



Case-fatality Ratio Due to Ebola Virus Disease in North-eastern Democratic Republic of the Congo in 2019

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To cite this article:

Aimee Lulebo Mampasi, Paul Samson Lusamba Dikasa, Joel Konde Nkiama, Patrick Kayembe Kalambayi, Emile Okitolonda Wemakoy, Vieux Mokoli Momeme, Jack Kokolomami Hyyombo Tambwe. Case-fatality Ratio Due to Ebola Virus Disease in North-eastern Democratic Republic of the Congo in 2019. *Central African Journal of Public Health*. Vol. 5, No. 6, 2019, pp. 310-315.

doi: 10.11648/j.cajph.20190506.23

Received: October 24, 2019; **Accepted:** November 22, 2019; **Published:** December 2, 2019

Abstract: During an Ebola virus disease (EVD) outbreak, health workers (HWs) are at high risk of EVD infection. Health workers infected with EVD are a major risk factor for the failure to control EVD outbreaks. The tenth outbreak is the largest recorded in the DRC, but unfortunately few studies have described the occurrence, case-fatality ratio (CFR) among HWs and their perceptions. The aim of this study was to describe: the occurrence of EVD; related mortality; and perceptions of EVD transmission among HWs. A mixed methods study was conducted in north-eastern DRC in August 2019. A review of EVD surveillance data and in depth interviews with 16 front line HWs were carried out. Interviews were audio recorded and transcribed verbatim in Swahili before being translated into French and subsequently into English. Quantitative data were imported from Microsoft Excel to Stata 14.0 for analysis. Mean and standard deviation (SD) were used to summarize numeric variables while frequency was used for categorical data. All descriptive statistics are reported with their 95% confidence interval. From 12 July 2018 to 17 August 2019, some 151 confirmed and three probable health worker cases were recorded in the viral haemorrhagic fever (VHF) surveillance dataset for the provinces of North-Kivu and Ituri. Health workers accounted for 5.5% [4.6-6.4]. More than half of the HWs infected were male, with a male to female ratio of 1.3. The mean age of HWs infected was 33.9 years (sd: 10.3). Nosocomial transmission was the most common route of transmission among HWs (94.1%). For more than a quarter of the HWs the contact case was unknown. From a total of 154 infected HWs, some 29 died (CFR: 18.8% [13.0-25.9]). The factors mentioned by HWs as being associated with EVD transmission among them were: ignorance that patient was infected; unavailability of protective equipment; non-compliance of hygienic measures like regular hand washing; violation of EVD infection prevention and control (IPC) standards; and their resistance thereto. The occurrence of EVD cases among HWs is a challenge for the control of the current outbreak in the DRC. It is important to implement strategies to reduce transmission in this population group.

Keywords: EVD, HWS, CRF, Perceptions, DRC

1. Background

Ebola virus disease (EVD) outbreaks have become a major public health threat since the late seventies. During such outbreaks, health workers (HWs) are at high risk of EVD infection. Indeed, in addition to being exposed to the disease as community members, they carry a risk of exposure during

patient care (nosocomial transmission). According to a systematic review conducted in 2017, the proportion of HWs infected with EVD varies from 2% to 100% [1]. The first case of laboratory infection with EVD was reported in 1977 [2].

In the 2014-2015 West African Ebola outbreak, the largest since the discovery of the virus in 1976, with more cases and deaths than all previous outbreaks combined; HWs accounted

for 5% of all cases recorded, they were up to 32 times more likely to be infected with Ebola than the general population and two-thirds of them who were infected died [3-5]. In the Kenema district in Sierra Leone from May 2014 to January 2015, some 600 cases of EVD were recorded including 92 health workers (15%) [6].

Multiple factors contributing to EVD transmission among HWs included deficiencies in administrative, engineering and environmental regulations, overcrowding of public hospitals and unsafe employment conditions [7]. Other factors associated with nosocomial transmission are described as incorrect triage of EVD patients, lack of training on EVD, limited availability and inappropriate use of personal protective equipment. Overall, nosocomial transmission of EVD among HWs occurs because of low compliance with infection prevention and control procedures (IPC) and exposure to patients with unrecognized EVD [1, 3]. Ebola related mortality is also high among HWs.

HWs infected with EVD are a major risk factor for failure to control EVD outbreaks. The Democratic Republic of the Congo (DRC) is among the countries most frequently affected by EVD. The DRC is currently experiencing the tenth EVD outbreak. In 1995, during the Kikwit EVD outbreak, some 80 EVD cases were recorded among HWs [8]. This tenth outbreak is the largest recorded in the DRC. However, few studies have described the occurrence of infection and the case fatality ratio (CFR) among HWs, and potential factors associated with EVD transmission among HWs. The aim of this study was to describe the occurrence of Ebola virus disease and related mortality among HWs, and their perceptions thereof.

2. Methods

2.1. Study Setting and Design

This study was carried out in north-eastern Democratic Republic of the Congo (DRC), notably Ituri and North-Kivu provinces that are the sites of the tenth outbreak of EVD. In this region that is rich in minerals and other natural resources, the DRC shares borders with Uganda and Rwanda. Eastern DRC and particularly the north-eastern region are prone to insecurity and different types of violence, several armed groups from neighbouring countries and local uncontrolled militia remain active. There are also many internally displaced persons (IDPs) who rely on humanitarian assistance for food and other needs.

A mixed methods study combining concurrently a review of surveillance data and a qualitative study were conducted. Mixed method research has been widely used in health system research (HSR) to consider opinion of HWs as well as those of clients or patients. Even though quantitative methods have been used widely in health system research (HSR) for a long time, investigators are showing more interest in combining quantitative and qualitative studies during the past two or three decades. This paradigm shift is motivated by the need to gain a comprehensive understanding of problems in

inquiries for which quantitative methods must be completed with qualitative ones [9-11].

2.2. Study Population

The qualitative study was conducted among front line HWs, notably nurses, not working in the Ebola Treatment Unit. We purposively chose three health zones (HZs) in three of the most affected districts: Katwa in Butembo city, Beni in Beni city and Mandima in Ituri Province.

A total of 16 in depth interviews were conducted: five respectively in Katwa and Beni; and six in Mandima.

2.3. Data Collection and Analysis

Data collection was performed in August 2019, more than a year since the declaration of the tenth EVD outbreak. A team of nine data collectors with previous experience in qualitative and quantitative data were recruited and trained by three supervisors, specialists in Public Health. Training was given for three days, including one day for piloting and tool refinement. Free and informed consent was obtained from health workers before the start of interviews. Interviews were conducted in Swahili and audio recorded; transcribed in the same language, translated into French and into English, successively.

The collected data in the qualitative study included HWs experience with EVD, their emotional feeling and perception of the factors associated with EVD transmission among them. The review of the viral haemorrhagic fever (VHF) surveillance dataset in North-Kivu facilitated the gathering of secondary data on HW characteristics, frequency and death toll related to EVD.

In this study, an EVD case was defined, according to the case definition adopted by the Ministry of Public Health of the DRC and the WHO, as either confirmed or probable. The term 'health worker' includes not only clinical staff, but all those who work in health services, including drivers, cleaners, traditional healers and community based workers amongst others.

Quantitative data were imported from Microsoft Excel to Stata 14.0 for analysis and summarized as mean and standard deviation for numeric variables or as frequency for categorical data. All descriptive statistics were reported with their 95% confidence interval.

Qualitative data analysis consisted of identifying trends in the opinions expressed by the participants in relation to the topics covered. It started during data collection. Indeed, at the end of each in depth interview, a preliminary analysis of the opinions expressed allowed interviewers to summarize the major trends related to the topics discussed. The recordings of the interviews were then transcribed using word processing software before being imported into Microsoft Excel for analysis. These transcripts were codified based on a grid of specific codes related to each topic.

3. Results

3.1. Characteristics of HWs Infected with EVD

From 12 July 2018 to 17 August 2019, some 151

confirmed and three probable HWs cases were recorded in the viral haemorrhagic fever (VHF) surveillance dataset covering the provinces of North-Kivu and Ituri. Health

workers accounted for 5.5% [4.6-6.4] of all EVD cases (154/2816). A total of 189 health areas on 359 reported cases at least one Ebola virus disease case.

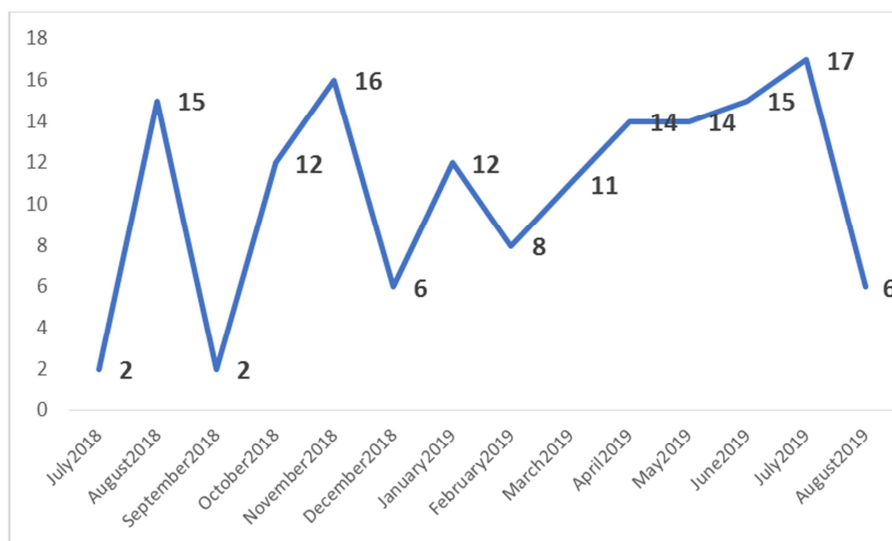


Figure 1. Number of confirmed and probable health worker EVD cases over time in Northeastern DRC from 12 July to 17 August 2019.

More than half of the infected HWs were male. The ratio of female to male among affected health workers was 1.3. The mean age of infected HWs was 33.9 years (SD: 10.3). The nurses constituted the most frequent category of infected HWs (75%) followed by medical doctors (7.3%) and laboratory technicians (5.9%).

Nosocomial transmission was the most common route for EVD transmission among HWs (94.1%). For more than a quarter of infected HWs the contact case was unknown (Table 1).

Table 1. Demographic, occupational and health characteristics of Health Care Workers infected by EVD in Northeastern DRC from 12 July 2018 to 17 August 2019.

Variables	% [95% CI] (n)
Status disease (n=154)	
Confirmed cases	98.1 [94.4-99.6] (151)
Probable cases	1.9 [0.4-5.6] (3)
Sex	
Male	57.1 [48.9-65.1] (88)
Female	42.9 [34.9-51.1] (66)
Age years Mean (SD)	33.9 (10.3) [32.3-35.5]
Health Worker category (n=136)	
Nurse	75.0 [66.8-82.0] (102)
Medical doctors	7.3 [3.6-13.1] (10)
Laboratory workers	5.9 [2.6-11.3] (8)
Hygienists	2.9 [0.1-7.3] (4)
Midwives	1.5 [66.8-82.0] (2)
Other	7.3 [3.6-13.1] (10)
Nosocomial infection (n=152)	
Yes	94.1 [89.1-97.3] (143)
No	5.9 [2.7-10.9] (9)
Contact case known (n=139)	
Yes	71.2 [62.9-78.6] (99)
No	28.8 [21.4-37.1] (40)
Outcomes (n=154)	
Alive	81.2 [74.1-87.0] (125)
Dead	18.8 [13.0-25.9] (29)

3.2. Case-fatality Ratio

Over a total of 154 infected HWs, some 29 died, yielding a case-fatality ratio (CFR) of 18.8% [13.0-25.9].

3.3. Occurrence of EVD Cases Over Time

The number of EVD cases fluctuated over time. Almost a year after the onset of the outbreak, a peak occurred in July 2019.

3.4. Characteristics of In-depth Interview Respondents

A total of 16 HWs were interviewed. Their mean age was 41.6 years (SD: 7.8). Male HWs were more represented than female HWs (11/5).

3.5. Know HWs Having Been Infected with EVD

Most of respondents reported knowing a HW infected with EVD. One respondent said, “In our health area four HWs were infected, two medical doctors and two nurses. Among them two died.”

Another HW said, “I have known several nurses to be infected with EVD. A nurse was infected when he injected a patient infected with EVD.”

3.6. How HWs Are Infected with EVD

All respondents interviewed indicated that most HWs were infected in the workplace. However, a HW mentioned community transmission, saying, “I have known a nurse who was infected in our family where several people were infected with EVD.”

Concerning the factors associated with EVD transmission among HWs, the respondents mentioned the following:

1. Ignoring that a patient was infected. “Our colleague was

infected when he was taking care of a child supposed to have respiratory distress;”

2. HWs were unaware of EVD occurrence;
3. Unavailability of equipment for preventing transmission;
4. Non-compliance with hygiene measures such as regular hand washing;
5. Violation of EVD infection prevention and control (IPC) standards; and
6. Several HWs’ refusal to acknowledge the existence of the disease. A HW said, “I work with a nurse who does not believe that EVD exists and until today, she refuses immunization but still takes care of patients.”

3.7. Perception of the Possibility of Avoiding Transmission of EVD Among HWs

All HWs thought that EVD could be avoided if preventative measures were respected. If they believe that EVD is real they could avoid contamination. Also important for the HWs is the respect for the counselling provided by EVD response team. “We must protect ourselves first and protect the community and together continue with the awareness to overcome the disease that is already among us,” said an HW.

3.8. Perception of Risk and Fear

All HWs declared that they were afraid of being infected with EVD while taking care of patients. One of the HWs said, “As a nurse, I feel insecure if I don’t protect myself during care administration.”

Most of them mentioned that they were victims of several threats from the community. “Every day I receive threatening leaflets from the community who accuse me of being an accomplice of the EVD response team,” said an HW.

Another HW said, “We are threatened every day. The population says that we received money from the Ebola response team, and we have become rich by declaring false positive cases. Then we have a serious concern with the community. Sometimes, we are afraid to present ourselves in the community.”

4. Discussion

This study showed that HWs are still being infected with EVD. Their profession is a high risk factor of transmission. The occurrence of EVD among HWs in the DRC is similar to the figure reported during EVD outbreak in West Africa from 2014 to 2015 [3]. Those countries were confronted with their first outbreak of EVD, while the DRC faces its tenth outbreak. The high frequency of EVD nosocomial transmission depicts the weakness of the health system in the face of EVD outbreak and the former’s need for strengthening its response thereto.

The predominance of male HWs among the infected as observed in this study is comparable with the reports from Guinea, Sierra Leone and Liberia during the Ebola virus disease outbreak from 2014 to 2015 [3]. According to the

2018 Report of Annual Statistics of Health Human Resources, male HWs represent two-thirds of all human resources in Ituri and North-Kivu provinces [12].

During the tenth outbreak in the DRC nurses were more frequently infected with EVD than those in the West African 2014-2015 outbreak (51.9%). This could be explained by the organization of the health system (HS) in the DRC, where nurses are responsible for the health centres (HCs) and the first points of contact between patients and the HS [3, 13]. Also, nurses (45.1% in 2017) are the category of health human resources the most represented in the DRC, while medical doctors represent only 5.9% [12].

The EVD CFR among HWs recorded in this study is much lower compared with the Guinea, Sierra Leone and Liberia 2014-2015 outbreak [3] and Kenema District in Sierra Leone (69%) [6]. This CFR must be interpreted with caution because these data could change over time, since the tenth EVD outbreak is still underway in the DRC.

The occurrence of high numbers of EVD cases among HWs one year after the outbreak onset shows a persisting problem in the implementation of and compliance with infection control measures in health care facilities. For comparison, in November 2014, a Chinese team composed of 164 HWs was dispatched to assist Liberia during the EVD outbreak. Two months later, no infection was recorded among the Chinese HWs. This was explained by the meticulous infection control measures applied by the team [14]. Also, during the same outbreak, it has been noted that there was a reduction in the infection rate of HWs from 12% in July 2014 to a low of 1% in February 2015 after putting in place IPC and Occupational Health and Safety (OHS) measures [3].

The factors associated with EVD mentioned by HWs are the same as those reported by previous studies [1, 3, 7]. Resistance to preventive measures such as vaccination was also reported in a study conducted in Sierra Leone where more than one-fifth of healthcare providers did not have a positive opinion on Ebola vaccination [15]. We believe that the resistance recorded during this epidemic in the DRC could be explained by the context of the armed conflicts that characterize the affected provinces. Indeed, both provinces have long been affected by armed conflicts. The affected communities believe that EVD is a means invented by the perpetrators of these armed conflicts to eliminate local people living in this region. The false perception of the risk exhibited by HWs has its roots in the conspiracy theory. Indeed, in the context of armed conflicts where population and some HWs did not believe that EVD existed, they perceived this disease as a conspiracy by foreigners to kill Congolese people.

Two major fears have been described by HWs: firstly the fear of being infected with EVD as described by McMahon in 2016; and secondly in this study, the fear of threats by the population has been also mentioned which could be explained by the context of armed conflicts as abovementioned [16].

Study participants cited the low awareness of EVD by HCWs as a transmission factor. This result corresponds to what is described in the literature that health care providers,

especially those working in areas never affected by EVD, had little knowledge of the EVD [17].

5. Limitations

The quantitative part of this study is based on secondary data from the EVD surveillance data set. Although there are many shortcomings related to the use of existing data, this data set is constructed on active data collection. The oversight of the outbreak response coordinating team including multiple stakeholders is a key factor for the quality of these data. It should also be noted that the undertaken study is based on available data of a dynamic phenomenon. The data reported in this study could change over time, since the outbreak is still underway. For this reason, these results should be confined to data which will be gathered at the end of this outbreak.

Notwithstanding the fact that the opinions expressed by the interviewees are related to their own experience and could not be applied to all health workers involved in the fight against EVD outbreak, the key findings of this study should be considered in the update of communication strategies targeting health workers and the community.

Two important variables notably the HW category and information on case contact were incomplete.

6. Conclusion

Health workers involved in the fight against the tenth EVD outbreak are accounting for an important death toll while working to protect the community. EVD among HWs is a challenge to control the current outbreak in DRC. Given the persistence of nosocomial transmission of Ebola virus disease among health care workers, it is important to question the effectiveness of the surveillance and communication system with not only the general population but also providers care. It is therefore urgent to strengthen the surveillance system and to implement strategies to overcome misconception about this outbreak and to really support behavioural change for HWs in order to reduce transmission in this population. The knowledge of the providers of care on the EVD must be reinforced in the areas at risk currently affected and not-affected.

Acknowledgements

We acknowledge all health care workers and EVD surveillance team for their participation. We are thankful to the World Bank for providing small grants to Kinshasa School of Public Health for data collection.

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