




# Self-Report Assessment of Nurses' Risk for Infection After Exposure to Patients With Coronavirus Disease (COVID-19) in the United Arab Emirates

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## Key words

COVID, infection control and prevention, personal protective equipment, registered nurses, risk exposure assessment

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## Abstract

**Purpose:** Nurses have an increased risk for acquiring COVID-19 infection. This study assessed levels of risk for exposure to COVID-19 among nurses, and determined those at the greatest risk.

**Design:** A cross-sectional design was used to assess risk for exposure to COVID-19 in nurses from five randomly selected governmental hospitals in the United Arab Emirates. Participants completed an online survey (including the World Health Organization survey) to assess their risk for exposure to COVID-19. Descriptive statistics were used to describe classes of risk for exposure, and logistic regression was used to identify factors associated with greater risk.

**Findings:** Of the 552 participants, 284 nurses (51.4%) were classified at high risk for COVID-19 exposure as they did not report adherence to infection control and prevention (ICP) guidelines at all times during health-care interactions and when performing aerosol procedures, or had accidental exposure to biological fluid and respiratory secretions. Compared with adherence to wearing medical masks, gloves, and hand hygiene practices, adherence to wearing face shields or goggles and disposable gowns and decontaminating high-touch surfaces was less frequent. Shifting to work in critical care units, not having adequate critical care experience, and reporting a need for training in ICP practices were factors that contributed to high-risk exposure ( $p$  values for Ex (Bs) = 2.60, 2.16, 1.75,  $\leq 0.05$ , consecutively).

**Conclusions:** A considerable number of nurses were classified at high risk for COVID-19 exposure. Critical care work experience and adequate evidence-based training in ICP practices related to COVID-19 must be considered to mitigate the risk for exposure to COVID-19 in nurses.

**Clinical Relevance:** This study provided a strong message regarding protecting nurses at high risk for exposure to COVID-19. Clinical leaders must stay vigilant to ensure nurses' adherence to ICP practices in the context of COVID-19, and to proactively address any related deficits.

The novel coronavirus, provisionally named 2019 novel coronavirus disease (COVID-19), is an infectious disease caused by a newly discovered coronavirus (World Health Organization [WHO], 2020a). This new coronavirus strain is transmitted from person to person, mainly via respiratory droplets produced when an infected person coughs or sneezes (WHO, 2020a). These droplets may land in the mouths, noses, or eyes of nearby people, or may possibly be inhaled into their lungs (WHO, 2020a). It has also been argued that the virus spreads through an individual touching surfaces contaminated with the virus (which remains live for hours or days) and then touching the mouth, nose, or eyes, thereby contributing to a greater transmission rate in humans (Centers for Disease Control and Prevention [CDC], 2020). Common symptoms of COVID-19 infection include severe respiratory symptoms, cough, fever, shortness of breath, muscle aches, sore throat, loss of taste or smell, diarrhea, and headache (WHO, 2020a).

The emergence of COVID-19 resulted in a large-scale global outbreak, and it remains a major public health crisis globally. Countries throughout the world are engaged in battling COVID-19. In a short time, the COVID-19 pandemic changed the lives of people and created massive burdens on healthcare systems and national economies. On January 30, 2020, the WHO held an emergency meeting and declared the global COVID-19 outbreak to be a public health crisis of international concern (WHO, 2020c).

In this critical situation, occupational exposure to COVID-19 has become an inherent risk for frontline healthcare providers (HCPs). A large-scale joint cohort study conducted in the United Kingdom and United States showed that the risk for COVID-19 infection among frontline HCPs was higher (adjusted hazard ratio 11.61, 95% confidence interval 10.93–12.33) compared with individuals in the general community (Nguyen et al., 2020). The term risk exposure assessment refers to anticipation of the magnitude of a certain loss-disease-harm-outcome resulting from a specific activity or event (Anderson, Geskus, Witte, & Putter, 2012). In the context of the COVID-19 outbreak, risk exposure assessment refers to identifying HCPs who were exposed to patients with COVID-19 (i.e., in close contact), which placed them at greater risk for infection with the virus. Risk for exposure among HCPs can be categorized as high, medium, and low (CDC, 2020) based on the period of exposure (more than 15 min to 24 hr) and protection of the HCP's nose, mouth, and eyes. High-risk exposure occurs when HCPs had prolonged exposure to a person with COVID-19 who was not wearing a mask while the HCP's own nose and mouth were unprotected from

potentially infectious material. Medium-risk exposure occurs following prolonged exposure to a patient with COVID-19 who was wearing a mask while the HCP's own nose and mouth were unprotected from potentially infectious material. Finally, low-risk exposure arises following brief interaction with a patient with COVID-19 or prolonged close contact with a patient who was wearing a mask while the HCP was wearing a mask or respirator (CDC, 2020).

Nurses represent the largest proportion (59%) of HCPs, and work at the frontline of the COVID-19 response (WHO, 2020c). Nurses' clinical work mandates direct contact with patients who could be asymptomatic, placing them at unpredictable risk for infection with COVID-19 (Huang, Lin, Tang, Yu, & Zhou, 2020; Jackson et al., 2020; WHO, 2020c). There are also special concerns related to cross-infection with COVID-19 for nurses in high-risk units such as emergency departments (where crowding is identified as a major concern), intensive care units, and surgical and medical departments due to close contact with respiratory pathogens when performing aerosol procedures (Ng et al., 2020).

The exact numbers of nurses who were infected, died, or even at risk for infection with COVID-19 remain unknown. However, evidence from unpublished reports from several countries confirmed a surge in the number of nurses infected with COVID-19. For example, recent information from the CDC based on data received from several U.S. states indicated that 11% of diagnosed COVID-19 cases occurred in healthcare professionals (CDC, 2020). A recent report indicated that medical personnel represented 9% of total COVID-19 cases (Goumenou et al., 2020). A study from Wuhan, China, found that 29% of admitted cases with COVID-19 ( $n = 138$ ) were HCPs, where one patient admitted to a surgical department had infected 10 HCWs (Wang, Hu, & Hu, 2020). Long working hours, exhaustion, and stigma are additional factors that place nurses at high risk for exposure to COVID-19 (Wang et al., 2020).

Risk for exposure has been identified as nurses providing direct health care for patients with COVID-19 (e.g., physical examinations, nursing care, specimen collection) and when performing or attending aerosol-generating procedures (e.g., intubation, extubation, induction of sputum, cardiopulmonary resuscitation, bronchoscopy) without using proper personal protective equipment (PPE), along with poor adherence to infection control and prevention (ICP) practices associated with COVID-19 (CDC, 2020). Therefore, this study aimed to estimate levels of risk for exposure to COVID-19 among nurses working in governmental hospitals,

and to identify those nurses at the highest risk. These hospitals experienced a rapid surge in the number of positive COVID-19 cases along with higher than expected hospital admission rates.

Since the beginning of the current outbreak, the United Arab Emirates (UAE) government imposed extensive restriction measures and awareness campaigns to contain the spread of this virus (Ministry of Health and Prevention [MOHAP], 2020). However, despite extensive training, it is common to find nurses who do not have sufficient knowledge about ICP guidelines related to COVID-19, especially as this is the first time UAE nurses have faced such a pandemic situation. In addition, the shortage of nurses in the UAE means that fewer competent frontline nurses are available, and a large number of nurses were transferred from noncritical care units and outpatient clinics to work in critical care units in COVID-19 wards and sites to support frontline nurses.

The results of the classification of risk for exposure from this study are expected to provide strong messages for local public health authorities regarding coordinating and assigning nurses based on levels of risk for exposure, implementing strong monitoring and surveillance measures, and determining the need for work restrictions. Moreover, our results will help to clarify current ICP practices and inform strong policies to mitigate the risks for exposure and nosocomial infections in nurses.

This study aimed to aid the early assessment of risk for exposure to COVID-19 among asymptomatic nurses to prevent the further spread of the virus. We included a representative sample of nurses from five randomly selected UAE hospitals that cared for or admitted patients with COVID-19. Our specific research questions were: (a) What is the exposure risk classification of asymptomatic nurses who have been exposed to patients with confirmed COVID-19? and (b) What are the factors that place nurses at greater risk for COVID-19 exposure?

## Methods

### Study Design

This research used a quantitative, cross-sectional research design.

### Participants and Procedure

We randomly selected five governmental hospitals that cared for and admitted patients with COVID-19. We coordinated with nurse managers to invite all nurses

in these hospitals to complete an online survey to assess risk for exposure. The number of nurses working in these sites ranged from 150 to 200 per site, and totaled around 1,000 nurses. Selection criteria for this study included exposure to patients with COVID-19 in the participating working units. Participants were excluded if they had been diagnosed with COVID-19 before this study (i.e., results of reverse-transcriptase polymerase chain reaction [RT-PCR] testing had to be negative for COVID-19 on a nasopharyngeal swab) or had any mild symptoms of COVID-19 infection. The invitation letter sent to participants asked them to decline to participate if they had prior positive test results for COVID-19 or mild symptoms of the disease.

We calculated the sample size ( $N = 500$ ) based on a 50% exposure rate (because of the absence of a precise COVID-19 exposure rate among nurses in the UAE), 95% confidence interval, significance level of .05, and a 3% margin of error (Naing, Winn, & Rusil, 2006). To compensate for incomplete responses and missing data, a total of 600 nurses were recruited.

Following ethical approval from the concerned parties, first-line managers at the selected sites were contacted, informed about this study, and asked to invite nurses working in their facilities to complete an online survey that assessed risk for exposure to COVID-19. The survey was delivered via SurveyMonkey. Statements on confidentiality and privacy of information were included at the beginning of the survey, and participants could decide whether or not to continue with the survey. Data were coded without personal identifiers and collected from March to June 2020. Data were collected until the expected sample size (600 participants) was reached.

### Data Collection Tools

The survey covered information about participants' age, gender, hospital work unit, marital status, number of children, and presence of chronic health conditions. We added additional questions on work status, including clinical experience, work experience in critical care units, recent shift to work in other units to support staff in the COVID-19 pandemic (i.e., support frontline workers), and need for training in ICP guidelines related to COVID-19. All items were assessed using a yes or no format.

### Risk Assessment of COVID-19 Exposure Among HCWs

The WHO risk assessment tool for COVID-19 exposure among HCWs was used to assess nurses' level

of risk for exposure to COVID-19 (WHO, 2020b). This survey comprised seven parts. The first three parts covered participants' general information, working department, and the last time they interacted with patients with COVID-19 in their current facility. Part 4 assessed exposure to patients with COVID-19 during direct contact, face-to-face contact, or aerosol procedures (yes or no). Part 5 assessed the level of adherence to ICP guidelines during healthcare interactions (seven items). For example, "During the period of a healthcare interaction with a patient with COVID-19, did you wear personal protective equipment (PPE)?" Part 6 assessed levels of adherence to ICP when performing aerosol-generating procedures (six items). For example, "During aerosol-generating procedures on the COVID-19 case, did you perform hand hygiene before and after touching the patient?" Each item assessed adherence to ICP guidelines on a 4-point Likert scale from "always/as recommended" ( $\leq 95\%$  of the time) to "rarely" ( $\leq 20\%$  of the time). The last part of the tool (part 7) asked whether participants were exposed to accidents with biological material.

Participants were classified as the low-risk exposure class if they answered "always/as recommended" to all adherence to ICPs questions during interactions and when performing aerosol-generating procedures for patients with COVID-19 (parts 5 and 6 of the survey). In addition, these participants did not report exposure to biological accidents during interactions with COVID-19 cases (part 7 of the survey). Participants who chose any other responses (e.g., "most of the time," "sometimes," and "rarely") or reported an incident of exposure to biological material from patients with COVID-19 were classified as having high-risk exposure (WHO, 2020b).

## Data Analysis

Analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were generated for nurses' levels of risk for exposure to COVID-19 using means, standard deviations, numbers, and frequency distributions. Multiple logistic regression was used to estimate independent determinants of classification of risk for exposure in participants. A  $p$  value of  $\leq .05$  was considered statistically significant.

## Ethical Considerations

Ethical approval was obtained from the MOHAP Research Ethics Committee (MOHAP/DXB-REC/MMJ/No. 58/2020). Since the MOHAP Research Ethics

Committee is a central committee with representatives from different health entities, ethical approval from this agency was endorsed and accepted by all local ethical subcommittees at the selected sites. Submission of a completed survey was considered provision of implied consent to participate.

## Results

### General Description of the Study Sample

Table S1 presents a general description of the study population. In total, 552 registered nurses were recruited for this study (92% response rate) due to incomplete surveys. The majority were women ( $n = 480$ , 87%) and the mean age was  $35.2 \pm 6.13$  years. Almost two thirds of the participants ( $n = 396$ , 72%) were married and 388 (70%) had children.

The majority of participants reported living in shared accommodation ( $n = 456$ , 83%), mainly with direct family members (e.g., husband, parents, children). More than half of the participants reported having chronic health conditions ( $n = 310$ , 56%). The most frequently reported conditions were asthma and chronic allergic rhinitis ( $n = 100$ , 18%); diabetes ( $n = 55$ , 10%); hypertension ( $n = 72$ , 13%); dyslipidemia ( $n = 120$ , 21.7%); back, neck, and other muscular pain ( $n = 150$ , 27.12%); and other conditions such as thyroid conditions, varicose veins, and heart problems ( $n = 55$ , 10%). Some participants reported more than one health condition (e.g., diabetes and asthma, diabetes and hypertension, and dyslipidemia and other combinations).

The mean length of working experience was  $8.8 \pm 3.7$  years; 120 (22%) participants reported that they were currently working in critical care settings and 73 (13.2%) reported having adequate work-related experience in such settings. Of the 552 participants, 167 (30.3%) had been shifted from their usual departments to support frontline nurses working with COVID-19 cases in critical care settings. Finally, 143 (25.9%) participants reported they needed more training in ICP practices related to COVID-19.

### Risk for Exposure and Adherence to ICP Practices

**Risk for exposure to COVID-19.** Table S2 presents the results of participants' risk for exposure from the first part of the risk exposure survey. All participants were exposed to COVID-19 through direct contact, face-to-face contact, or being present when aerosol procedures were performed for patients with confirmed COVID-19 (responded "yes" to any item in

part 4). The highest risk for exposure was through face-to-face contact with patients with confirmed COVID-19 in their healthcare facility ( $n = 473$ , 86%). In total, 300 participants (54%) reported exposure when performing aerosol procedures for patients with COVID-19, of whom 173 (58%) had performed sputum collection procedures (see Table S2).

Adherence to ICP during healthcare interactions and when performing aerosol-generating procedures. Overall, 225 participants (51.4%) were at a high risk for exposure to COVID-19 during healthcare interactions, when performing aerosol-generating procedures, or because of an accident with biological material (based on WHO criteria for exposure risk assessment). Tables S3 and S4 present detailed results for responses related to ICP adherence during healthcare interactions and when performing aerosol-generating procedures. Of the 552 participants, 338 (61.2%) responded "always/as recommended" for all items covering ICP practices during healthcare interactions, and were categorized as the low-risk group.

As shown in Table S3, all participants ( $N = 552$ ) reported adherence to wearing PPE during healthcare interactions more than 95% of the time. Most frequently, adherence was related to always wearing single gloves ( $n = 486$ , 88%) and medical masks ( $n = 430$ , 78%). Disposable gowns ( $n = 270$ , 49%) and face shields or goggles or protective glasses ( $n = 280$ , 50.7%) were the least frequently reported as being worn all of the time. Furthermore, the majority of participants reported adherence to hand hygiene practices during different healthcare interactions with patients who had COVID-19. However, fewer participants indicated they adhered to decontamination of high-touch surfaces more frequently during interactions with patients who had COVID-19 ( $n = 320$ , 58%).

With regard to performing aerosol-generating procedures, 277 participants (41.1%) were at high risk for exposure to COVID-19 (see Table S4). All participants reported wearing PPE all of the time, with gloves and N95 masks the most frequently selected equipment. However, fewer participants reported always wearing other types of PPE when performing aerosol-generating procedures, such as disposable gowns ( $n = 285$ , 52%) and face shields or goggles or protective glasses ( $n = 300$ , 54%). The frequency distribution showed that the majority of participants always adhered to hand hygiene practices when performing aerosol-generating procedures. However, fewer participants indicated always adhering to decontaminating high-touch surfaces during aerosol-generating procedures for COVID-19 cases ( $n = 330$ , 59.8%). Regarding exposure to biological fluid or respiratory secretions, 70 participants

(12.7%) reported biological accidents, with 37 (6.7%) of these being through a splash of biological secretions on the mucous membrane of the eyes or mouth or nose ( $n = 29$ , 5.3%).

### Independent Determinants of Risk for Exposure to COVID-19

The result of the overall binary logistic regression model was significant ( $\chi^2(9, N = 552) = 60.5, p = .001$ ; Table S5). Interpretation of the odds ratios for individual variables (determinants) indicated that participants who were shifted to work in critical care units to support frontline staff were 2.61 times more likely to be classified as at high risk for exposure to COVID-19 than those who remained in their working units (The exponentiation of the B coefficient [Odd Ratio],  $\text{Ex}(B) = 2.60, p = .001$ ). Similarly, participants who reported not having adequate critical care experience and those who expressed the need for more training in ICP practices related to COVID-19 were at greater risk for exposure than their counterparts who reported adequate critical care experiences and no need for further training in ICP practices ( $\text{Ex}(B) = 2.16, p \leq .05$ ). Also, participants with less clinical experience had greater odds of being in the high-risk exposure group than those with more clinical experience ( $\text{Ex}(B) = 0.810, p \leq .05$ ).

### Discussion

This study addressed an urgent clinical issue associated with the highly contagious COVID-19 and the safety of nurses, who are paramount to healthcare provision (International Council of Nurses [ICN], 2020). This study responded to the call of international organizations such as the WHO, CDC, and ICN to provide more scientific evidence to protect nurses when providing care during the COVID-19 pandemic. To our knowledge, this was the first study to estimate risk for exposure to COVID-19 among nurses and identify those at higher risk in a region that has a high prevalence of COVID-19.

The considerable proportion of nurses in our study at high risk for exposure to COVID-19 (41%) was expected given their direct and constant contact with the increasing number of cases admitted with the virus (Huang et al., 2020). The results from this study supported prior reports that demonstrated nurses had a disproportional risk for infection during past infectious pandemic or outbreaks such as Ebola and other influenza-related pandemics (Hudson, Toop, Mangin, Brunton, Jennings, & Fletcher, 2013; Selvaraj, Lee, Harrell, Ivanov, & Allegranzi, 2018).

In the context of the current COVID-19 pandemic, our results also support existing evidence of nurses' increased risk for exposure to infection with this virus globally (Gómez-Ochoa et al., 2020; Nguyen et al., 2020). A study from Korea conducted among 30 professional groups including nurses ( $N = 227,168$ ) found that 44.2% of the sampled nurses reported high-intensity exposure risk for infection with COVID-19 (Lee & Kim, 2020). In a recent cross-sectional study of nurses from Lebanon ( $N = 311$ ), 40% were classified at high risk for exposure to infection with the virus because they stated they rarely wore all PPE (especially goggles) when performing aerosol procedures with patients who had COVID-19 (Saadeh, Sacre, Hallit, Farah, & Salameh, 2020).

This increased risk for exposure to COVID-19 among nurses requires immediate action by nurse leaders and healthcare organizations to provide adequate safeguards to minimize threats to nurses (WHO, 2020a, 2020b). Organizational policies that integrate stringent measures to mitigate any risk for exposure associated with COVID-19 among nurses throughout the spectrum of care must be adopted at clinical facilities. It is also critical that healthcare institutions follow the recommended flowchart for the management of HCWs exposed to COVID-19 (WHO, 2020a, 2020b). This may include using clinical judgment, close monitoring and surveillance, risk identification, flexibility in shift schedules, and determining the need for any work restrictions (CDC, 2020; WHO, 2020a, 2020b).

Importantly, nurses' increased risk for exposure in the COVID-19 pandemic and in previous infectious pandemics has been positively associated with the increased prevalence of diagnosed cases in the community. Therefore, it is critical to re-envision the role of nurses during pandemic situations. Nurses must expand their roles in early detection and prevention of infectious diseases to minimize their own risk for exposure to such diseases (Corless et al., 2018). Sigma Theta Tau International identified infectious diseases as a top priority for nursing, and called for nurse leaders to be involved in policy formation to support early identification and prevention of the transmission of global infectious diseases. Partnership, proper coordination, and strategic planning will ultimately lead to mitigating the associated risk for exposure among nurses and ensure the involvement of nurses in combating future pandemics similar to COVID-19 at national and international levels (Corless et al., 2018).

Notably, our study showed that a considerable number of nurses did not report always wearing all types of PPE, which could explain the large number of participants categorized in the high-risk exposure group.

Face shields, goggles, and disposable gowns were less frequently worn compared with medical masks and gloves during direct healthcare interactions and when performing aerosol-generating procedures. Similar results were found among registered nurses from Lebanon ( $N = 311$ ), where 78.8% reported wearing masks at all times and more than 40% did not wear or rarely wore goggles and respirators while performing aerosol-generating procedures (Saadeh et al., 2020).

The association between greater risk for exposure and performing aerosol-generating procedures shown in our results may be because relatively few nurses adhered to wearing PPE at all times, especially face shields, goggles, disposable gowns, and aprons. The lack of PPE places nurses at greater risk for contracting the COVID-19 virus via respiratory droplets from coughing, sneezing, talking, or breathing (Harding, Broom, & Broom, 2020). However, there is a paucity of knowledge regarding types of aerosol-generating procedures associated with a high risk for exposure to COVID-19 among HCPs (Harding et al., 2020). Limited evidence exists as to whether noninvasive procedures such as administration of nebulized medications, use of oxygen masks, and performing diagnostic nose and throat swabs carry the same risk as invasive procedures (e.g., intubation, bronchoscopy, tracheotomy, cardiopulmonary resuscitation) (Cheung, Ho, Cheng, Cham, & Lam, 2020; Harding et al., 2020). To avoid such adverse consequences, it is recommended that nurses wear gowns, gloves, and N95 level masks, especially early in a pandemic when attending or performing aerosol-generating procedures (Ng et al., 2020). More research is needed to determine which aerosol-generating procedures are associated with increased risk for exposure to COVID-19, and to develop transparent ICP guidelines.

In the UAE, the current pandemic represents the first experience of nurses in caring for patients with COVID-19; therefore, healthcare organizations must stay vigilant to protect nurses from contracting this virus and integrate unified policies to prevent further transmission of the virus. Using PPE is only one means of containing the spread of COVID-19 among nurses. Promoting physical and mental readiness and support among staff and reducing foot traffic have been suggested as innovative approaches to reduce the risk for exposure to COVID-19 (Newby, Mabry, Carlisle, Olson, & Lane, 2020). Using videoconferencing and digital stethoscopes to assess patients without being in the room, relocating equipment to minimize staff movement, applying real time monitoring and instant correction mechanisms, and decreasing frequent movement between contaminated and clean areas have also been

suggested as ways to decrease the risk for infection (Huang et al., 2020).

Increasing awareness of and enforcing current best practice guidelines outlined by professional bodies such as the CDC and the WHO are critical to prevent the spread of infection. Integrating best practice ICP guidelines related to COVID-19 must be part of the annual appraisal and core competencies of nurses, which could assist in increasing adherence to these guidelines (Chen, Tian, Li, & Li, 2020). Nursing educational institutions could also play a vital role in preparing qualified nurses to assist the country in containing viruses such as COVID-19. The content of nursing education curricula must assimilate new knowledge in epidemiology, public health, and principles of ICP practices. Nursing curricula should place strong emphasis on preparing nurses to work in intensive care and end-of-life settings to ensure they are sufficiently qualified to play frontline nursing roles. With the curfew endorsed by governments, it is not difficult for nursing institutions to offer online graduate courses for working nurses in ICP practices related to COVID-19. Nurse educators must work to embed strategies that support student well-being and foster emotional resilience into their curricula (Carolan, Davies, Crookes, McGhee, & Roxburgh, 2020).

In our study, participants with less clinical experience, those who did not have adequate clinical experience in critical care settings, and those who had been shifted from their usual work units or places to support frontline nurses were at high risk for exposure to COVID-19. Therefore, hospital management needs to consider critical care experience when shifting staff to support frontline nurses to reduce exposure risk. Previous studies reported that nurses with no critical care qualifications were more likely to develop post-traumatic stress syndrome and burnout when moved to work in critical care sites (Jakimowicz, Perry, & Lewis, 2018). Therefore, it is urgent to create an appropriate mechanism to shift staff to support frontline nurses to prevent increased risk for exposure to COVID-19 and consider possible mental health sequelae related to feeling inadequate and not having sufficient preparation to care for patients with COVID-19 (Zhang, Sun, Latour, Hu, & Qian, 2020).

We also found that nurses who reported needing training in ICP related to COVID-19 were at greater risk for exposure, which has important implications for clinical practice. Jackson et al. (2020) highlighted the need for adequate training and resources to support new cadres of nurses and frontline nurses. This is particularly important given the shortage of nurses in the UAE and the limited number of frontline nurses

who are adequately prepared in ICP procedures and guidelines related to COVID-19. Although there is no “one size that fits all approach” and despite resources being available in the UAE, COVID-19 is still a new experience for the healthcare system, and few nurses are available that are well trained in ICP practices related to COVID-19.

Although our study highlighted the need to address threats to nurses in the context of the COVID-19 pandemic, this study used self-report data and a cross-sectional design, meaning predicted values for risk for exposure are limited. Further cohort research studies are needed to determine the recurrence of exposure to COVID-19 among nurses and their level of adherence to ICP guidelines throughout the pandemic. Conducting similar studies in neighboring countries may also reveal important practice gaps that nurse leaders in the region can identify as areas to be included in evidence-based ICP training programs.

## Conclusions

Because COVID-19 has disproportionately affected nurses, hospitals must be vigilant over their potential risk for exposure and ensure adherence to appropriate ICP practices. Flexible, adjustable policies play a vital role in reducing nosocomial infections among nurses. It is necessary to establish a unified hospital-specific protocol to reduce nurses’ risk in interactions with patients with COVID-19. Attempts must be made to ensure that healthcare settings work toward “zero nurse infection” rates while battling the COVID-19 epidemic.

Finally, without protecting nurses, the healthcare system may not be able to handle the burden of a complicated and novel disease such as COVID-19 and may eventually collapse. In this context, nurses’ safety remains paramount for healthcare systems globally. Decades ago, Nightingale revolutionized nursing care through sharing knowledge during war; today, nurses are in a better position to share and disseminate experiences to reduce the cross-contamination associated with viruses such as COVID-19 (Skretkiewicz, 1992).

## Limitations

Recall bias related to common practices in ICP guidelines was expected, which might have resulted in misclassification of risk for exposure to COVID-19. Limitations in access to some sites might impact the generalization of study findings to other sites, since ICP practices, resources, and policies may differ from one site to another.

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### Clinical Resources

- Centers for Disease Control and Prevention. Infection control guidance for healthcare professionals about coronavirus (COVID-19). <https://www.cdc.gov/coronavirus/2019-nCoV/hcp/infection-control.html>
- World Health Organization. Corona virus. [https://www.who.int/health-topics/coronavirus#tab=tab\\_1](https://www.who.int/health-topics/coronavirus#tab=tab_1)

## References

- Andersen, P. K., Geskus, R. B., de Witte, T., & Putter, H. (2012). Competing risks in epidemiology: Possibilities and pitfalls. *International Journal of Epidemiology*, 41(3), 861–870. <https://doi.org/10.1093/ije/dyr213>
- Carolan, C., Davies, C. L., Crookes, P., McGhee, S., & Roxburgh, M. (2020). COVID 19: Disruptive impacts and transformative opportunities in undergraduate nurse education. *Nurse Education in Practice*, 46, 102807. <https://doi.org/10.1016/j.nepr.2020.102807>
- Centers for Disease Control and Prevention. (2020). *Infection control guidance for healthcare professionals about coronavirus (COVID-19)*. Retrieved from <https://www.cdc.gov/coronavirus/2019-nCoV/hcp/infection-control.html>
- Chen, X., Tian, J., Li, G., & Li, G. (2020). Initiation of a new infection control system for the COVID-19 outbreak. *Lancet Infectious Diseases*, 20(4), 397. [https://doi.org/10.1016/S1473-3099\(20\)30110-9](https://doi.org/10.1016/S1473-3099(20)30110-9)
- Cheung, J. C. H., Ho, L. T., Cheng, J. V., Cham, E. Y. K., & Lam, K. N. (2020). Staff safety during emergency airway management for COVID-19 in Hong Kong. *Lancet Respiratory Medicine*, 8(4), e19. Retrieved from [https://www.thelancet.com/pdfs/journals/lanres/PIIS2213-2600\(20\)30084-9.pdf](https://www.thelancet.com/pdfs/journals/lanres/PIIS2213-2600(20)30084-9.pdf)
- Corless, I. B., Nardi, D., Milstead, J. A., Larson, E., Nokes, K. M., Orsega, S., ... Woith, W. (2018). Expanding nursing's role in responding to global pandemics 5/14/2018. *Nursing Outlook*, 66(4), 412–415. <https://doi.org/10.1016/j.outlook.2018.06.003>
- Gómez-Ochoa, S. A., Franco, O. H., Rojas, L. Z., Raguindin, P. F., Roa-Díaz, Z. M., Wyssmann, B. M., ... Muka, T. (2020). COVID-19 in health-care workers: A living systematic review and meta-analysis of prevalence, risk factors, clinical characteristics, and outcomes. *American Journal of Epidemiology*, 190(1), 161–175. <https://doi.org/10.1093/aje/kwaa191>
- Goumenou, M., Sarigiannis, D., Tsatsakis, A., Anesti, O., Docea, A. O., Petrakis, D., ... Aschner, M. (2020). COVID-19 in Northern Italy: An integrative overview of factors possibly influencing the sharp increase of the outbreak. *Molecular Medicine Reports*, 22(1), 20–32. <https://doi.org/10.3892/mmr.2020.11079>
- Harding, H., Broom, A., & Broom, J. (2020). Aerosol generating procedures and infective risk to healthcare workers: SARS-CoV-2—the limits of the evidence. *Journal of Hospital Infection*, 105(4), 717–725. <https://doi.org/10.1016/j.jhin.2020.05.037>
- Huang, L., Lin, G., Tang, L., Yu, L., & Zhou, Z. (2020). Special attention to nurses' protection during the COVID-19 epidemic. *Critical Care*, 24(1), 120. <https://doi.org/10.1186/s13054-020-2841-7>
- Hudson, B., Toop, L., Mangin, D., Brunton, C., Jennings, L., & Fletcher, L. (2013). Pandemic influenza A (H1N1) pdm09: Risk of infection in primary healthcare workers. *British Journal of General Practice*, 63(611), e416–e422. <https://doi.org/10.3399/bjgp13X668212>
- International Council of Nurses. (2020, April 17). *COVID-19 update*. Retrieved from <https://www.icn.ch/news/icn-COVID-19-update-17-april-2020>
- Jackson, D., Bradbury-Jones, C., Baptiste, D., Gelling, L., Morin, K., Neville, S., & Smith, G. D. (2020). Life in the pandemic: Some reflections on nursing in the context of COVID-19. *Journal of Clinical Nursing*, 29(13–14), 2041–2043. <https://doi.org/10.1111/jocn.15257>
- Jakimowicz, S., Perry, L., & Lewis, J. (2018). Compassion satisfaction and fatigue: A cross-sectional survey of Australian intensive care nurses. *Australian Critical Care*, 31(6), 396–405. <https://doi.org/10.1016/j.aucc.2017.10.003>
- Lee, J., & Kim, M. (2020). Estimation of the number of working population at high-risk of COVID-19 infection in Korea. *Epidemiology and Health*, 42, e2020051. <https://doi.org/10.4178/epih.e2020051>
- Ministry of Health and Prevention. (2020). *Novel coronavirus (COVID-19)*. Retrieved from <https://www.mohap.gov.ae/en/AwarenessCenter/Pages/COVID-19.aspx>



- Naing, L., Winn, T., & Rusli, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of Orofacial Sciences, 1*, 9–14.
- Newby, J. C., Mabry, M. C., Carlisle, B. A., Olson, D. M., & Lane, B. E. (2020). Reflections on nursing ingenuity during the COVID-19 pandemic. *Journal of Neuroscience Nursing, 52*(5), E13–E16. <https://doi.org/10.1097/JNN.0000000000000525>
- Ng, K., Poon, B. H., Puar, T. H. K., Quah, J. L. S., Loh, W. J., Wong, Y. J., ... Raghuram, J. (2020). COVID-19 and the risk to health care workers: A case report. *Annals of Internal Medicine, 172*(11), 766–767. <https://doi.org/10.7326/L20-0175>
- Nguyen, L. H., Drew, D. A., Graham, M. S., Joshi, A. D., Guo, C. G., Ma, W., ... Kwon, S. (2020). Risk of COVID-19 among front-line health-care workers and the general community: A prospective cohort study. *Lancet Public Health, 5*(9), e475–e483. <https://doi.org/10.1101/2020.04.29.20084111>
- Saadeh, D., Sacre, H., Hallit, S., Farah, R., & Salameh, P. (2020). Knowledge, attitudes, and practices toward the coronavirus disease 2019 (COVID-19) among nurses in Lebanon. *Perspectives in Psychiatric Care, 1*–10. <https://doi.org/10.1111/ppc.12676>
- Selvaraj, S. A., Lee, K. E., Harrell, M., Ivanov, I., & Allegranzi, B. (2018). Infection rates and risk factors for infection among health workers during Ebola and Marburg virus outbreaks: A systematic review. *Journal of Infectious Diseases, 218*(Suppl. 5), S679–S689.
- Skretkiewicz, V. (Ed.). (1992). *Florence Nightingale's notes on nursing*. London, UK: Scutari Press.
- Wang, D., Hu, B., & Hu, C. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *Journal of the American Medical Association, 323*(11), 1061–1069. <https://doi.org/10.1001/jama.2020.1585>
- World Health Organization. (2020a). *Coronavirus*. Retrieved from [https://www.who.int/health-topics/coronavirus#tab=tab\\_1](https://www.who.int/health-topics/coronavirus#tab=tab_1)
- World Health Organization. (2020b). *Risk assessment and management of exposure of health care workers in the context of COVID-19: Interim guidance*. Retrieved from <https://www.who.int/publications/i/item/risk-assessment-and-management-of-exposure-of-health-care-workers-in-the-context-of-covid-19-interim-guidance>
- World Health Organization. (2020c). *Statement on the second meeting of the International Health Regulations (2005)*. Retrieved from [https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulation-s-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulation-s-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov))
- Zhang, Y., Sun, Z., Latour, J. M., Hu, B., & Qian, J. (2020). Hospital response to the COVID-19 outbreak: The experience in Shanghai, China. *Journal of Advanced Nursing, 76*(7). <https://doi.org/10.1111/jan.14364>

## Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

### Table S1-S5