

Measuring Knowledge and Practicing of Infection Control Precautions among Radiology Departments Staff during COVID-19 Pandemic in Khartoum Hospitals

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Abstract:

Background: The rapid and extensive spread of the COVID-19 pandemic has become a major cause of concern worldwide which raising global public health concerns. The healthcare workers are at great risk of infection with this new infectious virus, whereas the radiological examinations have a crucial role in the primary diagnosis and follow-up of COVID-19, the radiological workers as other staff who worked in the medical field have a risk of infection with this virus when they are in close contact with patients who have COVID-19 or suspected COVID-19 during medical imaging procedures. **Objective:** this study aimed is to assess the awareness of COVID-19 disease and related infection control practices among the workers in the radiology departments in Khartoum hospitals.

Materials and Method: A cross-sectional, web-based survey was distributed to the radiology department workers via social media. Convenient Technique was used to collect data between May 29 and June 16, 2021, across different hospitals in Khartoum hospitals, where major of data have acquired through the google website and others collected via author's hospital visits. **Result:** Completed questionnaires were filled out by 130 participants (77 radiographers, 28 radiologists, 15 sonologist, 6 radiotherapists, and 5 medical physicists). Overall, only 21 (16.2 %) received formal training in infection control, 32 (24.6 %) attended a training session about the COVID-19 pandemic, and 37(56.2 %) have previous training in hand hygiene. Whereas the participants with the aged group more than 40 years and consultants were most knowledgeable and achieved the highest score. Regarding the implementation of SICPs related to COVID-19 were good among Medical Physicist and Radiologist as a majority of the respondents were correctly able to answer questions (95 %, n= 5 and 89.10 %, n=28, respectively).

Conclusion: This study found that the knowledge and practicing of staff who work in Radiology departments in Khartoum hospitals towards the implementation of standard precautions of infection prevention during COVID-19 were partly acceptable. However, the results clearly illustrate There is a need for regular educational interventions and training programs on infection control practices for COVID-19 across all healthcare professions in radiology departments.

Key Word: COVID-19, Infection Control, Medical Imaging, Radiology .

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I. Introduction

In December 2019, a series of pneumonia cases of unknown cause emerged in Wuhan, Hubei, China, with clinical presentations greatly resembling viral pneumonia [1], which later known as “severe acute respiratory syndrome coronavirus” (SARS-CoV-2)” and recognized as a global problem by World Health Organization (WHO) in January 2020 [2] after Covid19 has infected in 114 countries, it has spread mainly through a respiratory droplet and contact transmission, spread gradually across China and other countries in the following four months, raising global public health concerns, As of 20 February 2020, a cumulative total of 75,465 COVID-19 cases were reported in China [3]. according to a WHO report, as of 5 June 2021 179,686,071 confirmed cases of COVID-19, including 3,899,172 deaths [4]. In a recent report from the Chinese Center for Disease Control and Prevention (Chinese CDC), more than 3000 healthcare workers have been infected with COVID-19[5]. Sudan similarly to other country revealed the first COVID-19 case on 13 March 2020 [6] and then lockdown all over the country as well as declaring a public health emergency. Due to the nature of this disease, the medical field workers are the most affected and exposed by this infectious disease as they became the first-line defenses while providing their health care services either in diagnosis or treatment, and the number

of victims is rapidly increasing every day [6].Among the medical health workers, the radiology department staffs play an important role in both diagnoses and follow up of COVID-19 for Patients, who are suspected or confirmed to have the virus, where X-ray and chest computed tomography examinations role as an effective method for the screening and diagnosis of this disease for early screening, diagnosis, and evaluation of disease severity[7].

So Radiology departments are considered as high-risk sites for cross-infection with SARS-COV-2, Therefore the implementation of standard Infection Control Precautions (SICPs) in radiology departments is critically important. In this study, we aim to evaluate and measure of radiology department's staff's awareness and implementation of Standard Infection Control Precautions (SICPs)established by WHO and CDC [8][9], ultimately guiding them to prevent infection.

II. Material and Methods

A descriptive qualitative survey was prepared via google tool as questionnaire distributed on social media to include medical workers in all radiology departments in various Khartoum Hospitals whether governmental, private, teaching or military.The survey began in June 2021. 96 responses were received from healthcare workers in radiology departments via an online questionnaire and completed to 130 responses by author's hospital visits. The questionnaire consisted of 33 questions categorized into several groups, consisting of socio-demographic questions such age and gender followed by their education level, specialty, and area of work, The second question group was about response's experiences and training, the third question group was about their dealing with confirmed COVID-19 patients or suspected COVID-19 cases based on The standard of infection control guidelines established by WHO. The last question group was about their practicing of Standard Infection Control Precautions (SICPs).

Many of these questions were cited from the most recent and relevant scientific literature and developed by authors to include key areas of awareness and practicing of standard infection control precautions. A convenient sampling method was used for data collection, and distribution of responses was presented as frequency and percentages. Subgroups were classified into categories as shown in table 1.

Data Analysis:Collected data was transformed to Excel spreadsheet and then analyzed using version 64 of the Statistical Package for the Social Sciences(*SPSS Inc., Chicago, IL, USA*). Statistics, such as frequencies and percentages, were used to describe the participants' demographic characteristics and theircorrect answers. Median of percentages of correct responses divided by the frequency of each sub- group was used to describe the correlation between the demographic group (gender, age, and educational level) with participants' knowledge about SICPs and COVID-19, as shown in table 3.b. And then between profession with participants' correct answers about their practicing of SICPs when they came in contact with conformed or suspected patients with Covid-19. Table 4.c.

Results:A total of 130 participants from the Khartoum Region responded to the survey, demographic data were as follows: The majority of the responders (n=130) were 69 (53.1%) female, 73 (56.2%) were aged between 18 to 28 years, 76 (58.5%) from Khartoum state, 53 (40.8%) were at the undergraduate level, 77 (59.2%) were radiographer, 54 (41.5%) work at X-ray departments and 53 (40.8%) work at governmental hospitals. Other demographic data are shown in table 1.

Table 1.Demographic characteristics of participants (n = 130).

Demographic Group	Sub-Group	Frequency	Percent %
Gender	Male	61	46.9
	Female	69	53.1
Age	18 - 28 Years	73	56.2
	29 - 40 Years	32	24.6
	More than 40 years	25	19.2
City	Khartoum	76	58.5
	Bahri	28	21.5
	Omdurman	26	20.0
Educational level	Undergraduate	53	40.8
	Postgraduate	55	42.3
	Consultant	22	16.9
Profession	Radiographer	77	59.2
	Radiologist	28	21.5
	Radiotherapist	6	4.6
	Medical Physicist	4	3.1
	Sonologist	15	10.8

Department	X-ray	54	41.5
	CT	31	23.8
	MRI	24	18.5
	Nuclear Medicine	5	3.8
	Ultrasound	16	12.3
Hospital	Governmental	53	40.8
	Private	42	32.3
	Teaching	21	16.2
	Military	14	10.8

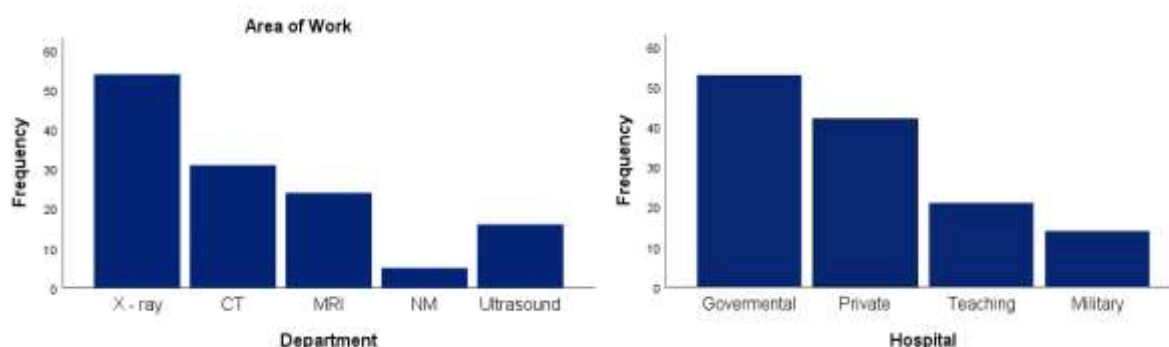


Figure 1. The distribution of participants according to their place of work.

Figure. 1 shows the distribution of respondents according to their place of work where the majority of the respondents work in X-ray departments (54 participants (41.5 %)), work in governmental hospitals (53 participants (40.8 %)) and the smallest group works in the nuclear medicine departments (five participants (3.8 %)).

Table 2. Participant's responses according their experience and training (n=130):

Question	Number and Percent of responded answers
Q1- Experience years that you have in Radiology Departments? 5 years	(111; 85.4%)
5-10 years	(9; 6.9 %)
More than 10 years	(10; 7.7 %)
Q2- Did you receive formal training in Infection Control?(Yes)	(21; 16.2 %)
Q3- Have you ever attended a training session about the COVID-19 pandemic? (Yes)	(32; 24.6 %)
Q4- Did you have previous training in hand hygiene?(Yes)	(73; 56.2 %)

Table. 2 shows the demographic characteristics of participants based on their experience and perceives training, where of the total respondents (N=130), the most populous group have experience almost 5 years in radiology departments (111 participants (85 %)), Only 21(16.2%) received formal training in infection control, 32(24.6%) attended a training session about COVID-19 pandemic, and 37(56.2 %) have previous training in hand hygiene.

Table 3.a Participant's Knowledge and awareness about SICPs and COVID-19:

Question	(No of correct answers; %)
Q5- Do you know what the Standard Infection Control Precautions measures established by WHO and CDC within the health care system?	(71; 54.6 %)
Q6- Do you know what the Standard Infection Control Precautions measures established by WHO and CDC within the radiology departments?	(49; 37.7 %)
Q7- Do you know the guidelines established by WHO to deal with COVID-19 patients or suspected COVID-19 cases?	(80; 61.5 %)
Q8- Standard Infection control precautions should be used in patients diagnosed with infection or patients who are in the incubation period for a given infection?	(58; 44.6 %)
Q9- What the Mean Mode of transmission of virus causing COVID-19?	(65; 50 %)

Table 3.a shows the demographic characteristics of participants according to their Knowledge and awareness about SICPs and COVID-19. Of the total of participants, Only 49 (37.7 %) stated that they knew the Standard Infection Control Precautions measures which established by WHO and CDC within the radiology departments. When participants were asked about using Standard Infection Control Precautions, 58 (44.6 %) answered that

SICPs should be applied for patients diagnosed with infection or patients who are in the incubation period for given infection and 65 (50 %) knew that respiratory droplets are the mean mode of transmission of the (SARS-CoV-2) from person to person.

Table 3.b Percentage of correct responses in different gender, age and education level group:

<i>Participant's corrected responses according to their experience and training</i>								
	<i>Gender</i>		<i>Age</i>			<i>Educational level</i>		
	Male N = 61	Female N = 69	18-28 years N = 73	29- 40 years N =32	> 40 years N =25	Undergraduate N = 53	Postgraduate N = 55	Consultant N= 22
Q1	52.7 %	47.3 %	56.1 %	24.7 %	19.2%	40.7 %	40.3 %	19 %
Q2	57.1 %	29.9 %	47.7 %	33.3 %	19 %	38 %	38 %	24 %
Q3	53.2 %	56.3%	34.4 %	31.2 %	34.4 %	39.2 %	45.8 %	15 %
Q4	51.6 %	48.3 %	60 %	16 %	24 %	32 %	48 %	20 %
<i>Median of Percentages of correct answers /n</i>	86.8 %	69.28 %	67.87 %	82.18 %	96.6 %	72.83 %	78.27 %	88.63 %
<i>Participant's corrected answers according to Knowledge and awareness regarding SICPs and COVID-19</i>								
Q5	49 %	51 %	56.3 %	21.1 %	22.6 %	37 %	43 %	20 %
Q6	52.5%	47.5 %	53.5 %	22.4%	24.6 %	32.6 %	41 %	26.4 %
Q7	48.3 %	51.7 %	55 %	25 %	20 %	37.6 %	43.7 %	18.7 %
Q8	50.8 %	49.2 %	62 %	19 %	19 %	36.2 %	46.6 %	17.2 %
Q9	62.5 %	40.6 %	44.6 %	32.3 %	23.1 %	40 %	38.5 %	21.5 %
<i>Median of Percentages of correct answers /n</i>	83.27 %	71.30%	75.34 %	70.62 %	90.4 %	69.81%	78.18 %	90.90 %

Table. 3.b shows the association relationship between the participants' experience, training, and knowledge about SICPs and COVID-19 across gender, age, and educational level. A median of corrected answers divided by the number of each sub-group came more from male (83.80 %) than female (71,30%) when they were asked about their knowledge and awareness related SICPs and COVID-19. Regarding the age groups, older employees (more than 40 years old) had more training and experience (96.6 %) and achieved the highest percentage of corrected answers (90.4 %) when they were asked about their Knowledge and awareness about SICPs and COVID-19. The consultant group had more knowledge and awareness about SICPs and COVID-19 than under and post-graduate groups. Regarding dealing of participants when they came in close contact with confirmed COVID-19 patients or suspected COVID19 cases in the radiology departments, when they were asked if there are WHO infection control instructions posted in their departments related to COVID19 pandemic guidelines targeting the patients, Only 57 (43,2 %) of participants stated correctly, A total of 100 (Only 48.5%) of the respondents stated that their department applied the social distancing during COVID-19 pandemic. Approximately 34.6 % of the responders stated that the patients wear a surgical mask when entering and leaving the radiology departments, Other demographic data are shown down in Table 4. a.

Additionally, 43 (26.2 %) of the responders correctly stated that they asked the patient to Keep a distance of 1 meter (3 feet) from them when dealing with patients whether confirmed or suspected COVID19. When participants were asked did they wear disposable, fluid-resistance isolation gowns when they dealing with patients have been confirmed with COVID-19 to protect themselves from infection, Only 43 (33.1 %) of the responders answered correctly table 4.a.

<i>Question</i>	<i>(No of correct answers; %)</i>
Q10- Are there WHO infection control and prevention guidelines for COVID-19 available in your departments?	(51; 39.2 %)
Q11- Are there WHO infection control instructions posted that related to COVID19 pandemic guidelines directed to the patients in your department?	(57; 43.8 %)
Q12-Is there an isolation waiting room for a confirmed patient with Covid-19 before enter the examination room in your department?	(44; 33.8 %)
Q13- Did your department apply a social distancing during the COVID-19 pandemic?	(50; 38.5 %)
Q14- Did the patient wear a surgical mask when entering and leaving the radiology departments?	(54; 34.6 %)
Q15- Did the patient have a previous history questionnaire about COVID-19 filled before entering the hospital?	(67; 51.5 %)
Q16-Did you ask the patient to Keep a distance of 1 meter (3 feet) from you?	(43; 26.2 %)
Q17- Did you use portable imaging equipment to limit the transportation of patients with COVID-19 or suspected COVID-19 to reduce the infection?	(31; 23.8 %)
Q18- Did you wear a disposable, fluid-resistance isolation gown when you dealing with a patient has been	(43; 33.1 %)

confirmed with COVID-19?	
Q19- When your personal protective equipment PPE come in contact with suspected or confirmed patient with Covid-19, do you discard them when the specific task is done?	(107; 82.3)

Table 4.a Participant's contacting with confirmed COVID-19 patients or suspected COVID19 cases in radiology department:

Regarding to the implementation standard infection control precautions (SICPs) in Radiology Departments against COVID-19, 117 (90.0 %) followed hand hygiene by washing their hands during work, whereas 55 (42.3 %) of responders consuming 20 minutes to do this procedure. 67 (51.5 %) confirmed that routine full sterilization of their departments was done only if there is COVID-19 cases. 81 (62,3) of the total participants confirmed that they clean image viewing station, mouse and keyboard after contact with COVID-19 patient or suspected COVID-19. Additionally 89 (68,5 %) of the total responders correctly stated that they clean ultrasound probes, tables, cassettes and gantries after contact with COVID-19 patient or suspected COVID-19 by using antiseptic techniques. When participants were asked about are there regularity visits by the Ministry of Health to ensure about the standard infection control precautions to their facilities , Only 23 (17,17 %) of responders answered correctly and only 17 (13.1 %) of responders think that all infection control precautions are sufficient and satisfied in Khartoum hospital during COVID-19 Pandemic. Other demographic data are shown down in table 4. b.

Table 4. b Participants contacting with confirmed COVID-19 patients or suspected COVID19 cases:

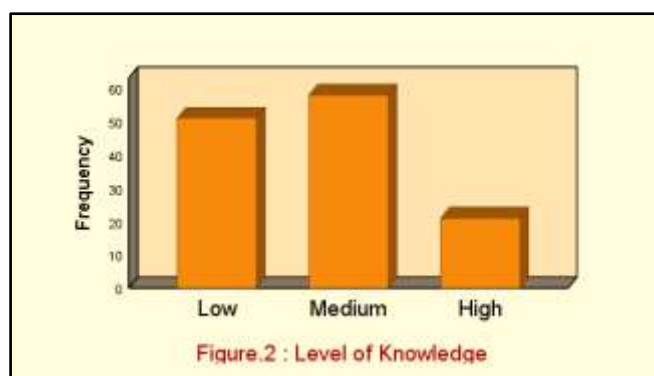
Question	(No of correct answers; %)
Q20- Did you follow hand hygiene by washing your hands during your work?	(117; 90.0 %)
Q21- What substance that you used to wash your hand?	(63; 50 %)
Q22- How much time are you consuming to wash your hands?	(55; 42.3 %)
Q23- Are you sharing your PPE with your colleagues or staff?	(107; 82.30 %)
Q24- Do you routinely use an alcohol-based hand rub for hands?	(39; 30 %)
Q25- When venipuncture procedures are required for special investigation did you use gloves always and Sterile instruments and devices either before or after this procedure?	(103; 79.2 %)
Q26- Are all cleaning and sterilizing equipment store correctly in your department?	(94; 72.3 %)
Q27- Is there routine full sterilization of the department?	(105; 80.08 %)
Q28- when this procedure is done?	
Daily	(29; 22.3 %)
Weekly	(19; 14.6 %)
Monthly	(15; 11.5 %)
Just if there is COVID-19 case	(67; 51.5 %)
Q29- Do you clean the image viewing station, mouse, and keyboard after contact with the COVID-19 patient or suspected COVID-19?	(81; 62.3 %)
Q30- Do you clean Ultrasound Probes, Tables, Cassettes, and Gantries after contact with COVID-19 patients or suspected COVID-19 by using antiseptic techniques?	(89; 68,5 %)
Q31- Did the hospital administration respond in providing personal protective equipment (PPE) during the COVID-19 pandemic?	(83; 63.3 %)
Q32- Are there regularity visits by the Ministry of Health to ensure the Standard Infection Control precautions in your facility?	(23; 17.7 %)
Q33- Did you think that all Infection Control Precautions are sufficient and satisfied in Khartoum hospital during the COVID-19 Pandemic?	(17; 13.1 %)

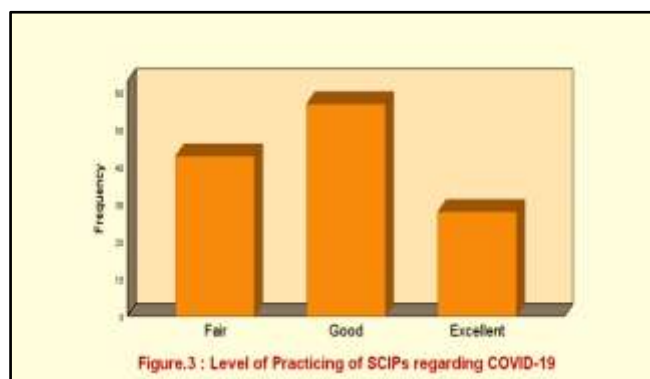
Table 4.c shows the association relationship between the demographic profession group and their dealing with confirmed COVID-19 patients or suspected COVID19 cases in the radiology department, and well as, their practicing of Standard Infection Control Precautions (SICPs) in Radiology Departments against COVID-19. It reveals Physicist and radiologists achieved the highest percentage of correct answers (95 % and 89.10, respectively). Where the lowest percentage of correct answers came from radiographers and radiotherapists (68.70 % and 75, 83 % respectively).

Table 4.c Percentage of correct responses in Profession group:

	Profession				
	Radiographer N= 77	Radiologist N= 28	Radiotherapist N= 6	Sonologist N= 4	Physicist N= 15
Q10	41.2	31.4	3.9	3.9	19.6
Q11	45.6	28.1	3.5	3.5	19.3
Q12	43.2	36.4	9.1	2.3	18.2
Q13	46.0	28.0	8.0	2.0	16.0
Q14	64.7	24.4	4.4	6.7	17.2
Q15	44.8	29.9	6.0	7.0	13.4
Q16	50.0	17.6	8.8	8.8	14.7
Q17	48.4	25.8	6.5	6.5	12.9
Q18	37.2	32.6	11.6	7.0	16.3
Q19	88.8	25.2	4.7	2.8	12.1
Q20	50.7	22.4	7.5	4.5	14.9
Q21	51.6	20.3	7.8	4.7	15.6
Q22	63.6	20.0	5.5	3.6	7.3
Q23	58.9	18.7	5.6	3.7	13.1
Q24	56.4	20.5	2.6	5.1	15.4
Q25	61.0	23.8	1.9	2.9	10.5
Q26	56.4	23.4	3.0	3.2	13.8
Q27	61.0	23.8	5.6	2.9	10.5
Q28	71.6	14.9	3.7	3.0	6.0
Q29	55.1	24.7	3.6	2.2	13.5
Q30	58.0	25.9	0.0	1.2	11.1
Q31	54.2	25.3	0.0	1.2	15.7
Q32	34.8	34.8	0.0	0.0	30.4
Q33	47.1	35.3	0.0	1.0	11.8
<i>Median of Percentages of correct answers/ n</i>	68.70 %	89.10 %	75.83 %	83.75 %	95 %

The rate of correct answers among participants ranged between 33 and 100%. The mean score of complete knowledge and awareness regarding SICPs and COVID-19 was 1.7 (SD = 0,7, Question: 5-9). Of all participants, 39.2% achieved less than seven correct answers, 43.9% answered between seven and nine correct answers, and 15.9 % had more than eleven correct answers out of a total of 9 questions, which reflects low, medium, and high knowledge, respectively. in Figure 2, whereas the rate of correct answers among participants ranged between 39 and 100%. The mean score of complete practicing of SICPs when they came in contact with confirmed COVID-19 patients or suspected COVID19 cases in radiology departments was 1.88 (SD = 0.73, Question 10 -33). Of the total of participants, 33.6% achieved less than 39 correct answers, 43.3% answered between 39 and 51 correct answers. And 21.9% had more than 51 correct answers out of a total of 33 questions, which reflects fair, good, and excellent practicing, respectively. Figure 3.





III. Discussion

Since its initial novel outbreak of coronavirus in China in December 2019, the COVID-19 disease spread quickly and has had a cascading effect worldwide, affecting both global health services and economies. According to the Federal Ministry of Health (FMH) last update on June 28, 2020, more than 36658 individuals have been confirmed positive in Sudan [10]. Employees in radiology departments are in directly close contact with COVID-19 patients, they are exposed to many risks during their work especially respiratory infection [11]. So their knowledge and implementation of infection control precautions are crucial to attempt to prevent or slow down the spread of this contagious virus. Overall, this study shows that radiology departments staff in different hospitals in Khartoum state have an adequate knowledge of SICPs and COVID-19 guidelines, where an overall percentage of 49.68 % correct answers when we asked them about their background about SCIPs and COVID-19. A higher percentage of correct responses were from consultant medical staff, and the lowest was from undergraduate students. Although this study found that many radiology staff had acceptable attitudes when they dealing with confirmed COVID-19 patients or suspected COVID19 cases in radiology departments, where was the total percentage of correct answers when they were asked about practicing of SIPCs was 55,55 %.The relationship between Practicing of Standard Infection Control Precautions (SICPs) in Radiology Departments against COVID-19 and professional participants revealed that physicists and radiologists achieved a high percentage of correct answers (95 % and 89.10, respectively). This study shows that there is a strong need to implement periodic educational interventions and training programs on infection control practices for COVID-19 across all healthcare professions in the radiology departments, These findings are consistent with related studies with other healthcare providers that showed there is a need to establish a central regulating body and promote IPC training programs to create more awareness among the concerned individuals in Sudan [12].

IV. Conclusion

In conclusion, upon the date of submission of this paper, this is the first study to measure and evaluate the practicing of Standard Infection Control Precautions (SICPs) regarding COVID-19 among radiology staff in Khartoum state. This study found that the knowledge and practicing of SICPs by radiology departments staff were acceptable, as indicated by our results. However, it clearly illustrate the need for more continuous training in order to increase awareness and implementation of standard infection control precautions and thus minimize infection exposure.

Abbreviation list:

SICPs - *Standard Infection Control Precautions.*
WHO - *World Health Organization*
CDC - *Chinese Center for Disease Control and Prevention.*
FMH - *Federal Ministry of Health in Sudan.*
PPE - *Personal Protective Equipment.*
SARS-CoV-2 - *Severe Acute Respiratory Syndrome Coronavirus.*

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Conflicts of Interest:*The authors declare no conflict of interest.*

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