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RESEARCH ARTICLE

Knowledge of infection prevention and control practices among health care workers caring for patients with suspected or confirmed COVID-19: a cross-sectional study [version 1; peer review: 1 approved, 1 approved with reservations]

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Abstract

Background: The COVID-19 pandemic is increasing rapidly. Hospital acquired infections enhance local outbreaks, impacting the vulnerable populations. Infection prevention and control practices (IPC) refer to all the activities used to reduce the risk of infection spread. This study aims to estimate the proportion of health care workers (HCWs) who acquired SARS-CoV2 infection, and evaluate their knowledge to IPC and suggest recommendations to reduce the risk of SARS-CoV2 infection.

Methods: This is a cross-sectional study conducted in Egypt from June 8, 2020, till August 19, 2020. A purposive sample of 518 HCWs from different governorates was included in the study. HCWs filled a structured questionnaire developed by the World Health Organization on a Google Form and a printed copy. The questionnaire link was shared on social media forums including HCWs such as Facebook.

Results: The mean age of HCWs was 33±7 and 65% were males. The majority of health care workers were affiliated with the Ministry of Health and Population (62.5%), recruited from Cairo (52.4%), and were physicians (78.2%). About 11% of the HCWs had been infected with SARS-CoV2. Their mean knowledge percent score regarding IPC was 36.19 ± 11.26. The highest rate of infection was among those with

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little experience ($p=0.002$), and those worked inside Cairo ($p=0.018$). About 89% mentioned that the leading cause of infection with SARS-CoV2 was the shortage in Personal Protective Equipment (PPE). About 42% recommended raising the awareness for the importance of IPC to decrease risk of infection.

Conclusions: HCWs had a low score of knowledge toward IPC. There was a considerable proportion of SARS-CoV2 infection among them. Lack of knowledge and shortage of PPE were the contributing factors. It is necessary to provide juniors with IPC training, and hospitals with sufficient PPE.

Keywords

Infection control, COVID-19 pandemic, health care workers, health care facilities

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Introduction

A pandemic of SARS-CoV2 was proclaimed on March 11, 2020.¹ As of March 26, 2020, more than 150 countries have registered more than half a million cases of COVID-19 globally. In all EU/EEA countries and the UK, the number of confirmed cases of COVID-19 is expanding, accounting for a growing share of the global cases.²⁻⁴

Healthcare facilities associated infections is considered a serious public health problem.⁵ Nosocomial outbreaks accounts for a substantial share of local outbreaks, hurting elders and exposed populations disproportionately.⁶ Infection prevention and control practices (IPC) encompass all measures taken to limit the risk of infection spread. IPC practices could be clustered into two classes: standard precautions and transmission-based precautions.⁷ IPC practices are vital to protecting health systems' functioning and mitigating the effects on vulnerable communities.⁸

According to the COVID-19 Situation Report by World Health Organization (WHO) 82, 52 countries had identified a total of 22,073 health care workers (HCWs) had caught COVID-19.⁹ Among total cases, the median percentage of HCW infection was 10.04% (range 0–24.09%). HCWs had a median fatality rate of 0.8% (range 0–18.95%). Indonesia had the highest case fatality rate (18.95%), followed by Uzbekistan, Iran, and Egypt, which had a 6.52% case fatality rate. The United States had the lowest recorded case fatality rate, at 0.29%.¹⁰

According to the Egyptian Medical Syndicate, since the outbreak of coronavirus in Egypt in mid-February, at least 68 frontline HCWs have died, and more than 400 have been confirmed positive, with a very high mortality rate of 15.8% which needs a clear justification by the health authorities.^{11,12}

IPC are considered a top priority for slowing infection transmission in healthcare facilities, reducing the demand for specialized healthcare, such as intensive care unit beds, protecting vulnerable groups, shielding healthcare workers, and finally preventing the spread of cases to other healthcare facilities and the general public.⁶

Coronaviruses are mostly believed to be transmitted via large respiratory droplets, getting in contact with infected fomites and breathing the aerosols generated during Aerosol Generation Procedures (AGPs). Aside from the protection by the different components of PPE, the virus' transmissibility at several stages of the disease remains uncertain. Consequently, attention should be applied when considering these elements.^{13,14} Except for AGPs, it is unknown if facial filtering piece (FFP) respirators offer the best protection against other coronaviruses and respiratory viruses such as influenza than surgical masks.^{15,16} As a result, a reasonable option would prioritize the use of Filtrating Face Piece (FFP2/3) respirators for therapeutic methods with a high risk of transmission, such as intensive care or AGPs.^{14,17}

COVID-19 spread among HCWs is exacerbated by a lack of awareness and knowledge of infection control measures among these workers.¹⁸ Therefore, applying preventive measures is the most critical intervention to control COVID-19 infection. HCWs display a greater risk of infection, as explained by their constant contact with patients. The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recently released recommendations for COVID-19 prevention and control among HCWs.^{19,20}

This study will estimate the proportion of SARS-CoV2 infection among HCWs at various health care facilities in Egypt, as well as assess healthcare workers' knowledge toward IPC while taking care for suspected or confirmed COVID-19 patients, primarily in settings with wider community transmission, based on the facts mentioned above. Finally, this study will explore the association between infection prevention and control practices knowledge and the proportion of infection among HCWs.

The objectives of this study are:

1. To determine the proportion of SARS-CoV2 infection among the participating HCWs.
2. To assess knowledge of IPC among HCWs caring for suspected or confirmed COVID-19 cases.
3. To discover the relationship between HCWs' knowledge and the proportion of SARS-CoV2 infection among them.
4. To suggest recommendations to reduce the risk of SARS-CoV2 infection among HCWs who care for confirmed or suspected COVID-19 cases.

Methods

Study design: We conducted a cross-sectional analytical study to assess the knowledge of HCWs to infection control practices caring for confirmed or suspected COVID-19 cases.

Sample size and technique: Purposive sample of 518 participants was targeted mainly through electronic data collection. The sample size was estimated based on evidence from a previous study assessing knowledge and practice of HCWs toward infection prevention and control practices conducted in 2018 due to lack of studies assessing the same issue in context with COVID-19 pandemic at the time of conducting our study.²¹ Considering the knowledge percent score as a primary outcome, Epi-calc 2000 (version 1.01) was used to calculate the sample size of this study. Assuming 80% power, a 0.05 level of significance, and an estimated proportion of 85%,²¹ the sample size was estimated to be 469 participants. After adding a non-response rate of 10%, so the estimated sample size was 516, but the final sample included 518 participants.

Study population and setting: The study was conducted on HCWs from different Egyptian governorates, affiliated with the Ministry of Health and Population (MOHP), academia, police/military hospitals, as well as freelancers.

Inclusion criteria: All HCWs' categories, physicians, pharmacists, and nurses, who approved participating in the study, were recruited.

Exclusion criteria: Non-HCWs and who were not fluent in English or could not complete the questionnaire were excluded.

Data collection tool: Based on the tool developed by WHO,²² a self-administered structured questionnaire composed of 29 questions was designed. Questions were presented in the English language. The authors checked content and face validity. The questionnaire was piloted on 26 HCWs who were excluded from the analysis. No modification in the questionnaire was needed based on the pilot testing. The internal consistency of the study questionnaire was assessed by calculating the Cronbach alpha. The value was 0.75 for the knowledge section. No potential sources of bias had been facing the investigators since data collection was mainly based on the electronic method. HCWs were asked to submit their e-mail address at the end of the survey to avoid duplicate entries; duplicate entries with the same e-mail address were excluded before analysis, and the first entry was maintained.

An online data collection method was used in line with lockdown measures conducted in Egypt to achieve social distancing. An online Google form was created, and participants were invited to complete and submit it. The questionnaire link was shared on social media forums including HCWs such as Facebook, Twitter, and What's App. 488 questionnaires were done as Google forms. About 32 copies of the questionnaire have been printed and disseminated to HCWs who worked at health care facilities that lacked internet connections through the help of two house officers and two residents in these health care facilities. Data were collected from June 8, 2020, till August 19, 2020 (No follow-up was done).

The questionnaire enclosed the following sections: (I) Socio-demographic characters and history of getting SARS-CoV2 infection: age, gender, affiliation, specialty, education, years of experience, place of work, attendance of any IPC courses and getting SARS-CoV2 infection diagnosed by the Polymerase Chain Reaction (PCR) test; (II) Knowledge section entailed knowledge questions covering the primary general information of infection prevention and control practices, specifically a) Applying standard precautions for all patients. b) Contact and droplet precautions, airborne precautions for aerosol-generating procedures, using environmental and engineering controls; (III) Two questions assessing HCWs' opinions and attitudes about underlying causes for widespread SARS-CoV2 infections among HCWs and their suggestions for improving adherence to IPC, improving infection control situation and decreasing the risk of SARS-CoV2 infections among them by answering an open-ended question.

For each of the 15 knowledge questions, a score of one point was assigned to the correct response, and a score of zero was assigned to the incorrect response. In the case of multiple-choice questions, choosing all the correct answers was scored one point while choosing some of the correct answers was scored 0 with the maximum score to be 15 (percent score = total score of every participant/15*100). Those attained ≥ 5.5 points (out of 15 points, the average for the score) were assigned as being knowledgeable, while those who attained < 5.5 points were assigned as being not knowledgeable.

Data analysis: The data were coded by two of the authors and exported on a data sheet prepared on Microsoft Excel program, version 2013. The data was analyzed using SPSS version 24. Simple descriptive statistics were used to create a

summary and simple frequency of quantitative data. The bivariate analysis was carried out and displayed in cross-tabulations, with proportions being compared using the chi-square and Fisher's exact tests as needed. To compare normally distributed data, an independent T-test was performed. P-value < 0.05 was used as the significance level.

Ethics approval and consent to participate: The Faculty of Medicine's ethical committee, Suez Canal University approved the study protocol (IRB number 4189-5-2020). Throughout the analysis, we protected participants' identities by keeping the data of the participants confidential and asking participants to provide truthful answers. The participation was non-compensated and voluntary. We put the informed consent in the first part of the online and printed questionnaire, and if participants refused to give consent to participate, they had been unable to complete the form. Participants had to choose by checking a box if they agree or refuse to participate in the study and publishing their result. Therefore, completion of the questionnaire denoted participant's agreement to participate in the study and publish their results.

Results

A total of 518 HCWs (65% males and 35% females) were included in this study. The Age range was (23 – 69) years, with a mean age of 33 ± 7 years and median (IQR) years of experience 7 (4–10). The majority of the participants were affiliated with the Ministry of Health and Population (MOHP) with a total percentage of 62.5%; 22.4% participants were affiliated to academia; and 3.1% were working at military hospitals. Our study included participants from 21 Egyptian governorate, the highest recruitment was from Cairo (52.4%), Giza (16.2%), Dakahlia (5.8%), Kafr Elsheikh (5%), and Alexandria governorates (3.9%). The majority of the participants were physicians (405/78.2%), followed by pharmacists (52/10%), dentists (39/7.5%), nurses (18/3.5%) and technicians (4/0.8%). The level of education obtained by the participants mainly were Bachelor and Master's degrees (35.5% and 32.4%, respectively), followed by a doctorate (15.1%), diplomas (10.4%), and obtained fellowships and higher institutes graduates (6.6%). The majority of our participants were entry-level physicians considered the frontline HCWs against the COVID-19 pandemic. Our participants' seniority level was mostly residents (32.4%) followed by participants who were specialists (27%), which corresponds to entry-level physicians with fewer years of experience. The specialties of physicians who took part in this survey were primarily internal medicine physicians (10.8%), clinical and chemical pathologists (8.9%), followed by anesthesiologists (ICU) (8.5%), pediatric (6.6%) and radiologists (6.2%) of the sample.

Out of the 518 HCWs, those who have taken infection prevention control courses were 54.4%. About two-thirds of HCWs working in Cairo governorate were infected compared to only 33.3% of those working outside Cairo (P-value = 0.018; OR = 1.965; 95% CI: 1.113-3.466). Regarding the years of experience, 76.7% of those working less than seven years were infected compared to 23.3% of those working more than seven years (P-value = 0.002; OR = 2.650; 95% CI: 1.416-4.958). About 93% of the infected group reported the presence of infected HCWs in their working facilities compared to 80% among the non-infected group (P-value = 0.014; OR = 3.422; 95% CI: 1.209-9.690) (Table 1).

As regards IPC knowledge association with infection among HCWs, less than 2% (10 participants) preferred not to declare if they had SARS-CoV2 infection, so they were excluded from the analysis. Wearing appropriate PPE while cleaning soiled bleeding toils and linens from patients with COVID-19 was significantly associated with lower proportion of infection (P-value = 0.011; OR = 2.318; 95% CI: 1.193-4.504). The knowledge about importance of wearing boots, impermeable aprons as routine PPE for HCWs caring for patients with suspected or confirmed COVID-19 was significantly associated with lower proportion of infection (P-value = 0.042; OR = 1.997; 95% CI: 1.016-3.546). The attitude towards the importance of specialized or referral hospitals for patients with suspected or confirmed COVID-19 infection when hospitalization is needed was significantly associated with lower proportion of infection (P-value = 0.005; OR = 2.298; 95% CI: 1.277-4.149) (Table 2). The knowledge score among HCWs was 5.43 ± 1.69 (percent score = 36.19 ± 11.26) (Table 3). The score was not significantly different between physicians and other HCWs among the study population (P-value = 0.824) (Table 4).

Regarding HCWs opinions about the high proportion of infection among them, they reported that the primary cause was PPE shortage (88.8%) and the least cause was their misbelief in the effectiveness of PPE (8.1%) (Figure 1). As for further suggestions to improve the infection control situation, adherence to IPC and decreasing the risk of SARS-CoV2 infection among HCWs taking care of patients with suspected or confirmed COVID-19 cases: the highest proportion of HCWs (42%) recommended raising the awareness for the importance of IPC among HCWs, an equal proportion of HCWs (12.9%) suggested both providing a proper system for IPC with punishment for the non-adherent, and advising to perform frequent testing every two weeks for HCWs in isolation hospitals, while the lowest proportion of HCWs (3.2%) suggested depending on CT for diagnosis of SARS-CoV2 infection (Figure 2).

Discussion

The novel COVID-19 pandemic is the center of attention worldwide, causing a massive burden on economies, health care systems, and HCWs.¹⁰ The cumulative number of infected cases is over 83 million reported cases and over 1.8 million

Table 1. The relation between socio-demographic characteristics and infection with SARS-CoV2 among the study population (n = 508).

		Did you get a COVID-19 infection?				P-value	OR	95% CI	
		Infected		Not infected					
		N (60)	% (100)	N (448)	% (100)			Lower	upper
Age	≤ 32 years	12	20.0%	66	14.7%	0.288	1.447	.730	2.869
	> 32 years	48	80.0%	382	85.3%				
Where do you work?	Cairo	40	66.7%	226	50.4%	0.018*	1.965	1.113	3.466
	Outside Cairo	20	33.3%	222	49.6%				
Years of experience	≤ 7 years	46	76.7%	248	55.4%	0.002*	2.650	1.416	4.958
	> 7 years	14	23.3%	200	44.6%				
Have you ever taken any infection control courses or certificates? (yes responses)		38	63.3%	238	53.1%	0.136	1.524	.873	2.660
Is there any health care worker in your facility tested positive for COVID-19? (yes responses)		56	93.3%	360	80.4%	0.014*	3.422	1.209	9.690
Affiliation	Cairo university hospital	24	40.0%	114	25.4%	0.062			
	Military/Police hospitals	2	3.3%	14	3.1%				
	Ministry of Health and Population	28	46.7%	288	64.3%				
	Private organization	6	10.0%	32	7.1%				
HCWs categories	Physician	50	89.3%	347	77.4%	0.23			
	Pharmacist	4	7.1%	48	10.7%				
	Dentist	2	3.6%	35	7.8%				
	Nurse	0	0%	18	4%				
	Technician	0	0%	4	0.9%				

*Significant P-value (≤ 0.05).

**Chi-square test.

deaths globally since the pandemic started.⁹ In Egypt, the cumulative number of cases is over 148 thousand reported cases and over eight thousand deaths since the pandemic, with a case fatality rate of 5.5%.¹¹ The infection rate among HCWs is 2.37% of the total confirmed cases, with a case fatality rate 6.52% with 244 tests per million.¹⁰

HCWs displays amplified occupational risk of acquiring COVID-19 infection and higher mortality rates due to a shortage of PPE and inapplicable social distancing within the healthcare work environment.^{23,24} Evidence concerning the burden of COVID-19 infection in HCWs is still insufficient.¹⁰ Strengthening and applying infection control measures in all health facilities is crucial to limit the spread of COVID-19 infection among HCWs.²⁵

Here, our aim was to explore the proportion of SARS-CoV2 infection among HCWs in Egypt, to assess their knowledge of infection control practices, its relation with the proportion of SARS-CoV2 infection among them, and to suggest recommendations for decreasing the risk of SARS-CoV2 infection among HCWs caring for confirmed or suspected COVID-19 cases.

We found that 82.2% of respondents have reported having a colleague within their working facility tested positive for COVID-19. In contrast, around 11% of HCWs themselves were admitted because of testing positive for COVID-19. However, these percentages could be underestimated because COVID-19 infection causes many asymptomatic and subclinical cases.²³ Compared to other studies in Egypt, showing the incidence of HCWs infection was 2.37%,

Table 2. The relation between IPC knowledge and infection with SARS-CoV2 among the study population (n = 508).

	Did you get a COVID-19 infection?				P-value	OR	95% CI	
	Infected		Not infected				Lower	upper
	N (60)	% (100)	N (448)	% (100)				
13-How can you clean soiled bedding, towels, and linens from patients with COVID-19?*								
a-Wear appropriate PPE	46	76.7%	396	88.4%	0.011*	2.318	1.193	4.504
b-Place soiled linen in a clearly labeled, leak-proof container	29	48.3%	225	50.2%	0.783	1.079	.629	1.849
c-Wash and disinfect linen with warm water and detergent	47	78.3%	365	81.5%	0.560	1.216	.629	2.351
d-If no washing machine, linen can be soaked in hot water and soap	28	46.7%	224	50.0%	0.628	1.143	.666	1.961
e-If no hot water, soak linen in 0.05% chlorine for 30 min	30	50.0%	272	60.7%	0.112	1.545	.900	2.653
14-What are the recommendations regarding the disinfection of vehicles, goods, and products coming from COVID-19 affected countries? (No, recommendations)	26	43.3%	190	42.4%	0.892	.963	.559	1.659
15-What PPE should be used by healthcare workers performing nasopharyngeal swab on patients with suspected or confirmed COVID-19?*								
a-A clean, non-sterile gown	48	80.0%	383	85.5%	0.265	1.473	.743	2.922
b-A medical mask	56	93.3%	419	93.5%	0.954	1.032	.350	3.045
c-Eye goggles or face shield	46	76.7%	382	85.3%	0.086	1.762	.917	3.384
d-Gloves	50	83.3%	393	87.7%	0.339	1.429	.685	2.981
e-Procedure should be conducted in a separate room	44	73.3%	315	70.3%	0.629	.861	.469	1.580
f-Request the patients to cover their mouth with a medical mask or tissue	34	56.7%	240	53.6%	0.651	.882	.512	1.519
16-Should blood centers routinely screen blood products for SARS-CoV2 virus? (Deferral of those with a suspected history of travel or close contact of a case)	16	26.7%	168	37.5%	0.257			
17-Are boots, impermeable aprons, or coverall suits required as routine personal protective equipment (PE) for healthcare workers (HCW) caring for patients with suspected or confirmed COVID-19 infection? (yes response)	44	73.3%	376	83.9%	0.042*	1.997	1.016	3.546
18-Can disposable medical face masks be sterilized and reused? (yes response)	8	13.3%	68	15.2%	0.707	.860	.391	1.890
19-Does WHO recommend contact and droplet precautions and not routine use of airborne precautions for healthcare workers providing care to patients with suspected/confirmed COVID-19 infection? (yes response)	36	60.0%	252	56.3%	0.582	1.167	.674	2.020

Table 2. *Continued*

	Did you get a COVID-19 infection?				P-value	OR	95% CI	
	Infected		Not infected				Lower	upper
	N (60)	% (100)	N (448)	% (100)				
20-Does WHO recommend routine wearing masks for healthy people during the COVID-19 outbreak? (yes response)	54	90.0%	406	90.6%	0.876	.931	.378	2.293
21-Can patients with suspected and confirmed COVID-19 infection be admitted in the same room? (yes response)	10	16.7%	70	15.6%	0.835	1.080	.523	2.231
22-Do patients with suspected or confirmed COVID-19 need to be hospitalized if they have a mild illness? (yes response)	2	3.3%	22	4.9%	0.589	.668	.153	2.914
23-Are specialized or referral hospitals required for patients with suspected or confirmed COVID-19 infection when hospitalization is needed? (yes response)	40	66.7%	368	82.1%	0.005*	2.298	1.277	4.149
24-What are the disinfectants recommended for environmental cleaning in healthcare facilities with suspected or confirmed COVID-19 infection?*								
a-Ethyl alcohol 70%	54	90.0%	414	92.4%	0.515	1.353	.543	3.371
b-Sodium hypochlorite at 0.5%	14	23.3%	200	44.6%	0.002*	2.650	1.416	4.958
c-Soapy water solution	34	56.7%	268	59.8%	0.640	1.139	.661	1.962
d-Chlorine	24	40.0%	174	38.8%	0.863	.953	.549	1.652
25-How long the COVID-19 can survive on a dry surface? (It depends on several factors including relative temperature, humidity, and surface type)					0.063			
a-24 hours	2	3.3%	22	4.9%				
b-3 days	2	3.3%	60	13.4%				
c-It depends on several factors including relative temperature, humidity, and surface type	56	93.3%	366	81.7%				
26-Is there a special procedure regarding waste produced by patients with suspected or confirmed COVID-19? (yes response)	56	93.3%	408	91.1%	0.559	1.373	.473	3.982
27-Are there special procedures for the management of bodies of persons who have died from COVID-19? (yes response)	58	96.7%	400	89.3%	0.071	3.480	.824	14.703

*Significant P-value (≤ 0.05).

**Chi-square test.

Table 3. Parameters of knowledge score of IPC practices among the study population.

	Mean	Standard Deviation	Minimum	Maximum
Score	5.43	1.69	1.00	12.00
Percent Score	36.19	11.26	6.67	80.00

Table 4. Comparison of knowledge score of IPC practices between physicians and other HCWs.

	Physicians and other HCWs	N	Mean	Std. Deviation	P value
Score	Physicians	405	5.4420	1.69878	0.824
	Others	112	5.4018	1.65197	

*Significant P-value (≤ 0.05).

**T-independent test.

Figure 1. Percent distribution of HCWs opinions regarding the high proportion of infection among HCWs in Egypt (n = 518). **Figure 2. Percent distribution of HCWs recommendations to decrease the risk of SARS-CoV2 infection (n = 62).**

11%, and 13.5%^{10,26,27} respectively. Another cross-sectional study in New York City²³ reported a 19.4% infection rate. Furthermore, 4.3% was estimated in a cross-sectional study in a hospital in Muscat, Oman²⁸ and 30.35% in a study in Mexico.²⁴

We found that HCWs infection rate was significantly higher in Cairo governorate (P-value = 0.018, OR = 1.965); it could be due to the highest population distribution, or that this governorate has specialized fever hospitals which were more exposed to infection burden on its health care systems. Also, a higher infection rate was found among workers with ≤ 7 years of experience (P-value = 0.002, OR = 2.650) which may be due to lack of experience and higher workload for junior physicians than senior ones. This goes in agreement with Vindrola *et al.*²⁵ However, the infection rate did not differ significantly with age. Among those who were ≤ 32 years, 20% were infected, and 14.7% were not infected by COVID-19 (P-value = 0.288). As regards the affiliation, the highest proportion of infection was among those affiliated to MOHP (46.7%), but the result was not statistically significant, this might be due to unpreparedness for such a pandemic, higher flow rate of patients with a shortage of PPE compared to military/police hospitals (3.3%) (P-value = 0.062), and this goes following Papoutsi *et al.*¹⁰ Regarding HCWs categories, there was no statistically significant difference between them regarding the proportion of SARS-CoV2 infection ($p = 0.23$). This may be explained by the fact that all HCWs were responsible for the fight against COVID-19 due to lack of health care personal, increased workload and the huge number of cases during the wave. This was contradictory to a recent systematic review that reported the most frequently affected personnel were nurses and non-emergency wards during screening.²⁵

Regarding the knowledge, although 54.4% of our participants took infection control courses, their mean knowledge percent score was 36.19 ± 11.26 , which is surprisingly low. It could be due to poor course content or not following the courses by proper practice. Therefore, they did not retain much information.

We noticed that the non-infected group of respondents got higher percentages of correct answers and significantly higher percent to the choice “wear PPE” to the question “How to clean soiled bedding, towels, and linens from patients with COVID-19” (P-value = 0.011, OR = 2.318). For the question “wearing PPE in the form of boots, impermeable aprons, or coverall suits while dealing with suspected or confirmed COVID-19 infection patients” (P-value = 0.042, OR = 1.997) while “knowing that specialized or referral hospitals required for suspected or confirmed COVID-19 patients when hospitalization is needed” (P-value = 0.05, OR = 2.298) and with the choice of “using sodium hypochlorite at 0.5% for cleaning the environment” (P-value = 0.002, OR = 2.650). These findings showed an inverse association between IPC knowledge and proportion of COVID-19 infection that was statistically significant, this was in accordance with recent studies.²⁹⁻³²

Regarding the HCWs’ opinions about the high proportion of infection among them in Egypt, they thought this could be due to shortage of PPE (88.8%) inconsistent with recent studies,^{9,25,33} work overload (84.2%) in agreement with recent studies³² and lack of knowledge on how to use PPE as estimated by Houghton systematic review,^{25,33} and the HCWs recommended raising the awareness for the importance of IPC (41.9%).

Recommendations

We recommend strengthening policies for applying IPC with proper supervision and providing junior physicians with mandatory IPC training. Besides, extending the surveillance within the facilities for early detection of infected workers and isolation of cases will minimize transmission risk. It was also supplying hospitals with sufficient PPE. It is crucial to consider the years of experience of workers while dealing with COVID-19 patients.

Strength of the study

- The study included representatives from all health care workers’ classes (physicians, pharmacists, dentists, and nurses), as well as physicians from different specialties (clinical pathologists, pediatric, radiologists, ophthalmologists, anesthesiologists, and internal medicine physicians).
- Up to our knowledge, this is one of the earliest papers examining infection prevention and control practices among HCWs caring for patients with suspected or confirmed COVID-19 during the pandemic peak in Egypt.

Limitations of this study

- Even though the study included different occupational classes, their distribution was not equal.
- Although the study included HCWs from 21 Egyptian governorate and from almost all central Egyptian governorates (Cairo, Giza, Dakahlia, Kafr Elsheikh, and Alexandria governorates), further studies will be in need on a larger scale including all Egyptian governorates using a probability sample.

Conclusion

We concluded that HCWs had low score of knowledge of infection prevention and control practices. There was a considerable proportion of SARS-CoV2 infection among HCWs in Egypt, especially among those working in Cairo governorate with experience less than seven years; due to lack of knowledge about IPC measures and shortage of PPE in their working facilities.

Data availability

Underlying data

Dryad: Knowledge and attitude of Infection prevention and control practices among health care workers caring for patients with suspected or confirmed COVID-19. <https://doi.org/10.5061/dryad.ht76hdr2>.³⁴

This project contains the following underlying data.

- Dataset (xlsx)

Data are available under a [CC0 1.0 Universal \(CC0 1.0\) Public Domain Dedication](#) license.

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Version 1

Reviewer Report 17 December 2021

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I think the idea of the paper is excellent and is an important addition to the literature. This study aims to estimate the proportion of health care workers who acquired SARS-CoV2 infection, and evaluate their knowledge to IPC. This in itself is very important as long as it adds something novel, although the method used is a well-known organized questionnaire. Despite the rather small temporal and spatial extent of the study, it makes an important contribution to reducing the prevalence of disease, as the idea of the study addresses the problem of lack of knowledge and lack of personal protective equipment among health care workers.

In more detail, this study is cross-sectional but the authors provide novel experimental data which demonstrates that lack of knowledge and shortage of PPE were the contributing factors, and it is necessary to provide juniors with IPC training, and hospitals with sufficient PPE.

The article was written in a clear and sequential manner and the work is technically sound, and the research idea is clearly and accurately presented, in addition to choosing the appropriate study design for the main idea. Despite the small sample size taken from health care workers compared to the population of Egypt, this study included participants from 21 Egyptian governorate. Even though the study included different occupational classes, their distribution was not equal. As for the statistical analysis, it depends on simple descriptive statistics that were used to create a summary and simple frequency of quantitative data; this is because of the type of study, and I believe that the results were interpreted well. It is possible to adopt the results of this study because the OR values are within the limits of the internal confidence IC and therefore are considered real and not extreme values. One of the most important outcomes that they touched on:

- Wearing appropriate PPE while cleaning soiled bleeding toils and linens from patients with COVID-19 was significantly associated with lower proportion of infection.
- The knowledge about importance of wearing boots, impermeable aprons as routine PPE for HCWs caring for patients with suspected or confirmed COVID-19, was significantly associated with lower proportion of infection, and regarding the years of experience.

Through their results, the authors suggest recommendations to reduce the risk of SARS-CoV2. Moreover, the conclusion highlights the main objective of the work. I think this is one of the earliest papers examining infection prevention and control practices among HCWs caring for patients with suspected or confirmed COVID-19 during the pandemic peak in Egypt.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?

No source data required

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: clinical immunology, immunology.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 25 August 2021

<https://doi.org/10.5256/f1000research.57695.r92220>

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Eman Omar Khashaba

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Reviewer comments:

- The title is not reflecting the study objectives or the results as the title is knowledge of IC practice and the analysis focused on knowledge according to Covid-19 infection.

- Sample size was calculated according to knowledge of infection control measures in general not Covid-19. A pilot study could be done to calculate relevant sample size.

Methods:**Study tool:**

- A self-administered structured questionnaire composed of 29 questions, however the knowledge score was 15 items. The tool needs detailed description for included sections in the questionnaire (number of questions in each section).

Stat analysis paragraph:

- How were the quantitative variables described with simple frequency?

Results:**General comment:**

- The sentences used for describing variables are too long; it would be better to summarize these variables, for example "Have you ever taken any infection control courses or certificates?" (Yes responses).

Received previous IC courses;

- The first objective is not highlighted in the results. Please demonstrate that in your results.

Table (1-2):

- Using reference category for polytomous variables and calculation of OR and 95%CI is recommended.
- The interpretation of total knowledge score was not used in tables.
- The score ≤ 5 & > 5 can be associated with different demographics, occupational and infection statuses.
- Weak presentation of data in tables 3 and 4.
- Comparison of total knowledge score in infected and non-infected can be done (Tables 3 and 4).
- How did the authors describe that there is a high proportion of infection although the percentage of infected HCWs is 11.6%?

Fig 1:

1. Provide a proper system for IPC with punishment for the...incomplete variable in figure (please complete the sentence).
2. HCWs recommendations to decrease the risk of SARS-CoV2 infection: How is the recommendation to depend on CT in diagnosis? The recommendation is related to CT in diagnosis (Fig 2).

Decision: major revision is required.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Occupational medicine & Environmental health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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