

REVIEW

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# Mitigating the escalating threat of infectious diseases outbreaks in tropical Africa: a perspective examination of challenges and strategies for future preparedness

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## Abstract

**Background** The escalating threat of infectious disease outbreaks in Africa, particularly emerging and re-emerging diseases, necessitates urgent and comprehensive action. The frequency of these outbreaks demands a robust enhancement of notification and reporting systems to enable swift public health interventions.

**Main body of the abstract** Tropical diseases such as malaria, COVID-19, typhoid fever, yellow fever, arboviruses, cholera, rabies, schistosomiasis, tuberculosis, black fungus, meningitis, evolving pathogens, and antimicrobial resistance pose significant health risks globally, especially in Sub-Saharan Africa. The region faces complexities in healthcare, including weak systems, inadequate surveillance, socioeconomic disparities, and other issues. Poor health literacy, traditional practices, and distrust hinder effective disease control and contribute to disease emergence in Sub-Saharan Africa. Continuous research and global collaboration are essential to address these public health concerns, especially given Africa's unique challenges. Disease surveillance emerges as a highly effective strategy, crucial in regions vulnerable to infectious diseases. Establishing and strengthening comprehensive surveillance and reporting systems at individual, regional, national, and international levels is crucial due to the unpredictable nature of borderless outbreaks and their significant impact on morbidity, mortality, and economic stability. National surveillance relies heavily on effective control mechanisms within local community areas, necessitating the active involvement of medical personnel. Successful systems depend on functional countries using collected data for timely warnings and localized interventions. Stakeholders, including governments, health authorities, and international organizations, must collaborate urgently to implement and sustain these vital systems, mitigating the devastating consequences of infectious disease outbreaks. Additionally, a holistic approach is crucial, involving prioritized local production of vaccines, medicines, and diagnostics through initiatives like the African Vaccine Producers Initiative. This approach emphasizes the need for domestic pharmaceutical production, intensified public awareness campaigns, and the training of the next generation of global health leaders, ensuring multidimensional strategies, political and diplomatic skills, and evidence-based assessments.

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**Conclusion** Collaboration among governments, international organizations, and educational institutions is essential for successful policy advocacy and implementation to strengthen health security and mitigate the continuous rise of infectious diseases on the continent.

**Keywords** Infectious diseases, Emerging diseases, Re-emerging infectious diseases, Disease surveillance, Global health security

## 1 Background

Tropical Africa refers to the entire geographic region between the Tropic of Cancer and the Tropic of Capricorn and includes a large and quite diverse collection of countries, encompassing a variety of vegetation conditions, from alpine grasslands to coastal mangroves and the most humid regions, from rainforest to semi-desert [1]. This African sub-region is composed of the following countries; Gambia, Upper Volta, Mali, Niger, Chad, Benin, Ivory Coast, Ghana, Guinea, Guinea-Bissau, Liberia, Nigeria, Sierra Leone, Togo, Angola, Cameroon, the Central African Republic, Congo, Gabon, Equatorial Guinea, Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Uganda, Rwanda, Somalia, Sudan, Tanzania, Zambia, Zimbabwe, Namibia and Botswana. These countries have been grappling with one or more infectious diseases due to poor health infrastructure and manpower [2]. Many outbreaks of diseases have emerged or re-emerged in Africa in the twenty-first century. Some of them are related to newly discovered diseases or infections, while others are known to be historical diseases, such as plague and cholera. In addition, diseases associated with previously known microorganisms, including the Ebola virus, Zika virus, and Chikungunya virus, have recently been implicated in large-scale outbreaks with global consequences for the first time [3]. Africa is distinguished from other regions of the world that are affected by the emergence and re-emergence of diseases, with the most dangerous infectious agents causing a higher mortality rate coming from Africa. Moreover, the problems of disease control in Africa are well known [4]. Many evaluations of surveillance systems in the context of many recognized infectious diseases have occurred over the past decade and have identified a variety of problems. Poverty and poor health care exacerbate health problems. African countries have the lowest per capita expenditure on health [5]. At the beginning of the twenty-first century, disease outbreaks accounted for a quarter of global deaths, killing at least 10 million people a year, mainly in tropical countries. Emerging infectious diseases pose a significant public health burden and impact the global economy. Its origin usually depends on environmental and ecological factors, as well as social and economic conditions. The risk of zoonotic and vector-borne infectious diseases in wildlife exists mainly in low-latitude

developing countries, such as tropical Africa. Overall, 60% of newly emerging disease outbreaks are zoonotic diseases, and 72% of these are animal diseases [6, 7]. The increasing frequency of disease outbreaks in Africa emphasizes the critical need for improved planning and response techniques. Africa requires a thorough examination of existing surveillance systems. Considering the climatic, biological, social, and economic aspects that influence the formation of infectious illnesses, the tropics, particularly tropical Africa, have been identified as high-risk areas for zoonotic and vector-borne diseases. Therefore, this study aims to evaluate the current challenges to disease outbreak preparedness in the tropics, notably in Africa, and to propose strategies to improve future preparedness in combating emerging infectious diseases.

## 2 Main text

### 2.1 Current disease epidemics in tropical Africa

Tropical diseases are a diverse group of infectious diseases common in tropical and subtropical regions, caused by pathogens such as viruses, bacteria, and parasites. Unfortunately, they are often “neglected” because they commonly affect people with low socioeconomic status, poor sanitation and housing, and areas with difficult access to healthcare [8]. Tropical diseases are generally becoming less isolated in tropical regions as a result of the increasing globalization of trade and travel to and from endemic places [9]. Infectious diseases, maternal diseases, perinatal disorders, and nutritional diseases accounted for 43.9% of all causes of mortality and disability about 20 years ago, whereas non-infectious diseases accounted for 40.9%. This picture has been drastically modified [10]. In 2017, the leading cause of death and disability worldwide shifted from communicable to non-communicable diseases. There is evidence of a decline in premature mortality from enteric infections, respiratory infections, tuberculosis, and maternal and neonatal diseases between 1990 and 2017, with the greatest declines in the poorest countries [11]. But these broad patterns of global disease mask enormous regional and geographic variations in health risks. Risks such as child underweight, indoor air pollution, and micronutrient deficiencies continue to place a disproportionate burden on health in Sub-Saharan Africa (SSA) [11, 12] (Table 1).

**Table 1** Cumulative cases of several diseases in the WHO African region with date

S No.	Infectious disease	Cumulative cases	Dates
1	Malaria	249,000,000	Till-2022
2	COVID-19	13,140,365	Till-2024
3	Typhoid fever	17.8 million	Till-2015
4	Yellow fever	203	2021–2022
5	Cholera	348 609	2022–2024
6	Rabies	2779	In 2021
7	Monkeypox	86 724	2022–March 2023
8	Ebola	11,310	2015–2016
9	Dengue virus	171 991	In 2023
10	Hansen's disease	33 690	in 2010
11	HIV	25.6 million	In 2022
12	Hepatitis B	82 million	In 2023
13	Hepatitis C	9 million	In 2023
14	Crimean–Congo hemorrhagic fever (CCHF)	499	Till 2023

Malaria has become one of the most common tropical diseases. About 3.2 billion people worldwide are at risk of contracting the disease [13]. There were 249 million cases of malaria worldwide in 2022, with an expected 608,000 fatalities. The WHO African region faces a disproportionate burden, accounting for approximately 94% of cases and 95% of deaths in 2022, with children under the age of five accounting for 78% of malaria-related deaths in the region. Notably, Nigeria, Uganda, the Democratic Republic of the Congo, and Mozambique combined accounted for more than half of all malaria deaths globally [14]. Typhoid fever, often known as enteric fever, is another tropical disease of major global health significance. It is a bacterial infection caused by *Salmonella typhi* [9], resulting in an estimated 11–20 million cases and 140,000 fatalities globally each year. SSA alone contributes significantly, with over 1.2 million cases and 29 thousand fatalities annually [15]. Like malaria, yellow fever, endemic to tropical and subtropical regions of Africa and South America, is transmitted by the bite of an infected mosquito. The yellow fever burden is 84,000–170,000 severe cases and 29,000–60,000 deaths in Africa [15]. Arboviruses, particularly dengue (DENV) and chikungunya (CHIKV), are becoming increasingly serious health concerns, attracting global interest [16]. Arbovirus cases globally reached 3,123,752 in 2022, with dengue accounting for 90% of infections and chikungunya accounting for 9%. This is a 119% rise from 2021, emphasizing the need for additional research on the shift away from established transmission methods [17]. Cholera constitutes a global health concern, affecting roughly 2.9 million people each year and resulting in 95,000 fatalities globally, the

majority of which occur in countries with low to middle incomes [18]. In Africa alone, 40 million people live in cholera-endemic areas, and since the 1st of January 2022, a total of 259,325 cholera cases have been reported to the WHO Regional Office for Africa (AFRO), including 4695 deaths, with a case fatality ratio (CFR) of 1.8% as of November 19, 2023 [19]. Currently, every country on the African continent is considered to be prevalent in dog-related rabies, resulting in approximately 21,000–25,000 deaths per year [19, 20]. Schistosomiasis, a fresh water-transmitted neglected tropical disease (NTD) of poverty in low-and middle-income countries (LMICs) in Africa, accounts for as many as 90% of cases across the globe, resulting in approximately 280,000 deaths attributed to schistosomiasis each year [21, 22]. In a given year, Africa accounts for one-quarter of all worldwide tuberculosis (TB) cases, with over 25% equivalent to 417,000 deaths of the nearly two million global deaths associated with TB occurring across Africa [23]. Because of the persistence of meningitis outbreaks and epidemics, SSA has been labeled the Africa meningitis belt (AMB). According to nearly four out of every five cases in Africa in 2016, AMB accounted for more than 45% of all cases globally [24].

Another escalated infectious disease that affected the African continent is COVID-19. Africa's first case of COVID-19 was confirmed in Egypt on February 14, 2020, reaching the continent through travelers returning from the tropics in Asia, Europe, and the United States. It emerged in early March 2020, and as of March 31, 2022, African regions had more than 900,000 confirmed cases and more than 12,000 deaths [25]. Thus far, the pandemic has impacted every nation in Africa. As of June 28, 2023, there were more than 9,538,679 confirmed cases and 175,394 deaths in the WHO Africa region [26]. However, while COVID-19 did not initially emerge faster in Africa than in other parts of the world, it accelerated along with the circulation of variants of concern (VOC) on the continent. In most African countries, the case fatality rate (CFR) is 2.2% higher than the global average [27]. In tropical African countries, the first case of COVID-19 was reported in Nigeria and spread throughout the region, leaving most of the countries with weak health systems facing a variety of health challenges due to the pandemic [28]. In addition, patients suffering from endemic diseases such as cholera, tuberculosis (TB), malaria, and bacterial infections tend to use drugs rationally due to limited access to healthcare, thereby contributing to the emergence of drug-resistant pathogens and increased morbidity and mortality from these endemic diseases [29]. Furthermore, the burden of fungal diseases has increased significantly in recent decades, representing a global threat to humans, animals, and plant health. Every year, more than 1 billion fungal diseases of varying

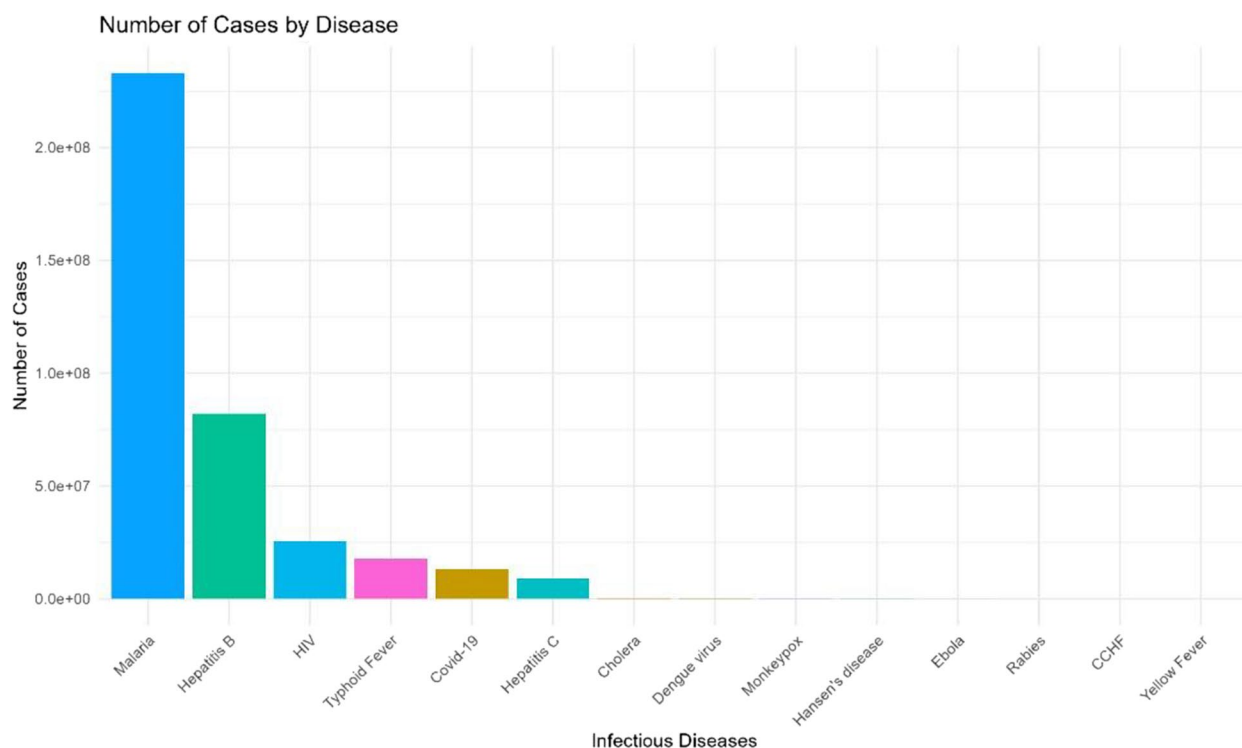
severity occur worldwide [30]. These fungal infections include dermatophytosis, *Vulvovaginal candidiasis*, allergic diseases, subcutaneous infections, and life-threatening invasive systemic diseases. Mucormycosis is one of the most common fungal infections in the African region. Recently, there have been approximately 408 fungal cases reported in 12 countries in Africa. North Africa accounted for 330 cases (80.9%), followed by Southern Africa with 63 cases (15.4%), East Africa with seven cases (1.7%), West Africa with seven cases (1.7%), and Central Africa with one case (0.2%) [31]. Some of the main causes of this fungal disease in Africa include human immunodeficiency virus infection (HIV), tuberculosis, poverty, and the increasing number of people suffering from non-communicable diseases, especially cancer, asthma and diabetes [32] (Fig. 1).

In the WHO African region in 2021, 118 outbreaks were documented, a rise from 106 in 2020. By October 2022, 129 outbreaks had been documented in the same region, with many of them spanning boundaries. The African region recorded 1,800 public health emergencies (PHE) during 2001 and 2022, the majority of which were emerging infectious illnesses [33]. In SSA, zoonotic epidemics increased by 63% between 2012 and 2022, compared with 2001–2011. Between 2001 and 2022, outbreaks of zoonotic diseases accounted for 33% of PHEs [33]. Many disease outbreaks have been reported

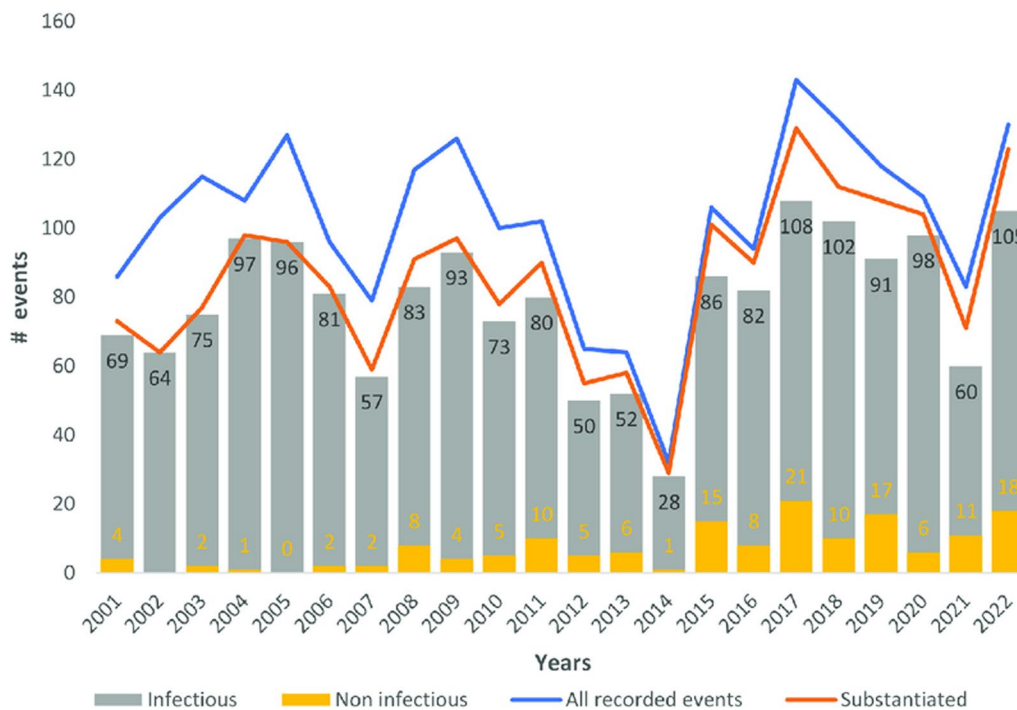
in African countries, such as cholera, meningitis, Ebola, measles, yellow fever, monkeypox, Zika, Rift Valley fever, and COVID-19 were some of the reported emerging infectious diseases [33]. Climate change, microbial adaptation, demographics, human susceptibility, shifting ecosystems, technology, international travel, economic development, breakdown of public health measures, famine, poverty, war, lack of political will, and social inequality are all factors that contribute to the emergence and re-emergence of diseases in Africa. Unfortunately, these contributing factors are extremely high in all African countries. Climate change has altered weather patterns in tropical Africa, facilitating the spread of vector-borne diseases. Human behavior continues to be an important variable in the development of new clinical disorders [3, 9] (Fig. 2).

### 2.2 Current challenges

The unpredictability and relentless features of infectious disease onset are an ongoing challenge. Despite tremendous progress, particularly during the last two decades, infectious diseases continue to kill millions of people annually. More virulent pathogens continue to emerge and reappear [6]. Genetic alterations in pathogenic microbes result in a big challenge, particularly in Africa, which can adapt to new or existing hosts, posing an enormous challenge due to antimicrobial



**Fig. 1** Graphical representation of the cumulative cases of disease in the WHO African region (Source: self-compiled online)



**Fig. 2** Patterns of occurrences in the WHO African region, from 2001 to 2022 [34]

resistance, which can potentially result in pandemics. High genomic variation during viral replication, as well as medication pressure, reduce antiretroviral therapy efficiency and necessitate regimen changes [35]. This problem extends to bacterial illnesses, which are also antibiotic-resistant. Aside from genetic changes, other variables can affect the pathogenicity of pathogens. Despite breakthroughs in diagnosis and control measures, the unforeseen emergence of new diseases and the emergence of drug-resistant diseases remain a concern, underscoring the importance of continued efforts and the creation of novel antiviral and antibacterial agents [36]. Addressing the complexity involved with emerging and re-emerging infectious illnesses is a continuous problem for African countries [3]. The widespread dissemination of diseases, including some that are not well known, and the participation of various animal species make effective surveillance and early action difficult. Predicting zoonotic emerging disease episodes is also a chronic scientific difficulty, highlighting the continuous and multifaceted nature of this public health challenge for African nations [37, 38]. SSA healthcare systems confront issues such as underinvestment, wars, limited disease surveillance, and an increase in non-communicable diseases [39]. Active surveillance is fragile due to critical shortages of healthcare staff, personal protective equipment (PPE), and testing platforms. Data quality suffers as a result of a lack of electronic databases.

Fragile states in SSA deal with weak institutions, poor governance, political instability, and violence [40]. A shortage of skilled healthcare staff, severe workloads, and low motivation are all associated with poor disease surveillance. Inadequate PPE and isolation rooms exacerbate infection control, resulting in cross-infections. In vulnerable groups, a lack of laboratory testing capacity contributes to virus spread [33]. Widespread poverty, low socioeconomic status, and limited access to healthcare are some of the prevailing challenges. Overcrowding and poor hygiene lead to several diseases in the SSA, where 34% of households live in extreme poverty. Malnutrition affects 20% of the entire African population, increasing susceptibility and limiting treatment options [40]. Low health literacy and low-risk perception lead to decreased knowledge, fewer vaccines, and postponed treatment, consequently facilitating the transmission of infectious illnesses [33]. Traditional burial customs, such as bathing dead bodies, aid in the rapid transmission of diseases such as Ebola in West Africa [41]. Illegal immigration in SSA, where porous borders lack comprehensive port-of-entry surveillance, allows for the import/export of new infectious diseases and complicates contact tracing. As seen in communities afflicted by several infectious diseases, mistrust of governments and healthcare systems has led to lower immunization and treatment rates, while social stigma has stopped people from accessing healthcare [42].

### 2.3 Future preparedness strategies for unforeseen disease outbreaks

Africa in general is likely to bear the burden of the current major infectious diseases for the next 10–15 years. In addition, the continent faces additional challenges from emerging diseases, the resurgence of older diseases with increased virulence, and disease threats from other parts of the world. In this context, the management and control of infectious diseases may become a major challenge for the African public sector. Fundamental and technical control measures will be required in the future. Basic control measures are widely available and can significantly contribute to risk management, particularly in tropical regions. However, effective implementation depends on political, economic, cultural, disease, and public health factors beyond the control of infectious disease experts [3]. The following is the future preparedness for disease outbreaks in African tropical regions:

Public health education is crucial for preventing and controlling emerging diseases in Africa. It serves as the foundation for knowledge among healthcare providers and the general population, guiding their actions in disease prevention and health promotion [43]. This proactive health education approach focuses on promoting health and discouraging habits that may contribute to disease, establishing a framework for a healthier and more resilient population in the face of emerging and re-emerging infectious diseases [44]. However, infectious diseases remain a leading cause of death in Africa, especially for children under five [45, 46]. A multifaceted strategy is needed to effectively tackle infectious diseases that are re-emerging and emerging. Continuous research and development of widely protective vaccinations using innovative technology are required to keep up with emerging infections [47]. Recognizing potential endgame scenarios and prioritizing broad immunization to avoid severe cases, disrupt viral propagation, and protect against new variations are expedient [48]. We must be able to forecast future dangers, invest in rapid-response vaccination platforms, speed up vaccine development with efficient processes [49] while maintaining robust monitoring capabilities by utilizing instruments such as wastewater surveillance and rapid diagnostic tests, and create a global epidemic response team for early identification and effective mobilization during epidemics, together with thorough public awareness campaigns to combat false information [47, 50]. It is imperative to prioritize and strengthen surveillance and response capabilities. Despite improvements in reducing tropical diseases, resource-constrained societies confront difficulties in generating less favorable pathogen habitats [51]. Global coordination, as demonstrated by smallpox and polio eradication programs, emphasizes the need for

integrating surveillance data into targeted, timely public health treatments. Effective surveillance systems provide critical information for disease prevention, control, and elimination [52]. Urgent operational research is required to adapt surveillance tactics to local conditions. To strengthen healthcare systems and promote long-term development, governments and policymakers should execute comprehensive policies that include prevention, control, community mobilization, and agricultural mechanization [53].

To successfully combat emerging and re-emerging infectious diseases in Africa, coordination and collaboration must be improved through a One Health system [53]. Considering the majority of emergent diseases in the region have zoonotic origins, a multifaceted approach integrating human, animal, and environmental health sectors is required. Zoonotic diseases, such as those that cause public health emergencies, demonstrate the interconnection of various areas [48, 49]. A One Health strategy, which includes collaborative efforts in program creation, policy formulation, law enforcement, and research, is effective in preventing, identifying, and responding to new zoonotic illnesses. With limited resources, a united strategy can produce cost-effective solutions while improving health outcomes for communities in Africa and around the world [54, 55]. Prioritizing Universal Health Coverage (UHC) is critical for Africa's future preparedness against emerging and re-emerging infectious diseases. UHC ensures that everyone has fair access to high-quality health care without incurring financial hardship [56]. Despite problems such as poor governance and inadequate resources, given Africa's enormous disease burden and small health workforce, building health systems for UHC is critical [39]. UHC can promote early disease diagnosis, avoid financial calamities, and defend against economic downturns, as demonstrated by the economic impact of the Ebola outbreak. Embracing UHC not only provides clinical and economic benefits but also promotes social equality by reducing the unequal burden on the poor [56, 57]. Global cooperation and collaboration are critical for sharing knowledge, resources, and expertise to combat infectious diseases that cross-borders [58]. It is critical to strengthen healthcare systems by investing in resilient infrastructure, training workers, and encouraging community participation. Preparedness planning, which includes regular drills, governance structures, and adaptive processes, is critical for limiting epidemic damage [59]. Research and development investments in diagnostics, treatments, and vaccinations are crucial for an effective response. Adaptability and flexibility in techniques, systems, and individual behaviors are critical for dealing with outbreaks of disease [60].

## 2.4 Recommendations

Urgent action is required to address the escalating threat of infectious disease outbreaks, particularly in African nations. The surge in the frequency of these outbreaks demands a robust enhancement of notification and reporting systems dedicated to tackling emerging and re-emerging infectious diseases that necessitate swift public health interventions. Disease surveillance stands out as a highly effective strategy in regions vulnerable to infectious diseases. Given the unpredictable nature of outbreaks, which respect no borders, their impact on morbidity, mortality, and economic stability is profound [39, 46]. To counteract these challenges, it is imperative to establish and fortify comprehensive surveillance and reporting systems at individual, regional, national, and international levels. National surveillance heavily relies on the efficacy of control mechanisms within local government areas, often necessitating active involvement from medical personnel. The success of these systems is contingent on functional countries utilizing the collected data to issue timely warnings and initiate localized interventions. Stakeholders, including governments, health authorities, and international organizations, must collaborate urgently to implement and sustain these vital systems, mitigating the devastating consequences of infectious disease outbreaks [3].

Addressing the burden of emerging and re-emerging infectious diseases in Africa requires a comprehensive approach. Governments must prioritize local production of vaccines, medicines, and diagnostics, investing in initiatives like the African Vaccine Producers Initiative. The heavy reliance on imported pharmaceuticals underscores the need for domestic pharmaceutical production, necessitating strategic investments and capacity-building efforts. Additionally, promoting local production of diagnostic products is crucial, especially in light of the challenges exposed by the COVID-19 pandemic [60]. Public awareness and education campaigns should be intensified to enhance knowledge about infectious diseases, considering cultural perceptions, to ensure effective health measures. Furthermore, training the next generation of global health leaders is imperative, emphasizing multidimensional approaches, political and diplomatic skills, and a focus on evidence-based assessments. Collaboration among governments, international organizations, and educational institutions is essential for successful policy advocacy and implementation of these recommendations to strengthen health security in Africa [48, 49].

## 3 Conclusion

In conclusion, this study underscores the imperative for immediate and concerted action to address the burgeoning threat of infectious disease outbreaks in Africa. Emphasizing the critical role of enhanced notification and reporting systems, the study advocates for the implementation of robust disease surveillance mechanisms at local, regional, national, and international levels. Moreover, the imperative to prioritize local production of vaccines and pharmaceuticals, coupled with intensified public awareness campaigns tailored to cultural perceptions, emerges as a cornerstone of effective preparedness. The pivotal need to invest in the training of a proficient cadre of global health leaders adept at multidimensional approaches, political acumen, and evidence-based assessments is urgent. The overarching recommendation resonates with collaborative endeavors among governments, health authorities, international organizations, and educational institutions to fortify health security in Africa. Recognizing the intricate challenges posed by infectious diseases, this study contends that proactive and unified measures are indispensable to mitigate their profound implications on public health, economic stability, and societal well-being on the African continent.

### Abbreviations

WHO	World Health Organization
SSA	Sub-Saharan Africa
NTD	Neglected tropical disease
LMICs	Low- and middle-income countries
TB	Tuberculosis
AMB	Africa meningitis belt
PHE	Public health emergencies
DENV	Dengue virus
CHIKV	Chikungunya virus
CFR	Case fatality ratio
AFRO	WHO Regional Office for Africa
UHC	Universal Health Coverage
COVID-19	Coronavirus disease of 2019
VOC	Variants of concern
CCHF	Crimean–Congo hemorrhagic fever

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### Author contributions

HKH, OAA, EM, NOO, MSA, DELP III, FAA, and OJO conceptualized, gathered data, and wrote the initial and final draft of this manuscript. All authors contributed equally to the writing of this paper and have read and approved the final draft.

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### Availability of data and materials

The dataset used and/or analyzed during the current study is available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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