



Knowledge and Practice on Infection Prevention among Medical Doctors Working at a COVID-19 Unit of a Tertiary Care Hospital in Bangladesh

Mohammad Tanvir Islam¹, Sarmin Sultana², Abid Hasan Khan³, Sabrina Mousum⁴, Sumayia Khaled⁵, Md Nazmul Hasan⁶, Abdullah A Masum⁷, Abed H Khan⁸, Md Maruf Haque Khan⁹, M Atiqul Haque¹⁰

¹Associate Professor, Department of Internal Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh; ²Research Assistant, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ³Research Assistant, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ⁴Research Assistant, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ⁵Research Assistant, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ⁶Assistant Professor, Department of Internal Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ⁷Assistant Professor, Department of Internal Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ⁸Assistant Professor, Department of Internal Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ⁹Assistant Professor, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; ¹⁰Professor, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[Received: 12 September 2021; Accepted: 3 November 2021; Published: 1 December 2021]

Abstract

Background: IPC knowledge and practice can shield HCWs from being infected or even worse. **Objective:** The study assessed the knowledge and practice of COVID-19 prevention among doctors in Bangladesh. **Methodology:** This cross-sectional study conducted from July to September 2020 recruited 210 medical doctors assigned to COVID-19 unit of BSMMU. Data were collected in two phases where 133 doctors completed both phases. Descriptive analysis and binary logistic regression were performed for statistical analysis. **Results:** About 1.5% of the doctors were infected with COVID-19 following their duty. 90% of doctors correctly identified indications for performing hand hygiene. Knowledge and compliance to PPE was high. The doctors having formal training on IPC were more likely to have an adequate practice of infection prevention measures. **Conclusion:** Knowledge and practice of IPC measures were better among doctors having prior training before entering their duty that led to less infection rate. [Bangladesh Journal of Infectious Diseases, December 2021;8(2):57-63]

Keywords: COVID-19; Knowledge; Practice; Infection prevention; Doctors; Bangladesh

Correspondence: Prof. Dr. M Atiqul Haque, Professor, Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka-1000, Bangladesh; **Email:** atiqulm26@bsmmu.edu.bd; **Cell no.:** +8801711428141; **ORCID ID:** <https://orcid.org/0000-0002-7598-2550>

Conflict of interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding agency: The first author received a grant from Bangabandhu Sheikh Mujib Medical University to conduct this research.

Contribution to authors: All authors were involved from protocol preparation to manuscript writing

How to cite this article: Islam MT, Sultana S, Khan AH, Mousum S, Khaled S, Hasan MN, Masum AA, Khan AH, Khan MMH, Haque MA. Knowledge and Practice on Infection Prevention among Medical Doctors Working at a COVID-19 Unit of a Tertiary Care Hospital in Bangladesh. Bangladesh J Infect Dis 2021;8(2):57-63

Copyright: ©2021. Islam et al. Published by Bangladesh Journal of Infectious Diseases. This article is published under the Creative Commons CC BY-NC License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits use, distribution and reproduction in any medium, provided the original work is properly cited, and is not used for commercial purposes.

Introduction

Coronavirus Disease 2019 (COVID-19) pandemic has rapidly spread worldwide and caused approximately 4 million deaths until July 2021. Transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) can occur directly and indirectly, as well as close contact within one meter of an infected person through saliva and respiratory secretions or droplets¹. Airborne transmission caused by the dissemination of droplet nuclei (aerosols) of SARS-CoV-2 can also occur during aerosol-generating procedures (AGPs). Primary preventive measures against COVID-19 include regular hand washing, maintaining social distance, and respiratory hygiene (wearing the mask, covering mouth and nose while coughing or sneezing) (REF). Most of the COVID-19 cases are self-limiting, and specific curative treatments are still under trial. Vaccination has shown promising efficacy but needs more time to cover the expected percentage of the population². As a frontline fighter against COVID-19, health care workers (HCWs) are at a higher risk of getting infected by the SARS-CoV-2 virus³. HCWs from the UK and USA were at least 3.4 times more likely to report a positive COVID-19 test than the general population during the early pandemic phase⁴.

The World Health Organization (WHO) has developed guidelines and introduced several online refresher courses for HCWs to boost their knowledge on different prevention strategies. To prevent transmission, maintaining hygiene and donning and doffing personal protective equipment (PPE) like masks, gowns, gloves, face shields, goggles, or visors have been recommended during patient treatment⁵. A respirator is also required while conducting AGPs such as endotracheal intubation, bronchoscopy, or airway suctioning⁵.

When appropriate measures are adopted, HCWs can be protected from COVID-19, according to⁶, who conducted a study in Wuhan city of China. Meanwhile, disease transmission can be accelerated due to a lack of understanding of disease transmission and protective measures among HCWs. Zhang et al. reported that 89.0% HCWs in China had sufficient knowledge on the preventive measures of COVID-19, while 90.0% of them practiced it correctly⁷. In Uganda, seven in ten HCWs had sufficient knowledge of the issue, and 93.0% practiced wearing masks⁸. On the contrary, one-third of dental health professionals from India were found not fully aware of using protective measures⁹. Only 25.0% of Nigerian HCWs had adequate knowledge of protective measures against COVID-19¹⁰.

Like other countries of the world, Bangladesh has been burdened with a high rate of COVID-19, where 10.79% HCWs have been infected¹¹, costing the lives of more than 180 physicians till August 2021. Ferdous et al¹² revealed that 48.3% of community people in Bangladesh had proper knowledge of COVID-19 prevention, while 55.0% practiced preventive measures¹². However, there is a lack of data on knowledge and practice of HCWs' preventive measures against SARS-COV-2 transmission in Bangladesh. Therefore, this study was aimed to fill the knowledge gap in this regard.

Methodology

Study Design: This cross-sectional study was conducted at Bangabandhu Sheikh Mujib Medical University (BSMMU), Bangladesh, from July to September 2020. This university has a 1900-bedded super-specialist hospital.

Study Population: The study participants were medical doctors assigned to work on rotation at the COVID-19 unit of the hospital. These doctors were post-graduate residents and medical officers. Every week, a group of 42 doctors was assigned to work in the COVID-19 unit. Prior to their duty, all participants were trained on diagnosing and managing COVID-19 patients through a two-day session. They were also trained on practicing primary preventive measures during their duty hours. All doctors on duty were equipped with standardized personal protective equipment, including N-95 masks, gloves, goggles, face shields, and gowns. The BSMMU hospital has a triage room for admission, assessment, and initial treatment of COVID-19 patients. The patients in need are later transferred to the COVID-19 unit for further management. This 200-bed COVID-19 unit is located in an isolated multi-storied building where every two patients share a single room, and there is adequate provision of High-Flow Nasal Canula (HFNC) oxygen therapy. There are working stations and separate donning and doffing rooms in each level of the building for the healthcare providers with well-displayed information education and communication (IEC) materials.

Sample Size: A total of 210 medical doctors were approached over five weeks of the data collection period. The sample size was determined considering a 50% proportion of adequate preventive practice, 7% margin of error, 5% alpha level and 10% dropout. A total of 133 doctors were included for the final analysis.

Data Collection Procedure: A semi-structured questionnaire was used to collect data on socio-demographic characteristics and knowledge and practice of COVID-19 preventive measures. Socio-demographic and health-related data included participants' age, sex, any co-morbidity, and history of COVID-19 infection. The knowledge and practice section of the questionnaire was developed following different national and international guidelines on COVID-19 infection prevention¹³⁻¹⁵. A total of 25 questions on knowledge were developed with 'yes' and 'no' response options. The practice domain included participant's self-reported frequency of hygiene practices. Practice questions had the response options as 'always, as recommended' (more than 95% of the time), 'most of the time' (50% or more but less than 95%), 'occasionally'(20% to under 50%), 'rarely' (less than 20%) and 'never happened' and the respondents were instructed to check only one. After seven days of their duty, they were placed in isolation for 14 days and monitored for COVID-19 symptoms. They were tested for COVID-19 on the seventh day of isolation and also later if they developed any COVID-19 like symptoms. Data were collected through self-administered questionnaires in two phases. Doctors were given the knowledge-related part of the questionnaire at their pre-duty orientation session, while the practice-related part of the questionnaire was distributed during their isolation at a residential hotel after their duty. The first part of the questionnaire was completed by 168 doctors, while 133 doctors completed the second part.

Data Management and Analysis: For knowledge-related questions, each correct response was scored one point, and the overall score was computed by summing all the points. For scoring the practice-related questions, the responses 'always' and 'most of the times' were scored as 1, while 'occasionally', 'rarely' and 'never happened' as 0. Knowledge and practice scores less than the means were considered poor knowledge and inadequate practice, respectively. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 23. Continuous variables were presented as mean and standard deviation (SD), while categorical variables as frequency and percentage. Binary logistic regression was done to identify the factors responsible for the adequate practice of infection prevention measures among the participants. The regression model included variables that were thought to have an impact on practice. Risk factors were expressed in odds ratio (OR) with a corresponding 95% confidence interval (CI). A *p*-value less than 0.05 was considered statistically significant.

Results

A total of 133 doctors completed both parts of the questionnaire, and they were included for analysis. More than three-fourths of the doctors were male, and 53% of doctors reported having at least one co-morbid condition. More than half of the doctors took medications as a preventive measure like Zinc (24.8%), Vitamin D (24.8%), Vitamin C (20.3%), azithromycin (4.5%), hydroxychloroquine (1.5%), and Ivermectin (0.8%). About 12% of the doctors reported being infected with COVID-19 prior to their duty. Two doctors (1.5%) in our study became positive for COVID-19 in the routine RT-PCR test following their duty (Table 1).

Table 1: Clinico-Demographic Characteristics of the Participants (n=133)

Variables	Frequency	Percent
Age, Mean (SD)	32.9 (3.3)	
Gender		
• Male	112	84.2
• Female	21	15.8
Co-morbid conditions		
• Absent	63	47.4
• Present	70	52.6
Smoking status		
• Never smoker	105	78.9
• Current smoker	15	11.3
• Past smoker	13	9.8
Have taken preventive medication		
• No	54	40.6
• Yes	79	59.4
Training before duty on COVID unit		
• No	26	19.5
• Yes	107	80.5
Tested positive for COVID-19		
• No	131	98.5
• Yes	2	1.5

More than 90% of the participants could correctly identify the indications for performing hand hygiene. However, knowledge about the time required for performing hand hygiene with alcohol-based solution (56.4%) and an indication of using soap water in case of visible contamination (64.7%) was relatively low. More than 80% of participants could correctly mention that the N-95 mask should be discarded in case of blood or body fluid contamination. However, knowledge regarding other indications for discarding N-95 masks was relatively low in cases such as the mask no longer providing a good seal, visible damage of the mask, or difficulty breathing in. About 67% of the doctors could

correctly mention the sequence of doffing. Knowledge regarding ideal PPE for AGP was high except for single-use gloves (62.4%) and waterproof aprons (57.1%). Approximately 57% of doctors could not correctly mention how many times high touch surfaces should be decontaminated (Table 2).

Table 2: Knowledge regarding Hand Hygiene, PPE, and other IPC measures (n=133)

Knowledge variable	Correct response	
	Frequency	Percent
Hand hygiene		
Time required for performing hand hygiene with alcohol-based solution (20-40 seconds)	75	56.4
Hand hygiene with soap and water in case of visible contamination	86	64.7
Indication for hand hygiene		
• Before donning	132	99.2
• After doffing	114	85.7
• Before touching patient	121	91.0
• After touching patient	117	88.0
• Before any aseptic procedure	129	97.0
• After aseptic procedure	124	93.2
• After coming into contact with patient's body fluid	132	99.2
• Before touching face and nose	130	97.7
• After removing gloves	127	95.5
• Between procedures on the same patient where soiling is likely	104	78.2
• After contact with patient's surrounding	131	98.5
Personal protective Equipment		
Appropriate PPE for eye protection (Face shield/goggles)	122	91.7
Conditions when N 95 respirator should be discarded		
• Contaminated with blood or body fluid	115	86.5

• No longer gives a good seal	102	76.7
• Visibly damaged or dirty	110	82.7
• Difficult to breathe in	44	33.1
Surgical mask cannot be reused	126	94.7
Medical gloves cannot be reused	121	91.0
Correct sequence of doffing	89	66.9
Appropriate PPE for the Aerosol-Generating Procedure		
• Single use gloves	83	62.4
• Surgical mask (not appropriate)	107	80.5
• N-95 mask (surgical grade)	125	93.2
• Face shield/goggles	123	92.5
• Disposable gown	112	84.2
• Waterproof apron	76	57.1
Other IPC Measures		
• Decontamination of high touch surface three times a day	76	57.1
• Decontamination of medical equipment every time after use	124	93.2
• One-meter distance with other healthcare professionals and patients	125	94.0

Most doctors practiced hand hygiene 'always' or 'most of the times' during healthcare interactions. However, less than 50% doctors reported of 'always' performing hand hygiene before touching the patient. Most of the doctors 'always' and 'most of the times' reported of using recommended PPEs except surgical gloves (Table 3). There was no significant association between demographic characteristics and knowledge score or practice score. The doctors who had participated in any formal training session before participating in this study were 2.42 times more likely to have an adequate practice of infection prevention measures (OR, 2.80; 95% CI, 1.10-7.15; *p*-value 0.031) (Table 4).

Table 3: Practice of hand hygiene and PPE among the participants

Hand Hygiene, PPE and Other IPC Measures	Rarely n (%)	Sometimes n (%)	Most of the times n (%)	Always n (%)	Not applicable n(%)
Practice hand hygiene					
Before touching patient	14(10.5)	17(12.8)	30(22.6)	66(49.6)	6(4.5)
After touching patient	5(3.8)	6(4.5)	26(19.5)	93(69.9)	3(2.3)
Before any aseptic procedure	1(0.8)	2(1.5)	12(9.0)	62(46.6)	56(42.1)
After an aseptic procedure	-	2(1.5)	11(8.3)	65(48.9)	55(41.4)
After aerosol generating procedure	1(0.8)	6(4.5)	13(9.8)	69(51.9)	44(33.1)
After contact with patients' surrounding	5(3.8)	9(6.8)	17(12.8)	102(76.7)	-
Practice of PPE					
Donning according to the protocol	-	-	5 (3.8)	128(96.2)	-
Doffing according to the protocol	-	-	6 (4.5)	127(95.5)	-
PPE used during healthcare interaction with COVID-19 patient					
N95 mask or equivalent double mask	-	-	1(0.8)	132(99.2)	-
Surgical gloves	21(15.8)	3(2.3)	3(2.3)	106(79.7)	-
Face shield/goggles	-	3(2.3)	20(15.0)	110(82.7)	-
Gown/coverall	-	-	3(2.3)	130(97.7)	-
Other IPC measures					
Cleaning medical equipment regularly	38(28.6)	13(9.8)	23(17.3)	59(44.4)	-

Table 4: Factors Affecting Adequate Practice On Infection Prevention Measures Among The participants (n=133)

Characteristics	Practice		aOR (95% CI)
	Inadequate	Adequate	
Age			
< 35 years	31 (30.7)	70 (69.3)	Ref.
≥ 35 years	9 (28.1)	23 (71.9)	1.14 (0.45-2.89)
Sex			
Male	31 (27.7)	81 (72.3)	Ref.
Female	9 (42.9)	12 (57.1)	0.54 (0.19-1.47)
Co-morbid conditions			
Absent	23 (32.9)	47 (67.1)	Ref.
Present	17 (27.0)	46 (73.0)	1.47 (0.66-3.25)
Participated in formal training			
No	12 (46.2)	14 (53.8)	Ref.
Yes	28 (26.2)	79 (73.8)	2.42 (1.00-5.85) *
Knowledge score			
Poor (<mean)	15 (30.6)	34 (69.4)	Ref.
Good (>mean)	25 (29.8)	59 (70.2)	1.10 (0.49-2.49)

aOR= adjusted odd ratio; Ref= reference category; *Significant at 5% level

Discussion

More than 70.0% of the doctors of this study had good knowledge and adequate practice on infection prevention measures. Only 1.5% of the 133 doctors became infected with COVID-19 during the incubation period. However, Yasmin et al¹¹ reported that about 11.0% of HCWs working in another COVID-19 dedicated hospital in Bangladesh became

COVID-19 positive. The low infection rate in this study could be attributed to the effective institutional initiatives such as triage protocols, PPE provision, waste management, colorful posters, and visual aids for infection prevention behavior, as well as designated donning and doffing area, and adequate personal protective measures such as HH practice and PPE use¹³⁻¹⁵.

Most of the doctors in this study could correctly identify the indications of hand hygiene (HH). The proportion of doctors practicing HH 'always' or 'most of the times' before touching the patients, after touching the patients and after contacting the patient's surroundings were 72.2%, 89.4% and 89.5%, respectively. Karim et al¹⁶ reported that the frequency of handwashing among HCWs was 69% before and after consulting or handling patients during the COVID-19 pandemic in Bangladesh. However, the Bangladesh National Hygiene Baseline Survey found poor hand hygiene in healthcare facilities before touching (11.0%) patients, after touching (26.0%) patients, before any aseptic procedure (8.0%), after exposure to body fluid (13.0%), and after contact with patient's surroundings (2.0%). In comparison to the baseline survey findings, HH practice has increased among HCWs in Bangladesh and other countries during the pandemic¹⁷⁻¹⁸. Roshan et al¹⁹ reported that before the COVID-19 pandemic, HH compliance was 50%, but it increased to 97.0% during the pandemic, resulting in a significant reduction in hospital-acquired infection rates in Pakistan.

The compliance to PPE was high in this study; the proportion of doctors always using N95 masks, surgical gloves, face shield/goggles and gown/coverall were 99.0%, 78.0%, 83.0%, and 98.0%, respectively. Karim et al¹⁶ reported that 61.8% HCWs used PPE; 16.4% used mask and gloves, 32.7% used gown, mask, and gloves and 50.9% used gown, mask, gloves, goggles and/ or face shield during COVID-19 pandemic in Bangladesh. Our study revealed that more than 95.0% of participants followed donning and doffing protocols during their duty.

A multi-center study in Bangladesh found that 70 to 80% of COVID-19 positive physicians correctly followed the donning and doffing protocol²⁰. In contrast, Alao et al¹⁰ showed that only 12.5% of HCWs knew the correct doffing sequence and only 4.4% of HCWs always utilized PPE in Nigeria. In Uganda, only 54.0% of HCWs always used masks during healthcare interaction. Prakash et al²¹ reported 96.3% compliance with PPE among HCWs during surgery amidst the COVID-19 pandemic.

A statistically significant association has been found between participation in training prior to duty and adequate practice of IPC measures. According to WHO, infection prevention education and training are fundamental for any IPC program to effectively reduce hospital-acquired infection²². Empirical studies also showed that the training of HCWs on

infection control significantly improves their compliance with the standard precaution²³⁻²⁴.

Previous research has shown that workload, resources constraints, uncomfortable equipment, skin irritation, forgetfulness, insufficient support from management, and certain socio-demographic variables like age, sex, job category, marital status, working site in the hospital and work experience have a significant influence on IPC measures^{21,25}. So, other variables associated with IPC practices among doctors were not evaluated in this study.

Conclusion

One of the most significant concerns in health care facilities is preventing COVID-19 infection in health care workers. COVID-19 is a novel and quickly evolving global health threat that has affected the entire population of the world. HCWs are not only at the frontier of the fight against this contagious infectious disease, but they are also directly or indirectly affected by it with a higher risk exposure than the general population. Inadequate knowledge on health hygiene, personal protective measures, and other IPC measures contribute to disease transmission among health care workers. The study looked at doctors' infection prevention knowledge, practice, and other characteristics. It showed a substantially higher awareness and practice of IPC measures among doctors who had received effective training before starting their duties, resulting in less infection.

References

1. WHO. Transmission of SARS-CoV-2: implications for infection prevention precautions. Published online 2020. <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>
2. Coon L. COVID-19 vaccines show promising potential in stopping pandemic. *OSF Healthcare*. 2020;1-5.
3. Hussen H, Alemu ZA. Risk of COVID-19 Infection and Associated Factors Among Healthcare Workers: A Cross-Sectional Study at Eka Kotebe Treatment Center in Ethiopia. *Int J Gen Med*. 2021;14:1763-1772
4. Nguyen LH, Drew DA, Graham MS, et al. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. *Lancet Public Heal*. 2020;5(9):e475-e483
5. Islam MS, Rahman KM, Sun Y, et al. Current knowledge of COVID-19 and infection prevention and control strategies in healthcare settings: A global analysis. *Infect Control Hosp Epidemiol*. 2020;41(10):1196-120
6. Liu M, Cheng SZ, Xu KW, et al. Use of personal protective equipment against coronavirus disease 2019 by healthcare professionals in Wuhan, China: Cross sectional study. *BMJ*. 2020;369:6-11
7. Zhang M, Zhou M, Tang F, et al. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. *J Hosp Infect*. 2020;105:183-187.

8. Olum R, Chekwech G, Wekha G, Nassozi DR, Bongomin F. Coronavirus Disease-2019: Knowledge, Attitude, and Practices of Health Care Workers at Makerere University Teaching Hospitals, Uganda. *Front Public Heal.* 2020;8(April):1-9.
9. Gambhir RS, Dhaliwal JS, Aggarwal A, Anand S. COVID-19 : A Survey on Knowledge , Awareness and Hygiene Practices among Dental Health Professionals in An Indian Scenario. *Rocz Panstw Zakl Hig.* 2020;71(2):223-229
10. Alao MA, Durodola AO, Ibrahim OR, Asinobi OA. Assessment of Health Workers' Knowledge, Beliefs, Attitudes, and Use of Personal Protective Equipment for Prevention of COVID-19 Infection in Low-Resource Settings. *Adv Public Heal.* Published online 2020
11. Yasmin R, Parveen R, Azad N, et al. Corona Virus Infection among Healthcare Workers in a COVID Dedicated Tertiary Care Hospital in Dhaka, Bangladesh. *J Bangladesh Coll Physicians Surg.* 2020;38(July):43-49
12. Ferdous MZ, Islam MS, Sikder MT, Mosaddek ASM, Zegarra-Valdivia JA, Gozal D. Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: An onlinebased cross-sectional study. *PLoS One.* 2020;15(10):1-17
13. WHO. WHO Guidelines on Hand Hygiene in Health Care : A Summary First Global Patient Safety Challenge Clean Care Is Safer Care. Vol 30.; 2009.
14. WHO. Risk Assessment and Management of Exposure of Health Care Workers in the Context of COVID-19: Interim Guidance.; 2020.
15. DGHS. National Guideline for Health Care Provider On Infection Prevention and Control of COVID-19 Pandemic in Healthcare Setting.; 2020.
16. Karim MR, Sah SK, Syeda A, et al. Hand Hygiene and Personal Protective Equipment in Healthcare Settings During COVID-19 Pandemic in Bangladesh. *Bangladesh J Med.* 2020;31(2):69-75
17. Ahmed MS, Yunus FM. Trend of COVID-19 spreads and status of household handwashing practice and its determinants in Bangladesh—situation analysis using national representative data. *Int J Environ Health Res.* Published online 2020:1-9
18. Dwipayanti NMU, Lubis DS, Harjana NPA. Public Perception and Hand Hygiene Behavior During COVID-19 Pandemic in Indonesia. *Front Public Heal.* 2021;9(May):1-12.
19. Roshan R, Feroz AS, Rafique Z, Virani N. Rigorous Hand Hygiene Practices Among Health Care Workers Reduce Hospital-Associated Infections During the COVID-19 Pandemic. *J Prim Care Community Heal.* 2020;11:10-13
20. Khalil MM, Alam MM, Arefin MK, et al. Role of Personal Protective Measures in Prevention of COVID-19 Spread Among Physicians in Bangladesh: a Multicenter Cross-Sectional Comparative Study. *SN Compr Clin Med.* 2020;2(10):1733-1739.
21. Prakash G, Shetty P, Thiagarajan S, et al. Compliance and perception about personal protective equipment among health care workers involved in the surgery of COVID-19 negative cancer patients during the pandemic. *J Surg Oncol.* 2020;122(6):1013-1019.
22. WHO. Guidelines on Core Components of Infection Prevention and Control Programmes at the National and Acute Health Care Facility Level.; 2016. <https://www.who.int/gpsc/core-components.pdf>
23. Assefa J, Diress G, Adane S. Infection prevention knowledge, practice, and its associated factors among healthcare providers in primary healthcare unit of Wogdie District, Northeast Ethiopia, 2019: A cross-sectional study. *Antimicrob Resist Infect Control.* 2020;9(1):1-9
24. Arinze-Onyia SU, Ndu AC, Aguwa EN, Modebe I, Nwamoh UN. Knowledge and practice of standard precautions by health-care workers in a tertiary health institution in Enugu, Nigeria. *Niger J Clin Pract.* 2018;21(2):149-155
25. Haile TG, Engeda EH, Abdo AA. Compliance with Standard Precautions and Associated Factors among Healthcare Workers in Gondar University Comprehensive Specialized Hospital, Northwest Ethiopia. *J Environ Public Health.* 2017;2017:8.