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Emerging Problems in Infectious Diseases

Fostering prevention and care delivery services capability on HIV pandemic and Ebola outbreak symbiosis in Africa

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Abstract

Human immunodeficiency virus (HIV) and the re-emerging Ebola virus disease (EVD) are closely intertwined and remain a persistent public health threat and global challenge. Their origin and rapid transmission and spread have similar boundaries and share overlapping impact characteristics, including related symptoms and other interactions. The controversies and global threat of these viruses require rapid response policy and evidence-based implementation findings. The constraints and dual burden inflicted by Ebola and HIV infections are highly characterized by similar socio-demographics, socio-economic and political factors. EVD has similar effects and burdens to HIV infection. This study seeks to understand EVD in the context of HIV epidemic despite the challenges in developing an effective vaccine against HIV and EVD. Our findings show that early understanding, prevention and treatment of these diseases a global health threat mainly in Africa is important and valuable. The lessons learned so far from HIV and Ebola epidemics are crucial in health programming and execution of rapid response interventions and continued vigilance against EVD before it become another worldwide health menace. Therefore, the current regional West Africa EVD requires strengthening healthcare systems and building preparedness and response capacity. Importantly, appropriate community participation, health education and resilience coupled with deployment of effective novel diagnostic approaches in early warning and surveillance of threats and emerging diseases. Therefore, there is an urgent need to develop novel key strategies are crucial in curbing the constant viral resurgence, persistence transmission dynamics and spread, as well in accelerating Ebola vaccines regimen (immunization) development and national implementation plans in achieving sustained control, and eventual elimination.

Key words: Ebola; HIV/AIDS; dual burden; surveillance; transition; response.

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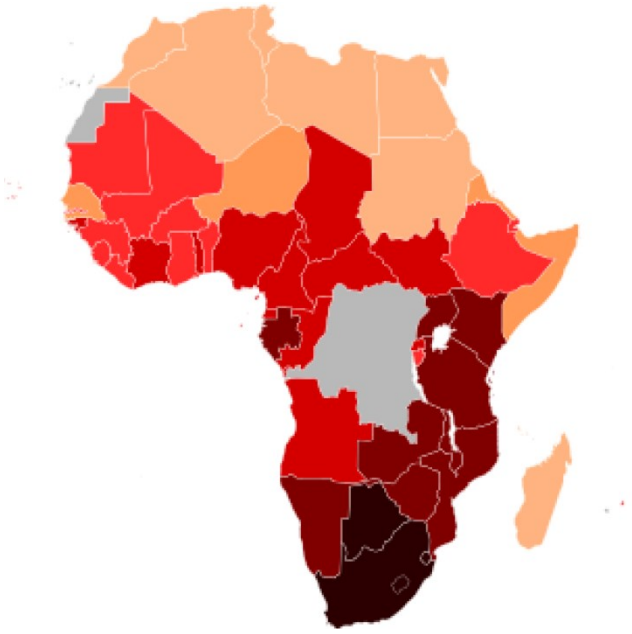
Introduction

The scaling up of effective, accessible, and affordable diagnostic tools for human immunodeficiency virus (HIV) and Ebola virus disease (EVD) detection are necessary, along with treatment and care, especially in hard-to-reach communities, to reduce HIV and EVD morbidity and mortality. In addition, robust surveillance interventions implementation strategies are required to predict, prevent and effectively control the resurgence and persistence of these diseases [1]. Unfortunately, most of these resurging infectious diseases are usually diagnosed late.

Despite the recommendations of the World Health Organization (WHO) and its partners, recommendations for routine HIV screening and treatment as prevention, the risk of new infection remains high in sub-Saharan Africa [2]. According to

Figure 1. Prevalence of HIV/AIDS in Africa, total (% of population ages 15–49), in 2011. Adapted from World Bank HIV/Aids in Africa 2011

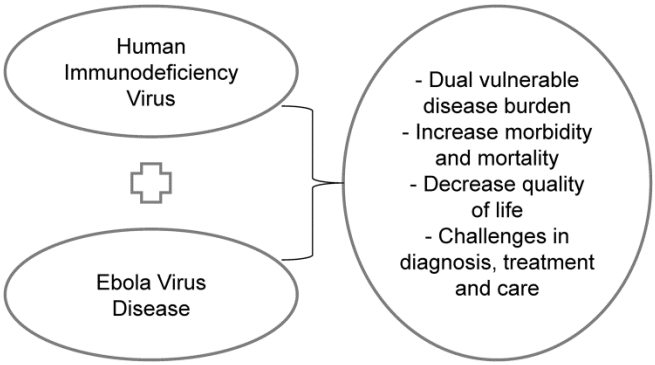


a report by the Joint United Nations Programme on HIV/AIDS (UNAIDS) [3], over 70% of all new HIV infections in sub-Saharan Africa occurred in 2012. According to Royal Victoria Regional Health (RVH) [4], over 90% of EVD cases were recorded in 2014 and early 2015. Additionally, global reports show that there are more than 25 million people living with HIV/AIDS (PLHIV) in sub-Saharan countries with South Africa and Nigeria constituting 6.4 and 3.5 million respectively [5-8]. In addition to these countries, South Africa, Nigeria and Côte d'Ivoire receive large numbers of temporary migrant workers every year from neighbouring countries, including sex workers and drug abuse, which tends to influence HIV epidemics [9,10]. Regionally, sub-Saharan Africa has an estimated adult HIV prevalence of 4.9 percent [3]. EVD countries have varying HIV prevalence rates: the Republic of Congo, 3.3%, Uganda (7.2%), the Democratic Republic of Congo (DR Congo) (1.1%), Guinea (1.4%), Sierra Leone (1.6%), and Liberia (1.1%) [11] (Figure 1).

To contain Ebola and HIV, more commitment is required from locals, civil society, local governments, and international organizations to curb the looming global public health challenges [11]. This includes enhancing the attitudes, behaviours, and communication skills of health workers and volunteers, as well as partnering with the affected communities. This can be done through new opportunities that help the local communities to understand humanitarian objectives and the need to stem Ebola, HIV and other emerging infectious diseases. These opportunities include social mobilization, training and workshops and local capacity building to empower communities to combat the consequences of emerging infections [1]. Others strategies include early diagnosis especially in remote rural communities compliance and adherence to antiviral therapy, standard protective measures, risk reduction processes, health-seeking behaviour, prompt reporting and tracing in health systems [12]. In addition, in-depth understanding of the socio-demographic socio-economic risk factors and ethical considerations are crucial in EVD and HIV quality care services delivery (Figure 2).

Although quarantining is another important means of containing emerging infectious diseases, proper disease containment does not mean restriction on international travelling, cross-border trade, and migration. It rather requires effective control, containment, and coordinated interventions in both affected and neighbouring countries. It also includes prompt and effective global united containment approach [1,13]. Moreover, the increasing transmission dynamics and persistent prevalence of HIV and associated consequences have been shown through cross-border activities and migration, especially in southern African countries, as well as through the early Ebola epidemic phase, and through weak diseases surveillance strategies. In addition, most countries affected by Ebola and HIV infections have extreme challenging conditions, with limited capacity and resources. Therefore, the impending co-infections threat in these countries are due to weak economic growth and development, public health system infrastructure, low gross domestic product (GDP) at purchasing-power parity, and the national health

Figure 2. HIV pandemic and Ebola outbreak symbiosis burden in Africa



priority when compared to developed countries [14,15]. Based on these differences, the containment of these diseases, including the 2014-2015 West Africa EVD outbreak, becomes a major challenge. However, the West African EVD outbreak could be contained if effective programmatic scalable preventive measures including prompt and effective EVD identification and isolation, of infected individuals, as well as contact tracing and monitoring of suspected cases, timely provision of personal protective equipment (PPE) and treatment, and care of patients are implemented. These measures can be undertaken with the support of locals, private firms and international humanitarian organizations, and governments. These include measures that will actively empower and engage the affected populations and community in timely response to future outbreaks [16]. Furthermore, other innovative measures include educating communities about dignified and safe burial practices and increasing risk factors awareness and education, especially those linked to body fluids of infected patients. In addition, community sensitization and health education promotion about the risk factors associated with these infections associated with HIV or EVD, as well as sexual behaviour and sexual lifestyle [17-20]. EVD and HIV are both infectious diseases of poverty with similar effects and related burdens; therefore, understanding the dual burden is crucial in health planning, and the allocation of limited resources that will foster effective strategic and innovative approaches to prevention and containment interventions. This paper assessed the impact of EVD in the context of the HIV pandemic and the absence of effective and safe HIV and EVD vaccines.

Methodology

Search strategy

Results from searches for Ebola outbreaks and HIV pandemic in Ebola-affected African countries in National Center for Biotechnology Information (NCBI) PubMed, national and regional reports, and data published in acknowledged websites were reviewed and analysed. This was done to assess the new public health threat and dual burden, as well as programs and interventions effectiveness in Ebola-affected countries.

Scrutiny and selection criteria

The prevalence and case fatality data of the affected population were documented. Data sources included results from all acknowledged web-based searches useful in providing detailed analysis on national and regional trends; health strategies and measures; and WHO guidelines for outbreak surveillance and response in humanitarian emergencies, global infectious disease surveillance, epidemic preparedness and response, Global Alert and Response, and the Global Outbreak Alert & Response Network documents specifically focused on EVD. The Centers for Disease Control and Prevention's National Notifiable Diseases Surveillance System, World Bank data, and United Nations databases were also used. The key terms related to HIV and/or Ebola were used in combination with terms referring to different types of outbreak responses and interventions, indexed in PubMed, including systematic reviews were scrutinized and analysed. The criteria for including studies were: Western Africa and DR Congo HIV/AIDS epidemic over time and space; Ebola and HIV/AIDS incidence, prevalence, and fatality rate per affected or proxy countries or areas in Africa; and programs and health response. Also, relevant findings relating to the study subject from reports were obtained. The data obtained were summarized and used to describe the dual HIV and EVD public health burden (Tables 1 and 2).

Results

A total of 1,414 papers were assessed, and 814 were selected based on capacity in programs and response interventions in the affected countries. Only 81 publications that met the inclusion criteria were fully assessed and analysed with respect to HIV infection interactions and capacity for Ebola burden, prevention, and care delivery services.

Trend and patterns of HIV/AIDS and EVD dual burden anecdotes in EVD-affected African countries

Understanding the dual burden of fatal epidemics such as EVD and HIV is crucial in planning united care and treatment programs aimed to eliminate re-emerging infections. This will facilitate coordination and information sharing among the stakeholders and the local communities, as well as policy makers, in disease containment. The trends and patterns of HIV and EVD in the most affected sub-Saharan Africa countries by EVD are summarized in Table 1, including the prevalence of HIV and case fatality of Ebola from 1976 to January 2015. Table 2 summarizes and compares the general characteristics of HIV/AIDS and Ebola infections including transmission, incubation period, infectiousness, diagnosis, prevention, and control. From May 2014 to January 2015, over 22,159 people had been affected with

EVD, and over 8,844 deaths were reported, mostly in Liberia, Sierra Leone, and Guinea, and imported cases were reported in Nigeria, Mali, Senegal, the United States of America, the United Kingdom, and Spain. In Mali, six deaths out of eight cases were confirmed, resulting in a high fatality rate of 75% (not indicated in Table 1) [21]. The findings also show that nationally, more than 85,000 out of a population 1.61 million people in Guinea are living with HIV, as indicated in a WHO report from 2012, with over 2,920 cumulative cases of EVD and over 1,913 deaths between May 2014 and January 2015. Table 1 also shows that 49,000 people are living with HIV in Sierra Leone, 25,000 in Liberia, and 3.4 million in Nigeria, whereas there are cumulative cases of 10,561 EVD in Sierra Leone, cumulative cases of 8,643 in Liberia, and over 35 imported cases in Nigeria, Mali, Senegal, the UK, the USA, and Spain, according to a WHO report from January 2015 [22]. In Gabon, there are 46,000 PLHIV and 208 cumulative cases of EVD, 56,0000 PLHIV and 1,056 cumulative cases of EVD in DR Congo, while in Uganda, there are 1.4 million PLHIV according to a 2012 report and 606 cumulative cases of EVD according to a January 2015 WHO report [22].

Comparison of the general characteristics of HIV/AIDS and Ebola infections

The Ebola and HIV infections that seem to have emerged from African rainforests and wildlife have erupted into an international health crisis. HIV/AIDS has been circulating over the last three decades [11]. Although Ebola emerged in 1976, the recently re-emerging West Africa EVD outbreak actually showed a resemblance and close association of Ebola with HIV. Although HIV differs from the Ebola virus, also is the high magnitude of HIV to EVD-related infectiousness and deaths. Although both diseases are caused by viruses and spread through similar contact of body fluids. Both HIV and EVD are mostly sub-Saharan diseases due to vicious cycles of poverty, political unrest, and high illiteracy rates in this region. However, EVD has become, in the developing world (especially sub-Saharan Africa), not only a public anxiety-inducing issue that strains health systems, but also a global health concern and burden with existing HIV pandemics.

Table 1. Trends and patterns of HIV/AIDS [3, 22] and Ebola virus disease (EVD) in Africa

	Human immuno-deficient virus/ Acquired immuno- deficiency syndrome (HIV/AIDS)								Ebola Viral Disease (EVD)				
Country	**Population (Million)**	**HIV species**	**People living with HIV/AIDS**	**HIV Adult (15-49) prevalence %**	**Women with HIV/AIDS**	**Children with HIV/AIDS**	**AIDS deaths**	**Orphans due to AIDS**	**Ebola Species**	**Cumulative cases(N)**	**Cumulative deaths(N)**	**Cumulative survivors (N)**	**Cumulative survivor's rate (%)**
Guinea	1,61	HIV1/2	85,000	1.4	41,000	11,000	4,000	52,000	Zev, 2014	2920	1913	1007	65.5
Sierra Leone	5,69	HIV1/2	49,000	1.6	27,000	4,300	2,600	18,000	Zev, 2014	10561	3216	7345	30.5
Liberia	3,95	HIV1/2	25,000	1.0	12,000	5,200	2,300	33,000	Zev, 2014	8643	3700	4943	42.8
Nigeria	173.6	HIV2/1	3,400,000	3.7	1,700,000	440,000	210,000	2,200,000	Zev, 2014	20	8	12	40%
Senegal		HIV1/2	53,000	0.7	28,000	-	1,600	7,600	Zev, 2014	1	0	1	100
Gabon	1,47	HIV1/2	46,000	5.0	24,000	3,100	2,500	21,000	Ze, 1994,1996,2001-2002	208	145	153	30.29
Congo	3,68	HIV1/2	83,000	3.3	40,000	13,000	4,600	51,000	Ze, 2001-2012,2003, 2005	207	49	16.87	207
DR Congo (2009)	66,02	HIV1/2	430,000-560,000	1.2- 1.6	220,000-300,000	33,000-86,000	26,000-40,000	350,000-510,000	Ze,1995,2005,2007,2008,2012,2014	1056	797	259	24.52
Uganda	32,71	HIV1/2	1,400,000	7.2	670,000	190,000	62,000	1,100,000	Ze,Be,Se,2000,2007,2011, 2012	606	284	312	53.14
Ivory Coast	21,07	HIV1/2	360,000	3.0	170,000	61,000	23,000	410,000	Tpe, 1994	1	0	1	100
South Africa	50,11	HIV1/2	5,600,000	17.3	2,900,000	460,000	270,000	2,100,000	Ze,1996	1	1	0	0
South Sudan	8.26	HIV1/2							Se,1976,1979, 2004	335	180	155	46.27

Zev: Zaire Ebola virus

Table 2. General characteristics of HIV/AIDS and Ebola infections.

Indicators/components	Human Immunodeficiency Virus (HIV)	Ebola virus disease (EVD)
Disease type	Viral disease	Viral disease
Nature	Pandemic since 1980s to date	Epidemic since 1976 to date
Genius, family and order	HIV is a retrovirus, family *Retroviridae and* member of the genus *Lentivirus* [43].	*Ebolavirus*, *Filoviridae and Mononegavirales*. The 4 infectious *Bundibugyo virus (BDBV), Sudan virus (SUDV), Taï Forest virus (TAFV),* and Ebola virus (EBOV, formerly *Zaire Ebola virus) and , Reston virus (RESTV*) [15, 44-45]
Transmission	Mainly through fluids of infected individuals: blood, semen, rectal fluids, vaginal fluids, Mother to child transmission via breast milk. Blood transfusion or needle exchange [21].	Human-human contact as well as via post-mortem contact Wildlife-Human, Blood transfusion or needle exchange [44-47]
Incubation	2-4 weeks to 3 months. However vary depending on the host immune response system. HIV infection to AIDS diagnosis ranges from 7 years and above [15].	2-21days at 95% 1-42 days at 98% [46-47].
Host reservoir	Human, gorillas, monkeys and chimpanzees [48]	Bats most likely natural reservoir of EDV, carcasses of gorillas, monkeys and chimpanzees. Plants, arthropods, and birds are also likely reservoir [46-47]
Vulnerable country	Globally, however sub-Saharan Africa most vulnerable (12,56)	Guinea, Liberia, Sierra Leone, Nigeria, Senegal, DR Congo, Uganda, Gabon, Congo, South Sudan, South Africa and Ivory Coast[46-47]
Risk factors	Unsafe sexual behavior**:** having sexually transmitted disease, uncircumcised men, breast milk, unsterilized HIV infected needles and sharp piercing materials, poverty [45].	Hunting, bush-meat consumption Poverty Food insecurity Poaching and poor wildlife conservation policy Direct contact with patients or patients body fluids
Route of transmission	Human-to-human transmission: Through un-protective anal and vagina intercourse, blood transfusion, intravenous drug inject [45]. Outbreak containment measures: Education and awareness about risk reduction, sexual behaviour and sexual life style.	Human-to-human transmission Wildlife-to-human transmission Direct contact with infected body fluids, blood of infected human and animal including blood, urine, sweat, semen, and breast milk. (sweat, semen, saliva[46-47] Containment measures include prompt and safe burial of the dead prevent further spread, good hygiene and clean environment [46-47]
Reservoir	Human $CD4^+$-memory T Cell contained latent form of HIV [49-51], Hematopoietic progenitor cells contained HIV that persist despite antiretroviral therapy [49]	Fruit bat harbor Ebola virus especially the following sub species *Myonycteris torquata*-little fruit bats, *Epomops franqueti*-singing fruit bats and Hypsignathus monstrosus-hammer-headed fruit beats [52]
Species	Two main species HIV-1 and HIV-2. Including several subtypes: HIV-1 the most virulent pathogenic form of HIV which is sub divided into M, N, O and P groups [54].The group M are the most rampant type responsible for 90 % of HIV cases with several sub types [52]. HIV-2 common in West Africa: Eight HIV-2 groups (A-H). Mostly group A & B are epidemic [55]. Group C & D found in Liberia, E&F found in Sierra Leone, G &H in Ivory Coast [55].	Viruses in the *genus Ebolavirus, family Filoviridae*, order Mononegavirales. The 4 infectious BDBV, SUDV, TAFV, and EBOV and RESTV. Ebola virus belong to the Zaire ebola virus species [46-47, 53]

Table 2 (continued). General characteristics of HIV/AIDS and Ebola viral infections

Indicators/components	Human Immunodeficiency Virus (HIV)	Ebola virus disease (EVD)
Stages of infections	Has 3 stages of HIV infection: (1) Acute HIV infection: develops within 2 to 4 weeks after infection. Usually characterized by flu-like symptoms, frequent headache, and rash, (2) Chronic HIV infection= called asymptomatic phase or clinical latency characterized by continues viral replication which usually advances to AIDS in 10 to 12 year (45), (3) Acquired immunodeficiency syndrome (AIDS): HIV destroy the immune system characterized by emerging opportunistic infections including tuberculosis and cancer. People with AIDS typically survive about 3 years [45].	The incubation is usually 2–21 days. Infected individuals or animals transmit the virus while febrile and through later stages of disease. Common transmission is via post mortem, persons-to-person-contact via body during burial preparations and traditional rite ceremonies. The virus found in all body fluids and semen for as many as 61 days after illness onset. Fatality rates ranged from 25% to 90% in previous outbreaks [46-47].
Signs and symptoms	Unexplained 10% lost in body weight over a month without diarrhoea greater than month, fever that lasts for more than a month either constant or irregular, persistent dry cough, Lack of energy [21]. Others include frequent sweats and persistent yeast infections, skin rashes, short-term memory loss. Mouth, genital, or anal sores from herpes infections [21]. Itchy skin, raised rash on the mouth, tongue, or throat, swollen glands with or without active infection [21] a. Usually the emerging of cancers known as AIDS defining cancers including Adenocarcinoma and Lymphoma, Kaposi Sarcoma, kidney and colon necrosis and condyloma acuminata leucopenia and lipoatrophy TB and carcinoma [46]	Usually 2-days to 3-weeks with influenza-like symptoms characterized by malaise, fatigue, fever, headaches, joint and abdominal pain, myalgia, arthralgia, sore throat, muscle pain. vomiting, diarrhea, and rash follow, along with decreased function of the liver and kidneys are typical symptoms [46-47] 40–50% cases, experience bleeding which may occur likely at puncture sites and mucous membranes. These include the gastrointestinal tract, nose, vagina, and gums. This typically begins start 5-7 days after first symptoms resulting into reddened eyes and bloody vomit. In most cases bleeding may create petechiae, purpura, ecchymoses, and hematomas needle injection sites [46-47]. Impaired blood clotting, multiple organ dysfunction syndrome may occur within 7 -16 days Bleeding may begin in most cases both internally and externally [46-47]
Diagnostic methods	HIV counseling and testing (HCT),-most common method include screening using rapid HIV antibody testing kits which are available in detecting HIV in blood, oral fluid, or urine [46], CD4 for the detection and quantification of immune status and viral load quantification methods in infected host. Detecting of viral RNA by polymerase chain reaction (PCR). Others include the detection of viral proteins by enzyme-linked immunosorbent assay (ELISA) and the western blot anti-HIV antibody confirmatory test [15]	Syndromic screening in most cases. Travel and work history exposure to wildlife Prognosis Others include differential diagnosis by detecting viral RNA, proteins and antibodies against the virus in infected patient's blood. Isolating the virus by cell culture. The detection of viral RNA by PCR and proteins by ELISA. Detecting the of antigen-capture detection tests, Serum neutralization test. Others include the reverse transcriptase polymerase chain reaction (RT-PCR) assay and the electron microscopy and virus isolation by cell culture.
Prevention and control measures	Behavioral, biomedical and community engagement (1)-Behavioral: Through education and awareness using various Information, education and communication (IEC) materials, risk reduction using condoms, lubes, antiretroviral therapy [28]. (2)-Biomedical: Testing for HIV, sexually transmitted infections (STI) including treatment and care of the pathogens, active TB case identification and treatment [28]. (3)-Community Engagement: Involvement of stage holders such as NGOs, local, national and international organization, key population groups, People living with HIV, traditional leaders, church leaders and influential individuals [28]	Health education, personal hygiene and sanitation especially hands washing and wearing of personal protective equipment when in close contact with infected person. Quarantine and contact tracing. Supportive oral rehydration therapy. Intensive care and Antivirals(Lamivudine, Favipiravir and very few treatment options) [46-47]. Active case identification and isolation of patients from the community to prevent spread, 2) identification of infected cases and case tracking for up to 21 days, 3) investigation of retrospective and current cases and breaking of chains of transmission, 4) identification of deaths in the community and safe burial practices and 5) active reporting of suspected cases. Continual education of health-care workers on infectious-control practices [46-47]; Integration of a comprehensive threat and disease surveillance and actions systems

According to history, HIV appeared to emerge in 1987, when HIV-positive individuals were restricted from travelling, mostly from sub-Saharan Africa to high-income countries; this rule was only reversed and amended in January 2010. The EVD cases were first diagnosed in 1976 [21] and were restricted mostly to Central Africa until the recent outbreak escalated in West Africa and some affected high-income countries in 2014–2015 (Table 2).

Community capability for quality preventive and care delivery services

Since both EDV and HIV are public health emergencies of international concern, to foster prevention and care deliveries, emphasis should be placed in addressing local and national health systems capacity development and community partnerships in enhancing community social mobilization and engagement, effective resilience and empowerment programs [23]. Others means of fostering prevention measures include community resilience, awareness campaigns and outreach, local HIV/EVD leadership and voices that provide advocacy and mitigation platform on healthier sexual lifestyle, use of protective tools and measures, safety adherence, training and building up human resources for emergency responses across Africa [24]. The training of adequate healthcare workers to effectively carry out operations and management is another approach to prevention and care which, through effective and efficient information communication, will be able to contain the diseases [15,21]. Therefore, to fully understand emerging disease outbreaks, enhanced community-based vigilance that monitors early warning signs of HIV/EVD and other community-based interventions can provide robust evidence of epidemiological, socio-cultural, and environmental information to enable improved decision-making policy and rapid responses. However, efficient laws and enforcement policies are needed in strengthening health systems, nurturing safe cultural practices and evidence-driven community HIV/EVD projects and ownership towards positive social behavioural attitudes and perceptions adoption. Thus, genuine efforts to sustainably contain these persistent threats and burdens and to accelerate the recovery programs and activities in affected communities and populations.

Discussions

HIV and EVD infections have important health consequences, mostly in sub-Saharan Africa, a region already affected by geographical, structural and biological risk factors, including poor community engagement to disease response. As indicated in Table 2, EVD and HIV have similar structural characteristics of fear, discrimination, and stigmatization [21]. Biologically, the viruses have similar host reservoirs, likely mode of transmission, and spread in human populations, mainly through human-to-human behavioural spread [21,25]. This includes exposure to bodily fluids such as blood and semen, although HIV is mainly transmitted via unprotected sex and EVD via semen during poor sanitary practices, including burial practices [15]. However, contacts with infected bodily fluids are the main route of person-to-person transmission of both EVD and HIV [15,21]. The incubation period of Ebola is shorter than three weeks (2–21 days); and progression to infectiousness is much faster than that of HIV [25].

As indicated in Table 1, HIV prevalence is low in West Africa when compared to other sub-Saharan Africa countries [11]. For example approximately 2.7% of people are infected with HIV in Liberia, Sierra Leone, Guinea, and Nigeria. This low infectivity may be due to high rates of male circumcision in West Africa [26]. Previous studies have shown that male circumcision, which is highly practiced in West Africa is associated to lower risk of HIV acquisition and other sexually transmitted diseases when compared to low/no male circumcision in other Africa countries [27,28]. Apparently, there is no evidence that male circumcision reduces transmission of HIV to women or men who have sex with men (MSM) [29], or other key population such as men who use injection drugs in West Africa [29]. Apart from that, HIV-2, which is mainly confined to West Africa, is less easily transmitted than HIV-1. HIV-1 is found predominantly in southern and eastern African regions [26]. In addition, with the rapid spread and fatality rate of current EVD, this may affect funding for HIV/AIDS programs and related humanitarian support. The Ebola response may stretch on HIV and intervention strategies. Recently, the African Union, during its meeting in Addis Ababa on 9th November 2014, raised USD 750 million to step up the fight against Ebola in the affected countries, money that would otherwise been directed to HIV [30]. Other funders of the fight against EVD include international partners such as the US, China, Cuba, Canada, the UK, France, Japan and Australia among regional AFRO actors and NGOs. Laudable and sustainable support may shift the HIV epidemic and leveraging on gains in achieving significant reduction toward both HIV and EVD effective control.

Currently, the Ebola outbreak has wreaked havoc in Guinea, Sierra Leone, and Liberia, the most affected countries [22], with over 28,607 cases and more than 11,314 reported deaths [22]. Other cases were reported in Nigeria, Senegal, the DR Congo, the US, the UK, and Spain, but were rapidly contained, and have been declared EVD-free, as well as Liberia, Guinea and Sierra Leone lately by the WHO [15,21-22]. Because of the high transmission rate of EVD, more than 400 healthcare workers have contracted the virus and more than 130 deaths were reported [31]. Ebola is more infectious and fatal than HIV-related infections. HIV is transmitted in the similar routes as Ebola virus, but is less contagious than Ebola. HIV infects silently and spreads slowly in human species because of its long incubation period. Secondly, it is not easy to identify an HIV carrier [32] when compared to EVD carrier. The HIV can be freely transmitted, unknowingly, over a long period of time in a society [33]. Both Ebola and HIV viruses attack T-lymphocytes and other cells responsible for the human host's immune system [33,34]. They infect these immune cells, replicate in them, disable or lyse and destroy these cells, thus compromising the immune system for opportunistic infections [33,34]. In addition, HIV virus can mutate rapidly and a patient who finally dies from HIV-related infections may have multiple strains of the same virus [33]. The same phenomenon is common in the Ebola virus, where the virus mutates, but not at the same rate of mutation and pace as the HIV, due to several factors [35].

The Ebola virus was discovered before HIV [36], in 1976 in the DR Congo [21]. From there on, the virus has been causing periodic outbreaks in Africa, including the current West African species [21], but HIV, since 1981, has been an epidemic spreading throughout the world. Yet, intervention with vaccines and treatments of resistant cases has been limited in HIV. In the beginning of the HIV epidemic, the infections were more challenging because health officials were faced with this mysterious illness and deaths of unknown cause [37]. HIV diagnosis only became available in 1985. Currently, no vaccine is available, although highly active antiretroviral therapy (HAART) can prolong the lives of infected individuals [11]. Early in the discovery of HIV/AIDS, the mysterious disease was perceived as an illness of gay men and intravenous drug users [15]. Therefore, infected individuals were able to silently and unknowingly spread the infection for years [32]. Ebola infections and related deaths are rapid and more terrifying, though EVD cases can be identified and isolated, and patients' contacts can be traced and monitored [15,21]. However, as indicated in early HIV, most healthcare workers and blood transfused patients were infected with HIV because of a lack of proper understanding of the HIV transmission and dynamics. A similar effect was observed among EVD health workers during early diagnosis of the disease where health workers become infected. In addition, lessons learned from the global HIV/AIDS response should be extended to EVD in a timely manner [25]. Apart from that, Ebola virus requires more sophisticated isolation measures to contain the disease [21] than does HIV.

Despite the fact that sub-Saharan Africa contains approximately 11% of the world's population, the region account for 70% of HIV/AIDS infections, with an adult prevalence rate of 4.9% [3] when compared to an adult world prevalence of 1.2% [3]. Globally, AIDS is the fourth leading cause of death, with 1.2 million related deaths in sub-Saharan Africa [3]. The high HIV-related mortality rate is responsible for more than 90% of cases of children becoming orphans [3]. In West Africa, the Ebola outbreak has the highest maternal mortality rate of malaria deaths, according to the WHO [3]. HIV and malaria in West African regions is linked with low life expectancies, low household and family income and healthcare systems burden income [3].

It is important to understand HIV and EVD in order to plan for future infection resurgence, especially in vulnerable regions. Since most Africans have limited perspective, surveillance indicators to assess the threat of re-emergence as well as early warning disease alert and surveillance. Both EVD and HIV are spread in a similar way, via body fluids, and currently do not have an effective antiretroviral cure [15,21]. Infections caused by Ebola hemorrhagic fever have killed 50%–70% of their victims, while 70% of people living with HIV are in sub-Saharan Africa [3]. Although EVD is highly lethal, more so than HIV [33,34], HIV is less transmissible than EVD. The number of HIV-infected individuals globally is far greater than the number of EVD-infected individuals [3,15]. Also, EVD and HIV are mostly restricted to low-income countries affected by poverty, civil wars, high maternal and infant mortality rates, low education levels, and internal strife [38,39]. The countries currently most affected by EVD include Guinea, Liberia, Sierra Leone, and the DR Congo, all of which have faced civil wars [38,39]. These countries have very weak health systems, which accounts for the re-emergence of these infectious diseases [15]. Therefore,

strengthening community health systems and fostering effective capacity in prevention and care delivery services are paramount. Migrants, including commercial sex workers who have a highly disproportionate burden of HIV, easily travel from one sitting to another [40]. This stretches the health systems of these settings and increases the rate of HIV transmission, which can spread, unrecognized, for decades. The spread is parallel to that of EVD in West Africa, which is due to social and economic rather than biological factors. Averting an Ebola outbreak and HIV-style epidemic crisis requires more opportunities and evidence-based innovative Ebola prevention and control approaches and interventions. Implementation of effective and sustainable interventions such as community social outreach, prompt identification and case management, surveillance and preparedness systems, contact tracing, laboratory diagnosis, community mobilization, recovery systems for survivors, and safe burial practices, behavioural changes of EVD victims offer new opportunities to stamp out and eliminate HIV and EVD in West African countries and other parts of sub-Saharan Africa [15,21].

Challenges and opportunities

A WHO report shows that more than 22,000 cases of EVD and over 8,800 deaths have occurred in the three most highly Ebola-affected West African countries, Guinea, Sierra Leone, and Liberia [22]. This is extremely challenging in a region already threatened by HIV, and has disrupted the underdeveloped health facilities. These viral diseases currently have no effective treatment and vaccine, and transportation within the urban and rural areas is extremely difficult [21]. Patients from hard-to-reach remote areas have to travel through difficult conditions to access EVD treatment centers, and tracing of cases by health officials is also difficult.

However, the shortage of trained healthcare workers, weak health systems, weak community engagement, lack of participation in early identification, challenging diagnostics and self-reporting, stigmatization and weak prompt isolation/quarantine facilities are some of the primary reasons HIV and Ebola infections continues to spread [21]. According to a World Bank report, there was one trained healthcare worker in Guinea for every 10,000 people in 2010 [41], and more than 10,000 people in Liberia and Sierra Leone per one healthcare worker [15]. Another challenge is the dual burden faced by and mothers who are living with HIV, especially those also affected by the EVD outbreak. Recently, a United Nations Children's Fund (UNICEF) report showed that children receiving antiretroviral treatment in Sierra Leone are unable to access healthcare facilities due to stigma and fear of Ebola [42]. The EVD outbreak also disrupted other aspects of HIV response, such as the delivery of antiretroviral drugs to affected communities of West Africa [42], making monitoring of HIV treatment difficult, reversing the gains made so far in response to HIV in EVD-affected West Africa countries [42].

Conclusions

The dual burden of EVD and HIV is posing great challenges to the countries most affected by Ebola. EVD is closely intertwined with HIV, Ebola survivors are faced with an increasing number of acknowledged co-infection and health complications. The global threats posed by Ebola and HIV viruses require rapid global response since there is currently no effective treatment or vaccines for HIV and Ebola. Novel socio-cultural, health educational, and communication approaches are urgently needed to curtail further misconceptions and future resurgence by intensifying knowledge-based information dissemination, innovative medical and paramedical curricula. Others include education reforms in community interventions especially in primary healthcare systems in Africa and other low- and middle-income countries in disease outbreak prevention and control. There is urgent need to generate evidence on how to strengthen and improve health systems for people living in low- and middle-income countries, and to inform evidence-based programs and interventions delivery, and structural changes and quality outcomes. The transmission and spread of Ebola and HIV are similar and share overlapping characteristics, especially in symptoms and disruption of immune-competent cells. EVD symptoms and presentation share similar symptoms with other tropical diseases, including malaria, HIV, influenza, typhoid, and diarrhoea. Putting in place aggressive and strategic innovative interventions to prevent or control the viral diseases will be tantamount to directly or indirectly promoting capacity building and empowerment in reducing infectious morbidity and mortality as well as disability-adjusted life years and quality-adjusted life years. In addition, understanding the dual burden will promote proactive preparedness, health planning in accelerating effective and safe immunization programs implementation plans in achieving and sustaining zero

cases, but also readiness to respond smartly and effectively to future emerging threats and outbreaks.

Authors' contributions

ET conceived the idea and design, performed the literature review and drafted the initial manuscript. ET and CSY scrutinized the review and analysed the information. ET, CSY, CEU, OAO, IW, LKJ, and JYN provided additional information to the manuscript. All authors read and approved the final manuscript.

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