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Readiness to manage Ebola Virus Disease among emergency healthcare workers in Uganda: a nationwide multicenter survey

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Abstract

Background Emerging infectious diseases like the Ebola Virus Disease (EVD) pose significant global public health threats. Uganda has experienced multiple EVD outbreaks, the latest occurring in 2022. Frontline healthcare workers (HCWs) are at increased risk, yet there is insufficient evidence of existing knowledge of EVD of these HCWs. We aimed to assess the readiness of Uganda's emergency HCWs to manage EVD and identify their training needs to inform targeted capacity-building interventions for future outbreaks.

Methods This multicentre nationwide cross-sectional study was conducted from July to September 2023 among HCWs providing emergency care in 14 secondary and tertiary hospitals across Uganda. Participants were consecutively recruited using the probability-proportional-to-size sampling technique, and data was collected using a self-reported questionnaire. Factors associated with EVD knowledge were identified through a mixed-effect linear model.

Results Data from 691 eligible HCWs with a median age of 32 (IQR: 28–38) was analyzed (response rate: 92%). Only one-third (34.4%, $n=238$) had received EVD training in the past year. The median EVD knowledge score was 77.4% (IQR: 71.2 −83.4%). EVD knowledge was associated with longer professional experience in years (β: 0.21, 95% CI: 0.03 to 0.39, $p=0.024$) and higher level of education: diploma (β: 3.37, 95% CI: 1.49 to 5.25, $p<0.001$), undergraduate degree (β: 6.45, 95% CI: 4.11 to 8.79) and postgraduate degree (β: 7.13, 95% CI: 4.01 to 10.25, $p<0.001$). Being a doctor (β: 2.55, 95% CI: 0.35 to 4.74, $p=0.023$), providing care in the obstetrics/gynecology department (β: −1.90, 95% CI: −3.47 to −0.32, $p=0.018$), previous EVD training (β: 2.27, 95% CI: 0.96 to 3.59, $p=0.001$) and accessing EVD information through social media (β: 2.52, 95% CI: 1.17 to 3.88, $p<0.001$) were also significantly associated with EVD knowledge. HCWs were mostly interested in training on management (92.9%), infection prevention and control (87.1%), and clinical presentation (84.1%), and preferred physical (51.5%) and hybrid (38.2%) training modes.

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Conclusion Our study shows that the readiness of HCWs in Uganda to respond to EVD outbreaks varies by individual factors and information sources. We recommend targeted training and suggest future research on educational innovations and social media's potential to fill knowledge gaps.

Keywords Ebola Virus Disease, Uganda, Readiness, Knowledge, Attitudes, Practices, Training needs, Healthcare Workers

Introduction

Emerging and re-emerging infectious diseases pose a significant global public health challenge [1]. The number of viral outbreaks has markedly increased in the past two decades, including SARS-COV-1, Swine Flu, MERS-CoV, Ebola Virus Disease (EVD), and Zika [2]. These outbreaks extend beyond health implications, affecting social structures, economies, security, education, mobility, and food security [3]. Low- and middle-income countries, burdened by existing health disparities, often bear the burden of these impacts. Uganda is among African countries that have had frequent viral hemorrhagic fever outbreaks, particularly EVD [4]. Since 2000, Uganda has experienced five EVD outbreaks, with the recent between September 2022 and January 2023 [4–6]. The index case was a 24-year-old man from Mubende district in Western Uganda, who reportedly developed signs and symptoms of viral hemorrhagic fever and passed on nine days later [7]. This outbreak culminated in over 142 confirmed cases and 55 deaths, spreading across several districts, including Kyegegwa, Kagadi, and Bunyangabu in western Uganda, Wakiso, Kampala, Masaka, and Kassanda in central Uganda, and Jinja in Eastern Uganda [8].

To date, the largest global EVD outbreak was the 2014–2016 outbreak in West Africa, in which more than 28,000 people were infected and left over 11,000 people dead [9, 10]. Lessons learned from this major outbreak and the subsequent EVD outbreaks in other countries have emphasized the critical need to strengthen healthcare systems worldwide [9–11]. This includes enhancing human resources for health, financing, service delivery, health information systems, and access to medicines and leadership to respond to outbreaks effectively [9–11]. Healthcare workers (HCWs) are very critical to outbreak responses. Unfortunately, they are often victims as well in disease outbreaks, including EVD outbreaks and, more recently, the COVID-19 pandemic [4, 5, 9, 12]. By the end of the 2022 EVD outbreak in Uganda, 19 health workers had contracted EVD, and 7 of them succumbed to the same [8]. Therefore, the need for readiness of the health workforce cannot be over-emphasized. Health workers are crucial in surveillance, case detection, and management, educating the population, and averting misinformation. Without adequate knowledge and skills in case detection, diagnosis, management, and infection prevention and control among emergency health workers, it is very challenging to control an outbreak.

Despite previous training on EVD in Uganda [13], recent studies, including one in Western Uganda, have identified significant knowledge gaps among healthcare workers, particularly in areas such as EVD biology, diagnosis, management, and prevention [14]. Similar challenges have been reported in some parts of Ethiopia [15], Pakistan [16], and Guinea [17]. There are also concerns about the readiness of healthcare facilities to manage EVD in Uganda, which in turn impacts how HCWs respond to the outbreak. In a study of 22 health facilities in the Kasese and Rubirizi districts in Western Uganda, over half lacked essential resources such as funds, case definition books, rapid response, and burial teams for EVD management [14]. Furthermore, none of the level III and IV health centers had dedicated EVD management centers, isolation units, or burial guidelines. The Uganda National Infection Prevention and Control Guidelines, however, recommends that all health units (from Health Center III and above) should have isolation rooms or sections. [18].

It is crucial that health workers are equipped with the necessary skills for diagnosing and managing patients with EVD, emphasizing the critical aspect of infection prevention and control. To effectively train health workers on EVD, it is important to assess their current knowledge and training needs. The lack of recent studies in Uganda documenting these aspects poses a significant challenge in developing and implementing evidence-based training programs tailored to prepare HCWs for future outbreaks. In this study, we aimed to evaluate the readiness of emergency HCWs in Uganda to manage the Ebola virus disease. We also aimed to assess their training needs regarding EVD to inform targeted interventions and build capacity for future outbreak management.

Methods

Study design

This cross-sectional study, employing quantitative techniques, was conducted between July and September 2023.

Study area

The study was conducted in 14 hospitals across all four regions in Uganda. These included one national referral hospital, ten regional referral hospitals, two private-not-for-profit hospitals, and one private hospital. A complete list of the surveyed hospitals is below.

a Government-Owned Hospitals:

- Mulago National Referral Hospital is located in Kampala, Central Region.
- Jinja Regional Referral Hospital is situated in Jinja, Eastern Region.
- Mbale Regional Referral Hospital is located in Mbale, Eastern Region.
- Soroti Regional Referral Hospital is situated in Soroti, Eastern Region.
- Moroto Regional Referral Hospital is located in Moroto, Northern Region.
- Gulu Regional Referral Hospital is situated in Gulu, Northern Region.
- Arua Regional Referral Hospital, located in Arua, Northern Region.
- Hoima Regional Referral Hospital is located in Hoima, Western Region.
- Fort Portal Regional Referral Hospital is situated in Kabarole, Western Region.
- Kabale Regional Referral Hospital is located in Kabale, Western Region.
- Mbarara Regional Referral Hospital is situated in Mbarara, Western Region.

b Private-Not-for-Profit (PNFP) Hospitals:

- St Francis Hospital Nsambya is located in Kampala, Central Region.
- St Mary's Hospital Lacor is situated in Gulu, Northern Region.

c Private-For-Profit (PFP) Hospital:

- Case Hospital is located in Kampala, Central Region.

These hospitals were chosen to provide a comprehensive representation of health facilities across all four regions in Uganda relevant to outbreak response. Two hospitals (Mulago National Referral Hospital and Case Hospital) provide tertiary care, while the rest are designated secondary care hospitals. It is important to note that while regional referral hospitals in Uganda are designed to provide secondary care, many can now offer tertiary care in some of their units. PNFP and PFP hospitals were selected to provide a balanced view of the varying levels of resources, management styles, and patient care strategies across different healthcare settings in Uganda.

Study population

Health workers providing clinical services at emergency departments or those providing emergency services at the fourteen selected hospitals constituted the study population. These are usually the first contact with all patients seen and admitted at the hospital and are at a higher risk of encountering patients with Ebola viral disease. In many Ugandan hospitals, emergency care is provided across various departments, including those without a designated emergency room, often integrating emergency services within outpatient or inpatient wards for efficiency.

Selection criteria

We included nurses, clinical officers, junior house officers, medical officers, residents, and specialists aged 18 years and above who provided emergency care services to patients in the selected hospitals and consented to participate. Auxiliary staff or support health workers, undergraduate health profession students, and eligible health workers who were critically ill or incapacitated to participate in the study were excluded.

Sample size and sampling criteria

The sample size was calculated using Epi Info StatCalc (Centers for Disease Control and Prevention (CDC), Atlanta, Georgia, USA) sample size calculator. Using an expected proportion of HCWs with good EVD knowledge of 50%, an acceptable margin of error of 5%, and a design effect of 2.0, a minimum sample size of 754 participants was required. This sample size is sufficient to answer the research question with 95% confidence intervals. The sample size was distributed proportionately across the 14 health facilities following a desk review of the current staffing norms at each level of care. Participants from each facility were recruited consecutively using convenience sampling until the desired sample size was reached.

Data collection tool

A self-reported semi-structured questionnaire was used to assess knowledge, readiness, and training needs regarding the EVD (Appendix 1). The questionnaire was developed from information on EVD (available on the CDC website: https://www.cdc.gov/vhf/ebola/index.html), and modified to suit the study population and setting. Some questions were also adopted from a previous study in Ethiopia [15]. The questionnaire included participants' sociodemographic data, as well as questions on the basic science, clinical presentation, diagnosis, management, and prevention of EVD. Current practices regarding infection prevention and control were also assessed to determine readiness. Finally, the participants

were asked to select the most important topics regarding EVD on which they would need training.

Table 1 Social and demographic characteristics of the study participants

Variables (*N* = 691)	Frequency (%)
Age in years: median (interquartile range)	32.0 (28.0–38.0)
Age Category: frequency (n), %	
18–35 years	455 (65.8)
36–59 years	232 (33.6)
≥ 60 years	4 (0.6)
Professional cadre: n (%)	
Clinical Officer	62 (9.0)
Medical Doctor	231 (33.4)
Nurse/Midwife	398 (57.6)
Sex: n (%)	
Female	380 (55.0)
Male	311 (45.0)
Hospital ownership: n (%)	
Public	586 (84.8)
Private-Not-For-Profit	82 (11.9)
Private	23 (3.3)
Hospital region: n (%)	
Central	177 (25.6)
East	147 (21.3)
North	176 (25.5)
West	191 (27.6)
Nature of current residence: n (%)	
Rural	55 (8.0)
Urban	636 (92.0)
Highest level of education: n (%)	
Certificate	113 (16.4)
Diploma	266 (38.5)
Undergraduate degree	225 (32.6)
Postgraduate	87 (12.6)
Professional experience in years: median (interquartile range)	6.0 (3.0–10.0)
Department (multiple responses accepted) : n (%)	
Internal medicine	225 (32.6)
Pediatrics	215 (31.1)
Surgery	179 (25.9)
Obstetrics and Gynecology	138 (20.0)
Acute and Emergency	42 (6.1)
Outpatient Department	20 (2.9)
Intensive Care Unit or Anaesthesia	15 (2.2)
Diagnosed with Ebola virus disease (EVD) : n (%)	
No	688 (99.6)
Yes	3 (0.4)
Contact with a person diagnosed or suspected to have EVD: n (%)	
No	580 (83.9)
Yes	111 (16.1)

Study variables

Dependent variables

The primary outcome variables were knowledge, attitudes, and practices regarding the Ebola virus disease. There were 25 questions on knowledge, 14 on attitudes using a five-item Likert scale (strongly agree to strongly disagree), and seven questions on practices. Finally, three questions were used to determine the training needs on EVD among the participants.

Independent variables

Social and demographic data (age, sex, level of education, professional cadre, hospital, and department), and EVD-related data (source of information on EVD, contact with an EVD patient, ever contracted EVD, ever isolated for EVD, prior EVD training).

Data collection procedure

All eligible participants were recruited, after signing a written informed consent form. Each participant received an explanation and a copy of the questionnaire, which was digitally designed using Kobo Toolbox (https://www.kobotoolbox.org/). The participants were then encouraged to fill in responses to all the questions in the data collection tool, to ensure completeness and accuracy.

Data management analysis

Completed questionnaires were exported to Microsoft Excel 365 for cleaning and coding. All statistical analyses were performed using STATA 18.0 software (StataCorp LLC, College Station, Texas, USA). To assess the level of knowledge, composite scores were calculated from the responses on knowledge of EVD and summarized as median (interquartile range). Attitudes, practices, and training needs were presented as frequencies and percentages. Factors associated with EVD knowledge were determined using a hierarchical linear regression model. Variables included in the model were selected based on extensive literature and those with p-values less than 0.2 with plausible explanations. The healthcare facility was included as a random effect, while individual-level parameters (age, sex, professional cadre, education, nature of residence (urban vs. rural), professional experience, previous EVD training, and source of information) and hospital-level variables (geographical region, hospital ownership and departmental affiliations) were included as fixed effects. The results of the regression analyses were presented as beta coefficients (β) with 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant.

Results

Sociodemographic characteristics

Seven hundred and eight ($n=708$) responses were received (response rate=94%). After removing duplicates and ineligible entries, data from 691 HCWs were analyzed (Table 1). The median age was 32 years (interquartile range: 28–38 years). More than half were females (55.0%, $n=380$) and nurses (57.6%, $n=398$). Most participants worked in public health facilities (84.8%, $n=586$) and resided in urban settings (92.0%, $n=636$). Nearly half (45.2%) had attained at least an undergraduate degree, while one-third (32.6%, $n=225$) provided emergency care services from the internal medicine department. Whereas 16.1% ($n=111$) reported ever having contact with persons suspected or confirmed to have EVD in their lifetime, only three reported ever being diagnosed with the disease. The distribution of the study participants is shown in Fig. 1.

Ebola Virus Disease outbreak awareness

Most participants (93.3%, $n=645$) were aware of the 2022 Ebola outbreak in Uganda. Social media (70.5%, $n=487$), television (69.3%, $n=479$), and hospital training (58.8%, $n=406$) were the most frequent sources of information on EVD for more than half of the HCWs (Fig. 2). Only 34.4% ($n=238$) had had training on EVD in the past year, with a median of 1 training (IQR: 1–2).

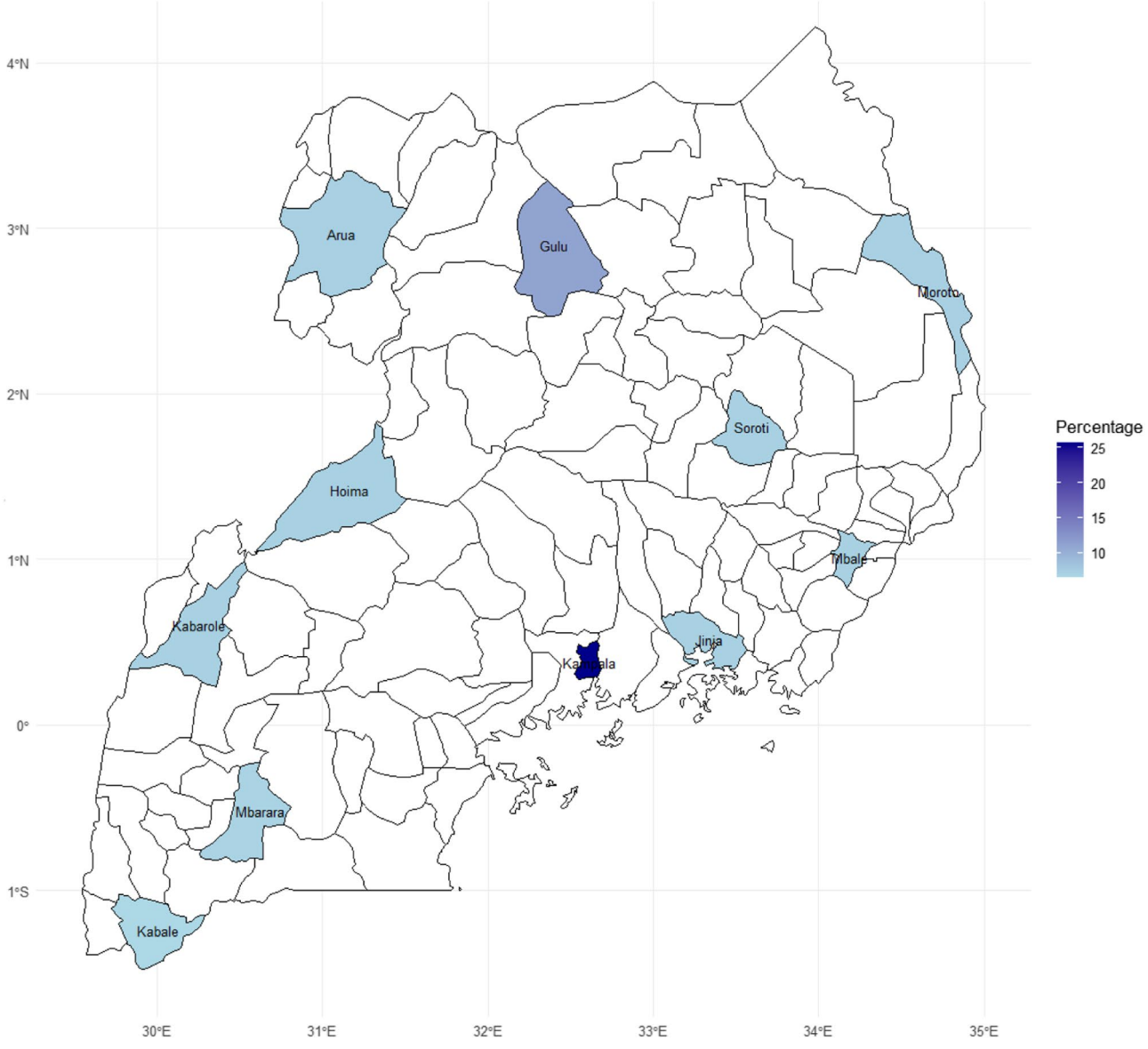

Fig. 1 A map of Uganda showing the distribution of the study participants

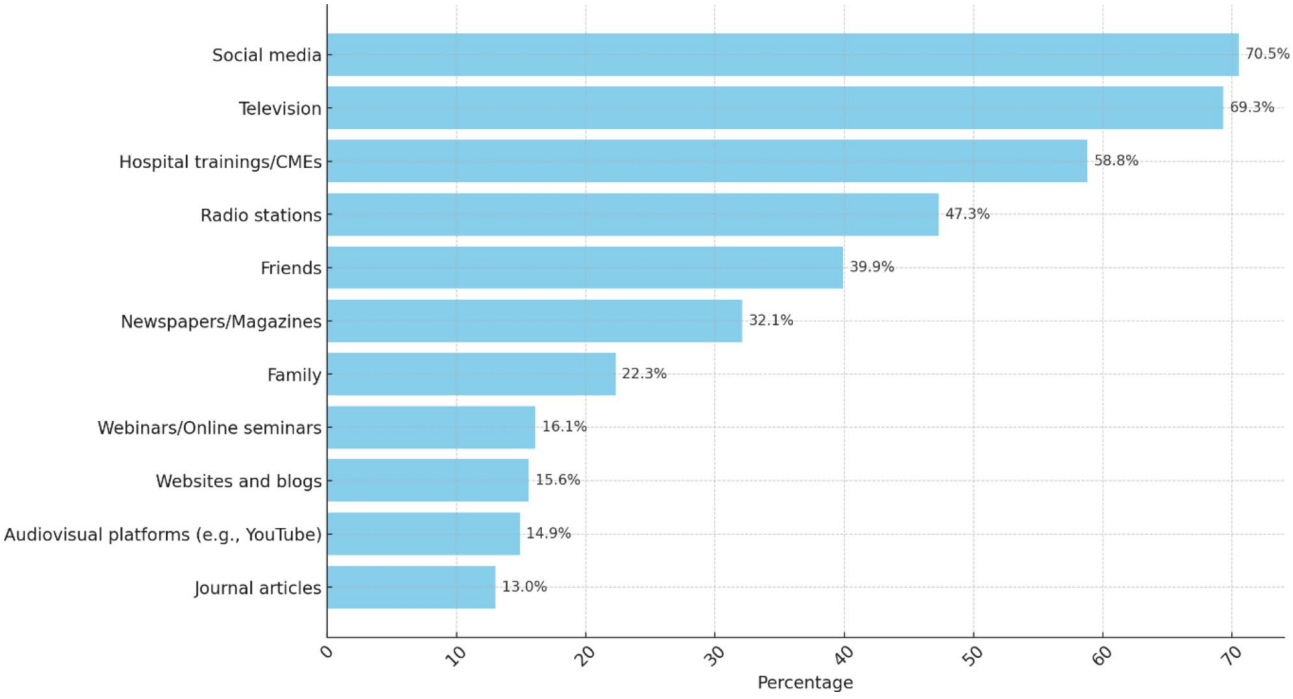

Fig. 2 Healthcare workers' source of information on the 2022 Ebola virus disease outbreak in Uganda

Knowledge of Ebola Virus Disease

Most HCWs could identify the causative agents, transmission, and diagnosis of EVD (Table 2). However, more than 1 in 10 thought EVD was an airborne disease (16.1%) and could not be transmitted through contaminated objects, surfaces, and materials (12.7%). While most of the EVD symptoms were identified by the participants (Fig. 3), more than one-third (37.8%) thought that bleeding from orifices was the first symptom of EVD. More than half were not aware of effective treatments (52.0%) or vaccines for certain species of Ebola (50.5%). Up to 20.4% (n=141) did not believe personal protective equipment could protect one from contracting EVD. The median knowledge score was 77.4% (IQR: 71.2 −83.4%, range: 39.2 −96.0%; scale internal reliability – 0.63). Based on Bloom's cut-off, 39.1% (n=270) had good knowledge (scores between 80 and 100%), 55.7% (n=385) had moderate knowledge (60–79%), and only 5.2% (n=36) had poor knowledge of EVD.

Factors associated with EVD knowledge

In bivariate analysis (Table 3), HCWs from Eastern (β: -5.18, 95% CI: -7.18 to -3.19, p<0.001) and Northern Uganda (β: −4.29,95% CI: −6.19 to −2.39, p<0.001) had significantly lower scores compared to those from Central Uganda. EVD knowledge scores were also significantly higher among males (β: 2.79,95% CI: 1.41 to 4.17, p<0.001), doctors (β:6.44,95%CI:5.01 to 7.87, p<0.001), and urban residents (β: 3.06,95% CI: 0.50 to 5.61, p=0.019). Furthermore, EVD knowledge scores significantly increased with the level of education, with participants having a diploma (β: 4.05,95% CI: 2.16 to 5.94, p<0.001), undergraduate (β: 8.83, 95% CI:6.89 to 10.77, p<0.001), and postgraduate degrees (β: 11.08,95% CI: 8.68 to 13.48, p<0.001) having higher scores compared to certificate holders. HCWs in internal medicine (β: 2.00, 95% CI: 0.52 to 3.47, p=0.008) had significantly higher scores than their counterparts working in other departments, while those in obstetrics and gynecology had significantly lower scores (β: −3.75, 95% CI: −5.46 to −2.03, p<0.001). Furthermore, those who had had contact with a patient with suspected or confirmed EVD had twice as high scores (β: 2.00, 95%CI: 0.11 to 3.89, p=0.038). Finally, having previous training on EVD (β: 2.27, 95%CI: 0.96 to 3.58, p=0.001) and accessing EVD information from social media (β: 2.52, 95%CI: 1.16 to 3.87, p<0.001) were significantly associated with higher knowledge scores.

At multilevel linear regression (Table 3), doctors (β: 2.55, 95% CI: 0.35 to 4.74, p=0.023) and HCWs with longer professional experience in years (β: 0.21, 95% CI: 0.03 to 0.39, p=0.024) had significantly higher EVD knowledge scores. Level of education also maintained a significant association with an increasing trend in EVD knowledge scores among those with diplomas (β: 3.37, 95% CI: 1.49 to 5.25, p<0.001), undergraduate degrees (β: 6.45, 95% CI: 4.11 to 8.79, p<0.001), and postgraduate degrees (β: 7.13, 95% CI: 4.01 to 10.25, p<0.001), compared to certificate holders. In addition, HCWs who had previous EVD training (β: 2.27, 95% CI: 0.96 to 3.59,

Table 2 Knowledge of healthcare workers in Uganda on Ebola virus disease

Statement	True: *n* (%)	False: *n* (%)
Ebola is a disease caused by microorganisms classified under the kingdom of Bacteria	65 (9.4)	626 (90.6)
EVD belongs to the group of organisms that are classified as viral hemorrhagic fevers	685 (99.1)	6 (0.9)
The following are EVD species that cause human disease.		
Zaire	522 (75.5)	169 (24.5)
Gulu (False)	55 (8.0)	636 (92.0)
Rakai (False)	16 (2.3)	675 (97.7)
Sudan	423 (61.2)	268 (38.8)
Bundibugyo	242 (35.0)	449 (65.0)
Mubende (False)	153 (22.1)	538 (77.9)
Tai Forest	62 (9.0)	629 (91.0)
Zika	81 (11.7)	610 (88.3)
None of the above	76 (11.0)	615 (89.0)
Fruit bats are the natural reservoir host for Ebola	576 (83.4)	115 (16.6)
Body fluids can transmit EVD from an infected person	683 (98.8)	8 (1.2)
EVD cannot be transmitted by objects and materials contaminated with body fluids (False)	88 (12.7)	603 (87.3)
EVD is an airborne disease spread through inhalation of air from infected persons (False)	111 (16.1)	580 (83.9)
One cannot get EVD by touching the dead bodies of Ebola patients (False)	90 (13.0)	601 (87.0)
EVD can be acquired directly from infected animals	660 (95.5)	31 (4.5)
Mosquito bites can transmit EVD from an infected person to an uninfected person (False)	68 (9.8)	623 (90.2)
One can get EVD by having sex with an infected person	646 (93.5)	45 (6.5)
A person with EVD cannot transmit the disease if they don't have symptoms	182 (26.3)	509 (73.7)
Symptoms of EVD can appear between 2 to 21 days after contact with an infected person	662 (95.8)	29 (4.2)
The first symptom of EVD is bleeding from the mouth, nose, or ears only (False)	261 (37.8)	430 (62.2)
There is currently no test for diagnosing EVD; therefore, only clinical presentation can be used (False)	158 (22.9)	533 (77.1)
EVD can be diagnosed using a polymerase chain reaction (PCR) test	621 (89.9)	70 (10.1)
There are effective treatments for the treatment of some species of EVD	332 (48.0)	359 (52.0)
Antibiotics can be used to cure patients with EVD (False)	155 (22.4)	536 (77.6)
The primary strategy of care for patients with EVD is supportive care	653 (94.5)	38 (5.5)
One can avoid contracting EVD by always wearing medical or surgical masks (False)	347 (50.2)	344 (49.8)
EVD can be prevented by avoiding contact with the blood and body fluids of infected individuals	678 (98.1)	13 (1.9)
Washing hands after touching surfaces contaminated with Ebola virus cannot prevent the spread of the disease (False)	215 (31.1)	476 (68.9)
There is currently an effective vaccine that can protect one from getting EVD	342 (49.5)	349 (50.5)
Using personal protective equipment accurately and consistently cannot protect one from EVD (False)	141 (20.4)	550 (79.6)

$p=0.001$) and those who accessed EVD information from social media (β: 2.52, 95% CI: 1.17 to 3.88, $p<0.001$) had more than twice higher EVD knowledge scores. However, HCWs in the obstetrics and gynecology department had significantly lower EVD knowledge scores (β: −1.90, 95% CI: −3.47 to −0.32, $p=0.018$).

Attitudes Towards Ebola Virus Disease.

HCWs in this study held diverse perceptions towards the EVD outbreak in Uganda (Fig. 4). Up to 60.8% believed the EVD epidemics could be controlled easily, while 92.3% agreed that patients with EVD should be isolated. About 86.8% reported being uncomfortable near patients with suspected or confirmed EVD, while 40.4% reported being uncomfortable with working in a hospital with an Ebola treatment unit. Only 3.9%, 8.9%, and 14.2% believed that EVD was a punishment from God, a government conspiracy, and that there was no EVD outbreak in Uganda in 2022, respectively. Some 5.2% of HCWs believed that the EVD outbreak was a trick by the government to get funds from donors.

Practices related to EVD Outbreak

More than half of the HCWs reported consistently wearing personal protective equipment (PPEs) while caring for all patients (57.9%). In comparison, 66.1% reported doing so only when caring for patients with symptoms of EVD (Table 4). The majority (72.4%) reported disinfecting their workspaces daily, while 82.1% reported consistently observing the five moments of handwashing while caring for patients with EVD symptoms. Only 14% ($n=97$) reported that they would never accept taking care of a patient with signs and symptoms suggestive of EVD. Nearly 46.0% ($n=318$) reported never attending EVD-related trainings or workshops after the outbreaks. Up to 40% of the HCWs were uncomfortable taking care of patients suspected of having EVD.

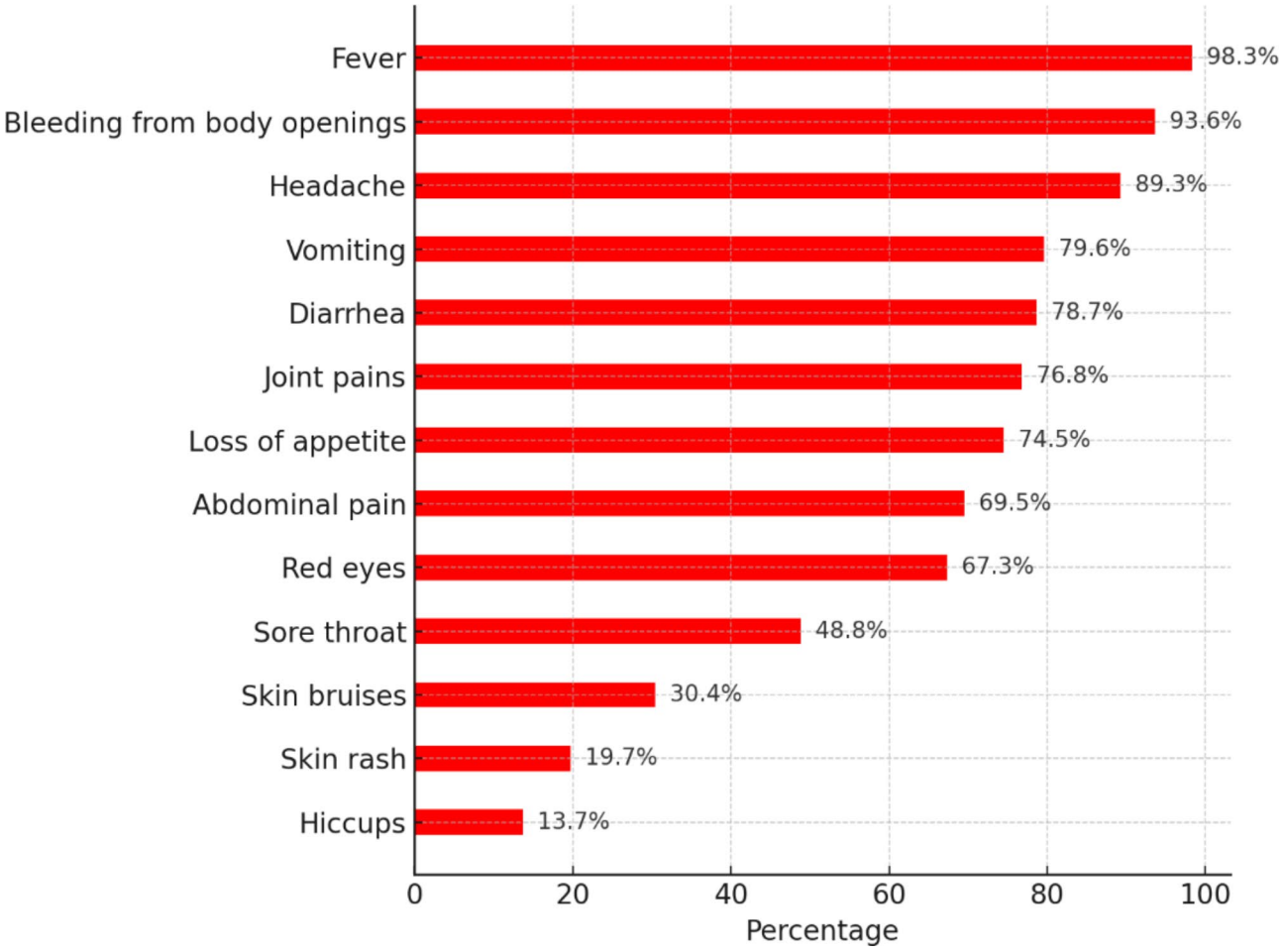

Fig. 3 Knowledge of Ebola virus disease symptoms among healthcare workers in Uganda

Training needs

Nearly all the participants (99.6%) were interested in additional EVD training, with 44.6% very interested. Physical training mode was the most preferred (51.5%), followed by a hybrid format (38.2%). Only 10.3% preferred exclusively receiving online training. HCWs were most interested in receiving training on EVD management (92.9%), infection prevention and control (87.1%), clinical presentation (84.1%), vaccination (82.6%), and diagnosis (80.5%), Table 5.

Discussion

The Ebola virus disease remains a persistent public health concern, particularly in regions where it is endemic, such as parts of the Democratic Republic of Congo (DRC). Uganda, DRC's neighboring country, bears a continuous threat of potential EVD outbreaks, having had at least five in the past two decades. This dilemma lays emphasis on the necessity for ongoing outbreak preparedness and the reinforcement of global health security, as highlighted by the 2022 Uganda Ebola outbreak. Our study sought to evaluate the readiness of emergency HCWs in 14 secondary and tertiary Ugandan hospitals and identify their specific training needs related to EVD. Results indicated that HCWs generally possess moderate to good EVD knowledge, with an average score of 77.4%. Despite a minority displaying poor attitudes, most demonstrated effective EVD infection prevention and control practices. Finally, HCWs in our study were strongly interested in additional EVD training.

The median knowledge score in our study closely aligns with that reported in Saudi Arabia [19] but surpasses the 52.0% reported in Iran [20]. Notably, 39.1% of HCWs in our study had good EVD knowledge, similar to findings in Nigeria [21] and Italy [22] but lower than in Pakistan [23], Sierra Leone [24], and Nigeria [25, 26]. Our participants had a good understanding of the etiology, transmission, diagnosis, management, and prevention of EVD, similar to studies in DRC [27], Nigeria [21, 28], and Romania [29]. However, HCWs in Guinea [30], Saudi Arabia [19], and South India [31] had poor knowledge of EVD management and transmission. A higher number of participants recognized the sexual transmission of EVD, markedly higher than 36% in Pretoria [32]. Conversely,

Table 3 Factors associated with Ebola virus disease knowledge among healthcare workers in Uganda

Variable Name	Crude Coefficient (95% CI)	*P*-value	Adjusted Coefficient (95% CI)	*P*-value
Hospital Region				
Central	Reference		Reference	
East	-5.18 (-7.18, -3.19)	< 0.001	-2.38 (-7.87, 3.11)	0.396
North	-4.29 (-6.19, -2.39)	< 0.001	-0.33 (-5.05, 4.39)	0.892
West	-1.67 (-3.53, 0.19)	0.079	-0.35 (-5.57, 4.87)	0.896
Public Hospital				
No	Reference		Reference	
Yes	-0.98 (-2.91, 0.96)	0.322	-0.41 (-5.13, 4.32)	0.866
Age	0.05 (-0.03, 0.13)	0.212	-0.08 (-0.22, 0.06)	0.266
Sex				
Female	Reference		Reference	
Male	2.79 (1.41, 4.17)	< 0.001	1.18 (-0.24, 2.61)	0.104
Profession Category				
Nurse/Midwife	Reference		Reference	
Clinical Officer	0.84 (-1.53, 3.20)	0.487	-0.49 (-2.90, 1.92)	0.689
Medical Doctor	6.44 (5.01, 7.87)	< 0.001	2.55 (0.35, 4.74)	0.023
Location				
Rural	Reference		Reference	
Urban	3.06 (0.50, 5.61)	0.019	1.64 (-0.59, 3.86)	0.15
Education				
Certificate	Reference		Reference	
Diploma	4.05 (2.16, 5.94)	< 0.001	3.37 (1.49, 5.25)	< 0.001
Undergraduate Degree	8.83 (6.89, 10.77)	< 0.001	6.45 (4.11, 8.79)	< 0.001
Postgraduate	11.08 (8.68, 13.48)	< 0.001	7.13 (4.01, 10.25)	< 0.001
Professional experience (years)	0.02 (-0.08, 0.12)	0.649	0.21 (0.03, 0.39)	0.024
Internal Medicine				
No	Reference		Reference	
Yes	2.00 (0.52, 3.47)	0.008	1.23 (-0.13, 2.59)	0.077
Surgery				
No	Reference		Reference	
Yes	-0.02 (-1.61, 1.57)	0.981	-1.01 (-2.40, 0.38)	0.156
Obstetrics				
No	Reference		Reference	
Yes	-3.75 (-5.46, -2.03)	< 0.001	-1.90 (-3.47, -0.32)	0.018
Pediatrics				
No	Reference		Reference	
Yes	-0.46 (-1.96, 1.04)	0.544	-0.26 (-1.61, 1.08)	0.704
Emergency or acute care unit				
No	Reference		Reference	
Yes	-0.71 (-3.62, 2.20)		-0.16 (-2.80, 2.49)	0.908
Contact with a patient with Ebola.				
No	Reference		Reference	
Yes	2.00 (0.11, 3.89)	0.038	-0.28 (-1.98, 1.42)	0.747
Previous EVD training				
No	Reference		Reference	
Yes	3.63 (2.19, 5.06)	< 0.001	2.27 (0.96, 3.59)	0.001
Information from social media				
No	Reference		Reference	
Yes	2.31 (0.80, 3.83)	0.003	2.52 (1.17, 3.88)	< 0.001
Information from television				
No	Reference		Reference	
Yes	0.70 (-0.81, 2.20)	0.364	0.88 (-0.45, 2.21)	0.193

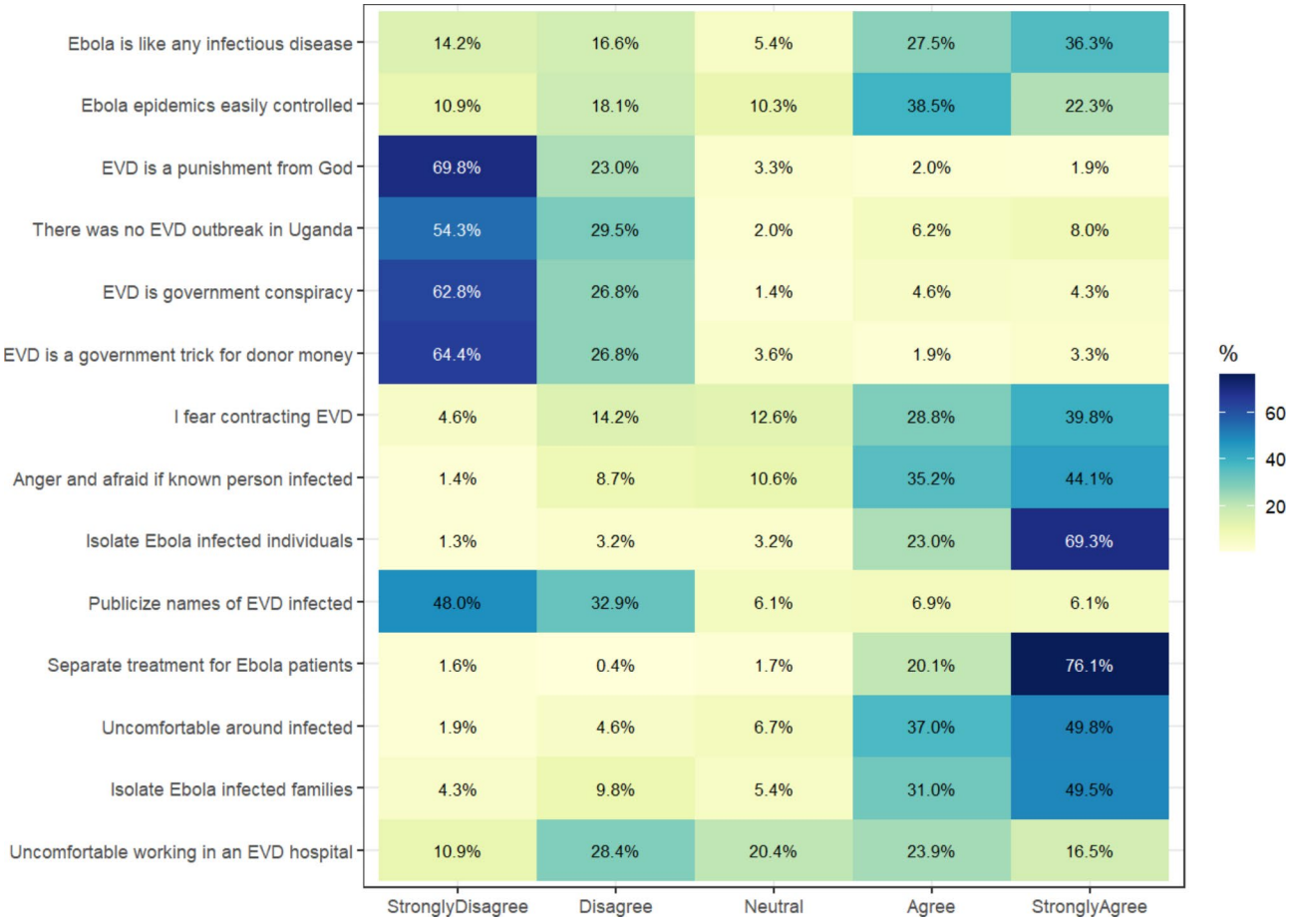

Fig. 4 Perceptions of healthcare workers in Uganda towards Ebola virus disease

misconceptions about EVD being airborne were less prevalent in our study than in Sudan [33]. Interestingly, while less than 1 in 10 of our study's participants believed EVD was bacterial, a notable 22.4% thought antibiotics could cure it, a belief similarly observed in Northwestern Ethiopia (28.4%) [15]. These variations in EVD knowledge among HCWs globally suggest a complex interplay of contextual factors. The fact that Uganda has experienced over five EVD epidemics in 20 years might have contributed to the HCW knowledge as a matter of vigilance.

The educational background of HCWs significantly influences their knowledge and understanding of EVD, as evidenced by our study. In our study, doctors had higher EVD knowledge scores than other professional cadres, consistent with studies in Sudan [33] and Nigeria [26, 28]. Only one study in Northeast Ethiopia found that doctors had lower EVD knowledge than allied health professionals, although this was not significant [15]. This could be attributed to differences in the medical curriculum, which emphasizes virology during pre-medical training while allied health professionals focus on prevailing illnesses. Given Uganda's low doctor-patient ratio of 1:25,725, medical doctors could be utilized to conduct training and support supervision for lower-level health facilities that clinical officers and nurses majorly serve.

HCWs in the obstetrics and gynecology department had significantly lower EVD knowledge scores, while those in the internal medicine department had higher scores in bivariate analysis. This could be attributed to several factors. Firstly, the focus of training and continuing education in different specialties varies; internal medicine often deals more directly with infectious diseases, including EVD, leading to more in-depth coverage in their training and practice. In contrast, obstetrics and gynecology may prioritize other areas of women's health, with less emphasis on general infectious diseases like EVD. Additionally, the nature of exposure and the perceived risk of encountering EVD can influence the level of knowledge. Internal medicine departments might be more likely to encounter a variety of infectious diseases, thereby necessitating a broader knowledge base. Conversely, in obstetrics and gynecology, the perceived risk of encountering EVD may be lower, potentially leading to less emphasis on EVD education and awareness. However, it's noteworthy that these differences were not significant after adjusting for confounders, suggesting that

Table 4 Ebola virus disease-related practices among healthcare workers in Uganda

Practices (*N* = 691)	Frequency (Percentage)
I wear personal protective equipment when taking care of all patients.	
Always	400 (57.9)
Sometimes	284 (41.1)
Never	7 (1.0)
I wear personal protective equipment only when caring for patients with symptoms of EVD.	
Always	457 (66.1)
Sometimes	102 (14.8)
Never	132 (19.1)
I do accept to take care of a patient once I notice signs and symptoms of EVD.	
Always	347 (50.2)
Sometimes	247 (35.7)
Never	97 (14.0)
I observe the five moments of handwashing while caring for patients with EVD symptoms.	
Always	567 (82.1)
Sometimes	108 (15.6)
Never	16 (2.3)
How often have you attended Ebola-related training or workshops after the outbreak?	
Daily	26 (3.8)
Monthly	41 (5.9)
Never	318 (46.0)
Rarely	284 (41.1)
Weekly	22 (3.2)
How often do you disinfect your workspace in light of the Ebola outbreak?	
Daily	500 (72.4)
Monthly	19 (2.7)
Never	31 (4.5)
Rarely	94 (13.6)
Weekly	47 (6.8)
How comfortable are you with treating patients suspected of having Ebola?	
Extremely comfortable	85 (12.3)
Somewhat comfortable	187 (27.1)
Neutral	142 (20.5)
Somewhat uncomfortable	153 (22.1)
Extremely uncomfortable	124 (17.9)

Table 5 Ebola virus disease training needs and preferences among healthcare workers in Uganda

Training Preferences (*N* = 691)	Frequency (%)
How interested are you in receiving more training on EVD?	
Extremely interested	308 (44.6)
Very interested	290 (42.0)
Somewhat interested	51 (7.4)
Slightly interested	39 (5.6)
Not at all interested	3 (0.4)
What would be your preferred mode of training?	
Physical	356 (51.5)
Online	71 (10.3)
Hybrid	264 (38.2)
Which aspects of Ebola virus disease would you like to be trained on? (Multiple responses allowed)	
Management - treatment and providing care	642 (92.9)
Infection prevention and control	602 (87.1)
Clinical presentation - signs and symptoms	581 (84.1)
Ebola vaccination	571 (82.6)
Diagnosis	556 (80.5)
Transmission - how Ebola spreads	547 (79.2)
Epidemiology - distribution of Ebola	517 (74.8)
Body handling and burial practices after death	502 (72.6)
Biology of Ebola - basic science	474 (68.6)

factors such as overall work experience, access to training, and individual motivation to stay informed could also play crucial roles in determining EVD knowledge levels across different specialties.

HCWs who had attended EVD training in the past year had knowledge scores that were more than twice as high as those who had not attended any EVD training. This finding is consistent with other studies in Romania [29], Saudi Arabia [19], and Guinea [24], where HCWs trained in EVD had higher knowledge. Differences in EVD knowledge among HCWs often result from how training resources are strategically prioritized and allocated. During the EVD outbreak in Uganda, HCWs were trained by the Ministry of Health, Uganda, with support from multiple local and international non-governmental organizations, including the World Health Organization (WHO), United States Agency for International Development (USAID), and the United Nations Children's Fund (UNICEF), among others [34]. Previous trainings had also been conducted for HCWs in the Ugandan districts bordering Eastern Congo, where the most significant threats were, with promising findings on knowledge and skills gained [13].

While knowledge of etiology and diagnosis was high in our study, there were pertinent gaps in infection prevention and control (IPC), with more than 20% believing that handwashing and PPEs do not protect one from getting infected with EVD. The gaps in IPC for EVD may stem from the lack of exposure to practical drills, such as outbreak simulations, encompassing screening and outbreak management. Unsurprisingly, 87.1% of HCWs in our study were interested in receiving training in IPC. We recommend continuous, pragmatic training for HCWs to build their capacity to respond better to similar outbreaks in the future. Over one-third of the respondents favored a blended learning approach. Integrating physical modules with interactive digital content could enhance engagement and efficacy in EVD training, particularly in

areas like clinical management and vaccination that the participants preferred.

Access to current, reliable medical information and resources also plays a crucial role; limited access can result in reliance on outdated or incorrect information. In our study, social media was the most frequent source of information on EVD among 70.5% of HCWs in Uganda and significantly had twice as much EVD knowledge. This can be attributed to the widespread accessibility of smartphones, which provide cost-effective access to news updates on outbreaks and academic content, including videos, primarily through digital platforms rather than traditional television or radio. However, in Ethiopia [15], television was the primary source of EVD information, whereas in Romania [29], the medical institutes were the main channel for such information among HCWs. The role of social media in disseminating information during outbreaks is controversial and has had mixed effects [35]. While it has become an essential and indispensable communication medium, especially among younger HCWs and the general population, it is also a significant source of misinformation, potentially causing an infodemic, especially when not regulated [35].

During the early days of the deadly EVD outbreak in Western Africa in 2014, 19 −24% of social media posts were on health information, while 2% consisted of misinformation [36]. In the United States of America (USA), up to 10% of Ebola-related tweets contained false information [37]. Myths such as salty water and nano silver as potential treatments for EVD, reported among HCWs [38, 39], were spreading through social media [36]. However, social media can also be important in dispelling such myths and misinformation [35, 40]. While television and radio speeches were widely used in Uganda, they were not significantly associated with higher knowledge among HCWs in our study. We recommend that governmental and non-government agencies actively consider adopting social media communications to disseminate information regarding outbreaks to HCWs. Innovative ways such as Twitter hashtags, social media groups, Telegram channels, TikTok, or Instagram reels could be explored with input from communication specialists and further studied for effectiveness, even in the general population, with caution towards privacy and confidentiality [41].

Knowledge differences could be attributed to exposure to EVD outbreaks among the HCWs. Countries with firsthand experience of EVD outbreaks, such as the DRC [6], Uganda [42], and Sierra Leone [43], will likely possess more practical understanding, enhancing their HCWs' knowledge. This direct exposure to EVD cases often necessitates a more immediate and in-depth learning experience, likely improving their knowledge and preparedness. The exposure may have provided health workers with unique, hands-on experiences that are not replicated through theoretical learning alone. Such experiences can deeply instill knowledge about EVD symptoms, transmission, and management. In our study, 16.1% had contact with persons suspected or diagnosed with EVD, and it was associated with higher EVD knowledge scores at bivariate analysis but lost significance after adjusting for potential confounders. This suggests that while direct exposure to EVD cases is an influential factor, it operates within a complex network of other variables contributing to knowledge levels. Factors such as educational background, access to resources, training programs, and personal motivation to stay informed about infectious diseases might play equally significant roles in shaping HCWs' knowledge base.

In our study, HCWs with more extended professional experience also had significantly higher EVD knowledge scores, which aligns with studies in Pakistan [44] and South India [31]. However, this was not significant in studies from Nigeria [21, 26], DRC [27], Iran [20], and Romania [29]. While this finding is inconsistent and inconclusive, there are several counterarguments to consider regarding the role of professional experience in influencing knowledge of EVD. Longer professional experience may be associated with cumulative learning, where HCWs acquire more comprehensive knowledge over time through continued education and practical experience. This can be particularly true in fast-evolving fields like infectious diseases, where staying updated with the latest information and guidelines is crucial. However, information learned at the beginning of one's career may become outdated in rapidly evolving fields. Newer HCWs might be more recently trained with current information and guidelines, giving them an edge in their EVD knowledge. Moreover, the motivation to continuously learn and stay updated can vary widely among individuals, regardless of their professional years.

Sociocultural beliefs, myths, and misinformation also significantly impact perceptions and understanding of EVD among HCWs, leading to varied beliefs about its transmission and treatment [45]. While these were less prevalent in our study, their impact cannot be underestimated and deserves further exploration, especially using qualitative methods. For instance, 14.2% of HCWs believed there was no EVD outbreak in Uganda, and nearly one in ten thought that EVD was a government conspiracy, including to obtain donor money. This can undermine efforts to control epidemics through mistrust of health messages and interventions disseminated by government agencies. About 86.8% of HCWs felt uncomfortable around EVD-infected individuals, and 40.4% were uncomfortable working in an EVD hospital, reflecting significant stigma and fear associated with the disease. This stigma can be detrimental, not only affecting

the mental health of HCWs but also potentially impacting patient care and willingness to work in high-risk areas. The damaging role of such beliefs, largely driven by misinformation, mistrust, and ineffective risk communication, has been documented in recent outbreaks [46–49]. To address these issues, it is critical that interventions to combat EVD not only focus on disseminating factual information but also engage with the underlying sociocultural contexts that shape these beliefs.

Strengths and Limitations

To our knowledge, our study is among the first and the largest to comprehensively assess clinical HCWs' preparedness in Uganda to manage EVD and evaluate training needs. This study recruited participants from 14 major secondary and tertiary health facilities in Uganda. While we did not achieve the target sample size, the response rate of 94% is substantially higher than typical response rates observed in prevalence surveys in health sciences education research (pooled response rate=67%) [50]. However, there are some limitations. First, there was only one private facility and two private-not-for-profit facilities, limiting its generalization to only public health facilities in Uganda. Secondly, we used consecutive non-random sampling methods that are prone to selection bias and might not adequately represent the entire population of HCWs in Uganda. Thirdly, our hierarchical model showed that healthcare facilities strongly moderated EVD knowledge among the participants (β: 6.80, 95% CI: 2.81 to 16.52, $p<0.001$). However, we could not perform additional facility-level analysis due to multiple hospitals with smaller sample sizes. Lastly, while the study adjusted for several confounders, other unmeasured variables could influence the results, such as access to ongoing professional development, personal motivation, or specific hospital policies and practices regarding infectious disease management.

Conclusion

Our findings reveal a generally moderate to good level of knowledge about Ebola virus disease among HCWs in Uganda. This was associated with longer professional experience, a higher level of education, being a medical doctor, being in the hospital department, having previous EVD training, and receiving information from social media. While attitudes were generally positive, significant practice gaps regarding infection prevention and control were identified. We recommend that health policymakers and hospital administrators prioritize targeted strategies for adaptive, high-impact training to bridge practice gaps in infection prevention and control to enhance the overall preparedness and response to EVD and similar infectious disease outbreaks. Future research should explore the impact of innovative educational interventions and the role of social media in information dissemination, particularly in specialties and regions where knowledge gaps exist.

Abbreviations

EVD	Ebola Virus Disease
HCWs	Healthcare Workers
RRH	Regional Referral Hospital
NRH	National Referral Hospital
PNFP	Private-not-for-profit
IQR	Interquartile Range
CI	Confidence Interval
SARS-COV-1	Severe Acute Respiratory Syndrome Coronavirus 1
MERS-CoV	Middle East Respiratory Syndrome Coronavirus
CDC	Centers for Disease Control and Prevention
PCR	Polymerase Chain Reaction
PPEs	Personal Protective Equipment

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-024-11741-2.

Supplementary Material 1.

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Authors' contributions

RO: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Supervision, Project administration.BA: Conceptualization, Methodology, Writing - Original Draft, Writing - Review & Editing, Supervision, Funding acquisition.IA: Conceptualization, Methodology, Writing - Review & Editing, Supervision, Project administration, Funding acquisition.TB: Methodology, Validation, Investigation, Resources, Data Curation, Writing - Review & Editing, Supervision, Project administration. PK: Methodology, Validation, Investigation, Writing - Original Draft, Writing - Review & Editing, Supervision.MA: Methodology, Validation, Writing - Review & Editing, Supervision.JK: Methodology, Validation, Writing - Review & Editing, Supervision.AN: Methodology, Validation, Writing - Review & Editing, Supervision.RB: Conceptualization, Methodology, Validation, Investigation, Resources, Writing - Review & Editing, Supervision, Project administration.VBK: Conceptualization, Methodology, Validation, Investigation, Resources, Writing - Review & Editing, Supervision, Project administration.All authors read and approved the final manuscript.

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Data availability

All data associated with this study has been adequately described in the manuscript. The original dataset and the STATA analysis do-file shall be freely available upon request from the corresponding author (Dr Ronald Olum, olum.ronald@gmail.com).

Declarations

Ethics approval and consent to participate

This study was approved by the St Francis Hospital Nsambya Research Ethics Committee (Reference Number: SFHN-2022-72), the Department of Clinical Services, the Ministry of Health Uganda, and the respective administrations of all hospitals. The study was conducted according to the Declaration of Helsinki. All participants signed a written informed consent form before enrollment.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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