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AWARENESS AND PRACTICES OF INFECTION CONTROL MEASURES AMONG HEALTH CARE PROVIDERS DURING COVID-19 PANDEMIC

By

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Abstract

Introduction: Health care providers (HCPs) are at the frontline of the response to the COVID-19 pandemic and are thus exposed to threats that place them at the risk of infection. The increased risk of COVID-19 nosocomial transmission can result from poor awareness among HCPs and inadequate infection control practices. **Aim of Work:** To appraise awareness of coronavirus COVID-19 infection control (IC) and practices of infection control measures among health care providers (HCPs) in Beni-Suef governorate, Egypt. **Materials and Methods:** A cross-sectional study of 477 HCPs was done using a structured questionnaire. In Google forms a questionnaire was created, and connection was shared with HCP's WhatsApp and Facebook groups.

In the investigators' contact lists the connection was also shared directly with HCPs. The questionnaire was divided into 3 parts to assess participants socio-demographics, awareness about the disease , infection prevention and control practices against COVID-19.**Results:** Among the participants; 69.2% were females, and the mean age of the group was 31.5±7.6 years with a mean professional experience of 8.2±7 years (50.7% had <6 years experience). The level of satisfactory awareness and practices about COVID-19 disease was reported in 67.5.6% and 75.3% of participants, respectively. Multivariable binary logistic regression analysis showed that; regular training in IC was the only factor increasing the probability of satisfactory awareness and practices (p-value <0.001, OR, 95% CI; 3.69, 2.39:5.71 and p-value=0.001, OR, 95%CI; 2.29, 1.43:3.67). HCPs with >6 years work experience had three times satisfactory practice level compared to their ≤6 years experience peers (p-value=0.004, OR, 95%CI; 2.81, 1.4:5.9). **Conclusion and Recommendations**: Awareness and practice scores among HCPs in Beni-Suef Governorate, Egypt were satisfactory with a

need towards improving the donning and doffing practices of their personal protective equipment (PPE). Effective infection control measures, including frequent skill-based training and continuous professional development would enhance competent practices of infection control for all categories of HCPs.
Keywords: Awareness, Practices, COVID-19 and Health care providers.

Introduction

Coronavirus disease (COVID-19) is a widespread pandemic affecting humans by the most recently discovered coronavirus. People affected with COVID-19 will experience mild to moderate symptoms and recover without the need for hospitalization (Guan et al., 2020;WHO, 2020[a] and Zhu et al., 2020). Two previous coronavirus outbreaks occurred in 2003 and 2012: SARS-CoV and Middle East Respiratory Syndrome-Corona Virus (MERS-CoV) which resembled the novel coronavirus (WHO, 2020[b]). In Egypt, from February 14 to 10 September 2020, there have been 100,403 confirmed cases of COVID-19 with 5,577 deaths who were severe cases or needed hospitalization (WHO, 2020[c]).

Coronavirus spreads primarily from infected people (coughs or sneezes) by close personal contact (approximately 6 feet) or can be transmitted by touching infected surfaces (CDC, 2020[a]). HCPs being frontliners in this epidemic chain aiming to control the outbreak are at a higher risk of infection owing to the overcrowding of healthcare facilities and lack of enough isolation rooms; thus practicable steps taken to prevent spread of infection should be implemented (Wu and McGoogan 2020). Standard guidelines include personal spacing, daily hand washing, mouth and nose covering while coughing and sneezing and thorough cooking of meat and poultry (CDC, 2020[b]).

Personal protective equipment (PPE) such as masks , gloves and gowns help to keep HCPs at a lower risk of infection when treating COVID-19 infected patients. Centers for Disease Control and Prevention (CDC) recommends wearing a properly used, well-fitted N95 masks for healthcare givers with proper disposal (WHO, 2020[d]).

Studies have shown that some HCPs lack knowledge and practices towards MERS CoV (Abdullah et al., 2016 and Sameer et al., 2018) and SARS (Deng et al., 2006) arising in inadequate awareness of some HCPs towards infection prevention practices (Wu and McGoogan, 2019). Approprite knowledge influences the

practices of HCPs and directly increase or decrease the risk of infection (McEachan et al., 2016).

Aim of Work

The current study was carried out aiming to appraise awareness of coronavirus COVID-19 infection control (IC) and practices of infection control measures among health care providers (HCPs) in Beni-Suef governorate, Egypt.

Materials and Methods

Study design: This is a multi-center cross-sectional survey-based study.

Place and duration of study: The study was conducted in Beni-Suef governoate─during a period of strict lockdown to implement social distancing to prevent COVID-19 spread. The survey covered the period from 25th of May till 20th June 2020.

Study population: The study included health care personnel as physicians, nurses, pharmacists, physiotherapist and technicians working in any health unit or center, general/ district/ health insurance hospital and / or university hospital.

Study sample: Considering that it was not feasible to conduct a population-based survey at this time, data collection was done using an online snowball sampling approach.

Using Epiinfo statcalc, the sample size for population survey was calculated at 95% confidence level, 5% acceptable margin of error, 1 design effect, 50% expected frequency (of unsatisfactory knowledge or practice), the minimum sample size was found to be at least 384 health care workers. To counteract any errors in completing the questionnaires, the questionnaire was distributed on 550 health care workers, then 477 personnel responded with a response rate 86.7% resulting in a final sample size of 477.

In Google forms a questionnaire was created, and connection was shared with HCP's WhatsApp and Facebook groups. In the investigators' contact lists the connection was also shared directly with HCPs.

Study methods :

Based on international guidelines for COVID-19 published by WHO, a semi-structured questionnaire was designed (WHO, 2020[d]). An initial questionnaire draft was drawn up, and then validated in two stages. Firstly, the study instrument was adapted to suit participants. The

questionnaire was checked and validated for content and relevance by the authors, and two external public health professors. Second, a pilot study was performed by asking a small number of HCPs (No=30) for their views on simplifying and shortening the questionnaire. Pilot research chose participants from all health care fields.

Reliability was measured using the SPSS version 25 (IBM Corp. Published 2017. IBM SPSS Statistics for Windows, version 25.0. Armonk, NY: IBM Corp.), and Cronbach's alpha was 0.87, and 0.79, respectively, for awareness and practice.

For the final analysis, data from the pilot study were not used.

The questionnaire was divided into 3 parts to assess participants socio-demographics, awareness about the disease and infection prevention and control practices against COVID-19.

Part 1: Included socio-demographic data such as age, gender, experience , profession, educational level and work place as well as attending regular training in infection control.

Part 2: Twelve questions to assess awareness about the COVID-19. The score for each question was zero or one. Questions with a correct answer were assigned a score of one and incorrect answers or don't know were assigned a zero score. The total score was classified as: Unsatisfactory (zero to ≤7) and Satisfactory (>7 to 12).

Part 3: Eleven questions to assess HCPs' practices for infection prevention and control against COVID-19. The total score ranged from zero to 11. Items that were correctly answered were given a score of one and incorrect or sometimes answered questions were given a zero score. The total score was classified as: Unsatisfactory (zero to <6) and Satisfactory (≥6-11).

Consent

Participants accepted voluntary participation in this study and answered the questionnaire on their own with consent that was put at the beginning of the google form.

Ethical Approval

This study was approved by the Faculty of Medicine; Beni-Suef University Research Ethics Committee (FBBSU-REC) which adhered to the principles of the Declaration of Helsinki. The investigators ensured the study participants' anonymous identity, and the data were secured to ensure the

confidentiality and privacy of the results.

Data Management

Statistical package for the social sciences (SPSS) version 25 (SPSS Inc., Chicago, Illinois, USA) was used to analyze the research data. Frequency distribution and descriptive statistics were calculated. McNemar test was used to follow the change in categorical variables before and after COVID-19. A binary logistic regression analysis was used to assess the independent variables for satisfactory awareness and practices, with results expressed as odds ratio (OR) and 95% CI. p-value was considered significant at ≤0.05.

Results

Table (1): Socio-demographic characteristics of the health care providers.

Characteristics	No=477 (%)
Age (years) (Mean ±SD)	(31.5±7.6)
<30	243 (50.9)
≥30	234 (49.1)
Gender	
Males	147 (30.8)
Females	330 (69.2)
Experience (years) (Mean ±SD)	(8.2±7)
<6	242 (50.7)
≥6	235 (49.3)
Profession	
Physician	251 (52.6)
Nurse	141 (29.6)
Pharmacist	40 (8.4)
Physiotherapist	28 (5.9)
Technician	17 (3.6)
Educational level	
Bachelors or Institute	265 (55.6)
Postgraduate	212 (44.4)
Work place	
Health unit or center	158 (33.1)
General/district hospital	183 (38.4)
University hospital	136 (28.5)
Attending regular training in infection control	
Yes	245 (51.4)
NO	232 (48.6)

Table (1) shows that the mean age of the 477 HCPs participants was 31.5±7.6 years and 69.2% of them were females and 50.7% had experience <6 years. Health care providers (physicians, nurses, pharmacists and physiotherapists) constituted 96.4% of participants and 3.6% were technicians. Regarding educational achievement: 55.6% were university /high institute graduates and 44.4% had postgraduate education. Regarding the place of work, general/district hospital was reported by 38.4% of the participants, followed by 33.1% at health unit / center (33.1%) and only 28.5% worked at the university hospital.

Table (2): Awareness about COVID-19 among health care providers.

Part 2: 12 questions	**Correct answer No (%)**
Is COVID-19 a zoonotic disease?	168 (35.2)
What is the mode of transmission of COVID-19?	323 (67.7)
What are the precautions taken during visual triage of COVID 19 cases?	268 (56.2)
What are the precautions taken during nasopharyngeal swabbing for COVID-19 cases?	87 (18.2)
Hand wash / Rub frequently can decreases the risk of transmission of COVID-19?	449 (94.1)
Are you aware of the appropriate method of donning and doffing of PPE#?	344 (72.1)
What are the PPEthat should be donned during airborne isolation?	406 (85.1)
What are the PPE that should be donned during droplet isolation?	132 (27.7)
Does the isolation of COVID-19 cases need HEPA filter##?	173 (36.3)
Should the ambulance driver wear a surgical mask?	461 (96.6)
Are you aware about infection control policies in your facility?	333 (69.8)
Did you read the infection control policies after the COVID-19 pandemic?	446 (93.5)
Awareness score Unsatisfactory awareness (score ≤ 7) Satisfactory awareness (score >7) Mean ± SD of total score (total score=12) Median	 155 (32.5) 322 (67.5) 7.2±1.7 7

#:PPE: Personal Protective Equipment ##:HEPA filter: High Efficiency Particulate Air

Table (2) shows that the overall satisfactory awareness (score >7) was reported in 67.5% of participants; two thirds of participants were knowledgeable about mode of transmission, 72.1% were aware of the appropriate method of donning

and doffing, 85.1% were aware that PPE should be used during airborne isolation and 93.5% read policies of infection control during the COVID-19 pandemic. COVID-19 - as a zoonotic disease- was known by 35.2%; 27.7% knew about PPE use during droplet isolation and 18.2% were aware of the precautions taken during nasopharyngeal swabbing.

Table (3a) : Practices of health care providers for COVID-19 prevention.

Part 3: 11 questions	**Correct answer No (%)**
Follow the optimal time for hand wash with water and soap	83 (17.4)
Follow the optimal time for hand hygiene with ABHR^	312 (65.4)
Follow the 5 moments for hand hygiene	328 (68.8)
Don the PPE# in the right way	174 (36.5)
Doff the PPE in the right way	170 (35.6)
Washing hands with soap and water or using an ABHR before wearing and after removing the PPE	458 (96.0)
Washing hands with soap and water or using an ABHR before and after wearing the gloves	446 (93.5)
Touch the outer surface of the PPE	444 (93.1)
How did you disinfect reusable eye goggle or face shield?	308 (64.6)
Is it mandatory to do the candle test before using surgical mask?	278 (58.3)
Do you always wear a well-fitting N95 mask in dealing with patients?	142 (29.8)
Practice score Unsatisfactory (score <6) Satisfactory (score ≥6) Mean±SD of total score (total score =11) Median	 118 (24.7) 359 (75.3) 6.6±1.7 6

^:ABHR= Alchol Based Hand Rub #:PPE: Personal Protective Equipment

Table (3) shows that satisfactory practices of participants towards COVID-19 were reported by 75.3%. Participants who practiced safe measures for COVID-19 prevention, including hand wash /rub before wearing and after removing the PPE; before and after wearing the gloves, and no touch practice for the PPE outer surface constituted 96%, 93.5% and 93.1% of study participants, respectively. On the contrary; only a minority did follow the optimal time for hand wash (17.4%), and the necessity to do the fit test before wearing N95 mask (29.8%).

Table (3b): Comparing adherence of infection control measures before and after COVID 19 pandemic among the studied health care workers:

Did you apply the IC^^ measures before COVID 19?	After covid do you apply the IC measures? No (%)	No (%)	Total
	NO	Yes	
NO	58 (15.4)	319 (84.6)	377 (79)
Yes	2 (2)	98 (98)	100 (21)
Total	60 (12.6)	417 (87.4)	477(100)
p-value of Mc Nemar test	**<0.001***		

*:Statistically significant ^^:IC: Infection Control

Comparing adherence to infection control (IC) measures before and after COVID-19 pandemic among HCPs showed that 79% of participants did not adhere to the IC measures before the pandemic; while 87.4% of them became adherent after the pandemic as shown in Table (3b).

Table (4) Predictors of health care providers' satisfactory awareness about COVID-19 by multivariable binary logistic regression analysis.

Variables after the pandemic	p-value	OR#	95% CI## for OR	
			Lower	Upper
Age/ years				
<30	1	1	1	1
≥30-	0.177	1.697	0.788	3.659
Gender				
Males	1	1	1	1
Females	0.154	0.703	0.434	1.141
Experience/ years				
<6	1	1	1	1
≥6	0.841	1.079	0.513	2.270
Occupation				
Physician	0.613	0.722	0.204	2.556
Nurse	0.813	1.165	0.328	4.132
Pharmacist	0.415	0.547	0.128	2.340
Physiotherapist	0.132	0.311	0.068	1.421
Technician	1	1	1	1
Educational level				
Bachelors or Institute	1	1	1	1
Postgraduate	0.499	0.818	0.457	1.465
Work place				
Health unit or center	0.984	0.994	0.546	1.808
General/district hospital	0.599	0.865	0.505	1.484
University hospital	1	1	1	1
Attending regular training in infection control				
Yes	**<0.001***	3.694	2.392	5.705
NO	1	1	1	1

#:OR = Odd Ratio ##: CI=Confidence interval *Statistically significant

Table (4) shows that attending regular training in infection control practices was the only factor increasing the probability of satisfactory awareness (p <0.001, OR, 95%CI; 3.69, 2.39:5.71).

Table (5) Predictors of HCPs satisfactory practices on COVID-19 prevention by multivariable binary logistic regression analysis.

Variables	p-value	OR#	95% CI## for OR	
			Lower	Upper
Age/ years				
<30	1	1	1	1
≥30	0.534	0.764	0.328	1.783
Gender				
Males	1	1	1	1
Females	0.301	0.757	0.447	1.283
Experience/ years				
<6	1	1	1	1
≥6	**0.004***	2.812	1.4	5.9
Occupation				
Physician	0.755	1.223	0.345	4.328
Nurse	0.394	1.734	0.489	6.148
Pharmacist	0.841	1.169	0.255	5.355
Physiotherapist	0.749	1.303	0.258	6.567
Technician	1	1	1	1
Educational level				
Bachelors or Institute	1	1	1	1
Postgraduate	0.351	0.736	0.387	1.401
Work place				
Health unit or center	0.879	1.051	0.556	1.985
General/district	0.853	0.947	0.533	1.682
hospital	1	1	1	1
University hospital				
Attending regular training in infection control	**0.001***	2.291	1.429	3.671
Yes	1	1	1	1
NO				

#:OR = Odd Ratio ##: CI=Confidence interval * Statistically significant

Table (5) shows that satisfactory practice of participants' with >6 years experience was three folds compared to ≤6 years experience (p =0.004, OR, 95%CI; 2.81, 1.4:5.9) and attending regular training in infection control increased the probability of satisfactory practices (p =0.001, OR, 95%CI; 2.29, 1.43:3.67).

Discussion

The pandemic of Corona Virus Disease (COVID-19) is a global public health problem and a popular topic for discussion in all walks of life, particularly among healthcare workers. The knowledge and practice of healthcare personnel with regards to the COVID-19 pandemic was tested in this study.

In the present study, 51.4 % of study participants had COVID-19 infection control training (Table 1), in agreement with the 50% and 54% training pattern in Pakistani and Ghanaian reports (Afulani et al., 2020 and Khan et al., 2020 and) a finding which poses a challenge and highlights the need to increase the number and improve the quality of training courses in these areas.

Awarness and understanding about COVID-19 infection control measures among health care providers revealed a satisfactory score of 67.5% (Table 2) , a finding which is in agreement with regional and African studies reporting awareness levels ranging from 56.5% to 78.6% (Ayindeet al., 2020, Nemati et., 2020 and Olum et al., 2020) but lower than the levels of the East-Asian region as reported in: China (89%), Vietnam (88.4%), and Pakistan (93.2%) (Huynh et al., 2020, Saqlainetal., 2020 and Zhang et al., 2020). The differences might be explained by the better preparedness and quick response of the health care system in crisis management in these countries and possible time delay of others.

Unexpectedly, a minority (35.2%) of the study participants were knowledgeable of zoonotic source of coronavirus (Table 2); a finding which is lower than the 58.7% -70.8% reported in similar studies in Nepal (Kafle et al., 2020 and Nepal et al., 2020). In addition, awareness about COVID-19 transmission modes was reported by 67.7% of participants (Table 2), a finding which is higher than the (39%) reported in the United Arab Emirates (Bhagavathula et al., 2020) and lower than the levels reported in a Nigerian study (97%) (Ayinde et al., 2020), in a Chinnese study (97.8%) (Zhong et al., 2020) and in an Irannian study (99%) (Maleki et al., 2020) respectively. These figures reflect the need to implement a continuous professtional development strategy through educational and training courses among all levels of heath care providers to raise the awareness and improve their preventive and active timely practices against such threats.

Awareness and practicing

preventive measures for COVID-19 was satisfactory as 94.1 % and 72.1% of participants, respectively, were knowledgeable that hand wash / rub and appropriate technique/sequence of PPE donning and doffing are the cornerstone for its prevention (Table 2); similar Vietnamese and Nigerian findings (92.7% % 93.4% , respectively) were reported for the former (Ayindeet al., 2020 and Huynh et al., 2020); whilst higher than Nepalese finding (65.1%) for the latter (Nemati et., 2020). Of note, 65.4% and 17.4%, respectively, of particpants used alchol based hand rub (ABHR) and adopted hand washing technique (water and soap) for disinfecting their hands (Table 3); similar to Ugandese and Ethiopian reports (Saito et al., 2017 and Engdaw et al., 2020). In addition, hand washing or using ABHR before wearing and after removal of personal protective equipments (PPE) was practiced by 93.5% of study participants (Table 3a) similar to a Chinnese study reporting best hand hygiene practice after removing PPE (Zhou et al., 2020).

Donning and doffing the PPE was correctly practiced by 36.5% and 35.6% of participants in the current study (Table 3a), a finding which is higher than the 10% reported in an American study (Phan et al., 2019); findings that might call for an action to improve their practices.

The implementation of the hand hygiene five moments were practiced by 68.8% of study participants (Table 3a) which is lower than the 76% and 90-97% compliance reported in an Ethiopian and a Pakistani study (Engdaw et al., 2020 and Roshan et al., 2020). In addition, well-fitting N95 face masks were only adopted by 29.8% of participants when dealing with patients (Table 3a) which is lower than the 49% reported in an Oceanian study (Tan et al., 2020). Infection control practices and their implementation among studied HCPs improved dramatically during the pandemic where 87.4% of the non-adherent group (79%) became adherent to IC practices and satisfactory practices were reported among 75.3% of them (Table 3b) . This finding was higher than the 64.2% reported in an Ethiopian study (Tsegaye et al., 2020) and comparable to the 78.9% satisfactory practice level reported in a Nepalese study (Tamang et al., 2020) but lower than the 89.7% and 88.7% level reported in a Chinese and a Pakistani study, respectively (Zhang et al., 2020 and Saqlain et al., 2020).

These discrepancies might reflect the importance of continuous internal and external auditing for the adherence to the basic component of infection control practices in our study facilities.

The multivariable binary logistic regression analysis (Table 4), revealed that attending regular training in infection control was the only factor associated with an increased probability of satisfactory awareness, similarly, positive association between awareness and training in IPC, age, years of experience and availability of guidelines was reported by Desta et al., 2018 and Russell et al., 2018. In addition, workplace experience of >6 years was associated with a threefold satisfactory practice compared to ≤6 years experience (p=0.004, OR, 95%CI; 2.81, 1.4:5.9) (Table 5). Similar findings were reported in an American study reporting that years of experience was a significant determinant of good practice and behavior (Fix et al., 2019). Aso, attending regular training in infection control increased the probability of satisfactory practices (p=0.001, OR, 95% CI; 2.29, 1.43:3.67) (Table 5). Similar findings were reported showing that training in IC and access to guidelines improved compliance with IPC measures (Geberemariyam et al., 2018 , Sahiledengle et al., 2018 and Fix & Reisinger, 2019).

Conclusion and Recommendations: HCPs had satisfactory awareness and practices toward COVID-19. Comparing the adherence of IC measures before and after COVID-19 pandemic showed three fold improvement among HCPs in practice component. The continuous educational development strategy should be implemented to guarantee a good health care service, as well as minimizing the risk of personal and family infection with COVID-19.

Conflict of interest

The authors declared that they had no conflict of interest

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