Khalij-Libya Journal of Dental and Medical Research
http://journal.khalijedental.com.ly/ eISSN:2708-888X

Original Article

Knowledge and Practices of Infection Prevention and Control towards COVID-19 among Healthcare Workers in Benghazi Medical Centre, Libya

Naeima Houssein 1*, Kamla Othman [2], Fatma Mohammed [3], Aeiad Saleh [3], Hanan Sunaallah [3]

[1] *Department of Epidemiology, Faculty of Public health, University of Benghazi, Libya.*
[2] *Department of Statistic, Faculty of Arts and Science Al – Marj, University of Benghazi, Libya.*
[3] *Office of quality control and patient safety, Benghazi Medical Center, Libya.*
Corresponding Email: naeima_idris@yahoo.com

ABSTRACT

Background: The current pandemic puts a substantial pressure on the health-care system worldwide. Healthcare workers especially those in frontline of patients' care are at increased risk of being infected. The aim of this study is to assess infection prevention and control knowledge and practice toward COVID- 19 among health care workers. **Methods**: A cross-sectional study was conducted from July to September of 2020 at Benghazi Medical Centre in Benghazi, Libya. Self-administered questionnaire was distributed to 400 health care workers. **Results**: Of those surveyed, the majority of participants were females; (40 .6%) in frontline, the overall percentage of correct answers was (64.8%). Knowledge was gained mainly from news media by (27.8%) of participants, while official government websites were used by nearly 21% of participants. The percentage of total good practice score was (76.28%). The knowledge scores were significantly associated with differences by gender, occupation, and level of education ($p<0.05$). **Conclusion**: The study found a satisfactory knowledge and relatively good practice towards COVID-19 among health care workers. However; there were areas with poor knowledge and practices. These areas should be addressed through continuous public health education on COVID-19 infection prevention and control.

Keywords: Knowledge, Practice, COVID-19, Health Care Workers, Benghazi.

Citation: Houssein N, Othman K, Mohammed F, Saleh A, Sunaallah H. Knowledge and Practices of Infection Prevention and Control towards COVID-19 among Health Care Workers in Benghazi Medical Centre, Libya. Khalij-Libya J Dent Med Res. 2021;5(1):30–42. https://doi.org/10.47705/kjdmr.215106
Received: 25/01/21; **accepted**: 04/02/21

INTRODUCTION

The global outbreak of coronavirus disease (COVID-19) is caused by (SARS-CoV-2) zoonotic virus, the reservoir as assumed is the bats. Human-to-human transmission of (COVID-19) occurs mainly through droplets or direct contact [1]. Spread though respiratory aerosol and oral- faecal route was also reported [2]. The pandemic negatively impacts all life aspects and causes considerable numbers of morbidity and mortality over the world [3,4]. To date, no specific medication is available; however, there have been a number of suggested vaccines

approved by clinical trials. Nevertheless, many challenges have been reported regarding the safety and efficiencies of these vaccines [5].

Given that COVID -19 puts a substantial pressure on the health-care system worldwide, health care workers especially those in frontline of patients' care are at increased risk of being infected [6]. Consequently, they have further constrained in application of infection control procedures in their work environment [7]. In this regard, the WHO and the CDC have developed a series of guidelines on infection prevention and control measures in addition to online courses to promote awareness towards COVID 19 among health care workers at health care facilities. [8.9]

Public health measures are targeted to prevent community transmission, including social distancing and quarantine and others [10]. Similarly, in hospitals managing patients infected with COVID-19, Health care workers should rely on facility-based infection prevention and control (IPC) measures to prevent both nosocomial and community acquired infections. The international recommended IPC guidelines include; use of personal protective equipment, physical distancing, rapid diagnosis, isolation, investigation, and follow-up of close contacts [11]. With reference to Middle East respiratory syndrome coronavirus (MERS-CoV) epidemic in 2012, previous epidemiological studies [12-14] indicate nosocomial outbreak which reflect poor compliance with infection control measures among health-care workers. As a result, this increased the burden of infections in the affected societies [15].

There has been a growing body of literature focusing on assessing knowledge and practice of health care workers towards this novel virus [16-19]. In light of such researches, health care workers' adherence to practice of preventive measures is mostly affected by their awareness toward COVID-19 [20]. To the best of our knowledge, limited published studies have examined the knowledge and practice of health care workers in Libya [21, 22]. The aim of this study is to assess infection control knowledge and practice toward COVID- 19 among health care workers at Benghazi Medical Centre (BMC), Libya.

METHODS

A cross-sectional study was conducted from July to September of 2020 at Benghazi Medical Centre in Benghazi, Libya. The study included a sample size of 400 participants from medical and allied medical professions. Study population, and sampling methods were previously described [23].

Study tool and data collection

Self-administered questionnaire was designed and adapted from some recent published studies [17, 18] in addition to interim guidance and information for healthcare workers published by the Centres for Disease Control and Prevention (CDC) and the WHO guidelines and course materials [8,9]. The survey was distributed online through the official page of the BMC and social media, and as hard copies by trained research assistants followed the preventive precautions and distancing during the data collection. A pilot study has been conducted on 20 health care workers before data collection and excluded from the final analysis.

The survey instrument was divided into three sections, the first section on demographic and occupational characteristics of study participants including a question whether he/ she on

frontline of COVID-19 management. The second, on knowledge; contains (**14**) questions with additional (**2** items) asking on source of information, and whether they attended any lectures/discussions about COVID -19 or not. The third contains (**9**) questions regarding infection prevention and control practices. Sufficient time was given to participants to read, and answer all the questions.

Knowledge was assessed by questions focusing on COVID-19 aetiology, signs and symptoms, the incubation period, mode of transmission, complications, treatment, risk prevention, defining close contact, and some infection prevention and control measures. Knowledge scores were calculated by assigning (1) point to each correct answer, and a (0) to an incorrect/unknown answer. The total knowledge score ranged from 0 to 14.

Infection control practice was examined by questions on applying the standard precautions recommended by the WHO and the CDC during the pandemic including, quarantine, disinfection of surfaces, and hand hygiene. The measure for practice scores ranged from (0 to 9), and were calculated by assigning (1) point to each good practice answered by (Yes), and a (0) to a poor practice answered by (No) or (sometimes).

Ethical consideration

Ethics approval was obtained from the respective medical board of the BMC. Personal consent was taken to participate in this survey. The responses of study participants were treated confidentially and anonymously.

Statistical analysis

The obtained data were coded, validated, and analysed using SPSS version 24. Descriptive analysis was applied to calculate the frequencies and proportions. As data were not normally distributed, non-parametric versions of statistical tests were performed to identify statistical differences. Chi-square tests were applied to find a difference in scores of knowledge and practice by occupation group for each question being asked. Mann-Whitney U test was used for two independent groups' comparisons, and the Kruskal-Wallis test for more than two independent group's comparison. Two-tailed $P < 0.05$ considered to indicate statistical significance.

RESULTS

A total of 400 health care workers participated, 320 of whom completed the study questionnaire. Of those surveyed, 232(72.5%) were females, 88 (27.5%) were males. Most of the participants were 30-49 years of age 220 (68.8%). Other participant characteristics are summarised in table 1.

Table 1: Demographic characteristics of study participants (N=320)

Characteristic	**N**	**%**
Gender		
Male	88	27.5%
Female	232	72.5%
Age		
18-29	86	26.9%
30-49	220	68.8%

50-59	12	3.8%
More than 60	2	0.6 %
Place of residence		
Benghazi	314	98.1%
Out of Benghazi	6	1.8%
Level of Education		
Intermediate Diploma	26	8.1%
High Diploma	73	22.8%
Bachelor's degree	175	54.7%
Master or PhD	46	14.4%
Occupation		
Medical professions		
Public Health	93	29.1%
Medicine	66	20.6%
Pharmacy	24	7.5%
Allied Medical professions		
Nursing	57	17.8%
Technician	80	25%
Years of Experience		
1-5	116	36.3%
6-10	83	25.9%
More than 10	105	32.8%
Whether frontline		
Yes	130	40.6%
No	171	53.4%
Total	320	100%

Source of information on COVID-19

As to source of information, (27.8%) of participants used news media (TV, radio, newspapers). While official government websites (WHO, CDC, etc.) were used by nearly 21% of participants. **Table 2** shows the responses of study participants regarding other sources to obtain information about COVID-19.

Table 2: Source of information about COVID-19

What is your source of information about COVID-19?		
Statements	N	%
News Media (TV, Radio, newspapers)	89	27.8%
Social media (Facebook, Twitter, WhatsApp, YouTube, etc.)	65	20.3%
Official government websites (WHO, CDC, etc.)	66	20.6%
Family member, colleague or friend	20	6.3 %
Seminars and workshops	21	6.6%
All of the above	59	18.4%
Total	320	100%

Further descriptive analyses were done regarding sources of reliable information that used by study participants. Figure 1 illustrates variations in information sources according to occupation

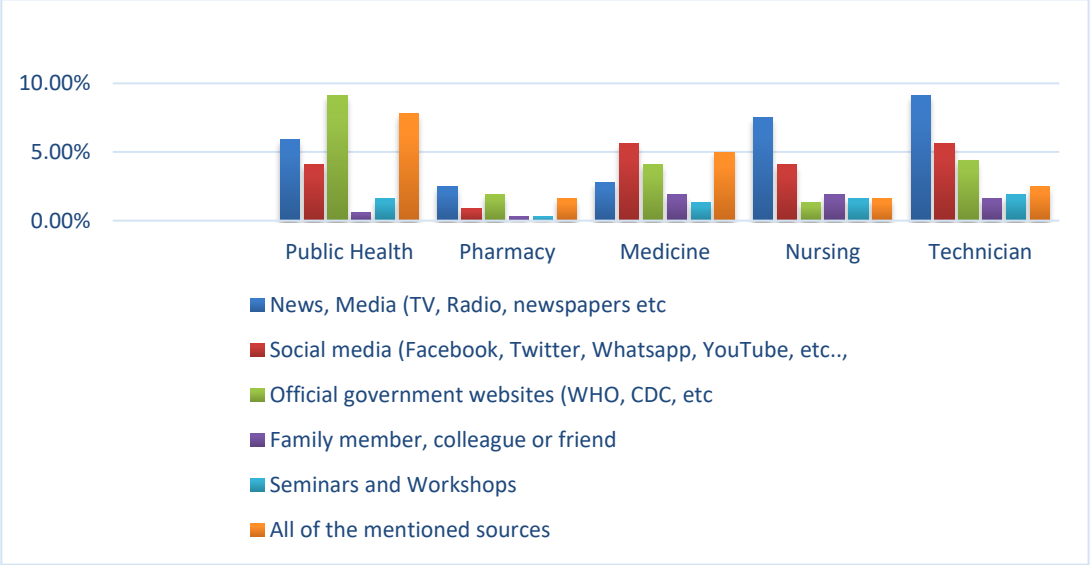

Figure1. Information sources according to occupation

The highest proportion of public health (9.10%) used official government websites. Compared with the highest proportion of medical (5.60%) used the social media. Whereas, the news media were used by the highest proportion of pharmacy, nursing, and technicians (2.50%, 7.50%, 9.10%) respectively. Additionally, we asked the participants whether they have attended lectures or seminars about COVID-19. Figure 2 describes their answers according to each profession

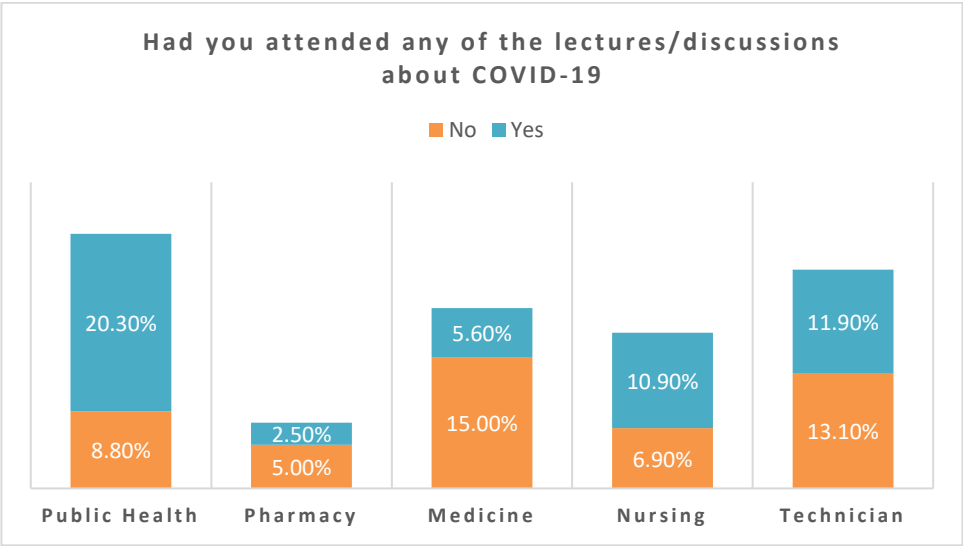

Figure 2. Responses of participants in each occupation regarding attendance of lectures or discussion about COVID-19

Knowledge about COVID-19

Results of knowledge assessment of the participants regarding COVID-19 are shown in table 3. In total of all health care workers participated in this study (n=320), the overall percentage of correct answers was (64.8%). Correct answers were mostly identified for all questions by the more than the half of participants with a higher percent in public health (20.15 %) of total percentage of correct answers, followed by medicine and technician (15.01%, 14.9%) respectively. There were statistically significant differences among healthcare workers with regards to their knowledge on the origin, main mode of transmission, complications, and treatment of the disease, incubation period, definition of close contact, and infection control measures ($p<0.05$). On the other hand, knowledge did not vary significantly by occupation for questions about reduction of transmission risk, symptoms of COVID-19, hand hygiene action, use of a face mask, and use personal protective equipment PPE.

Generally, the highest percentage of correct answers, was (90.3%) related to measures which reduce the risk of transmission including hand hygiene, avoiding sick contacts, covering the nose and mouth when coughing and having well-cooked food. The majority of participants reported adequate knowledge at other areas. For instance, (85.3%) agreed that gloves, gown, eye protection, N95 mask should be worn by individuals transporting patients who are confirmed with or under investigation for COVID-19 within a health care facility. In addition, (80.0%) answered that PPE should be worn by health care provider who providing care to a symptomatic patients with history of exposure of COVID -19 and being evaluated for non-infectious disease However, least correct answers were related to the question regarding definition of close contact, where only (43.1%) correctly identified that close contact is considered as being within approximately 6 feet (2 meters) of a patient with COVID-19 for a prolonged period of time and having direct contact with infectious secretions(sputum, blood, serum) from patient with COVID-19. A knowledge gap was also observed in number of questions. For example, only (49.1%) of study participants thought that novel corona virus origin is from bat. Furthermore, only (46.3%) of participants knew that the virus is transmitted from person to person via respiratory droplets, and treatment of disease by supportive care was reported by (53.8%).

Practice of infection prevention of COVID-19

Self-reported practice on prevention of COVID-19 infection was good as the percentage of total good practice score was (76.28%). The vast majority of participants-maintained quarantine with families (75.6%), avoiding touching your eyes, nose, and mouth with unwashed hands (87.5%), staying home when they were sick or had a cold (81.3%). However, only (57.8%) of participants reported that they fellow prevention precaution at shopping places. The other lower percentage was (65.9%) reported by participants who apply the recommended prevention precautions in the BMC. The significance of statistical difference by occupation was noticed only in two practice questions regarding disinfection of surfaces and mobile phone ($p<0.05$).

Table 3: Knowledge towards (COVID-19) among health care workers (N=320)

Questions	Medical Professions			Allied Medical Professions		Total Correct Answers N=320	P-Value
	Public Health n=93	Pharmacy n=24	Medicine n=66	Nursing n=57	Technician n=80		
Q1 Novel Coronavirus origin is thought to be from	52 55.9%	13 54.2%	45 68.2%	17 29.8%	30 37.5%	157 49.1%	**0.00**
Q2 The main mode of transmission of virus from person to person is via	53 57%	9 37.5%	46 69.7%	14 24.6%	26 32.5%	148 46.3%	**0.00**
Q3 What are the complications of Novel Coronavirus?	76 81.7%	19 79.2%	58 87.9%	33 57.9%	53 66.3%	239 74.7%	**0.001**
Q4 What is the treatment of Novel coronavirus?	50 53.8%	14 58.3%	54 81.8%	19 33.3%	35 43.8%	172 53.8%	**0.00**
Q5 How to reduce the risk of transmission?	88 94.6%	23 95.8%	59 89.4%	50 87.7%	69 86.3%	289 90.3%	0.623
Q6 Symptoms of COVID-19 are all except	68 73.1%	16 66.7%	42 63.6%	25 43.9%	44 55%	195 60.9%	0.187
Q7 What is the incubation period of Novel coronavirus?	45 48.4%	8 33.3%	43 65.2%	16 28.1%	42 52.5%	154 48.1%	0.024
Q8 Which of the following is considered as close contact?	31 33.3%	12 50%	25 37.9%	33 57.9%	37 46.3%	138 43.1%	0.00
Q9 Which of the following hand hygiene action prevent transmission of virus to health care worker?	78 83.9%	19 79.2%	56 84.9%	44 77.2%	57 71.3%	254 79.4%	0.176
Q10 Use of a face mask is essential in which of the following groups?	61 65.7%	13 54.2%	30 45.5%	26 45.6%	43 53.75%	173 54.2%	0.051
Q11 What personal protective equipment PPE should be worn by individuals transporting patients who are confirmed with or under investigation for COVID-19 within a health care facility?	83 89.3%	21 87.5%	59 89.4%	45 78.9%	65 81.3%	273 85.3%	0.048
Q12 Do you think PPE should be worn by health care provider who providing care to a symptomatic patient with history of exposure of COVID -19 and being evaluated for non-infectious disease?	74 79.6%	19 79.2%	56 84.8%	44 77.2%	63 78.8%	256 80.0%	0.051
Q13 Which of the following are recommended infection control measures upon arrival of a patient with arrival of a patient with suspected COVID-19 infection?	84 90.3%	22 91.7%	51 77.3%	39 68.4%	63 78.8%	259 80.9%	0.001
Q14 A recommended infection prevention and control measure is to perform aerosol generating procedure including collection of diagnostic respiratory specimens in airborne infection isolation room	59 63.4%	12 50%	49 74.2%	35 61.4%	42 52.5%	197 61.6%	0.026

Table 4. Infection prevention and control practice towards (COVID-19) among health care workers(N=320).

Questions	Medical Professions			Allied Medical Professions		Total Correct Responses N=320 n (%)	P-Value
	Public Health n=93 n (%)	Pharmacy n=24 n (%)	Medicine n=66 n (%)	Nursing n=57 n (%)	Technician n=80 n (%)		
Q1. Have you maintained quarantine hours with family?	73 (78.5%)	19 79.2%	48 (72.7%)	38 (66.7%)	64 (80%)	242 (75.6%)	0.495
Q2. Do you follow prevention precaution when you do your essential activities such as shopping?	57(61.3 %)	14 (58.3%)	38 (57.6%)	32 (56.1%)	44 (55%)	185 (57.8%)	0.269
Q3. When you come work, do you apply the recommended prevention precautions in the BMC?	58(62.4 %)	14 (58.3%)	48 (72.7%)	40 (70.2%)	51 (63.8%)	211 (65.9%)	0.686
Q4. Avoiding touching your eyes, nose, and mouth with unwashed hands	84 (90.3%)	22 (91.7%)	54 (81.8%)	50 (87.7%)	70 (87.5%)	280 (87.5%)	0.439
Q5. Staying home when you were sick or when you had a cold	74 (79.6%)	21 (87.5%)	2 (78.8%)	43 (75.4%)	70 (87.5%)	260 (81.3%)	0.700
Q6. Do you disinfect surfaces	73 (78.5%)	22 (91.7%)	45(68.2 %)	51 (89.5%)	74 (92.5%)	265 (82.8%)	0.002
Q7. Disinfecting the mobile phone	78(83.9 %)	24 (100%)	47 (71.2%)	47 (82.5%)	67 (83.8%)	263 (82.2%)	0.024
Q8. Physical distancing	78 (83.9%)	21 (87.5%)	51(77.3 %)	43 (75.4%)	61 (76.3%)	254 (79.4%)	0.354
Q9. Do you apply (My 5 Moments for Hand Hygiene before touching a patient, before clean/aseptic procedures, after body fluid exposure/risk, after touching a patient, and. after touching patient surroundings?	73(78.5 %)	18 (75%)	52 (78.8%)	37 (64.9%)	57 (71.3%)	237 (74.1%)	0.100

Results demonstrated that our participants expressed better self-reported practice as overall (76.28%) compared with them over all knowledge (64.8%). In order to investigate whether lower knowledge level was associated with demographic factors, we examined the differences in scores of knowledge part according to characteristics of participants**.**

The findings are given in Table 5, which shows the distribution of mean ranks for each group. Sex differences and attendance of lectures or discussions about COVID -19 were tested using Mann-Whitney tests. Differences in age, occupation, level of education, and years of experience were tested using the Kruskal-Wallis tests.

Table 5: Differences in total knowledge towards (COVID-19) and some characteristics of participants

Variable	N	Mean Rank	P value
Gender			
Males	88	178.31	**0.03**
Females	232	153.75	
Age Group			
18-29	86	153.18	
30-49	220	162.00	0.35
50-59	12	195.46	
More than 60	2	100	
Occupation			
Public Health	93	203.98	
Pharmacy	24	155.33	**0.00**
Medicine	66	179.78	
Technician	80	135.40	
Nursing	57	116.11	
Level of Education			
Intermediate Diploma	26	74.75	
High Diploma	73	110.86	**0.00**
Bachelor's degree	175	182.55	
Master or PhD	46	203.87	
Years of experiences			
1-5 years	132	161.74	0.41
6-10 years	83	149.79	
More than 10 years	105	167.41	
Had you attended any of the lectures/discussions about COVID -19?			
Yes	141	165.43	0.39
No	179	156.62	

The overall scores of knowledges varied across several occupation of the study participants. The difference was statistically significant (< 0.05). Similar significant evidence observed by gender and level of education. Men healthcare workers and those who had Master or PhD degree were more likely to have adequate knowledge than their counterparts. On the other hand, there were not statistically significant differences between participant 's scores of knowledges and their age, years of experience, and whether they attended any of the lectures/discussions about COVID -19 or not.

DISCUSSION

Adequate knowledge and appropriate practice regarding infection prevention and control are vital in reducing the burden of COVID-19 in health care settings. The first part of this study assessed knowledge regarding COVID-19, and asked the participants on their sources of information to gain the reliable knowledge about this novel virus. Few health care workers 20% reported that they used official government websites, and only 44% of them

attended lectures and discussions about Covid-19. As the pandemic is caused by a novel virus, health care workers are expected to provide reliable information and depend on trusted sources such as the WHO and the CDC, and encouraged to attend scientific discussion to improve their awareness.

The participants demonstrated satisfactory knowledge as the overall percentage of correct answer was only 64.8 %. Approximately the half of HCWs correctly answered the questions regarding the origin of coronavirus, the main mode of transmission, treatment, incubation period, defining of close contact, and use of face mask. Nevertheless, better performance cannot be denied on other parts of knowledge assessment. As the majority of participants manifested high knowledge regarding the use of PPE, and were aware of risk reduction and complication of COVID-19.

Even though not all our participants are actively involved in care of COVID-19 patient (only40.6% in frontline), there is a high risk of spreading the infection in their work environment. Therefore, it is important to know the methods of "donning and doffing" of personal protective equipments and the safe disposal according to the CDC guidelines [24]. More importantly, only 61.6% of participants knew the concept that Airborne Infection Isolation Room (AIIR) must be provided by aerosol generating procedures which are performed for patients with suspected or known COVID-19 [25].

When comparing our results to those of related studies, it must be pointed out that researchers in the literature have assessed knowledge of COVID-19 from different perspectives in terms of epidemiological and clinical aspects of the disease, as well as measures of prevention and control. The present findings are comparable with a national study [21] in which the overall level of knowledge was not calculated, but the authors found higher knowledge level in each area of their assessment. By contrast, our participants' knowledge level as an overall was better than that reported in another Libyan study [22]. In the international context, our study reports lower level of knowledge compared with what was reported in Nigeria [19], China [26], and Greece [27]. In comparison of specific knowledge area, our findings were in line with a similar survey [18]. For example, 43.1% of our participants correctly defined the close contact. We considered this percentage as the lowest of correct answers. The Indian study found that less than half of the responders were aware of defining a "close contact." Further, regarding the question on PPE use, 85.3% of our participants were aware of the essential PPE needed for transporting a suspected patient within a healthcare facility. Likewise, this question was answered by 87% of participants in the Indian study. In consideration of factors which may affect the knowledge outcomes, the results demonstrated that scores of knowledges significantly varied by gender and across different occupational categories and educational level of participants. A similar pattern of results was obtained in previous literature [28,29].

The second part of assessment was on practice of infection prevention and control measures both in daily life and at work. Receiving a relatively good overall percentage practice in our study is encouraging. The majority of participants reported that they fellow the WHO Simple precautions to reduce chances of being infected or spreading the infection. (75.6%) maintained quarantine hours with family, (81.3%) Staying home when they sick or had a cold, and (87.5%) avoiding touching their eyes, nose, and mouth with unwashed hands. Furthermore, they demonstrated good practice in disinfection of mobile phone and surfaces; maintaining physical distancing, and following the five Moments for hand hygiene practices

as recommended by the WHO [30]. The findings on practice of health care workers are in line with previous studies [19,21].

However, for a highly contagious disease like COVID-19, it is crucial to fellow prevention precaution during essential activities such as shopping. Only 57 % of our participants take care of that. The other concern is that only 65.7% apply the recommended prevention precautions in the BMC. For health care practitioners, all prevention precautions at the health care setting are mandatory in order to prevent infections, both for oneself and for the patients [31]. Health care workers at the BMC in a previous survey indicated to a number of infection control barriers in their work environment [23]. This may imply the reason of less compliance with infection control precautions reported in this study.

The current study has highlighted insights of knowledge and practices of a sample of health care workers towards COVID-19, during a period was considered as a peak in Benghazi. The outcomes of this survey may contribute to identify knowledge gaps and practice patterns in order to implement effective behavioural and educational interventions. However, several limitations in our study are acknowledgeable. Being a cross sectional survey may contain a recall bias, as data presented in this study were self-reported depend on participant' honesty. Due to restriction in work caused by COVID-19, we included only 14% of health care workers in the BMC as a convenient sample. Some health care workers were unwilling to participate, and this was a major challenge, we had to extend time of data collection to reach a maximal sample size. Consequently, the findings cannot be extrapolated to all health care workers at the BMC or generalised on other health care setting in Libya. Further observational studies at different health centres are recommended.

In conclusion, this study showed that health care workers at the BMC had in general a satisfactory knowledge and good practice towards COVID-19. The knowledge scores were significantly associated with differences by gender, occupation, and level of education. However; there were areas with poor knowledge and practices. These areas should be addressed through continuous public health education on COVID19 infection prevention and control. Moreover, health care workers should depend on authentic sources of information. It is also recommended that the ministry of health provides regular updates on COVID-19 through official social media.

REFERENCES

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. China Novel Coronavirus Investigating and Research Team. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med. 2020 Feb 20;382(8):727-733. doi: 10.1056/NEJMoa2001017.
2. World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. 2020. Available from: https://www.who.int/publications-detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations
3. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report—51. Geneva: WHO. 2020. Available from www.who.int/emerg encie s/disea ses/novel -coronaviru s-2019/situa tion-repor ts.
4. Sanders JM, Monogue ML, Jodlowski TZ, Cutrell JB. Pharmacologic treatments for coronavirus disease 2019 (COVID-19): a review. *J Am Med Assoc.* 2020;323(18):1824–1836.

5. Haque, A.; Pant, A.B. Efforts at COVID-19 Vaccine Development: Challenges and Successes. *Vaccines* **2020**, *8*, 739.
6. Chang, Xu H, Rebaza A, Sharma L, Dela Cruz CS. Protecting health-care workers from subclinical coronavirus infection. *Lancet Respir Med* 2020; **8:** e13.
7. Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Epidemiology of and risk factors for coronavirus infection in health care workers: a living rapid review. *Ann Intern Med* 2020; DOI: 10.7326/M20-1632
8. World Health Organization. Infection prevention and control during health care when COVID-19 is suspected. 2020.
9. Centers for Disease Control and Prevention. Interim infection prevention and control recommendations for patients with suspected or confirmed coronavirus disease 2019 (COVID-19) inhealthcare settings. Coronavirus Disease 2019 (COVID-19).2020.
10. Güner R, Hasanoğlu I, Aktaş F. COVID-19: Prevention and control measures in community. *Turk J Med Sci*. 2020;50(SI-1):571-577. doi:10.3906/sag-2004-146
11. Islam MS, et al. Current knowledge of COVID-19 and infection prevention and control strategies in healthcare settings: a global analysis. Infect. Control Hosp. Epidemiol. 2020 doi: 10.1017/ice.2020.237.
12. Assiri A, McGeer A, Perl TM, et al. Hospital outbreak of Middle East respiratory syndrome coronavirus. N Engl J Med 2013; 369: 407–16
13. Korea Centers for Disease Control and Prevention. Middle East respiratory syndrome coronavirus outbreak in the Republic of Korea, 2015. Osong Public Health Res Perspect. 2015; 6:269–327
14. Hunter JC, Nguyen D, Aden B. Transmission of Middle East respiratory syndrome coronavirus infections in healthcare settings, Abu Dhabi. Emerg Infect Dis. 2016; 22:647–656
15. Choi S, Jung E, Choi BY, Hur YJ, Ki M. High reproduction number of Middle East respiratory syndrome coronavirus in nosocomial outbreaks: mathematical modelling in Saudi Arabia and South Korea. J Hosp Infect. 2017 doi: 10.1016/j.jhin.2017.09.017
16. Limbu DK, Piryani RM, Sunny AK (2020) Healthcare workers' knowledge, attitude and practices during the COVID-19 pandemic response in a tertiary care hospital of Nepal. PLoS ONE 15(11): e0242126. https://doi.org/10.1371/journal.pone.0242126
17. Bhagavathula AS, Aldhaleei WA, Rahmani J, Mahabadi MA, Bandari DK. Knowledge and Perceptions of COVID-19 Among Health Care Workers: Cross-Sectional Study. JMIR Public Health Surveill. 2020 Apr 30;6(2):e19160. doi: 10.2196/19160.
18. Modi P D, Nair G, Uppe A, et al. (April 02, 2020) COVID-19 Awareness Among Healthcare Students and Professionals in Mumbai Metropolitan Region: A Questionnaire-Based Survey. Cureus (April 02, 2020) 12(4): e7514. DOI 10.7759/cureus.7514
19. Francis Enenche Ejeh, Adamu Saleh Saidu, Samuel Owoicho, Nanven Abraham Maurice, Solomon Jauro, Laura Madukaji, Kenneth O. Okon. Knowledge, attitude, and practice among healthcare workers towards COVID-19 outbreak in Nigeria, Heliyon, 2020; 6(11): e05557.
20. McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-Analysis of the Reasoned Action Approach (RAA) to Understanding Health Behaviors. Ann Behav Med. 2016;50(4):592–612
21. Hweissa NA, Shawesh FA, Krema SO, Mansour AA. Knowledge, attitude and practice (KAP) for preventing the coronavirus (COVID19) pandemic among libyan health care workers. Libyan J Med Sci 2020; 4:109-14
22. Elhadi, M., Msherghi, A., Alkeelani, M., Zorgani, A., Zaid, A., Alsuyihili, A., et al. Assessment of healthcare workers' levels of preparedness and awareness regarding COVID-19 infection in low-resource settings. *Am. J. Trop. Med. Hyg*2020;103: 828–833.
23. Houssein N, Othman K, Mohammed F, Aiad A, Sunallah H. Barriers in Infection Control Practice against COVID-19: A Survey of Healthcare Workers in Benghazi Medical Centre. Alq J Med App Sci. 2021;4(1):54-59

24. Centres for Disease Control and Prevention. Sequence for putting on personal protective equipment (PPE). 2020.
25. Tsui BCH, Pan S. Are aerosol-generating procedures safer in an airborne infection isolation room or operating room? *Br J Anaesth*. 2020;125(6):e485-e487. doi: 10.1016/j.bja.2020.09.011 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7494260/
26. Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L, You G. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. J Hosp Infect. 2020 Jun;105(2):183-187. doi: 10.1016/j.jhin.2020.04.012.
27. Papagiannis D, Malli F, Raptis DG, Papathanasiou IV, Fradelos EC, Daniil Z, Rachiotis G, Gourgoulianis KI. Assessment of Knowledge, Attitudes, and Practices towards New Coronavirus (SARS-CoV-2) of Health Care Professionals in Greece before the Outbreak Period. Int J Environ Res Public Health. 2020 Jul 8;17(14):4925. doi: 10.3390/ijerph17144925.
28. Huynh G, Nguyen T.N.H, Vo KN, Pham LA. Knowledge and attitude toward COVID-19 among healthcare workers at District 2 Hospital, HoChi Minh City. Asian Pacific Journal of Tropical Medicine, 2020;13:260
29. Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, *et al*. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. Int J Biol Sci 2020;16:1745-52
30. World Health Organization. Hand hygiene: why, how & when. (2020). https://www.who.int/gpsc/5may/Hand_Hygiene_Why_How_and_When_Brochure.pdf
31. Centres for Disease Control and Prevention. Clean Hands Count for Safe Healthcare. Available online: https://www.cdc.gov/patientsafety/features/ clean-hands-count.html