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Knowledge and Practice about Transportation of Infectious Substance among Healthcare Providers, Khartoum State

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Abstract Proper shipping of infectious materials is an important practice to prevent healthcare workers (HCWs), other people and environment from spread of biological threats. The main purpose of this study was to determine healthcare providers' knowledge, and practices about transportation of infectious substances. A self-administered designed questionnaire was used to collect relevant data from study respondents. Primary data were double entered and analyzed by using statistical package for social sciences (IBM SPSS statistics 20). Descriptive, in addition to the effects of predictors on dependent variables were applied. Multiple logistic regression model was used to assess the association between dependent variables and predictors. It has been found that; the overall mean percentage of knowledge was 57.1 (95 CI: 54.1, 60.2), while mean percentage of practice was 68.9 (CI: 95% 66.7 – 71.1). Response reliability scale was 89.0% based on Cronbach's alpha. The highest knowledge regarding transportation of infectious substances was observed among laboratory specialist (33.9%) and doctors (25.4%) respectively. High percentage of practice was observed among laboratory specialist was (34.6%) and low percentage was among public health officers and doctors (15.9%). Majority of study respondents did not receive training in transportation of infectious substances (70.9%). Knowledge and practice on transportation of infectious substances among health care providers are low. More efforts are needed to fill the gap in knowledge and practice by applying effective training programs that can lead to increase skills and awareness of health care providers.

Keywords Infectious Substance, Shipping, Transportation, Biosafety, Biosecurity, Healthcare Workers

1. Introduction

Recently, considerable attention has been paid to biosafety, biosecurity and quality management system (QMS) issues [1-3]. In addition; proper transportation practice play a vital role in surveillance system and emergency public health events assessment based on international health regulations (IHR) [4, 5]. Regulations of transportation process include categorization of infectious substance into: 1) category A, 2) category B and 3) exempt. Transportation of these infectious substance require special type of packaging provide three layers of containment termed "triple packaging" derived from risk assessment and required specific marking and labeling [6]. Material transport policies should include accountability measures for the movement of materials between laboratories within an institution as well as between institutions or locations outside of the facility [4,7] utilizing different transportation modes of air, sea, road and railway [8,9].

In 2015 the United Nation (UN) adopted the seventeen sustainable development goals (SDGs), a set of targets for 2030 to mobilize action on three interwoven dimensions of our existence—people, planet, and prosperity [10]. Matching these goals, in particularly SDG 3 and SDG 11 are devoted to ensure healthy lives and promote well-being for all at all age; and for make cities and human settlements inclusive, safe, resilient and sustainable respectively. SDG 14 dedicated to conserve and sustainable use the oceans, seas and marine resources for sustainable development [11] it can terminate that

proper transportation can maintain the achievements of above mentioned goals and prevent spreading of biological threats which strengthening the compliance of national and global public health programs to the SDGs agenda.

With regard to improper transportation; unmarked, unidentified and improperly packaged infectious substances; was observed several times in daily work practice. WHO recorded no case of illness attributable to the release of infectious substances or diagnostic specimens during transport process; nevertheless, there are low reported incidents (0.002% breakages) of damage to improperly and sometimes even properly packaged materials leads to increases the overall potential for exposure to public as well as clean-up of hazardous spills is expensive and time consuming [6,12].

In Sudan; Ministry of Health in collaboration with the WHO organized -up to now- four workshops in shipping of infectious substances during the past seven years. One workshop was organized by the epidemiology directorate and the other three workshops were arranged by the National Public Health Laboratory. The purpose of these workshops is to trained lab and healthcare staff in how to transport infectious substances according to the international health regulations (IHR). Participants were come from national public health laboratory as well as from states laboratories. Participants who had passed the final exam after the training obtained shipping certification for consecutive two years. But, the number of trainees was small; and the successes rate was low plus the loss of participants' follow-up [13]. Several studies had been conducted in biosafety and biosecurity field. However, none of them was elaborated specifically for shipping of infectious substances [14-16].

2. Materials and Methods

2.1. Study design and Study settings

A cross sectional study was conducted to determine the knowledge and practice of health care workers in the transportation of infectious substances in Khartoum State. Following informed written consent, respondent who met the inclusion criteria and agreed to participate were interviewed. The Healthcare providers participating in this study included doctors, nurses, laboratory specialists, public health officers, and other health care providers. Questionnaire was distributed in governmental and private healthcare service (ministry of health, primary health care administration) and in management facilities (hospitals and laboratories) during a period between November 2017 and March 2018.

2.2. Data collection and procedures

A self-administration designed questionnaire was divided into three section; the first one include the demographic data of respondent, gender, Age, occupation, education level, type of institution, and training; section two include information about knowledge and section three was devoted for practice. Questionnaire was distributed into English and Arabic languages. Respondent's knowledge was assessed by 8 structured questions and a practice was assessed by 9 questions. The response to knowledge questions were recorded as No, Low, Moderate and High, whereas practice questions were recorded as Yes, No and I do not know. The total knowledge score was calculated using sum method.

2.3. Data analysis

Primary data were cleaned; double entered and analyzed using statistical package for social sciences (IBM SPSS statistics 20). Descriptive frequencies and regression model was used to find association between dependent and independent variables. Cronbach's Alpha was scaled to measure questionnaire reliability and Kolmogorov-Smirnov (K-S) was applied to test normality of study population distribution. Sum of the knowledge score was calculated and summarized as mean of different responses. Then, mean knowledge score recode to dichotomous Variable with two categories, low is the percentage less than 70% and high for more than this percentage. Also, this process was applied to practice score. Multiple logistic regression model was used taking the knowledge and practice as dependent variables and gender, age, years of experience, training, occupation and place of work as independent variables.

2.4. Ethical clearance

Study protocol was ethically and scientifically approved by the scientific and ethics Committees of ministry of health, Khartoum state. Respondents were signed written informed consent on voluntary basis. According to ministry of health, Khartoum state regulations, respondents' confidentiality was maintained. Study respondents had the right to withdraw from the study during data collection period.

3. Results

A total number of 206 healthcare workers with a mean 35.2 ±8.3 and response rate (87%) were responding to this study. Demographic data included gender, Age, occupation, education level, type of institution, and training and it was normally distributed based on one-sample Kolmogorov-Smirnov statistical test. Cronbach's Alpha test was 89.0% for the entire questionnaire, 89.8% and 78.3% for knowledge and practice respectively.

A total number of 139 (67.5%) of study respondents were working at governmental institutions and 67 (32.5%)

of them were belonged to private institutions. 112 study respondents (54.4.2%) were postgraduates, 73 (53.4%) were graduates, 16 (7.8%) of respondent with diploma (2-3 years) and 5 (2.4%) of respondents have general education. The majority of study respondents were not receiving training in transportation of infectious substances (70.9%). The mean years of experience were 8.2 ±6.6 SD ranged between 1 and 35 years (table 1). The highest knowledge regarding transportation of infectious substances was observed among laboratory specialist (33.9%) and doctors (25.4%) respectively. High percentage of practice was observed among laboratory specialist was (34.6 %) and low percentage was among public health officers and doctors (15.9%).

Table 1. Demographic characteristics of the study respondents

	Frequency	%	Confidence interval 95%
Gender			
Female	135	65.5	59 – 72
Male	71	34.5	28 – 41
Occupation			
Doctor	49	23.8	17.98 – 29.62
Nurse	59	28.6	22.43 - 34.77
Lab specialist	57	27.7	21.59 – 33.81
Public health officer	21	10.2	6.1- 14.33
Other	20	9.7	5.7 - 13.7
Education level			
Postgraduate	112	54.4	47.5 – 61.0
Graduate	73	35.4	29.2 – 42.2
2-3 years diploma	16	7.8	4.1 – 11.4
General education	5	2.4	0.31 – 4.5
Type of institution			
Government	139	67.5	61.1 – 73.9
Private	67	32.5	26.1 – 38.9
Age group			
20 – 30	83	40.3	33.6 - 47.0
31 – 40	86	41.7	43.97 - 48.43
41 – 50	25	12.1	7.65 - 16.55
51 – 60	9	4.4	1.6 - 7.2
More than 60	3	1.5	0.16 - 3.16
Year of experiences			
1 – 5	92	44.7	37.91 - 51.49
6 -10	65	31.6	25.25 - 37.95
11 -15	27	13.1	8.49 - 17.71
16 -20	10	4.9	1.95 - 7.85
More than 20	12	5.8	2.85 - 8.75

Table 2. Respondents' knowledge related to transportation of infectious substance

	Frequency (%)				*P value*
	High	***Moderate***	***Low***	***No***	
1.Do you have any information about triple packging of infectious substances?	44(15.5)	52(25.2)	32(21.4)	78(37.9)	0.000
2. Have you any idea about classification of infectious materials into carogory A, catogory B and exmpt?	35(17)	72(35)	39(18.9)	60(29.1)	0.000
3. Do you know that classification of infectious substance affect the choice of packaging?	45(21.8)	58(28.2)	39(18.9)	64(31.1)	0.052
4. Have you any knowledge about labeling and marking of packaging of infectious substance?	45(21.8)	46(22.3)	50(24.3)	65(31.6)	0.173
5. Do you know that the name and address of the shipper and receiver should provide in each package?	60(29.1)	36(17.5)	36(17.5)	74(35.9)	0.000
6. Do you know that these shipping boxes have special specifications and pass specific tests (pressure, drop, puncture, stacking)?	53(25.7)	40(19.4)	37(18)	76(36.9)	0.000
7. Do you know that, regulations of transportation of infectious substance by any mode (air, railway, sea and road) are advised by WHO?	45(26.2)	46(22.3)	34(16.5)	72(35)	0.002
8. Do you know about IATA or any other national or international agency regulations for transportation of infectious substance?	28(13.6)	22(10.7)	39(18.9)	117(56.8)	0.000

Table 3. Respondents' practice related to transportation of infectious substance

	Frequency (%)			*P value*
	Yes	*No*	*I don't know*	
1. In your daily work, do you follow your SOPs for samples transportation?	84(40)	69(33.5)	53(25.7)	0.03
2. In your institution; is there a nominated person for transportation of infectious substances?	96(46.6)	70(34)	40(19.4)	0.00
3. In your institution; is the 24 hours emergency contact number for sending and receiving infectious substance is available?	53(25.7)	90(43.7)	63(30.6)	0.005
4.Is the transport box available in your institution?	90(43.7)	62(30.1)	54(26.2)	0.005
5. In your daily practice; are you consider and stick to proper outer packaging markings information (writing or print of shipper, receiver, and type of packaging instructions)?	65(31.6)	81(39.3)	60(29.1)	0.173
6. In your daily practice; did you concern and adhere to proper outer packaging labels (infectious substances)?	75(36.4)	74(35.9)	57(27.7)	0.225
7. Is the document identifies the content of the primary container or request form clearly written and positioned?	76(36.9)	67(32.5)	63(30.6)	0.524
8. Is an incident report is available in your institution?	77(37.4)	82(39.8)	47(22.8)	0.005
9. In your institution or in your daily practice; is the procedure for transportation of specimens met IATA or any other national or international regulatory requirements?	45(21.8)	61(29.6)	100(48.5)	0.000

3.1. Knowledge

The mean percentage of knowledge of the study respondents was 57.1 with STD±22.1 (95 CI: 54.1 - 60.2). Different variables assess the knowledge of respondents regarding transportation of infectious substance were explained in (table 2). The multiple logistic regressions revealed an association between low knowledge and working in private institution, having 2-3 years diploma and lack of training in sample transportation (table 4).

Table 4. Multivariate logistic regression for the predictors of percentage of knowledge

			CI 95%	
	Adjusted OR	*p. value*	**Lower**	**Upper**
Gender				
Male	**Ref**			
Female	0.201	0.000	0.087	0.464
Occupation				
Doctors	**Ref**			
Nurse	2.343	0.195	0.647	8.480
Lab specialist	1.822	0.244	0.664	5.000
Other	1.377	0.649	0.347	5.472
Public health specialist	1.325	0.679	0.350	5.023
Education				
Postgraduate	**Ref**			
Graduate	0.790	0.587	0.338	1.850
Diploma (2-3 years)	0.124	0.043	0.017	0.934
General education	0.501	0.607	0.036	7.006
Experience	0.901	0.148	0.783	1.083
Age	1.082	0.147	0.973	1.204
Institution				
Government	**Ref**			
Private	0.272	0.010	0.101	0.731
Training				
Yes	**Ref**			
No	0.154	0.000	0.071	0.334

Table 5. Multivariate logistic regression for the predictors of percentage of the mean practice

			CI 95%	
	Adjusted OR	***p. value***	**Lower limit**	**Upper limit**
Gender				
Male	**Ref**			
Female	0.455	0.048	0.208	0.992
Occupation				
Doctors	**Ref**			
Nurse	6.062	0.002	1.936	20.038
Lab specialist	5.001	0.001	1.927	12.982
Other	2.789	0.094	0.841	9.251
Public health specialist	7.278	0.005	1.835	28.862
Education				
Postgraduate	**Ref**			
Graduate	1.184	0.675	0.538	2.602
Diploma (2-3 years)	0.205	0.036	0.046	.905
General education	0.544	0.607	0.062	4.781
Experience	0.960	0.535	0.842	1.093
Age	1.046	0.381	0.946	1.157
Institution				
Government	**Ref**			
Private	0.266	0.002	0.106	0.607
Training				
Yes	**Ref**			
No	0.244	0.000	0.106	0.472

3.2. Practice

The mean percentage practice of study respondents was 68.9% with STD± 15.9 (CI: 95% 66.7 – 71.1). Variables that assess the practice of study respondent in the transportation of infectious substances were explained in (table 3). The outcome of the multiple logistic regression reveals a significant association between practice and occupation, government institution, low training and working in private institutions and having diploma (2 – 3 years) (table 5).

4. Discussion

As reported by WHO 2008, Knowledge, attitudes and practices (KAP) studies are a useful method in the communication processes and important sources for defining effective activities and messages. Furthermore, it may be used to identify needs, problems and barriers in program delivery, as well as solutions for improving quality and accessibility of services [17]. This study revealed that healthcare providers are lack of training where 71% they did more attend any training session before. This finding is supported by study conducted in Sudan to assess biosafety precautions in diagnostics laboratories where training was low [14]. Multivariate logistic regression shows that public health professionals are significantly practice better than other groups. This may be because they are working at the highest level and actually receive more and quality training. On the other hand males are significantly has a more knowledge and better practice than females in transport of infectious substance; this may indicate poor quality or not specified trainings programs [18].

Technically, for many different reasons infectious samples are shipped between hospitals and laboratories in a daily base. In addition, shipping of samples is a pre analytical step may result or negatively affect the quality of diagnosis, turnaround time (TAT), and/or pathogens recovery [19]. Moreover improper shipping may also deleteriously affect the biosafety measures. According to this study, dissimilar response from same institution is observed and this may reflect poor accessibility of important materials and documents. Challenges found by this study included that standard laboratory procedures (SOP) are either not available in 25.7% or not accessible in

33.5% of institutions. Moreover, the number of nominated person for transportation of infectious substances was very low (19.4%). Also, standard shipping boxes were not available for the majority of state laboratories [20-21].

Knowledge and practice of healthcare providers toward the transportation of infectious substances was low. Majority of respondents 37.9% don't have any knowledge about sample transportation regulations. In addition about 50% of the health care providers practice their work without IATA or any other national or international regulations. In Sudan, some efforts were made to develop national guidelines and regulations for shipping of infectious substance, still the guidelines are not in place [12]. Furthermore, some companies are working in the transportation of infectious samples from states to the National reference laboratories, but we do not know if they have guidelines or not.

According to the findings of this study, healthcare providers working in government institution are more aware of how to transport infectious substances and practice betters when compare with those working in private sector. This was also supported by studies conducted in Africa, China, but in some countries in Asia particularly the private institutions they practice better than governmental institutions [22-25].

5. Conclusions

Remarkable gaps in knowledge and practice about transportation of infectious substances among health care providers was observed. Training activities have to be implemented to raise awareness of health care providers to comply with the international health regulations in dealing with infectious substances.

6. Recommendations

1. Effective training. (courses, workshops)
2. Improve laboratory supply chain management system.
3. Development of national guideline for infectious substances transportation
4. Provision of Important documents and materials of transportation of infectious substance.
5. Establishment of Effective partnerships and collaboration.

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