

Knowledge, Attitude and Practice of Sudanese Health Care Providers toward Ebola Virus Outbreak

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Ebola virus disease (EVD) is a highly contagious and fatal disease in humans. Healthcare providers (HCPs) are often at the frontline of epidemics and can thus be in jeopardy of contracting EVD. Sudan is at a great risk of an EVD outbreak, as it borders countries that experienced EVD outbreaks. It is therefore imperative in Sudan to assess the HCPs' awareness and knowledge, attitude, and practice (KAP) about EVD for its control and management and for preparedness. A KAP survey was conducted among 387 HCPs (physicians, nurses and laboratory technicians) in the three main tertiary hospitals in Khartoum, Sudan. The majority of the survey respondents (54.5%) were females, <30 years old (76.3%), and single (77.4%). Most (94%) had heard about EVD, 62% from classical media. Only 14% had received education or training regarding EVD. About 40% reported being adherent to universal precautions and 72% were willing to deal with EVD patients under safety precautions. Only 10% knew of any available standard national guidelines for EVD. Nearly half of the HCPs (47%) rated the potential risk of an EVD outbreak in Sudan as high, and 52% rated health authorities' effort against it as weak. These findings revealed the HCPs' insufficient knowledge of EVD and the necessary universal precautions. This lack of knowledge would negatively affect the HCPs' preparedness toward any potential EVD outbreak. There is a dire need to train HCPs in Sudan on the management of EVD, including preventive and control measures.

Key words: Ebola virus, Sudan, healthcare provider, knowledge, attitude and practice

Ebola virus disease (EVD) is a fatal disease caused by viruses belonging to the family Filoviridae. Four viruses (Ebola virus, Sudan virus, Taï Forest virus, and Bundibugyo virus) are known to be infectious to humans and nonhuman primates (monkeys, gorillas, and chimpanzees) [1]. Although it has not yet been confirmed, researchers believe that bats are the most likely animal reservoir for EV [2]. EVD can be transmitted through direct contact with blood or body

fluids of an infected individual or of someone who died from Ebola, as well as by contaminated objects and through sexual intercourse [2]. The virus RNA was isolated up to 406 days after the onset of symptoms according to WHO reports <<https://www.who.int/reproductivehealth/topics/rtis/ebola-virus-semen/en/> (accessed June 2, 2018.)>.

The incubation period of EV is from 2 to 21 days, and infected individuals are not considered infectious until they develop symptoms [2]. During the 2014 West

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Africa outbreak of EVD, the most common symptoms reported were fever (87.1%), fatigue (76.4%), loss of appetite (64.5%), vomiting (67.6%), diarrhea (65.6%), headache (53.4%), abdominal pain (44.3%), and bleeding (18%) [3]. Without treatment, the case fatality rates in people infected by EVD can reach up to 90% for the Zaire strain (60-90%) and up to 60% for the Sudan strain (40-60%) [4].

Healthcare providers (HCPs) are usually at a great risk of contracting the infections — especially in the case of EVD, as it is a virus with a high potential for human-to-human transmission and a high fatality rate. There is no doubt that EVD represents a major occupational risk to all HCPs who come into contact with infected patients. During the 2014 outbreak of EVD, 881 healthcare workers became infected with the disease in Guinea, Liberia, and Sierra Leone, and 513 of them lost their lives (case fatality rate: 58.2%) [5]. In Sierra Leone, where more HCPs were infected and died than in any other country, the confirmed EVD incidence in healthcare workers was 100-fold higher than that of the adult general population [6, 7].

Although Sudan has not yet experienced an EVD outbreak, it remains at high risk of such an outbreak because of its geographic location and shared borders with seven African countries, and high movements of individuals into and out of the country. South Sudan was the site of small-scale EVD outbreaks that happened in 1976, 1979, and 2004; it is also adjacent to countries where cases of EVD were reported [8]. A study by Alfaki *et al.* conducted in 2014 in Sudan revealed a lack of knowledge among HCPs toward EVD, and those authors noted that a clear majority of the HCPs had not received specific training regarding EVD [9]. We conducted the present study to assess the awareness and the knowledge, attitude and practice (KAP) of HCPs in Sudan regarding the control and management of EVD. Our study hypothesis was that there is still a lack of knowledge and insufficient training regarding EVD among HCPs in Sudan that will negatively affect their preparedness toward and willingness to manage any potential EVD outbreak.

Materials and Methods

Ethics approval. The study received ethical clearance from the Research Board at the Federal Ministry of Health in Sudan and the Research Board at Nagasaki

University in Japan (Approval no. 16098157-2).

Study design. This was a cross-sectional facility-based study and a multi-site knowledge, attitude and practice (KAP) survey of healthcare providers in Sudan regarding Ebola virus disease.

Study setting and sites. The study was conducted at the main tertiary hospitals in the 3 cities comprising Khartoum the capital of Sudan (Khartoum, Omdurman, and Khartoum North), which are Ibrahim Malik, Omdurman, and Khartoum North hospitals, respectively. These hospitals have the largest staff, the greatest admission capacity, and the highest numbers of patients in Sudan.

Study respondents. The study targeted HCPs who usually encounter patients or their body fluids in their workplace. These included physicians, nurses, and laboratory technicians. The HCPs were selected using convenience sampling. All HCPs who were available at the selected hospitals and volunteered to participate were included.

Data collection. The data collection was carried out in March and April 2018 using a structured questionnaire that we created after a review of the literature and examination of articles that consider EVD and viral hemorrhagic fevers (VHFs). We conducted a pilot survey to pre-test the questionnaire, and the questionnaire was then administered as hard copies by trained research assistants. The research assistants explained the purpose of the study to the respondents and obtained their consent. The questionnaires were presented in both English and Arabic, and the anonymity of each respondent was ensured and maintained throughout the entire research process.

The questionnaire was composed of nine sections, collecting the respondent's (1) background data, (2) general knowledge and attitude about VHFs, (3) knowledge of the epidemiology of VHFs in Sudan, (4) adherence to guidelines regarding VHFs, (5, 6) general knowledge about EVD and its nature, (7) knowledge about the prevention of EVD, (8) willingness to manage and deal with cases of EVD, and (9) preparedness for any potential viral outbreak.

Sample Size. A total of 400 HCPs were surveyed. After drop-outs and invalid questionnaires were omitted, the results of the remaining 387 HCPs were analyzed.

Data analysis. The questionnaire data were analyzed using descriptive and inferential statistics, with

SPSS ver. 20 software (IBM, Armonk, NY, USA). Chi-square and logistic regression tests were used for the inference analysis. The significance level was set at $p < 0.05$.

Results

Of the 387 respondents analyzed, the majority were females (54.5%, $n = 108$) and 151 (76.3%) were < 30 years old; 151 (77.4%) were single/unmarried, and 148 (74.7%) had ≤ 5 years of clinical practice experience. Most of the respondents were physicians (MDs; 51%, $n = 198$), of which the majority were house officers (interns) (38%, $n = 75$), followed by medical officers (general practitioners) (33%, $n = 65$), then the registrars (residents) (25%, $n = 49$) and lastly the specialists/consultants (5%, $n = 9$). The other 2 categories of respondents were nurses (25%, $n = 97$) and laboratory technicians (24%, $n = 92$). The characteristics of study respondents are summarized in Table 1. Of the study respondents, 94% stated that they had heard about EVD; 62% of them heard of it from classical media like television, radio, and newspapers, and 48% heard of it from social media.

To score the knowledge questions, we used the cut-off point of $< 50\%$ of correct answers to rate the respondent as having poor knowledge, 50-75% as moderate knowledge, and $> 75\%$ as good knowledge, and when

we assessed the respondents' general knowledge of VHF, we found that 55.6% of the physicians, 42.3% of the nurses, and 56.5% of the laboratory technicians had good knowledge about VHF. Most of the respondents showed moderate knowledge on the epidemiology of VHF in Sudan, demonstrating that HCPs in Sudan are somewhat familiar with VHF that occur from time to time in Sudan.

Almost half of the respondents in each category had either poor or moderate knowledge about EVD and its nature, with physicians scoring the worst among the respondents. In addition, only 67% of the respondents said they were aware of the 2014 West Africa epidemic despite its widespread coverage in the media. Although 83% of the respondents identified EVD as a disease of viral origin, 22% of them incorrectly described mosquitos as the natural host and 65% said mosquitos could transmit EVD. Only 15% of the MDs, 11% of the nurses, and 9% of the laboratory technicians had good knowledge about EVD prevention. Most of the MDs had either moderate or poor knowledge. For example, while 70% of the respondents believed it is possible to stop EVD spread, 33% of them claimed that the use of a vaccine (at the time of the study) could protect individuals from being infected with EV.

Although both of the following behaviors present a very high risk, 16% of the respondents said they would

Table 1 Demographic characteristics of the study respondents, Khartoum, Sudan 2018

Socio-demographic characteristic	Medical Doctors n (198) (51%)	Nurses n (97) (25%)	Lab technicians n (92) (24%)	Total n (387) (100%)
Sex				
Male	90 (45.5%)	27 (27.8%)	48 (52.2%)	165 (42.6%)
Female	108 (54.5%)	70 (72.2%)	44 (47.8%)	222 (57.4%)
Age				
≤ 30	151 (76.3%)	55 (56.7%)	72 (78.3%)	278 (71.8%)
31-40	40 (20.2%)	34 (35.1%)	12 (13.0%)	86 (22.2%)
41-50	6 (3.0%)	8 (8.2%)	8 (8.7%)	22 (5.7%)
51-60	1 (.5%)	0 (0.0%)	0 (0.0%)	1 (.3%)
> 60	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Marital status				
Single	151 (77.4%)	61 (69.3%)	67 (75.3%)	279 (75.0%)
Married	44 (22.6%)	27 (30.7%)	22 (24.7%)	93 (25.0%)
Years in practice				
≤ 5	148 (74.7%)	65 (73.0%)	72 (80.9%)	285 (75.8%)
6-10	37 (18.7%)	16 (18.0%)	12 (13.5%)	65 (17.3%)
> 10	13 (6.6%)	8 (9.0%)	5 (5.6%)	26 (6.9%)

allow relatives' visits and 18% would allow ritual Islamic washing of deceased bodies. Like the HCPs' professions, none of the other characteristics (sex, age, marital status, or years of practice) had any significant association with the HCPs level of knowledge of EVD.

The questionnaire's items about the HCPs' adherence to guidelines and daily standard precautions revealed that only 40% of the respondents believed that the medical staff at their hospital are adherent to these practices, and they attributed this nonadherence to a lack of knowledge (43%), lack of training (57%), lack of guidelines (49%), lack of motivation (34%), lack of supplies (71%), and lack of time (19%). Fifty-five percent of the respondents indicated that they had reported the incidence of needle stick injuries, yet only 32% indicated that written protocols for needle stick injuries were available at their respective hospitals, and 46% of those respondents said that these protocols were explained to them. Only 14% of the respondents stated that their hospital offers them and the rest of the hospital staff the vaccine for yellow fever.

Most of the HCPs were willing to care for EVD patients under safety precautions: 73.7% of the MDs, 76.3% of the nurses, and 65.9% of the laboratory technicians; the overall percentage for HCPs investigated

was 72%. There was a significant association between the HCPs' willingness to treat EVD patients and being <30 years old ($p=0.012$). Being male ($p=0.04$) and being single ($p=0.001$) were significantly associated with the willingness to treat or manage EVD patients (Table 2).

Most of the respondents (72%) stated they did not have access to essential equipment needed to deal with any potential EVD outbreak: 74% of the MDs, 65% of the nurses, and 76% of laboratory technicians. Only 61% of the HCPs knew about personal protective equipment (PPE), and only 49% of the respondents had standard procedures for biomedical waste disposal at their hospitals; 54% reported having a biomedical waste management system. Only 45% of the HCPs knew of any available guidelines for managing patients with VHF and performing infection control. In addition, only 10% knew of any available standard national guidelines for Ebola active surveillance and patient management at their hospitals, and of those, 56% received training about these topics. Moreover, only 19% said that EVD-related information, education, and communication (IEC) materials were available to the healthcare providers and the public at their hospitals. Only 14% stated they received any education or training on EVD.

Table 2 Willingness to care for EVD suspected cases among HCPs, Khartoum, Sudan 2018

		I am willing to deal with EVD patients (under safety precautions)				P-value
		No		Yes		
		n	%	n	%	
Type	Medical Doctors	52	26.3%	146	73.7%	0.244
	Nurses	23	23.7%	74	76.3%	
	Lab technicians	31	34.1%	60	65.9%	
Sex	Male	37	22.6%	127	77.4%	0.04*
	Female	69	31.1%	153	68.9%	
Age	≤ 30	65	23.4%	213	76.6%	0.012*
	31–40	30	35.3%	55	64.7%	
	41–50	11	50.0%	11	50.0%	
	51–60	0	0.0%	1	100.0%	
	> 60	0	0.0%	0	0.0%	
Marital status	Single	67	24.0%	212	76.0%	0.001*
	Married	38	41.3%	54	58.7%	
Years in practice	≤ 5	63	22.2%	221	77.8%	0.000
	6–10	30	46.2%	35	53.8%	
	> 10	7	26.9%	19	73.1%	

Chi-square test analysis, * $P<0.05$.

Our analyses revealed that the odds ratio (OR) of the willingness of physicians to care for EVD patients was 3.27 times higher when there was a belief that infection control policies and procedures of the hospital were adequate, with the 95% confidence interval (CI) of 1.4-7.66.

Our respondents rated the potential risk of Sudan having an Ebola outbreak as high risk (47%) low risk (26%), and no risk (7%). They rated the health authorities' efforts against any potential outbreak of EVD and other VHFs as weak (52%) or absent (42%); only 8% believed the authorities are ready for such an outbreak, and only 15% of the respondents believed that their hospital's set-up is adequate to care for patients with VHFs.

Discussion

The respondents' answers to our questionnaire demonstrated that 62% of the HCPs surveyed in Sudan knew about EVD from classical media, which is similar to a finding obtained in a 2014 study conducted in Sudan by Alfaki *et al.* in which 68.6% of the participants learned about EVD from classical media. In that study, the physicians achieved poor (27.85% of the MDs) or very good (27.7%) scores in EVD knowledge, and most of the other HCPs (41.5% of non-MD HCPs) achieved poor scores [9]. In our present investigation, most of the HCPs had either poor or moderate knowledge about EVD, with the physicians scoring the worst among the respondents, indicating a deterioration in the level of knowledge of EVD among HCPs in Sudan. This deterioration between the time points of the Alfaki *et al.* and present studies might be attributed to the fact that the 2014 study was conducted during the West African outbreak, when EVD was a common topic in the media and among health professionals.

In their 2014 Nigeria study, Abisola Oladimeji *et al.* revealed that a significantly high proportion of HCPs had good knowledge of EVD, but this, in their opinion,

did not translate to good practice [10]. In our study, the HCPs did not have sufficient knowledge about EVD, and their adherence to guidelines and universal precautions was also inadequate. The authors of the Nigerian study attributed the HCPs' non-adherence to lack of training in EVD, whereas our respondents chose the lack of supplies most often as the reason for their non-adherence (71%), then lack of training (57%), lack of guidelines (49%) and lack of knowledge (43%). In a study conducted in India in 2014 by Raghavendra Vailaya *et al.*, the researchers observed gaps in the knowledge and practices of HCPs and attributed them to a lack of knowledge, poor motivation, busy work schedules, and lack of supplies [11].

Herein, 72% of the HCP respondents indicated that they are willing to deal with EVD patients under safety precautions; this is a lower percentage than that in the 2014 Alfaki *et al.* Sudan study where the majority of participants (81.3%) would treat patients with suspected EVD using a safe approach [9]. Younger age, single marital status, and male sex were predictors of willingness to care for EVD patients in our study. We hypothesize that these associations are likely because older, married HCPs tend to have families and children to care for and are thus more fearful of a fatal disease such as EVD. Another predictor we identified for the willingness of MDs to care for EVD patients was a belief in their hospital's infection control system. This is comparable to a study conducted among nurses in South Korea by Ji Soo Kim *et al.* in which the willingness to care for EVD patients was four times higher when there was a high belief in public service [12].

In the Alfaki *et al.* study, 56.6% of the respondents ranked Sudan's risk of having an EVD as high [9]. This result is in line with our finding that 47% of the respondents ranked Sudan as being at high risk, but in both studies this EVD risk perception did not translate into good knowledge, attitude, or practice toward EVD.

The respondents in the Alfaki *et al.* study described health authorities' efforts against EVD as absent (41.7%)

Table 3 Willingness to care for EVD patients against risk perception and belief in hospital's infection control system among medical doctors, Khartoum, Sudan 2018

Variables	B	S.E.	OR	95% CI		P-value
If I care for Ebola patients, I may be infected more easily than others	0.57	0.47	1.77	0.71	4.43	0.22
Infection control policy and procedures of the hospital are adequate	1.19	0.43	3.27	1.40	7.66	0.01*

Logistic regression analysis, * $P < 0.05$. CI, confidence interval; OR, odds ratio; SE, standard error.

or weak (38.1%) [9], whereas in our study, 52% of the HCPs rated it as weak and 42% as absent. We consider these results alarming as they indicate that 4 years after the West African EVD epidemic, HCPs in Sudan still do not believe the health system is ready for a potential outbreak. Moreover, in the 2014 study, 91.1% of the HCPs investigated never attended any training sessions on EVD, which is true of 86% of our respondents. This points to lacking or inadequate training of HCPs in Sudan, even though EVD training was recommended by the health authorities following the 2014 epidemic.

Another concern is that only 16% of our respondents believed that the infection control policies and procedures of their respective hospitals were adequate. This result is comparable to a study conducted among Nigerian HCPs by Anu Olowookere *et al.* in which only 11% reported that the infection control policies of their hospital were adequate to protect them from EVD [13]. Such a belief would make HCPs more fearful of a deadly disease like EVD and reluctant to manage EVD patients, and what makes it more difficult is that only 28% of our respondents had access to essential equipment to perform their jobs and protect themselves and their patients in case of an EVD outbreak.

Our study also revealed the scarcity of personal protective equipment (PPE) in the three main tertiary hospitals in Sudan's capital, as well as a lack of adequate medical waste management standard procedures and systems. This may also reflect the preparedness level of HCPs and their willingness to manage EVD patients. In a 2014 study conducted in Nigeria, Garba Iliyasu *et al.* pointed to the lack of the PPE as a potential reason for the reluctance of HCPs to treat EVD patients [14].

Only 10% of our respondents had standard national guidelines for EVD active surveillance and patient management at their hospitals, and only 19% had EVD-related information, education, and communication (IEC) materials. Moreover, only 14% of the respondents stated that yellow fever vaccinations are offered in their hospitals. We used this finding as a proxy indicator for the application of preventive policies by the investigated health facilities.

Collectively, our results highlight Sudan's insufficient level of preparedness in handling a potential EVD outbreak in terms of health facilities, health personnel, medical equipment, and national guidelines. This is particularly alarming given the high-risk potential for an EVD outbreak especially considering the recent out-

break in the Democratic Republic of the Congo (DRC), a country not far from Sudan. Such a weak health system for an EVD response will have implications for both patients and HCPs.

Limitations. This study has some limitations. The convenience sampling technique may be imprecise, and our sample is not representative of the whole target population and may thus have led to selection bias and affected the results, which cannot be generalized. In addition, when using the self-reporting method, the respondents may tend to give favorable answers that do not reflect their actual attitudes and practices. We also did not analyze the knowledge and preparedness of HCPs across the three hospitals. In addition, most of the physicians we surveyed were juniors, since it was difficult to interview the more senior MDs due to their demanding schedule. This may have resulted in an underestimation of the overall knowledge and practice results since the senior MDs (consultants and specialists) tend to have better knowledge and more years of practice. It may also have overestimated the willingness to care for EVD patients among physicians, which our analyses and similar studies indicate is significantly associated with younger age.

Lastly, combining a qualitative study with the KAP survey described herein will increase the understanding of healthcare providers' willingness to care for patients with EVD and the reasons behind the poor practices at hospitals in Sudan.

In conclusions, Our study surveying HCPs in the tertiary hospitals of Sudan's capital revealed poor levels of knowledge among HCPs toward EVD, poor adherence to universal precautions and standard practices, a lack of IEC materials and national guidelines in infection control and EVD surveillance and management, and the scarcity of essential equipment (especially PPE) in a country with a high potential risk of having an EVD outbreak.

There is a thus a serious need to create and sustain a good level of preparedness by applying measures such as the training of all HCPs, simulation exercises, the provision of protective equipment, the application of universal precaution protocols, and national policies and guidelines for infection and epidemic prevention and control. EVD-related IEC materials should be designed and made available to HCPs and the public.

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