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Ebola Epidemic in Africa: Comparative Experiences and Lessons Learned from the DRC, Guinea, Liberia, and Sierra Leone

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ABSTRACT

Ebola virus disease remains a major public-health and governance challenge in Africa because of its high case-fatality rates and its capacity to disrupt health systems, economies, institutions, and communities. This article provides a qualitative comparative analysis of the Democratic Republic of the Congo (DRC), Guinea, Liberia, and Sierra Leone, combining structured documentary analysis, secondary epidemiological and economic data, institutional reports, and peer-reviewed studies. It examines health, economic, social, political, institutional, and science, technology, and innovation (STI) impact through the analytical lens of differentiated resilience. The study addresses a gap in the literature by integrating interregional comparison, institutional learning, community trust, innovation capacity, and the Bundibugyo virus disease extension within a single framework. The findings reveal divergent trajectories: the 2014–2016 West African outbreak produced a systemic crisis and severe disruption of health services, whereas recurrent outbreaks in the DRC contributed to accumulated operational experience, improved surveillance, vaccination strategies, and institutional learning, despite conflict and mistrust. Ebola thus operates simultaneously as a destructive shock and a catalyst for adaptation. The article argues that effective preparedness requires the articulation of national capacity, international coordination, community legitimacy, and locally embedded innovation systems. It concludes that African health resilience should be treated as a strategic STI and health-governance priority requiring sustained investment in surveillance, diagnostics, vaccine delivery, emergency financing, community trust, essential-service continuity, and cross-border response mechanisms.

Keywords: Ebola, Health Resilience, Health Governance, Democratic Republic of the Congo, West Africa, Science, Technology, and Innovation Policy

INTRODUCTION

Ebola virus disease is one of the most severe health crises of the twenty-first century, owing both to its high case fatality rate and to systemic effects on affected states. First identified in 1976 in Central Africa, Ebola was long considered a localized threat. The 2014-2016 outbreak in West Africa profoundly changed this perception because of its exceptional scale, with more than 28,600 cases and more than 11,300 deaths recorded, mainly in Guinea, Liberia, and Sierra Leone (WHO, 2016). The outbreak also demonstrated that a localized zoonotic event can rapidly become a regional and global emergency when surveillance systems, public communication, and emergency response capacities are weak.

This unprecedented crisis was distinguished by its transnational character and the partial collapse of health systems in the affected countries. In Guinea, Liberia, and Sierra Leone, the lack of prior experience in managing Ebola outbreaks strongly contributed to the rapid spread of the virus. By contrast, the Democratic Republic of the Congo (DRC), where several outbreaks have been recorded since 1976, gradually developed expertise in outbreak response, particularly through epidemiological surveillance and rapid response mechanisms (Muyembe-Tamfum *et al.*, 2012). This contrast makes the comparison analytically useful because it allows the study to examine how accumulated experience, institutional memory, and field-based response routines influence epidemic outcomes.

Bundibugyo virus disease is integrated in this article as a deliberate analytical extension of the comparison. Its relevance lies in the way it tests whether lessons derived primarily from Zaire (now DRC) ebolavirus outbreaks remain valid when vaccine and therapeutic options are more limited, cross-border risks are acute, and public trust must be built under conditions of scientific uncertainty. Bundibugyo therefore does not replace the core comparison between West Africa and the DRC; rather, it serves as a stress-test for the framework of differentiated resilience by showing that preparedness must be adaptable to different viral species, knowledge gaps, and operational uncertainties.

In this context, Ebola epidemics cannot be understood from a purely biomedical perspective. They are also multidimensional crises that affect the economic, social, and political structures of states. For example, the World Bank estimated that the 2014-2016 outbreak generated economic losses exceeding US$2.8 billion in the three most affected West African countries, mainly because of declining investment, disrupted trade, and reduced productivity (World Bank, 2016). The broader cost of Ebola also included school closures, loss of livelihoods, reduced access to maternal and child health services, and the erosion of public trust in institutions.

The central problem addressed by this study lies in the analysis of the differentiated effects of Ebola epidemics across national contexts. The observed variations in mortality, transmission, and crisis management raise fundamental questions about the role of institutional capacity, health governance, and social trust in the resilience of health systems.

The main research question is therefore formulated as follows: What differentiated impacts did Ebola epidemics have in the DRC, Guinea, Liberia, and Sierra Leone, and what lessons can be drawn to strengthen health resilience in Africa? This question falls within the broader field of global health security and the governance of transnational crises (Gostin & Friedman, 2014). It also speaks to a policy concern that remains highly relevant after COVID-19: how African states can move from emergency reaction to anticipatory preparedness.

The central hypothesis of this article is that the effects of Ebola epidemics vary significantly according to initial institutional capacity, the preparedness of health systems, and the level of trust between populations and public authorities. However, regardless of these differences, such crises act as catalysts for transformation by revealing structural fragilities while also encouraging the emergence of new response capacities (Moon *et al.*, 2015).

The article is organized into ten substantive sections. Following the introduction, Section 2 presents the literature review and analytical positioning, while Section 3 explains the methodology. Section 4 examines the health

impacts of Ebola outbreaks, Section 5 analyzes their economic effects, and Section 6 discusses their social consequences. Section 7 focuses on political and institutional impacts, and Section 8 identifies the main lessons for differentiated resilience, including the Bundibugyo analytical extension. Section 9 discusses the findings in relation to the existing literature. Finally, Section 10 presents the conclusion, outlines policy implications for science, technology, and innovation (STI) and health-governance mechanisms, states the study's limitations, and formulates the recommendations.

LITERATURE REVIEW AND ANALYTICAL POSITIONING

The literature on Ebola has evolved primarily from biomedical and emergency-response analyses toward broader approaches that connect epidemic control with institutional capacity, social trust, innovation systems, and health-system resilience. Classic studies remain essential because they explain Ebola's clinical severity, zoonotic origins, and exceptional case fatality (Feldmann & Geisbert, 2011), while governance-oriented work shows how delayed recognition and fragmented coordination transformed the West African outbreak into a global health-security crisis (Gostin & Friedman, 2014; Moon *et al.*, 2015). Social-science contributions have also demonstrated that community practices, funeral norms, rumor, stigma, and structural violence were not peripheral issues but central determinants of epidemic outcomes (Wilkinson & Leach, 2015; Richards, 2016).

More recent post-2020 empirical studies strengthen three dimensions that are central to this article. First, research on recurrent Ebola outbreaks in eastern DRC underlines the importance of integrated disease surveillance and response, especially where conflict, displacement, and weak local infrastructure complicate field operations (Kavulikirwa & Sikakulya, 2022). Second, recent work on community engagement and One Health practice in the DRC shows that bottom-up participation, local leaders, women, youth groups, anthropologists, psychologists, and community liaisons improve acceptance and operational legitimacy (Mwamba *et al.*, 2026). Third, studies on mental health and service continuity demonstrate that resilience must include psychosocial care, survivor support, protection of essential services, and post-outbreak recovery rather than focusing only on emergency isolation and case management (Wirsiy *et al.*, 2024).

The science, technology, and innovation (STI) policy literature is also central to the argument. Advances in vaccination, rapid diagnostics, genomic sequencing, digital surveillance, and bioinformatics have transformed Ebola preparedness from a purely clinical response into an innovation-governance challenge. Recent work on genomic surveillance in Africa emphasizes that sequencing capacity, bioinformatics expertise, laboratory networks, data governance, and sustainable financing are now core components of health security (Inzaule *et al.*, 2021; Ochola, 2025). For African health systems, this means that epidemic resilience is not produced only by hospitals and emergency teams. It also depends on innovation systems linking laboratories, universities, public-health institutes, regulators, communities, data platforms, and emergency managers.

The research gap addressed by this article is threefold. First, existing Ebola studies often examine either biomedical control, social resistance, economic disruption, or global health governance separately, while fewer studies integrate these dimensions in a comparative interregional framework. Second, the contrast between the 2014-2016 West African crisis and the recurrent Ebola experience of the DRC is still insufficiently used to explain how institutional memory, local trust, security conditions, and response routines shape different outcomes. Third, recent STI-policy questions - including genomic surveillance, diagnostics, vaccine-delivery systems, data governance, and preparedness for non-Zaire ebolavirus species such as Bundibugyo - remain underdeveloped in comparative Ebola scholarship.

The originality of the article lies in its articulation of Ebola as a multidimensional crisis of health systems, governance, society, economy, security, and innovation policy. Rather than treating the DRC and West Africa as separate empirical narratives, the article compares them through the concept of differentiated resilience. This concept explains why countries exposed to similar

pathogens may experience divergent impacts depending on prior outbreak experience, institutional preparedness, community legitimacy, security context, innovation capacity, and regional coordination. The Bundibugyo extension further strengthens this originality by showing that resilience must be pathogen-flexible and capable of adapting to emerging variants for which vaccines, therapeutics, and operational protocols may be more limited.

This article contributes to the literature by developing differentiated resilience as a replicable analytical lens. Differentiated resilience refers to the unequal capacity of health systems to anticipate, absorb, adapt to, and recover from epidemic shocks according to prior experience, institutional memory, public trust, security conditions, technological capacity, financing, and external coordination. The concept can be applied across cases through comparable dimensions: preparedness, surveillance, continuity of essential services, community legitimacy, innovation uptake, emergency financing, cross-border coordination, and post-outbreak recovery.

METHODOLOGY

This study adopts a qualitative comparative research design based on structured documentary analysis and secondary data synthesis. The comparison focuses on the DRC, Guinea, Liberia, and Sierra Leone because these countries represent two analytically distinct Ebola trajectories: recurrent outbreak management in Central Africa and the systemic 2014-2016 West African crisis. The DRC case makes it possible to analyze accumulated institutional learning under recurrent outbreak conditions, while Guinea, Liberia, and Sierra Leone make it possible to analyze large-scale epidemic disruption in countries with limited prior Ebola experience at the time of the crisis.

Data were selected according to four criteria: relevance to Ebola outbreak impacts; reliability of the source; comparability across the four country cases; and usefulness for assessing health, economic, social, political, institutional, and STI-policy dimensions. The study prioritizes outbreak data from the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), economic assessments from the World Bank and the International Monetary Fund (IMF), reports from the United Nations (UN) system and non-governmental organizations (NGOs), and peer-reviewed empirical studies, including post-2020 literature on health-system resilience, One Health, community trust, genomic surveillance, and service continuity. Sources were excluded when they lacked clear methodological grounding, duplicated already verified figures, or focused on countries outside the analytical scope without offering transferable lessons.

The comparative dimensions were operationalized as follows:

a. Health impact refers to cases, deaths, case-fatality patterns, health-worker risk, surveillance, vaccination, infection prevention and control, and continuity of essential services.

b. Economic impact refers to macroeconomic disruption, livelihood loss, trade interruption, food-security effects, and fiscal pressure.

c. Social impact refers to trust, stigma, risk communication, cultural practices, survivor reintegration, and community participation.

d. Political and institutional impact refers to coordination, legitimacy, financing, state capacity, international dependence, and institutional learning.

e. STI-policy impact refers to diagnostics, vaccines, genomic surveillance, data systems, local research capacity, innovation governance, and preparedness for less familiar viral species such as Bundibugyo.

The analytical process followed a three-step synthesis. First, comparable factual indicators were extracted from institutional and academic sources. Second, these indicators were organized in synthesis tables to support cross-case comparison, not to substitute for interpretation. Lastly, the evidence was interpreted through the concept of differentiated resilience by asking how institutional memory, preparedness, community trust, security context, financing, and innovation capacity shaped response trajectories. The main limitation of this design is its reliance on secondary and institutional data, which may underrepresent local perceptions and informal coping mechanisms. The study therefore does not claim statistical causality; it offers a theoretically

informed comparative interpretation designed for policy learning and future field-based research.

Health Impacts: Between Collapse and Learning

The health impact is the most immediate and visible dimension of Ebola virus disease outbreaks. Because of its high case fatality rate, often estimated between 40% and 70% depending on the context. Ebola places extreme pressure on health systems, especially in low-resource countries. The 2014-2016 outbreak in West Africa is an emblematic case of systemic collapse, while recurrent outbreaks in the DRC illustrate a gradual process of learning and capacity-building (WHO, 2016; WHO, 2020). In both contexts, the most important lesson is that epidemic control depends not only on treatment centers but also on surveillance, infection prevention and control, safe referrals, laboratory capacity, and sustained public communication.

West Africa: A Systemic Crisis

In West Africa, the epidemic spread rapidly because health systems were not prepared for an event of such magnitude. Before presenting the comparative data, it is important to note that the crisis affected both direct Ebola care and the continuity of ordinary health services. The collapse of routine services amplified the human cost of the outbreak, as many people also lost access to vaccination, maternal care, malaria treatment, and basic consultations.

Table 1: Health Impact of the Ebola Outbreak in West Africa (2014-2016)

Country	Confirmed cases	Deaths	Case fatality rate (%)
Guinea	3,814	2,544	66.7%
Liberia	10,678	4,810	45.0%
Sierra Leone	14,124	3,956	28.0%
Total	28,616	11,310	39.5% (average)

Source: WHO (2016); CDC (2019)

Table 1 highlights the exceptional scale of the outbreak in West Africa in terms of both cases and mortality. Sierra Leone recorded the largest number of cases, whereas Guinea had the highest case fatality rate, partly because access to care was more limited at the beginning of the outbreak. Although Liberia was heavily affected, gradual improvements in clinical management contributed to a relative reduction in its fatality rate. Overall, these figures reflect a systemic health crisis characterized by rapid transmission and an initially insufficient response. The high infection and mortality rates among health-care workers further weakened health services, because the loss of trained personnel reduced treatment capacity at the very moment when demand for care was increasing.

The indirect effects were equally serious. Declines in vaccination coverage, facility-based deliveries, and routine consultations increased the risk of preventable deaths from other diseases. For this reason, Ebola response strategies should not suspend the rest of the health system; they should protect essential services through separate patient pathways, infection-prevention protocols, and emergency staffing plans.

Overall, West African health systems were rapidly overwhelmed. The outbreak was characterized by saturated hospital infrastructure, shortages of medical personnel, disruptions of essential services, and the systemic nature of the crisis.

DRC: Progressive and Experienced Management

Unlike West Africa, the DRC has developed significant expertise in managing Ebola outbreaks over several decades. This experience has translated into the gradual improvement of response capacities, particularly during the 2018-2020 outbreak in the eastern part of the country. However, the DRC experience also shows that technical expertise alone is not sufficient when public health interventions take place in a context of armed conflict, displacement, and community mistrust. As summarized in Table 2, this accumulated experience is reflected in strengthened surveillance, ring vaccination, and high-level international coordination during the 2018–2020 outbreak.

Table 2: Health Impact and Response Indicators in the DRC Outbreak (2018-2020)

Indicator	Value / characteristic
Confirmed and probable cases	3,470
Deaths	2,287
Case fatality rate	65.9%
Vaccination strategy	Ring vaccination (rVSV-ZEBOV)
Epidemiological surveillance	Strengthened
International coordination	High

Source: WHO (2020); Henao-Restrepo *et al.* (2017)

Although the case fatality rate remained high, the total number of cases was significantly lower than what was observed in West Africa. This suggests a stronger capacity to contain the outbreak. However, the high fatality rate also points to persistent challenges related to access to care in affected areas. Reduced detection delays and the use of ring vaccination were decisive in limiting viral transmission, while coordination with international partners strengthened the effectiveness of the response.

The early introduction of the recombinant vesicular stomatitis virus-Zaire Ebola virus (rVSV-ZEBOV) vaccine was a major innovation in Ebola outbreak management. Its use contributed to reducing transmission and marked an important advance compared with the situation in West Africa in 2014, when no vaccine was available for operational use (Henao-Restrepo *et al.*, 2017). The DRC case therefore demonstrates the value of linking scientific innovation to field logistics, surveillance, and community-based implementation.

Despite these advances, outbreak management in the DRC took place in a particularly complex context marked by insecurity, community mistrust, and the presence of armed groups. These factors sometimes obstructed health interventions and limited their effectiveness.

The comparison between West Africa and the DRC reveals two distinct dynamics: a systemic and disorganized crisis in West Africa, and a progressive, adaptive management model in the DRC. Thus, while Ebola exposed the fragility of African health systems, it also contributed to strengthening response capacities in certain contexts. This dual dynamic of collapse and learning is central to understanding health resilience in Africa.

Economic Impacts: Asymmetric Losses

Beyond its health consequences, Ebola generated major economic disruptions, affecting both macroeconomic dynamics and local activities. However, the intensity and nature of these impacts varied considerably between West Africa, where the crisis became systemic, and the DRC, where the effects remained more localized. This asymmetry can be explained by the scale of viral transmission, the economic integration of affected regions, and state capacity to contain the outbreak (World Bank, 2016). The economic dimension is essential because epidemic shocks reduce public revenue, disrupt household income, weaken food systems, and divert state resources from development priorities toward emergency response.

West Africa: A Systemic Macroeconomic Shock

In West Africa, the epidemic affected national economies through multiple channels. Movement restrictions disrupted markets, fear reduced consumption and investment, and the suspension of activities in agriculture, mining, trade, and services weakened growth. The crisis also revealed that health emergencies can quickly become development emergencies when they strike economies with limited fiscal space and high dependence on informal livelihoods.

Table 3: Comparative Economic Impacts of Ebola in West Africa and the DRC

Indicator	West Africa (Guinea, Liberia, Sierra Leone)	DRC
Scale of impact	National and systemic	Localized and regional
Main economic losses	More than US$2.8 billion estimated for the three most affected countries	Significant local disruption but limited national macroeconomic effect
Sectors most affected	Agriculture, trade, mining, services, investment	Local markets, agriculture, mobility, cross-border trade
Effect on GDP	Severe decline in projected growth	Low to moderate at national level
Duration of impact	Longer and more diffuse	Relatively shorter but severe for affected communities

Source: Author's synthesis based on World Bank (2016, 2019), IMF (2015), FAO (2015), and WHO (2020)

Table 3 shows that West Africa experienced a systemic economic shock characterized by a significant fall in GDP, a collapse of regional and international trade, and a sharp decline in foreign direct investment. Sierra Leone and Liberia were particularly affected in relation to GDP, while Guinea also suffered a major contraction in expected growth. These losses confirm that epidemic preparedness should be treated as an economic investment rather than only a health expenditure.

DRC: A Localized but Real Impact

In contrast, the economic impacts of Ebola outbreaks in the DRC were relatively contained at the national level. This was mainly due to the geographical concentration of outbreaks in rural or peripheral areas, especially in North Kivu and Ituri (WHO, 2020). However, local markets, agricultural production, mobility, and cross-border trade were significantly disrupted.

Despite this relative national resilience, local impacts in the DRC had significant consequences for the living conditions of affected populations, particularly in terms of food security and income. Insecurity in some areas also exacerbated the economic effects of the outbreak and limited the prospects for rapid recovery. This shows that macroeconomic stability can coexist with severe local vulnerability; therefore, response plans should include livelihood protection, food assistance, and support for small traders and farmers in affected zones.

This analysis of the economic impacts of Ebola reveals a strong asymmetry between West African and Congolese contexts. While West Africa faced a systemic macroeconomic shock, the DRC experienced a localized but non-negligible impact. This difference underscores the importance of outbreak containment capacity and the level of economic integration in shaping the consequences of health crises.

Social Impacts: Crisis of Trust and Social Recomposition

Beyond health and economic dimensions, Ebola outbreaks profoundly influenced the social structures of affected countries. They transformed community relations, cultural practices, and trust dynamics between populations and authorities. In crisis contexts, the social management of disease therefore becomes a decisive factor in the success or failure of health interventions (Wilkinson & Leach, 2015). The social dimension is especially important because epidemics are managed not only in hospitals but also in households, religious spaces, markets, burial practices, and everyday interactions.

West Africa: Social Disorganization and Normative Rupture

In West Africa, quarantine measures, safe burial protocols, and restrictions on movement transformed everyday social practices. Although these measures were necessary to reduce transmission, they sometimes weakened traditional mechanisms of solidarity and generated suspicion toward public authorities and external responders (UNICEF, 2016). The challenge was therefore to reconcile biomedical urgency with cultural legitimacy.

DRC: Community Resistance and Security Complexity

As shown in Table 4, the social impacts of Ebola in the DRC unfolded in a specific context marked by insecurity and the presence of armed groups. This situation complicated perceptions of the disease and the implementation of health interventions (WHO, 2020). Community resistance in eastern DRC was not merely a problem of misinformation; it was also linked to historical grievances, insecurity, political distrust, and perceptions of unequal attention to local suffering.

Table 4: Comparative Social Dynamics of Ebola Outbreaks

Dimension	West Africa	DRC
Community organization	Disruption of social networks and quarantine effects	Variable cooperation depending on local security and trust
Cultural practices	Suspension or modification of traditional funeral rites	Resistance to external protocols in some areas
Trust in authorities	Mistrust and contestation during the early response	Low to moderate trust, influenced by insecurity
Stigmatization	Rejection of survivors and affected families	Persistent rumors and fear in some communities
Key operational lesson	Culturally sensitive communication is essential	Security-sensitive community engagement is essential

Source: Author's synthesis based on Wilkinson & Leach (2015), Richards (2016), UNICEF (2016), WHO (2020), and Vinck *et al.* (2019)

In both contexts, Ebola outbreaks produced a deep crisis of social trust, affecting relationships among populations, authorities, and international actors. In West Africa, this crisis resulted in social disorganization and the disruption of cultural norms. In the DRC, it was amplified by security and political factors, generating more complex forms of community resistance.

Social trust therefore appears as a decisive condition for successful health interventions. Without population adherence, public-health measures, even when technically sound, remain limited in their reach. This reality underscores the importance of participatory, culturally sensitive, and locally adapted approaches to outbreak management. Community leaders, survivors, women's groups, youth representatives, and religious authorities should therefore be treated as co-producers of epidemic response rather than as passive recipients of public-health messages.

POLITICAL AND INSTITUTIONAL IMPACTS

Ebola outbreaks profoundly affected the political and institutional structures of the affected states, revealing both their vulnerabilities and their capacity for adaptation. Beyond health management, these crises highlighted issues of governance, coordination, and political legitimacy. A comparison between West Africa and the DRC points to two trajectories: a governance crisis in the former case, and a gradual process of institutional consolidation in the latter (Moon *et al.*, 2015). These impacts show that epidemic management is also a test of state capacity: the ability to collect information, make timely decisions, coordinate actors, mobilize resources, and maintain public trust.

West Africa: A Governance Crisis

In West Africa, the affected states were initially unable to respond effectively because of limited institutional capacity and insufficient coordination. Delayed recognition of the emergency, weak surveillance systems, and insufficient health infrastructure allowed the virus to spread rapidly and transform a localized outbreak into an international public-health emergency (Gostin & Friedman, 2014). The crisis therefore exposed the high cost of underinvestment in routine public-health institutions before emergencies occur.

DRC: Gradual Consolidation of Institutional Capacity

Unlike West Africa, the DRC has gradually strengthened its institutional capacities through experience accumulated from successive outbreaks. This learning dynamic has produced notable improvements in health governance and response mechanisms (Muyembe-Tamfum *et al.*, 2012). Improved alert and surveillance systems enabled faster case detection, while national coordination, although still imperfect, facilitated crisis management. Table 5 synthesizes this trajectory by contrasting the DRC's experience-based preparedness and more structured surveillance with the weaker and more fragmented initial preparedness observed in West Africa.

Table 5: Comparative Institutional Trajectories in Ebola Response

Institutional dimension	West Africa (2014-2016)	DRC (2018-2020)
Initial preparedness	Weak and fragmented	Relatively more developed due to previous outbreaks
Epidemiological surveillance	Insufficient at the beginning	More structured and experience-based
Government responsiveness	Delayed at the early stage	Faster but constrained by conflict
International dependence	Very high	High, but more integrated with national response structures
Institutional learning	Post-crisis reforms	Continuous learning through repeated outbreaks

Source: Author's synthesis based on Moon *et al.* (2015), WHO (2016, 2020), MSF (2019), and Muyembe-Tamfum *et al.* (2012)

The professionalization of response teams was another central element of this evolution. Specialized teams were trained to intervene rapidly during outbreaks, combining expertise in epidemiology, logistics, and crisis communication. This specialization improved the effectiveness of field interventions (WHO, 2020). Nevertheless, institutional consolidation remains incomplete when it is not supported by stable financing, decentralized health infrastructure, and credible communication with communities.

International Cooperation: Between Assistance and Reconfiguration of Global Governance

In both regions, international cooperation played a decisive role in managing Ebola outbreaks. Organizations, worldwide especially WHO, as well as numerous NGOs, were at the center of response systems, providing essential technical, financial, and logistical support (Moon *et al.*, 2015). The Ebola response illustrates the emergence of a multi-level model of health governance in which national authorities, international agencies, humanitarian organizations,

financial institutions, and security actors interact under emergency pressure.

One notable feature of the Ebola response was the partial militarization of health interventions, especially in West Africa. National and international armed forces were mobilized to provide logistics, build treatment centers, and secure affected areas. This involvement reflects a shift toward an expanded conception of security that includes health threats (Gostin & Friedman, 2014). However, the use of security actors must be carefully balanced with community acceptance, because coercive approaches can undermine trust and reduce compliance with public-health measures.

The diversity of cooperation mechanisms reflects the complexity of contemporary health crises. The Ebola response required a multidimensional approach combining medical expertise, financial resources, and logistical capacities. However, dependence on international assistance raises the question of the sustainability of national capacities.

The analysis of political and institutional impacts reveals contrasting trajectories between West Africa and the DRC. In the first case, the outbreak exposed a governance crisis marked by structural weaknesses and heavy external dependence. In the second, it contributed to the gradual consolidation of institutional capacities, despite persistent constraints. In both cases, international cooperation played a central role while redefining the contours of global health governance. Ebola epidemics therefore appear not only as health crises but also as moments of reconfiguration of political and institutional systems.

LESSONS LEARNED: TOWARD DIFFERENTIATED RESILIENCE

The comparative analysis of Ebola epidemics in West Africa and the DRC reveals a set of structuring lessons for the management of health crises. These lessons show that health resilience depends not only on available resources, but also on accumulated experience, the quality of governance, and the integration of social and political dimensions into response strategies (Moon *et al.*, 2015). Resilience should therefore be understood as a permanent capacity to anticipate, absorb, adapt to, and recover from health shocks without abandoning essential services.

Strengthening Health Systems: Learning Through Experience

A major lesson from Ebola outbreaks is the crucial importance of strengthening health systems. The DRC experience illustrates how repeated crises can foster progressive institutional learning and improved response capacities. Conversely, the lack of experience in West Africa contributed to the initial disorganization of health systems (Muyembe-Tamfum *et al.*, 2012). The key priority is to move from temporary emergency units to durable national systems capable of surveillance, diagnosis, isolation, referral, treatment, and risk communication.

Multi-Actor Coordination: A Strategic Imperative

Initial failures in West Africa revealed the limits of fragmented coordination between national and international actors. The absence of effective coordination mechanisms delayed the response and contributed to the expansion of the outbreak (Moon *et al.*, 2015). In the DRC, pre-existing coordination mechanisms enabled a faster and more integrated response, even though insecurity complicated implementation.

Centrality of Communities: A Decisive Factor

One of the most important lessons concerns the central role of communities in managing health crises. Experiences in West Africa and the DRC show that the absence of community adherence can undermine the effectiveness of public-health measures (Wilkinson & Leach, 2015). Community engagement should begin before outbreaks through health education, trust-building, survivor networks, and the inclusion of local authorities in preparedness planning.

Innovation and Research: Decisive Advances

Ebola outbreaks also stimulated significant advances in innovation and research. The development of vaccines, especially rVSV-ZEBOV, and the improvement of epidemiological surveillance techniques were major steps forward in the fight against emerging diseases (Henao-Restrepo *et al.*, 2017). Future resilience will depend on the ability of African states to participate actively in research, clinical trials, genomic surveillance, data systems, and vaccine-

delivery strategies rather than depending only on external innovation.

Health Security and Global Security: A Strategic Redefinition

Finally, Ebola outbreaks profoundly changed the way health is perceived in international relations by positioning it as a global security issue. The rapid spread of the virus across national borders demonstrated that health crises can become major transnational threats (Gostin & Friedman, 2014). This redefinition requires stronger regional cooperation, especially in cross-border surveillance, emergency stockpiles, laboratory networks, and rapid-response mechanisms as shown in Table 6.

Table 6: Key Lessons for Differentiated Health Resilience

Lesson	Operational meaning
Health-system strengthening	Invest in infrastructure, staff, surveillance, laboratories, infection prevention, and continuity of essential services
Institutional coordination	Clarify responsibilities among national authorities, WHO, NGOs, donors, and local actors
Community engagement	Build trust through participatory communication, local leadership, and cultural sensitivity
Research and innovation	Support vaccines, diagnostics, data systems, and locally adapted technologies
Regional cooperation	Develop cross-border alert systems, shared preparedness plans, and rapid-response mechanisms

Source: Author's synthesis based on Moon *et al.* (2015), WHO (2016, 2020), Wilkinson & Leach (2015), and Henao-Restrepo *et al.* (2017)

The lessons learned from Ebola outbreaks point to differentiated resilience based on experience, coordination, community engagement, and innovation. Although the crises exposed structural vulnerabilities, they also helped strengthen response capacities and redefine priorities in health governance. The construction of sustainable resilience in Africa therefore requires an integrated approach combining institutional strengthening, community participation, and international cooperation.

Bundibugyo as a Stress-Test of Differentiated Resilience

Bundibugyo virus disease functions as a stress-test of the differentiated-resilience framework. It changes the policy problem because response systems cannot rely on the same stock of licensed vaccines and specific therapeutics available for Zaire ebolavirus, while cross-border mobility, diagnostic uncertainty, and public fear may intensify mistrust (WHO, 2026). In this sense, Bundibugyo highlights the STI-policy dimension of Ebola preparedness: African health systems need platform technologies, flexible clinical-trial networks, pathogen-agnostic diagnostics, genomic sequencing, specimen-referral systems, interoperable data platforms, and regulatory readiness for rapid evidence generation.

For the DRC and neighboring countries, the Bundibugyo lesson is that operational experience is necessary but not sufficient. Institutional memory must be connected to adaptive innovation capacity. A country may have experienced response teams and still remain vulnerable if diagnostic pipelines, genomic surveillance, risk communication, emergency procurement, and community-negotiation mechanisms cannot be rapidly adjusted to a less familiar viral species. Bundibugyo therefore reinforces the central argument of this article: resilience is differentiated, and its strongest form combines experience, trust, local legitimacy, scientific capacity, emergency financing, and regional coordination.

DISCUSSION

The comparative analysis of Ebola outbreaks in West Africa and the DRC reveals a fundamental distinction between crisis dynamics and response trajectories. West Africa faced a sudden and systemic crisis that exposed deep structural fragilities, whereas the DRC experienced recurrent outbreaks that encouraged a gradual process of institutional learning and professionalization of response mechanisms (Moon *et al.*, 2015; WHO, 2020).

Conceptually, these findings allow differentiated resilience to be treated as more than a descriptive label. It can be used as an analytical lens for comparing health systems according to five interacting capacities: anticipatory capacity before the shock; absorptive capacity during the first weeks of transmission; adaptive capacity during operational adjustment; legitimacy capacity through trust and community ownership; and innovation capacity through vaccines, diagnostics,

data systems, emergency logistics, and genomic surveillance. This lens helps explain why similar pathogens can produce different institutional outcomes across countries and why technical interventions fail when they are not embedded in trusted governance arrangements.

This finding is consistent with the literature on global health security, which argues that epidemic preparedness depends not only on biomedical tools but also on governance capacity, institutional coordination, and trust between populations and authorities. Gostin and Friedman (2014) interpret the West African Ebola outbreak as a crisis of global health leadership, while Moon *et al.* (2015) identify it as a moment that exposed the weaknesses of the international outbreak-response system. The results of this article confirm these arguments by showing that delayed recognition, weak surveillance, and fragmented coordination transformed a localized health emergency into a transnational crisis.

The results also support the argument that repeated exposure to outbreaks can generate institutional learning. The DRC's experience demonstrates that accumulated practice, trained response teams, surveillance networks, and cooperation with international partners can improve preparedness over time. Muyembe-Tamfum *et al.* (2012) emphasize the long history of Ebola outbreak management in Central Africa, and the present analysis shows how this experience contributed to more structured responses during later outbreaks, even in difficult security environments.

At the same time, the comparison shows that learning is not automatic. In both West Africa and the DRC, health responses were constrained by structural weaknesses, including fragile health infrastructure, insufficient personnel, and dependence on external resources. This observation aligns with Elston *et al.* (2017), who show that the 2014-2015 outbreak had extensive indirect effects on health systems, including reduced use of essential services. The article therefore confirms that epidemic response must be linked to the long-term strengthening of health systems rather than limited to emergency intervention.

The social dimension of the findings also resonates strongly with existing literature. Wilkinson and Leach (2015) argue that Ebola responses cannot be reduced to technical interventions because they are embedded in histories of inequality, distrust, and social interpretation. Similarly, Richards (2016) demonstrates that communities were not merely obstacles to outbreak control but also producers of local knowledge and practical solutions. The results of this study confirm that community engagement was decisive in both contexts: where populations trusted response teams and participated in prevention strategies, interventions were more effective; where distrust, rumors, or coercive approaches prevailed, resistance increased.

The DRC case further demonstrates the intersection between health insecurity and armed conflict. The presence of armed groups in North Kivu and Ituri shaped perceptions of the outbreak and increased risks for responders. Vinck *et al.* (2019) show that institutional mistrust and misinformation affected preventive behavior during the 2018-2019 Ebola outbreak in eastern DRC. The findings of this article confirm that health governance in conflict-affected settings requires more than medical capacity; it also requires security-sensitive strategies, community negotiation, and political legitimacy.

Economically, the results confirm that epidemic shocks are shaped by the structure of national economies and by the spatial distribution of outbreaks. In West Africa, Ebola became a systemic macroeconomic shock, reducing growth, disrupting trade, and weakening investment. In the DRC, the impact remained more localized, although local livelihoods, markets, and food security were significantly affected. This supports the World Bank's analysis that Ebola produced large economic losses in the most affected West African countries while also revealing how health crises can undermine development gains (World Bank, 2016).

Finally, the article shows that Ebola acted both as a revealer of vulnerabilities and as a catalyst for institutional transformation. It exposed weak health systems, limited governance capacity, and fragile social trust, but it also encouraged innovation, vaccination strategies, rapid response mechanisms, and renewed attention to global health security. This dual role is essential for

understanding resilience: crises do not automatically produce stronger institutions, but they can create opportunities for reform when lessons are institutionalized and when communities are treated as partners rather than passive beneficiaries.

In sum, the findings are broadly consistent with the existing literature but add a comparative interregional perspective. They show that the difference between West Africa and the DRC does not lie only in the number of cases or deaths, but in the historical depth of preparedness, the degree of institutional learning, the strength of community engagement, and the capacity to integrate national and international responses. The central lesson is that health resilience in Africa must be built before crises occur, through investments in health systems, surveillance, trust-building, local participation, and regional cooperation.

CONCLUSION, POLICY IMPLICATIONS, STUDY LIMITATIONS AND RECOMMENDATIONS

Ebola epidemics have profoundly transformed African health systems in both structural and functional terms. The West African experience, particularly in Guinea, Liberia, and Sierra Leone, demonstrates the devastating effects of a health crisis on fragile and insufficiently prepared systems. Conversely, the DRC provides an example of relative resilience based on accumulated experience and the gradual improvement of response capacities (WHO, 2020). The comparative evidence confirms that resilience is not improvised during emergencies; it is constructed through long-term investment, institutional continuity, and public trust.

This synthesis highlights the divergence of trajectories between the two contexts. It confirms that health resilience depends not only on available resources but also on institutional experience and the adaptive capacity of systems. Despite progress, major challenges persist. Fragile health systems, the deficit of trust between populations and authorities, and dependence on international assistance continue to limit the effectiveness of health responses. These challenges call for an integrated and sustainable approach to strengthening resilience to future crises.

Policy Implications for STI and Health-Governance Mechanisms

The findings have direct implications for STI policy, health-security governance, and epidemic-preparedness financing. First, African governments should treat pathogen surveillance, diagnostic capacity, vaccine-delivery systems, genomic sequencing, bioinformatics, and health data platforms as strategic STI infrastructure. These capacities should be financed as permanent public goods rather than temporary emergency inputs. Ministries responsible for health, science and technology, higher education, finance, and defense should therefore establish joint epidemic-innovation mechanisms linking public-health institutes, universities, laboratories, regulators, local manufacturing actors, and community-based response structures.

Second, STI policy should strengthen regional preparedness mechanisms. The African Union (AU), the Africa Centres for Disease Control and Prevention (Africa CDC), regional economic communities, and national public-health institutes should consolidate interoperable early-warning systems, cross-border sample referral, shared genomic databases, emergency procurement rules, and regional rapid-response teams. This is especially important for border zones where trade, displacement, conflict, and informal mobility make national-only preparedness insufficient.

Third, innovation policy must be socially embedded. Technologies such as vaccines, diagnostics, digital tracing, genomic sequencing, and data dashboards are effective only when communities trust the institutions that deploy them. Policy mechanisms should therefore finance community-trust infrastructure, including trained community liaisons, survivor networks, anthropologists, psychologists, religious and traditional leaders, women's groups, and youth communicators. These actors should be integrated into preparedness plans before outbreaks occur, not mobilized only after resistance appears.

Fourth, the study supports the creation of dedicated emergency-financing windows that protect essential health services during outbreaks. Epidemic response should include budget lines for

maternal care, vaccination, malaria treatment, mental-health support, food security, and livelihood protection. This prevents outbreak control from becoming a source of secondary mortality and social disruption.

Finally, the Bundibugyo analytical extension shows that STI-policy mechanisms must be pathogen-flexible. Preparedness should not be limited to a single Ebola species or a single vaccine platform. It should build adaptive systems capable of rapidly evaluating new diagnostics, therapeutics, vaccines, genomic signals, and operational protocols when less familiar variants emerge. This is the core policy meaning of differentiated resilience.

Study Limitations

This study has several limitations. First, it relies mainly on secondary data from reports produced by international organizations, which may introduce biases related to data quality and availability. Second, the absence of fieldwork limits the ability to fully capture local dynamics and the perceptions of affected actors. Finally, the qualitative approach, although appropriate for comparative analysis, does not allow for the quantitative measurement of all variables studied. Future research should therefore combine documentary analysis with field interviews, community-level surveys, and comparative quantitative indicators in order to better capture local experiences of epidemic governance.

Recommendations

In light of the results of this study, several recommendations can be made to strengthen health resilience in Africa as shown in Table 7. These recommendations point to a multidimensional approach in which health-system strengthening, governance reform, research investment, emergency financing, regional coordination, and community participation are treated as mutually reinforcing priorities.

a. Sustainable strengthening of health systems should be a strategic priority, especially through investment in infrastructure, staff training, surveillance systems, and infection-prevention capacity.

b. Investment in research and health technologies is essential to anticipate and contain future outbreaks. African research institutions should be more actively involved in vaccine evaluation, field epidemiology, and operational research.

c. Improved health governance requires effective coordination among national and international actors, as well as transparent communication that builds confidence before and during crises.

d. The development of regional rapid-response mechanisms would improve the anticipation and management of transboundary crises, especially where population mobility and cross-border trade are high.

e. Community integration in crisis-management strategies is indispensable for ensuring adherence and the effectiveness of interventions. Communities should be engaged as partners in preparedness, surveillance, safe burial practices, and survivor reintegration.

f. In conflict-affected areas, epidemic response must include security analysis, protection of health personnel, negotiation with local actors, and measures that avoid reinforcing political mistrust.

Table 7: Strategic Recommendations for Strengthening Health Resilience in Africa

Strategic area	Key Recommendations
Health systems	Strengthen infrastructure, train health personnel, protect essential services, and improve infection prevention and control
Research and innovation	Invest in vaccines, diagnostics, genomic surveillance, data systems, and locally adapted technologies
Health governance	Improve national coordination, clarify institutional responsibilities, and establish emergency financing mechanisms
Regional cooperation	Develop cross-border surveillance, rapid-response teams, laboratory networks, and shared preparedness plans
Community engagement	Integrate populations, survivors, local leaders, women's groups, and youth networks into crisis-management strategies
Security-sensitive response	Adapt interventions to conflict settings through negotiation, protection of health workers, and locally legitimate communication

Source: Author's synthesis based on the findings of this study

Ultimately, Ebola epidemics offer valuable lessons for the management of health crises in Africa and beyond. They underline the importance of an integrated approach combining institutional strengthening, scientific innovation, and social participation in order to build sustainable resilience to global health threats.

REFERENCES

Center for Disease Control and Prevention. (2019). 2014-2016 Ebola outbreak in West Africa. https://www.cdc.gov/ebola/outbreaks/index.html

Elston, J. W. T., Cartwright, C., Ndumbi, P., & Wright, J. (2017). The health impact of the 2014-15 Ebola outbreak. *Public Health*, *143*, 60-70. https://doi.org/10.1016/j.puhe.2016.10.020

Feldmann, H., & Geisbert, T. W. (2011). Ebola haemorrhagic fever. *The Lancet*, 377 (9768), 849-862. https://doi.org/10.1016/S0140-6736(10)60667-8

Food and Agriculture Organization of the United Nations. (2015). Guinea, Liberia and Sierra Leone: Ebola outbreak. https://openknowledge.fao.org/handle/20.500.14283/i4003e

Gostin, L. O., & Friedman, E. A. (2014). Ebola: A crisis in global health leadership. *The Lancet*, *384* (9951), 1323-1325. https://doi.org/10.1016/S0140-6736(14)61791-8

Henao-Restrepo, A. M., Camacho, A., Longini, I. M., Watson, C. H., Edmunds, W. J., Egger, M., Carroll, M. W., Dean, N. E., Diatta, I., Doumbia, M., Draguez, B., Duraffour, S., Enwere, G., Grais, R., Gunther, S., Gsell, P.-S., Hossmann, S., Watle, S. V., Konde, M. K., Kieny, M.-P. (2017). Efficacy and effectiveness of an rVSV-vectored vaccine in preventing Ebola virus disease: Final results from the Guinea ring vaccination, open-label, cluster-randomised trial (Ebola Ca Suffit!). *The Lancet*, *389*(10068),505-518. https://doi.org/10.1016/S0140-6736(16)32621-6

International Monetary Fund. (2015). Regional economic outlook: Sub-Saharan Africa. https://www.imf.org/en/Publications/REO/SSA

Inzaule, S. C., Tessema, S. K., Kebede, Y., Ogwell Ouma, A. E., & Nkengasong, J. N. (2021). Genomic-informed pathogen surveillance in Africa: Opportunities and challenges. *The Lancet* Infectious Diseases, *21*(9), e281-e289. https://doi.org/10.1016/S1473-3099(20)30939-7

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

Medecins Sans Frontieres (MSF). (2019). Ebola response reports. https://www.msf.org/ebola

Moon, S., Sridhar, D., Pate, M. A., Jha, A. K., Clinton, C., Delaunay, S., Edwin, V., Fallah, M., Fidler, D. P., Garrett, L., Goosby, E., Gostin, L. O., Heymann, D. L., Lee, K., Leung, G. M., Morrison, J. S., Saavedra, J., Tanner, M., Leigh, J. A., ... Piot, P. (2015). Will Ebola change the game? Ten essential reforms before the next pandemic: The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola. The Lancet, 386(10009), 2204–2221. https://doi.org/10.1016/S0140-6736(15)00946-0

Muyembe-Tamfum, J. J., Mulangu, S., Masumu, J., Kayembe, J. M., Kemp, A., & Paweska, J. T. (2012). Ebola virus outbreaks in Africa: Past and present. Onderstepoort *Journal of Veterinary Research*, *79*(2), Article a451. https://doi.org/10.4102/ojvr.v79i2.451

Mwamba, D. K., Akilimali, P. Z., Manianga, C., Kapanga, S., Ngombe, N. K., Shonganye, J., Angendu, K. B., Moullec, G., & Zarowsky, C. (2026). Current experiences and practices of surveilling and managing Ebola virus disease outbreaks in the Democratic Republic of Congo by involving the community in a One Health approach. *Pandemics*, *1*(1), Article 3. https://doi.org/10.3390/pandemics1010003

Ochola, R. (2025). The case for genomic surveillance in Africa. *Tropical Medicine and Infectious Disease*, *10*(5), Article 129. https://doi.org/10.3390/tropicalmed10050129

Richards, P. (2016). Ebola: How a people's science helped end an epidemic. Zed Books. https://doi.org/10.5040/9781350219779

United Nations Children's Fund (UNICEF). (2016). The social impact of Ebola and UNICEF response reports. https://www.unicef.org/emergencies/ebola

Vinck, P., Pham, P. N., Bindu, K. K., Bedford, J., & Nilles, E. J. (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

Wilkinson, A., & Leach, M. (2015). Briefing: Ebola - myths, realities, and structural violence. *African Affairs*, *114*(454), 136-148. https://doi.org/10.1093/afraf/adu080

Wirsiy, F. S., Tahmo, N. B., Tatah, L., & Brett-Major, D. M. (2024). Resilience of mental health services amidst Ebola disease outbreaks in Africa. *Frontiers in Public Health*, *12*, Article1369306.https://doi.org/10.3389/fpubh.2024.1369306

World Bank. (2016). The economic impact of the 2014 Ebola epidemic: Short- and medium-term estimates for West Africa. https://www.worldbank.org/en/topic/macroeconomics/publication/2014-ebola-epidemic-short-and-medium-term-estimates-for-west-africa

World Bank. (2019). Democratic Republic of Congo economic update and Ebola response resources. https://www.worldbank.org/en/country/drc

World Health Organization. (2016). Ebola outbreak 2014-2016West Africa.https://www.who.int/emergencies/situations/ebola-outbreak-2014-2016-West-Africa

World Health Organization. (2020). Ebola virus disease - Democratic Republic of the Congo. Disease Outbreak News, 26 June 2020. https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON284

World Health Organization. (2026). Ebola disease caused by Bundibugyo virus - Democratic Republic of the Congo and Uganda. Disease Outbreak News, 16 May 2026. https://www.who.int/emergencies/disease-outbreak-news/item/2026-DON602