A shift from reactionary towards more proactive and sustainable approaches is required for effective Ebola virus disease preparedness in Africa: A case study of key lessons learned from the Democratic Republic of Congo

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Abstract

Background

From May 2018 to the end of June 2022, the Democratic Republic of Congo (DRC) experienced six Ebola virus disease outbreaks within its borders. During the 10th EVD outbreak, the largest experienced in the DRC and the second largest and most prolonged EVD outbreak recorded globally, a WHO risk assessment identified nine countries bordering the DRC as moderate to high risk from cross border importation. Burundi, Rwanda, South Sudan and Uganda were classified as priority one countries while Angola, Central African Republic, Congo, Tanzania and Zambia as priority two. These countries implemented varying levels of Ebola virus disease preparedness interventions. This case study highlights the gains and shortfalls with the Ebola virus disease preparedness interventions against the background of a renewed and growing commitment for global epidemic preparedness highlighted during recent World Health Assembly events.

Main text

Several positive impacts from preparedness support to countries bordering the affected provinces in the DRC were identified, including development of sustained capacities which were leveraged upon to respond to the subsequent COVID-19 pandemic. Shortfalls such as lost opportunities in vertical approaches to response pillars such as surveillance, over dependence on external support and duplication of efforts especially in the areas of capacity building were also identified. A recurrent theme that emerged from this case study is the propensity towards implementing short-term interventions during Ebola virus disease outbreak preparedness and response rather than sustainable investment into strengthening systems for improved health security in alignment with IHR obligations and the Sustainable Development Goals.

Conclusions

Despite several international frameworks established at the global level for emergency preparedness, a shortfall exists between global policy and practice in countries at high risk of cross border transmission from persistent Ebola virus disease outbreaks in the Democratic Republic of Congo. With renewed global health commitment for country emergency preparedness resulting from the COVID-19 pandemic and cumulating in a resolution for a pandemic preparedness treaty, the time to review and address these gaps and provide recommendations for more sustainable approaches to emergency preparedness towards achieving global health security is now.

Background
From May 2018 to the end of May 2022, the Democratic Republic of Congo (DRC) has experienced six Ebola Virus Disease (EVD) outbreaks within its borders [1]. Observations during these outbreaks showed that the country and neighboring at-risk countries were not prepared despite lessons learnt from previous experience, not least the unprecedented West Africa EVD outbreak [2–5]. The revised International Health Regulations (IHR 2005) and several international policy frameworks have since been established to guide countries worldwide to build functional emergency preparedness and response capacities for all emergency events of significant threat to humans [6–14]. Unfortunately, the Coronavirus (COVID-19) pandemic demonstrated to the world that policy guidelines did not necessarily translate into practice [15]. In view of the fact that countries in sub-Saharan Africa will continue to carry the burden of endemic and emerging infectious disease outbreaks including EVD outbreaks, it is an imperative that lessons learnt from the preparedness and response to these events are well documented. This case study thus highlights the gains and shortfalls with the EVD preparedness interventions against the background of the renewed and growing commitment for global epidemic preparedness during the 73rd, 74th and 75th World Health Assembly (WHA) events [16] Focusing specifically on the tenth and eleventh EVD outbreaks in the DRC, the findings of this case study were synthesized from various sources such as reports of joint monitoring exercises [17], simulations [18] and field support missions as well as regular descriptive reports captured during regular telecommunication sessions with country focal points and members of the field teams directly engaged with the coordination and roll out of EVD preparedness activities in priority countries. Many of the authors were also engaged during EVD preparedness as participant observers in several coordination meetings at regional and country levels and provided insights into the key issues, challenges and lessons learnt from the EVD preparedness in the priority countries.

The Case Study: Focus On The 10th And 11th EVD Outbreaks In The DRC And Emergency Preparedness (2018 – 2022)

The most recent (and ongoing) outbreak of EVD in the DRC represents the 14th outbreak since the first EVD outbreak reported in the country and globally in 1976 [19] The 9th, 11th and 14th outbreaks occurred in Equateur Province in Western DRC whilst the 10th, 12th and 13th occurred within eastern DRC’s conflict affected provinces of Ituri, North and South Kivu [19-21]. Among these, the 10th EVD outbreak was the world’s second largest and the first to occur within an active conflict zone, making it the most complex and prolonged experienced in the DRC [19]. The peak of the 10th outbreak occurred in April 2019 when up to 120 newly confirmed cases were reported weekly [19]. Over the 23-month period of the 10th outbreak, 29 health areas across 9 health zones in three Provinces were affected, namely North and South Kivu and Ituri Provinces. A total of 3,463 cases including 2,280 deaths, 1,004 children (29%), 173 health workers, and 1,171 recoveries were recorded [19].

Based on a World Health Organization risk assessment, nine countries sharing borders with the DRC during the 10th EVD outbreak were considered as moderate to high risk and referred to as “priority countries”. The priority countries were further classified into priority one and two depending on their geographic proximity to the epi-centre of the outbreak, volume of cross border movement and shared
transport routes. As a result, Burundi, Rwanda, South Sudan and Uganda were identified as priority one countries and Angola, Central African Republic (CAR), Congo, Tanzania and Zambia as priority two. Between October 2018 and December 2019, over 70 million USD was provided by the international donor community to the priority one countries [22, 23] for EVD Preparedness. Efforts to sustain preparedness capacities were retained up until the outbreak was declared over on the 25th June 2020 despite dwindling resources. The priority countries updated their EVD National Contingency Plans in late 2019, some adopting a strategy for transitioning capacities developed during EVD preparedness to other public health emergencies. However, with the emergence of COVID-19 in early 2020, funding secured for implementation of 2020 transition plans was mostly repurposed to the COVID-19 response. The key pillars in the EVD response programmes of these countries were namely coordination, surveillance at the community, points of entry and health facility levels, laboratory diagnosis, case management, infection prevention and control, risk communications and community engagement, operational support and logistics and preventive vaccination of frontline health workers.

The country’s 11th outbreak was declared following laboratory confirmation of samples taken during investigation of a suspected cluster of deaths in Equateur Province on 1st June 2020 and prior to the ending of the 10th outbreak [20]. The nature of this outbreak was low intensity, but cases emerged sporadically across a broad area affecting 42 health areas in 13 of the 18 health zones in Equateur Province [20]. The wide geographical emergence of cases led to concerns of possible new introductions from zoonotic spillover as almost two thirds of confirmed cases were not registered contacts. From early October 2020 the number of reported cases reduced dramatically, and the outbreak was declared over on the 18th November 2020. This outbreak recorded a total of 130 confirmed cases, 55 deaths and 75 recoveries [21].

**The keys lessons from the EVD preparedness programmes in countries adjacent to the DRC**

The lessons learnt from the outbreaks captured the benefits of EVD preparedness of the countries bordering the DRC that were at high risk of a cross border transmission during DRC’s 10th and 11th and subsequent EVD outbreaks. The reports and experiences also captured several shortfalls in implementation processes. The gaps between building detection and response capacities in a sustainable manner in alignment with global policy frameworks as stipulated under Article 44 of the IHR 2005 and other international frameworks are highlighted and discussed.

**National and local capacity building during EVD outbreaks as a more sustainable approach to emergency preparedness**
Experiences from the priority countries showed how national capacities built under several pillar areas were leveraged upon to respond to the COVID-19 response. Capacities in national and sub-national multi-sectoral coordination were strengthened, the need for institutionalization for infection prevention and control was realized and a heightened appreciation for the role of risk communication and community engagement in public health was acknowledged. Rwanda and Uganda reported that surveillance strengthened in the high-risk districts under EVD Preparedness was easily translated to the COVID-19 response [22]. In South Sudan, surveillance capacities developed during EVD Preparedness resulted in the early detection and aversion of a Yellow Fever outbreak in November 2018 [24]. The extent to which the EVD preparedness investments mitigated the impact of subsequent outbreaks and the COVID-19 pandemic in the priority countries is an area requiring further exploration and quantification.

However, in some cases during these EVD outbreaks, some countries continue to depend on external intervention and a significant proportion of donor funding to conduct a response. For example, following emergence of the DRC’s 11th EVD outbreak on 1st June 2020 in Equateur Province, little evidence of local capacity developed during the 9th outbreak, occurring in the same location less than two years earlier, was evident. Most of the response pillar areas had to be re-established and re-operationalized by external partners resulting in a delayed response. A similar situation was observed during the EVD outbreak in Guinea in 2021 and to a less extent in Beni in 2020 and 2021. One pillar area where the gap in national capacity is most evident is in critical care specific to managing EVD patients. In the majority of EVD outbreaks critical patient management was conducted by external partner organisations due to inadequately trained healthcare workers in critical care capacities within the health sector of sub-Saharan African countries [25].

Building local capacity from the existing pool of experienced human resources in countries and communities or sharing this capacity between countries in the region was not fully exploited as a more sustainable investment in EVD preparedness at that time. While Rwanda sent a national team to Beni during the 10th EVD outbreak to acquire patient management capacity, CAR was unable to do this due to lack of funding during the DRCs 11th outbreak. The gap in investment into building national critical care capacity became particularly evident during the COVID-19 response in several countries in the region when deployment of international Emergency Medical Teams was necessitated [26].

Experiences from these EVD outbreaks also conveyed how communities played a critical role in the prevention, detection, investigation and response operations during outbreaks and their need to be better capacitated to initiate and operationalize response operations including decision making on how preparedness and response resources are used in their localities. Communities in the DRC argued that large deployments of international personnel during EVD outbreaks undermines local expertise and little opportunity remains for sustaining the skills developed during a response after withdrawal [27].

**Quality of EVD preparedness and response capacity building methods**
EVD outbreaks are usually accompanied by rapid investment into the response phase allowing little time for formal planning of quality training programmes. During the preparedness and response phase of these outbreaks, national staff and community volunteers were provided with basic trainings to implement field level activities under several pillar areas. Trainings were largely undertaken by an array of partner agencies in an ad hoc manner using multiple methods such as sensitizations, briefings, orientations, theoretical and practical workshops. An independent evaluation of EVD Preparedness conducted in Uganda in 2020 identified how on occasions several partners were conducting trainings in the same area with the same theme and objectives [28]. While duplication is not a new phenomenon in development contexts, more effort is required for its identification and prevention through effective coordination mechanisms. In addition, mapping trainees, evaluating retention of their knowledge or application of the skills transferred in the medium to long term is seldom undertaken. Evidence that capacity is transferred into sustainable outcomes such as employment opportunities within the health system or engagement in other public health emergencies and improved quality of care beyond periods of active EVD response are also lacking.

There were few examples demonstrating effective coordination of EVD Preparedness trainings or establishment of formal procedures for reviewing the structure, mode of delivery and quality of the training content, assessing the capacity of the trainers or selection process of the participants. The collaboration between the academic and public health sectors for EVD Preparedness capacity in the priority countries during the 10th EVD outbreak was a new development and represented an opportunity for countries to encourage inter-regional partnerships between higher level institutions to ensure institutionalization of training programmes for EVD outbreak preparedness and response.

Increased recognition of the need for sustainable context appropriate research and innovations

The importance of research and development in EVD outbreaks cannot be overemphasized, particularly the development of vaccines and therapies for high impact pathogens including EVD [29]. The low intensity outbreaks observed during DRC's 11th, 12th, 13th and 14th EVD outbreaks may have resulted from the roll out of the investigative rVSV-ZEBOV-GP Zaire ebolavirus vaccine during the 9th and 10th EVD outbreaks in these same locations. Studies on the duration of vaccine efficacy are ongoing [30-32]. However, a key concerning observation during these outbreaks, is that while funding to support research and development of experimental therapies and vaccines during EVD outbreaks is high, support to these same communities to access these life-saving and oftentimes unaffordable products after licensing is limited.

Observations show that countries seeking vaccination of high-risk health workers in districts bordering the 11th, 12th and 13th outbreaks failed to access adequate quantities of the licensed vaccine. Furthermore, little attention was targeted towards local clinical research into homegrown interventions which could reduce mortality in low resource settings. For example, allocation of research funding to
explore the contribution of supportive care interventions such as blood volume enhancers including intravenous fluids, colloid and crystalloid solutions, blood transfusion and parenteral nutrition as life-saving interventions in patient management during EVD preparedness was lacking in the DRC and other at-risk countries during EVD outbreaks.

EVD outbreaks were frequently accompanied by a cascade of medico-technical innovations such as the use of robots to monitor patient body temperatures at airports in some African countries and piloting drones to transport EVD alert samples across the equatorial forests of Equateur Province raising serious safety concerns are some examples. Whilst technological interventions can address gaps in response operations and reduce costs, such innovations need to be informed by public health principles.

**Sustainable solutions for Ebola Treatment Centres**

When the 11th EVD outbreak emerged in Equateur Province at the end of May 2020, temporary facilities constructed during the 9th EVD outbreak to isolate and treat patients either no longer existed or were unfit for purpose. This demanded rapid construction of inferior quality structures that were poorly managed in the initial phase of the response due to weak partner co-ordination. In some communities, in addition to fear and stigma, reports of poor patient care for those admitted at the treatment centres translated into additional fear, avoidance to report alerts and resistance to allow access for safe and dignified burial teams to respond to community deaths. Reversing mistrust required considerable time and investment, not only by improving the physical infrastructure and system of care but through intensive community engagement. In the 2021 EVD outbreak in Guinea mistrust remained among communities from bad experiences associated with Ebola Treatment Centres (ETCs) during the West African outbreak (2014-2016) [33].

The design and materials used to construct ETCs have witnessed several innovative improvements in the past decade. These innovations materialized in response to the need for improved health worker and patient safety, improved comfort and visibility for the patient of their surroundings and for family members, reduced time constraints to monitor and treat patients and a reduction in Personal Protective Equipment (PPE) use and waste management costs without compromising infection prevention. The concept of transit centres introduced in North Kivu during the 10th EVD outbreak using semi-permanent materials as extensions to existing permanent structures also helped to buffer community fear.

Building permanent or semi-permanent structures for isolating and treating patients versus temporary structures became an area of considerable debate between donors and countries throughout EVD Preparedness efforts in the at-risk countries. The argument for not investing in infrastructural projects lies in the assumption that such projects are highly costly, take time to complete and funds might be misused or diluted into a larger funding pool resulting in a poor-quality product that does not serve the intended purpose. Another argument against permanent structures is that the location of an EVD outbreak cannot be known in advance, therefore constructing permanent buildings in several locations in expectation of a
confirmed case is not feasible. Temporary structures are considered suitable to serve the purpose for the duration of the project and pose a lower risk for the investment. However, in practice it has been shown that the cost of constructing and maintaining a temporary ETC is equivalent and (in some cases) more costly to construct and maintain than semi-permanent/permanent structures. Temporary structures inevitably decompose over time due to exposure to weather and represent poor value for money. Many of the at-risk countries expressed preference for semi-permanent/ permanent structures or renovation of existing buildings as a more sustainable and cost-effective solution that can be repurposed to general isolation facilities for other infectious diseases following EVD outbreaks. In South Sudan, the semi-permanent structures built during EVD preparedness in 2019 were sustained and continued to be used throughout the ongoing COVID-19 response [23]; their design has been adopted for use in other countries such as Burundi.

However, despite attempts to humanize ETC design in recent years, all six EVD outbreaks in the DRC between 2018 and 2022 continue to see patients treated in temporary structures. The consensus that emerged is that there is “no one size fits all solution”. Each outbreak evolves and behaves differently and can emerge in a variety of contexts warranting different design options. Decision making processes at country level requires further dialogue and review of case studies from EVD preparedness and inclusion of community perspectives.

**Integrating EVD readiness into existing health systems and programmes**

The large influx of funding and resources associated with epidemics has in the past resulted in the duplication of efforts and implementation of short-term interventions that fail to strengthen country capacity in the longer term oftentimes representing missed opportunities. A key lesson from the EVD preparedness in the priority countries was the need to leverage existing health programmes and identify existing systems and use them as entry points for integrating EVD preparedness. One example was the need for enhanced integration of EVD surveillance into the Integrated Disease Surveillance and Response (IDSR) system, the primary disease surveillance system for the general population, used in the priority countries. In South Sudan for example, a project approach under EVD Preparedness resulted in an EVD alert management system limited to high-risk districts for EVD that ran parallel to the existing IDSR system [23]. On review this was acknowledged as a lost opportunity that could have integrated EVD surveillance with nationwide training of health workers and roll out of the 3rd Edition IDSR for all priority infectious diseases in the country. Although the detection and aversion of a Yellow Fever outbreak identified under EVD surveillance was a benefit of the vertical surveillance model described above, the system was not sustained beyond the funding period. This is largely due to funding reporting mechanisms which demand results on the performance of specific activities under specific programmes or diseases within a fixed time frame dictated by the length of the funding period. This approach encourages “new” or duplicated systems that can undermine existing systems and resources that could
have been leveraged upon. Such lost opportunities justify a need for more coordinated, informed and negotiated planning processes.

**Reflections on the lessons learned**

A recurrent theme that emerged in the lessons learned from the preparedness for the EVD outbreaks in countries bordering the DRC outbreaks is a propensity towards implementing short-term vertical interventions during EVD outbreak preparedness and response rather than sustainable investment into strengthening systems for health security in alignment with IHR 2005 obligations and the Sustainable Development Goals (SDGs).

Since the first recorded EVD outbreaks in 1976, response interventions have been mostly reliant on international emergency funding and expertise. As a result, resources are limited to the timeframe of the outbreak period and withdrawn once the outbreak is declared over. In contexts such as the DRC known to frequently experience EVD outbreaks, negligible national investments have been made to establish foundational preparedness elements on which emergency responses can rapidly become operational prior to arrival of external support. Unfortunately, the current approach for supporting EVD preparedness, follows a declared outbreak and is an extension of the response. Limiting EVD preparedness support to “operational readiness” after emergence of a nearby outbreak risks undermining the importance and volume of work required to build the foundation of preparedness in countries, particularly in contexts where weak health systems exist. Even more concerning than limiting EVD preparedness support is absence of support for preparedness in high-risk areas bordering outbreaks as observed in relation to all the DRC outbreaks following the 10th EVD outbreak. This is particularly concerning for CAR and Congo bordering Equatorial Province in western DRC where no significant investment towards implementing EVD preparedness has occurred despite three outbreaks since 2018 across a shared landscape.

While extending EVD response capacities to support preparedness appears to make sense at several levels it has several limitations. In support of the argument, preparedness benefits from being an extension of a response in that having expertise, experience and capacities available during the response can inform and guide inputs and activities required for co-ordinating preparedness activities simultaneously. Also, the proximity of a response influences increased alert reporting in neighboring areas due to enhanced awareness and surveillance activities. This also increases willingness of neighbouring countries to engage in preparedness activities and cross-border collaboration and finally it highlights gaps and funding needs. However, when EVD preparedness is limited to being an extension of the response, it falls within the timeline allocated for supporting the response. This does not allow sufficient time to develop national capacities and skills for countries to effect an independent response or generate a baseline of resilience to mitigate future events. Once the outbreak is declared over, support for the response and preparedness efforts initiated in bordering countries is withdrawn leaving these health systems in much the same state as prior to the outbreak. As the DRC's 10th EVD outbreak phased down in the latter part of 2019, funding for additional EVD contingency plans waned, yet several gaps remained
for the priority countries to reach a minimum level of capacity. Another limitation is that when preparedness support is an extension of a response it can become defined by the response, resulting in carbon copied approaches and activities, some of which tend to be reactive in nature allowing little scope to conceptualize more sustainable or more context appropriate methods. Constructing temporary ETCs versus permanent structures in EVD prone contexts is one example highlighted above. If issues such as ETC design, incentive payments to responders and vaccination strategy were explored and resolved at country level outside the urgency of a response environment, analysis of previous case studies and lessons learnt could be more effectively reviewed to inform decision-making processes for future responses.

Conclusion

Global health security and health system strengthening are two sides of the same coin. Unfortunately, the lessons learned from the priority countries’ preparedness for cross-border transmission of EVD during the 10th and 11th outbreak in DRC demonstrate that rapid and temporary mitigation measures in reaction to EVD outbreaks threatening international borders and regional health security on the Africa continent continue to be the preferred approach to EVD preparedness in high-risk contexts. Hard lessons learnt including those highlighted in this paper should be advocacy for a shift from reactionary and short-lived interventions towards more sustainable long-term approaches to EVD and emergency preparedness which would build health system resilience in general. A starting point would be for countries and global actors to create a space where much-needed open dialogue can occur to review these and other best practices and lessons learnt around EVD preparedness long before outbreaks. From here resolutions, contextual view-points and recommendations can evolve and disentangle recurrent bottlenecks that emerge time and again during EVD response and preparedness. The time for this open dialogue, engagement and inclusive collaboration is now.

Recommendations

Some recommendations to inform more sustainable preparedness approaches for future EVD Preparedness investments into EVD and other Viral Hemorrhagic Fevers (VHF) prone contexts have emerged from this case study. First, investment in community engagement and skills development for local health cadres trained to manage EVD patients is critical. Second, national accreditation and quality assurance of training content for emergency responders, post training evaluation and registration of trainees in communities is important. Third, capacity and funding for local research and development into context appropriate and affordable treatment innovations should be developed in high-risk countries. Fourth, permanent/semi-permanent infrastructural development for infectious disease isolation and treatment units near existing health facilities in VHF prone communities should be encouraged. Fifth, EVD preparedness pillars should be integrated into routine health programmes as much as practicable. Lastly but importantly, investments into the development and integration of human and veterinary public health
surveillance and laboratory services for early detection and diagnosis should be encouraged within the framework of the One Health approach.

Abbreviations

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<tr>
<td>CAR</td>
<td>Central African Republic</td>
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<td>COVID-19</td>
<td>Coronavirus disease</td>
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<td>DRC</td>
<td>Democratic Republic of the Congo</td>
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<td>ETC</td>
<td>Ebola Treatment Centre</td>
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<td>EVD</td>
<td>Ebola Virus Disease</td>
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<td>IDSR</td>
<td>Integrated Disease Surveillance and Response system</td>
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<td>MoH</td>
<td>Ministry of Health</td>
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<td>PPE</td>
<td>Personal Protective Equipment</td>
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<td>Sustainable Development Goals</td>
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<td>World Health Assembly</td>
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<td>World Health Organisation</td>
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<td>VHF</td>
<td>Viral Hemorrhagic Fevers</td>
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Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

All authors consented in writing to their inclusion in this article for publication.

Availability of data and materials

Not applicable

Competing interests

The authors declare that they have no competing interests

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**Authors' contributions**

CSR, MRDB, MN and OOO made substantial contributions to the conception of the work, interpretation of data, writing and preparation of the manuscript for submission. YAA, AL, MTKY, BB, JT, NN and AOT contributed to revising the work. All authors read, approved and agreed to be responsible for the final manuscript.

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References


18. https://apps.who.int/iris/handle/10665/254741


23. Olu OO, Lako R, Wamala JF, Ramadan PO, Ryan C, Udenweze I et al. What did we learn from preparing for cross-border transmission of Ebola virus disease into a complex humanitarian setting -


