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Impacts of Ebola disease outbreak in West Africa: Implications for government and public health preparedness and lessons from COVID-19

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ABSTRACT

There has been an increase in the outbreak of communicable diseases in recent times; the most recent ones are Ebola Virus Disease (EVD) and COVID-19. These diseases have had different impacts on society and the ecosystem. However, underlying these impacts are the levels of preparedness of governments and public health institutions to mitigate and control these diseases. Therefore, this paper aims to explore these impacts, government and institutional interventions and their nexus towards the effective management of such crises. A critical review of empirical literature was adopted for the methodological approach and narrative synthesis used for analysis. Results show that EVD had diverse impacts on West Africa; economically through the loss of income from economic activities due to widespread sickness among workers and movement restrictions. EVD also had significant social impacts, such as reduced community cohesion, school and business closures, job losses, food insecurity, and high morbidity and mortality. Though some good efforts have been made by different countries in collaboration with international organisations like the World Health Organization to control disease outbreaks more effectively, the recent COVID-19 pandemic has however exposed major weaknesses in the capacity of most African countries to cope. Poor capacity for testing and treatment, inadequate health facilities, poor incentives for health care workers, poor governance systems, poor border control, and awareness and research capacities impacted negatively on the capacity to control disease outbreaks. There is, therefore, a need to strengthen health systems across Africa through improved resource mobilisation, staff training, and coordination of investment strategies to sustain health system preparedness to manage future emerging or re-emerging outbreaks.

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Introduction

The last two decades have witnessed a steady increase in the outbreak of communicable diseases [11]. Several reasons have been given for this, such as increased rapidity of trans-border movements, uncontrolled deforestation, poor insect and rodent control programmes, overcrowding and poor sanitary conditions associated with urbanisation etc. [28,48,65]. However, underlying these reasons is the preparedness of government and public health institutions to identify sporadic diseases and control them before they become endemic or epidemic [79]. The Ebola Virus Disease (EVD) outbreak in West Africa came with many lessons, including the apparent lack of functional proactive disease control mechanisms for early disease detection and consequent control by most developing countries [19]. While there is a need for public health workers to be conversant with emerging epidemic management framework [29], there is more need for policymakers to develop a response plan that will detect, prevent, characterise, and quickly respond to the outbreak of epidemics. This has become pertinent owing to the evolving situation of EVD and the latest COVID-19 pandemic. World Health Organization [WHO] [88] reported that EVD risk cases might reappear in former affected countries or appear in current unaffected countries. Therefore, an adequate response plan is needed to contain the virus before it escalates into a larger outbreak.

The Ebola disease outbreak has shown a need to build capacities to handle potential epidemics before launching a response [24]. This implies ground-level preparations at the national scale for responses to disease outbreaks and emergencies. Such preparations, according to Marston et al. [52], must include but not be limited to coordination and leadership skills, technical support, functional communication, health system, logistics, and human resource management. The Ebola outbreak in West Africa further reveals that most outbreaks have transnational impacts [47]. This means that national governments must collaborate very closely with international agencies such as WHO and other countries for an effective response to outbreaks and emergencies. Although the WHO has been providing support in the forms of technical assistance and aid to Ebola-affected countries (a role they have played in several other disease outbreaks), Hoffman and Silverberg [36] observed that the deficiency in capacity and late response to outbreak noticed in the case of EVD and the recent COVID-19 pandemic by some national governments [82] suggest that individual countries must prepare for and respond to outbreaks and emergencies in a way that genuinely complements the efforts and supports from WHO.

Although several studies have been carried out on EVD, not many review studies have integrated the fragmented empirical evidence to provide coherent insight into its impact and the current situations with regard to the preparedness of different governments, especially the previously affected countries, to curtail a further sudden outbreak. A lack of understanding of the level of impact and preparedness of government and health institutions has the potential to cause more harm in situations of a resurgence or emergence of other communicable diseases [37]. This is evident in the way many national governments, especially in developing countries, responded to the COVID-19 pandemic [43]. Hence, understanding the country-level preparedness for disease outbreaks can help intervene appropriately with policies to enhance public health.

Methodology

We employed a critical literature review approach. A critical literature review analyses and evaluates several sources of information on a specific topic to provide a nuanced overview of the research that has been carried out and the general implications for policy and practice [71]. We started by identifying five key concepts/themes relevant to this study and articulated them into a logic grid as follows: Ebola virus disease, government efforts, public health preparedness, COVID-19, and West Africa as geographical scope. The alternative terms and variants of these key concepts/themes were also searched for robustness in the literature search. For instance, variants of the key theme 'Ebola virus disease' were searched, such as 'Ebola outbreak' and Ebola epidemic'. Variants of the 'government efforts' were also searched, such as 'government action', 'government programmes', and 'government interventions. 'Public health response' was also searched as an alternative to public health preparedness' while 'coronavirus' was searched as an alternative to COVID-19. These key themes and alternatives were searched in various online databases such as the web of science, MEDLINE Scopus, EMBASE, google scholar, and CINAHL.

After the compilation and removal of duplicates from search results, articles were screened for suitability for inclusion in the study, using their titles and abstracts. We included only studies whose abstracts directly or indirectly indicated the impacts of the EVD outbreak in West Africa, efforts of national governments in comparting EVD outbreak, and the status of COVID-19 in West Africa. Using the 'snowball method' additional papers were sourced by examining the reference lists of selected manuscripts that were considered suitable to include in the review.

We used a narrative synthesis approach to synthesise our search results. This approach brings together multiple evidence that tells a convincing story about the current state of knowledge regarding a research question [70]. In the first stage, we developed a preliminary synthesis of the selected studies using clusters and translating data via thematic analysis. In the second stage, we did an in-depth exploration of relationships within and between studies. Here, the emergent themes from the preliminary synthesis were examined and grouped into broader themes that represent different impacts of EVD outbreaks covering Economic, social, and health. We focused on the findings/results of each article and highlighted phrases and sentences that communicate the impacts of the EVD outbreak, government efforts/responses, healthcare system preparedness and lessons from COVID-19.

Table 1
Ebola virus Cases, deaths, and duration in West Africa (Source: [87])

Country	Cases	Deaths	Duration
Liberia	10,675	4,809	30th March 2014 to 9th June 2016
Sierra Leone	14,124	3,956	11th July 2014 to 17th March 2016
Guinea	3,811	2,543	26th December 2013 to 1St June 2016
Nigeria	20	8	23rd July 2014 to 19th October 2014
Mali	8	6	23rd October 2014 to 18th January 2015

Countries affected by EVD outbreak in West Africa

To understand the response of each government, we first provide a table with the total number of cases, deaths and duration of the EVD outbreak in West Africa between 2013 and 2016 (Table 1).

Impact of EVD outbreak on West Africa

Economic impact. Ebola profoundly impacted West Africa, with more impact on education and the economy [17,26]. Most economic impacts did not come from direct sicknesses but from "aversion behaviour" to avoid exposure to the Ebola virus [18]. Due to widespread sickness among workers and the restriction of the movement of goods and people, businesses closed, and economic activities declined. Many people fled from the affected zones for safety, and others were quarantined while many were cut off from food access to food supplies [26]. Furthermore, the epidemic also affected the economy of many nations in West Africa. About 50% of Sierra Leone's private-sector workforce was lost [16], the poor became even poorer [18], and more than $3.6 billion was lost per year between 2014 and 2017 in managing the epidemic [35]. According to CDC [16] and World Bank (2014), affected countries in West Africa, especially Guinea, Liberia and Sierra Leone, lost about $2.2 billion in 2015 in the gross domestic product (GDP). It was reported that it cost the healthcare sector in West Africa about $54 billion to manage the virus [54]. This huge cost would have been channelled to other productive sectors of the economy.

Social impact. Access to healthcare was compromised as healthcare systems were under pressure due to overwhelming demand [27]. Out of over 17,000 cases of EVD in West Africa, 898 cases were among healthcare workers resulting in 518 deaths [75]. This not only created shortage of healthcare workers in a region with an insufficient healthcare system but also created a social panic and demoralised most healthcare workers [80]. Furthermore, resources were diverted, and health facilities were closed down. There was reduced cohesion in communities, schools were closed, jobs were lost, and there were food insecurity, high morbidity, and mortality. The education of 5 million children and youth was set back [27]. For instance, in Sierra Leone, schools were closed for eight months, which resulted in the loss of learning period and increased social vices as many school children engaged more in crimes when idle and unoccupied with school activities [68]. The impact of EVD outbreak on food security had a more adverse effect in countries like Liberia, Guinea, and Sierra Leone, where household income was reduced and access to food was limited, especially where a member of households contracted the virus resulting in compulsory quarantine [78]. This situation limited physical movement and access to food. Moreover, before the EVD outbreak, there was free movement of goods and persons within and across countries. However, with the outbreak of EVD, there was a restriction on the movement of goods and persons, which threatened food security in the affected countries. More so, some countries like Liberia and Sierra Leone imposed a ban on hunting and consumption of bushmeat (Food and Agricultural Organization [31], 2014) since it was suspected as a host to the virus. The ban on bushmeat reduced the quality of diets, especially for households that depend on them for protein nutrient supply. It also incited fear and rumours among rural communities, exacerbating pre-existing tension within communities [7]. It also produced other unintended consequences. For example, following the ban on bushmeat, there was a proliferation of illegal networks of bushmeat trade across West Africa. This frustrated and drastically reduced the effectiveness of mitigation strategies and evidence-based surveillance systems meant to contain the spillovers of the zoonotic disease [7].

About 28,652 cases of Ebola were reported, with about 11,325 deaths [16]. The majority of the deaths occurred in Liberia (4,810), Sierra Leone (3,956), and Guinea (2,544). Fewer deaths were recorded in West African countries like Nigeria (8) and Mali (6) [17]. The impact of these widespread deaths created structural voids in the family system, which can result in socio-economic hardship and impede a child's development.

Health impact. The healthcare system in West Africa was severely affected due to the excess demand for healthcare services during the epidemic. More so, the healthcare system lost many health workers, resulting in panic, fear and loss of trust in healthcare systems [27]. Furthermore, many health facilities were closed, which reduced access to healthcare. For instance, Elston et al. [27] reported 80% reductions in maternal delivery, 40% national reductions in malaria admissions among children <5 years and significant reductions in vaccination coverage. Generally, there was a 60% mortality rate of those infected with Ebola [1] and an estimated 10,600 deaths due to a reduction in healthcare services because of the outbreak. Surviving victims also suffered permanent disability [26], and about 17,300 infants lost either one or both parents.

Psychological impact. Most epidemics are usually traumatic illnesses. Thus, beyond economic, social, and psychological impacts, the EVD outbreak in West Africa resulted in a lot of mental breakdowns, which generally reduced the quality of life. For instance, Bortel et al. (2016) noted that many people in isolation suffered from depression. The fear of death and the feeling of shame and guilt were also some psychosocial issues associated with EVD. There was also the issue of stigmatisation and ostracism associated with Ebola patients [61]. Some survivors were threatened and evicted from their families, which compounded the outbreak's actual health challenge. Furthermore, Nyanfor & Xiao [59] reported that out of the 116 people who survived the EVD, 66% suffered from post-traumatic stress disorder, 53% suffered from depression, 37% suffered from anxiety, and 34% attempted suicide.

Key stakeholders' role in containing EVD outbreak

The World Health Organization (WHO), even though slow to recognise and respond to the EVD outbreak in West Africa, played a critical role in coordinating, facilitating, and supporting national governments in the affected countries, especially in the area of communication, evaluation of research results, and sharing of research information to prevent duplication of research efforts [32]. Aside from the initial delay in taking action, WHO partnered with agencies like UNICEF, the Center for Disease Control (CDC), and other health-related international bodies to provide clinical and public health interventions [17] and also local agencies. WHO provided outbreak guidance on the strategic response, prevention, and treatment, and conducted capacity building to achieve immediate isolation, treatment, and burial of victims, and accelerated access to EVD vaccines, finance, and deployment of friendly diagnostic tools for easy detection of outbreaks [32]. The immediate response and collaborative effort of all concerned stakeholders and government is undoubtedly, a reason for the sustainable progress in tackling the outbreak.

Government EVD interventions and programs to manage a future outbreak

The EVD epidemic was an unexpected occurrence in West Africa. Starting from Guinea, where the first case was confirmed, the virus quickly spread to neighbouring countries like Liberia and Sierra Leone, mainly due to the high level of cross-border movement between these countries [5]. The outbreak in various countries was unexpected, and their health systems were not set up to deal with it [27]. But quickly, they mobilised with development partners to set up Ebola Treatment Units and successfully championed Ebola awareness campaigns. Here, we use WHO technical guidance for EVD as a benchmark to examine the efforts of the affected countries and assess government preparedness to manage future outbreaks adequately. To do this, we outlined the major programmes, policies, and infrastructures that enabled affected countries to manage the EVD outbreak between 2014 and 2016 and examined the current state of these programmes, policies, and infrastructures to ascertain readiness and preparedness to manage future outbreaks in line with WHO technical guidance for EVD.

The WHO technical guidance for EVD comes under six themes [83]. These include i) Strategy and coordination, which requires countries to review and enhance national public health emergency preparedness and response plans, and national command and coordination structures. ii) Surveillance, contact tracing, and laboratory. This requires countries to set up a public health surveillance system to detect and report cases of an illness compatible with the Ebola virus disease. iii) Case management, infection prevention and control: This requires countries' health workers to provide the best medical care to improve patient survival and provide symptom relief and palliation when required. iv) Safe and dignified burials: This guideline recognises that unprotected handling of the bodies of infected patients who have died constitutes a biosafety hazard. However, their burial process should be sensitive to family and community cultural and religious rights in a dignified manner. v) Community engagement, social mobilisation, and communication: This requires governments to carry communities along in their Ebola control and management programmes through effective communication channels. vi) Travel and points of entry: This requires countries to put in place public health emergency plans and standard operating procedures at designated points of entry, following international best practices, agreements and the International Health Regulations.

We now examine how the affected countries have attempted to implement these guidelines.

Strategy and coordination

The Incident Management System (IMS) was the primary vehicle for strategy and coordination in all the affected countries in West Africa. IMS was set up to manage the Ebola epidemics in countries like Guinea, Liberia, and Sierra Leone between 2014 and 2016 as part of the strategy and coordination plans [10]. During the outbreak, this system was used to coordinate emergency technical assistance of staff, response capacities, and activities of international partners in various affected countries. In monitoring and assessing the functionality and readiness of this system to respond to future outbreaks, Brooks et al. [10] and Olu et al. [64] observed that in Liberia and Sierra Leone respectively, IMS through the Emergency Management Development Team (EMDT) has established three data collection strategies to identify and respond to future outbreaks [10,64]. These include weekly situation reports, coordination calls, and an emergency management dashboard tool. Data collected through these strategies have been used to strengthen and improve government capacity to respond to long-term Ebola emergencies in Guinea, Liberia, and Sierra Leone. The IMS structure also strengthened collaborations between affected countries, establishing the foundation for enduring future emergency management systems. Similarly, Fitzgerald et al. [30] study show that several Ebola Holding units still exist in Sierra Leone, which helped manage affected individuals during the outbreak [30]. However, Kirsch et al. [47] also believed that in addition to the functionality of IMS, a behavioural change within the local communities was also a major factor that drove down the Ebola epidemic curve.

In Nigeria, upon the outbreak of EVD, the Nigeria Ministry of Health, together with the country's Centre for Disease Control, used the lessons and experience gathered in managing Polio in the country to declare a health emergency on EVD [57]. With the assistance of some development partners like WHO, an Ebola Incident Management Centre, which later evolved into the country's Emergency Operations Centre, was set up and used to manage the virus. Nigeria's corporate (private) sector also played a key role in managing the EVD [66]. Several indigenous and multinational companies took it up as corporate social responsibility (CSR) to assist the federal government in combating the virus. Notable donors include the Dangote Group, which donated ₦152 million (about 4 million USD as of 2017) and the Elumelu foundation, which donated ₦50 million(about $150) [63]. Other oil companies like SEPLAT, Shell, and Total also donated funds, utility vehicles, and other medical supplies [66]. These facilities will help combat the novel coronavirus.

In Sierra Leone, several types of EVD care facilities were established for an adequate response to the EVD outbreak. These facilities were operated under three models [41]. First is the traditional Ebola Treatment Centres (ETCs), which are newly built medical facilities with enough medical and nursing teams for testing and isolation of suspected patients and management of confirmed cases until they are discharged upon recovery or until death. International organisations mostly operated the ETCs. The second model is the Ebola Holding Units (EHUs), which are isolation units established within existing health facilities for screening and initial treatment of EVD. These units were largely staffed and managed by local health-care workers, with different amounts of support from international organisations [49]. The third model is the Community Care Centres (CCC) which are temporary and smaller centres mostly situated in rural areas, to enhance the mobilisation of affected persons [49].

In Liberia, the Ministry of Health and Social Work [MOHSW] set up an Incident Management System (IMS) composed of several technical committees, partners, and donors, to cover case management, social mobilisation, psychosocial management, laboratory management, contact tracing, dead body management, logistics, and Expanded Program on Immunization (EPI) surveillance [55]. However, Kennedy et al. [46] previously noted that the country's weak, fragmented and uncoordinated laboratory system affected government performance during the fight against the Ebola epidemic. As a result, the country established a National Reference Laboratory System to improve diagnostic services, manage public health surveillance, and strengthen and sustain laboratory services for future outbreaks. Despite this effort, there is still a need to further strengthen the initiative through improved resource mobilisation, staff training, and coordination of investment strategies to sustain health system preparedness to manage future emerging or re-emerging outbreaks [40].

Surveillance, contact tracing, and laboratory

To address the issues of surveillance, contact tracing, and laboratory, arguably the most central theme of the WHO's guideline to forestall future outbreaks, our review found that all the affected countries in West Africa set up a public health surveillance system to detect and report cases. Contact tracing is a systematic assessment, identification, and management process of individuals exposed to EVD to prevent further transmission [73,83]. Anybody who gives a positive history of exposure by direct physical contact to a confirmed, probable or suspected case is referred to as a contact [83,84]. Contact tracing and surveillance are key tools in the control of EVD outbreaks. Contact tracing is intricately connected to surveillance. The detection of an EVD case activates the process of surveillance, at which time contacts are traced and identified. These efforts further rely on other concurrent multi-pronged strategies, which are essential to halt the rise in several cases, such as case management and laboratory capacity ([6,25,84] & [60]). Contact tracing is closely linked with case detection and surveillance processes so that subsequent symptomatic patients can be effectively managed [34,60]. The exposed persons are followed for 21 days (the maximum incubation period for the disease) from the date of the most recent exposure so that any symptomatic person can be detected and managed at the earliest, and thus any possibility of subsequent transmission of the virus can be neutralised [12,50,84]. Further, as this enables prompt isolation of a symptomatic person in a health centre, the treatment can be initiated earlier, thus reducing death rates [60,74]. Surveillance in Guinea, Liberia, Nigeria and Sierra Leone had case reporting contact tracing as the main components. Case reporting helped response staff to understand the current EVD distribution and impact trends in the countries and the projection of the current status of the response efforts. Contact tracing, on the other hand, helps in rapid case identification and referrals to isolation units, thus improving clinical outcomes and reducing transmission opportunities. It requires exposed persons tracking for 21 days and constant, effective community engagement [12,50,84].

The countries in West Africa had adopted similar overall surveillance components at the end of the epidemic. Cases were identified by contact tracing or surveillance, such as calls to the national alert systems and a visit to ETUs, isolation centres, and hospitals. Once a probable case is identified, additional information, such as their contacts, is gathered. Generally, contact tracing in all the countries was often hindered by poor staffing to follow the enormous contacts, with difficulties in accessing some remote villages, staff insufficient pay and training. Community mistrust of contact tracers was among the main difficulties encountered in contact tracing. At the peak period of the epidemic, when the number of infected cases dramatically surged, few laboratories in-country were equipped to test samples from patients, resulting in substantial delays in sample transport, testing, and reporting. Difficulties linking laboratory results with epidemiologic data exacerbated reporting delays. Sometimes, sample testing and reporting were delayed a week or longer, which hindered the use of test results for patient management. To improve in-country laboratory capacity, the CDC and the National Institutes of Health established an additional laboratory in Monrovia, Liberia, in August 2014; CDC also established a laboratory in Kenema, Sierra Leone (later moved to Bo), that tested up to 180 samples each day at the peak of the epidemic. Expanding laboratory capacity improved patient management and the overall function of the surveillance system and resulted in a shift toward reporting

primarily confirmed cases (rather than suspected or probable cases) from all the countries by December 2014. The difficulties encountered in providing timely laboratory testing during this epidemic highlight the need to expand public health laboratory capacity in these countries.

Case management, infection prevention, and laboratory

Expanded Programme on Immunisation, although initially targeted to manage diseases such as measles, tuberculosis, diphtheria, tetanus, poliomyelitis, and whooping cough, was very instrumental in containing the EVD outbreak and was used for case management, infection prevention and control structures. This programme coordinated by the World Health Organization is still active– a positive indication of international institutions' preparedness to manage future outbreaks [77]. On the other hand, many community event-based management systems in countries like Liberia and Sierra Leone are no longer functional [69]. This may not be unconnected to the fact that these were short-term emergency responses initiated during the outbreak, which started losing relevance after the Ebola epidemic was declared over. Furthermore, Caceres et al. (2017) found that the Community event-based management generated several false alerts of Ebola incidents, unlike the National management system. At the national level, several countries have strengthened their national management system to manage possible future outbreak (Adokiya and Awoonor-Williams, 2016).

As part of the support interventions for case management, the WHO and CDC epidemiologists assisted the national health staff in each country in identifying cases and contacts and other essential public health activities [58]. In contact tracing, the CDC also helped strengthen the capacities of the national staff on the quality of contact identification and follow-up mechanisms, including isolation for clinical assessment and laboratory testing [85]. The Global collaboration with laboratories from the European Union consortium made real-time quantitative reverse transcription PCR available in the heavily affected West African countries for patients and decedents suspected of having Ebola. And the CDC experts also helped in coordinating the laboratory section of the incident management system, supported laboratories in Liberia with the US Department of Defense (DoD) and National Institutes of Health, and operated a field laboratory in Bo, Sierra Leone, that processed more than 2,000 samples during 3 weeks at the height of the epidemic; by mid-2015, that laboratory had processed above 20,000 samples [13].

Our review shows that all the affected countries in West Africa had limited capacity to isolate and treat patients safely and effectively. There was very limited availability of medication. At the beginning of the EVD outbreak, there was very little knowledge about treating or preventing the disease. As such, many people engaged in unorthodox self medications and prevention practices, which were very unhealthy and unscientific. In Nigeria, for instance, there were reports of people bathing with salted water as a cure and preventive practice for the EVD, out of ignorance and panic [45].

However, the national government of the affected countries in West Africa made good efforts towards a proferring solution to the problem. For instance, the National Institutes of Health in Sierra Leone conducted randomised controlled trials of Ebola treatment [20] and vaccines (ClinicalTrials.gov. [21]. The CDC staff worked with Sierra Leone authorities to implement a parallel Sierra Leone trial to introduce a Vaccine against Ebola (STRIVE), an adaptive, phased-introduction trial of a vaccine candidate among health workers in that country ([22,42]c).

However, support from international agencies was also very crucial. One of the key strategies for case management, infection prevention and control is Rapid Isolation and Treatment of Ebola (RITE). Beginning in early October 2014, the CDC, in collaboration with the US Agency for International Development's Office of Foreign Disaster Assistance (USAID/OFDA), WHO, DoD, and multiple other partners, designed and helped implement a strategy for RITE in Liberia. This was very helpful in controlling the outbreaks faster and supported the care of patients in remote areas, thereby cutting the time to control outbreaks in half and doubling survival rates [44]. The CDC and Médecins Sans Frontières organised a 3-day hands-on training course designed to train over 25,000 healthcare workers in infection control, including using personal protective equipment (PPE) in Guinea, Liberia and Sierra Leone [14].

The CDC, Médecins Sans Frontières', WHO, and other international partners helped the three most affected countries mobilise support, especially the advocate to the US government and the global community for more involvement. Technical guidance was also offered to the affected countries as part of case management and infection prevention and control. For instance, the CDC issued $>$200 scientific documents, including $>$100 technical guidance documents, covering many aspects of the response. CDC staff also worked closely with UNICEF and other partners to develop guidance in related areas, such as the safe reopening of schools [81].

Safe and dignified burials

To further control the spread of EVD, the WHO developed a guideline for a safe and dignified burial. However, given that West Africa consists of different cultures that highly emphasise funeral and burial practices, adopting this guideline was challenging (Manguvo & Mafuvadze, 2015). As noted by a WHO's report on the factors that contributed to the late detection of EVD within the region, most affected countries in West Africa hardly followed the WHO's guidelines on safe and dignified burials for dead Ebola patients. According to the report, cultural burial practices such as washing corpses and bathing with rinse water called the 'love touch' was linked to 80% and 60% of the Ebola cases in Sierra Leone and Guinea, respectively (WHO & [86]). On the other hand, media reports recorded that some dead bodies of Ebola patients were burned and not buried in countries like Liberia [4], while [9] noted that the bodies of those that died in isolation were safely buried, which helped to contain the outbreak. Most research on this guideline emphasised the challenge the affected countries faced in adhering and suggested that communities' social and behavioural patterns be embedded in creating theory and

practice-based interventions for such outbreaks. According to the research by Park [67], the Liberian government, the Guinea government, and the CDC deployed the 'National Ebola Response Strategy' and 'National Communication Strategy for Ebola' to manage safe and dignified burials. In Liberia, the CDC response team created 'Ebola Must Go: Bury All Dead Bodies Safely', a no-cost burial protocol that considered the communities' cultural inclination to encourage adherence to the WHO guideline [67]. There was a significant change in the initial resistance by the locals against the WHO guideline as long it took cognisance of their religious and cultural beliefs. For future outbreaks, guidelines should be created while understanding the culture of the people in question to drive adherence and practice.

Community engagement, social mobilisation, and communication

The World Health Organization (WHO) played a critical role in assisting national governments to communicate health intervention programmes to communities [32]. Effective communication and community engagement were very useful in contact tracing, rapid case identification, and referrals to isolation units (Lopaz. Furthermore, to enhance effective communication, the government of Liberia and Guinea, in partnership with the CDC, established the 'National Communication Strategy for Ebola' to reach out to local people to carry them along in their Ebola control and management programmes [67]. In Nigeria, effective communication via national dailies, radios and television broadcasts was instrumental in correcting the public on the earlier false knowledge about EVD, which was rooted in fear and ignorance [45].

In addition to the efforts of partner organisations, CDC field teams included emergency risk communication specialists to generate and disseminate accurate information, address rumours, decrease stigma, reduce unsafe burial practices, and respond to community needs. Through effective communication, the CDC staff in Liberia and Sierra Leone identified and promulgated burial practices that met community needs for culturally acceptable mourning, thus reducing resistance to safe burials. In all countries, community engagement and effective communication were key strategies for successful outbreak control [56,76].

Affected countries in West Africa also set up mechanisms to engage in community social mobilisation of affected persons. An example of this was the Community Care Centres (CCC) set up in rural communities in Sierra Leone. Overall, although the government of Sierra Leone, just like most other governments in West Africa, was initially criticised for the late response to the EVD outbreak, they seem to have put the right machinery in place to respond to the potential outbreak through proper community engagement [49]. This particularly has been facilitated with collaborations from WHO.

Travel and points of entry

On border security, the CDC worked closely with health ministries, airports, land borders and marine port authorities in most of the affected countries in West Africa to screen travellers leaving and coming into the countries by air, land and sea to prevent exposed persons from exposing others. To effectively implement this, the CDC partnered with airlines to address flight crew concerns which helped to enable humanitarian and public health organisations to sustain travel to affected areas by regular commercial airline flights. The CDC laboratory scientists implemented high-throughput laboratory capacity by using robotics and collaborated with private industry to promote the development of lateral-flow assays to detect Ebola at the point of entry into the country within 30 minutes after a finger stick or oral swab [15]. Effective border control measure and the vigilance of the aviation and health authorities was reported as one of the major reasons why Nigeria was able to contain the EVD outbreak quickly.

However, despite the efforts recorded to manage future outbreaks, one crucial area that is still porous and requires improvements is proper immigration control. Poor border control remains one of the major challenges in controlling and mitigating disease spread in Africa. To date, there is little evidence to show that the government has strengthened immigration and border control to identify infectious diseases before they get into the country. It would be recalled that EVD came into countries like Nigeria when an infected man from Liberia came into the country without being detected [51]**.** This is evident in the index case of COVID-19 in Nigeria, an Italian man who made his way into the country on a business visit on a Turkish Airlines flight in late February 2020. He was the first known case of COVID-19 infection in Nigeria. When he arrived in Nigeria, the Italian made contact with different persons, which resulted in several suspected and confirmed cases of the coronavirus pandemic in the country, especially in Lagos State and some South-West states where he visited. Border control is, therefore, one area that African national governments should pay serious attention to if the war against the spread of infectious diseases is won.

Overall, the outbreak of EVD in West Africa spurred many countries in the region to strengthen their health system. For instance, available evidence also shows that some West African countries have strengthened their Centres for Disease Control to be proactive in identifying and isolating emerging or re-emerging diseases (Musa et al., 2016; Saidu, 2018). In Nigeria, Musa et al. (2016) noted that the lessons learned from the Ebola epidemic in 2014 have reinforced the country's Centre for Disease Control to improve rapid response capacities, strengthened early warning systems, and the country's preparedness for future outbreaks. Similarly, Saidu (2018) reported that the emergence of the Ebola virus in most West African countries was an eye-opener for Ghana's health sector, which revealed the country's areas of weakness in disease control, and the consequent actions are taken to strengthen those identified areas.

Lessons learnt from COVID-19 pandemic

The first case of the new coronavirus outbreak was recorded in Wuhan on December 31st, 2019 and was declared an International Public Health Emergency on 30th January 2020 by the World Health Organisation [72]. The virus, which was

officially named COVID-19 was said to be transmitted through contact with infected individuals, and thus, control measures such as isolation of symptomatic patients, quarantine, and contact tracing were implemented in countries where the virus had been reported [90]. As of the end of January 2020, the World Health Organisation reported that there had not been a single case of COVID-19 in West Africa. Despite this, there were varying views with regard to the region's capacity to contain the virus due to its relatively poor financial capacity when compared to other high-income countries; most of the countries in the region are listed among the top 25 poorest countries in the world [53]. The opposing view was that the region could manage such a pandemic as it could draw from the experience used in handling outbreaks such as Lassa fever, Tika virus and the recent Ebola Virus Disease outbreak [66]. Speculations that the virus may not be able to withstand warm climates at the early stage of the outbreak may have escalated the othering behaviour in Africa. At the time the first case was recorded, only two countries (Nigeria and Sierra Leone) had testing facilities for the virus [53]. This unpreparedness was the same in 2014 during the early phase of the Ebola Virus Disease Outbreak (EVD) in West Africa.

The Ebola Virus Outbreak, which occurred in West Africa between 2014 and 2016, had the highest historical mortality and morbidity rate of 90%, with over 10,000 people dead by the end of 2016 [39]. The outbreak was termed an 'emergency' by many. The emergency served as an eye-opener to how fragile the healthcare system was in West Africa. For example, the study by Boozary et al. [8] observed that in Liberia, there were only 51 physicians to take care of over 4.3 million people in the country. In this case, there has always been a loophole in the system which have been neglected as such a workforce cannot handle even simple infection within the country. As EVD had no known vaccine, the support care technique was predominantly used yet the region lacked quality healthcare staff, resources and a system to tackle the outbreak. Many International Health Organizations deployed both human and physical resources to boost the region's healthcare capacity. Many suggestions and lessons to learn from the EVD outbreak were put forward by many studies [3,8] at the end of the emergency phase in 2016, which identified the different loopholes within the system and ways the regions could prepare itself for future epidemics. Training of healthcare workers in Infectious Disease Control increased funding for research in epidemic control, collaboration amongst member countries, integration of local authorities within the primary healthcare system to eliminate the distrust felt by the people and overall increased national capacity for diagnosing and managing such cases were just a few of the points put forward for action. The evidence of further action will be adjudged by the increased capacity to handle a situation like this in the future, such as COVID-19.

Country readiness to manage COVID-19

The World Health Organisation took a survey in early February 2021 to ascertain the African region's level of preparedness to combat COVID-19, and the result is shown in Fig. 1. In West Africa, only Cote D'ivoire had adequate resources to combat the virus. One might expect countries such as Nigeria, Congo, Guinea or Liberia, with extensive experience in epidemics such as this to have put up a readily available system to tackle health emergencies. Nigeria was the first country to record its first case in West Africa, followed by Senegal, and since then, there has been a significant rise in the number of cases which has debunked the myth that the warmer climate may have less number of cases than most cold climates. Although the African regional office of the World Health Organisation has deployed staff and Personal Protection Equipment (PPE) to many countries within this region, there are still inadequate healthcare facilities to cater to the region's massive population [90]. Most countries do not even have the resources to test for the virus.

During the Ebola Virus Outbreak, the lack of testing kits was one of the underlying factors in the high number of cases in Liberia and Guinea [33]. The testing kit is a necessity in the fight against any outbreak; its unavailability may ruin the whole effort to combat the outbreak. Over seven countries in West Africa did not have the basic testing kit for the coronavirus a month after the outbreak was reported (Fig 2). Most of these countries are among the poorest countries in the world and may be limited by their financial capabilities. However, despite some countries' capacity to test, the sufficiency of the testing kit still comes into question. The WHO reported that as of 22nd April 2020, Nigeria had only four testing centres which is worrisome for a country listed as one of the most populous countries in the world [90]. The efficiency of such a system is then questioned, showing a level of unpreparedness despite the region's window of opportunity to strengthen its defence. Boozary et al. [8] reported that many countries during the West African EVD outbreak used depleted hospitals or public buildings as isolation centres during the dire time. This situation persists as many countries are just establishing makeshift isolation centres, which are inappropriate for containing the virus.

The unprecedented increase in the number of cases in West Africa as seen in Fig 3, has been a cause for concern both for the countries and the international community, as the socio-economic implication of such an outbreak will be huge.

Most of the countries show a rapidly increasing trend line which may persist, except drastic measures within the healthcare system are taken.

In Nigeria and Guinea Bissau, health practitioners embarked on indefinite strikes during the peak of the coronavirus outbreak due to an unfavourable work environment and salaries owed [2]. This brings to mind the point made by Boozary et al. [8] and Otu et al. [66] that although the inadequate resource in the healthcare system was a core challenge to face, the basic issue was the health system. The EVD claimed the lives of many health practitioners in just the same manner as COVID-19, and thus, incentives should be put in place to boost the morale of front-liners. This shows that the case in most African countries is the lack of adequate health facilities and incentives for healthcare workers and a poor governance system that does not favour these key workers. These points were culled from the Joint External Evaluation which was carried out by the International Health Regulations in 2019 on the health sector vulnerability of African countries [38].

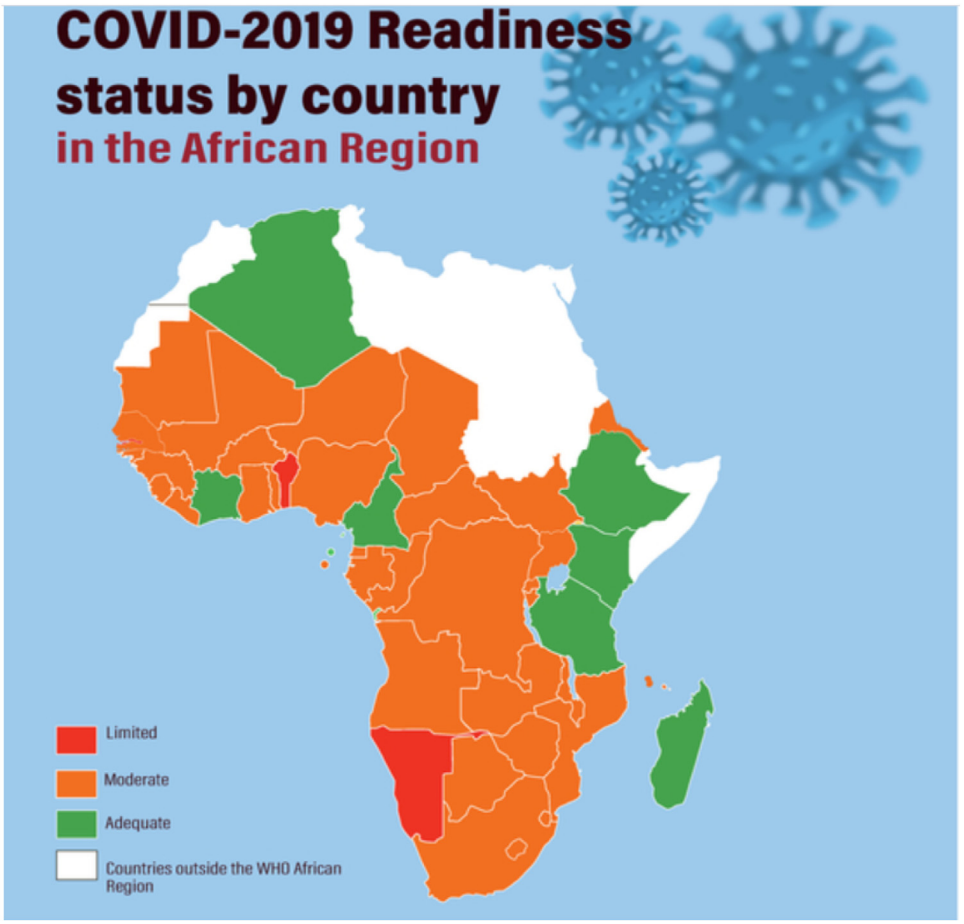

Fig 1. Result of the survey for COVID-19 readiness in 47 countries in Africa [90].

On a positive note, it is very commendable that the evidence from the response of African health practitioners to the COVID-19 pandemic shows that Africa still possesses the requisite human resource capacity to deal with any form of health challenges. All they need is the provision of the necessary political and infrastructural support from their respective governments. This is because most health practitioners surmounted the decay and loopholes in their health systems to demonstrate their medical prowess in the face of the pandemic. Most African countries made outstanding strides far above global expectations, which probably made Africa record the least number of deaths from the COVID-19 pandemic. In some cases, these achievements resulted in breakthroughs using unconventional methods or by improving the status quo.

Nigeria and Senegal have improved their molecular laboratory diagnostic skills for other disease outbreaks, such as Lassa fever and HIV, for COVID-19 testing [89]. On the other hand, Ghana has discovered a unique way of carrying out pool testing for a large population within a short time despite the lack of access to diagnostic reagents [38]. The 2020 Coalition for Africa report stated that the inadequate funding from the government sector was supplemented by many businesses from the private sector. In Nigeria, over $70 million was donated by such a coalition [23]. This show the significant impact of multi-sector partnership in achieving results.

In the race search for a cure for COVID-19, Madagascar was reported to have made a breakthrough by producing a herbal remedy – COVID-Organics from *Artemisia annua* plant, which was reported to have successfully been used for the treatment of the pandemic in the country and beyond, although its efficacy is still undergoing investigation by WHO. There has also been a surge of improvisation for vital tools used for the control of COVID-19 across Africa, such as locally manufactured testing kits, face masks, soap and hand sanitisers, which have been put out to serve the large population within this region [38].

The efforts of medical experts across West Africa paid off; despite the many doomsday predictions about the situation in Africa due to the perceived vulnerability of most African countries, Africa still stood tall in the front line of innovations for the control of this virus. On this note, the United Nations unit that manages epidemics, the Office for the Coordination of Humanitarian Affairs (OCHA), has therefore commended the giant strides that some African innovators have made [62]. Pioneering ideas which have significant potential to manage the pandemic have been put forward by health experts

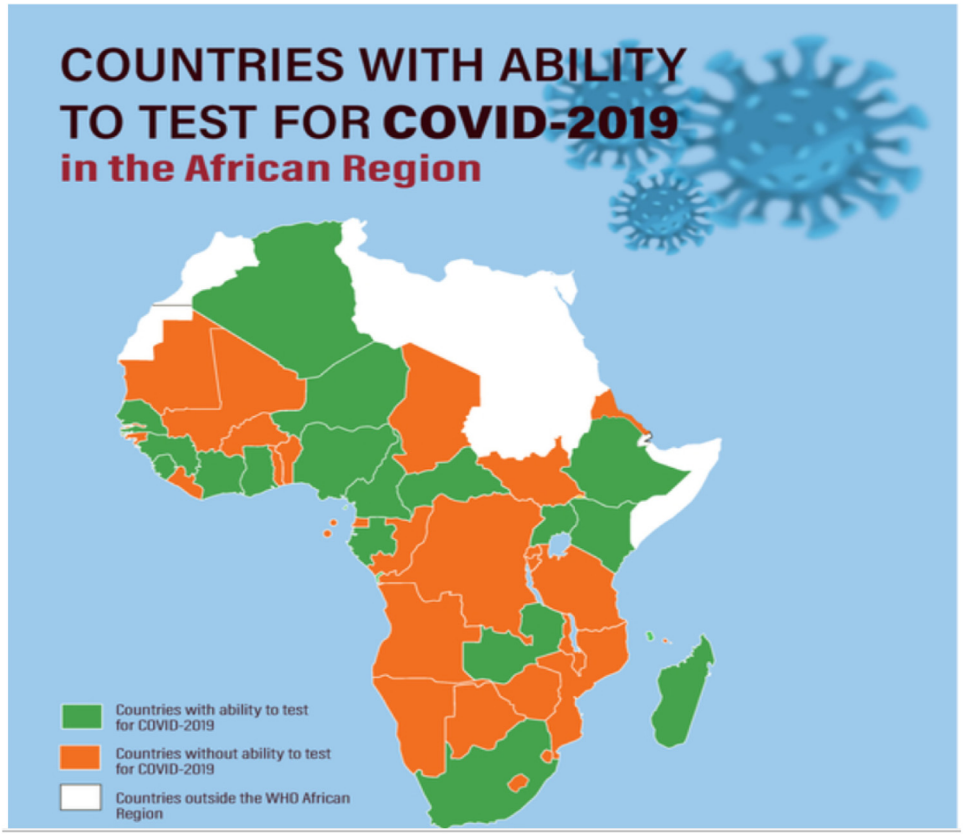

Fig 2. Countries with the ability to test for COVID-19 in the African region [90]

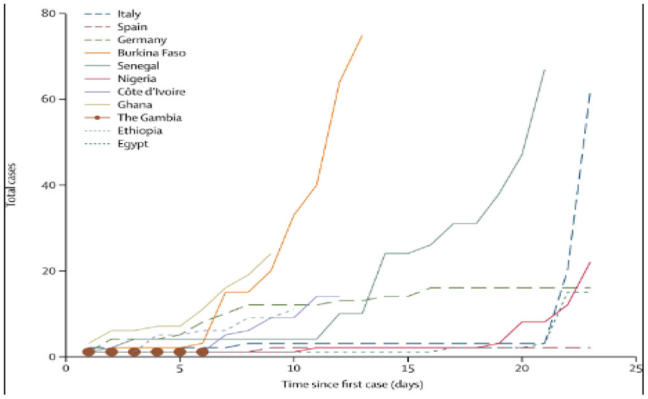

Fig 3. Evolution of the COVID-19 pandemic [53]

from Nigeria, Ghana, Guinea, South Africa, and Kenya. As these new adaptation strategies which fit into the African system emerge, there is still hope that the African healthcare sector can be at the forefront of control of pandemics such as COVID-19 if the sector is well funded, and the innovations arising from the pandemic are properly managed and advanced for the betterment of the African continent and world at large.

Conclusion

This review aims to shed light on understanding the impacts of the Ebola Disease outbreak in West Arica, the implication for government preparedness, and lessons from the COVID-19 pandemic. It identifies the collaborative linkage between key international stakeholders, particularly the WHO, and national governments and explores the vital lessons from the COVID-

19 pandemic regarding the shortcomings in government and public health preparedness in tackling disease outbreaks in West Arica.

The emergence of infectious diseases can be unpredictable. The Ebola outbreak in West Africa generated a lot of fear, prompting many national governments to take preventive measures to forestall a possible future outbreak. However, even after the epidemic, these countries' preparedness level to contain future epidemics is still in doubt; the actual status of programmes, policies, and infrastructures put in place to manage future occurrences are still weak. A clear case is the recent outbreak of the C-19 pandemic, which caught many African countries unprepared and gasping for breath in the face of the overwhelming decay and gaps in their health sectors. Aside from the general investment to improve the healthcare system by national governments in developing countries to manage future disease occurrences, governments should designate special emergency funds for another epidemic or pandemic. They should not wait for emergency health situations like EVD or COVID-19 before taking action.

Finally, there is a need to coordinate and manage the different innovations arising from the different disease outbreaks by governments, donor agencies and private organisations to ensure that such knowledge is not lost or exploited by unintended bodies.

Author declaration

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, concerning intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

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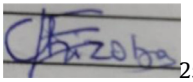
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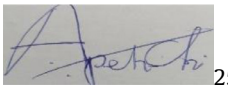
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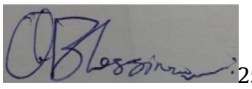
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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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