

Preparedness of Radiology Departments against COVID-19: An Online Survey

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ABSTRACT

Objectives: To determine the preparedness of the radiologists and their departments against COVID-19 and the impact of institution type, training, and written guidelines

Methodology: We conducted this survey by sending an online questionnaire to practicing radiologists in April 2020. The questionnaire included queries about institution (type, training status, written guidelines) and the preparedness against COVID-19. The groups sorted by institution were compared for preparedness i.e. appropriate personal protective equipment (PPE), equipment decontamination protocol, and infection prevention measures (IPM) for public (screening, masks, social distancing, and hand sanitizers).

Results: We received 100 responses out of which 72% were from females. The mean age of the respondents was 37.2±8.2 years. Government institutes (68%) did not differ from private institutes (32%) except in screening at the entrance of the institute [7/68 (10.2%) vs. 9/32 (28.1%), p-value: 0.039], respectively. Comparison of training institutes (32%) with non-training institutes (68%) revealed higher adherence of radiologists to the appropriate PPE [30/32 (93.7%) vs. 44/68 (64%), p-value: 0.001] and equipment surface decontamination [22/32 (68.7%) vs. 18/68 (26.4%), p-value: 0.029]; however, the difference between IPMs for public was not statistically significant. Institutions that provided written guidelines, achieved significant impact on masks (cloth/surgical) and social distancing for public, in addition to appropriate PPE by radiologists and surface decontamination of equipment.

Conclusion: Institutional training combined with written guidelines has significant impact on preparedness of radiologists and radiology departments against COVID-19.

Key words: Personal Protective Equipment, infection control, public health practice, decontamination, training, guidelines

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INTRODUCTION

Corona Virus Disease-19 (COVID-19) is a highly infectious disease, first identified in Wuhan, China in December 2019, and declared a pandemic by the World Health Organization (WHO) within a span of four months¹. Pakistan reported its first case on February 26, 2020 and by May 2020, more than 209,000 COVID-19 positive cases had been reported including healthcare workers (HCW)². Insufficient data is available related to the spread of infection in hospital settings; however, reports suggest that HCWs make up 3% to 11% of the positive cases³.

Radiological examinations including X-ray and computed tomography (CT) chest are instrumental in the diagnosis and management of COVID-19 and its related complications⁴. The key role of radiology leads to proportional increase in the risk of healthcare associated infection within the radiology departments³. There have been reports of infection acquired by radiology staff during examination of patients. Strict infection control practices are required during and after imaging of a suspected case and failure to do so may lead to cross-infections⁵.

Although the breakthrough discovery of COVID-19 vaccine early in year 2021 has changed the landscape; however, its manufacturing, procurement, and execution across a critical percentage of the population to achieve herd immunity would take quite a long time. Therefore, still the most important step is to break the chain of transmission. In radiology departments, various safety measures are suggested in the wake of current pandemic

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especially social distancing, appropriate PPE, hand hygiene, and equipment disinfection⁶⁻⁹, which can be achieved by training and enforcing protocols^{10,11}. This aim has huge bearing especially in a developing country with limited resources to fight the disease.

Therefore, we sought to ascertain the preparedness of radiologists and radiology departments against COVID-19 in a developing country in order to identify the lacunae in the existing systems which should be addressed with effective and timely interventions. The objective was to determine the preparedness against COVID-19 i.e. appropriate use of PPE by radiologists, the equipment surface decontamination and IPMs in public areas of the radiology departments, and the impact of institution type, training and written guidelines on it.

METHODOLOGY

This was an online, unlinked, and anonymous survey on 'Google Forms' conducted in April, 2020. It included consent to participate and was approved by the Ethical Review Board (PMEC reference#128). Convenient sampling was used to send the link of online form to practicing radiologists via WhatsApp and email for their responses alongwith the request to forward the link to radiologists in their directory (snowballing) until the desired sample size was achieved.

The content of instrument focused on the institution type (government or private), training received for IPMs against COVID-19 (yes or no), written guidelines (yes or no), and the preparedness of radiologists and radiology departments against COVID-19 e.g. PPE, hand hygiene, social distancing (seating/queue arrangement with 1-2 m distance), professional distancing (workstation and seating arrangement with 1-2 m distance), and IPMS in public areas of radiology departments (screening at the entrance, hand sanitizers in public areas, social distancing with 1-2 m in queues/sitting areas, compulsory cloth/surgical masks for every patient/visitors).

As per CDC and Royal College of Radiologists^{12,13}, appropriate PPE for Group-A radiologists (posted in ultrasound, conventional, and interventions) include mask (surgical for ultrasound and conventional radiology; N-95 for interventional radiology), gown and glove as appropriate PPE. For Group-B (posted in cross-sectional imaging), at least a surgical mask was considered appropriate PPE against infection transmission to and/or from co-workers.

Using the lowest compliance for hand hygiene i.e. 40.7% reported by Xu et al.¹⁴, using 95% confidence

level and 10% bound of error (Since there was a lack of qualified radiologists and early publication of this information was considered vital, the authors used a higher level of bound of error at 10%), a sample of 93 was calculated by World Health Organization software for Sample Size Determination in Health Sciences. We decided to inflate the sample size to 100 participants.

Analysis was conducted on SPSS version 21. Frequencies with percentages were calculated for categorical variables and means with standard deviations for continuous variables. Comparison of institute type (government with private), training with non-training institutes and written guidelines (yes or no) was done with chi-square test for the outcome variables signifying preparedness i.e. appropriate PPE, surface decontamination of machines and IPMs in public areas of radiology departments.

RESULTS

We received 100 responses in four days in which the majority of respondents were serving in university hospitals (55%), followed by those in tertiary care centers (26%). The mean age of participants was 37.2±8.2. Majority of participants were females (72%) and worked in government hospitals (68%). Fifty-three percent (53%) of all respondents were posted in cross sectional reporting (Table 1).

Table 1: Summary of the Responses

Variable	Frequency (n=100)
Demographics	
Sex	
Female	72
Male	28
Institute	
Government	68
Private	32
Set up	
University Hospital	55
Tertiary care center	26
Diagnostic Radiology center	17
Others	2
Current Posting	
CT/MRI	53
Ultrasound	28
X-ray/Fluoroscopy/Mammography	10
Interventional Radiology	09

Table 2: Summary of the Infection Prevention Measures for Radiologists and Their Departments

Variable	Frequency (n=100)
Infection Prevention Measures Practiced by Radiologists	
Hand wash/sanitization before and after interacting with patients	92
PPE used by radiologists	
· Surgical Masks	85
· Gloves	81
· Sanitizers	72
· Gowns	30
· N-95	24
· Plastic Aprons	13
· Full PPE suit e.g. tyvec	7
· Goggles/eye shield	5
Hand sanitization at workstation	72
Ensure patients wear masks during procedures/scan	41
Infection Prevention Measures Practiced by Institutes to Protect Employees of Radiology Departments	
Optimized workforce (reduced working days and employees)	88
Mandatory use of at least surgical masks by all HCWs	69
Provision of sanitizers around workstations	62
Promoting social distancing (1-2m) within the radiology department premises	44
Separate workstations	42
Disinfection protocol following imaging of a suspected or confirmed COVID-19 patient	40
Generated some guidelines for radiology department	39
Contingency plan for at-risk staff (e.g., pregnant, other defined risk groups) including job expectations and potential alternate roles and locations	37
Formal infection control training of employees	32
Family support	15
Reporting from home	7
Infection Prevention Measures Practiced by Institutes to Protect Patients and Visitors in Radiology Departments	
Surveillance on patients to wear at least cloth masks in public areas	13
Queue management with 1-2 m distance	19
Seating arrangement with 1-2 m distance	25
Screening (thermal/history) at the entrance	16
Hand sanitizers in public areas	22

Radiologists reported favorable adherence to individual IPMS; highest being hand hygiene followed by masks (Surgical/N-95) and gloves (Table 1). However, the PPE level of 26% radiologists was found to be inappropriate and deficient. On further analysis, the use of appropriate PPE reported by Group-A radiologists posted in cross-sectional imaging (51/53, 96.2%), was higher than Group-B radiologists posted in interventional radiology (4/9, 44.4%), ultrasound (14/28, 50%) and conventional radiology (5/10, 50%), and the difference among the four categories was statistically significant (p-value- 0.001).

IPMs practiced by institutions to protect the employees (Table 2) were favourable in terms of workforce optimization by reducing the working days from a routine of six days a week to reduce foot count and exposure (88%), mandatory use of at least surgical masks by all HCWs (69%), and supply of sanitizers around workstations (62%). However, social distancing, surface decontamination, training, guidelines and employee support were the neglected areas (Table 2). The most neglected of all were the IPMs of the institutes needed to protect the public against COVID-19 (Table 2).

Table 3.1 Preparedness of the Institutes Where Radiologists Received Training Against COVID-19 Compared to The Institutes Where Radiologists Did Not Receive Training

	Training (n=32)	No Training (n=68)	p-value
Appropriate PPE by Radiologists	30 (93.7%)	44 (64%)	0.001
Infection Prevention Measures for public			
Social distancing (seating/queues at 1-2 m) for public	21 (65.6%)	12 (17.6)	0.64
Masks (cloth, surgical) mandatory for everyone	04 (12.5%)	07 (10.2%)	0.74
Hand sanitizers in public areas	10 (31.2%)	12 (17.6%)	0.19
Screening (temperature, history) at entrance	08 (25%)	08 (11.7%)	0.14
Surface decontamination following imaging of a suspected or a confirmed case	22 (68.7%)	18 (26.4%)	0.029

Table 3.2 Comparison of Preparedness Between Government and Private Institutes

	Government (n=68)	Private (n=32)	p-value
Appropriate PPE by radiologists	51 (75%)	23 (71.8%)	0.8
Infection Prevention Measures for Public			
Social distancing (seating, queues at 1-2 m) for public	22 (32.3%)	11 (34.3)	1.0
Masks (cloth, surgical) mandatory for everyone	06 (8.8%)	05 (15.6%)	0.32
Hand sanitizers in public areas	13 (19.1%)	09 (28%)	0.31
Screening (temperature, history) at entrance	07 (10.2%)	09 (28.1%)	0.039
Surface decontamination following imaging of a suspected or a confirmed case	24 (35.3%)	16 (50%)	0.19

Table 3.3 Preparedness of the Institutes Where Radiologists Received Written Institutional Guidelines Compared to The Institutes Where No Guidelines Were Received.

	Guidelines (n=39)	No guidelines (n=61)	p-value
Appropriate PPE by Radiologists	33 (84.6%)	41 (67.2%)	0.042
Infection Prevention Measures for Public			
Social distancing (seating, queues at 1-2m) for public	20 (51.3%)	13 (21.3%)	0.002
Masks (cloth, surgical) mandatory for everyone	10 (25.6%)	6 (10%)	0.038
Hand sanitizers in public areas	11 (28.2%)	11 (18%)	0.171
Screening (temperature, history) at entrance	7 (17.9%)	04 (6.6%)	0.075
Surface decontamination following imaging of a suspected or a confirmed case	22 (56.4%)	18 (29.5%)	0.007

Comparison of government institutes with private institutes did not yield any statistically significant differences of dependent variables except screening at the entrance of institute [7/68 (10.2%) vs. 9/32 (28.1%), p-value: 0.039], which was 17.9% higher in private than in government institutes (Table 3.1). Comparison of training institutes with non-training institutes revealed better adherence to the use of appropriate PPE [30/32 (93.7%) vs. 44/68 (64%), p-value: 0.001] and surface decontamination of equipment [22/32 (68.7%) vs.

18/68 (26.4%), p-value: 0.029]; however, the difference of IPMs for public was not statistically significant (Table 3.2).

Institutions that provided written guidelines, achieved significant impact on the use of masks (cloth/surgical) by everyone entering the department and social distancing for public (1-2 m in queues/seating), in addition to appropriate PPE by radiologists and surface decontamination of equipment (Table 3.3).

DISCUSSION

In this study, the radiologists report favorable adherence to individual infection prevention measures; however, 26% of respondents were still using inappropriate PPE at their postings. Training of radiologists yielded 30% and 40% higher adherence to appropriate PPE and equipment surface decontamination, respectively; while the guidelines achieved added impact on use of masks (cloth/surgical) and social distancing for public. IPMS of government institutes did not differ from the private institutes except screening at the entrance i.e., 17.9% higher in the private than in government institutes.

There were a few limitations of our study: (i) radiographic technicians and nurses working in the radiology departments were not included; (ii) our study demonstrated gender bias (70% females). Females stay cautious about IPMs for the sake of family; thus overestimating the over all adherence to individual practices; (iii) designation and/or work experience of the radiologists was not included in our questionnaire; (iv) The survey was conducted early in lockdown during the first wave of COVID-19 with experience of six weeks following the first diagnosed case.

This survey highlights several lacunae in the existing system of radiology set ups in Pakistan: (i) lack of formal training of employees, (ii) non centralized guidelines, (iii) shared workstations and/or improper social distancing, (iv) suboptimal droplet/airborne precautions in suspected or confirmed COVID-19 patients, (v) limited contingency plan for at-risk staff or family support services, (vi) scarce reporting from home facility, (vi) Lack of surveillance on patients to wear masks in public areas and maintain social distance, and (vii) screening (history, temperature) at entrance to detect high risk patients. State of the art healthcare systems throughout the world are suggesting strict protocols, to fill these lacunae^{5,10}, and contingency plans taking into consideration factors such as illness, pregnancy, and school closures^{9,14}.

The training of radiologists was associated with significant increase in the appropriate use of PPE by 30% in all areas of posting (Table 3.1). As the radiologists keep rotating from one to the other station, therefore, training of the staff is highly advocated in the literature concerning COVID-19^{5,10,15}. It is important to note that only 41% radiologists reported to ensure that patients were wearing masks, which means that the training has major impact on personal protection; while the protection of public requires protocols and refined management by the department or institute¹⁴.

In our study, 99% radiologists reported wearing masks (surgical mask/N-95) and a similar response has been reported from China with use of masks by 100% participants¹⁴. This study from China reported 99% compliance to wearing a mask and temperature screening at the entrance, which in our case are reported only at 13% and 16%, respectively. In our study, 92% radiologists reported practicing hand hygiene especially before and after interaction with the patients. On the contrary, 22% reported availability of sanitizers in public areas that means 78% of public did not have access to sanitizers. The similar kind of neglect was observed from China¹⁴, with 40.7% compliance rate of hand hygiene.

For infection prevention and control, World Health Organization (WHO) strongly recommends training of healthcare workers⁵, reported only by 32% of the participants. Training is crucial because a study conducted by Bello et al. in Ghana, way before COVID-19 pandemic, revealed intermediate knowledge of standard infection control measures among radiology department technicians¹⁶. Xu *et al.* summarized the IPMS against COVID-19 in non-isolated areas in a general hospital, and they reported no hospital acquired infection among staff when they developed and implemented standards for prevention and control¹⁴. Similar results were also reported by Cheng et al. in Hong Kong¹⁷.

During SARS outbreak in 2003, King et al. concluded that radiology staff was not familiar with infection control practices and suggested that standardized operating procedures should be imparted to minimize spread of infection via staff or radiology equipment¹⁸. In our study, 60% of radiologists reported no post procedural decontamination procedures. This is alarmingly high considering extreme contagious nature of COVID-19¹⁹. Studies conducted before COVID-19 pandemic suggest that standardized cleaning of medical equipment can reduce hospital acquired infection by up to one-third²⁰. The studies conducted during COVID-19 pandemic era suggest that hospitals should devise appropriate protocols for decontamination of imaging rooms with proper PPE worn by radiology technologists, including CT and MR machine gantries, ultrasound probes, blood pressure cuffs, image viewing station mouse, and keyboard^{15,21}.

The utility of radiology is increasing and the radiology department is a common place, visited frequently by staff (doctors, nurses, and nursing aides), patients, and attendants with the capacity to spread infection in all the directions. In spite of international and national recommendations and guidelines^{12,13,22,23} for optimum

use of radiology and infection control measures, noncompliance by radiologists, technicians, other HCWs, patients or attendants in radiology departments is unacceptable as the consequences can be disastrous for healthcare workers as well as the community^{5,8}.

CONCLUSION

It is not the type of institute (government or private) that determines the preparedness against COVID-19. It is the institutional training combined with written guidelines that leaves significant impact on the preparedness of radiologists and their departments during a pandemic. Radiology departments have a central place in modern healthcare systems, hence, these are visited by various HCWs and public. Institutional training and written guidelines have strong potential to diminish the transmission of COVID-19.

Authors' contribution: NR worked on introduction, methodology, and proof reading. BR worked on data collection, interpretation, and writing of manuscript. AS conceived the idea, worked on discussion, and proof read. GM worked on statistical measures using SPSS, worked on results, and proof read.

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