Available online at www.sciencerepository.org

Science Repository

Research Article

Knowledge, Attitude & Practices of Primary Healthcare Workers on COVID-19 from a Rural Setting of KwaZulu-Natal, South Africa

Akm Monjurul Hoque[1*], Somaya Buckus[2], Maariyah Hoque[3] and ME Hoque[4]

[1] *Medical Manager, KwaDabeka Community Health Centre, KwaDabeka, Westville, South Africa*
[2] *Medical officer KwaDabeka Community Health Centre, KwaDabeka, Clernaville, South Africa*
[3]*South African College of Applied Psychology, Morningside, Berea, South Africa*
[4]*Management College of Southern Africa, Durban, South Africa*

ARTICLE INFO

Article history:
Received: 22 October, 2020
Accepted: 31 October, 2020
Published: 17 November, 2020

Keywords:
COVID-19
knowledge
attitude
practice
healthcare workers
primary healthcare
South Africa

ABSTRACT

Introduction: Knowledge, attitude and practices (KAP) of COVID-19 pandemic play a significant role in reducing the transmission of the virus. There is limited information available about HCWs KAP regarding COVID-19. Therefore, the objective of this study was to investigate the KAP of KCWs from a primary healthcare setting in South Africa.

Method: This was a cross-sectional study conducted among all medical and nursing healthcare professionals of KwaDabeka Community Healthcare Center (KCHC) and seven PHC clinics. Self-administered questionnaire was used to collect data. Student's t-test and ANOVA test were carried out to compare the overall mean knowledge, attitude and practice scores between two or more groups. Pearson's correlation test was undertaken to establish correlation between KAP scores.

Results: Majority HCWs were female (82.8%), single or unmarried (56.6%) and nurses comprised the most (69.2%). Nearly half (44%) reported to have recognized vulnerable co-morbid illnesses for COVID-19. Only 24% of HCWs had good knowledge (scored > 60%), however, 81% had positive attitude (scored >60%) and 63% had good practice (>60% scores). Nursing practitioners had significantly lower mean knowledge and practice scores than medical officers and allied healthcare workers ($p<0.05$). Healthcare workers with bachelor's degree had significantly higher level of positive attitude ($p<0.05$).

Conclusion: The majority of healthcare workers at this primary healthcare facility had poor knowledge and practice but good attitude towards COVID-19 at the middle of the pandemic in SA. Frontline and lowest level healthcare workers need more education and training on basic epidemiology of COVID-19 to prevent occupational transmission.

Introduction

COVID-19 is a global pandemic infected more than 30 million people globally. It is by far the largest outbreak of atypical pneumonia since the severe acute respiratory syndrome (SARS) outbreak in 2003 [1, 2]. The number of cases has continued to escalate exponentially. To date, there is no antiviral curative treatment or vaccine that is recommended for COVID-19 [3]. The rapid spread of the disease over different continents is due to person-to-person transmission [4]. Transmissibility of COVID-19 as indicated by its reproductive number has been estimated at 4.08, suggesting that on average, every case of COVID-19 will create up to four new cases [5]. The average incubation period is estimated to be 5.2 days, with significant variation among patients, and it may be capable of asymptomatic spread to communities and Health Care Workers (HCW) [6-8]. Older men with vulnerable medical comorbidities are more likely to get infected, with worse outcomes [9]. Severe cases are found to lead to cardiac injury, respiratory failure, acute respiratory distress syndrome, and death [10].

According to CDC, coronavirus spreads mainly from person-to person by close contact (within about 6 feet) with infected people via respiratory

[*]*Correspondence to: Dr. Akm Monjurul Hoque, M.B.B.S., M.Sc., M.P.H., Medical Manager, KwaDabeka Community Health Centre, 21 Pitlochry Road, Westville 3629, KwaZulu-Natal, South Africa; Tel: +27317143704; Fax: +27317143710; E-mail: mhoque75@gmail.com, monjurul.hoque@kznhealth.gov.za*

http://dx.doi.org/10.31487/j.CEI.2020.03.02

(coughs or sneezes) or transmitted by touching a surface or object that the virus is on it [11]. HCW of all levels including Primary Health Care (PHC) level are involved in caring for COVID-19 patients as a first contact in South Africa (SA) with this highly transmittable pathogen. Thus COVID-19 has posed serious occupational health risks to HCWs due to their frequent exposure to infected individuals [12]. The COVID-19 outbreak has impacted significantly on the HCWs and general population of SA as there are 589 886 cases and 11,982 deaths as of 18 August 2020 [13]. The numbers of infected HCWs are 27,360, of which 78% from public and 22% from private sectors with 240 deaths as of 13 August 2020 [13]. The National government of SA has taken commendable interventions to fight the COVID-19 pandemic based on the WHO recommendations for HCWs [14]. SA national department of health has issued several guidelines, and started online courses and training sessions to raise awareness and preparedness regarding prevention and control of COVID-19 among HCWs [14, 15].

The literature suggests that lack of knowledge and misunderstandings among HCWs lead to delayed diagnosis, spread of COVID-19 among HCWs, family members, and community members and poor infection control practices. Study conducted in China on HCWs showed that they had good knowledge on COVID-19 spread (67%), symptoms of the disease (72%), isolation period (66%) and a positive attitude of 82%. However, the treatment of the disease was known to 58.4% [16]. Similarly, good knowledge and practice were found among 92.7% and 79.5 % of the dentists respectively from a multinational study [4]. Further studies from other countries showed that HCWs have good knowledge (93.2%), a positive attitude and good preventive practices (88.7%) regarding COVID-19. HCWs perceived that limited infection control material (50.7%) and poor knowledge regarding infection transmission (40.6%) were the major barriers to infection control [4].

Currently, there is scarce information regarding the level of knowledge, awareness and preventive practices of HCWs and particularly PHC workers, the lowest level of HCWs in SA. In addition, HCWs are at a high risk of getting the infection and can become a potential source of transmission in the family and the community. This is especially pertinent with the uncertainty surrounding an outbreak of such unparalleled magnitude. Based on our understanding, most of the research related to this outbreak focuses on identifying the epidemiology and clinical characteristics of infected patients, the genomic characterization of the virus, and challenges for global health governance [9, 17-19]. However, there is very limited research investigating the knowledge, attitude and preventative practices of the PHC healthcare workers in South Africa. Therefore, this study aimed to determine the current level of knowledge, attitude and practice (KAP) regarding COVID-19 among HCWs working at KwaDabeka Community Health Center (KCHC). This will assist government agencies and healthcare professionals and managers to design and implement necessary health promotion interventions, health education and training of healthcare workers in the face of COVID-19 outbreak expansion in South Africa.

Methods

I Study Design

A cross-sectional study was conducted among all medical, allied and nursing care professionals at KCHC and seven PHC clinics.

II Settings and Subjects

KCHC is situated in the community of KwaDabeka and manages KCHC and seven PHC clinics of western sub-district of eThekwini (Durban) Metropolitan. There is a total of 225 (Doctors 10, Nurses 160 and 55 others allied healthcare professionals) healthcare professional working at KCHC and affiliated clinics. Medical and allied healthcare professionals are based at KDCHC and provide care both at KCHC and 7 affiliated PHC clinics on a rotational basis. These PHC facilities provide comprehensive PHC services using National Guidelines.

III Data Collection

Data were collected using self-administered anonymous questionnaire. The questionnaire was developed by the researchers using different published articles [4, 11, 14]. Questionnaire dealt with HCWs demographics, personal risk factors (comorbidities), knowledge, attitude and practices on COVID-19. The questionnaire was distributed to HCWs of KDCHC and PHC clinics on the fourth and seventh September 2020, respectively. The completed questionnaires from HCWs were received back from the participating respondents on the 9 from KCHC and 10 September 2020 from PHC clinics, respectively. The knowledge questions were posed on 9 true and false or yes or no answer type questions. The true or false questions were; the virus survives for days outside the body in open air, the virus survives for days outside the body on a plastic surface, most people who get COVID-19 become very ill, you can have the virus without any symptoms, children get less ill from the virus than adults, only elderly people die from COVID-19, HCWs need to isolate at home while they are working, and incubation period for corona virus. The attitude questions had 6 items to gain insight on how the respondents feel about COVID-19 epidemic in SA.

The following questions with yes or no answers were asked; are you confident that you will get proper PPEs at work, Will you be able to handle if infected with COVID-19, Do you think that COVID-19 is not a serious infection, SA Government can handle the COVID-19 epidemic optimally, are you confident that the clinic can handle COVID-19 epidemic, do you think the clinic had provided you with adequate information on prevention of COVID-19. The practice question consisted of the following 5 questions; do you use correct PPEs as prescribed by WHO, do you isolate yourself at home while dealing with COVID-19 cases, do you keep a distance of 1-2 meters in public places and do you wash or sanitise your hands after examining a patient.

IV Measurements

Knowledge, attitude and practices were measured using a score of "1" for true or correct answer and "0" for false or incorrect answers. The total score of knowledge, attitude and practices were measured by adding the scores for the correct and incorrect answers. Total score above 60%

was considered good knowledge, positive attitudes and good practices towards COVID-19.

V Data Analysis

Data was captured in Microsoft Excel programme, coded, transported, recoded and analysed using SPSS version 22. Descriptive statistics such as mean with standard deviation (SD) for continuous variables and frequency distribution for categorical variables were undertaken. Student's t-test and ANOVA test were carried out to compare the mean knowledge, attitude and practice scores between two or more groups. Pearson's correlation test was conducted to determine the relationship between knowledge, attitudes and practices regarding COVID-19. P-values <0.05 was considered statistically significant.

VI Ethical Consideration

Ethical approval was obtained from uMgungundlovu Health Ethics Review Board (Reference no. UHERB 0007/2020). Permission was sought from the institutional management. Anonymity and confidentiality of the respondent was maintained at all times. Participation in the study was voluntary. The study questionnaire contained a information section that stated the purpose, nature and objectives of the study and participation was voluntary. The study used informed consent from the participants.

Results

The survey questionnaire was given to 182 HCWs (as others were absent or on leave). A total of 159 (87%) respondents returned the completed questionnaire and thus were included in the final analysis (Table 1). Majority HCWs were female (82.8%), single or unmarried (56.6%) and nurses comprised the most (69.2%). As this study was conducted in a primary healthcare setting, doctors comprised of only 5.7%. Most of the healthcare workers' (65.6%) were between 31 to 50 years of age. Half (50%) of them had obtained a postgraduate diploma or degree. Nearly half (44%) reported to have recognized vulnerable co-morbid illnesses for COVID-19. Among those co-morbidities the common was hypertension (16.4%), obesity (6.9%), HIV (5.7%), diabetes (4.4%). Only 3% had more than one co-morbidity.

Table 1: Demographic characteristics of the health care workers.

Variables	Frequency	Percentage
Gender (n=157)		
Male	27	17.2
Female	130	82.8
Marital Status (n=152)		
Single	69	45.4
Married	66	43.4
Others (Living together/Widow)	17	11.2
Age (n=145)		
20-30 years	22	15.2
31-40 years	48	33.1
41-50 years	48	33.1
51-59 years	22	15.2
60 years and over	5	3.4
Category of staff (n=136)		
Medical Officer	7	5.1
Nursing Practitioner	89	65.4
Allied Health Worker	40	29.4
Highest Level of Education (n=141)		
Matric with diploma	25	17.7
Bachelor degree	26	18.4
Postgraduate Diploma	74	52.5
Postgraduate degree (Honors/ Masters/ Doctoral)	16	11.0
Having Comorbidity (Yes)	69	44

The assessment on the HCWs knowledge of COVID-19 revealed that average knowledge of HCWs was 4.49, (SD= 1.54 out of 9 items/scores) and was thus considered poor (Table 2). Only 24% HCWs had good knowledge (> 60%). However, good knowledge was displayed by HCWs on items; one can be asymptomatic whilst infected with COVID-19 (91.8%), not only the elderly people that will succumb to COVID-19 (95%) and correct knowledge on mode of transmission of COVID-19 (87.4%). The poor knowledge were displayed on the following statements: "the virus survives for a week outside the body on plastic surfaces" (23.3%), "the virus survives for days outside the body in open air" (57.2%) and "those people infected with COVID-19 will become seriously ill" (27.7%) and "on incubation period of COVID-19" (37.7%). With regards to the attitudes the PHC HCWs showed positive attitude as the average score was 4.36, (SD=1.14 out of a total of 6 scores/items). Positive attitude (>60%) was scored by 81% HCWs. Positive attitude were found on; confident that they will get proper PPEs

at work (87.4%), they will be able to handle well if get infected with COVID-19 (91.2%), they are confident that the clinic can handle COVID-19 epidemic (93.7%). The information received from the institution was perceived at low of 36.5%. However, the average attitude is good of 73%.

The practice on prevention of COVID-19 infection was poor as the average total score was 58%. However, good practice >60% was scored by 63% HCWs. Higher scores were reported on items; the correct use of PPEs (80.3%) and sanitize their hands at work (73.2%) respectively. However, low practice scores were found on items; isolation at home while they are dealing with COVID-19 confirmed or suspected cases at work (28.9%), maintain social distance at public places (46.5%) and wash hands after each consultation with patients (46.5%). Pearson correlation test was conducted to determine the relationship between knowledge, attitude, and practice scores (Table 3). There was no significant correlation found between KAP scores ($p>0.05$). Comparing the overall knowledge, attitudes and practice scores among the different HCWs, it was found that nursing practitioners had significantly lower mean knowledge and practice scores than medical officers and allied healthcare workers ($p<0.05$) (Table 4). Healthcare workers with bachelor's degree had significantly higher level of positive attitude ($p<0.05$) towards COVID-19 than other healthcare practitioners (Table 4).

Table 2: Knowledge, attitude and practice of healthcare workers on COVID-19 (n=159).

Variables: Knowledge	**Frequency**	**Percentage**
The virus survives for days outside the body in open air	91	57.2
The virus survives for a week on a plastic surface	37	23.3
Most people who get COVID-19 get very ill	115	72.3
You can have the virus without any symptoms	146	91.8
On average, children get less ill from the virus than adults	59	37.1
Only elderly people die from COVID-19	151	95.0
Incubation period of COVID-19 virus	60	37.7
HCWs need to isolate at home while they are working	113	71.1
COVID-19 mode of Transmission	139	87.4
Mean Knowledge (SD)	4.49 (1.54)	
Attitude		
Confident that they will get proper PPEs at work	139	87.4
Will you be able to handle if infected with COVID-19	145	91.2
SA Government can handle the COVID-19 epidemic optimally	95	60.1
Do you think that COVID-19 is not a serious infection	100	62.9
Institution had provided adequate information on prevention of COVID-19	58	36.5
Confident that the clinic can handle COVID-19 epidemic	149	93.7
Mean attitude	4.36 (SD=1.14)	
Practice		
Use correct PPEs as prescribed by WHO at work	126	80.3
Sanitize hands after each consultation	115	73.2
Isolate yourself at home as dealing with COVID-19 cases	46	28.9
do you keep a distance of 1-2 meters in public places	74	46.5
Wash or sanitize hands after examining a patient	74	46.5
Mean Practice score	2.86 (SD=1.11)	

Table 3: Correlation between knowledge, attitude and practice scores of HCW on COVID-19.

		Total Knowledge	Total attitude	Total practice
Total Knowledge	Pearson Correlation	1	.072	.020
	Sig. (2-tailed)		.368	.803
	N	159	159	159
Total attitude	Pearson Correlation	.072	1	.008
	Sig. (2-tailed)	.368		.921
	N	159	159	159
Total practice	Pearson Correlation	.020	.008	1
	Sig. (2-tailed)	.803	.921	
	N	159	159	159

Table 4: Comparison of knowledge, attitude and practice with regards to category and level of education of HCWs.

Variables		**N**	**Mean**	**P- value**
Knowledge	Medical Officer	110	4.636	.003
	Nursing Practitioner	40	3.875	
	Allied Health workers	9	5.556	
Practice	Medical Officer	110	3.027	.025
	Nursing Practitioner	40	2.500	
	Allied Health workers	9	2.556	
Attitude	Matric with diploma	35	4.057	.005
	Bachelor	30	4.667	
	Postgraduate diploma	77	4.481	
	Postgraduate degree	16	3.625	

Discussion

COVID-19 is not only causing a health risk to the general population but unquestionably to healthcare workers as they have a greater exposure and chances of contracting the COVID-19. It is therefore imperative that the risk factors for contracting COVID-19 are understood in order to prevent high occupational transmission amongst HCWs, their family members and community members at large. The importance of assessing the knowledge, attitude and practice of healthcare workers was to ensure that our frontline HCWs are taking the necessary precautions to avoid transmission amongst their colleagues, thereby ensuring that our healthcare facility has adequate healthy staff for efficient operation.

Safe and qualitative care in the COVID-19 pandemic hinges on the health and mental wellbeing of our frontline healthcare workers [20]. Healthcare workers above the age of 50 (known as vulnerable group) comprised of 19.1% of the total study population. A risk stratification tool for HCWs conducted in England and found that mortality from COVID-19 was doubled in 50-59 years, quadrupled in the 60-69 years of age groups and 12 times higher after the age of 70 years [21]. According to the CDC, older healthcare workers are at higher risk of infection and complications related to COVID-19. People aged 50 years or older are almost 10 times likely to die from COVID-19 than otherwise healthy younger people [22]. The CDC also mentions that that the median age of health care professionals who were infected with COVID-19 in USA was 42 years, and 73% were female [23]. The similar trend is found in SA [13]. The National Institute for Occupational Health in South Africa reported that, the median age of COVID-19 HCW admissions in SA was 44 years, there were 9.7% admissions among HCWs who were 60 years and older and majority (80.7%) were female [13]. The most common co-morbid conditions reported in healthcare workers admissions due to COVID-19 in SA were hypertension and diabetes [24].

Evidence highly suggests that pre-existing comorbid conditions such as cardiovascular disease, uncontrolled diabetes, hypertension, and obesity are associated with a higher risk of hospitalization, admission to an intensive care unit, and death among those HCWs infected with COVID-19 [25]. In our cohort, just under half (44%) of healthcare workers had comorbid diseases of which hypertension was the most common (16.4%). In a recent study from China, hypertension was found the most common co-morbid disease in healthcare workers diagnosed with COVID-19 [26]. Therefore, the higher rate of co-morbidity among these HCWs are likely. It is surprising that only 28.9% HCWs from these PHC facilities are isolating at their homes. Thus they are faced with higher risk of exposure and hence are at a higher risk of transmitting COVID-19 to their families. This is even more evident in PHC facilities where the enforcement of social distancing is challenging to maintain due to space and infrastructural limitation [27].

The poor knowledge displayed by PHC workers in our study (mean knowledge of 50%) demonstrated lack of training in the early stages of the pandemic in relation to incubation period, survival of the virus and the severity the infection. This is of concern when comparing the knowledge of healthcare workers in other parts of the world. Hospital based study from China and Nepal reported 89%, and 83.5% of HCWs had good knowledge [7, 28]. Good knowledge was also displayed in 99% of healthcare workers based in a hospital in Iran and a hospital in Pakistan (92%) [29, 30]. In a study conducted in Uganda, 69% of healthcare workers displayed sufficient knowledge on COVID-19 [31]. Inadequate knowledge is not only a risk factor but also a higher risk for infection [32]. Despite the provision of training, easily accessible information sources by both National Department of Health, SA and WHO therefore, these findings have shown a knowledge gap among the HCWs of KCHC. The study found positive attitude among HCWs towards COVID-19. The information received from the institution was perceived at low of 36.5%. However, the average attitude is good of 73%. A possible explanation is that different strategies adopted in the facility including ensuring PPEs, settng isolation facilities for suspected and confirmed cases of COVID-19 are some of the initiatives might lead to a positive attitude. Other studies from India and China have reported similar level of positive attitude among HCWs [15, 16].

The practice on prevention of COVID-19 infection was found to be poor as the average total score was 58%. However, good practice >60% was scored by 63% HCWs. Higher scores of (80.3%) and (73.2%) were reported on items; the correct use of PPEs and sanitize their hands at work, respectively. However, low practice scores were found on items; isolation (28.9%) at home while they are dealing with COVID-19 confirmed or suspected cases at work, maintain social distance at public places (46.5%) and wash hands (46.5%) after each consultation with patients. These are items are considered very important practices for HCWs when they are working with suspected or confirmed cases of COVID-19. These are the gaps identified among HCWs practices in the

PHC health facility. It is thus important that the managers of the facility must ensure and continuous monitoring such practices to prevent HCWs to acquire COVID-19 due to their practice gap.

Comparing the overall knowledge, attitudes and practice scores among the different HCWs, it was found that nursing practitioners had significantly lower mean knowledge and practice scores than medical officers and allied healthcare workers ($p<0.05$) (Table 4). This difference is comparable to other findings that they found that doctors had better knowledge than other practitionals [15, 30]. This could be attributeable to disparities of knowledge among HCWs. The doctors and allied healthcare workers highly educated and are expected to actively seeking information due to their active roles in improving treatment outcomes of patients with COVID-19 and other medical conditions. Similarly, HCWs with bachelor's degree had significantly higher level of positive attitude ($p<0.05$) towards COVID-19 than other healthcare practitioners (Table 4). This is possible as these group of HCWs are highly qualified group of doctors and pharmacists working in PHC facilities. Knowledge is a known prerequisite for developing prevention belief, thus leads to positive attitude and promotes preventive and or positive behaviour. It is thus known to improve individuals' knowledge and attitudes towards a disease prevention behaviour and practices [33, 34]. This study had some limitations. The study was conducted in one small PHC facility in one of the province of SA, so the results may not be generalizable to all other health facilities (different level hospitals) HCWs. Further study is needed to include HCWs from different types of health facility and geographic locations to overcome these limitations.

Conclusion

In the face of this overwhelming global challenge, the findings indicate that the majority of healthcare workers at this primary healthcare facility had poor knowledge and practice but good attitude towards COVID-19 at the middle of the pandemic in SA. In-service training of healthcare workers and educational interventions are of paramount importance in ensuring the halt of this pandemic. Frontline and lowest level healthcare workers need more education and training on basic epidemiology of COVID-19 such as incubation period, mode of transmission, and universal precaution for prevention of infectious diseases to prevent occupational transmission. Adequate knowledge, positive attitude and safe and efficient practices are integral part in combating infectious diseases including COVID-19 epidemic in SA.

Acknowledgements

We thank all the participants who voluntarily took part in this study.

Conflicts of Interest

None.

Author Contributions

AMH, SB, MEH: Conceptualisation, analysis, finalisation of the manuscript; MH: Data capture, analysis and finalisation of the manuscript.

Funding

None.

References

1. Wang C, Horby PW, Hayden FG, Gao GF (2020) A novel coronavirus outbreak of global health concern. *Lancet* 395: 470-473. [Crossref]
2. Mahase E (2020) China coronavirus: WHO declares international emergency as death toll exceeds 200. *BMJ* 368: m408. [Crossref]
3. Sahin AR, Erdogan A, Agaoglu PM, Dineri Y, Cakirci AY et al. (2020) 2019 novel coronavirus (COVID-19) outbreak: a review of the current literature. *EJMO* 4: 1-7.
4. Kamate SK, Sharma S, Thakar S, Srivastava D, Sengupta K et al. (2020) Assessing Knowledge, Attitudes and Practices of dental practitioners regarding the Covid-19 pandemic: A multinational study. *Dent Med Probl* 57: 11-17. [Crossref]
5. Cao Z, Zhang Q, Lu X, Pfeiffer D, Jia Z et al. (2020) Estimating the effective reproduction number of the 2019-nCoV in China. *medRxiv*.
6. Li Q, Guan X, Wu P, Wang X, Zhou L et al. (2020) Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med* 382: 1199-1207. [Crossref]
7. Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G et al. (2020) Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *N Engl J Med* 382: 970-971. [Crossref]
8. Ryu S, Chun BC, Korean Society of Epidemiology 2019-nCoV Task Force Team (2020) An interim review of the epidemiological characteristics of 2019 novel coronavirus. *Epidemiol Health* 42: e2020006. [Crossref]
9. Chen N, Zhou M, Dong X, Qu J, Gong F et al. (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. *Lancet* 395: 507-513. [Crossref]
10. Holshue ML, DeBolt C, Lindquist S, Lofy KH, Wiesman J et al. (2020) First Case of 2019 Novel Coronavirus in the United States. *N Engl J Med* 382: 929-936. [Crossref]
11. Centers for Disease Control and Prevention (2020) Coronavirus Disease 2019: COVID-19.
12. Gan WH, Lim JW, Koh D (2020) Preventing intra-hospital infection and transmission of COVID-19 in healthcare workers. *Saf Health Work* 11: 241-243. [Crossref]
13. Department of Health, Republic of South Africa (2020) National COVID-19 daily report.
14. World Health Organization (2020) Guidance for health workers.
15. Bhagavathula AS, Aldhaleei WA, Rahmani J, Mahabadi MA, Bandari DK (2020) Novel coronavirus (COVID-19) knowledge and perceptions: a survey on healthcare workers. *MedRxiv*.
16. Huynh G, Nguyen TNH, Tran VK, Vo KN, Vo VT et al. (2020) Knowledge and attitude toward COVID-19 among healthcare workers at District 2 Hospital, Ho Chi Minh City. *Asian Pac J Trop Med* 13: 260-265.
17. Huang C, Wang Y, Li X, Ren L, Zhao J et al. (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 395: 497-506. [Crossref]
18. Lu R, Zhao X, Li J, Niu P, Yang B et al. (2020) Genomic characterisation and epidemiology of 2019 novel coronavirus:

Implications for virus origins and receptor binding. *Lancet* 395: 565-574. [Crossref]

19. Rubin GJ, Wessely S (2020) The psychological effects of quarantining a city. *BMJ* 368: m313. [Crossref]
20. Chersich MF, Gray G, Fairlie L, Eichbaum Q, Mayhew S et al. (2020) COVID-19 in Africa: care and protection for frontline healthcare workers. *Global Health* 16: 46.
21. Jankowski J, Davies A, English P, Friedman E, McKeown H et al. (2020) Risk Stratification tool for Healthcare workers during the CoViD-19 Pandemic; using published data on demographics, co-morbid disease and clinical domain in order to assign biological risk. *medRxiv*.
22. Ehrlich H, McKenney M, Elkbuli A (2020) Protecting our healthcare workers during the COVID-19 pandemic. *Am J Emerg Med* 38: 1527-1528. [Crossref]
23. Mhango M, Dzobo M, Chitungo I, Dzinamarira T (2020) COVID-19 risk factors among health workers: A rapid review. *Saf Health Work* 11: 262-265.
24. Covid-19 Sentinel Hospital Surveillance Weekly Update on Hospitalized Healthcare Workers. Update: Week 24 (2020).
25. Centers for Disease Control and Prevention (2020) COVID-19 Response Team Preliminary Estimates of the Prevalence of Selected Underlying Health Conditions Among Patients with Coronavirus Disease 2019,United States. *MMWR Morb Mortal Wkly Rep* 69: 382-386.
26. Lai X, Wang M, Qin C, Tan L, Ran L et al. (2020) Coronavirus Disease 2019 (COVID-2019) Infection Among Health Care Workers and Implications for Prevention Measures in a Tertiary Hospital in Wuhan, China. *JAMA Netw Open* 3: e209666. [Crossref]
27. Garg S, Basu S, Rustagi R, Borle A (2020) Primary Health Care Facility Preparedness for Outpatient Service Provision During the COVID-19 Pandemic in India: Cross-Sectional Study. *JMIR Public Health Surveill* 6: e19927. [Crossref]
28. Nepal R, Sapkota K, Adhikari K, Paudel P, Adhikari B et al. (2020) Knowledge, attitude and practice regarding COVID-19 among healthcare workers in Chitwan, Nepal. *J Chit Med Coll* 10.
29. Maleki S, Najafi F, Farhadi K, Fakhri M, Hosseini F et al. (2020) Knowledge, Attitude and Behavior of Health Care Workers in the Prevention of COVID-19.
30. Saqlain M, Munir MM, Rehman SU, Gulzar A, Naz S et al. (2020) Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: a cross-sectional survey from Pakistan. *J Hosp Infect* 105: 419-423. [Crossref]
31. Olum R, Chekwech G, Wekha G, Nassozi DR, Bongomin F (2020) Coronavirus Disease-2019: Knowledge, Attitude, and Practices of Health Care Workers at Makerere University Teaching Hospitals, Uganda. *Front Public Health* 8: 181. [Crossref]
32. Zhang M, Zhou M, Tang F, Wang Y, Nie H et al. (2020) Knowledge, attitude and practice regarding COVID-19 among health care workers in Henan, China. *J Hosp Infect* 105: 183-187. [Crossref]
33. McEachan R, Taylor N, Harrison R, Lawton R, Gadner P et al. (2016) Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Ann Behav Med* 50: 592-612. [Crossref]
34. Fisher WA, Fisher JD, Rye BJ (1995) Understanding and promoting AIDS-preventive behavior: insights from the theory of reasoned action. *Health Psychol* 14: 255-264. [Crossref]