

1 **Revisiting Ebola outbreaks public health emergencies in fragile conflicts zones and displaced populations in Africa**

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17 Abstract

18 Little is documented on conflict and displacement impact on West Africa Ebola Virus disease (EVD) outbreaks. The paper revisits Ebola
19 outbreaks public health emergencies in fragile conflict zones and displaced populations across Africa. Findings showed that the duration of
20 conflict/war events varied one to forty three years. Notably, Darfur war in Sudan lasted between 18-23 years, RD Congo and Guinea incessant
21 political and ethnical or mining conflict instability repeatedly ranging between 2-6 years, Liberia and Sierra Leone 5 and 12 years conflict/war
22 events associated Ebola outbreaks were documented following seven and four years of conflicts from 1989-1996 and 1999-2003 prior to a
23 democracy nation era in Liberia respectively. Worldwide, there have been 28,639 cases of Ebola virus disease and 11,316 deaths as at
24 December, 2016. Ebola outbreak public health emergencies advocacy, community social mobilization and engagement, Ebola awareness,
25 effective and culturally dignified communications, social media and mass media risk communication, community literacy and preparedness,
26 emergency response engagement and participation, access and deployment of digital technology applications (Health map) in surveillance,
27 tracking and monitoring and key traditional burial practice behaviours changes were being translated into positive successes and benefits that
28 geared rapid and effective prevention of further spread and containment activities of West Africa Ebola outbreak. Inter-humanitarian
29 organizations, institutions and other stakeholders including government cooperation and coordinated leadership, commitment and investment
30 were laudable in supporting accountability and transparency in the overall objectives of public health emergency preparedness planning, care
31 management systems in Ebola outbreak centres, public awareness, epidemic early detection and rapid response as well as effective immunization
32 programs implementation to outwit Ebola virus. Sierra Leone conflict lasted from 1991-2002, Guinea recorded frequent relentless instability
33 than Liberia with two major conflict periods from 1989-1996 and 1999-2003. For the first time, we established a statistical significant correlation
34 between duration of war/conflict events and Ebola outbreaks onsets in Africa ($P < 0.05$). Unexpectedly; the total fatality rate in Liberia or Sierra
35 Leone only was greater than the previously reported cumulative EVD cases across Africa since 1976. It is crucial to intensify advocacy on
36 conflicts/wars resolutions to disaster risk reduction framework evidence practice implementation in fostering health and socioeconomic
37 development and growth. Authors call for the urgent need for concerned commitment and engagement of all stakeholders to develop, implement

38 and strengthening local, national, regional and global public health emergencies evidence practice approaches and strategies including national
39 public health disaster emergency situations insurance schemes in paramount in disaster high risk prone settings and particular in Africa.

40 **Key Words:** Public health emergencies, evidence, practice, preparedness, response, conflict, war, displacement, resolution, consequence, Ebola,
41 outbreak, Africa

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43 **Introduction**

44 Given the unprecedented scale and emerging outbreaks public health emergencies with limited absorptive capacity and functional surveillance
45 and early warning systems in most African countries, the West Africa Ebola outbreak in the most affected three countries was declared as public
46 health emergency of international concern (PHEIC) in early 2014. The deadliest diseases in history and highly unparalleled dimensions of
47 human contagious through diverse transmission routes dynamics and severe to contain, leading to over almost 28,638 cases affected and more
48 than 11,316 deaths worldwide (1). The West Africa Ebola outbreaks requires further in-depth in untangling the potential drivers and issues that
49 trigger the unhealthy events and reducing life expectancy with diverse health and socioeconomic consequences in different geospatial affected
50 and non-affected communities in Africa (2). The WHO declared Ebola outbreak as a public emergency of international concern in West Africa
51 early March 2014 as the number of cases and fatality rate has increased significantly with more than 6,700 children orphans from previous 1,433
52 deaths due to Ebola outbreaks prior 2014 (1). The Ebola epidemic has taken a heavy toll on the already limited health workforce including some
53 humanitarian workers having about 21 to 32 times high risk probability to be infected with Ebola (815 confirmed and probable cases reported)
54 than people in the general population in the three most affected countries (1,2). Several reasons to scale up West Africa Ebola outbreak public
55 health emergency were attributable to deficiencies in mounting national and regional infectious diseases surveillance-response and early warning
56 systems, governments and stakeholders including humanitarian organisations, coordinated logistics and management inappropriateness, weak or
57 lack of capability of health systems to respond to health emergencies and meeting routine community healthcare needs. In addition to local staff

58 shortages, long working hours, unpredictable and delayed health workers remuneration, community resistance and stigmatization, poor social
59 protection, lack of preparedness capabilities (workforce and infrastructure) to personal protective equipment (PPE), defective infection
60 prevention and control (IPC) and cultural- behaviour practice, and poor mastering of frontline conditions and social-anthropological
61 determinants(1,2,3). The resulting unsettled conflict resolution and peace agreements consequences such as, human and animal displacement,
62 food insecurity, forest and wildlife incursions, illicit hunting and poaching and complex vicious cycle of poverty could be responsible for the
63 West Africa Ebola eruption and public health consequences and losses (2,4). Africa has been home to a range of conflicts and wars event-linked
64 public health emergencies since the era of colonisation up to date. From West to Central Africa, Liberia, Sierra Leone, Guinea political unrest
65 and long wars to Nigeria Biafra war activities of the armed group that calls itself Islamic State's West Africa Province (also known as Boko
66 Haram) continues throughout the Lake Chad region along with its neighbours Cameroon, Chad and Niger (2,4,5).

67 Conflict-related public health outbreak emergencies have been documented over time in Africa and still remain a topical issue in fragile
68 countries, displaced populations and refugees camps to residents of host communities in Cameroon, Central African Republic (CAR), Nigeria,
69 Kenya, DR Congo and Angola, Senegal, Mali, Niger, Zimbabwe, Gabon and Congo. Moreover, South Sudan, Somalia to Eritrea and Kenya
70 maintains its support for combat operations against the armed groups and terrorism (1,2,3,4). Political concerns and socio-economic frustrations
71 still persist throughout the region; governments maintain tight security measures in response to, and to forestall, insecurity and unrest. The spill
72 over effects of the conflict continues to affect communicable diseases emergence and spread humanitarian needs. Central African refugees are
73 still present in eastern Cameroon and northern Congo as the overall security situation in the (hereafter CAR) remains fragile and displaced
74 population remain in need humanitarian assistance (5,6). In the Congo, Cameroon, Gabon to CAR and South Sudan and Kenya, political
75 tensions occasionally culminate into violence, arrests and episodes of temporary displacement, exile and refugees (2,4,6). Conflict and civil wars
76 to political unrests have left several consequences including huge socio-economic losses across Africa (1, 5), such as dysfunctional, inadequate
77 and severely disabled health systems, high level of illiteracy amidst populations of years without education, lack of qualified health personnel
78 and brain drain syndrome, chronic unemployment, fluid population movement and migration; fear, anxiety and hostility, rumours and
79 Ebolaphobia, discrimination and stigmatization, lack of portable water and environmental sanitation, lack of integration of African traditional
80 medicine in the health systems and other sociocultural factors such as traditional burials and funeral practices involving close contact with the

81 corpses threatening national security and international responses (3,6). Nevertheless, the lack of access to basic healthcare was reported to 8.8
82 million living in severely affected areas at risk of life-threatening illnesses made worse with rising prices of food commodities and severely food
83 insecurity. In addition, weakened or interrupted functioning health facilities had been damaged or destroyed in the conflict zones. Other
84 challenges includes depletion of essential medicine, equipment and staff shortages, lack of or epileptic electricity, supplies, portable drinking
85 water and fuel, coupled with insecurity and damage to markets and roads also prevented supplies from being distributed timely and effectively
86 (4,5,6,7).

87 Documented public health emergencies research and evidence knowledge are sporadically and randomly distributed across the region and
88 perpetuated by a variety of ill- actions ranging from conflict, wars and political leadership motivated civil unrest, ethnical genocide and mining
89 groups incursions (1,3,5,6). But also, most conflicts are accentuated by local insecurity and volatility linked population displacements and
90 resettlements to regional neo-colonial excitements splintering across African conflict-fragile countries with few effective and stable peace and
91 reconciliation leadership and functional competency processes and strategies (1,4,5,6). In addition, African governments exhibit significant
92 distinctive intra and inter country conflicts types and events as well as diverse conflict trends and patterns. How do conflicts/wars and displaced
93 populations events bring about Ebola outbreak public health emergencies in Africa? Can peace-building and conflict resolutions reduce or
94 enhance public health humanitarian emergencies (outbreak or disaster crisis / catastrophe) preparedness, control and resilience in Africa?

95 Few previous studies have documented that infectious diseases mainly Ebola virus outbreaks public health emergency linked to conflicts/wars or
96 disaster crises events extend and severity across Africa. The relationship between conflicts/wars events, population displacements and
97 resettlements implications on Ebola outbreak emergence and spread in most Ebola affected communities is still poorly understood (1, 4, 7, 8).
98 Tackling the growing and persisting conflict burden and challenges requires understanding the multifaceted effects and benefits that ranged from
99 access constraints to humanitarian aid or relief, damaged infrastructure and unreliable access to fuel, together with lack of funding, has hampered
100 their efforts.

101 The article examines conflict/wars related displacement events impacts on alarming West Africa EVD outbreak public health emergencies
102 consequences, and provides practical and effective evidence-based knowledge, in nurturing peace-building evidence practice to conflict linked
103 emerging infectious diseases outbreak public health emergencies preparedness, prevention and management strategies within Africa territories
104 towards promoting resilient health system strengthening and health equity, social justice and global economic prosperity.

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106 **Methods**

107 **Search strategy and scrutiny**

108 The systematic review dataset was collected from PubMed and acknowledged website searched based in West Africa region conflict events to
109 emergence and spread of Ebola outbreak emergencies in the affected countries without restriction to language of studies published from January
110 1, 1960, to July 31, 2017. We used the Uppsala/PRIO Armed Conflict Dataset (ACD) and “conflict, location and resettlement/ displacement
111 public health emergencies events dataset [4] which contains information on the geo-location of conflict events impacts in West African countries
112 over the period 1997-2010 and other reference United Nations (UN) reports on conflicts, peace and conflict resolutions meetings in West Africa
113 Ebola affected countries. A unique feature of ACLED dataset is that it contains information on the type of events, as well as the characteristics of
114 the actors on both sides of the conflicts, events trend and patterns from 1997- July 31, 2017.

115 **Selection criteria and assessment**

116 To assess both the direct and indirect impacts of conflict/wars and Ebola outbreaks, we used the following keywords: “Ebola epidemics or
117 outbreaks linked conflict/war, civil unrest,” “political unrest, political instability,” and “displacement, resettlement, humanitarian assistance for
118 displaced or refugees’ camps public health emergencies”. To assess articles that focused on Ebola outbreaks and conflicts zones we used free
119 text and MESH terms (where available). These conflict events public health emergencies are obtained from various, including national, annual

reports, regional and local conflicts proceeding and humanitarian agencies or research publications. Exclusion criteria were determined a priori such as Ebola outbreaks editorials, view point or protocol guidelines and letters in isolated case report in military or tourists.

Statistical analysis

Data were analysed using Statistica version 12.0 software frequency of exposure, resurgence of diseases throughout the duration of conflict and post-conflict EVD outbreak public health emergencies prevention and management or humanitarian assistance or relief. Analyses were two-tailed with a significant P- value threshold set at less than 0.05. Correlation analyses were performed between war duration, years for epidemic minus war start, years for epidemic minus war end, cumulative cases (n) and cumulative fatality rate (%).

Results

Of the 304 publications produced by the search strategy, 56 reported conflicts and infectious diseases and 19 reports describing conflicts-related separate outbreaks were evaluated, found eligible and analysed.

3.1 Trend and pattern of political conflict/wars duration and Ebola Outbreaks in African countries from 1960 -2015

The trend and patterns of conflict events related public health emergencies in Africa countries were diverse and complex ranging from civil unrest and wars associated displacement, diseases outbreaks (Ebola, Cholera, Polio, Meningitis, Rift Valley Fever, Dengue), natural disaster events (climate change and global warming impact, Droughts related hunger and famine, deforestation and intense mining, flooding and mud-/landsliding, volcanic eruptions and coast sea rise or *el-nino*). The pattern of these situations were multi-faceted and complicated by where rebels

and militias or terrors capitalized on wild and forest jungles to hide, plan and stage their plots against the opponents to mining conflicts linked population displacement and forest incursions and wildlife those varied from one fragile country to another. The duration of conflict/war events varied from one to forty three years. Notably, the Darfur war in Sudan between 18-23 years, RD Congo and Guinea incessant political and ethnical or mining conflict instability repeatedly ranging between 2-6 years; whereas Liberia and Sierra Leone 5 and 12 years conflict/war events were documented in Liberia for seven and four years of conflicts from 1989-1996 and 1999-2003 prior to a democracy nation. Worldwide, there have been 28,639 cases of Ebola virus disease and 11,316 deaths as at December 2016. The most affected countries were Liberia and Sierra Leone and Guinea with a total of 10,675 and 11,123 cases, and 4,809 and 3,956 deaths respectively (Table 1).

Interestingly, the total Ebola outbreaks fatality rate in Liberia and Sierra Leone alone was greater than the documented cumulative fatality rate in Sudan, DR Congo, Congo, Gabon, Uganda, South Africa, Nigeria and Mali. The geopolitical ethnic rebels and militias or terrors conflicts, repression and fragility showed to influence greatly Ebola geographical distribution in the region in addition to ethnic, religious and economic divisions to gain control of political power, and natural resources. Conflict and war events appear to be directly linked to persisting emergence of Ebola outbreaks (e.g., DR Congo) in most affected communities in Africa (Table 1).

3.2 Correlation between conflict/war event duration displacement impacts on geographical distribution of EVD across affected countries

The duration of conflict/war events in fragile conflict zones and displaced populations varied weeks to years across community and country. The longest duration was recorded in Sudan with 17 years (1955-1972) prior the first Ebola outbreak in Sudan in 1976 Uganda (1979-1986 prior to their first Ebola episode in 2000, and 1993-2003 with the 2007 and 2012 Ebola outbreaks respectively. Guinea in West Africa also recorded the constant instability with Liberia 7 and 4 years conflicts and wars from 1989-1996 and 1999-2003 respectively. As well as conflict in Sierra Leone broke out from 1991-2002 (10 years) with the cumulative resulting effect and emergence of West Africa Ebola outbreak. Conflicts/wars fragile African zones have also lasted longer, on average they lasted averagely weeks to eight years. There was a strong and statistically

significant correlation between conflict/war event duration, years of Ebola epidemic minus war onset and cumulative cases and cumulative fatality rate to Ebola outbreak in Africa ($R=0.57$, $P=0.0016$; $R=0.74$, $P=0.000$). Also, there was a weak negative correlation between the conflict/war event duration and years of Ebola epidemic minus conflict/war end. Our findings showed the duration of conflict/war could be responsible for human displacement, forest and wildlife incursions and hunting as the source of food (Table 1). Community or national/sub-regional instability was documented at different time points across Africa and probably the epicentres, were areas of former resettlement, neighbouring districts or communities where wildlife have been chased or hunted away then rendering the next communities more susceptible to EVD outbreak due to exposure to wildlife animals reservoirs and cultural practices.

3.3 Building and strengthening early preparedness and response resilience capacity to future public health emergencies

Promoting and strengthening Public Health Emergency Response (PHER) Framework implementation as recommended by, the WHO and adopted by the Africa Union is needed to accelerate local and regional public health emergency surveillance, preparedness and response benefits and gains to conflict-related infectious diseases threats and outbreaks burden compared to the existing reluctance and inaction. Moreover, promoting collective engagement and commitment to accelerate the implementation of International Health Regulations, demonstrate the resolve of African countries to strengthen public health systems and core capacities critical to address the health security. It is important to note that strengthening local and regional research collaboration and network is needed for evidence translation into robust and effective conflict prevention and mitigation action in infectious disease burden control programs and poverty alleviation.

Regional and global humanitarian assistance commitments remain and rely on mobilizing philanthropic funding from member states and other partners. For example, the West Africa EVD outbreaks has taught us that WHO Grade 3 PHEIC declaration delaying an announcement imperils lives and health systems and more economic losses, and undermine domestic political legitimacy those motivate responses to international emergencies and establishment of a US\$100 million contingency fund for rapid response WHO, UN and other humanitarian organizations

178 including NGOs. Yet, 2014-2016 West Africa Ebola outbreaks pledges remain unfulfilled and need can be fulfilled for sustained investment by
179 global partners in strengthening establishment and functioning of a global emergency fund in public health emergencies capacity development
180 and training of local health workers. Thus, leveraging on quality preparedness and proactive planning of citizenry and professionals knowledge
181 and skills capabilities is necessary in prevention and control of potential emergencies situations including diseases outbreak. Moreover,
182 strengthening integrated public health emergencies early warning alert and surveillance, timely risk communication, community awareness and
183 engagement, and quality management in accordance with International Health regulations, Human Rights and upholding global health security
184 Alma Mata and principles is essential to uphold children and women to humanitarian workers and volunteers safety and security in current and
185 future conflict-related public health emergency situations in Africa and elsewhere.

186 Recent years, has witnessed increasingly globalized infectious disease outbreaks due to displaced populations in refugees' camps, population
187 growth and increased cross-border movement (trade and travel), climate changes and environmental degradation. There is an urgent need to
188 increasing public health emergencies partnerships and collaborative capabilities of local institutions, researchers and private sectors to rapidly
189 identify, investigate, track or map and define contextual acceptable response approaches and strategies development and implementation is
190 crucial. Efforts in more granularity, development of public health emergencies quality monitoring indicators and metrics, guidelines and best
191 practices is important in risk stratify geographic settings susceptible to disease outbreaks and earlier responses to localized epidemics before they
192 reach epidemic proportions and great potential of fund for the global public health community respond early documented prolonged periods of
193 civic unrest and insecurity. In such, the impact of decimated health systems ad food insecurity in affected countries with limited human resource
194 capacity led to re-emerging and emerging outbreaks as documented in Nigeria Ebola and Lassa fever outbreaks, Guinea, Sierra Leone, and
195 Liberia rebuilding from 2014 West Africa EVD outbreak. This situation is compared to unstable DR Congo with persistent Ebola outbreak in
196 different parts of the countries since 1976 with challenging humanitarian assistance access and emergency response delivery.

197 Investing in Public health emergencies preparedness and response capabilities in conflict prone settings in Africa is core in and require the
198 establishment of robust and resilience local and regional public health emergency health policies, and integration into national health agenda.

199 While exploring local public health disaster insurance schemes, insourcing and outsourcing supply chain procurement processes and life
200 emergency fund from all stakeholders. where routine weak health systems, limited diagnostic tools and resources for structured surveillance and
201 data transmission are lacking to stem the Ebola virus disease epidemic is laudable but should not encourage complacency in our efforts to
202 improve the global public health infrastructure concerted international response is required to prevent urgent natural, technological and others
203 hazards and disasters occurrence and emergence before they become catastrophic.

205 Discussions

206 The devastating effects and the aftermath of political violence, civil war and ethnic conflicts have generated millions of displacement and
207 resettlement with unbelievable pictures of suffering and unnecessary associated persistence of Ebola outbreaks and emerging infectious diseases
208 mortality and disability across the African continent (4, 9, 12, 13). Africa is still facing complex conflicts and political instability where the vast
209 majority of man-made conflicts and public health emergencies reported yearly since post-colonization included ethnic divisions and civil wars,
210 civil or political conflict, battle over local natural resource ownership and benefits sharing inequities due to international commodity pricing and
211 demand, fragile institutions and systems (4, 14, 15). It was documented that the basic Human Rights, healthcare delivery and food security acute
212 to severe shortages responsible for the public health emergencies during reported armed conflict, civil disturbance, state incursion and repression
213 across Africa (6,9,12,13,14,18,19). Attacks on and interference with health care providers, facilities, and services pose enormous challenges to
214 effective health care delivery where it is most needed (4). African populations continue to suffer from many different consequences of violent
215 conflict, wars and forced mass migration since the early day of colonization up to the contemporary neo-imperialism facets. They are challenged
216 by highly significant risk and impact of poverty related disease outbreaks including Ebola, cholera and HIV/AIDS pandemics, unemployment,
217 low and loss of income owing to mortality and disability, and disruption in economic activity and uncertainties that increased cost of doing
218 business, and capital flight leading to socio-economic consequences and humanitarian crises (6).

219 Since 2003 the Integrated Disease Surveillance and Response (IDSR) existed in Sierra Leone, but just like in most African countries remain
220 dormant until when Ebola hit. The extent, to which Ebola spreads, therefore, depends on the actions of politicians, doctors, and patients and on
221 how much those who are not infected trust their governments. At the very basic level, the local governments of Guinea, Sierra Leone, and
222 Liberia need to focus on building a proper healthcare infrastructure, training medical professionals, and sending a unified clear message about
223 Ebola to the masses (14). In addition to the basic steps that West Africa needs to take to contain Ebola, is the need to encourage regional
224 cooperation and cross-border collaboration in effective control as the strength of health systems varies across countries and an increase in health
225 standards within each country is necessary for successful assistance and mutual trust in effective and timely cross-country information
226 communication (1, 6).

227 Public health epidemic preparedness measures to be taken should involve training staff to use surveillance tools and manage cases of epidemic-
228 prone diseases and equipping them with reliable means of communication. Isolation facilities and high containment biosafety laboratories for
229 pathogen confirmation must be identified in advance, and support must be provided to local institutions regarding training and supplying
230 equipment and reagents. Data should be analyzed locally and regular feedback provided (e.g., a weekly bulletin) to health partners. A rapid
231 response mechanism for investigation alerts and implementation of control measures as outlined in outbreak preparedness plans (e.g., by an
232 interagency outbreak control committee) are also crucial. Diseases threat and outbreak surveillance systems rely on close partnerships with
233 NGOs, international organizations, and community groups and are built on resources and capacities of all organizations present. Effective
234 surveillance systems in emergencies have involved selecting a small number of syndrome-based priority events, using standard surveillance
235 forms, simplifying case definitions; health facilities weekly reporting of data, immediate reporting if set alert thresholds are passed. Establishing
236 community-based programs and mechanisms for identifying disease clusters. Improving detection and control of infectious diseases pre, during
237 and post-conflict situations in any disaster risk and emerging infectious diseases primarily require a functional healthcare system, preparedness
238 and response systems. It is imperative that the technical capacity of all humanitarian health partners and ministries of health regarding disease
239 surveillance, prevention, and control in conflict-affected countries be enhanced to ensure effective implementation of infectious disease

240 interventions. Such implementation can be achieved through availability of internationally accepted standards, guidelines, and tools adapted to
241 conflict situations, which can be supported by specific training of health planners and health facility staff, and rapid mobilization of international
242 experts to provide technical field support as required. In poor resource settings such as Africa and elsewhere, building local, national and
243 regional capacity peace and conflict resolutions, and disease prevention and control should be an integral part of programs implementation.

244 It is worth noting that major humanitarian international and local non-governmental organizations (NGOs) have been created, with the purpose
245 to improve the effectiveness of relief operations and to alleviate the suffering of these vulnerable populations. However, humanitarian aid
246 logistics and coordination during previous decade had remained mainly justified on the basis of humanitarian geopolitical strategies and its
247 charitable nature of emergency response, rather than its effectiveness (9,15). More detailed investigations are required to establish the links
248 between Ebola outbreak emergence and transmission dynamics pre, in or post conflict events. Such will include assessing the role of population
249 displacement, forest and wildlife encroachment, ecological and environmental consequences on biothreats and public health crises. Conflict may
250 lead to the displacement of large populations into temporary settlements or camps with overcrowding and rudimentary shelters, inadequate safe
251 water and sanitation, and increased exposure to disease vectors during the acute phase of the emergency. In protracted and post-conflict
252 situations, vulnerable populations in remote and hard to reach rural settings documented high morbidity and mortality rates due to breakdown of
253 health systems, flight of trained staff, failure of existing disease control programs, and destroyed infrastructure (5,6,8,9,11,16,17).

254 Our finding showed the need for more operational conflict and outbreak crises humanitarian research for evidence-based public health
255 emergencies programs and strategic actions. This should aim at proactive and resilient early peace-conflict prevention and resolutions, reducing
256 conflict disabilities and consequences based on the understanding of spatio-temporal conflicts related public health humanitarian root causes and
257 needs. But also, effective monitoring and evaluation of humanitarian relief programs effectiveness and performance metrics on quality lifelong
258 health and economic development. Thus, informed policy-making through the provision of reliable evidence based knowledge and information
259 for emergency decision making and response including rapid diagnosis, case isolation and management, contact tracing, safe burials, and the
260 identification of transmission chain implementation and performance (6, 16, 17).

261

262 Our findings showed that conflict/war events affect the spatial and temporal patterns of Ebola outbreaks both in a quantitative and qualitative
263 ways across affected African countries (Table1). The history of conflict in the region and noted that after decades of civil wars in West Africa
264 outsiders and authorities are widely distrusted as result in Guinea, Sierra Leone, and Liberia, the response to the Ebola outbreak has been highly
265 politicized, with political factions pointing fingers at each other, further contributing to the social instability. Similar trends are beginning to be
266 seen in the case of Ebola in West Africa. Violence against civilians in Guinea where a crowd attacked an Ebola isolation centers and threw rocks
267 at aid workers, likely stemming from fear and misinformation about the disease, was seen as early as April 5, 2014 with the first official
268 diagnosis of the disease probably as result of three instances of violence against civilians occurring in Guinea in 2014 thus far (1, 4, 14, 15).
269 Conflict prevention, peace and security training and awareness could provide several opportunities to civil society, and citizens highly vulnerable
270 to the influence, governments and conflict early warning in Africa and elsewhere as capacity to respond to these complex challenges remains
271 weak with structural weaknesses, requisite institutional capacity and frameworks and significant economic growth albeit obvious democratic
272 government and development gains. Some explanations have been given by Jonathan and colleagues (2008), however it can be directly
273 established that the emergence of Ebola outbreak can be linked with years of conflicts, displacements, forest and wildlife insurgences as well as
274 human hunt for food for survival in the wild Africa forest. It has also been shown that mining activities have direct and indirect implications on
275 the wildlife and ecosystems leading to emergence and resurgence of known and emerging infectious diseases outbreaks (19, 20).
276 In contrast to central Africa, DR Congo persistent conflict/war events instability in the military ruling era, the 1990s and 2000s periodic conflicts
277 witnessed the highest second after Congo with more than 7 times episodes of Ebola outbreak in 1977, 1995, 2005, 2007, 2008, 2012 and 2014
278 compared to the first West Africa cases s in 2014 (Table 1).In West Africa, Liberia had a long civil conflict / wars from 1989-1996 and 1999-
279 2000 respectively. Only this total fatality in Liberia is greater than the cumulative fatality rate in Sudan, Congo, Gabon, Uganda, South Africa,
280 and Nigeria (Table 1). It could be demonstrated that DRC, Liberia and Sierra Leone's violence supports the notion that more events drive
281 increase in locations and actors vulnerability to Ebola outbreaks and psychosocial challenges. The WHO is working with the governments of
282 EVD affected countries to strengthen the health system, including bolstering the capacity of public laboratories to detect most existing infectious

likely to cause epidemics (20,21). Since the middle 1990s, wars and political instabilities in West Africa (Liberia, Sierra Leone, Côte d'Ivoire), Great Lakes and East regions (DR Congo, Uganda, Burundi, Rwanda, Ethiopia, Eritrea, Somalia) have forced millions of people to flee their homes or communities within and across their own borders stretching from northern Mali through Southern Algeria to Libya into Egypt. Nowadays, recent outbreaks on Cholera and Polio, Meningitis and Influenza to famine and malnutrition/food insecurity have been reported sporadically in conflict zones in South Sudan, Central Africa Republic (CAR) and Nigeria insurgency-related activity of Boko Haram and associated actors, DR Congo recent Ebola outbreak and Somalia continue to be worrisome due to high rate of displacement of indigenous populations and casualty attacks relatively bleak. Interestingly, in Uganda, more than half of the 1.8 million of internal displaced populations in 2005 returned homes by December 2009, similar to Burundi from 800,000 displaced in 1999 to 100,000 at the end 2009. With considerable decreased in recent years, strengthening African leaders political commitment is the most important factor in increasing financial resource capacity and peace building instilling national patriotism and resilience, disarmament and reintegration post conflicts programs.

Conflict-affected countries represent one of the weakest links in global health security and should be prioritized by the international community in provision of technical and operational support to implement core capacities for detection and response to epidemics. The trend and patterns of conflicts war events in Africa countries is diverse and complex ranging from ethnic, civil to mining conflicts and varied from one country to another and resulting to incursion in wildlife and forest where rebels and militias or terrorists capitalized on wild and forest jungles to hide, plan and stage their plots against the opponents. Consequentially, insidious and spread of rape and sexual violence against girls and women, lack of food, shelter and medical access to forced recruitment of children into armed groups (e.g. Boko Haram in Northern Nigeria) have been documented. Boko Haram in Nigeria eight years conflict left more than 20,000 deaths and 2.6 million displaced in Nigeria, with spilled out violence in Cameroon, Chad and Niger, and creating major humanitarian catastrophes in refugees' camps in recent times (17,18,22). Military humanitarian forces (local, US, UK) were been deployed in most affected Ebola outbreak West Africa countries emergency humanitarian responses in 2014-2015 and slow down during recovery and rebuilding programs amongst survivors and affected populations (22,23). These programs have a crucial role and are valuable resource in health systems development and socioeconomic growth. However, military

humanitarian assistance in outbreak has not been fully elucidated and requires further attention in terms of neutrality, community liaisons, and cooperation, consistent and transparent policy and humanitarian interventions especially in previous war zones. Also, it might be of importance in avoiding resurgence of geopolitical conflicts, repression and fragility showed to influence greatly Ebola geographical distribution in the region. In addition to ethnic, religious and economic divisions, conflicts to gain control of political power, and natural resources appears to be directly linked to Ebola outbreak in most affected communities in Africa (4, 20). Although the difficulty to access communities, security problems and poor communications and transport infrastructure, weak health systems and human health resources, poor leadership and the delay in international emergency response contributed to the worsening situation in the ongoing Ebola crisis in West Africa.

Based on the historical trends and dynamics patterns of instability and emerging outbreak in these countries, others countries worldwide suffering from similar challenges and issues in Africa such as central Africa Republic, Sudan, Libya, Burundi, Nigeria, Mali, Kenya, Rwanda, Niger, Somalia, Egypt, Tunisia, Algeria, Mozambique, Senegal, Madagascar, and Malawi can simply take the right steps in the right direction to avoid the horrors of Ebola and other emerging infectious diseases (18,19, 20). Again, lessons learnt from EDV outbreaks and conflict related public health emergencies consequences can serve in early warning alert and mitigation on incessant Middle East and Asia-Pacific countries whirling in the same dilemma and perpetual state of fragility including Syria, Iraq, Lebanon, Pakistan-Kashmir, Palestine, Myanmar, Sri Lanka, Thailand, as well as Latin America countries including Colombia, Guatemala, in Europe Northern Ireland and Western Balkans. Our findings provide evidence and information insights to leaders, organizations such as mining, policy makers and other stakeholders especially communities on their importance and role in seeking and undertakings rebuilding strategies pre-/post conflict events, and advocating on protection of environment and wildlife in Africa and elsewhere on sustainable national and global health, socio-economic and environment development and growth (3,22, 23, 24,25). In 2016, the growth in displacement figures was largely driven by the conflicts, gender violence, hunger and human rights violations in Middle Eastern countries such as Syria, Yemen, Iraq and India-Pakistan border. But conflicts in sub-Saharan Africa also forced millions of people to flee their homes in countries such as South Sudan, the Central African Republic, Burundi, the Democratic Republic of Congo, and Sudan. The region also hosted a large and growing number of refugees, which continued to exert enormous pressure on public services and local infrastructure in neighboring countries far-reaching political implications. African governments and local

326 and multinational actors including humanitarian organizations should agree to shoulder primary responsibility for preventing forced
327 displacement, access to the displaced and delivery of relief supplies. Recent Cholera outbreak in Yemen requires detailed outbreak investigation
328 and rapid assessment is currently ongoing due to limited local capacity. The source of this cholera infection needs to be quickly established to
329 facilitate appropriate strategies and interventions for rapid containment. There is an urgent need to strengthen the cholera case management
330 system as the current treatment centre falls short of the minimum standard. There is also a need to secure culturally fit-personal protective
331 equipment, stock of medical supplies and dedicated personnel, in case of an influx of patients; likewise mudsliding and flooding related public
332 health emergency disaster with potential cholera outbreaks threat in Sierra Leone that led to over 1,000 deaths in August 2017 (23,25).
333 Therefore, both public health emergencies events require urgent local and international requisite resources (mobilization and technical support in
334 recovery and rebuilding (mental, food and social, human capacity, funds and logistics) efforts as well as urban planning laws and reforms are
335 critical to strengthening Sierra Leone and other prone disasters countries public health emergencies preparedness and response capabilities. The
336 insufficiencies in national and regional surveillance and early warning and emergency response systems showed to favor Ebola outbreaks in both
337 urban and rural areas under natural and human made conditions. The central Africa of DR Congo neighbourhood area had been affected by civil
338 war since 1997 and was controlled by Congolese rebels. Moreover, an estimated 850,000 children of 1.4 million indigenous populations have
339 been forcefully displaced and horrific atrocities of committed with over 3,383 deaths in over 20 ethnic (Luba and Lulua) groups villages
340 completely destroyed in Kasai provinces, DR Congo in due to constitutional crisis by violation of presidential term limits set out in the
341 constitution, succession deal brokered and Bana Mura government-backed militia versus Kamuina Nsapu militia factions uprising since March
342 2016 to date. For example, Boko Haram terrorism and insurgency in Nigeria has been linked to political instability and insecurity, threatening
343 displaced populations and local indigenous in northern Cameroon, Chad and Niger. Similarly, political instability, militia factions and ethnics'
344 violence impacts in CAR and Burundi on neighbouring Uganda, South Sudan, DR Congo, Angola and other civil unrest in African countries
345 remain of regional and global public health concerns. African leaders have limited peace-building technical capacity and leadership
346 competencies, peace-conflict resolution to public health laboratory know-how capacities, facilities and lack of technical expertise require an
347 urgent attention. For example, in South Sudan, the situation has led to continued food insecurity as no tangible agricultural activities have taken

place. The armed conflict has resulted in massive population displacement, disrupted people's livelihoods, trade and access to humanitarian assistance, which remains the main source of food and livelihood in the conflict areas. The situation is being compounded by the high food prices and economic meltdown, which has eroded household purchasing power. High levels of severe acute malnutrition remain a serious public health concern across South Sudan, being driven by widespread fighting, displacement and poor access to services, disease outbreaks, extremely poor diet and extremely critical levels of acute malnutrition, putting 45,000 people at risk of famine (in terms of both quality and quantity), low coverage of sanitation facilities, provision of healthcare services have been severely compromised, and poor hygiene practices (15,24,25).

Continuous support of displaced populations and refugees humanitarian crisis needs remain indispensable through local, regional and global humanitarian assistance and relief programs. For example, the recent upsurge of cholera in the populous cosmopolitan Nairobi city and refugee setting in the north-eastern part of Kenya has been driven by mass population movements across borders leading to high population density in peri-urban and refugees camps, low care access to unsafe water and sanitation, inadequacies to timely humanitarian care, shelter and food assistance by WHO, UN agencies, humanitarian organizations and other partners NGOs. Hence, high level multisectoral engagement and advocacy is needed to tackle complex public emergencies crises across Africa including improving access to diagnostic screening and treatment adherence against resistance, scaling up vaccination programs (Polio, Rift valley fever, Measles and Tetanus, Ebola, Zika), vegetable seeds, fishing tools, improved WASH and borehole repair kits to 1,600 vulnerable households for cumulative socio-economic and public health impact. Strengthening local and regional conflict-linked biothreats and disease outbreaks early detection, surveillance and monitoring implementation is crucial in generating evidence-based national public health emergency preparedness, prevention and control programs and countermeasures.

Hence, strengthening public health emergencies events surveillance, knowledge and abilities is crucial in investigating and monitoring invasive pest, vector and associated diseases threats or outbreaks for effective prevention and control programs, improving access, to safe water and proper sanitation in the refugees' camps. Authors recognized the urgent need to increase proactive and resilient leadership and investment in sensitizing the local population awareness, behaviour social mobilization and resilience empowerment programs to activities ownership mainly the youths is imperative against biothreats disasters or humanitarian crises in the region.

369 However, it should be noted some conflict related data were obtained from geo-coding conflicts events in form ACLED and other international
370 agencies datasets are not immune from potential biases and measurement, and not exhaustive. We cannot rule out the possibility of under-
371 reporting of some conflicts and regional emergencies events towards some countries due to media coverage restrictions and access control.

372

373 **Conclusion and recommendations**

374 This paper provides the first comprehensive evidence-based conflict and wars public health emergencies associated Ebola outbreaks events
375 implications in Africa and provide practical and effective approaches, programs and activities in full rebuilding processes (peacekeeping, peace-
376 building, conflict resolution, healthy outbreak recovery) for wellbeing and productivity. Authors call for the urgent need for concerned
377 commitment and engagement of all stakeholders to develop, implement and strengthening local, regional and global public health emergencies
378 evidence practice approaches and strategies including national public health disaster emergency situations insurance schemes in paramount in
379 disaster high risk prone settings and particular in Africa is imperative to fostering health and socioeconomic development and growth. The
380 importance of implementation of effective and timely outbreak early warning alert, surveillance and emergency response systems is recognised,
381 but there is a scarcity of evidence on optimal ways to detect these outbreaks in most conflict eventful countries in Africa. Building positive
382 legacy through investing in evidence-based and effective public health emergencies partnerships strengthening by financing community-based
383 programmes in championed by the Africa CDC centres core public health laboratory infrastructure and Human resources capacity development
384 and targeted training, and epidemiologic surveillance expertise are all urgently needed in West Africa and beyond. Global funding and local
385 public-private commitment and investment including disaster insurance schemes capabilities could be assets to deploy resources successfully
386 and in a timely fashion to prevent and respond to disaster emergencies. The collective public health emergencies benefits is vital in health
387 systems strengthening including substantial resource expenditures and routine full functioning health services successful implementation in line
388 with IHR, 2005 and global community agenda against international infectious disease threats. While advocating for an effective implementation

389 of outbreaks and emerging tropical diseases surveillance response systems in Africa, Surveillance systems are often weak in conflict situations,
390 which results in delays in detection and reporting of epidemics.

391

392 **Competing interests**

393 The authors declare that they have no conflict interests

394

395 **Author's contributions**

396 ET conceived the study and designed methodological search strategy and assessment. ET performed the review search and wrote the primary
397 draft of the paper. OAO, ECU, MF and JYN provided additional country information. ET provided extensive revision and update. All authors
398 read and approved the final manuscript

399

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403 **References**

- 404 1. WHO, 2014. WHO Ebola virus disease outbreak -West Africa 2015. [http://www.who.int /csr/don/2015 _03_27_ebola /en/](http://www.who.int/csr/don/2015_03_27_ebola/en/) accessed on 15
405 March 2015.
- 406 2. Ernest Tambo, Emmanuel Chidiebere Ugwu and Jeane Yonkeu Ngogang. Need of surveillance response systems to combat Ebola outbreaks
407 and other emerging infectious diseases in African countries. *Inf Dis Poverty* J, **3**:29. 27th July 2014b
- 408 3. WHO, 2014b.WHO Statement on the Meeting of the International Health Regulations Emergency Committee Regarding the 2014 Ebola
409 Outbreak in West Africa (accessed 10 September 2014).<http://www.who.int/mediacentre/news/statements/2014/ebola-therapies-consultation/en/>
- 410 4. Loretta A, Tegegn Y. Disasters in Africa: old and new hazards and growing vulnerability. *World Health Stat Q*. 1996;49(3-4):179-84.
- 411 5. Kalipeni E1, Oppong J. The refugee crisis in Africa and implications for health and disease: a political ecology approach. *SocSci Med*. 1998
412 Jun;46(12):1637-53.
- 413 6. E. Tambo. Non-Conventional Humanitarian Interventions in Ebola Outbreak Crisis in West Africa: Health, Ethics and Legal Implications.
414 *Infectious Diseases of Poverty* 2014, 3:42 (25 November 2014)
- 415 7. Morse SS. Factors and determinants of disease emergence. *Rev Sci Tech*. 2004;23:443–51
- 416 8. Wakabi W. Health situation remains grave in southern Sudan. *Lancet*. 2008 Jul 12;372(9633):101-2. No abstract available.
- 417 9. Völkl-Kernstock S, Karnik N, Mitterer-Asadi M, Granditsch E, Steiner H, Friedrich MH, Huemer J. Responses to conflict, family loss and
418 flight: posttraumatic stress disorder among unaccompanied refugee minors from Africa. *Neuropsychiatr*. 2014;28(1):6-11. doi: 10.1007/s40211-
419 013-0094-2.
- 420 10. Lalis A, Leblois R, Lecompte E, Denys C, Ter Meulen J, Wirth T. The impact of human conflict on the genetics of *Mastomys natalensis* and
421 Lassa virus in West Africa. *PLoS One*. 2012;7(5):e37068. doi: 10.1371/journal.pone.0037068. Epub 2012 May 15.

- 422 11. Betancourt TS, Agnew-Blais J, Gilman SE, Williams DR, Ellis BH. Past horrors, present struggles: the role of stigma in the association
423 between war experiences and psychosocial adjustment among former child soldiers in Sierra Leone. *SocSci Med*. 2010 Jan;70(1):17-26. doi:
424 10.1016/j.socscimed.2009.09.038. Epub 2009 Oct 28
- 425 12. Ernest Tambo, Clarence S. Yah, Chidiebere E. Ugwu, Oluwasogo A. Olalubi, Isatta Wurie, Jeannetta K. Jonhson and Jeane Y. Ngogang.
426 Fostering prevention and care delivery services capability in Human Immunodeficiency virus and Ebola outbreak symbiosis in African
427 vulnerable populations. *J Infect Dev Ctries* 2016; 10(1):001-012. doi:10.3855/jidc.6875
- 428 13. Roddy P, Weatherill D, Jeffs B, Abaakouk Z, Dorion C, Rodriguez-Martinez J, Palma PP, de la Rosa O, Villa L, Grovas I, *et al.*: The
429 Medecins Sans Frontieres intervention in the Marburg hemorrhagic fever epidemic, Uige, Angola, 2005. II. lessons learned in the
430 community. *The Journal of infectious diseases* 2007, 2:S162-167.
- 431 14. Enserink M: Crisis of confidence hampers Marburg control in Angola. *Science* 2005, 308(5721):489
- 432 15. Roberts B, Damundu EY, Lomoro O, Sondorp E. Post-conflict mental health needs: a cross-sectional survey of trauma, depression and
433 associated factors in Juba, Southern Sudan. *BMC Psychiatry*. 2009 Mar 4;9:7. doi: 10.1186/1471-244X-9-7.
- 434 16. Roberts B, Felix Ocaka K, Browne J, Oyok T, Sondorp E. Factors associated with the health status of internally displaced persons in
435 northern Uganda. *J Epidemiol Community Health*. 2009 Mar;63(3):227-32. doi: 10.1136/jech.2008.076356. Epub 2008 Nov 21.
- 436 17. Neuner F, Onyut PL, Ertl V, Odenwald M, Schauer E, Elbert T. Treatment of posttraumatic stress disorder by trained lay counselors in an
437 African refugee settlement: a randomized controlled trial. *J Consult Clin Psychol*. 2008 Aug;76(4):686-94. doi: 10.1037/0022-006X.76.4.686.
- 438 18. Obilom RE, Thacher TD. Posttraumatic stress disorder following ethnoreligious conflict in Jos, Nigeria. *J Interpers Violence*. 2008
439 Aug;23(8):1108-19. doi: 10.1177/0886260507313975. Epub 2008 Fe

19. Catherine Bruckner and Francesco Checchi Detection of infectious disease outbreaks in twenty-two fragile states, 2000-2010: a systematic review. *Conflict and Health* 2011, **5**:13 doi:10.1186/1752-1505-5-13
20. Feldmann H, Czub M, Jones S, Dick D, Garbutt M, Grolla A, Artsob H. Emerging and re-emerging infectious diseases. *Med Microbiol Immunol*. 2002 Oct;191(2):63-74. Epub 2002 Sep 3. Review.
21. Parpia AS, Ndeffo-Mbah ML, Wenzel NS, Galvani AP. Effects of Response to 2014-2015 Ebola Outbreak on Deaths from Malaria, HIV/AIDS, and Tuberculosis, West Africa. *Emerg Infect Dis*. 2016 Mar;22(3):433-41. doi: 10.3201/eid2203.150977.
22. Cohn S, Kutalek R. Historical Parallels, Ebola Virus Disease and Cholera: Understanding Community Distrust and Social Violence with Epidemics. *PLoS Curr*. 2016 Jan 26;8. pii: ecurrents.outbreaks.aa1f2b60e8d43939b43fbd93e1a63a94. doi:
23. Oluwasogo A. Olalubi, Abdulrasheed A. Adio, Shola K. Babatunde, Henry O. Sawyerr, Taofiq Ajara, Ernest Tambo. Response of undergraduates to institutional emergency strategies on Ebola virus disease in Kwara State University, Nigeria. *Journal of Public Behaviour*, 2017, Feb. Vol 7 4-21-28
24. Ernest Tambo. Improving disaster risk reduction preparedness and emergency response readiness and resilience in Africa. *Intl J of Public Health Science*, Vol.6, No.2, June 2017, pp. 183-191
25. Ernest Tambo; Chryseis F. Chengho; Chidiebere E Ugwu; Isatta Wurie; Jeannetta K Johnson; Jeanne Y Ngogang. Rebuilding transformation strategies in post-Ebola epidemic in Africa. *J. Infectious Diseases of Poverty*. Vol 6:71
26. Siedner MJ, Gostin LO, Cranmer HH, Kraemer JD (2015) Strengthening the Detection of and Early Response to Public Health Emergencies: Lessons from the West African Ebola Epidemic. *PLoS Med* 12(3): e1001804.

467 **Table 1: Trend and pattern of political conflict/wars events and Ebola Outbreaks in African countries from 1976 -2016**

Country	Conflict/War start year	Conflict/War end year	Conflict/War duration	Ebola species	Ebola epidemic year	Years for Epidemic minus war start	Years for Epidemic minus war end	Cumulative cases(n)	Cumula deaths
Guinea	2009	2010	2	Zaire ebolavirus	2014	5	4	3,804	2,53
Liberia	1999	2003	5	Zaire ebolavirus	2014	15	11	10,675	4,80
Sierra Leone	1991	2002	12	Zaire ebolavirus	2014	23	12	11,123	3,95
Nigeria	1967	1970	4	Zaire ebolavirus	2014	47	44	20	8
Mali	1960	2012	2	Zaire ebolavirus	2014	2	2	8	6
Senegal	2010	2012	3	Zaire ebolavirus	2014	4	2	1	0
South Sudan	1955	1972	18	Sudan ebolavirus	1976	21	4	284	151
South Sudan	1955	1972	18	Sudan ebolavirus	1979	24	7	34	22
South Sudan	1983	2005	23	Sudan ebolavirus	2004	21	-1	17	7
Gabon	1960	1963	3	Zaire ebolavirus	1994	34	31	52	31
Gabon	2000	2000	1	Zaire ebolavirus	2002	2	2	65	53
Congo	1996	1997	2	Zaire ebolavirus	2002	6	5	59	44

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Congo	1996	1997	2	Zaire ebolavirus	2003	7	6	143	128
Congo	1998	2003	6	Zaire ebolavirus	2003	5	0	35	29
Congo	1998	2003	6	Zaire ebolavirus	2005	7	2	12	10
Uganda	1998	2003	6	Zaire ebolavirus	2000	2	-3	425	224
Uganda	1998	2003	6	B. ebolavirus	2007	9	4	149	37
Uganda	1998	2003	6	Zaire ebolavirus	2011	13	8	149	37
Uganda	1998	2003	6	Sudan ebolavirus	2012	14	9	7	4
DR Congo	1960	1965	6	Zaire ebolavirus	1976	16	11	318	280
DR Congo	1960	1965	6	Zaire ebolavirus	1977	17	12	1	1
DR Congo	1960	2017		Zaire ebolavirus	2017	8	4	4	813
DR Congo	1960	1965	6	Zaire ebolavirus	1995	35	30	315	254
DR Congo	2005	2006	2	Zaire ebolavirus	2007	2	1	264	187
DR Congo	2005	2006	2	Zaire ebolavirus	2008	3	2	32	14
DR Congo	2008	2008	1	Zaire ebolavirus	2012	4	4	57	29
DR Congo	2008	2008	1	Zaire ebolavirus	2014	6	6	82	50
				Tai Forest					
Ivory Coast	2008	2011	4	ebolavirus	1994	-14	-17	1	0
South Africa	1948	1994	47	Zaire ebolavirus	1996	48	2	1	1