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By Yu-Ling Qin, Henry S Bangura, Bo Li, Yue-Su Zhou, Yue Yuan, Yi Sun, Jing Li,
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Keywords: healthcare workers: occupational exposure and protection: knowledge: practices: sierra leone.

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Self-Reported Knowledge and Practices of Healthcare Workers on Occupational, Exposure and Protection from Infectious Disease at the Military Hospital in Sierra Leone

Yu-Ling Qin ^α, Henry S Bangura ^σ, Bo Li ^ρ, Yue-Su Zhou ^ω, Yue Yuan [¥], Yi Sun [§], Jing Li ^χ,
Zhong-Peng Zhao ^ν, Jun Jiao ^θ, Bing-Song ^ζ, Stephen Sevalie [£], Ya-Jun Song [€],
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Results: A total of 190 (86.3%) of 220 questionnaires were completed and returned. More than half of HCWs (52.6%) reported having been injured by medical sharps during an operation or associated work. Knowledge, practice and the degree of training level was significant by occupation or department ($P=0.029$ and $P=0.039$, respectively). Multivariate logistic regression analysis showed that the Under Fives Clinic ($P = 0.013$, $OR = 9.874$) was a risk factor for sharps injury, while receiving specialized training ($P = 0.015$, $OR = 0.422$) was protective.

Conclusions: The HCWs at the hospital had insufficient knowledge and practices on occupational exposures and protective measures. The need for more intensive training and the establishment of the evaluation systems for occupational exposures are required for the study hospital.

Keywords: healthcare workers; occupational exposure and protection; knowledge; practices; sierra leone.

Author ^{α ρ ω ¥ ζ ϕ}: Intensive Care Unit, Beijing 302 Hospital, Beijing, China. e-mail: aba302@163.com

Author ^{σ £ ²}: Public Health Department, 34 Military Hospital, Wilberforce, Freetown, Sierra Leone. e-mail: fadaysahr1@gmail.com

Author ^{§ χ ν θ € ƒ}: State Key Laboratory of Pathogen and Biosecurity, Beijing Institute of Microbiology and Epidemiology, Beijing, China. e-mail: jiangjf2008@gmail.com

Author ^²: College of Medicine and Allied Health Sciences, Freetown, Sierra Leone. e-mail: fadaysahr1@gmail.com

I. INTRODUCTION

The protection of medical personnel from exposures to infectious agents is crucial to ensure occupational health and safety, while reducing the risk of hospital-acquired infections. Proper training and safe practices help reduce the spread of disease, especially in outbreak scenarios. West Africa serves as a natural focus for multiple highly infectious agents, many of which are considered blood-borne pathogens and pose a serious risk for occupational exposure in HCWs. It is particularly important in developing countries, like Sierra Leone, which lacks resources and infrastructure, and has limited access to infection prevention and control (IPC) training. Although attempts have been made to characterize gaps in training in these settings, research focusing on knowledge and practices of HCWs towards adhering to basic precautions has been largely ignored.

The Ebola virus disease (EVD) outbreak from 2014-2016, which infected 28,616 and resulted in over 10,000 deaths in West Africa serves as a grim reminder of the importance of protecting the health and safety of HCWs [1]. The cumulative incidence rate of Ebola was almost 100 times higher in HCWs than in the general population [2]. A total of 199 laboratory-confirmed Ebola cases reported from Sierra Leone were in HCWs [3], of which, 101 out of 127 (79.6%) died [4]. With the help of the international community, the epidemic was effectively contained in 2016 in part due to increased training in IPC [5].

Ebola infection prevention and control in primary healthcare facilities located in Sierra Leone, gradually improved during the outbreak as preventative practices were followed [6]. However, the dilemma facing Sierra Leone and other Ebola-affected countries is how to maintain proper IPC. Unfortunately, data on HCW occupational exposures and acquired infections in West Africa including Sierra Leone remains scarce. Survey data from 19 hospitals in Ethiopia, showed that the level of awareness of general preventive measures

was lower in the HCWs, with reported sharps injuries at 29.1% a year [7]. Now that Ebola has been controlled for over two years, HCWs knowledge, self-efficacy and experiences with IPC practice in this country required further investigation.

In order to better understand gaps in knowledge and practice regarding occupational safety and exposure, we surveyed HCWs, post-Ebola epidemic, at the No. 34 Military Hospital, the only general hospital in the army, where these same staff admitted and treated a large volume of EVD patients months earlier. Our objectives were to assess HCWs knowledge, and experiences with IPC practice, which in turn can be used to identify areas that require additional training. It is hoped that the findings and recommendations in this article will influence hospital authorities and elicit lasting change in how these outcomes are measured and what is needed to reduce the risk of infection in HCWs in Sierra Leone.

II. METHODS

a) Study Design and Population

A descriptive cross-sectional study was conducted at the 34 Military Hospital, which has 200 beds for the admission of various medical conditions and is located at the Wilberforce Barracks, Freetown, Sierra Leone. This hospital provides both the secondary and tertiary health care for soldiers, their families and civilian workers in the Ministry of Defence. A few in hospital educational opportunities (such as lecture for occupational health) were held periodically in the hospital as a reason for extremely humble and broken lecture room etc. All health care workers at the Hospital must have completed the secondary school level of education before enrolling in any category of health related courses. Some state Enrolled Community Health Nurses (SECHNs) have completed the three years course in community health nursing from the recognized nursing schools in Sierra Leone. Some are Health Care Assistants (HCA) who serve as assistants to the SECHNs. All 220 HCWs involved in clinical diagnosis and treatment of patients were invited to participate in this study (Table 1). All responses to the questionnaire were confidential and de-identified. Recruitment took place from December 9 to 23, 2016. Ethical approval was obtained from the study hospital.

b) Design and Administration of the Questionnaire

Data were collected using a self-filled in, structured questionnaire, which was developed after reviewing related references [8-11]. The survey had questions on socio-demographic characteristics, and 45 questions across five themes, including actual practice of preventive measures (Q5-Q8, Q10-Q11, Q17-Q19 and Q29-31, Appendix), knowledge and perception of universal precautions and infectious disease (Q32-Q45), training level (Q20-Q26, Q28), and some probable

reasons for poor practice (Q9, Q12-Q15), as well as self-evaluation and external evaluation (Q1-Q4, Q16, Q27) (Appendix). Ten questions had binary (yes or no) responses, seventeen multi-items questions had one correct answer, and eighteen multiple choice questions focusing on practice and knowledge of infectious diseases which had more than one correct answers. Each study participant was required to fill out information mentioned above. For some volunteered nurses or low education level nurses who cannot really understand the meaning of some question and choices, the investigators from the hospital explained them. Three co-investigators from Chinese Military Medical Experts Group in Sierra Leone supervised data collection.

The questions which had only one correct answer were graded in the categories of wrong and right. Eighteen multiple choice questions which had more than one correct answers were graded in the categories of completely wrong (very poor), poor, intermediate or adequate according to the combination of the response answer. These levels were given scores of zero, one, two and three for completely wrong (very poor), poor, intermediate or adequate (right), respectively. Total scores for knowledge, practice, and training were calculated and split into three cut-points based on quartiles of ranked data values. Education levels were stratified as follows: Bachelor's degree and above as 'High', diploma certificate as 'Middle', and technical, SECHNs, HCA, secondary school, and midwife all categorized as 'Tertiary' background.

c) Data Analysis

Univariate analysis was used to access the association between socio-demographic characteristics and knowledge, practice, and training level, by using a chi-square test or a Fisher's exact test. All variables with a P-value of <0.05 from univariate analysis were entered into a multivariate forward stepwise logistic regression analysis. All analyses were conducted using SPSS (version 18.0, SPSS Inc. Chicago, IL).

III. RESULTS

a) Participant Characteristics

There were 190 respondents with valid questionnaires, giving a response rate of 86.3% (190/220). Demographic data can be found in Table 1. More than half of HCWs were categorized as 'tertiary' for educational level and according to the self-evaluation, 77.9% of participants rate their level of occupational protection knowledge and protection awareness as high.

b) Survey Response Results

According to responses, 17.4% of the staff knew how to deal with needles and syringes correctly, and 12.1% of staff knew how to respond to sharp

injuries correctly. Less than 10 % of staff knew exactly what scenarios required follow-up hand washing or disinfection, and 15.8% knew in what cases they should wear gloves. When responding to questions about the routes of transmission for HIV and Hepatitis B Virus, 26.3% and 27.9% of participants answered correctly, respectively. Less than half of staff (42.6%) answered correctly about proper protection from blood-borne exposures from HIV patients. The results also showed that 27.9% of the HCWs never received professional protection training. Furthermore, 98.4% think it is necessary to set up occupational protection courses regularly and more than half (64.7 %) reported that the hospital is insufficiently supplied with protective equipment (Table S1 Appendix).

A majority of self-reported sharp injuries occurred when recapping (56.8%), breaking the ampoule (52.1%), and removing the needle from the syringe or infusion set (31.1%). A total of 101 (53.2%) HCWs responded that the reason why people operate without gloves is that gloves are not available or there is a shortage. Less than half of HCWs (48.9%) have never been injured by medical sharps during operation before. Of those who did report a previous sharps injury, 23-76% was due to carelessness, in a hurry, inadequate lighting in the work place or not following the standardized sharps protocol. Among staff who were suffered from the sharp injury, the breakdown by department is as follows, 84.6% in the Under Fives Clinic, 80% in the Laboratory, 70% in Physiotherapy, 56.7% in Internal Medicine and 40.6% in the Surgical Department. Encouragingly, 86.3% participants responded that they would report to superior immediately if they get a sharp injury.

c) Knowledge & Practice & Training and Associated Factors

Sixty (31.6%) and thirty-four (17.9%) of HCWs had intermediate and adequate knowledge on occupational exposure and protection from infectious disease respectively, while eighty-two (43.2%) and twelve (6.3%) had an intermediate and good practice on them respectively (Table 2). Findings also revealed that work experience years, type of occupation, type of department were associated significantly with knowledge on occupational exposure and protection. In addition, occupation, type of department and gender were also associated significantly with practice level. In addition, the level of received training among occupation or department was significantly different respectively (Table 2). A majority of volunteer nurses scored below poor in training (90.9%). The training level of staff from the surgical department and the Under Fives Clinic were also below other staff, with 61.8% and 66.7% at the very poor level, respectively.

Analysis of practices showed significant differences between younger and older staff compared to

middle age staff members for the following: when hand washing and disinfection of hands should occur (Q31), when should you report to your superior if you get a sharp injury (Q43) and what should a nurse wear when receiving a new patient with Fever of Unknown Origin (Q35). The participants with different education levels had significantly different responses based on the following questions: disinfecting nursing equipment (Q29), dealing with contaminated medical equipment (Q30), frequency of cleaning and disinfecting the surface of trolleys or desks (Q31) as well as when should you wash your hands (Q32) (Table 3, $P < 0.05$). The military nurses and technicians had significantly more correct responses than those from other groups. It also showed that there are a higher proportion of participants from the laboratory who had correct practices (Q11, Q43). However, the participants from the Surgical Department and the Under Fives Clinic had more poor or incorrect responses (Q11, Q17, Q29, Q33, Q36-Q45). Among the 97 (51.1%) HCWs who reported having been injured by medical sharps during medical-associated work, multivariate logistic regression analysis showed that the Under Fives Clinic ($P = 0.013$, $OR = 9.874$) was a risk factor for sharps injury, while receiving specialized training ($p = 0.015$, $OR = 0.422$) was protective.

IV. DISCUSSION

The present study assessed knowledge and practices of healthcare workers (HCWs) on risks of occupational exposure and proper protection from infectious diseases at the military hospital located in Sierra Leone after the Ebola outbreak. To our knowledge, this is the first study to quantitatively / qualitatively describe the knowledge and practices of HCWs towards infectious disease prevention and control in Sierra Leone post-Ebola outbreak.

We found that 49.5% of the participants had an intermediate or adequate knowledge on occupational exposures and protection from infectious diseases, and good practice, while 42.6% staff had a positive response for protection from blood-borne exposure of HIV patients. This low insufficient knowledge and perception are at a similar level to that which was reported in Ethiopia [7] and Iran [12]. Only 26.3% and 27.9% of staff understood the route of transmission for HIV and Hepatitis B Virus, respectively. It is also similar to same settings in South Africa [13] and lower than that (two third) at some regional hospitals in Tanzania [14], as well as the developed countries [15, 16]. In addition, the present study also showed that the proportion that received training among participants were very low according to self-assessment and objective assessment, with variations observed by occupation and department (Table 2). According to a retrospective descriptive study of Ebola virus disease transmission among health care workers in Sierra Leone from May to December 2014, 34

% (85) reported that they had not been trained in infection prevention and control [2]. Our results showed that 27.9% of the HCWs in this hospital never received professional protection training. In addition, the training level of staff from the Surgical Department and Under Fives Clinic was deemed insufficient and most of the volunteer nurses received inadequate training. Receiving special training, such as post exposure prophylaxis and infection prevention and control [14], as well as stressing the importance and proper practice of hand hygiene along with improving hand sanitizer options in disinfection protocols can improve occupational protection from infectious disease [17].

Needle-stick and sharps injuries carry the risk of infection and are occupational hazards for all health care professionals involved in clinical care. Our present study showed that more than half of HCWs (51.1 %) had been injured by medical sharps during work, which indicates that the overall occupational exposure among the subjects was alarmingly higher than the 29.1% needle stick injury prevalence reported in Ethiopia[7] and 27.5% in India [18]. Additionally, 17.4% of the staff knew how to dispose of used needles and syringes, suggesting that more than 80% of the staff were inadequately trained in handling needles and syringes correctly. According to survey responses, 12.1% of staff can deal with sharp injury correctly, indicating a potential risk of nosocomial infections. However, though occupational sharps injuries are common among HCWs in this study area, 86.3% participants responded that they will report to superior immediately if a sharp injury occurs, which scores higher than the 42.3% who would report a sharp injury to a superior in Ethiopia [19] and 37% of respondents reporting needle sticks in Nigeria [20].

Our results found that more sharp injuries happened when recapping (56.8%), breaking the ampoule (52.1%), removing the needle from the syringe or infusion set (31.1%). This is comparable to a multi-center research study in Lagos, Nigeria, which found that the most common activity leading to needle-stick and sharps injuries was recapping of needles (45%) [20]. In addition, among the HCWs injured by medical sharps, 41-76% was due to carelessness, hurry, or not following standard protocols. However, it should be noted that 23.7% was due to inadequate lighting in the work place. Thus, administrative and hospital policies, should also be strengthened to reduce the risk of occupational exposures in HCWs. The present study showed that 84.6% staffs in the Under Fives Clinic, which provides services for children under- five years and pregnant women, were suffered from the sharp injury. The reason and the risk factors maybe are that there is more outpatient volume as more free treatment, more frequency for re-capping of needles after injection procedures, or A more humble and crowded environment in this hospital.

Proper hand hygiene is one of the most simple and effective measures to prevent occupational exposure and reduce hospital infections in HCWs. This present study showed middle compliance (82.6%) to standard six-step hand wash procedure, with more problems on hand washing among doctors and lab technicians. While 66.8% had correct knowledge and practice of drying hands after washing, less than 10 % of staff knew exactly what occasions they should wash or disinfect hands, especially for younger and older staff members. We did not investigate the reasons for non-compliance to hand washing and drying. Good practice of basic hygiene need not only proper training, but also available amenities like portable water, hand washing stations and other enhanced infrastructure [21, 22]. As there has the high prevalence of cholera, typhoid fever, tuberculosis, pneumonia, influenza it is important and necessary that hand hygiene is stressed heavily in healthcare settings, as it is the most simple and effective measures to prevent and reduce hospital acquired infections.

It was not surprising that the degree of training was associated with level knowledge ($\chi^2=52.04$, $P<0.01$). However, this was not the case with practice level ($\chi^2=11.86$, $P=0.221$), which suggest that good practice should be stressed more in field operations, clinical settings, and under direct supervision, while ensuring that facilities are well equipped to maintain HCW safety.

a) *Limitations*

This study is based solely on self-reported results, which can allow for potential recall bias. Furthermore, less than half of clinical doctors (8 out of 19) responded to the questionnaires, limiting our ability to infer findings among this population and potentially exposing this study to non-response bias. In addition, because of the lack of data for HCW's knowledge before the outbreak of EVD in 2014-2015, the impact of the outbreak of EVD on the knowledge level of HCWs was not assessed. Finally, this study only occurred in one Hospital, which may not be representative of other healthcare settings in Sierra Leone.

V. CONCLUSIONS

Relatively scarce knowledge and practicing of hand hygiene, high frequency of sharp injuries, lack of understanding of important infectious diseases, and the insufficient facilities and supplies will continue to place HCWs at risk of hospital-acquired infections in Sierra Leone. We recommend that more intensive and targeted training be carried out as soon as possible, focusing on the above mentioned. Additionally, this hospital should strengthen supervision, particularly of volunteer nurses, while providing adequate supplies critical to reducing disease exposure risks, such as gloves, sharp boxes, and gowns. There is an urgent to establish the infection

control evaluation systems for occupational exposures, including necessary designated infection control / occupational health professionals, regular infection control committee meetings to resolve issues, and provision of necessary supplies for the study hospital in Sierra Leone.

VI. AUTHOR STATEMENTS

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Ethics and Consent to Participate: Before commencing the study advice was sought from the ethics committee of No.34 Military Hospital, Wilberforce, Freetown. Because the survey was anonymous, only involved contact and interview with health care worker, and was essentially an audit of current occupational health arrangements, ethical approval was unnecessary. The written informed consent was obtained from participants as they chose to respond to the survey questionnaire.

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Competing Interests: None declared.

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Table 1: Demographic Characteristics of Healthcare Workers who had Validity Response to Questions and all Participants

Groups	Parameters	Validity Response No. (%) (n=190)	Required Participants No. (%) (n=220)
Sex	Male	114 (60.0)	129 (58.6)
	Female	76 (40.0)	91 (41.4)
Age	21 - 25	15 (7.9)	18 (8.1)
	26 - 45	129 (67.9)	151 (68.6)
	> 45	46 (24.2)	51 (23.3)
Work Years	1 - 5	64 (33.7)	75 (34.0)
	6 - 20	104 (54.7)	121 (55.0)
	> 20	22 (11.6)	24 (11)
Education	High	5 (2.6)	6 (2.7)
	Middle	81 (42.6)	94 (42.7)
	Tertiary	104 (54.7)	120 (54.6)
Occupation	Military Nurse	108 (56.8)	120 (54.5)
	Civil Nurse	48 (25.3)	54 (24.5)
	Volunteer Nurse	12 (6.3)	14 (6.4)
	Technical	13 (6.9)	13 (5.9)
	Medical Doctor	8 (4.1)	19 (8.6)
Department	Surgical Depart Department	34 (17.9)	41 (18.6)
	Internal Medicine	31 (16.3)	37(16.8)
	Emergency Depart	25 (13.2)	30 (13.6)
	Pediatrics Depart	21 (11.1)	24 (10.9)
	Laboratory	15 (7.9)	18 (8.1)
	Under Fives Clinic	13 (6.8)	15 (6.8)
	Physiotherapy	11 (5.8)	13 (5.9)
	Medical Inspection Room	7 (3.7)	9 (4.1)
	Gynecology	6 (3.2)	8 (3.6)
	Mortuary Dept.	5 (2.6)	6 (2.7)
	Others*	22 (11.7)	19 (8.6)

* : From Ebola Survivors Clinic, Dental Department, X-Ray Department, Chest Clinic, Ophthalmology Department, Operation Theatre, Infectious Disease Control Unit, where the number of participator are under four respectively.

Table 2: Knowledge, Practice and Training of Respondents on Occupational Exposure and Protection
Response % (n=190)

	Knowledge Level Grade Score					Practice Level Grade Level					Training Level Grade Level					
	Very Poor	Poor	Intermediate	Good	P Value	Very Poor	Poor	Intermediate	Good	P Value	Very Poor	Poor	Intermediate	Adequate	Total	P Value
	≤18	19-22	23-27	28+		≤29	30-31	32-34	≥ 35		≤ 11	12-13	14-17	≥18		
	Age (Years)				0.244					0.986					0.247	
>45	23.9	21.7	37.0	17.4		28.3	19.6	47.8	4.3		29.5	11.4	36.4	22.7	100	
21-25	53.3	26.7	13.3	6.7		26.7	20.0	46.7	6.7		33.3	26.7	33.3	6.7	100	
26-45	24.0	24.8	31.8	19.4		31.8	20.2	41.1	7.0		42.1	11.9	23.0	23.0	100	
	Sex				0.287					0.012					0.012	
Male	21.9	25.4	35.1	17.5		23.7	17.5	51.8	7.0		33.6	9.1	33.6	23.6	100	
Female	33.3	22.7	25.3	18.7		41.3	24.0	29.3	5.3		45.9	18.9	16.2	18.9	100	
	Work Experience (Years)				0.032					0.295					0.108	
>20	18.2	31.8	36.4	13.6		13.6	31.8	45.5	9.1		28.6	9.5	42.9	19.0	100	
1-5	42.2	15.6	26.6	15.6		29.7	25.0	39.1	6.3		47.6	17.5	22.2	12.7	100	
6-20	18.3	27.9	33.7	20.2		34.6	14.4	45.2	5.8		34.7	10.9	26.7	27.7	100	
	Education Background				0.154					0.616					0.225	
High	24.0	26.0	34.6	15.4		29.8	18.3	47.1	4.8		31.4	16.7	30.4	21.6	100	
Middle	28.4	23.5	29.6	18.5		29.6	22.2	39.5	8.6		45.6	8.9	24.1	21.5	100	
Tertiary	40.0	0.0	0.0	60.0		60.0	20.0	20.0	0.0		75.0	0.0	0.0	25.0	100	
	Occupation				0.010					0.043					0.029	
Civil Nurse	20.8	25.0	35.4	18.8		35.4	20.8	37.5	6.3		47.9	14.6	20.8	16.7	100	
Medical Doctor	37.5	25.0	00.0	37.5		50.0	25.0	12.5	12.5		71.4	0.0	0.0	28.6	100	
Military Nurse	22.2	25.0	36.1	16.7		26.9	16.7	51.9	4.6		32.7	11.5	31.7	24.0	100	
Technical	26.7	20.0	26.7	26.7		33.3	13.3	33.3	20.0		20.0	6.7	46.7	26.7	100	
Volunteer Nurse	81.8	18.2	0.0	0.0		27.3	54.5	18.2	0.0		54.5	36.4	0.0	9.1	100	
	Department				0.012					0.006					0.039	
Emergency Depart	12.0	16.0	52.0	20.0		24.0	16.0	60.0	0.0		40.0	8.0	20.0	32.0	100	
Gynecology	50.0	0.0	50.0	0.0		50.0	33.3	16.7	0.0		33.3	16.7	33.3	16.7	100	
Medical Inspection	0.0	14.3	57.1	28.6		0.0	14.3	57.1	28.6		16.7	0.0	33.3	50.0	100	
Internal Medicine	19.4	51.6	25.8	3.2		29.0	12.9	45.2	12.9		40.0	13.3	43.3	3.3	100	
Laboratory	20.0	20.0	33.3	26.7		33.3	13.3	33.3	20.0		20.0	13.3	33.3	33.3	100	
Mortuary	20.0	20.0	60.0	00.0		0.0	60.0	40.0	0.0		0.0	20.0	20.0	60.0	100	
Pediatrics Depart	23.8	23.8	33.3	19.0		42.9	19.0	38.1	0.0		28.6	14.3	19.0	38.1	100	
Physiotherapy	27.3	18.2	36.4	18.2		45.5	0.0	45.5	9.1		36.4	18.2	18.2	27.3	100	
Surgical Department	38.2	14.7	20.6	26.5		23.5	29.4	44.1	2.9		61.8	5.9	23.5	8.8	100	
Under Fives Clinic	61.5	7.7	7.7	23.1		69.2	30.8	0.0	0.0		66.7	16.7	8.3	8.3	100	
Others	22.7	36.4	22.7	18.2		18.2	18.2	59.1	4.5		20.0	25.0	35.0	20.0	100	
Total	26.3	24.2	31.6	17.9		30.5	20.0	43.2	6.3		38.4	13.0	27.0	21.6	100	

Notes: The open-ended questions for knowledge, practice, and training regarding infectious diseases were graded in the categories of very poor (completely wrong), poor, intermediate or adequate and then were given scores of zero, one, two and three respectively. Total scores for knowledge, practice, and training for each HCWs participants were calculated respectively, and then split into three cut-points level based on quartiles of ranked data values.

Table 3: Relationship between Risk Factors and Selected Main Question on Occupational Exposure and Protection With Significant Differences

Number of Response

	Age (Years)			Work Experience			Education Level			Occupation*						Department**										P					
	21-25	26-45	>45	1-5	6-20	>20	Tertiary	Middle	High	P	Med Doc	Civ- Nur	Mil- Nur	Vol- Nur	Tec	Vol- Nur	P	Eme	Gyn	MIR	Int	Lab	Mor	Oth	Pae		Phys	Surg	UndFve	Total	
How do you deal with needles and syringes after using? (Q11)	0	18	16	0.138	6	16	2	0.248	17	6	1	0.464	13	5	1	3	2	0.012	3	1	1	2	2	3	5	2	2	2	24	0.000	
	9	88	34		41	74	16		69	59	3		80	37	5	5	4		21	4	3	20	4	2	17	16	4	30	10	131	
	6	23	6		17	14	4		18	16	1		15	6	2	7	5		1	1	3	10	9	1	2	0	5	2	1	35	
Do you protect yourself from patients' blood and body fluids as potential sources of infection? (Q17)	0	3	0	0.352	3	0	0	0.002	1	2	0	0.465	2	1	0	0	0	0.876	0	0	0	0	0	0	0	0	0	3	0	3	0.087
	14	121	44		56	103	20		97	77	5		101	46	8	14	10		24	5	7	27	14	5	22	21	11	30	13	179	
	0	1	2		1	0	2		1	2	0		2	0	0	1	0		1	0	0	0	1	0	0	0	0	1	0	3	
How do you deal with contaminated items from the patients? (Q18)	1	4	0		4	1	0		5	0	0		3	1	0	0	1		0	1	0	4	0	0	0	0	0	0	0	5	
	14	119	40	0.766	57	97	19	0.258	95	74	4	0.454	98	44	7	14	10	0.996	24	4	7	30	14	0	22	20	11	29	12	173	0.000
	1	10	6		7	7	3		9	7	1		10	4	1	1	1		1	2	0	1	1	5	0	1	0	5	1	17	
How often do you disinfect the nursing equipment (eg. blood pressure monitors, temperature gun) (Q29)	3	21	7	0.855	12	16	3	0.806	19	12	0	0.001	18	5	2	3	3	0.028	5	3	0	3	3	0	1	3	5	4	4	31	0.091
	10	87	34		45	70	16		74	55	2		75	34	3	11	8		17	3	7	21	10	5	18	16	4	25	5	131	
	1	10	1		4	8	0		5	7	0		4	7	0	1	0		1	0	0	4	1	0	2	2	0	2	0	12	
If medical items are contaminated by the patient's blood, body fluids, how to do? (Q30)	1	11	4		3	10	3		6	7	3		11	2	3	0	0		2	0	0	3	1	0	1	0	2	3	4	16	
	1	7	1	0.322	3	6	0	0.547	7	1	1	0.010	5	3	1	0	0	0.014	2	0	0	0	0	0	0	3	0	1	3	9	0.044
	1	18	2		9	11	1		7	12	2		8	3	3	3	4		2	1	0	6	4	1	1	0	2	2	2	21	
How often do you clean and disinfect the surface of trolleys or desks (Q31)	13	104	43		52	87	21		90	68	2		95	42	4	12	7		21	5	7	25	11	4	21	18	9	31	8	160	
	2	10	7	0.332	7	11	1	0.554	11	7	1	0.016	9	8	1	1	0	0.074	1	0	0	5	1	0	1	3	2	4	2	19	0.681
	13	111	37		56	86	19		88	71	2		92	39	5	14	11		24	6	7	25	14	4	21	16	7	27	10	161	
When should you wash your hands? (Q32)	0	8	2		1	7	2		5	3	2		7	1	2	0	0		0	0	0	1	0	1	0	2	2	3	1	10	
	9	53	18	0.581	31	40	9	0.311	43	35	2	0.001	45	19	4	5	7	0.048	8	2	0	26	4	1	9	5	2	15	8	80	0.000
	5	63	25		31	52	10		54	39	0		52	26	1	10	4		12	4	6	4	11	4	10	15	8	16	3	93	
When should you wash hand and then disinfect your hands? (Q33)	1	13	3		2	12	3		7	7	3		11	3	3	0	0		5	0	1	1	0	0	3	1	1	3	2	17	
	4	15	11	0.037	10	14	6	0.621	17	13	0	0.189	19	5	0	3	3	0.700	1	2	0	8	2	1	4	1	3	5	3	30	0.388
	8	105	29		48	80	14		81	56	5		78	38	8	11	7		19	4	7	22	11	4	15	19	6	25	10	142	
How often do you wash hand and then disinfect your hands? (Q33)	3	9	6		6	10	2		6	12	0		11	5	0	1	1		5	0	0	1	2	0	3	1	2	4	0	18	

Wrong	8	52	19	0.045	33	39	7	0.111	44	34	1	0.164	45	21	2	3	8	0.043	11	5	1	7	2	1	14	9	5	16	8	79	0.008	
Poor	1	3	0		3	1	0		1	2	1		1	0	1	1	1		0	0	0	1	2	0	0	0	0	1	0	4		
Intermediate	6	25	14		9	28	8		26	18	1		28	9	1	6	1		8	0	4	5	6	3	6	5	3	4	1	45		
Adequate	0	49	13		19	36	7		33	27	2		34	18	4	5	1		6	1	2	18	5	1	2	7	3	13	4	62		
Standard	9	45	12	0.102	30	30	6	0.088	35	30	1	0.136	34	18	2	4	8	0.011	6	3	1	21	3	0	6	3	1	14	8	66	0.003	
Intermediate	3	43	22		19	38	11		38	30	0		45	17	0	4	2		11	2	2	8	5	2	7	9	7	12	3	68		
Adequate	3	41	12		15	36	5		31	21	4		29	13	6	7	1		8	1	4	2	7	3	9	9	3	8	2	56		
Wrong	0	5	2	0.438	3	1	3	0.009	1	6	0	0.162	3	0	0	2	2	0.002	0	1	1	2	2	0	0	0	0	0	0	1	7	0.006
Poor	5	24	6		17	15	3		19	14	2		18	7	3	2	5		4	1	0	2	2	0	4	3	10	6	35			
Intermediate	9	67	24		35	56	9		60	39	1		56	34	2	5	3		11	3	4	25	3	4	13	12	7	16	2	100		
Adequate	1	33	14		9	32	7		24	22	2		31	7	3	6	1		10	1	2	2	8	1	5	6	1	8	4	48		
Wrong	0	10	1	0.089	3	7	1	0.006	7	4	0	0.481	7	1	0	3	0	0.063	4	0	0	0	3	0	1	2	0	1	0	11	0.000	
Poor	9	41	10		31	26	3		28	31	1		28	17	3	4	8		11	3	0	2	4	0	4	4	5	19	8	60		
Intermediate	3	44	18		13	44	8		40	22	3		40	19	2	3	1		2	0	4	25	1	3	9	12	1	7	1	65		
Adequate	3	34	17		17	27	10		29	24	1		33	11	3	5	2		8	3	3	4	7	2	8	3	5	7	4	54		
Wrong	10	70	26	0.653	38	57	11	0.714	58	45	3	0.981	58	23	5	11	9	0.169	9	2	3	7	14	5	13	19	7	16	11	106	0.000	
Adequate	5	59	20		26	47	11		46	36	2		50	25	3	4	2		16	4	4	24	1	0	9	2	4	18	2	84		
Wrong	8	77	24	0.640	37	58	14	0.792	58	48	3	0.886	62	30	5	6	6	0.647	9	4	4	25	6	3	13	9	7	26	3	109	0.003	
Adequate	7	52	22		27	46	8		46	33	2		46	18	3	9	5		16	2	3	6	9	2	9	12	4	8	10	81		
Wrong	2	23	1	0.030	8	16	2	0.696	13	12	1	0.827	10	9	3	0	4	0.008	1	3	0	4	0	0	2	8	3	2	3	26	0.002	
Adequate	13	106	45		56	88	20		91	69	4		98	39	5	15	7		24	3	7	27	15	5	20	13	8	32	10	164		
Poor	5	18	9	0.404	16	13	3	0.208	15	16	1	0.267	15	6	2	3	6	0.006	5	1	0	3	3	0	2	2	2	7	7	32	0.000	
Intermediate	5	54	17		25	44	7		49	26	1		42	20	1	10	3		6	1	3	23	9	0	9	11	4	7	3	76		
Adequate	5	57	20		23	47	12		40	39	3		51	22	5	2	2		14	4	4	5	3	5	11	8	5	20	3	82		
Wrong	13	81	31	0.176	41	68	16	0.755	70	52	3	0.873	68	31	6	9	11	0.155	19	6	3	25	9	5	14	6	5	23	10	125	0.002	
Adequate	2	48	15		23	36	6		34	29	2		40	17	2	6	0		6	0	4	6	6	0	8	15	6	11	3	65		
Total	15	129	46						104	81	5								25	6	7	31	15	5	22	21	11	34	13	190		

* Mil-Nur: Military Nurse, Civ-Nur: Civil Nurse, Med Doc: Medical Doctor, Tec: Technical, Vol-Nur: Volunteer Nurse.
 ** Emr: Emergency Depart, Gyn: Gynecology Department, Operation Theatre, Infectious Disease Control Unit, Pae: Paediatric Depart, Phys: Physiotherapy, Surg: Surgical Department, Und-Fiv: Under Fives Clinic.

APPENDIX

Table S1: Descriptive statistics for responses to the hand washing and medical sharps disposal (n=190)

Questions	Parameters / Answers	Percent %
After operation, how do you deal with the medical sharps? (Q10)	Directly disposing in dustbins.	3.7
	Deposit into the specified sharp-box immediately.	85.8
	First put them into the lower treatment trolley, then put them into the sharp box when get back to the office.	10.0
How do you deal with needles and syringes after using? (Q11)	Settle the needle back to the needle cap manually with Right and left hand.	11.1
	Settle the needle back to the needle cap with single hand.	17.4
	Remove the needle by hand and then discard it in the sharps box.	68.9
How many times were you injured by medical sharps during operation before? (Q12)	5 times or more	3.7
	Once	28.9
	2 -4 times	20.0
	Never	47.4
If you have been injured by sharps, what was the cause of the injury? (Q13)	Carelessness	21.6
	In a hurry	40.0
	Collision with others	6.3
	Inadequate lighting in work place	23.7
	Unskilled Operation	8.9
	Not followed with standardized protocol	22.6
When did the injury (injuries) occur to you or your colleagues? (Q14)	Poor quality of sharps	9.5
	When recapping the cap (no blood contamination)	37.9
	When recapping the cap (with blood contamination)	18.9
	When disposing medical supplies	12.6
	When removing the needle from the syringe or infusion set	31.1
	When breaking the ampoule split	52.1
	In the aspiration of the drug, dispensing drug	12.6
	When injecting, or collecting blood	13.7
	When pulling out the needle	16.3
When transferring surgical blade, suturing wound or deal with other surgical instruments	18.4	
Which kind of medical devices caused you or your colleagues` sharp injuries? (Q15)	Disposable intravenous infusion set	22.1
	Disposable syringe	20.5
	Scalp needle	43.2
	Indwelling needle	7.4
	Ampule	52.6
	Blade	35.3
	Sewing needle	10.5
What kind of awareness and skills of protection do you think you have been enhanced after Ebola outbreaks? (Q21)	Handwashing	34.2
	Disinfect the contaminated medical supplies timely	45.8
	Choose PPE in different area (eg. clean area, contaminated area)	49.5
	Wear gloves, masks when contacting with contaminated items	21.1

Questions	Parameters / Answers	Percent %
How often do you receive the occupational protection training course? (Q25)	Every six months	32.1
	Every year	31.1
	Never	25.8
	During the outbreak of endemic situation	0.0
	Occasionally but not regularly	4.7
	Every 3 months	1.1
What kinds of training course on protection knowledge have you received? (Q26)	Disinfection and isolation methods	55.3
	Occupational exposure and prevention	30.0
	Hospital infection control and monitoring	50.0
	Personal protection	75.8
How do you get the occupational protection knowledge? (Q28)	Clinical experience	59.5
	Professional protection training	54.7
	Medical school	37.4
	Regular supervision	24.7



QUESTIONNAIRE ON KNOWLEDGE, ATTITUDE AND PRACTICES OF OCCUPATIONAL EXPOSURE AND PROTECTION OF HCWS

INTRODUCTION AND CONSENT

Hello everyone. I am Sister Qin from China Military Medical Expert Group, working in 34 MH now. We are conducting a survey on the knowledge, attitude and behavior of HCWs (health-care workers) in occupational exposure and protection. The study will help us to carry out one comprehensive training in the near future. The information will help the hospital to plan much better for nurses and health services. You are selected for the survey. I would like to ask you some questions and it may take about 15 to 20 minutes. All of your answers will be confidential and will not be shared with any other person except members of our survey team. We hope you will answer the questions accurately since your views are very important.

Thank you very much!

Please Tick (✓) in the "☐", or Write the Figure

Year 2018

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PART 1: GENERAL INFORMATION

Age: Years Old.

Sex: 1. Male 2. Female

Years of Working Experience: Years

Educational Qualification:

- A. Secondary school leaving certificate
- B. Nursing diploma certificate
- C. Bachelor's degree
- D. SECHN
- E. Lab technical diploma
- F. HCA
- G. Nursing certificate
- H. X-Ray technical
- I. Others

Occupation:

- A. Military Nurse
- B. Civil Nurse
- C. Volunteer nurse
- D. Medical doctor
- E. Lab technical
- F. X-Ray technical
- G. Others

Which Department do you Work in?

- A. Internal medicine
- B. Surgical Department.

- C. Emergency Department
- D. Paediatric
- E. Department of gynecology
- F. Under Fives Clinic
- G. Laboratory
- H. OP Theatre
- I. X-Ray dept.
- J. Physiotherapy dept.
- K. Dental dept.
- L. Ophthalmology dept.
- M. MIROOM
- N. Montuary
- O. Survivors clinic
- P. Others_

PART 2: QUESTIONS ABOUT YOUR ACTUAL PRACTICE

1. Do you like your job?
 A. Yes B. No C. Uncertain D. Never
2. How do you rate your level of occupational protection knowledge?
 A. Know well B. Common C. Know little
3. How do you rate your level of protection awareness?
 A. High B. General C. Low
4. Have you mastered the six steps in hand washing procedure?
 A. Yes B. No
5. Do you wash your hands before and after any sterile operation?
 A. Always B. Occasional C. Seldom
6. Do you implement hand washing following the correct six-step procedure after serving for the patient directly (eg.by touching or treatments)?
 A. Yes B. Occasionally C. No
7. How do you dry your hands after washing hands?
 A. With paper towels or single-use cloth towels
 B. With work clothes
 C. Not drying hands
8. Do you wear gloves when you do any operations those may contact blood or body fluids?
 A. Always (skip to Q10)
 B. Often but not every time
 C. Occasionally
9. Why do you operate without gloves? The reason is
 A. It's unnecessary to wear gloves.
 B. There isn't enough time to wear gloves.
 C. It's not convenient when operating with gloves.
 D. Gloves are not available .
 E. Shortage
 F. Others _
10. After operation, how do you deal with the medical sharps?
 A. Directly disposing in dustbins.
 B. Deposit into the specified sharp-box immediately.
 C. First put them into the lower treatment trolley, then put them into the sharp box when get back to the office.
11. How do you deal with needles and syringes after using?
 A. Settle the needle back to the needle cap manually with right and left hand.
 B. Settle the needle back to the needle cap with single hand.
 C. Remove the needle by hand and then discard it in the sharps box.
12. How many times were you injured by medical sharps during operation before?
 A. 5 times or more B. Once
 C. 2 times D. 3 times

- E. 4 times F. Never (*skip to Q14*) J. Others__
13. If you had been injured by sharps, what was the cause of the injury? (*You can select multiple answers according to actual condition*)
- A. Carelessness B. In a hurry
- C. Collision with others D. Inadequate lighting in work place
- E. Unskilled Operation F. Not followed with standardized protocol
- G. Poor quality of sharps H. Others __
14. When did the injury (injuries) occur to you or your colleagues? (*You can select multiple answers according to actual condition*)
- A. When recapping the cap (no blood contamination)
- B. When recapping the cap (with blood contamination)
- C. When disposing medical supplies
- D. When removing the needle from the syringe or infusion set
- E. When breaking the ampoule split
- F. In the aspiration of the drug, dispensing drug
- G. When injecting, or collecting blood
- H. When pulling out the needle
- I. When transferring surgical blade, suturing wound or deal with other surgical instruments
15. Which kind of medical devices caused you or your colleagues` sharp injuries? (*You can select multiple answers according to actual condition*)
- A. Disposable intravenous infusion set
- B. Disposable syringe
- C. Scalp needle
- D. Indwelling needle
- E. Ampule
- F. Blade
- G. Sewing needle
- H. Others__
16. Is the protective equipment supplied sufficient in the hospital?
- A. Yes B. No
17. Do you protect yourself from patients' blood and body fluids as potential sources of infection?
- A. Yes
- B. No
- C. Unclear
18. How do you deal with contaminated items from the patients?
- A. Clean with bare hands
- B. Clean with hands in gloves
- C. Clean with auxiliary equipment
- D. Others__

19. If your skin contacted with patient's blood, body fluids, secretions, how do you deal with it?
- A. Wipe off with paper towel
- B. Rinse off with running water repeatedly
- C. Rinse with running water and disinfect
20. What kinds of protective skills training did the hospital or other health care facilities do after the Ebola outbreak? *(You can select multiple answers according to actual condition)*
- A. How to deal with sharps
- B. Six-step hand-washing technique
- C. When to wash your hands
- D. How to choose PPE (personal protective equipment) in different circumstances
- E. Disinfection methods
- F. Others_.
21. What kinds of awareness and skills of protection do you think you have been enhanced after Ebola outbreaks? *(You can select multiple answers according to actual condition)*
- A. Hand-washing
- B. Disinfect the contaminated medical supplies timely
- C. Choose PPE in different area (eg. clean area,contaminated area)
- D. Wear gloves, masks when contacting with contaminated items
- E.Awareness on ensuring clean areas are separate fromcontaminated area
22. Have you attended occupational protection courses before practicing in the hospital or other health care facilities?
- A. Yes B. No
23. Is it necessary to establish an occupational protection training course in your opinion?
- A.Necessary B.Unnecessary
24. Have you received any occupational training for prevention, post-event reporting and disposition?
- A. Yes B. No
25. How often do you receive the occupational protection training course?
- A. Every six months
- B. Every year
- C.Never
- D.During the outbreak of endemic situation
- E. Occasionally but not regularly
- F. Every 3 months
- G. Others_.
26. What kinds of training course on protection knowledge have you received? *(You can select multiple answers according to actual condition)*
- A. Disinfection and isolation methods
- B. Occupational exposure and prevention
- C. Hospital infection control and monitoring
- D. Personal protection
27. Do you think the hospital supervisor pay more attention to occupational safety andprotection?
- A. Yes B. No C. Don't care
28. How do you get the occupational protection knowledge? Multiple choices

- A. Clinical experience
 - B. Professional protection training
 - C. Medical school
 - D. Regular supervision
29. How often do you disinfect the nursing equipment (eg. blood pressure monitors, temperature gun)?
- A. Not require disinfection
 - B. Once a day, or at any time when contaminated with blood or other items
 - C. Once a week, at any time when contaminated with blood or other items
 - D. Unclear
 - E. After each patient
 - F. Others _

30. If the medical items are contaminated by the patient's blood, body fluids, how do you deal with it?
- A. Wash with water
 - B. Wipe with disinfectant
 - C. Wash with water immediately and disinfect
31. How often do you clean and disinfect the surface of trolleys or desks?
- A. Not require disinfection
 - B. Once a day, or at any time when contaminated
 - C. Once a week, at any time when contaminated
 - D. Unclear
 - E. Others_

PART 3: QUESTIONS ABOUT YOUR KNOWLEDGE

32. Multiple choices When should you wash your hands?
- A. Before & after direct contact with the patient
 - B. Before & after removing gowns
 - C. After removing the gloves
 - D. Before & after injection, infusion and other sterile operation
 - E. Before & after dealing with contaminated items
 - F. Visible contaminants on hands
 - G. Before putting on gloves
 - H. Before putting on mask
33. Multiple choices When should you disinfect your hands?

- A. Contact with the patient's blood, body fluids and secretions
 - B After directly examination, treatment and care for HBV patients
 - C After removing the glove
 - D Before & after putting on or removing gowns
34. Multiple choices What actions should you take when a sharp injury occurs:
- A. Rinse the wound with disinfectant.
 - B. Rinse the wound with running water immediately and squeeze blood away from the body to the distal end.
 - C. Rinse with soap under the running water.
 - D. Report immediately and inject immunoglobulin following the doctors' advice.

35. **Multiple choices** What should a nurse wear when receiving a new patient with Fever of Unknown Origin?
- A. Mask
 - B. Cap
 - C. Gloves
 - D. Face shield or goggles if necessary
 - E. Coverall or gown if there is a certain epidemic situation
36. **Multiple choices** Standard precautions for medical personnel protection includes:
- A. Wear gloves when contact with patients' blood, body fluids, secretions, excretion
 - B. Remove gloves and do hands hygiene after contact with contaminated items or exit from isolation ward
 - C. Wear double gloves when there is a wound on your hands.
 - D. Wear gown when entering the isolation ward, or contact with contaminated items
37. **Multiple choices** When should you wear gloves? Choosing from the following circumstances
- A. There is a wound or breakage on your hands.
 - B. There is blood or body fluid on the instruments those you are dealing with
 - C. When preparing chemotherapy drugs
 - D. When performing sterile operation
38. **Multiple choices** What are the routes of transmission of HIV?
- A. Blood
 - B. Body fluid
 - C. Unprotected sexual contact
 - D. Mother to child vertical transmission
 - E. Handshake
- F. Hug
- G. Other _.
39. **Multiple choices** What are the routes of transmission of Hepatitis B Virus?
- A. Sexual contact
 - B. Mother to child vertical transmission
 - C. Body fluid
 - D. Handshaking
 - E. Others _.
40. How long is the best period to take prophylaxis for HIV after exposed to contaminated items of HIV patient?
- A. Within 2h
 - B. 4h
 - C. 24h
 - D. Unclear
41. **Multiple choices** What should you do if blood from HIV patients splashed into your eyes?
- A. Wipe with a cotton swab immediately
 - B. Rinse the mucosa of your eyes with water or saline repeatedly
 - C. Rinse with water and use sanitizer
42. **Multiple choices** When should you go to have HIV antibody tests after exposed contaminated items of HIV patient?
- A. Immediately
 - B. After 4 weeks
 - C. After 8 weeks
 - D. After 12 weeks
 - E. After 6 months

43. When should you report to your superior if you get a sharp injury?

- A. In 24 hours
- B. In 1 hour
- C. Immediately
- D. It needn't to be reported
- E. Unclear

44. Multiple choices What do you need to wear when receiving EVD (Ebola virus disease) patients?

- A. Face masks(eg.N99 or N95)
- B. Coverall

- C. Waterproof apron
- D. Double set gloves
- E. Rubber boots
- F. Head covering
- G. Face shield or goggles

45. When should you dispose the sharp box?

- A. When it is full
- B. When it is 1/2 full
- C. When it is 3/4 full

