Short report

Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China

M. Zhang [a],*, M. Zhou [a], F. Tang [b], Y. Wang [a], H. Nie [a], L. Zhang [a], G. You [c]

[a] The Affiliated Cancer Hospital of Zhengzhou University, Zhengzhou University, Zhengzhou, China
[b] School of Health Sciences, Wuhan University, Wuhan, China
[c] Xinxiang Central Hospital, Xinxiang Medical University, Xinxiang, China

ARTICLE INFO

SUMMARY

The study analysed healthcare workers' (HCWs) knowledge, practices, and attitudes regarding coronavirus disease 2019 (COVID-19). A cross-sectional survey was conducted from February 4th to February 8th, 2020, involving a total of 1357 HCWs across 10 hospitals in Henan, China. Of those surveyed, 89% of HCWs had sufficient knowledge of COVID-19, more than 85% feared self-infection with the virus, and 89.7% followed correct practices regarding COVID-19. In addition to knowledge level, some risk factors including work experience and job category influenced HCWs' attitudes and practice concerning COVID-19. Measures must be taken to protect HCWs from risks linked to job category, work experience, working hours, educational attainment, and frontline HCWs.

© 2020 The Healthcare Infection Society. Published by Elsevier Ltd. All rights reserved.

Introduction

According to the World Health Organization (WHO), the outbreak of coronavirus disease 2019 (COVID-19) has become a pandemic, which at the time of writing had affected more than 100,000 people and caused more than 3000 deaths worldwide [1]. As of February 21st, 2020, the virus has affected 3019 healthcare workers (HCWs) with five deaths [2]. The fact that HCWs are at risk of infection in the epidemic chain is a critical issue because HCWs help in controlling the outbreak.

Therefore, all possible actions must be taken to control the spread of the infection to HCWs, first by identifying the risk factors for infection and then by taking appropriate measures to reduce these risks.

It is well established that transmission of the disease among HCWs is associated with overcrowding, absence of isolation room facilities, and environmental contamination. However, this is likely compounded by the fact that some HCWs have inadequate awareness of infection prevention practices [3]. Knowledge of a disease may influence HCWs' attitudes and practices, and incorrect attitudes and practices directly increase the risk of infection [4]. Understanding HCWs' knowledge, attitudes, and practices (KAPs) and possible risk factors helps to predict the outcomes of planned behaviour. Thus, this study aimed to investigate KAPs concerning patients infected with COVID-19 among HCWs. If

---

* Corresponding author. Address: Department of Hepatobiliary Surgrey, The Affiliated Cancer Hospital of Zhengzhou University, 127 Dong Ming Road, Henan, Zhengzhou, 450008, China. Tel.: +86 1583 7185160; fax: +86 0371 65961505.
E-mail address: 15837185160@163.com (M. Zhang).

HCWs' KAPs concerning the virus and the factors that affect their attitudes and behaviours can be determined promptly in the early stages of the epidemic, then this information can inform relevant training and policies during the outbreak and guide HCWs in prioritizing protection and avoiding occupational exposure.

Methods

Study population and participants

This study was conducted in Henan province, China. Henan is geographically close to Wuhan, an area critically affected by COVID-19, and many people from Wuhan travel to Henan before the Spring Festival. Next to Wuhan, Henan is the worst-hit area in China. Thus, Henan province was selected as the setting to analyse HCWs' KAPs. The *China health statistics yearbook* reports a total of 1825 general hospitals, 180,402 doctors, 263,100 nurses, and 103,306 paramedics registered in Henan province [5]. Inquiry surveys were sent to all 1825 general hospitals in the province. Approximately 100 hospitals provided feedback and register data for their HCWs. An electronic survey was then sent to 10 hospitals (10%) to collect information on HCWs' KAP concerning COVID-19. These hospitals were selected based on the accessibility of the respondents (location, cooperation, and interest of the hospital management). All ten hospitals were public, accredited multi-specialty, tertiary care with 1800 to 10,000 beds. Data were collected from HCWs in medical and surgical wards and intensive care units (ICUs) using a self-administered questionnaire designed to assess KAP concerning COVID-19. All participants were guaranteed anonymity and they provided informed consent. During the study period, i.e. February 4th to 8th, 2020, a total of 1357 completed questionnaires were received.

Knowledge, attitudes, and practices questionnaire design

The questionnaire consisted of two parts (detailed information is presented in the Supplementary Appendix). The first part assessed HCWs' general information and demographic variables including gender, work experience (years), job category (doctors, nurses, and paramedics), educational attainment, frontline or non-frontline status, and overworked status (Table I).

Frontline healthcare workers

Frontline HCW was defined as a worker directly involved in COVID-19 prevention and treatment and having direct contact with confirmed or suspected cases through patient intake, screening, inspection, testing, transport, treatment, nursing, specimen collection, pathogen detection, pathologic examination, or pathologic anatomy of medical and healthcare professional and technical personnel.

Overworked status

A growing body of research demonstrates that HCW fatigue increases risk of patient care errors and employee injuries

Table I
Characteristics of the respondents ($N = 1357$)

Demographic variables	No.	%
Gender		
Male	724	53.4
Female	633	46.7
Job category		
Doctors	495	36.5
Nurses	631	46.5
Paramedics	231	17.0
Work experience		
<5 years	460	33.9
5–9 years	409	30.1
>9 years	488	36.0
Whether frontline		
Frontline HCWs	578	42.6
Non-frontline HCWs	779	57.4
Overworked status		
<8 h	647	47.7
≥8 h	710	52.3
Educational attainment		
Junior college and below	277	20.4
College	764	56.3
Postgraduate	316	23.3

[6,7]. In this survey, HCWs were considered overworked if they had worked more than 8 h per day on average during the previous week.

The second part of the survey contained 16 items to assess HCWs' KAPs concerning the epidemic. KAPs questions were informed by the 2020 WHO guidelines [8]. A short test including eight items assessed epidemic infection knowledge to avoid excessively broad questions that might affect the quality of the data. Responses were recorded on a Likert scale ranging from 1 to 6 ('Not understanding' to 'Master') with total scores ranging from 8 to 40. Attitudes were assessed through four items regarding HCWs' level of fear of COVID-19, confidence in defeating the virus, feelings of fatigue after the outbreak, and attitude regarding whether patients should disclose their exposure. Practices were measured through four items regarding the frequency of hand washing, whether HCWs always remove protective equipment carefully, how many times HCWs participated in training before and after the outbreak (≥3 times a week = good; <3 times a week = poor), and whether they maintained quarantine with family.

Statistical analysis

Data were analysed using Stata for Windows, version 15 (Stata Corp., College Station, TX, USA), with two-tailed $P < 0.05$ considered to indicate statistical significance. Multivariate regression was performed to estimate the influencing factors.

Practices (four items) and attitudes (four items) were calculated based on the self-administered questionnaire. Each dependent variable had two possible values: 1 = 'Yes, I always/most of the time have this practice/attitude' or 0 = 'No, I some time/occasionally/rarely have this practice/attitude'. Forward conditional logistic regression analysis was performed to identify the main factors affecting HCWs' practices and

Table II

Multivariate logistic regression analysis of odds ratio for practices and attitudes of healthcare workers in relation to potential risk factors

Variables	Practices, OR (95% CI)				Attitudes, OR (95% CI)			
	Maintained quarantine with family	Participation in training	Always remove protective equipment carefully	Frequency of hand washing	Level of fear of COVID-19	Feelings of fatigue after the outbreak	Confidence in defeating the virus	Patients should disclose their exposure
Gender (ref.: female)	1	1	1	1	1	1	1	1
Male	0.95 (0.75–1.20)	0.98 (1.77–1.24)	1.18 (0.94–1.49)	1.14 (0.86–1.51)	1.22 (0.89–1.67)	1.22 (0.89–1.67)	0.84 (0.56–1.26)	1.22 (0.94–1.59)
Educational attainment (ref.: junior college and below)	1	1	1	1	1	1	1	1
College	0.88 (0.65–1.19)	1.06 (0.78–1.44)	1.11 (0.82–1.50)	0.71 (0.49–1.02)	0.87 (0.57–1.31)	0.87 (0.57–1.31)	0.86 (0.53–1.41)	0.95 (0.68–1.33)
Postgraduate	0.57 (0.37–0.87)	1.01 (0.66–1.55)	2.12*** (1.39–3.24)	0.90 (0.54–1.50)	1.09 (0.61–1.93)	1.09 (0.61–1.93)	0.47 (0.23–1.06)	1.08 (0.67–1.74)
Overworked (ref.: yes)	1	1	1	1	1	1	1	1
No	0.99 (0.76–1.30)	0.99 (0.76–1.30)	1.03 (0.79–1.35)	0.71* (0.51–0.98)	0.66 (0.46–0.96)	0.66* (0.46–0.96)	0.80 (0.50–1.27)	0.87 (0.65–1.17)
Job category (ref.: doctors)	1	1	1	1	1	1	1	1
Nurses	1.37 (0.10–1.87)	1.14 (0.83–1.56)	0.93 (0.68–1.27)	0.87 (0.61–1.30)	0.81 (0.54–1.23)	0.81 (0.54–1.23)	1.07 (0.63–1.82)	0.94 (0.67–1.33)
Paramedics	0.87 (0.62–1.23)	0.71 (0.50–1.01)	1.03 (0.74–1.45)	0.64* (0.41–1.0)	0.44** (0.26–0.75)	0.44** (0.26–0.75)	0.94 (0.51–1.75)	0.99 (0.68–1.45)
Work experience (ref.: <5 years)	1	1	1	1	1	1	1	1
5–9 years	1.54** (1.16–2.05)	1.32 (1.0–1.75)	0.72* (0.54–0.96)	1.42 (1.0–2.01)	0.64* (0.43–0.95)	0.64* (0.43–0.95)	0.77 (0.48–1.31)	0.56*** (0.41–0.77)
>10 years	0.73* (0.55–0.96)	0.69** (0.52–0.91)	1.0 (0.76–1.31)	1.36 (0.97–1.92)	1.13 (0.79–1.62)	1.131 (0.79–1.62)	0.76 (0.47–1.23)	0.60** (0.44–0.82)
Frontline status (ref.: frontline)	1	1	1	1	1	1	1	1
Non-frontline	0.75* (0.59–0.94)	0.55*** (0.43–0.69)	0.90 (0.71–1.13)	0.82 (0.62–1.08)	0.97 (0.71–1.33)	0.97 (0.71–1.33)	0.56** (0.38–0.84)	1.09 (0.84–1.41)
Knowledge (scored as a continuous variable)	1.14 (0.99–1.31)	1.14 (0.99–1.31)	0.96 (0.84–1.10)	0.91 (0.77–1.07)	0.99 (0.82–1.19)	0.99 (0.83–1.19)	1.41** (1.12–1.77)	1.217* (1.04–1.42)

OR, odds ratio; CI, confidence interval.
*P < 0.05; **P < 0.01; ***P < 0.001.

attitudes from among the seven independent variables: gender, work experience, job category, educational attainment, frontline or non-frontline status, overworked status, and knowledge level (scored as a continuous variable).

Results and discussion

This study was conducted in the middle and early stages of the COVID-19 outbreak in a non-epidemic but still critically affected area. The analysis of HCWs' knowledge and the factors affecting their attitudes and practices could provide a reference for preventing further spread of the epidemic among HCWs. Nearly one-half of the study respondents (46.5%) were nurses, and 36.5% were doctors. Most respondents (36.0%) had more than nine years of work experience. Frontline HCWs accounted for 42.6% of the respondents, approximately half of the respondents worked less than 8 h per day, and more than half of the respondents had a college degree (56.3%) (Table I). Table II presents the results of multivariate logistic regression analysis with odds ratios (ORs) for practices and attitudes related to the aforementioned potential risk factors.

Of the HCWs surveyed in this study, 89% demonstrated sufficient knowledge of COVID-19. Doctors showed higher knowledge scores (38.56 $\pm$ 3.31) than nurses (37.85 $\pm$ 2.63) and paramedics (36.72 $\pm$ 4.82). Knowledge is a prerequisite for establishing prevention beliefs, forming positive attitudes, and promoting positive behaviours, and individuals' cognition and attitudes towards disease affect the effectiveness of their coping strategies and behaviours to a certain extent [4]. This investigation similarly found that knowledge directly affected attitudes. The greater the HCWs' knowledge, the more confident they were in defeating the virus (OR: 1.41; 95% confidence interval (CI): 1.12–1.77). Additionally, HCWs with greater knowledge of COVID-19 believed that visitors with significant risk factors for COVID-19 (e.g. close contact with a confirmed case, recent travel to an area with community transmission) should disclose their exposure (OR: 1.22; 95% CI: 1.04–1.42). A previous study reported that in the initial outbreak of the virus at non-communicable diseases (NCDS), two-thirds of the 31 infected medical staff worked in general wards, 17.5% in the emergency department, and 5% in the ICU [9]. An important reason for early infection among general ward medical staff was that patients were admitted to the ward without protective measures in place. By contrast, infection rates in the more well-protected ICU and emergency departments were lower in cases with no early warning of the disease.

Around 85% of the surveyed HCWs were afraid of becoming infected at work. In the isolation ward and ICU, where patients are seriously ill and have difficulty in breathing, HCWs assist patients in their daily tasks such as patient consultation, infusion, dressing changes, and surgery. They must also handle various emergency situations, and they may become infected with the virus if they are not careful. This may explain why doctors felt more tired than did paramedics during the outbreak (OR: 0.44; 95% CI: 0.26–0.75), and why overworked HCWs felt more tired after the outbreak than those who were not overworked (0.66; 0.46–0.96). HCWs with five to nine years of experience were less likely to feel tired (0.64; 0.43–0.95), demonstrating that this group has particular skill and experience in dealing with public health emergencies. Compared to frontline HCWs, non-frontline workers had lower confidence in defeating the virus (OR: 0.56; 95% CI: 0.38–0.84). The motivation and optimism demonstrated by frontline HCWs are likely related to the materials and policies of the Chinese government regarding frontline support because frontline medical staff in China receive strong material support and care, and they are more confident in their ability to defeat the virus [7].

However, inadequate knowledge is not the only risk factor for care. A previous study showed that the causes of higher risk of infection are related to HCW types and the frequency of their occupational exposure [6]. In the present study, 89.7% of the surveyed HCWs followed correct practices regarding COVID-19, consistent with research showing that practices are associated with work experience, working time, and other factors. Non-frontline HCWs were less likely to maintain quarantine with family (OR: 0.75; 95% CI: 0.59–0.94), which could cause the worker to inadvertently infect family members; by contrast, quarantine with family was positively correlated with five to nine years of work experience (1.54; 1.16–2.05). Moreover, nurses must collect saliva samples from patients' pharyngeal isthmus; if they neglect their own protection to facilitate their work, then they may greatly increase the risk of infection among HCWs, and they are more vulnerable to infection if they do not wash their hands carefully and frequently [10]. Overworked HCWs washed their hands less frequently than those who were not overworked (OR: 0.71; 0.51–0.98); to prevent virus transmission between themselves, overworked HCWs should maintain appropriate working hours with breaks. Paramedics were also found to be less likely to wash their hands frequently (OR: 0.64; 95% CI: 0.41–0.10). Frequent participation in training was negatively associated with length of work experience (OR: 0.69; 95% CI: 0.52–0.91) and frontline status (0.55; 0.43–0.69).

From the perspective of scientific prevention and control, HCWs should place a high value on correct removal of protective equipment. When removing contaminated equipment such as gowns, gloves, medical masks, and eye protection worn in contaminated or high-risk environments, it is necessary to prevent further contamination and infection [8]. In this study, careful removal of protective equipment was found to be positively associated with a higher education level (OR: 2.12; 95% CI: 1.39–3.24) and negatively with median work experience (0.72; 0.54–0.96). Therefore, education and training on proper removal of protective equipment should target novices and HCWs with lower educational attainment.

In conclusion, training regarding protection should be organized according to different factors (work experience, educational attainment, and so on), and medical systems should ensure that frontline workers have enough time to rest between shifts, to avoid overwork and non-conscious errors during epidemic relief efforts. Moreover, to reduce the risk of infection among healthcare professionals who are not in direct contact with patients, policy and education should be implemented to convey the importance of disclosing possible exposure to the virus.

This study has some limitations. The survey was conducted in only one province of China, so the results may not be generalizable to other hospital HCWs. Additionally, the measurement of KAP may be imprecise due to the limited number of items. Further study is needed to expand upon and resolve these issues.

Acknowledgements

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhin.2020.04.012.

References

[1] World Health Organization. Coronavirus disease (COVID-19) pandemic. 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019 [last accessed March 2020].

[2] National Health Commission of China. Update on epidemic situation of novel coronavirus-infected pneumonia by 24:00 on Feb 22, 2020 [in Chinese]. 2020. http://www.nhc.gov.cn/xcs/yqtb/202002/ac1e98495cb04d36b0d0a4e1e7fab545.shtml [last accessed February 2020].

[3] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. JAMA 2020 Feb 24 [online ahead of print].

[4] 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;50:592—612.

[5] National Bureau of Statistics. China health statistics yearbook. 2020. http://www.stats.gov.cn/tjsj/tjcbw/201909/t20190924_1699095.html [last accessed February 2020].

[6] Jiang L, Ng IHL, Hou Y, Li D, Tan LWL, Ho HJA, et al. Infectious disease transmission: survey of contacts between hospital-based healthcare workers and working adults from the general population. J Hosp Infect 2018;98:404—11.

[7] Chen Q, Liang M, Li Y, Guo J, Fei D, Wang L, et al. Mental health care for medical staff in China during the COVID-19 outbreak. Lancet Psychiatry 2020;7:e15—6.

[8] World Health Organization. Guidance for health workers. 2020. https://www.who.int/emergencies/diseases/novelcoronavirus-2019/technical-guidance/health-workers [last accessed February 2020].

[9] Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020 Feb 7 [online ahead of print].

[10] Murthy S, Gomersall CD, Fowler RA. Care for critically ill patients with COVID-19. JAMA 2020 Mar 11 [online ahead of print].