Evaluation of clinicians' knowledge of and attitudes to Ebola virus disease in Ebonyi State, Nigeria

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Abstract

Introduction: Ebola virus disease (EVD) remains a global threat of international concern. Being at the frontline of medical care, clinicians are at high risk of infection. Inadequate knowledge of, or poor attitudes to, EVD among clinicians may lead to failure in the detection of and timely responses to EVD. We determined the knowledge of and attitudes to EVD among clinicians in Ebonyi State, Nigeria.

Materials and methods: A descriptive, cross-sectional study was conducted among clinicians attending an EVD training programme in Ebonyi State, Nigeria. Knowledge and attitudes of the clinicians were evaluated using a structured questionnaire. Data were analysed using descriptive and inferential statistics.

Results: Of 398 clinicians who participated in the study, 274 (68.8%) were 40 years and below and 312 (78.4%) were male. Most of the clinicians surveyed (298, 74.9%) had worked for 10 years or less, and 354 (88.9%) of them had not undergone any training on EVD. The overall mean knowledge score of EVD among respondents was 42.0±3.9 (maximum 51), and 370 (93.0%) respondents had a good overall knowledge of EVD. Overall, 334 (83.9%) respondents had an appropriate attitude towards EVD control, while 64 (16.1%) had a poor attitude towards EVD control. Only male gender was an independent predictor of good knowledge of EVD (adjusted odds ratio 4.0, 95% confidence interval 1.8–9.0).

Conclusions: There was generally a high level of knowledge and good attitude to EVD among the clinicians surveyed. The gaps in knowledge and attitudes identified should inform post-EVD control strategies and future training programmes.

Keywords: Ebola virus disease, clinicians, preparedness, awareness, attitude, Nigeria

Introduction

Ebola virus disease (EVD) is a very serious and often fatal illness caused by the Ebola virus [1]. The disease was first notified in 1976 following two simultaneous outbreaks in Nzara, South Sudan, and in Yambuku, Democratic Republic of Congo. The 2013–2016 EVD outbreak in West Africa has been the largest and most widespread since the virus was discovered. The most severely affected countries were Guinea, Liberia and Sierra Leone [1], countries characterised by very weak health systems, poor human and infrastructural resources and only recent emergence from prolonged conflict and instability [1]. This outbreak had also spread between countries: between Guinea, Sierra Leone and Liberia, by air to Nigeria and the USA, and by land to Senegal and Mali [1].

Healthcare workers (HCWs) in countries with EVD are crucial to any systematic response to outbreaks [2–4]. In addition, the disease may affect HCWs if extreme care is not taken to ensure standard infection prevention and control measures in health facilities [1,5,6]. A recent World Health Organization (WHO) study found that the risk of transmission of EVD among health workers was highest among clinicians and nurses, followed by laboratory staff and trade and elementary workers [7]. Therefore, critical to the identification of suspected EVD cases is a high index of suspicion among clinicians involved in the management of individuals with febrile illnesses.

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Since the onset of the last EVD outbreak, a number of studies have reported on the knowledge of and attitudes to EVD in order to identify gaps and to optimise training needs [8–13]. These studies, however, were conducted on community members [8–10], pilgrims [11], port workers [12] and students [13,14]; and to assess the preparedness of health facilities for managing EVD cases [15,16]. Although some studies have been carried out in general health workers (doctors, nurses, laboratory staff and other support staff), due to their varied qualifications, they did not assess in detail knowledge of EVD presentation, diagnosis and treatment [2–5,9,17]. Only a few studies have specifically evaluated these knowledge parameters in medical practitioners [18–21], but these studies were limited by either small sample sizes [19,20] or a lack of detail [21], or focusing on knowledge of EVD notification [18].

Holistic knowledge of EVD aids early detection and containment by HCWs as experienced in Sudan [22]. The EVD outbreak in Nigeria was detected, investigated and notified early by clinicians who evaluated the individual who imported the disease from Liberia [5,23]. This early detection led to control strategies – partly drawn from previous experience in managing Lassa fever and using the existing contact tracing system – which resulted in disease containment [5,23]. A poor understanding of EVD among clinicians in settings without previous outbreaks can lead to a late detection of the outbreak. Even in countries with previous outbreaks, poor knowledge can lead to a failure to detect disease resurgence [24]. In both instances, poor EVD knowledge among clinicians may put the lives of individuals, HCWs and the general public at risk, leading to inappropriate behavioural and emotional responses [25]. Therefore, the aim of this study was to assess the current knowledge of and attitudes to EVD among clinicians in Ebonyi State, Southeast Nigeria.

Materials and methods

Study design

This was a cross-sectional descriptive study carried out between August and September 2014.

Setting

The study was conducted at the Federal Teaching Hospital Abakaliki Ebonyi State. The hospital is one of two tertiary hospitals in the state, serving an estimated 4 million people in the state and in neighbouring Abia, Cross River and Benue States. The study was conducted during a training programme organised by the Ebonyi State chapter of the Nigerian Medical Association for clinicians working in primary, secondary and tertiary care facilities in Ebonyi State at the peak of the EVD outbreak in Nigeria. The primary objective of the training was to improve clinicians' knowledge of the disease, index of suspicion, reporting proficiency and exposure-risk assessment.

Participants

The study participants were male and female clinicians participating in the training programme who consented to participate in the study.

Procedure

Before the survey, approval was obtained from the hospital management and organisers of the training programme (ref: NMA/EB/Vol 1/2014/169, 5 September 2014). All clinicians participating in the training were invited to complete a self-administered questionnaire prior to the commencement of the training programme.

Instrument and scoring

A self-administered questionnaire was used for the study. The questionnaire was divided into three parts, eliciting information on demographic characteristics, knowledge and attitudes of the respondents. Demographic characteristics included the profile of the participants, any previous training on EVD and interest in undergoing EVD training. The knowledge component consisted of 51 questions covering the clinical presentation (20 questions), transmission (15 questions) and diagnosis, treatment and prevention (16 questions) of EVD. The questions consisted of factual statements with 'yes', 'no' or 'I don't know' answers. A scoring system was applied to assess the level of knowledge of each respondent: one point was given for each correct answer, and no points were given for an incorrect answer. Questions related to attitudes towards the disease were assessed by eight statements with 'agree', 'neutral' and 'disagree' answers. A scoring system was applied, where a point was given for a correct attitude towards the disease, and no points were given for incorrect attitudes. The correct answers to the questions assessing both knowledge and attitude to EVD were based on information provided by the WHO and the US Centers for Disease Control and Prevention about EVD [1,26].

The survey instrument was reviewed by a group of academics, infectious disease physicians, epidemiologists and public health physicians within the Ministry of Health in Ebonyi State who considered it to have face validity. The reviews resulted in minor modifications to the initially designed questionnaire.

Analysis and statistics

Data were entered and analysed using Epi Info 3.5.1 (CDC, Atlanta, GA, USA). Participants with a knowledge score of >70% were considered to have good knowledge, and those with ≤70% were considered to have poor knowledge. Similarly, those with an attitude score of >70% were considered to have appropriate attitudes, and those with a score of ≤70% were considered to have poor attitudes towards EVD. Frequencies were presented as percentages (%). The chi-square test was used to compare categorical data, and continuous variables were summarised as mean±SD. Multivariable logistic regression analysis was performed to identify independent predictors of good knowledge and appropriate attitudes towards EVD. A *P*-value of <0.05 was considered to be statistically significant.

Ethical issues

The survey was conducted according to the principles expressed in the Declaration of Helsinki, and all protocols and consent procedures were approved by the Ethics Committee of the Nigeria Medical Association, Ebonyi State (ref: NMA/EB/Vol 1/2014/169, 5 September 2014). A verbal consent process was used because we utilised a self-administered questionnaire; signed consent forms represented a source of concern with respect to the protection of confidentiality. Prior to the survey, a verbal consent script was read to all clinicians participating in the training. Consenting clinicians received, completed and returned their questionnaires. Non-consenting participants either did not accept the questionnaire or (if they did) did not return their completed questionnaire. Of 426 clinicians who participated in training, 398 consented and completed the survey. Confidentiality and anonymity were maintained throughout the study.

Results

Demographic characteristics

A total of 398 (93.4%) of the 426 clinicians attending the training from 12 health facilities in Ebonyi State completed the survey. Of these, 274 (68.8%) were 40 years old or younger, and 312 (78.4%) were males, as shown in Table 1. A total of 298 (74.9%) were registrars, 78 (19.6%) were consultants and 22 (5.5%) were medical officers. The majority (388, 97.5%) of respondents worked in tertiary care settings followed by secondary care (6, 1.5%). Most of the clinicians surveyed (298, 74.9%) had worked for 10 years or less, and were working in the departments of obstetrics and gynaecology (62, 15.6%) followed by surgery (60, 15.1%), paediatrics (56, 14.1%), internal medicine (50, 12.6%) and family medicine (36, 9.0%; Table 1). Other departments included ophthalmology, otorhinolaryngology, radiology and psychiatry. In addition, 354 (88.9%) respondents had not had any training on EVD, but 374 (94.0%) indicated that they were interested in undergoing a training on EVD.

Knowledge of Ebola virus disease

The respondents' knowledge of the clinical presentation of EVD according to duration of clinical practice is shown in Table 2. The overall mean (SD) knowledge score was 17.9±2.3 (maximum 20), indicating that the respondents had excellent knowledge of the symptoms and signs of EVD. Knowledge deficits for the features of EVD were mostly for nonspecific symptoms such as stomach ache and rash, with 308 (77.4%) and 310 (77.9%) having correct responses, respectively. Also, 290 (72.9%) knew that the absence of fever did not exclude EVD, and 288 (72.4%) knew that EVD could cause unexplained abortion in pregnant women. Overall, 370 (93.0%) respondents had a good knowledge of the clinical presentation of EVD. In addition, clinicians who had practiced over 10 years tended to have better knowledge of the symptoms of EVD than their younger colleagues.

The respondents' knowledge of the transmission of EVD according to the duration of clinical practice is shown in Table 3. The

Table 1. Sociodemographic characteristics of the respondents ($n=398$)

Variables	Frequency *n* (%)
Age (years)	
≤40	274 (68.8)
>40	124 (31.2)
Gender	
Female	86 (21.6)
Male	312 (78.4)
Cadre	
Consultant	78 (19.6)
Nonconsultants	320 (80.4)
Type of clinical practice	
Primary	4 (1.0)
Secondary	6 (1.5)
Tertiary	388 (97.5)
Duration of practice (years)	
≤10	298 (74.9)
>10	100 (25.1)
Department	
Accident and emergency	14 (3.5)
Anaesthesiology	30 (7.5)
Community medicine	20 (5.0)
Dental care	4 (1.0)
Family medicine	36 (9.0)
Internal medicine	50 (12.6)
Obstetrics and gynaecology	62 (15.6)
Paediatrics	56 (14.1)
Surgery	60 (15.1)
Others	66 (16.6)
Previous training on Ebola	
Yes	44 (11.1)
No	354 (88.9)
Interested in Ebola training	
Yes	374 (94.0)
No	24 (6.0)

overall mean (SD) knowledge score was 10.7±21.6 (maximum 15), indicating that the respondents had a fair knowledge of EVD transmission. Most of the deficits in knowledge regarding EVD transmission were among clinicians who did not know that EVD cannot be transmitted by rats (122, 30.7%) and through the air/aerosols (62, 15.6%) and that asymptomatic individuals could not transmit the disease (212, 53.3%). In addition, only a few knew that EVD survivors could not transmit the disease by contact (152, 38.2), EVD is not transmitted through food and water (148, 37.2%), and many could not identify the minimum number of months for safe coitus between EVD survivors and healthy persons (142, 35.7%). Overall, only 226 (56.8%) respondents had good knowledge of EVD transmission.

The respondents' knowledge of the diagnosis, treatment and prevention of EVD according to duration of their clinical practice is shown in Table 4. The overall mean (SD) knowledge score was 13.6±1.6 (maximum 16), indicating that the respondents had a good knowledge of the diagnosis, treatment and prevention of EVD. Most deficits in knowledge regarding EVD diagnosis, treatment and prevention were as follows: 316 (80%) knew that an enzyme-linked immunosorbent assay test could detect EVD antibodies, 300 (75.4%) knew that an antigen detection test could be used to diagnose EVD, only 224 (56.3%) knew that an Ebola antigen test and PCR could give false-negative results, and only 80 (20.1%) correctly knew that corticosteroids may be useful in the treatment of EVD. Overall, 352 (88.4%) respondents had good knowledge of the diagnosis, treatment and prevention of EVD.

Taken together, the overall mean knowledge score of EVD among respondents was 42.0±3.9 (maximum 51), indicating that respondents had a fairly good overall knowledge of EVD. In addition, 370 (93.0%) respondents had a good overall knowledge of EVD, while 28 (7.0%) had an overall poor knowledge of EVD.

Attitudes to Ebola virus disease

Respondents' attitudes to EVD are shown in Table 5. All respondents (100%) indicated concerns about the seriousness of EVD, 374 (94%) indicated that they might be at risk of EVD infection, 394 (99%) indicated the correct attitude towards preventability of EVD using appropriate measures, and 388 (97.5%) indicated that appropriate hand washing and standard precautionary measures could lower the risk of EVD transmission. However, only 304 (76.7%) had the correct attitude towards the role of herbs in curing/preventing EVD, 270 (67.8%) had the correct attitude regarding eating bush meat and 350 (87.9%) had the correct attitude regarding the role of community engagement for EVD prevention. Overall, 334 (83.9%) respondents had an appropriate attitude towards EVD control, while 64 (16.1%) had a poor attitude towards EVD control.

Relationships between EVD knowledge and attitudes and the characteristics of the respondents

In a multivariable logistic regression analysis shown in Table 6, only male gender was a predictor of good overall knowledge of EVD (adjusted odds ratio 4.0, 95% confidence intervals 1.8–9.0). Only consultant cadre was found to be a predictor of appropriate attitude towards EVD control. None of the other factors evaluated were predictors of appropriate attitudes to EVD among respondents.

Discussion

In this study, we have shown that the clinicians surveyed had a high level of knowledge regarding EVD presentation, prevention and treatment, but there was a major deficit in their knowledge of its transmission. We also found that most clinicians had the correct attitude towards EVD, with a major deficit being that almost a quarter considered herbs appropriate for curing the disease. Male gender was a predictor of overall good knowledge, and consultant cadre was a determinant of appropriate attitude to EVD. However, other sociodemographic and clinical characteristics of the respondents were associated with neither their knowledge of nor their appropriate attitudes to EVD.

Clinicians had a high level of knowledge of EVD across specialties and duration of practice, indicating that these clinicians can easily identify the symptoms and signs of EVD whenever suspicious cases present. Furthermore, the majority of respondents had good knowledge of diagnostic, treatment and preventive measures against EVD. The reason for this high level of knowledge could be due to early preparation, education and training of HCWs in the West African subregion following the first index cases in

Table 2. Knowledge of the clinical features Ebola according to duration of practice

Variables	Total	≤10 years	>10 years	*P*-value
	n (%) correct	*n* (%) correct	*n* (%) correct	
Overall	398	298	100	
Ebola caused by a virus	398 (100)	298 (100)	100 (100)	1.00
Incubation period	388 (97.5)	292 (98.0)	96 (96)	0.46
Fever as a symptom	398 (100)	298 (100)	100 (100)	1.00
Headache as a symptom	382 (96.0)	286 (96.0)	96 (96.0)	0.41
Nausea/vomiting as a symptom	396 (99.5)	296 (99.3)	100 (100)	0.41
Diarrhoea as a symptom	384 (96.5)	290 (97.3)	94 (94.0)	0.30
Passage of blood in stool as a symptom	386 (97.0)	290 (97.3)	96.0 (96)	0.03
Stomach ache as a symptom	308 (77.4)	234 (78.5)	74 (74.0)	0.61
Rash as a symptom	310 (77.9)	230 (77.2)	80 (80.0)	>0.05
Headache as a symptom	374 (94.0)	280 (94.0)	94 (94.0)	0.64
Painful/difficult swallowing as a symptom	354 (88.9)	268 (89.9)	86 (86.0)	0.02
Joint pains as a symptom	350 (87.9)	264 (88.6)	86 (86.0)	0.53
Bleeding from mucosa	392 (98.5)	294 (98.7)	98 (98.0)	0.64
Fever refractory to treatment as a symptom	344 (86.4)	254 (85.2)	90 (90.0)	00.4
Absence of fever in a sick individual excludes Ebola	290 (72.9)	220 (73.8)	70 (70.0)	0.49
Absence of profuse mucosal bleeding excludes Ebola	358 (89.9)	270 (90.6)	88 (88.0)	0.76
Conjunctival haemorrhage as a symptom	328 (82.4)	244 (81.9)	84 (84.0)	0.08
Are cough and chest pain a symptom?	324 (81.4)	242 (81.2)	82 (82.0)	0.78
Does Ebola affect children?	388 (97.5)	292 (98.0)	96 (96.0)	0.05
Abortion in pregnant women as a symptom	288 (72.4)	214 (71.8)	74 (74.0)	0.07
Good knowledge of clinical features				0.66
Yes	370 (93.0)	278 (93.3)	92 (92.0)	
No	28 (7.0)	20 (6.7)	8 (8.0)	

Table 3. Respondents' knowledge of Ebola transmission according to duration of practice

Variables	Total	≤10 years	>10 years	*P*-value
	n (%) correct	*n* (%) correct	*n* (%) correct	
Total	398	298	100	
Transmission through rats	122(30.7)	88 (29.5)	34 (34)	0.06
Transmission through bats	394 (99.0)	296 (99.3)	98 (98.0)	0.26
Transmission through handling bush meat	386 (97.0)	294 (98.7)	92 (92.0)	<0.001
Causative organism can penetrate unbroken skin	232 (58.3)	174 (58.4)	58 (58.0)	0.38
Transmission by contact with blood of infected persons	392 (98.5)	292 (98.0)	100 (100.0)	0.17
Transmission through air/aerosol	62 (15.6)	38 (12.8)	24 (24.0)	0.02
Transmission through semen of infected person	394 (100)	294 (98.7)	100 (100.0)	0.50
Transmission through contact with dead individuals with Ebola	396 (99.5)	298 (100.0)	98 (98.0)	0.06
Transmission from an infected person who have no symptoms	212 (53.3)	160 (53.3)	52 (52.0)	0.57
Transmission through mosquito bite	318 (79.9)	236 (79.2)	82 (82.0)	0.55
Transmission by survivors of the Ebola disease	152 (38.2)	112 (37.6)	40 (40.0)	0.55
Duration post Ebola before safely having coitus	142 (35.7)	102 (34.2)	40 (40.0)	0.73
Transmission through blood/tissue transfusion	374 (94.0)	278 (93.3)	96 (96.0)	0.32
Transmission through food and water	148 (37.2)	110 (36.9)	38 (38.0)	0.98
Transmission through physical contact only	288 (72.4)	224 (75.2)	64 (64)	<0.001
Good knowledge of transmission				0.04
Yes	226 (56.8)	178 (59.7)	48 (48.0)	
No	172 (43.2)	120 (40.3)	52 (52.0)	

Table 4. Respondents' knowledge of the treatment and prevention of Ebola according to duration of practice

Variables	Total	≤10 years	>10 years	*P*-value
	n (%) correct	*n* (%) correct	*n* (%) correct	
Regular hand washing by health workers	396 (99.5)	296 (99.3)	100 (100.0)	0.56*
Water for hand washing should be chlorinated	376 (94.5)	280 (94.0)	96 (96.0)	0.44
Health workers psychosocial support needed in outbreak situation	390 (98.0)	290 (97.3)	100 (100.0)	0.10
PCR can be used to confirm Ebola infection	366 (92.0)	276 (92.6)	90 (90.0)	0.40
ELISA can be used to detect Ebola antibodies	316 (80.0)	236 (79.2)	80 (80.0)	0.86
An antigen detection test can be used to confirm Ebola	300 (75.4)	220 (73.8)	80 (80.0)	0.22
Ebola antigen test and PCR can give a false-negative test result	224 (56.3)	170 (57.0)	54 (54.0)	0.60
Vaccine against Ebola	364 (91.5)	268 (89.9)	96 (96.0)	0.06
Effective drug for treating Ebola	346 (86.9)	258 (86.6)	88 (88.0)	0.72
Ebola management is mainly supportive care	356 (89.4)	268 (89.9)	88 (88.0)	0.59
In Ebola management, fluid and electrolyte balance are important	392 (98.5)	296 (99.3)	96 (96.0)	0.02
In Ebola management, oxygen and BP control are important	388 (97.5)	288 (96.6)	100 (100.0)	0.06
In Ebola management, treatment of infections is important	326 (81.9)	240 (80.5)	86 (86.0)	0.22
In Ebola management, health workers should wear personal protective equipment	396 (99.5)	296 (99.3)	100 (100.0)	0.56*
In Ebola management, individuals are best nursed in open wards	378 (95.0)	284 (95.3)	94 (94.0)	0.61
In Ebola management, use of corticosteroids may be important	80 (20.1)	52 (17.4)	28 (28.0)	0.02
Good knowledge of prevention and treatment				0.04
Yes	352 (88.4)	258 (86.6)	94 (94.0)	
No	46 (11.6)	40 (13.4)	6 (6.0)	

BP: blood pressure; ELISA: enzyme-linked immunosorbent assay; HW: Health workers.
* *P*-value is based on Fisher's exact test.

Table 5. Respondents' attitudes to Ebola according to duration of practice

Variables	Total	≤10 years	>10 years	*P*-value
	n (%) correct	*n* (%) correct	*n* (%) correct	
Overall	398	298	100	
Attitude to extent of seriousness of Ebola illness	398 (100.0)	298 (100.0)	100 (100.0)	1.00
Attitude to being at risk of Ebola infection	374 (94.0)	288 (96.6)	86 (86.0)	<0.001
Attitude to preventability of Ebola	394 (99.0)	296 (99.3)	98 (98.0)	0.25
Attitude to using herbs to cure/prevent Ebola	304 (76.4)	230 (77.2)	74 (74.0)	0.52
Attitude to hand washing for Ebola prevention	388 (97.5)	290 (97.3)	98 (98.0)	0.71
Attitude to banning bush meat handling for Ebola prevention	270 (67.8)	214 (71.8)	56 (56.0)	0.003
Attitude to community engagement for Ebola prevention	350 (87.9)	256 (85.9)	94 (94.0)	0.03
Attitude to role of media campaign for Ebola prevention	384 (96.5)	284 (95.3)	100 (100.0)	0.03
Appropriate attitude to Ebola control				0.99
Yes	334 (83.9)	250 (83.9)	84 (84.0)	
No	64 (16.1)	48 (16.1)	16 (16.0)	

Guinea [6]. Moreover, the high political commitment from the Nigerian government and swift support given by religious leaders (e.g. banning of physical contact greetings in places of worship) allowed for a coordinated response and quality community mobilisation and information dissemination [20,23]. In addition, the success of the Nigerian national EVD response may partly be due to prior establishment of the Integrated Disease Surveillance and Response Strategy, which allowed for prompt notification of the EVD outbreak; the availability of trained field epidemiologists through The Nigeria Field Epidemiology and Laboratory Training Program and the establishment of a central coordinating unit at The Nigerian Center for Disease Control [27,28]. Also, prompt participation of state governments, adequate funding, mobilisation of skilled health workers and the support of local, national and international development partners were contributory [27,28].

Table 6. Multivariable logistic regression analysis of the factors associated with good knowledge of and attitudes to Ebola among study respondents

Variables	Crude OR 95% CI	Adjusted OR 95% CI	Adjusted *P*-value
Factors associated with good knowledge			
Older age (>40 years)	1.7 (0.7–4.3)	1.4 (0.4–4.4)	0.60
Male gender	4.1 (1.9–9.1)	4.1 (1.8–9.2)	<0.001
Consultant cadre	1.5 (0.5–4.5)	1.6 (0.4–7.7)	0.55
Younger duration of practice (≤10 years)	1.3 (0.5–3.2)	1.5 (0.4–6.4)	0.57
Has had a training on Ebola	1.6 (0.4–7.3)	1.5 (0.3–7.1)	0.63
Interested in Ebola training	0.0 (0.0–1.7)	0.0 (0.0–1.6)	0.98
Factors associated with good attitude			
Younger age (≤40 years)	1.0 (0.6–1.8)	1.1 (0.5–2.4)	076
Male gender	1.3 (0.7–2.3)	1.3 (0.7–2.5)	0.43
Consultant cadre	1.9 (0.8–4.1)	2.9 (1.1–8.2)	0.04
Older duration of practice (>10 years)	1.0 (0.5–1.9)	1.6 (0.6–3.9)	0.31
Has not had a training on Ebola	1.2 (0.5–2.7)	1.2 (0.5–2.9)	0.70
Interested in Ebola training	1.1 (0.3–3.2)	1.3 (0.4–4.0)	0.68

CI: confidence interval; OR: odds ratio.

Although we did not specifically evaluate information sources on EVD among the clinicians surveyed or how they were received, the national response coordinated by the Nigeria Federal Ministry of Health allowed for consistent dissemination of appropriate information to both health workers and the public through a centralised 'command-chain' structure accessible through various media channels [20,23]. The Nigerian Medical Association response to the outbreak included almost regular training and retraining of clinicians on how to identify presumptive EVD cases and initial strategies needed to combat the disease. Furthermore, non-governmental organisations played a pivotal role in ensuring information dissemination using social media channels to the general public.

Despite the above mentioned positives, our study showed that there are still some knowledge gaps on EVD among clinicians in Nigeria. For example, more than one-quarter of them did not know that the absence of fever does not exclude EVD and that the disease can be a cause of unexplained abortion in pregnant women [29]. In addition, as reported by previous studies [2–4], the highest knowledge deficits were observed in the area of disease transmission. More than four-fifths of the clinicians surveyed incorrectly believed that EVD can be transmitted through the air. Also, about two-thirds each of the respondents believed that EVD can be transmitted by rats, by EVD survivors or through consumption of poorly prepared food and water. The findings previously mentioned highlight some of the misinformation and widespread misconceptions about EVD regarding its mode of transmission, which has resulted in many cases of fear and inappropriate behavioural and emotional responses within the general public and the healthcare community [2–4,19–21,25]. Also, only one-fifth of the respondents correctly knew that corticosteroids may be useful in the management of EVD. This may be because the respondents have very limited to no experience in EVD management. The WHO has now recommended the use of corticosteroid in EVD management because some of its clinical manifestations are immune mediated and may be characterised by inflammatory processes [30,31]. This should be reflected in future EVD training programmes for clinicians in our setting.

In the present study, the duration of practice of the clinician did not seem to substantially affect the proportion with good knowledge scores. This could be because the regular training that clinicians underwent during the outbreak was well received both by younger and older practicing clinicians. When comparisons were made based on gender, knowledge scores of male clinicians were found to be better than those of female clinicians. Indeed, after adjustment for confounders, male gender remained an independent predictor of good knowledge of EVD among the clinicians surveyed. The reason for this gender difference in EVD knowledge is not clear. This finding suggests that male clinicians in this region have better EVD knowledge than female clinicians, probably through better social interactions and less fear about the disease.

Similarly, this study showed that most of the clinicians surveyed had correct attitudes towards EVD control, particularly in the use of standard precaution measures, the use of personal protective equipment, adopting infection control measures in the hospital and ensuring adequate community engagement/media for EVD control. However, more than one-third considered that herbs could play a role in EVD control and that banning 'bush meat' was not an appropriate strategy for EVD control. These gaps in the attitudes of physicians need to be addressed in future training programmes. Only consultant cadre was found to be a predictor of appropriate attitude towards EVD control. This may be due to the additional training the clinicians in the consultant cadre have had.

The strengths of this study are its focus on the area of EVD control in the context of little literature available from Nigeria and its inclusion of almost all participating clinicians from the major health facilities in Ebonyi State. The findings of this study can help stakeholders and other health policymakers to evaluate the effectiveness of their training policies and the preparedness of clinicians in the detection and management of EVD. However, the inclusion of a single state and the use of convenience sampling are possible limitations. A few of the questions regarding EVD transmission in our survey are still subject to research, for example,

the duration post Ebola before safely having coitus. At the time of our survey, it was considered safe to have unprotected coitus 3 months post EVD. However, one of the lessons learned in the 2013–2016 West Africa EVD outbreak is that Ebola RNA/live virus may persist for months in the semen with the possibility to be sexually transmitted [32,33]. Despite these limitations, the findings of this study can contribute to the development of recommendations that could be useful nationally and internationally in an effort to detect and contain the scourge of EVD by identifying gaps in the knowledge and attitudes of clinicians. The recent 2017, 2018 and 2019 EVD outbreaks in the Democratic Republic of Congo suggest the need for African countries to strengthen their outbreak preparedness and response strategies.

In conclusion, there was a high level of knowledge regarding EVD among the clinicians surveyed, with a major deficit being not knowing some of the symptoms and not having a clear understanding of disease transmission patterns. Also, most clinicians had the right attitude towards EVD. The knowledge gaps identified should be used in preparing for post-EVD control strategies, since there is a possibility for EVD resurgence in West Africa. Readiness is important to avoid the mistakes observed in the early periods of the 2013–2016 EVD outbreak.

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Conflicts of interest

None declared.

Authors' contributions

Conceptualisation: NAA, CKO, IAA and KNU; data curation: NAA, CKO, IAA and KNU; formal analysis: NAA, CKO, IAA and KNU; funding acquisition: NAA, CKO, IAA and KNU; investigation: NAA, CKO and IAA, KNU; methodology: NAA, CKO, IAA and KNU; project administration: NAA; resources: NAA, CKO, IAA and KNU; supervision: NAA; validation: KNU; writing – original draft: NAA, CKO, IAA and KNU; writing – review and editing: NAA, CKO, IAA and KNU.

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