Land mobility was then obtained as residual mobility by subtracting air mobility from the Global Transnational Mobility Dataset 2.0[19] (GTMD2), which provides estimates of overall population movements between countries (**Fig. 1d**). Mobility volumes spanned more than five orders of magnitude across country pairs, ranging from less than a traveller per day to more than 10^4 daily travellers on the most connected routes. Land mobility dominated regional connectivity around the outbreak area, accounting for 95% of cross-border mobility with neighbouring countries. The contribution of air transportation was substantially smaller (by two orders of magnitude) but geographically broader, with nearly half of movements linking the source area to more distant African countries (**Fig. 1b**).

To characterize spatial accessibility from the outbreak area and the potential for land-based spread within the incubation period, we computed travel-time surfaces using a global motorized-travel friction surface map[20] integrating road networks, land cover, rivers, topography, and transport infrastructure. Travel times were estimated from each affected health district (DRC) and ADM3 units (Uganda) to all destination countries in Africa. As armed conflict can substantially alter travel time, our estimates were adjusted for conflict-related disruptions using the most recent conflict data at ADM2 level obtained from the Armed Conflict Location & Event Data Project[21] (ACLED), and calibrated against Google Maps driving-time estimates. **Fig. 1e** shows as an example the estimated travel time from Bunia, the health district reporting the largest epidemic activity, under the assumption of 8h driving time per day; additional daily driving times were considered for sensitivity.

Populations in health districts (DRC) and ADM3 units (Uganda) were linked to land and air mobility networks through spatial allocation models. For land travel, the share of the population in each administrative unit travelling to each destination country was estimated through a gravity model calibrated on observed land mobility patterns. For air travel, it was assigned using weights proportional to population size and decreasing with the distance to each airport of the country. The same spatial allocation framework was also used in the amplification scenarios (see below).

Border restrictions and closures related to the current outbreak were not considered, because the implemented measures were partial, temporary and largely limited to official points of entry. Also, available data on cross-country mobility suggested no meaningful reduction in cross-border movement occurred during such restrictions.

The importation risk for each African country was estimated separately for air and land mobility, as the probability that an infected traveller from the affected areas would reach that country. We assumed that Ebola infected cases could travel only in their latent phase, as

symptomatic patients would be expected to either remain in the affected country for clinical management or, if transferred internationally, travel under medically supervised and controlled conditions. Therefore, for land mobility, travel times were explicitly incorporated to estimate the destination reached before the onset of symptoms. For air travel, journey times were considered negligible relative to the incubation period. Risks were weighted by the cumulative attack rate in each affected administrative unit. Air and land importation risks were then combined to obtain an overall estimate of relative importation risk for each destination country. Risk was stratified by mobility component (air vs. land) and by border distance (i.e., minimum number of border crossings) from the source countries. Average risk by country stratified by border distance were also computed.

National epidemic readiness was assessed using several complementary frameworks, including the WHO State Parties Self-Assessment Annual Reporting[14] (SPAR, 2025), the Global Health Security Index[22] (GHS, 2021), the Infectious Disease Vulnerability Index[23] (IDVI, 2016), and the Epidemic Risk Index[24] (INFORM-WHO, 2020). From each framework, we extracted indicators describing *Healthcare system capacity* and *Emergency preparedness and response*. Correlation analysis was performed to assess agreement and complementarity across indicators (**Fig. 1h**). Given its complete coverage of African countries, recent update, and direct relevance to the current WHO Framework for Health Emergency Preparedness and Response Capabilities for national public health agencies[25], SPAR was selected as the primary epidemic readiness metric for the main analysis (**Fig. 1fg**). Corresponding GHS indicators, complementary to SPAR indicators, were used in sensitivity analyses. All values are defined on a 0-100 scale, with 100 corresponding to the highest capacity or response value.

Countries were classified into quartiles of relative importation risk, healthcare system capacity, and emergency preparedness and response, corresponding to high (n=11), intermediate-high (n=12), intermediate-low (n=12), and low categories (n=11).

Amplification scenarios were designed to assess the potential impact of geographical expansion of the epidemic beyond the currently affected area into highly connected urban centers[10] . Tested locations included the capital cities of the two affected countries, Kinshasa (DRC) and Kampala (Uganda), and the capitals of neighboring countries scoring highest in importation risk: Juba (South Sudan), Kigali (Rwanda), Bujumbura (Burundi), Nairobi (Kenya), and Lusaka (Zambia). Bujumbura was selected instead of Gitega as it is the economic capital and largest city of Burundi.

RESULTS

Overall importation risk was concentrated geographically (**Fig. 2a**). The 11 countries in the high-risk quartile – South Sudan, Rwanda, Kenya, Zambia, Ethiopia, Tanzania, Burundi, Angola, South

Africa, Central African Republic, and Nigeria – accounted for 93% of the total estimated importation risk, and formed a largely contiguous regional belt surrounding the affected area, with the exception of Ethiopia, South Africa, and Nigeria, which were geographically more distant (at border distance 2, 3, and 3 from the outbreak source, respectively). All countries directly bordering DRC and Uganda were classified as high risk, except the Republic of the Congo at low risk. Neighboring countries alone accounted for 85% of the total estimated risk, while countries located two border crossings away contributed an additional 9%, highlighting the strong spatial concentration of potential spread around the outbreak source (**Fig. 2f**).

The observed risk pattern was primarily driven by land mobility (**Fig. 2b,c,e**). Risk rankings based on overall importation risk largely mirrored those obtained using land mobility alone. As land-mediated risk decreased gradually with border distance, countries at highest overall risk were also those most strongly connected to the affected area through land mobility. Air mobility instead generated a different risk distribution (**Fig.2d**) and a partially distinct risk geography. Air-mediated risk displayed two broad regimes, with countries located within two border crossings of the outbreak source (plus South Africa and Nigeria) displaying, on average, high importation risk, whereas more distant countries had consistently low average risk. Kenya and Ethiopia ranked among the five countries at highest risk of importation mediated by each mobility layer (**Fig. 2b,c**), reflecting their strong regional connectivity, despite Ethiopia being located two border crossings from the outbreak source. Ethiopia, South Africa, and Nigeria were the only non-neighbouring countries classified as high risk overall, and each ranked substantially higher when considering air importation risk than land importation risk: Ethiopia ranked first for air importation risk but fifth for land importation risk, while South Africa ranked third and ninth, respectively, and Nigeria seventh and eleventh.

National epidemic readiness varied considerably across Africa and showed no significant association with importation risk (**Fig. 3**; Spearman r=0.15, p-value=0.31 with healthcare system capacity, Spearman r=0.28, p-value=0.06 with emergency preparedness and response). Countries with similar levels of exposure displayed markedly different healthcare system capacity and emergency preparedness and response scores (**Fig. 3a,b**). Among the 11 high-risk countries, three (Zambia, Ethiopia, and Tanzania) combined high healthcare system capacity with high emergency preparedness and response, while Nigeria exhibited intermediate-high healthcare system capacity and high emergency preparedness and response (**Fig. 3c**). In contrast, South Sudan, Burundi, and the Central African Republic had high importation risk but low epidemic readiness. South Sudan exhibited low healthcare system capacity and intermediate-low emergency preparedness and response; Burundi exhibited intermediate-low healthcare system capacity and low emergency preparedness and response; the Central African Republic ranked low on both indicators. The remaining high-risk countries (Rwanda, Kenya, Angola, and South Africa) showed intermediate levels of readiness.

Similarly, countries with intermediate-high importation risk had variable levels of readiness. Four countries exhibited high scores of readiness, in either the healthcare system capacity (Mozambique), or the emergency preparedness and response (Malawi, Côte d'Ivoire), or both (Egypt). Botswana instead had low scores in both indicators, while Burkina Faso and Cameroon showed low healthcare system capacity (together with intermediate-low response), and Chad and Ghana showed low emergency preparedness and response (together with intermediate-low capacity).

We next examined how importation risk would change if sustained local transmission became established in major regional hubs of countries currently at high importation risk (**Fig. 4**). Across the seven scenarios tested, the ranking of high-risk countries remained largely unchanged and closely matched that estimated under the current epidemic spread. Specifically, South Sudan, Rwanda, Kenya, Tanzania, and Zambia remained among the 5 countries at highest risk of importation (**Fig. 4a**). Only a few countries entered the high-risk group in some of the amplification scenarios, as was the case of the Republic of the Congo under the expansion of the Ebola epidemic in Kinshasa. In contrast, the magnitude of importation pressure across the continent varied substantially across scenarios (**Fig. 4b**). Epidemic amplification in Nairobi and Lusaka produced the largest increase in continental importation (4-fold increase), and especially in southern Africa (up to 15-fold). Amplification in Kampala and Kigali produced a moderate increase in importation risk across the continent (2.5-fold and 2.8-fold, respectively), whereas expansion to Kinshasa, Bujumbura, or Juba produced comparatively limited continental effects. The relative contribution of air and land mobility also varied substantially across scenarios (**Fig. 4c**). Amplification in major transportation hubs markedly increased the contribution of air travel. Ethiopia saw the largest shift, with the contribution of air travel increasing from the current 8% of overall risk to between 15% (amplification in Lusaka and Nairobi) and 48% (amplification in Kinshasa). Kenya exhibited a similar pattern, whereas South Sudan remained dominated by land-mediated importation.

DISCUSSION

We developed an integrated analytical framework combining high-resolution epidemiological and population data with complementary air and land mobility, geographical accessibility, conflict-adjusted travel times, and national preparedness indicators to jointly quantify importation risk and national readiness across Africa, in the context of the current outbreak of Bundibugyo Ebola virus disease in eastern DRC and Uganda. This integrated perspective provides an operational basis for prioritizing preparedness activities, surveillance, and international support during the current outbreak.

Countries at highest risk of Ebola importation differed substantially in their capacity to detect, investigate and respond to imported cases, resulting in a heterogeneous landscape of epidemic vulnerability. Distinct readiness profiles emerged, ranging from countries combining high exposure with strong operational capacity, such as Zambia, Ethiopia and Tanzania, to countries where high importation risk coincides with substantial readiness gaps, including South Sudan, Burundi, and the Central African Republic. South Sudan, the country at highest importation risk, combined intermediate-low emergency preparedness and response with limited healthcare system capacity, raising concerns that imported cases could more readily generate secondary transmission. This reinforces the importance of continued investments in surveillance, laboratory capacity, emergency preparedness, and cross-border cooperation, consistent with the recent Tabletop Exercise[26], contingency planning, and preparedness activities coordinated by WHO and Africa CDC. At the same time, recent outbreak experience demonstrates that operational preparedness is not solely determined by structural readiness indicators. During the 2024–2025 mpox outbreak, Burundi benefited from the deployment of multidisciplinary African Volunteers Health Corps teams[27], strengthening local expertise in epidemiology, infection prevention and control, case management, laboratory services, and risk communication. Likewise, Rwanda, a high-risk country with only intermediate readiness scores, successfully contained the 2024 Marburg virus disease outbreak[28], illustrating how accumulated operational experience and regional coordination can substantially reinforce response capacity. These examples illustrate the broader evolution of epidemic preparedness across Africa. Repeated responses to Ebola, Marburg virus disease, Sudan virus disease, mpox and cholera, as well as the COVID-19 pandemic experience, have progressively strengthened surveillance, laboratory capacity, emergency operations, and regional coordination, demonstrating the continent's expanding capacity to control epidemics[29]. The ongoing Bundibugyo outbreak nevertheless highlights that important heterogeneities persist, emphasizing the need to sustain preparedness investments while prioritizing countries where high importation risk coincides with lower readiness.

Our findings are broadly consistent with the current operational prioritization[30] coordinated by WHO and Africa CDC, with a few important differences. South Sudan, Burundi and Rwanda, currently classified as Priority 1 countries, all emerged among the countries at highest importation risk in our analysis. Ethiopia, Kenya, Tanzania, Zambia, Angola and the Central African Republic, all classified by WHO as Priority 2, were here identified as high-risk destinations. The main exceptions were the Republic of the Congo and Somalia, both classified as Priority 2 but estimated to have low and intermediate-low importation risk in our analysis, respectively. The Republic of the Congo ranked low because the currently affected areas are geographically distant from its borders and therefore contribute little to regional dissemination through land mobility. Somalia, despite being relatively more connected by air than by land, has

limited overall connectivity with the affected areas compared with other Priority 2 countries. Conversely, South Africa and Nigeria, although classified as Priority 3 countries by WHO (together with all remaining Member States), were estimated to have a high importation risk despite their greater geographical distance from the outbreak source, reflecting their strong long-range air connectivity. Beyond the identification of countries at highest risk, our quantitative estimates of importation risk also allow preparedness priorities to be refined further. Botswana, Burkina Faso, Cameroon, Chad, and Ghana emerged as a second tier of priority countries, combining intermediate-high importation risk with important preparedness gaps. Strengthening surveillance and response capacities in these settings could further reduce the risk of regional amplification should the outbreak continue to expand.

The observed geography of importation risk reflects the complementary roles of land and air mobility in regional dissemination. Land mobility dominated the overall pattern of importation risk, generating a strong spatial concentration of risk around the outbreak source that progressively declined with increasing border distance. However, geographical proximity alone was insufficient to identify countries at highest risk. As illustrated by the Republic of the Congo, neighbouring countries can differ substantially in exposure depending on the location of the affected areas and their connectivity through regional mobility. For example, under the outbreak amplification scenario in Kinshasa, the Republic of the Congo entered the high-risk group because epidemic expansion into a densely populated area near its borders substantially increased its exposure. Preparedness priorities can therefore rapidly shift as the epidemic expands geographically. The strong dependence on the heterogeneous spatial distribution of epidemic activity and population size may also explain the discrepancies with recent modeling estimates[8] of cross-border spillover, which classified Rwanda and Burundi as low- and very-low-risk countries, respectively. By explicitly accounting for high-resolution spatial heterogeneity, together with geographically explicit travel times adjusted for conflict, our framework identifies a different pattern of regional dissemination risk. Beyond this strong local component, air transportation remained an important driver of long-range dissemination, elevating the importation risk of countries such as Ethiopia, South Africa, and Nigeria despite their greater border distance from the outbreak source. Regional importation risk cannot therefore be inferred from geographical proximity alone, and – even beyond neighboring countries – analyses based exclusively on air transportation[12] fail to capture the full geography of regional dissemination. Disentangling air- and land-mediated risk is also operationally relevant, because these pathways require different preparedness measures: air-mediated risk points to surveillance at major air transport hubs, whereas land-mediated risk calls for strengthened detection along formal and informal cross-border land mobility corridors.

The outbreak amplification scenarios highlight that preparedness priorities should remain dynamic. The highest-risk countries remained largely unchanged, reinforcing the need for

sustained investments in preparedness capacities in these settings. However, epidemic expansion into major regional hubs brought additional countries into the high-risk group. These countries should therefore be considered potential priority targets should the epidemic evolve. Moreover, amplification would substantially increase continental importation pressure, highlighting the importance of anticipating epidemic spread beyond the initial outbreak area. In the absence of licensed vaccines and specific therapeutics against Bundibugyo Ebola virus, strengthening surveillance, laboratory capacity, infection prevention and control, contact tracing, risk communication, and cross-border coordination remains the cornerstone of preparedness[7].

This study has limitations. First, reliable data on cross-border land mobility in Africa remain scarce. We therefore estimated land mobility from the best available continental dataset, combining multiple mobility sources and deriving land movements as the residual after discounting commercial air travel. Although uncertainty remains, sensitivity analyses reducing land mobility by 66% and 90% produced only limited changes in country rankings, supporting the robustness of our findings. Second, land-mediated importation risk was estimated assuming an average travel duration of 8h per day, and analyses were restricted to contiguous Africa because comparable data on maritime mobility are not available. Alternative travel durations produced no changes in the estimated geography of risk. Third, air-mediated importation risk only considered commercial passenger flights and did not account for humanitarian, military, or charter flights. Fourth, both epidemiological and behavioural uncertainties remain. We assumed that infected individuals travelled only during the latent phase, consistent with the rapid onset of symptoms and progressive clinical deterioration characteristic of Ebola virus disease. However, some individuals with early or mild symptoms may still travel before seeking care, particularly over shorter distances, potentially increasing importation risk to more distant destinations. We also assumed homogeneous travel behaviour and exposure risk across travellers, although age, occupation, socioeconomic conditions, purpose of travel, and individual exposure may modify infection risk, as illustrated by the imported case in France involving a medical doctor working in the response[2]. Similarly, geographically heterogeneous under-ascertainment is difficult to quantify. We therefore used the proportion of investigated alerts as a proxy for reporting rates by health district, and found the results to be robust to alternative assumptions. Finally, we did not explicitly model behavioural adaptations or the impact of border control measures. While some border restrictions were implemented during the current outbreak, independent mobility data suggested no measurable change in cross-border movements. Moreover, evidence from previous Ebola outbreaks highlights that travel restrictions have limited impact on spatial dissemination while potentially hampering response activities[5].

Our findings demonstrate that the geography of regional Ebola risk in Africa is more complex than proximity to the outbreak alone, emerging from the interplay of local epidemic activity with land and air mobility mediated by geographic accessibility. Our approach provides an operational framework for refining preparedness priorities, updating them as outbreaks evolve and medical countermeasures become available, and anticipating changes before regional dissemination accelerates.

AUTHORS' CONTRIBUTION

VC and EV conceived and designed the study. VC supervised the research. FF, FP, BW, MAP collected and analyzed the data. EV, FP, VC developed the analytical framework. FF developed the conflict-adjusted travel-time framework. FF, FP, BW wrote the code and performed the risk analysis. FF, FP, MAP, BW, YB, MF, PM, RLO, VR, YY, CP, EV, VC contributed to the methodology. FF, BW, MAP produced the figures. FF, FP, MAP, BW, YB, MF, PM, RLO, VR, YY, CP, EV, VC interpreted the results. CP, VC wrote the Article. All authors contributed to and approved the final version of the Article.

DECLARATION OF INTEREST

We declare no competing interest.

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FIGURES

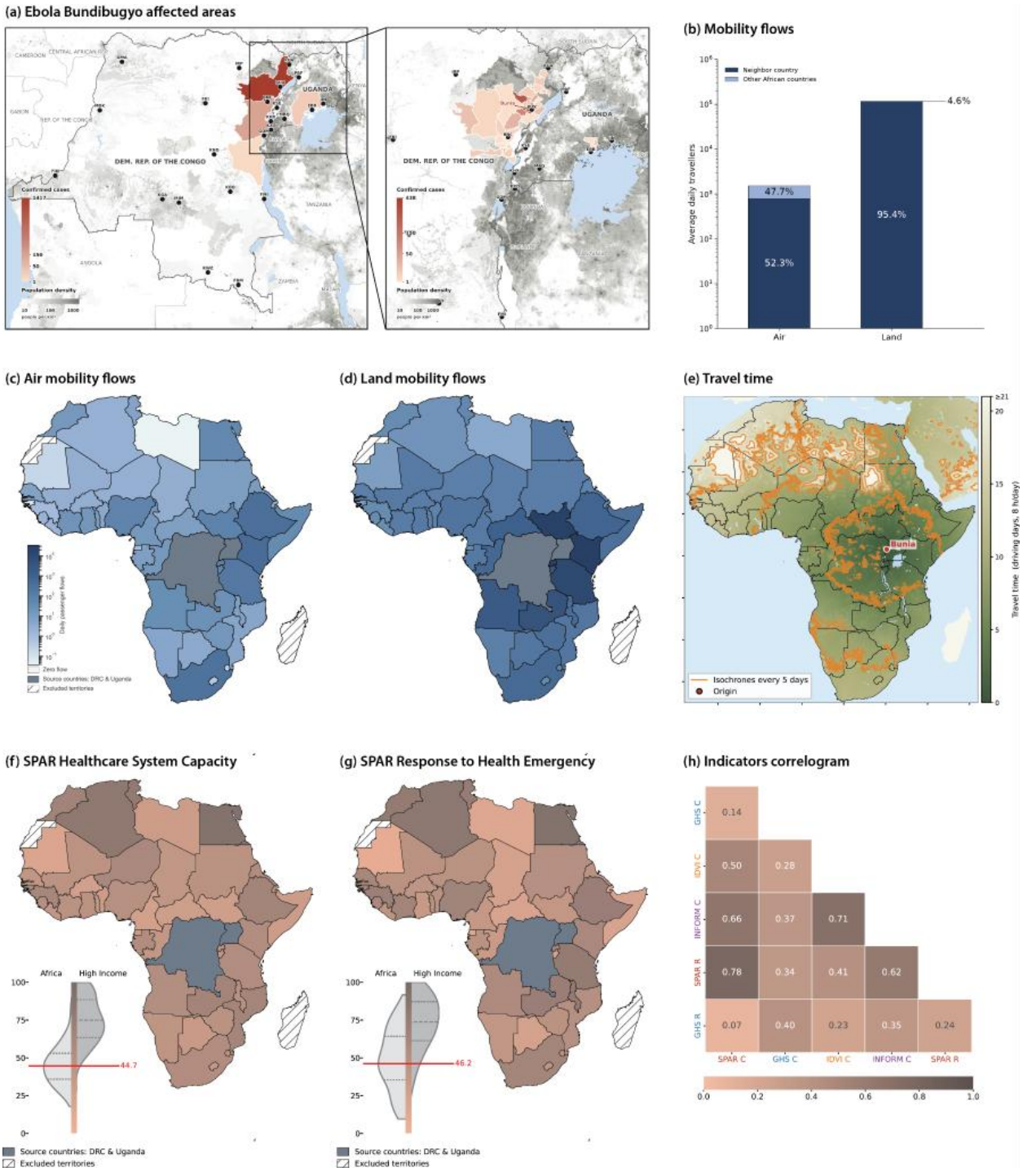

Figure 1. Epidemiological context, mobility flows, travel time, and preparedness indicators. **(a)** Spatial distribution of reported Bundibugyo Ebola-affected areas in the Democratic Republic of the Congo and Uganda, with the inset showing the affected area in greater detail. The color

code indicates the cumulative number of confirmed cases per affected health district (DRC) and ADM3 unit (Uganda), overlaid on population density (grey). **(b)** Average daily outbound mobility flows from the DRC and Uganda, stratified by travel mode and by neighboring vs. other African countries. **(c, d)** Average daily air (c) and land (d) mobility flows from the DRC and Uganda to African countries, on a logarithmic colour scale. Source countries are shown in grey, and countries with zero flow are indicated separately. Excluded islands and territories are shown with hatching. **(e)** Estimated overland travel time from the outbreak source expressed in driving days assuming 8 hours of travel per day; isochrones are shown for every five days. The map shows the example of travel time from Bunia, the health district with the largest activity as of 4 July 2026. Travel time was computed from all affected health districts and ADM3 in DRC and Uganda. **(f, g)** Country-level readiness scores based on SPAR healthcare system capacity (f) and SPAR preparedness and response to health emergencies (g); the inset violin plots compare the distribution of indicator values across African and high-income countries, and the red line marks the median across African countries. Excluded islands and territories are shown with hatching. **(h)** Correlation matrix of selected healthcare system capacity (C) and emergency response (R) indicators derived from the SPAR, GHS, IDVI, and INFORM frameworks, computed across the African countries.

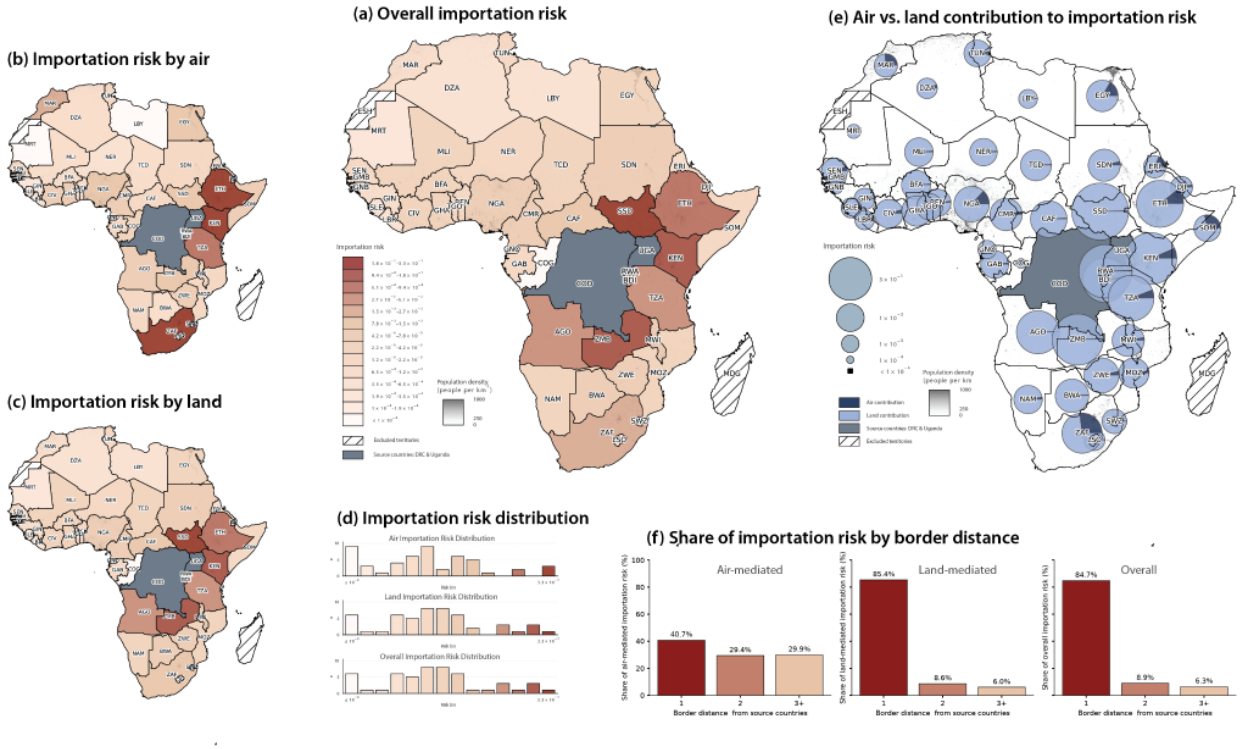

Figure 2. Importation risk of Bundibugyo Ebola across African destination countries under the current epidemic spread. (a) Overall importation risk from the Democratic Republic of the Congo (DRC) and Uganda to each African country, coloured on a categorical logarithmic scale, with population density shown in grey in the background. **(b, c)** Importation risk from the DRC and Uganda to each African country decomposed into (b) air-mediated and (c) land-mediated importation risk, shown on the same scale as panel (a). **(d)** Distribution of importation risk considering air-mediated risk (top), land-mediated risk (center), and overall risk (bottom). The y-axis gives the number of countries (n) in each bin. **(e)** Overall importation risk (coded by the circle size) per country along with its relative contribution of air and land mobility pathways (pie shares with dark blue indicating air mobility and light blue indicating land mobility). Population density is shown in grey in the background. **(f)** Share of importation risk by border distance from the source countries, shown separately for the air-mediated risk, land-mediated risk, and overall risk. Border distance is the smallest number of border crossings from the source countries (either DRC or Uganda) to the destination country. In all maps, source countries (DRC and Uganda) are shown in grey, and excluded islands and territories are shown with hatching.

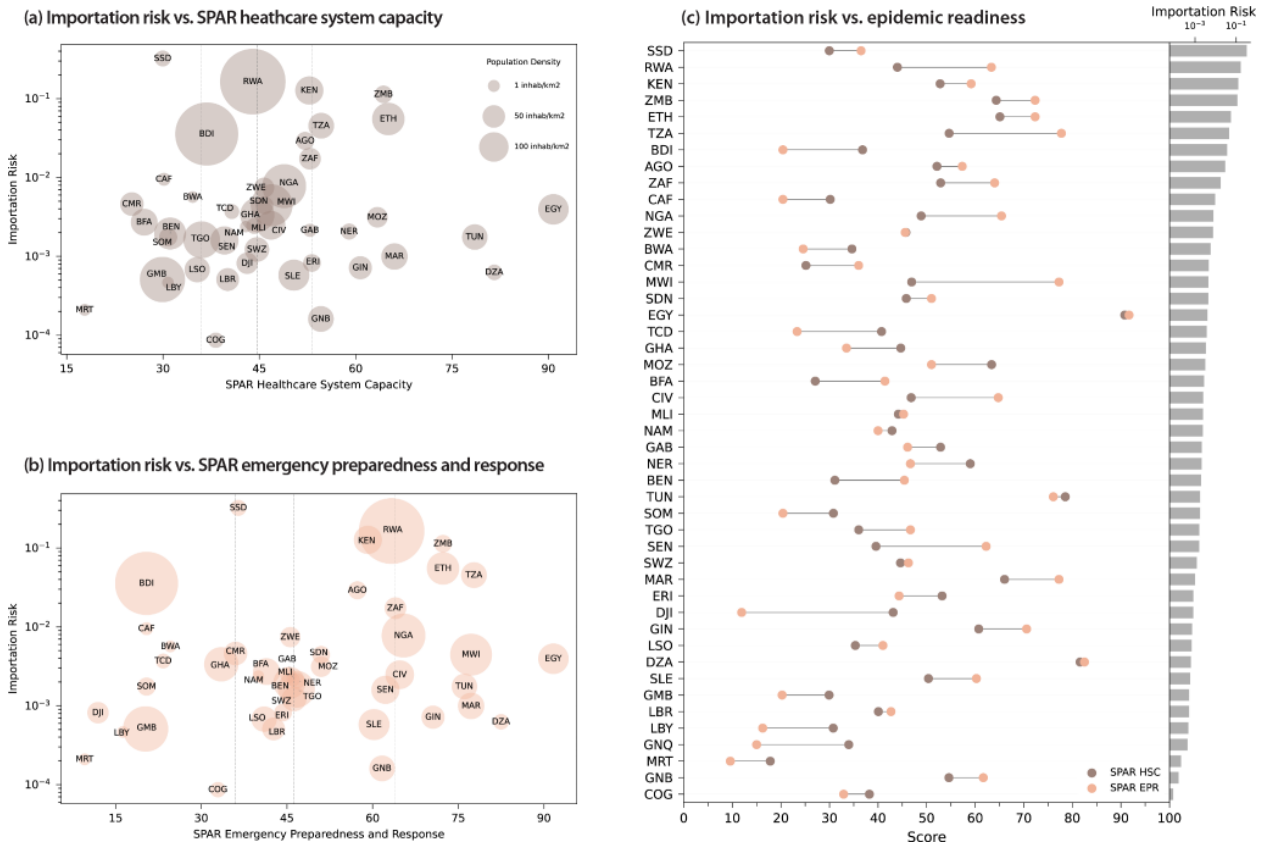

Figure 3. Importation risk as a function of country readiness. (a, b) Scatter plots of overall importation risk versus SPAR Healthcare System Capacity (a) and SPAR Emergency Preparedness and Response (b) scores. The y-axis is displayed on a logarithmic scale. Circle size is proportional to the population density of each country. The three vertical dashed grey lines indicate the 25th, 50th (median), and 75th percentiles of the corresponding SPAR epidemic readiness dimension. **(c)** SPAR Healthcare System Capacity and SPAR Emergency Preparedness and Response scores for African countries ranked by overall importation risk (from highest risk at the top, to lowest risk at the bottom). The corresponding risk values are shown in the inset bar plot on the right, whose risk axis is displayed on a logarithmic scale.

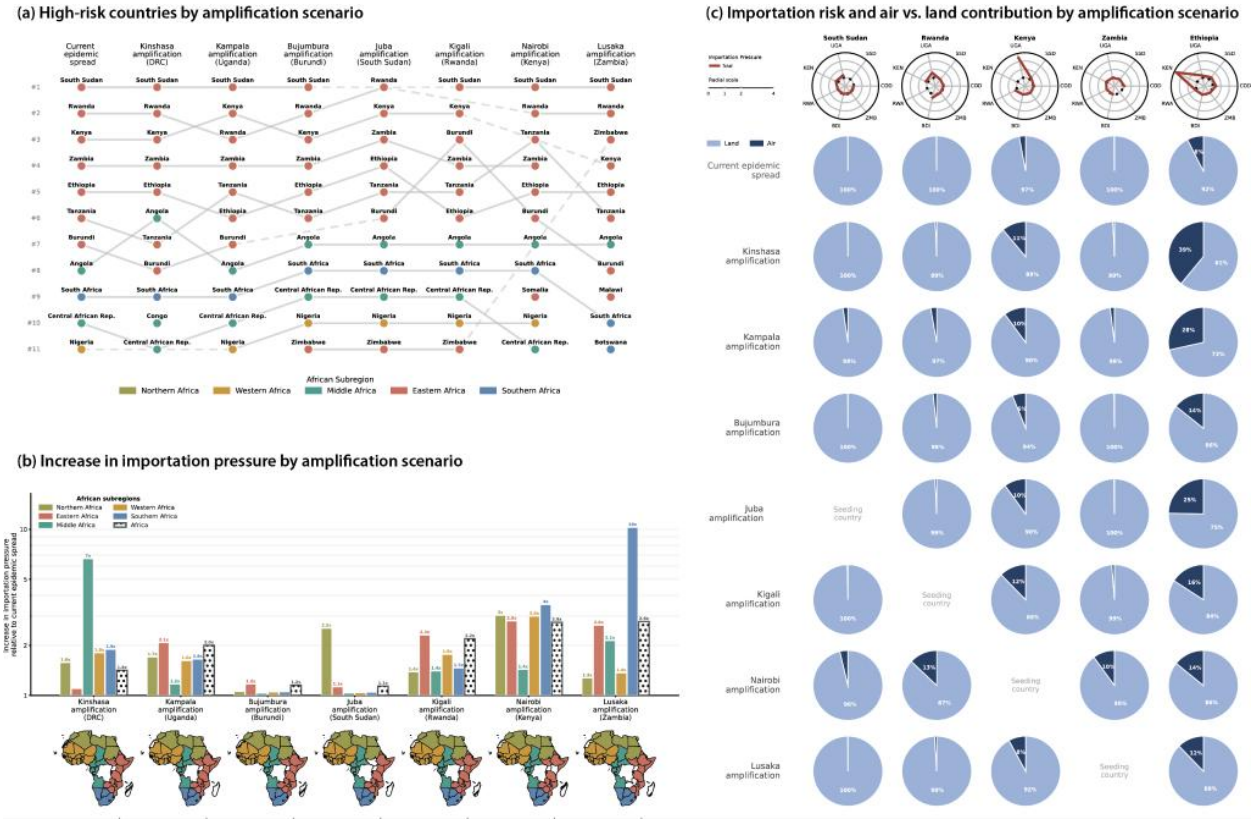

Figure 4. Importation risk and importation pressure to African countries and subregions across different amplification scenarios. Scenarios include the capital cities of the two currently affected countries (DRC, Uganda) and the capitals of neighboring countries scoring highest in importation risk. Bujumbura was selected instead of Gitega as it is the economic capital and largest city of Burundi. **(a)** The bump chart shows the change of the rank of high-risk countries (n=11) under the current epidemic spread (first column) and the amplification scenarios. Dots are colored according to subregions. **(b)** Increase in Ebola Bundibugyo overall importation pressure to African subregions under the outbreak expansion scenarios, relative to the current epidemic spread. The dotted bar represents the overall increase for the African continent. The maps show the subregions definitions and the seeding countries (in white) in each scenario. **(c)** Top row: Radar plots showing the change of overall importation pressure across each amplification scenario relative to the current epidemic spread for the 5 highest-risk countries. Second to ninth row: Pie charts indicating the relative contributions of land and air to the overall importation pressure for these countries, under the current epidemic spread (second row) and under each amplification scenario (from third to ninth row).