JOURNAL OF VETERINARY AND APPLIED SCIENCES
VOLUME 16, ISSUE 2: 1534 – 1552 (2026)
Published by: Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria
ISSN: 2315-6856; e-ISSN: 2636-5553; Website: www.jvasonline.com

Evolving epidemiological patterns of Ebola virus disease in the Democratic Republic of Congo: Implications for preparedness and One Health systems in Africa – A review

Patricia I. Otuh* [1, 2], Ifeoma V. Ugwueke [1], Udoka C. Unigwe [1], Reginald I. Igwe [3], Anna E. Nwaezza Ugwu [4], Nnenna M. Otta [5]

[1] Department of Public Health, Faculty of Allied Health Sciences, David Umahi Federal University of Health Sciences, Uburu, Nigeria.

[2] Institute of One Health for Zoonotic Disease Research and Animal Production, David Umahi Federal University of Health Sciences, Uburu, Nigeria.

[3] Department of Biochemistry and Animal Production, College of Veterinary Medicine, Michael Okpara University of Agriculture Umudike, Nigeria.

[4] Department of Public Health, Ahmadu Bello University, Zaria, Nigeria.

[5] Department of Community Medicine, Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Nigeria.

==========

Abstract

Ebola virus disease (EVD) remains one of the most significant emerging zoonotic threats in sub-Saharan Africa, with recurrent outbreaks continuing to challenge regional health security, economic stability and public health preparedness, culminating in topical global health concern. This review examines the historical background of the previous and current outbreaks, the evolving epidemiological trends, transmission dynamics of zoonotic and human to human transmissions, preparedness gaps challenging health system, and One Health implications of Ebola virus disease across Africa with emphasis on Nigeria and Democratic Republic of Congo (DRC). The findings highlighted indicate that reactive outbreak responses alone are insufficient for long-term epidemic prevention. Sustainable control of EVD and other emerging zoonotic diseases in Africa will require sustained political commitment, nationally driven preparedness programmes, resilient health systems, scientific investment, regional collaboration and fully operational One Health implementation frameworks capable of supporting early detection, rapid response and long-term public health resilience.

Keywords: Ebola virus disease; Zoonosis; One Health approach; Outbreak preparedness; Sub-Saharan Africa; Global health security.

*** Correspondence:** Patricia I. Otuh; Email: otuhpi@dufuhs.edu.ng; Phone: +2348037509237

Article History: Initial manuscript submission received – June 02, 2026; Final revised form received – June 18, 2026; Accepted for publication – June 23, 2026; Published – July 01, 2026.

Introduction

Recent outbreaks of Ebola virus disease (EVD) in the Democratic Republic of the Congo (DRC) and Uganda have escalated into a major public health threat for sub-Saharan Africa. The severity of this regional disease resurgence prompted the Africa Centres for Disease Control and Prevention (Africa CDC) to declare a Public Health Emergency of Continental Security on 18 May 2026, followed shortly by the World Health Organization's (WHO) designation of the outbreak as a Public Health Emergency of International Concern (PHEIC) (ACDC, 2026; Baraniuk, 2026; WHO, 2026). As observed in previous epidemics, this renewed EVD crisis has intensified regional concern, driven by the continued weakness of health systems across sub-Saharan Africa (Mulenga-Cilundika *et al*., 2022). In Africa, national health systems remain constrained by chronic underfunding, weak diagnostic and surveillance capacity, as well as inadequate epidemic preparedness infrastructure (Oleribe *et al*., 2019). These institutional lapses are further compounded by shortages in the health workforce, sub-optimal infection prevention and control (IPC) practices, and limited access to intensive and critical care services (Armstrong-Mensah *et al*., 2025). These deficits significantly impair the capacity of many countries to rapidly detect, contain, and respond effectively to highly infectious diseases such as EVD.

In Nigeria, Africa's most populous country and a major regional transportation hub, these vulnerabilities remain particularly relevant. Although the 2014 EVD outbreak was successfully contained through rapid contact tracing and coordinated public health interventions, underlying systemic weaknesses persist (Oleribe *et al*., 2015; Fawole *et al*., 2017; Oleribe *et al*., 2019). These include recurrent health worker strikes, inadequate funding for health systems, overcrowded tertiary health facilities, limited rural health access, weak sub-national surveillance systems and dependence on external outbreak response financing (O'Sullivan *et al*., 2020). In addition, rapid urbanization, porous borders, insecurity, and socioeconomic disparities further increase the risk of rapid disease transmission, underscoring Nigeria's continued vulnerability to cross-border epidemics (Aliyu and Amadu 2017).

Since its first identification in 1976, EVD has been characterized as a sporadic zoonotic disease affecting rural populations in Central Africa and historically controlled through isolation, barrier nursing and contact tracing (Laupland and Valiquette, 2014; IRC, 2026). However, socioecological, environmental, and political changes in the DRC have significantly altered transmission dynamics, reducing the effectiveness of traditional containment strategies (Sikakulya *et al*., 2019). The DRC has increasingly become the epicentre of recurrent EVD outbreaks, particularly following the large-scale 2018–2020 Kivu epidemic, which was the second largest recorded outbreak with over 3,400 cases and sustained transmission across multiple provinces (Park *et al*., 2026). This evolving epidemiological pattern is further demonstrated by the ongoing 2026 outbreak, caused by Bundibugyo ebolavirus and centred in Ituri Province, with rapid spread into North and South Kivu and documented cross-border transmission into Uganda (WHO, 2026). Unlike previous outbreaks caused by Zaire ebolavirus, for which the rVSV-ZEBOV vaccine (Ervebo) and monoclonal antibody therapies are effective, no licensed vaccines or widely available specific therapeutics currently exist for Bundibugyo ebolavirus (Kupferschmidt, 2026; WHO 2026).

The persistence and recurrence of EVD in the DRC signals a broader epidemiological transition from isolated zoonotic spillover events to a sustained regional public health security threat. This shift is driven by interacting factors including viral persistence in human reservoirs, armed conflict,

population displacement, environmental degradation, fragile health systems, and increased human-wildlife interface (Sah *et al*., 2022). These recurring outbreaks highlight the limitations of reactive outbreak response strategies and underscore the need for integrated, preventive and sustainable preparedness approaches.

This review examined the historical evolution and shifting epidemiology of EVD in Africa, identified systemic surveillance gaps contributing to regional spillover risk, and assessed cross-border vulnerability in high-risk countries such as Nigeria. To mitigate future resurgences, a transition from reactive epidemic response to a proactive One Health framework is required, which will integrate human health surveillance, wildlife monitoring, community engagement and health system strengthening to enhance regional epidemic resilience**.**

Research Methodology

An organized literature search was done by the authors to compile data on the epidemiology and history of Ebola virus disease, systemic factors causing its re-occurrence, zoonotic transmission dynamics, surveillance challenges and implication for One health approach in the prevention and control of Ebola disease in DRC epicentre and other African regions. The literature search for this review were publications from 2015 to 2026 covering the current Ebola outbreak situation in DRC and Uganda as well as other countries that had the outbreak in the past. Several databases such as African Journals Online (AJOL), Elsevier, Google Scholar, PubMed, Scopus were employed for the search while keywords included Ebola Virus disease, DRC, Nigeria, Uganda, epidemiological trends, zoonotic disease, Health system, surveillance, transboundary infectious disease, One Health approach. More information was gathered from websites of international and regional organizations such as Africa CDC, CDC, WHO, MSF and online bulletins of health organizations. Documents utilized for this review were peer-reviewed journal articles, online textbooks, bulletin publications, conference proceedings, books of abstracts and scientific monographs. Materials not within the context of Ebola disease in Africa were excluded from the study.

Historical and epidemiological trends of Ebola virus disease outbreaks in the Democratic Republic of Congo

Ebola virus disease (EVD) remains one of the most significant viral hemorrhagic fevers affecting sub-Saharan Africa, with the DRC recording more outbreaks than any other country since the virus was first identified in 1976 (CDC 2025; WHO 2026). To understand the current epidemiological landscape of EVD in the DRC, it is essential to situate the disease within its historical context (Figure 1). The epidemiology of EVD in the DRC can be categorized into three phases: the classical era of isolated rural outbreaks of 1976 – 2014, the conflict-associated urban transmission phase of 2018 – 2020, and the contemporary phase characterized by increasingly frequent and heterogeneous resurgences of 2021 – 2026 (Kavulikirwa and Sikakulya, 2022; CDC 2025, WHO 2026).

The first recognized outbreak occurred in August 1976 in Yambuku, Équateur Province. The index case presented with a febrile illness initially misdiagnosed as malaria, and the outbreak subsequently resulted in 318 cases with an estimated case fatality rate (CFR) of approximately 88% (CDC, 2025). Transmission was amplified in healthcare settings through re-use of contaminated medical equipment at the Yambuku Mission Hospital, underscoring early weaknesses in Infection Prevention and Control (IPC) systems that would persist across subsequent outbreaks (Breman and Johnson, 2014). Following a small cluster in Tandala in

1977, the country experienced a prolonged period of epidemiological latency until the 1995 outbreak in Kikwit, Bandundu Province. This event represented a major epidemiological transition, marking the first large infiltration into a semi-urban setting and resulting in 315 cases and 250 deaths (Muyembe-Tamfum *et al*., 2012). Over the next two decades, intermittent outbreaks occurred in Mweka (2007; 2008 – 2009), Isiro (2012), caused by Bundibugyo ebolavirus, and Boende (2014), the latter occurring independently of the West African Ebola epidemic (Hulseberg *et al*., 2021; CDC, 2025). Outbreaks during the classical period were largely confined to remote forested regions and were categorized by self-limiting transmission dynamics determined by geographic isolation. Control was generally achieved through conventional public health interventions such as barrier nursing, quarantine and safe burial practices (Ojoma *et al*., 2020). This pattern of EVD as a sporadic and containable zoonotic disease was basically interrupted by the 2018 – 2020 Kivu epidemic in eastern DRC which is marked as the country's tenth recorded epidemic, occurring in North Kivu, South Kivu, and Ituri provinces amid armed conflict, population displacement and mistrust of health authorities. It became the second-largest EVD outbreak in history, with 3,470 cases and 2,287 deaths (CFR: 66%) (Guetiya Wadoum *et al*., 2021). Unlike earlier outbreaks, transmission extended into densely populated urban centres such as Beni, Butembo and Goma, with cross-border spread into Uganda. This period also marked a major advancement in countermeasures, including deployment of the rVSV-ZEBOV vaccine and monoclonal antibody therapies (mAb114 and REGN-EB3), which improved survival but were insufficient to fully interrupt transmission due to insecurity and operational constraints (Kikwango *et al*., 2025). In the post-Kivu period (2021 – 2025), the epidemiological pattern of EVD in the DRC shifted towards shorter inter-epidemic intervals and recurrent restricted outbreaks across North Kivu, Équateur and Kasai Provinces (WHO, 2025). Genomic and spatial investigations by the Institut National de Recherche Biomédicale (INRB) suggested that several resurgences were not solely the result of zoonotic spillover, but were also linked to viral persistence in immune-privileged sites among survivors, highlighting an important mechanism in post-outbreak transmission dynamics (Fairhead *et al*., 2021; Kinganda-Lusamaki, *et al*., 2021; Park *et al*., 2026).

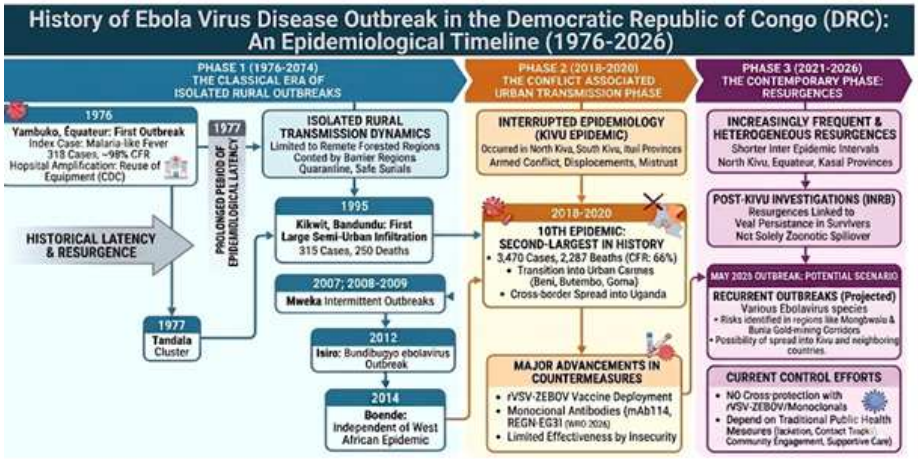

Figure 1. The epidemiological evolution of Ebola virus disease in the Democratic Republic of Congo (DRC), a three-phase flowchart timeline of outbreaks, transmission dynamics, and countermeasures (1976 – 2026).

This evolving pattern culminated in the recent outbreak reported on 15 May 2026, declared by the WHO as a public health emergency of international concern (PHEIC), representing the seventeenth documented EVD outbreak in the DRC (WHO, 2026). The outbreak is predominant around the gold-mining areas of Ituri Province, including Mongbwalu and Bunia, and rapidly spreading into North and South Kivu, led to cross-border transmission into Uganda (ACDC, 2026, WHO 2026). The concern raised by the current outbreak of Bundibugyo ebolavirus is the non-possession of cross-protective efficacy with available rVSV-ZEBOV vaccine and monoclonal antibody treatments, which points to the dependence of control efforts mainly on traditional public health measures such as isolating cases, contacts tracing, engaging communities and providing supportive medical care (MSF, 2026).

Systemic causes of sustained Ebola virus transmission across the Democratic Republic of the Congo and Uganda

The recurrent EVD outbreaks in the DRC and spillover into Uganda represent a persistent regional public health threat rather than isolated epidemiological events and highlights weaknesses in outbreak preparedness and response systems across sub-Saharan Africa (Kavulikirwa and Sikakulya, 2022). The recent resurgence of Ebola in May 2026, alongside rapid cross-border transmission, reflects a more complex interplay of determinants beyond viral pathogenicity alone (IMC, 2026). These outbreaks are sustained by interconnected ecological exposures, fragile healthcare systems, socio-political instability, and weak public health governance structures (Mukadi-Bamuleka *et al*., 2024).

Across many EVD-endemic settings, healthcare systems remain chronically underfunded, with inadequate laboratory infrastructure and weak epidemiological surveillance, leading to delayed case detection and slow outbreak response (Oleribe *et al*., 2019). Early clinical manifestations of EVD closely resemble common febrile illnesses such as malaria, typhoid fever, yellow fever, leptospirosis, shigellosis, meningitis and other viral haemorrhagic fevers, frequently resulting in misdiagnosis and delayed containment (WHO, 2025). Consequently, healthcare facilities often become amplification points for transmission when IPC measures are insufficient or inconsistently applied (Baller *et al*., 2022). Limited access to personal protective equipment, inadequate workforce training and overstretch of health personnel further increase the risk of nosocomial transmission and institutional breakdown during outbreaks (Webber *et al*., 2015; Baller *et al*., 2022). These factors collectively demonstrate that recurrent EVD outbreaks reflect broader systemic weaknesses in health security and governance rather than purely biological events.

Recent advances in filovirus genomics have further reshaped understanding of Ebola epidemiology. Emerging evidence indicates that the virus can persist in immunologically sequestered sites such as the testes, ocular tissues and central nervous system of survivors, enabling possible delayed viral reactivation and sexual transmission long after clinical recovery of patients (Zeng, 2017; Di Paola *et al*., 2020). Ecological drivers remain equally critical, as the Congo Basin serves as a natural reservoir for filoviruses, with dense forest ecosystems supporting zoonotic hosts such as bats, with increasing human encroachment through deforestation, artisanal mining, agricultural expansion and bushmeat hunting, causing continued intensification of human-wildlife contact and elevated spillover risks (Hussein, 2023). Although vaccines and monoclonal antibody therapies have improved outcomes for some ebolavirus species, substantial biomedical gaps remain for others, including Bundibugyo

ebolavirus, for which no widely accessible licensed vaccines or therapeutics exist (Iversen *et al*., 2020; WHO 2026).

Sociopolitical instability in eastern DRC further exacerbates transmission dynamics by disrupting surveillance systems, limiting humanitarian access, and weakening vaccination and response efforts (Masumbuko Claude *et al*., 2019). Armed conflict drives population displacement into overcrowded settlements with poor water, sanitation and hygiene (WASH) infrastructure, thereby accelerating viral spread (Marou *et al*., 2024; Beck *et al*., 2025; UNICEF, 2026). Highly mobile populations engaged in cross-border trade and informal migration facilitate transmission between rural spillover zones and urban centres. In addition, entrenched mistrust of health authorities, rooted in historical marginalization and misinformation, continues to hinder outbreak control by delaying healthcare seeking, resisting contact tracing and sustaining household transmission (Vinck *et al*., 2019).

The recurring nature of Ebola virus disease outbreaks underscores the insufficiency of reactive emergency responses alone. Countries in sub-Saharan Africa, including Nigeria, remain vulnerable due to porous borders and rapid urbanization despite previous containment successes (Onyekuru *et al*., 2023). Sustainable health security therefore requires a fully integrated One Health approach that strengthens collaboration across human, animal and environmental health systems. Long-term domestic investment in health infrastructure, enhanced cross-border surveillance coordination, community-centered risk communication and sustained trust-building are essential for improving preparedness, resilience and future outbreak prevention.

Ecological disruption, human activities and zoonotic transmission dynamics in EVD resurgence

Zoonotic transmission constitutes the primary mechanism by which EVD is introduced into human populations (Jacob *et al* 2020). Ebola viruses are maintained in animal reservoirs within tropical forest ecosystems, with growing evidence identifying fruit bats as the most likely natural hosts (Caron *et al*., 2018). Spillovers occur when humans come into direct or indirect contact with infected wildlife, contaminated tissues or body fluids, enabling cross-species transmission (Ellwanger and Chies, 2021). The ecological landscape of Central and West Africa, particularly the Congo Basin, provides highly suitable conditions for such zoonotic emergence due to dense biodiversity and extensive human-wildlife interfaces (Kuisma *et al*., 2026). Countries such as the DRC and Uganda, with vast rainforest ecosystems, support diverse species including bats, non-human primates, antelopes and other mammals involved in Ebola transmission cycles (Sospeter *et al*., 2023). Human activities that increase exposure to these environments significantly elevate spillover risk (Figure 2).

Fruit bats of the Pteropodidae family are widely regarded as the most probable natural reservoirs because they can carry the virus asymptomatically while shedding it through saliva, urine, faeces and partially eaten fruits (Olivero *et al*., 2020). Human infection may occur through hunting, preparation, and consumption of bushmeat or contact with contaminated environmental surfaces (WHO, 2026). Many index cases in outbreak investigations have been linked to forest exposure, wildlife handling or carcass contact (Rulli *et al*., 2017). Non-human primates such as chimpanzees and gorillas function as incidental hosts rather than reservoirs, often dying rapidly after infection, yet still serving as sources of human infection through hunting and butchering practices (Hayma, 2019).

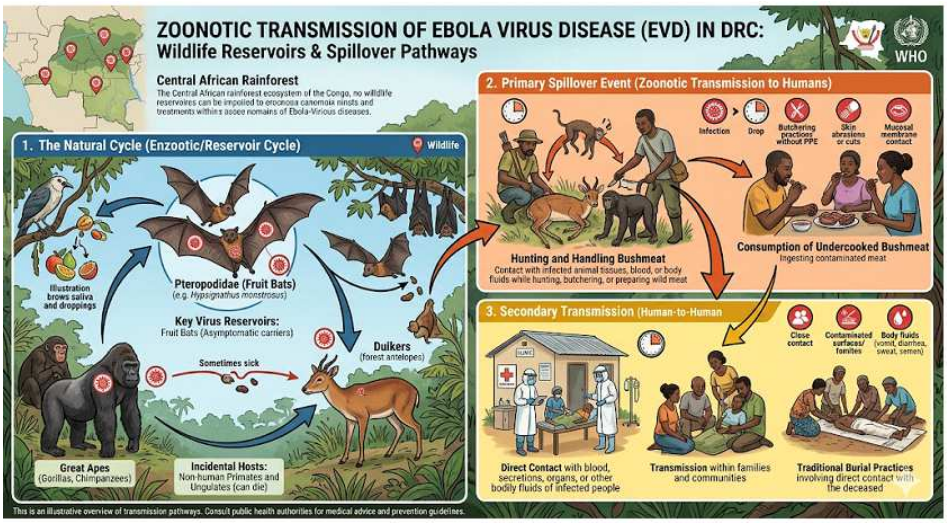

Figure 2. Zoonotic spillover pathways and transmission dynamics of Ebola virus disease (EVD) in the Democratic Republic of the Congo.

Environmental and anthropogenic pressures further intensify zoonotic risk of Ebola disease in humans (Segala *et al*., 2025). Anthropogenic activities like deforestation, mining, agricultural expansion, urban encroachment and climate-driven ecological changes increase human intrusion into wildlife habitats and in Eastern DRC, artisanal mining and conflict-driven displacement push populations deeper into forested areas, increasing contact with potential reservoir species (Baranowski and Bharti, 2026). These spillover events often occur in remote regions with weak surveillance and limited healthcare access, allowing early transmission to go undetected and spread to occur before containment measures are implemented, and once established in humans, the Ebola virus spreads through direct contact with infected body fluids, transforming isolated spillover events into wider outbreaks (David *et al*, 2016).

Although genomic and epidemiological evidence suggests that outbreak recurrence may also involve viral persistence in survivors, zoonotic transmission remains the principal pathway of Ebola emergence (Goldstein *et al*., 2020). Therefore, for a sustainable effective prevention of Ebola disease, One Health approach should be incorporated into health systems, integrating human, animal and environmental health systems. Key strategies include strengthened wildlife surveillance, regulation of bushmeat trade, ecological monitoring, improved community education and enhanced preparedness systems to reduce future spillover risk in sub-Saharan Africa**.**

Ebola virus disease surveillance challenges in sub-Saharan Africa

It has been constantly emphasized that effective surveillance remains a central pillar in the prevention, early detection and containment of emerging and re-emerging infectious diseases, especially the ravaging EVD outbreaks (Woolhouse *et al*., 2015; Dahl *et al*., 2024). However, across sub-Saharan Africa, structural, operational, socioeconomic and geopolitical constraints continue to undermine surveillance effectiveness, contributing to delayed detection and recurrent epidemic amplification (Moyo *et al*., 2023). A major challenge continues to be the fragility of healthcare systems in many outbreak-prone countries, including the DRC,

Uganda, South Sudan and Nigeria, where chronic underfunding limits infrastructure, training of personnel, IPC capacity and reliable reporting systems (Oleribe *et al*., 2019; Lowe *et al*., 2024). In such settings, early EVD cases are frequently misdiagnosed as malaria, typhoid fever, or other endemic febrile illnesses, allowing undetected community transmission before alerts are raised (Hsu *et al*., 2018).

A further limitation to the control of EVD in Sub-Saharan Africa is inadequate laboratory diagnostic capacity (Presser *et al*., 2021). Reports have it that confirmatory Ebola virus disease testing relies on molecular tools such as reverse transcription polymerase chain reaction (RT-PCR), yet laboratory services are often centralized in urban areas (Muzembo *et al*, 2022; Bettini *et al*., 2023). In remote regions, insecurity, weak transport networks and logistical constraints delay sample transport and result turnaround, thereby slowing isolation, contact tracing and outbreak containment (Gonzalez *et al*., 2026). Additionally, community-based surveillance systems are weak, particularly in remote forest settlements where community health workers are often under-trained, under-paid, and poorly supported (Alhassan and Wills, 2024). Inadequate risk communication, misinformation and deep-seated mistrust of authorities have been reported to further reduce community engagement because in several outbreaks, fears of political manipulation or harmful interventions, alongside traditional burial practices are known to delay reporting and reduce cooperation with surveillance teams (Koren and Weidmann, 2025).

Insecurity and armed conflict, particularly in Eastern DRC, further disrupt surveillance through attacks on health facilities, population displacement and restricted humanitarian access, creating epidemiological blind spots where transmission persists undetected (Yokolo *et al*., 2025). Equally, cross-border mobility through porous borders between countries such as the DRC and Uganda also complicates surveillance due to informal migration, trade and limited harmonization of regional data-sharing systems (Bedford and Akello, 2018). Complicating these challenges, surveillance across the regions remains largely reactive rather than proactive, with limited investment in inter-epidemic preparedness, genomic surveillance, wildlife monitoring and early warning systems (Hamza *et al*., 2025).

Emerging evidence of Ebola viral persistence in immune-privileged sites in the body systems such as testes (semen), eyes (ocular fluid) and the central nervous system further confound surveillance, as flare-ups may occur long after outbreak resolution (Hartmann *et al*., 2017; Hartley *et al*., 2025).

Overall, these challenges reflect broader systemic weaknesses in public health infrastructure as represented in Table 1. Strengthening surveillance therefore requires sustained investment in laboratory systems, decentralized diagnostics, digital reporting, workforce capacity, community engagement, cross-border coordination, genomic surveillance and integrated One Health strategies.

Cross-Border spread of Ebola virus disease within sub-Saharan Africa and beyond

The trans-boundary spread of EVD has become a major public health security concern in sub-Saharan Africa (Hassan *et al*., 2019). Despite having been considered as a geographically restricted zoonotic infection of remote forest communities, EVD now demonstrates a clear capacity to cross national borders through human mobility, trade networks, humanitarian displacement and increasing urban interconnectedness (Figure 3), hence it is no longer a localized disease but a significant regional and global health security threat (Rulli *et al*., 2017; Chirawurah *et al*., 2022; Narashim, 2022).

Table 1. Epidemiological characteristics, surveillance challenges, and public health lessons learned from major Ebola and Sudan virus disease outbreaks in Sub-Saharan Africa (2014 – 2026).

Outbreak/Event with dates	Affected countries	Major surveillance challenges		Key public health lessons
		Transmission dynamics	Critical gaps identified within the health system	
2014–2016: West African Epidemic	Guinea, Liberia, Sierra Leone	Porous borders, urban spread, community transmission.	Collapsed health systems, inadequate IPC, weak surveillance, workforce shortages.	Importance of early detection, regional coordination, and resilient health systems.
2014: Imported Case in Nigeria	Nigeria	International air travel from Liberia to Lagos.	Weak emergency preparedness, hospital vulnerability, overstretched workforce.	Rapid contact tracing and coordinated emergency response can contain outbreaks.
2018 – 2020: Kivu Outbreak	Democratic Republic of the Congo, Uganda	Cross-border migration, conflict-driven displacement	Insecurity, mistrust, disrupted surveillance.	Security and community trust are essential for outbreak control.
2022: Sudan Virus Disease Outbreak	Uganda	Domestic mobility and regional exposure risk.	Lack of licensed vaccines for Sudan strain, healthcare strain.	Need for diversified filovirus vaccine development.
2026: Bundibugyo Resurgence	Democratic Republic of the Congo, Uganda	Mining corridors, urban expansion, border mobility.	Absence of cross-protective vaccines, fragile regional preparedness.	One Health preparedness and sustained surveillance are critical.

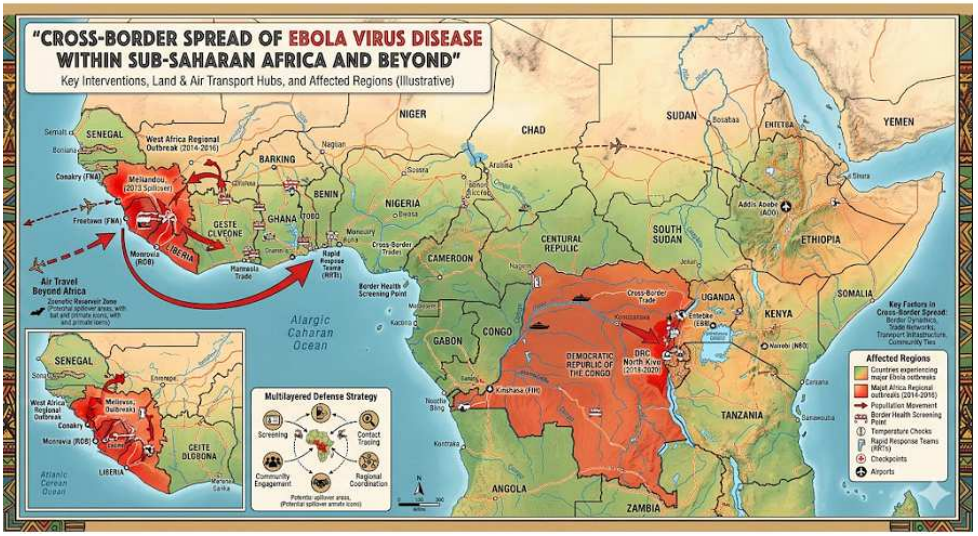

Figure 3. Geospatial dynamics of cross-border Ebola Virus Disease (EVD) transmission, regional transport hubs, and multi-layered containment strategies within Sub-Saharan Africa and beyond.

The 2014 – 2016 West African Ebola epidemic marked a turning point in understanding cross-border transmission, having originated in rural Guinea, it spread rapidly to Liberia, Sierra Leone and Nigeria, becoming the largest Ebola outbreak in history, with over 28,000 cases and more than 11,000 deaths (Narashim, 2022). Weak surveillance systems, porous borders and delayed international response facilitated sustained transmission, while urban spread overwhelmed fragile health systems in capitals such as Monrovia and Freetown (Chirawurah *et al*., 2022). Liberia's experience highlighted how health infrastructure weakened following years of civil conflict, contributed to poor infection control, limited laboratory capacity, low public trust and disruption of essential health services (Ako-Egbe *et al*., 2023). In contrast, Nigeria's 2014 importation of Ebola via an infected traveller into Lagos demonstrated both vulnerability and the importance of rapid response (Lokossou *et al*., 2026). Although Nigeria successfully contained the outbreak through aggressive contact tracing, isolation and risk communication, the event exposed systemic weaknesses and reflected reactive rather than sustained preparedness (Olumade *et al*., 2020). Similarly, recurrent outbreaks in the DRC have repeatedly affected neighboring Uganda through cross-border mobility, with Uganda's stronger surveillance systems enabling quicker containment, yet still revealing regional weakness (WHO, 2021). More recent outbreaks, including Uganda's 2022 Sudan virus disease event and the current (May 2026) Bundibugyo-related resurgence, further highlight persistent gaps, particularly the absence of widely available vaccines and therapeutics for several Ebola species (Pimundu *et al*., 2026; WHO, 2026).

Across sub-Saharan Africa, a recurring limitation is reliance on reactive "fire brigade" responses rather than sustained preparedness. Weak surveillance systems, underfunded laboratories, inadequate personal protective equipment (PPE) stockpiles, and poorly institutionalized emergency systems consistently highlighted earlier in one of the sections of this Article, lead to delayed detection and prompt public health response/intervention. These recurring weaknesses reflect broader structural failures in regional health governance and preparedness financing, hence calling for more concerted efforts of member countries within the sub-Saharan Africa region to collaborate and proactively control Ebola virus disease. Finally, controlling cross-border Ebola transmission requires a shift from reactive outbreak response to proactive, resilient and regionally coordinated health security systems grounded in One Health principles, strengthened surveillance and sustained cross-border collaboration (Figure 3).

Implications for African health systems and the One Health approach

From a One Health perspective, the recurrent resurgence and transnational spread of EVD across sub-Saharan Africa represent a persistent and complex threat to regional health security. This is particularly significant for Nigeria, where high population density, rapid urbanization and extensive connectivity within West Africa increase vulnerability to rapid disease transmission (WHO, 2015). These interconnected realities underscore the urgent need for a fully operationalized One Health framework capable of addressing the ecological, social and geopolitical drivers that facilitate zoonotic disease emergence and spread (OHHLEP *et al*., 2023). The evolving epidemiology of Ebola virus disease further demonstrates that traditional, reactive outbreak responses are no longer sufficient, as transmission increasingly occurs across human, animal and environmental interfaces, requiring integrated and forward-looking

public health strategies (Baranowski and Bharti, 2026).

As emphasized by OHHLEP *et al* (2023), a central implication of this analysis is the need for a systemic shift across sub-Saharan African health systems from reactive, emergency-driven outbreak responses towards resilient One Health approach that is prevention-oriented and capable of sustaining preparedness during inter-epidemic periods. It is pertinent to recall that while countries such as Nigeria, DRC, Uganda and Liberia have demonstrated varying levels of success in containing Ebola virus disease outbreaks (Guetiya Wadoum *et al*., 2021; Ako-Egbe *et al*., 2023), these responses have often relied on rapid emergency activation rather than robust, continuously strengthened health systems that can stand the test of time. Although Nigeria's containment of the 2014 Ebola importation illustrated the effectiveness of coordinated response mechanisms, similar experiences across the region consistently reveal structural weaknesses (Otu *et al*., 2017).

The evident and recurring institutional fragilities within health systems in EVD epicentres, as well as across other African countries, underscore the need for a deliberate shift in leadership toward more pro-active governance capable of addressing persistent under-investment in surveillance systems, laboratory infrastructure, health workforce development and emergency logistics across the sub-Saharan African region (OHHLEP *et al*., 2023). The shared environmental, institutional and geographical characteristics of Ebola virus disease (EVD) outbreak settings in DRC, Uganda, Liberia and Nigeria reflect common regional vulnerabilities across Central and West Africa. In particular, the presence of high-density urban centres, coupled with weak health system capacities, significantly increases the risk of rapid outbreak amplification when index cases are not detected early (Onyekuru *et al*., 2023).

The One Health approach provides a unifying framework for addressing these challenges by integrating human, animal, environmental and agricultural health systems (OHHLEP *et al*., 2023). In rural and forest-adjacent ecological zones across the region, spillover prevention requires strengthened wildlife surveillance, regulation of bushmeat practices, community-based reporting systems, and improved access to primary healthcare and water, sanitation and hygiene (WASH) infrastructure (Vora *et al*., 2023). According to One Health Trust (2023), integration of veterinary and environmental health services is essential for early identification of zoonotic threats at the human–animal interface. In peri-urban settings across multiple African countries, priority should be given to decentralizing laboratory capacity, expanding digital disease surveillance systems and improving IPC compliance in both public and private healthcare facilities, where informal care pathways often delay outbreak detection (Onyekuru *et al*., 2023). With similar submission in the reports by Oposhia *et al*., (2026), in major urban centres such as Kampala, Lagos, Kinshasa and Monrovia, preparedness will require sustained emergency operation centres, strengthened isolation units, expanded genomic surveillance capacity and coordinated multi-sectoral engagement across health, immigration, aviation and transport systems. Furthermore, efforts at national and regional levels for effective EVD preparedness will largely depend on strengthening One Health governance through legally mandated coordination mechanisms across health, agriculture, environment and wildlife sectors (OHHLEP *et al*., 2023). Adopting this must be complemented by expanded cross-border surveillance, genomic sequencing capacity, and increased domestic financing for preparedness (Oposhia *et al*., 2026). In other words, regional platforms such as the Africa CDC should provide critical opportunities for

harmonized response strategies and shared technical capacity.

Across sub-Saharan Africa, sustainable health security depends on transitioning from fragmented, reactive outbreak control to integrated, proactive and adequately funded One Health systems capable of detecting and containing threats before they escalate into epidemics.

Conclusion

Ebola virus disease is no longer a rare and geographically isolated zoonotic infection confined to remote African communities. Over the years, it has evolved into a recurring regional public health threat shaped by ecological disruption, population displacement, weak health systems, insecurity and increasing human mobility across sub-Saharan Africa. Nigeria occupies a particularly critical position within this evolving landscape because of its large population, rapid urbanization, extensive regional and international connectivity and expanding informal settlements. Although the successful containment of the 2014 Lagos (Nigeria) outbreak demonstrated the country's outbreak response capacity, the current realities across the region show that reactive containment alone may be insufficient for sustainable epidemic prevention.

Going forward, there is an urgent need for African governments, including Nigeria, to prioritize long-term investment in Ebola virus disease research, vaccine development, genomic surveillance and therapeutic innovation across all Ebola virus species. Nigeria is strategically positioned to lead regional collaborations through its academic institutions, public health agencies and growing scientific capacity. At the same time, health systems must be strengthened through sustained financing, improved surveillance infrastructure, laboratory expansion and workforce retention strategies that address the continuing migration of skilled healthcare professionals.

Sustainable Ebola virus disease control will also depend on fully operational One Health approaches that integrate human, animal and environmental surveillance with stronger cross-border coordination, community engagement and behavioral risk reduction. In the final analysis the future control of Ebola virus disease and other emerging zoonotic diseases in Africa will depend on sustained political commitment, resilient health systems, scientific innovation, environmental stewardship and nationally driven preparedness efforts.

Acknowledgement

The authors acknowledge the guidance and valuable contributions of Prof. O. C. Eneh of the Department of Public Health, David Umahi Federal University of Health Sciences, Uburu, Nigeria. They also appreciate the Institute of One Health for Zoonotic Disease Research and Animal Production, for their support in sourcing materials for this review.

Conflict of Interest

All authors declare no conflict of interest.

References

ACDC (Africa Centres for Disease Control and Prevention) (2026). Africa CDC declares the ongoing Bundibugyo Ebola outbreak a public health emergency of continental security. *Africa CDC.* Africa CDC Official Publication

Ako-Egbe L, Seifeldin R, Saikat S, Wesseh SC, Bolongei MB, Ngormbu BJ, George R, Ocan C. and Peter Lasuba CL. (2023). Liberia health system's journey to long-term recovery and resilience post-Ebola: a case study of an exemplary multi-year collaboration. *Frontiers in Public*

Health, 11: 1137865. https://doi.org/10.3389/fpubh.2023.1137865

Alhassan JAK and Wills O (2024). Public health surveillance through community health workers: a scoping review of evidence from 25 low-income and middle-income countries. *BMJ Open*, *14*(4): e079776. https://doi.org/10.1136/bmjopen-2023-079776

Aliyu AA and Amadu L (2017). Urbanization, cities, and health: The challenges to Nigeria - A review. *Annals of African Medicine*, *16*(4): 149 – 158.

Armstrong-Mensah E, Burke A, Vasquez R, Corbett K and Olanlege A (2025). Health emergencies in sub-Saharan Africa: Response, challenges, and strategies for the future. *Medical Research Archives,* 13(1). https://doi.org/10.18103/mra.v13i1.6271

Baller A, Padoveze MC, Mirindi P, Hazim CE, Lotemo J, Pfaffmann J, Ndiaye A, Carter S, Chabrat M D, Mangala S, Banzua B, Umutoni C, Niang NR, Kabego L, Ouedraogo A, Houdjo B, Mwesha, D, Ousman KB, Kolwaite A, Blaney DD … Fall IS (2022). Ebola virus disease nosocomial infections in the Democratic Republic of the Congo: a descriptive study of cases during the 2018-2020 outbreak. *International journal of infectious diseases: IJID: official publication of the International Society for Infectious Diseases*, 115: 126 – 133. https://doi.org/10.1016/j.ijid.2021.11.039

Baraniuk C (2026). Ebola: WHO declares emergency as strain with no vaccine kills 100 in DRC and Uganda. *BMJ,* 393: e313572. https://doi.org/10.1136/bmj-2026-313572

Baranowski K and Bharti N (2026). Multiple environmental conditions precede Ebola spillovers in Central Africa. *Biology Letters*, 22(1): Article 20250654. https://doi.org/10.1098/rsbl.2025.0654

Beck L C, Owen BN, Scott E, Winkler MS and Galli A. (2025). Exploring Associations Between WaSH-Related Health Outcomes and Terrorist Activities in the Sahel: A Scoping Review. *Public Health Reviews*, 46: 1608490. https://doi.org/10.3389/phrs.2025.1608490

Bedford J and Akello G. (2018). Uganda–DRC cross-border dynamics in the context of Ebola outbreak in North Kivu and surrounding provinces. *Social Science in Humanitarian Action Platform (SSHAP*). Relief Web. https://reliefweb.int/report/democratic-republic-congo/uganda-drc-cross-border-dynamics

Bettini A, Lapa D and Garbuglia AR (2023). Diagnostics of Ebola virus. *Frontiers in Public Health*, 11: 1123024. https://doi.org/10.3389/fpubh.2023.1123024

Breman JG and Johnson KM (2014). Ebola then and now. *New England Journal of Medicine,* 371(18): 1663 – 1666. https://doi.org/10.1056/NEJMp1410540

Caron A, Bourgarel M, Cappelle J, Liégeois F, De Nys HM and Roger F (2018). Ebola Virus Maintenance: If Not (Only) Bats, What Else? *Viruses*, 10(10): 549. https://doi.org/10.3390/v10100549

CDC (Centers for Disease Control and Prevention). (2025). *Outbreak History*. U.S. Department of Health and Human Services. CDC Ebola Outbreak History

CDC (Centers for Disease Control and Prevention) (2026). *Ebola Disease: Current Situation*. U.S. Department of Health and Human Services. https://www.cdc.gov/ebola/outbreaks/current-outbreaks/index.html

Chirawurah D, Santua N and Apanga S (2022). Interactions among cross-border contiguous communities and implications for managing pandemics – The case of Ghana and Burkina Faso during the Ebola

outbreak in West Africa: A qualitative study. *Annals of Global Health,* 88(1): 40. https://doi.org/10.5334/aogh.3807.

Dahl EH, Mbala P, Juchet S, Touré A, Montoyo A, Serra B, Kojan R, D'Ortenzio E, Blomberg B and Jaspard M (2024). Improving Ebola virus disease outbreak control through targeted post-exposure prophylaxis. *The Lancet Global Health*, 12(10): e1730 – e1736. https://doi.org/10.1016/S2214-109X(24)00255-9

David O, Moses E, Agatha N and Onyede OA (2026). Patterns in Ebola Virus Disease Outbreaks: A Systematic Review of Epidemiological Trends and Contributing Factors. *International Journal of Scientific Research and Modern Technology*, 5(3): 90 – 98. https://doi.org/10.38124/ijsrmt.v5i3.1351

Di Paola N, Sanchez-Lockhart M, Zeng X, Kuhn JH and Palacios G (2020). Viral genomics in Ebola virus research. *Nature Reviews: Microbiology*, 18(7): 365 – 378. https://doi.org/10.1038/s41579-020-0354-7

Ellwanger JH and Chies JAB (2021). Zoonotic spillover: Understanding basic aspects for better prevention. *Genetics and Molecular Biology*, 44(1 Suppl 1): e20200355. https://doi.org/10.1590/1678-4685-GMB-2020-0355

Fairhead J, Leach M and Millimouno D. (2021). Spillover or endemic? Reconsidering the origins of Ebola virus disease outbreaks by revisiting local accounts in light of new evidence from Guinea. *BMJ Global Health*, 6(4): e005783. https://doi.org/10.1136/bmjgh-2021-005783

Fawole OI, Dalhat MM, Park M, Hall CD, Nguku PM and Adewuyi PA (2017). Contact tracing following outbreak of Ebola virus disease in urban settings in Nigeria. *The Pan African Medical Journal*, 27(Suppl 1): 8.

Goldstein T, Belaganahalli M N, Syaluha EK, Lukusa JK, Greig DJ, Anthony SJ, Tremeau-Bravard A, Thakkar R, Caciula A, Mishra N, Lipkin WI, Dhanota JK, Smith BR, Ontiveros VM, Randhawa N, Cranfield M, Johnson CK, Gilardi KV and Mazet JAK. (2020). Spillover of ebolaviruses into people in eastern Democratic Republic of Congo prior to the 2018 Ebola virus disease outbreak. *One Health Outlook*, 2(1): 21. https://doi.org/10.1186/s42522-020-00028-1

Gonzalez A, Nikparvar B, Matson MJ (2026). Links between infrastructure for human movement and early Ebola outbreak trajectories. *Scientific Reports,* 16: 3920. https://doi.org/10.1038/s41598-025-33688-y

Guetiya Wadoum RE, Sevalie S, Minutolo A, Clarke A, Russo G, Colizzi V, Mattei M and Montesano C (2021). The 2018-2020 Ebola Outbreak in the Democratic Republic of Congo: A Better Response Had Been Achieved Through Inter-State Coordination in Africa. *Risk Management and Healthcare Policy*, 14: 4923 – 4930. https://doi.org/10.2147/RMHP.S327616

Hamza IA, Mao K, Gao C, Hamza H and Zhang H. (2025). Elements of Viral Outbreak Preparedness: Lessons, Strategies, and Future Directions. *Viruses*, 18(1): 50. https://doi.org/10.3390/v18010050

Hartley CD, Linderman S, Fashina T, Ward L, Drews-Botsch C, Pratt C, Kuthyar S, Fernandes AF, Huang Y, Choo C, Nguyen N, Carag J, Morgan J, Kraft CS, Hewlett A, Brett-Major D, Schieffelin JS, Garry RF, Grant D, Justin, GA.,… SMILE and EVICT-VR Investigator Study Groups (2025). Understanding the pathogenesis of uveitis in Ebola virus disease survivors: an observational cohort and cross-sectional study protocol for clinical, molecular virologic and immunologic characterisation. *BMJ Open*, 15(12): e104843.

Hartmann RK, Grünweller A and Strecker T (2017). Persistence of Ebola virus in the semen of male survivors. *Journal of Public Health and Emergency*, 1(1): https://jphe.amegroups.org/article/view/3698

Hasan S, Ahmad SA, Masood R. & Saeed S. (2019). Ebola virus: A global public health menace: A narrative review. *Journal of Family Medicine and Primary Care*, 8(7): 2189 – 2201. https://doi.org/10.4103/jfmpc.jfmpc_297_19

Hayman DTS. (2019). African primates: Likely victims, not reservoirs of Ebola viruses. *The Journal of Infectious Diseases*, 220(10): 1547 – 1550.

Hsu CH, Champaloux SW, Keïta S, Martel L, Bilivogui P, Knust B and McCollum AM (2018). Sensitivity and specificity of suspected case definition used during West Africa Ebola Epidemic. *Emerging Infectious Diseases*, 24(1): 9 – 14.

Hulseberg CE, Kumar R, Di Paola N, Larson P, Nagle ER, Richardson J, Hanson J, Wauquier N, Fair JN, Makuwa M, Mulembakani P, Muyembe-Tamfum JJ, Schoepp RJ, Sanchez-Lockhart M, Palacios GF, Kuhn JH and Kugelman JR. (2021). Molecular analysis of the 2012 Bundibugyo virus disease outbreak. *Cell Reports. Medicine*, 2(8): 100351. https://doi.org/10.1016/j.xcrm.2021.100351

Hussein HA. (2023). Brief review on Ebola virus disease and one health approach. *Heliyon*, 9(8): e19036. https://doi.org/10.1016/j.heliyon.2023.e19036

IMC (International Medical Corps) (2026). *DR Congo Ebola Outbreak, Central Africa, Situation Report #4*. ReliefWeb. https://reliefweb.int/report/democratic-republic-congo/dr-congo-ebola-outbreak-central-africa-situation-report-4-may-26-2026

IRC (International Rescue Committee) (2026). Ebola outbreak in DRC and Uganda: What you need to know. *International Rescue Committee*. https://www.rescue.org/article/ebola-outbreak-drc-and-uganda-what-you-need-know

Iversen PL, Kane CD, Zeng X, Panchal RG, Warren TK, Radoshitzky SR, Kuhn JH, Mudhasani RR, Cooper CL, Shurtleff AC, Nasar F, Sunay MM, Duplantier AJ, Eaton BP, Zumbrun EE, Bixler SL, Martin S, Meinig JM, Chiang CY, Sanchez-Lockhart M, Saunders DL (2020). Recent successes in therapeutics for Ebola virus disease: no time for complacency. *The Lancet. Infectious Diseases*, 20(9): e231 – e237. https://doi.org/10.1016/S1473-3099(20)30282-6

Jacob ST, Crozier I, Fischer WA, Hewlett A, Kraft CS, Vega MA., Soka MJ, Wahl V, Griffiths A, Bollinger L, Kuhn JH (2020). Ebola virus disease. *Nature Reviews. Disease Primers*, 6(1): 13. https://doi.org/10.1038/s41572-020-0147-3

Kavulikirwa OK and Sikakulya FK. (2022). Recurrent Ebola outbreaks in the eastern Democratic Republic of the Congo: A wake-up call to scale up the integrated disease surveillance and response strategy. *One Health (Amsterdam, Netherlands)*, 14: 100379. https://doi.org/10.1016/j.onehlt.2022.100379

Kikwango EM, Akilimali PZ. and Tran NT. (2025). Impact of most promising Ebola therapies on survival: a secondary analysis during the tenth outbreak in the Democratic Republic of Congo. *Virology Journal*, 22(1): 144. https://doi.org/10.1186/s12985-025-02766-y

Kinganda-Lusamaki E, Black A, Mukadi DB, Hadfield J, Mbala-Kingebeni P., Pratt, C. B., Aziza, A., Diagne, M. M., White, B., Bisento, N., Nsunda, B., Akonga, M., Faye, M., Faye, O., Edidi-Atani, F., Matondo-

Kuamfumu, M., Mambu-Mbika, F., Bulabula, J., Di Paola, N., Muyembe Tamfum, J.-J. (2021). Integration of genomic sequencing into the response to the Ebola virus outbreak in Nord Kivu, Democratic Republic of the Congo. *Nature Medicine,* 27(4): 710 – 716. https://doi.org/10.1038/s41591-021-01302-z

Koren O and Weidmann NB. (2025). Infectious disease outbreaks drive political mistrust. *Proceedings of the National Academy of Sciences of the United States of America*, 122(29): e2506093122. https://doi.org/10.1073/pnas.2506093122

Kuisma E, Gottdenker NL and Olson SH. (2026). Future risks of disease emergence in humans, wildlife, and livestock in the Congo Basin: Predicting outcomes under current trends and policy-driven solutions. In: Inogwabini BI, Sonké B, Koutika LS and White LJ (Eds.), *Resilience and Sustainability in the Congo Basin*. Springer. https://doi.org/10.1007/978-3-032-02023-9_31-1

Kupferschmidt K (2026). Post on confirmation of Bundibugyo virus in DRC samples. Bluesky. 15 May 2026 https://bsky.app/profile/kakape.bsky.social/post/3mlwb4x6n3c2u

Laupland KB and Valiquette L (2014). Ebola virus disease. *The Canadian Journal of Infectious Diseases &Mmedical Microbiology*, 25(3): 128 – 129. https://doi.org/10.1155/2014/527378

Lokossou VK, Usman AB, Okunromade O, Sombie I, and Aïssi MA (2026). Ten years after the Ebola outbreak: Lessons, progress, and preparedness and response in West Africa. *Journal of Interventional Epidemiology and Public Health,* 9(1): 10. https://doi.org/10.37432/jieph-d-25-00222

Lowe H, Woodd S, Lange I L, Janjanin S, Barnet J and Graham W (2021). Challenges and opportunities for infection prevention and control in hospitals in conflict-affected settings: a qualitative study. *Conflict and Health*, 15(1): 94. https://doi.org/10.1186/s13031-021-00428-8

Marou V, Vardavas CI, Aslanoglou K, Nikitara K, Plyta Z, Leonardi-Bee J, Atkins K, Condell O, Lamb F and Suk JE. (2024). The impact of conflict on infectious disease: a systematic literature review. *Conflict and Health*, 18(1): 27. https://doi.org/10.1186/s13031-023-00568-z

Masumbuko Claude K, Underschultz J and Hawkes MT (2019). Social resistance drives persistent transmission of Ebola virus disease in Eastern Democratic Republic of Congo: A mixed-methods study. *PLoS One*, 14(9): e0223104. https://doi.org/10.1371/journal.pone.0223104

Moyo E, Mhango M, Moyo P, Dzinamarira T, Chitungo I and Murewanhema G (2023). Emerging infectious disease outbreaks in Sub-Saharan Africa: Learning from the past and present to be better prepared for future outbreaks. *Frontiers in Public Health*, 11: 1049986. https://doi.org/10.3389/fpubh.2023.1049986

MSF (Médecins Sans Frontières) (2026). *The Bundibugyo virus challenge: Why is this Ebola disease outbreak different?* https://www.msf.org/ebola-disease-drc-bundibugyo-virus-challenge

Mukadi-Bamuleka D, Nkuba-Ndaye A, Mbala-Kingebeni P, Ahuka-Mundeke S and Muyembe-Tamfum JJ (2024). Impact of Ebola epidemics on the daily operation of existing systems in Eastern Democratic Republic of the Congo: a brief review. *Journal of Medical Economics*, 27(1): 184 – 192. https://doi.org/10.1080/13696998.2024.2305009

Mulenga-Cilundika P, Ekofo J, Kabanga C, Criel B, Van Damme W and Chenge F (2022). Indirect Effects of Ebola Virus Disease Epidemics on Health Systems in the Democratic Republic of the Congo, Guinea, Sierra Leone and Liberia: A Scoping Review Supplemented with Expert Interviews. *International Journal of Environmental Research and Public Health*, 19(20): 13113. https://doi.org/10.3390/ijerph192013113

Muyembe-Tamfum JJ, Mulangu S, Masumu J, Kayembe JM, Kemp A and Paweska JT (2012). Ebola virus outbreaks in Africa: Past and present. *Onderstepoort Journal of Veterinary Research*, 79(2): Article 451. https://doi.org/10.4102/ojvr.v79i2.451

Muzembo BA, Kitahara K, Ohno A, Ntontolo N P, Ngatu NR, Okamoto K and Miyoshi SI (2022). Rapid diagnostic tests versus RT-PCR for Ebola virus infections: a systematic review and meta-analysis. *Bulletin of the World Health Organization*, 100(7): 447 – 458. https://doi.org/10.2471/BLT.21.287496

Narashim A (2022) Social and Economic Factors Behind Ebola in Sierra Leonne. *International Archive of Public Health and Community Medicine,* 6: 086. https://doi.org/10.23937/2643-4512/1710086

Ojoma, AQ, Davidb O, Chukwumad AC, Ugochukwue ND and Ezikek MGC. (2020). Transmission dynamics of Ebola virus disease with vaccine, condom use, quarantine, isolation and treatment drug. *African Journal of Infectious Diseases*, 15(1): 10 – 23. https://doi.org/10.21010/ajid.v15i1.2

Oleribe OO, Crossey MM and Taylor-Robinson, S. D. (2015). Nigerian response to the 2014 Ebola viral disease outbreak: lessons and cautions. *The Pan African Medical Journal*, 22 (Suppl. 1): 13. https://doi.org/10.11694/pamj.supp.2015.22.1.6490

Oleribe OO, Momoh J, Uzochukwu BS, Mbofana F, Adebiyi A, Barbera T, Williams R and Taylor-Robinson SD. (2019). Identifying Key Challenges facing Healthcare Systems in Africa and potential solutions. *International Journal of General Medicine, 12:* 395 – 403. https://doi.org/10.2147/IJGM.S223882

Olivero J, Fa JE, Farfán MA, Márquez AL, Real R, Juste J, Leendertz SAJ and Nasi R (2020). Human activities link fruit bat presence to Ebola virus disease outbreaks. *Mammal Review,* 50(1): 1 – 10. https://doi.org/10.1111/mam.12173

Olumade TJ, Adesanya OA, Fred-Akintunwa IJ, Babalola DO, Oguzie JU, Ogunsanya OA, George UE, Akin-Ajani, OD and Osasona DG (2020). Infectious disease outbreak preparedness and response in Nigeria: history, limitations and recommendations for global health policy and practice. *AIMS Public Health*, 7(4): 736 – 757. https://doi.org/10.3934/publichealth.2020057

OHHLEP (One Health High-Level Expert Panel), Hayman DTS, Adisasmito WB, Almuhairi S, Behravesh CB, Bilivogui P, Bukachi SA, Casas N, Becerra NC, Charron DF, Chaudhary A, Ciacci Zanella JR, Cunningham AA, Dar O, Debnath N, Dungu B, Farag E, Gao GF, Khaitsa M, Machalaba C … Koopmans M (2023). Developing One Health surveillance systems. *One Health (Amsterdam, Netherlands)*, 17: 100617. https://doi.org/10.1016/j.onehlt.2023.100617

One Health Trust. (2023). Monitoring zoonotic spillover by assessing global bushmeat activity. https://onehealthtrust.org/news-media/monitoring-zoonotic-spillover-by-assessing-global-bushmeat-activity/

Onyekuru NA, Ihemezie EJ, Ezea CP, Apeh CC and Onyekuru BO (2023). Impacts of Ebola disease outbreak in West Africa: Implications for government and public health preparedness and lessons from COVID-19. *Scientific African*, 19: e01513.

Oposhia, J, Kungu JM, Nantamu PD, Namayanja J, Okuyo CAB, Mulowoza M, Kabali K, Edson K and Olupot-Olupot P (2026). Ebola virus disease preparedness in sub-national health systems: A readiness assessment of Jinja District, Uganda. *Journal of Tropical Medicine*, 2026: 5519966. https://doi.org/10.1155/jotm/5519966

O'Sullivan B, Leader J, Couch D and Purnell J (2020). Rural Pandemic Preparedness: The Risk, Resilience and Response Required of Primary Healthcare. *Risk Management and Healthcare Policy*, 13: 1187 – 1194. https://doi.org/10.2147/RMHP.S265610

Otu A, Ameh S, Osifo-Dawodu E, Alade E, Ekuri S and Idris J (2017). An account of the Ebola virus disease outbreak in Nigeria: implications and lessons learnt. *BMC Public Health*, 18(1): 3. https://doi.org/10.1186/s12889-017-4535-x

Park SJ, Nkuba-Ndaye A, Muhindo-Wema K, Mulopo-Mukanya N, Kavira-Muhindo MA, Kwizera-Sendegeya J, Muloki-Nsele M, Morisho-Mungeleza M, Morisho-Mwanabiningo N and Mukadi-Bamuleka D (2026). Investigating the spatiotemporal links between the EVD outbreaks in Likati (2017) and Eastern DRC (2018-2020): a retrospective transdisciplinary study. *BMC Infectious Diseases*, 26(1): 489. https://doi.org/10.1186/s12879-026-12607-0

Pimundu G, Muyigi T, Nambozo EJ, Okiira C, Kanamwanji B, Nalwanga R, Sekate J, Mugabe R, Naiga J, Sewanyana I, Lutwama J, Balinandi S, Kaleebu P, Aceng JR, Atwiine D, Mwebesa H, Bosa HK, Kagirita A, Olaro C, Nsawotebba A, … Nabadda S (2026). Investigating the Sudan virus outbreak in Uganda through the deployment of a mobile laboratory. *BMC Infectious Diseases*, 26(1): 175. https://doi.org/10.1186/s12879-026-12556-8

Presser LD, Coffin J, Koivogui L, Campbell A, Campbell J, Barrie F, Ngobeh J, Souma Z, Sorie S, Harding, D., Camara, A., Tohonamou, P., Traore, B., Hamill, F. A., Bogan, J., Altmann, S., Ross, C., Mansheim, J., Hegerty, R., Poynter, S., … Krcha, S. (2021). The deployment of mobile diagnostic laboratories for Ebola virus disease diagnostics in Sierra Leone and Guinea. *African Journal of Laboratory Medicine*, 10(1): 1414. https://doi.org/10.4102/ajlm.v10i1.1414

Rosello A, Mossoko M, Flasche S, Van Hoek AJ, Mbala P, Camacho A, Funk S, Kucharski A, Ilunga BK, Edmunds WJ, Piot P, Baguelin M and Tamfum JJ (2015). Ebola virus disease in the Democratic Republic of the Congo, 1976 – 2014. *eLife*, 4: e09015. https://doi.org/10.7554/eLife.09015

Rulli MC, Santini M, Hayman DT and D'Odorico P (2017). The nexus between forest fragmentation in Africa and Ebola virus disease outbreaks. *Scientific Reports*, 7: 41613. https://doi.org/10.1038/srep41613

Sah R, Mohanty A, Mehta V, Satapathy P, Padhi BK and Rodriguez-Morales AJ (2022). The Ebola Resurgence in Democratic Republic of Congo. *Annals of Medicine and Surgery,* 82: 104616. https://doi.org/10.1016/j.amsu.2022.104616

Segala FV, Guido G, Stroffolini G, Masini L, Di Gennaro F and colleagues (2025). Insights into the ecological and climate crisis: Emerging infections threatening human health. *Acta Tropica*, 262: 107531. https://doi.org/10.1016/j.actatropica.2025.107531

Sikakulya FK, Mulisya O, Munyambalu DK and Bunduki, G. K. (2019). Ebola in the Eastern Democratic Republic of Congo: One Health approach to infectious disease control. *One Health (Amsterdam, Netherlands)*, 9: 100117. https://doi.org/10.1016/j.onehlt.2019.100117

Sospeter SB, Udohchukwu OP, Ruaichi J, Nchasi G, Paul IK, Kanyike AM and Dewey RS. (2023). Ebola outbreak in DRC and Uganda; an East African public health concern. *Health Science Reports*, 6(8): e1448. https://doi.org/10.1002/hsr2.1448

UK Health Security Agency. (2026). *Ebola and Marburg haemorrhagic fevers: Outbreaks and case locations*. GOV.UK. https://www.gov.uk/guidance/ebola-and-marburg-haemorrhagic-fevers-outbreaks-and-case-locations

UNICEF (United Nations Children's Fund) (2026). *Ebola in humanitarian WASH response 2026*. UNICEF. https://www.unicef.org

Vinck P, Pham PN, Bindu KK, Bedford J and Nilles EJ (2019). Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: A population-based survey. *The Lancet Infectious Diseases*, 19(5): 529 – 536. https://doi.org/10.1016/S1473-3099(19)30063-5

Vora NM, Hannah L, Walzer C, Vale MM, Lieberman S, Emerson A, Jenning J, Alders R, Bonds MH, Evans J, Chilukuri B, Cook S, Sizer NC and Epstein JH (2023). Interventions to Reduce Risk for Pathogen Spillover and Early Disease Spread to Prevent Outbreaks, Epidemics, and Pandemics. *Emerging Infectious Diseases*, 29(3): 1 – 9. https://doi.org/10.3201/eid2903.221079

Weber DJ, Fischer WA, Wohl DA and Rutala WA (2015). Protecting healthcare personnel from acquiring Ebola virus disease. *Infection Control and Hospital Epidemiology*, 36(10): 1229 – 1232. https://doi.org/10.1017/ice.2015.205

Woolhouse ME, Rambaut A and Kellam P (2015). Lessons from Ebola: Improving infectious disease surveillance to inform outbreak management. *Science Translational Medicine*, 7(307): 307rv5. https://doi.org/10.1126/scitranslmed.aab0191

WHO (World Health Organization) (2015). Factors that contributed to undetected spread of the Ebola virus and impeded rapid containment. In One year into the Ebola epidemic. https://www.who.int/news-room/spotlight/one-year-into-the-ebola-epidemic/factors-that-contributed-to-undetected-spread

WHO (World Health Organization) (2021). Cross-border response to Ebola at points of entry: Difficult but possible with rapid response [Case study]. *World Health Organization.* https://www.who.int/publications/i/item/cross-border-response-to-ebola-at-points-of-entry-difficult-but-possible-with-rapid-response

WHO (World Health Organization) (2025). *Ebola virus disease – Democratic Republic of the Congo*. https://www.who.int/emergencies/disease-outbreak-news/item/ebola-virus-disease-democratic-republic-of-the-congo

WHO (World Health Organization) (2026). *Ebola disease caused by Bundibugyo virus – Democratic Republic of the Congo*. World Health Organization. https://www.who.int/emergencies/disease-outbreak-news/item/2026-DON603

Yokolo H, Tague C, Ekouo J, Makeda D and Akilimali A (2025). The impact of armed conflict in eastern Democratic Republic of Congo on the risk of malaria outbreaks in children under five years old. *New Microbes and New Infections*, 67: 101636. https://doi.org/10.1016/j.nmni.2025.101636

Zeng X. (2017). Unveiling the mystery of hidden Ebola virus persistence. *Microbiology*. U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID). https://microbiologycommunity.nature.com/posts/unveiling-the-mystery-of-hidden-ebola-virus-persistence.