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Risk assessment and management among frontline nurses in the context of the COVID-19 virus in the northern region of the Kingdom of Saudi Arabia

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ABSTRACT

Objective: This study aimed to assess the post-contact risk of nurses who provide care for patients diagnosed with COVID-19.

Methods: This investigation employed a quantitative-descriptive design. The study sample was comprised of the frontline nurses in the COVID-19 center hospitals in the northern part of Saudi Arabia. Snowball sampling was used, resulting in 80 frontline nurses. A survey using a self-administered questionnaire in a Google form was employed to collect the data, which was collected from May 20 through June 25, 2020.

Results: Some of the study participants were reported to have a history of both staying in the same household with each other (35%) and of traveling with a confirmed COVID-19 patient (20%). These participants were considered as community exposed to COVID-19. There were 8.8% who were classified as high risk due to failure in removing and replacing personal protective equipment (PPE); 6.3% were at high risk for not performing hand hygiene before and after touching COVID-19 patients, and 5% did not follow the recommended guidelines in performing hand hygiene after touching the patients’ surroundings. In addition, 3.8% of the participants had an accident related to biological material, such as with splashes of biological fluid (in the eyes). These nurses were classified as high risk for COVID-19 virus infection.

Conclusion: This study identifies practices that need improvement in combatting this virus. Since policies and guidelines may not always be optimal in all settings, a tailor-fitted guideline is appropriate. Nurse leaders, for example, need to establish an infection control system that provides real-time monitoring and facilitates immediate correction for nurses. Doing so will provide the nurses with a continuous awareness of predisposing themselves to acquiring the virus.

1. Introduction

In late December of 2019, a group of individuals in China were reported as diagnosed with pneumonia having an unknown cause (World Health Organization, 2020a). This disease was associated with the seafood found in the locality of Huanan South China in Wuhan, particularly in the Province of Hubei, China (Zhu et al., 2020). According to the Health Protection and Surveillance Centre (HPSC, 2020), when genetically analyzed, this pneumonia with an unknown cause was highly linked to the severe acute respiratory syndrome-corona virus, popularly known as SARS-CoV. Consequently, it was clustered inherently within the type of betacoronavirus that forms a separate group of microorganisms in the group B subtype sarbecovirus, and it is associated with two similar strains of bat-originated SARS (HPSC, 2020). Although the disease was initially named N-CoV, it was later called corona virus disease-19, which is popularly known as COVID-19 (WHO, 2020a). Numerous individuals throughout the world have been infected since the outbreak of the virus, causing the pronouncement of a public health emergency of international concern (WHO, 2020b). With the increasing number of infected persons across the globe, this public health emergency was declared a pandemic on March 11, 2020 (WHO, 2020c). Nurses are the first line of defense in any outbreak, and this pandemic has caused tremendous concern for hospital authorities. It is the responsibility of hospitals to ensure that an appropriate management plan is in place to respond to the health needs of the people. This includes support in identifying patients with potential coronavirus and in protecting healthcare workers (HCW) so that they can care for the patients safely. In this current study, the term “healthcare workers” refers...
primarily to nurses (Tables 1-4).

Health authorities have provided guidelines for both rapid risk assessment (e.g., hospital preparedness, rapid risk assessment) and for management to respond to the ongoing health crisis. The World Health Organization (WHO), for example, provided interim guidance to the threat classification of every healthcare worker post-contact with a patient diagnosed with COVID-19 (WHO, 2020d). Exposure could be prevented with the rapid identification of infected patients upon assessment; otherwise, contracting the disease is likely. In outbreak cases of the past, many healthcare workers were reported as likely to acquire the disease in question. For instance, in 2002, during the SARS outbreak, 21.07% of the healthcare workers were infected worldwide (WHO, 2003). The MERS-COV, which was detected in Saudi Arabia in 2012, also has infected a significant percentage of the healthcare workers (Alfaraj et al., 2018). These previous outbreaks could have been prevented if the risk assessment had been conducted among the hospitals and risk management had responded immediately. To date, the developed countries have reported that a tremendous number of healthcare workers have been infected with COVID-19 since its outbreak in 2019 (Wang, Hu, & Hu, 2020). Data from developed countries such as Italy represent at least 9% of the total cases of healthcare workers who have been infected (Livingston & Bucher, 2020). Data from China indicates that healthcare workers are categorized as high risk (Koh, 2020; Zhou, Huang, Xiao, Huang, & Fan, 2020). Moreover, the health experts claimed that the healthcare systems of underdeveloped countries were potential weak links in combating COVID-19 (Walton, 2020). As such, the underdeveloped countries do not have enough resources to purchase protective gears that is needed to protect their healthcare workers, thus, putting them at a high percentage likelihood of acquiring the COVID-19 disease.

The significance of conducting this study is that it supports the frontline nurses from acquiring such a virus, thus protecting both their patients and their families. A thorough understanding of the frontline nurses’ exposure to the COVID-19 virus can assist policy makers in designing a strategy to mitigate the probability of transmission of the virus from these nurses to others. The results of the risk assessment can additionally guide on-going management to the highly exposed nurses or even to other healthcare workers. The study findings could provide a foundation to be used for benchmarking good practices and improvement purposes. Therefore, this study aims to assess the risk classification of healthcare workers, especially nurses after contact with a patient diagnosed with COVID-19.

### Table 1
Demographic information of frontline nurses.

| Demographic information                        | Frequency | Percentage |
|-----------------------------------------------|-----------|------------|
| **Age**                                       |           |            |
| 20-25                                         | 6         | 7.5        |
| 26-30                                         | 46        | 57.5       |
| 31-35                                         | 17        | 21.25      |
| 36 and above                                  | 11        | 13.75      |
| **Sex**                                       |           |            |
| Male                                          | 8         | 10         |
| Female                                        | 72        | 90         |
| **Years of experience**                       |           |            |
| 1-5                                           | 47        | 58.75      |
| 6-10                                          | 22        | 27.5       |
| 11 and above                                  | 11        | 13.75      |
| Outpatient                                    | 5         | 2.5        |
| **Health care facility unit in which the health worker works** | | |
| Emergency                                     | 29        | 36.3       |
| Medical unit                                  | 34        | 42.5       |
| Intensive care unit (ICU)                     | 12        | 15         |

| Community exposure to COVID-19                |           |            |
| Does the nurse have a history of staying in the same household or classroom environment? | Yes 28 35 | No 52 65 |
| Does the nurse have history of traveling together in close proximity (within 1 m) with a confirmed COVID-19 patient in any kind of conveyance? | Yes 16 20 | No 64 80 |

### Table 2
Frontline nurses’ activities performed on COVID-19 patient in health care facility.

| Item                                                                 | Frequency | Percentage |
|---------------------------------------------------------------------|-----------|------------|
| Did you provide direct care to a confirmed COVID-19 patient?         | Yes 48    | 60         |
| No 32                                                                | 40        |
| Did you have face-to-face contact (within 1 m) with a confirmed COVID-19 patient in a health care facility? | Yes 37    | 46.3       |
| No 36                                                                | 45        |
| Unknown                                                             | 7         | 8.8        |

| Were you present when any aerosol-generating procedures were performed on the patient? | Yes 42 | 52.5 |
| No 38                                                               | 47.5 |

### Table 3
Adherence to IPC procedures during health care interactions.

| Statement                                                                 | Frequency | Percentage |
|--------------------------------------------------------------------------|-----------|------------|
| During a health care interaction with a COVID-19 patient, did you wear personal protective equipment (PPE)? | Yes    | 80 100 |
| No                                                                       | 48 60    |
| Single gloves                                                            | Always, as recommended | 80 100 |
| Medical mask                                                             | Always, as recommended | 80 100 |
| Face shields or goggles                                                 | Always, as recommended | 80 100 |
| Disposable gowns                                                         | Always, as recommended | 80 100 |
| Did you have direct contact with the environment where the confirmed COVID-19 patient was cared for? E.g. bed, linen, medical equipment, bathroom etc | Yes | 42 52.5 |
| No                                                                       | 38 47.5  |

| During a health care interaction with the COVID-19 patient, did you perform hand hygiene before and after touching the COVID-19 patient (whether or not you were wearing gloves)? | Yes | 73 91.3 |
| No                                                                       | 7 8.8  |

| During a health care interaction with the COVID-19 patient, did you perform hand hygiene after exposure to body fluid? | Yes | 80 100 |
| No                                                                       | 5 6.3  |

| During a health care interaction with the COVID-19 patient, did you perform hand hygiene after touching the COVID-19 patient? E.g. while inserting a peripheral vascular catheter, urinary catheter, intubation, etc.? | Yes | 80 100 |
| No                                                                       | 5 6.3  |

| During a health care interaction with the COVID-19 patient, did you perform hand hygiene after touching the patient’s surroundings (bed, door handle, etc.), regardless of whether you were wearing gloves? | Yes | 80 100 |
| No                                                                       | 5 6.3  |

| During a health care interaction with the COVID-19 patient, were high touch surfaces decontaminated frequently (at least three times daily)? | Yes | 80 100 |
| No                                                                       | 5 6.3  |
2. Methods

2.1. Design

This study employed a quantitative descriptive design to assess the risk classification of frontline nurses after contact with a patient diagnosed with COVID-19.

2.2. Participants

The study sample was comprised of the frontline nurses in the hospitals designated for COVID-19 in the northern region of the Kingdom of Saudi Arabia. With the aim of risk assessment and management, only those nurses (frontline) who had direct contact with a COVID-19 patient were included in this study. Snowball sampling was used, resulting in 80 frontline nurses.

2.3. Data collection

The survey data was collected using questionnaire in a Google form link. The instrument included an informed consent form explaining the study, the study procedure, the purpose, the risk and benefits, and voluntary participation. The researchers coordinated with the health authorities of the hospitals that the Ministry of Health had identified as COVID-19 Centers in Hail, Kingdom of Saudi Arabia. The researchers sent the link to the respective contact persons, where they shared the link with those frontline nurses who had actual contact with patients diagnosed with COVID-19. There was close coordination with the researchers and the health authorities to ensure that the initial reports regarding the risk assessment would have direct management, as accorded by the WHO. The daily results of the assessment were reported to the health authorities of the hospitals. The data gathering was done from May 15 until June 20, 2020.

2.4. Questionnaire

The researchers used the World Health Organization’s COVID-19 Virus Exposure Risk Assessment Form for HCWs (WHO, 2020). This form is open access and can be used by any facility. According to the WHO, the tool was designed to assess the post-contact risk classification of healthcare workers with patients diagnosed with COVID-19. There were two parts to the questionnaire. The first collected the demographic information of the healthcare workers, and the second was a risk assessment survey, adapted from the WHO. A slight modification was made to the tool regarding the WHO’s suggestion to de-identify data that may refer to the personal information of the participants: The name, city, and contact details were de-identified. However, the important assessment questions for gaining information on the risk of COVID-19 were ensured (e.g., COVID-19 Virus Exposure Risk Assessment [2 questions], activities performed on COVID-19 patients in the healthcare facility [4 questions], adherence to infection prevention and control [IPC] procedures during healthcare interactions [7 questions], adherence to IPC measures when performing aerosol-generating procedures [6 questions], and accidents regarding biological material [1 question]). The “Yes” answers of the nurses to the questions on the COVID-19 Virus Exposure Risk Assessment were considered as “Community exposure to COVID-19.” Similarly, a “Yes” to any of the questions referring to “Activities performed on COVID-19 patient in the healthcare facility” was considered as being “Exposed to the COVID-19 virus.” In the risk classification, the participants who did not respond “Always, as recommended” to questions under “Adherence to IPC procedures during healthcare interactions” (7 questions) and “Adherence to IPC measures when performing aerosol-generating procedures” were classified as being “High risk for COVID-19 virus infection.” Finally, participants who did not answer “Yes” to the question, “Did you have any type of accident with body fluid secretions?” were also classified as “High risk.” All other answers were classified as “Low risk for COVID-19.”

Prior to using the tool, the internal consistency was tested using Cronbach’s alpha with at least 10 participants. The internal consistency of the tool used in this study was 0.89, which means that the tool is highly reliable.

2.5. Ethical considerations

This study obtained ethical approval from the Institutional Review Board of the University of Ha’il (H-2020-144).

2.6. Data analysis

Microsoft Excel was used to analyze the data. Frequency and percentages were used to determine the demographic characteristics of the healthcare personnel and their adherence to IPC procedures during healthcare interactions, when performing aerosol generating procedures, and regarding accidents with biological material.

3. Results

3.1. Demographic information

The majority of the frontline nurses were ages 26 to 30 years old. The occupational categories were divided into five categories: 1. Doctors, 2. Nurses, 3. Other health personnel, 4. Administrative and technical personnel, and 5. Others, with the frequency of each group being as follows: Doctors 20%, Nurses 70%, Other health personnel 5%, Administrative and technical personnel 5%, Others 0%

Table 4

| Statement | Frequency | Percentage |
|-----------|-----------|------------|
| During aerosol-generating procedures on a COVID-19 patient, did you wear personal protective equipment (PPE)? | | |
| Single glove | Yes | 80 | 100 |
| | Always, as recommended | 80 | 100 |
| N-95 mask (or equivalent respirator) | Always, as recommended | 80 | 100 |
| Face shield or goggles/protective glasses | Always, as recommended | 80 | 100 |
| Disposable gown | Always, as recommended | 80 | 100 |
| Waterproof apron | Always, as recommended | 80 | 100 |
| During aerosol-generating procedures on the COVID-19 patient, did you perform hand hygiene before and after touching the COVID-19 patient, regardless of whether you were wearing gloves? | | |
| Always, as recommended | 80 | 100 |
| During aerosol-generating procedures on the COVID-19 patient, did you perform hand hygiene before and after any clean or aseptic procedure was performed? | | |
| Always, as recommended | 80 | 100 |
| During aerosol-generating procedures on the COVID-19 patient, did you perform hand hygiene after touching the patient’s surroundings (bed, door handle, etc.), regardless of whether you were wearing gloves? | | |
| Always, as recommended | 76 | 95% |
| Most of the time (50% or more but not 100%) | 4 | 5% |
| During aerosol-generating procedures on the COVID-19 patient, were high-touch surfaces decontaminated frequently (at least three times daily)? | | |
| Always, as recommended | 80 | 100 |
| Accidents with biological material during a health care interaction with a COVID-19 patient, did you have any type of accident with body fluid/respiratory secretions? | | |
| Yes | 3 | 3.8 |
| No | 77 | 96.3 |
| Splash of biological fluid (eyes) | 3 | 3.8 |
Of the 80 frontline nurses, 35% had a history of living in the same household. Specifically, they were all living in the same house provided by the hospital. In addition, 20% had a history of traveling together in a vehicle (for transportation) in close proximity (within 1 m) with a confirmed patient. These healthcare workers were considered to have “Community exposure to COVID-19.”

Of the frontline nurses, 60% were considered exposed to COVID-19 due to providing direct care to a confirmed COVID-19 patient with face-to-face contact (46.3%). Of the 80 participants, 40% were present when aerosol-generating procedures were performed on a patient (e.g., open airway suctioning [28.1%], nebulizer treatment [21.9%], and cardiopulmonary or CPR [21.9%]). In addition, 52.5% had direct contact with the environment where a confirmed COVID-19 patient had received care.

Interestingly, all of the participants (100%) adhered to IPC procedures such as wearing PPEs, performing hand hygiene before and after performing any clean or aseptic procedure (e.g., while inserting a peripheral vascular catheter, urinary catheter, intubation), performing hand hygiene after exposure to body fluid, performing hand hygiene after touching the patient’s surroundings (bed, door handle, etc.), and constant use of PPE. These practices were frequently performed at least three times daily. However, only 8.8% of the participants reported that they removed and replaced their PPE according to protocol and few (6.3%) performed hand hygiene before and after touching COVID-19 patients, irrespective of wearing gloves.

It is noteworthy that all of the healthcare providers (100%) wore their PPE during aerosol-generating procedures on COVID-19 patients, removed and replaced their PPE according to protocol, performed hand hygiene before and after touching COVID-19 patients, irrespective of wearing gloves, performed hand hygiene before and after any clean or aseptic procedure was performed, and decontaminated high-touch surfaces frequently (at least three times daily). However, regardless of whether they wore gloves or not, few participants (5%) performed hand hygiene after touching the patients’ surroundings.

Regarding accidents with biological materials, 3.8% reported to have had accidents with biological material during a healthcare interaction with a COVID-19 patient, particularly with splashes of biological fluid in the eyes.

4. Discussion

This study aimed to assess the post-contact risk classification of nurses with a patient diagnosed with COVID-19. Overall, most of the participants were classified as low risk and few were at high risk. Few of the nurses in this assessment had a history of staying in the same household environment with a confirmed COVID-19 patient; however, some had a history of traveling in a vehicle in close proximity with a confirmed COVID-19 patient. One possible reason for the exposure of these nurses is that they were housed or accommodated in one building and different drivers transported them from their housing/accommodations to the hospital. Exposure to COVID-19 is likely to occur among nurses in this context; there is a possibility of infecting other patients as well. This is in accordance with Wang et al. (2020) who posited that healthcare workers could serve as a means of transferring the disease. In fact, it has been estimated that approximately 12% of the patients infected with COVID-19 were infected through exposure to infected healthcare workers (Wang et al., 2020). While this study found few nurses who had this type of community exposure to COVID-19, the WHO Risk Assessment Interim Guide suggests that nurses need to self-monitor daily for symptoms—such as an increase in temperature and respiratory problems—for 14 days after their last exposure to a confirmed or suspected COVID-19 patient (WHO, 2020d). In addition, the Centers for Disease Control and Prevention (CDCP) suggest that healthcare workers who have been exposed need to be isolated in a single room while waiting for the results of the test (Centers for Disease Control and Prevention (CDCP), 2020). This study finding highlights the importance of strict precautionary measures such as social distancing, hand hygiene, and the use of PPE, such as masks, even outside the hospital zone.

Upon assessment, some nurses were considered to have been exposed to the COVID-19 virus because they provided a direct care contact (e.g., face-to-face interaction within 1 m) to patients diagnosed with COVID-19; this is in addition to involvement during aerosol generating procedures and direct interaction with an environment in which a confirmed COVID-19 patient received care. Indeed, one of the routes for the spread of COVID-19 is considered to be through aerosolized droplets that are emitted while coughing, sneezing, or breathing. Therefore, it is essential to have PPE in this situation. An earlier study found that, although 85% of the involved healthcare workers had been exposed during an aerosol-generating procedure, none were infected because they had followed standard procedures, such as with protective equipment and hand hygiene (Ng et al., 2020). These precautionary measures are recommended to all healthcare workers—that a rational, accurate, and constant use of PPE must be reinforced (WHO, 2020e). It is additionally recommended that contact and droplet precautions must be reinforced with the care for patients with symptoms of acute respiratory illness (Ng et al., 2020). This study finding contributes to the realization of addressing COVID-19 where having strict policies and systems in place can prevent the rapid spread of COVID-19. Nurse administrators and clinicians also play crucial roles in improving and advocating effective anti-infection protective environments and strategies.

Regarding adherence to IPC procedures during healthcare interactions, a few nurses were considered to have a high risk for COVID-19 virus infections; only 8.8% of them were considered to be according to protocol “most of the time,” particularly on the removal and replacement of PPE, and only 6.3% were performing hand hygiene “before and after” touching the COVID-19 patients. These study findings indicate that a lack of awareness on the part of the nurses and their being uncomfortable in using the equipment may hinder the sustained use of PPE. For instance, one survey observed that gowns and goggles were tight, foggy, and induced intense perspiration and visual acuity, which hampered the healthcare workers in their care of the patients (Chan, Lee, & Tang, 2004). In addition, overworked healthcare workers washed their hands less frequently than those who were not overworked (Lai et al., 2020). In this case, nurses who were overworked should put a high significance on the correct removal of protective equipment. Further interventions regarding the nurses who had a high risk encounter were to stop them from interacting with patients for a period of 14 days (WHO, 2020d) and to mandate a 14-day quarantine (WHO, 2020e). These study results contribute to revisiting the protocol for an outbreak whereby hospitals should both establish and take full advantage of an infection control system that provides real-time monitoring and facilitates immediate correction during an outbreak.

Although frontline nurses were found to adhere to IPC measures when performing aerosol-generating procedures, a few were considered high risk regarding performance of hand hygiene after touching the patients’ surroundings (bed, door handle, etc.), regardless of whether they were wearing gloves or not. Such practices can be hindered by influx and volume of patients in the hospital. This is true where healthcare facilities are overcrowded and lack distancing and access to adequate, reliable alcohol-based hand rub (ABHR), which are among the numerous challenges preventing effective hand hygiene practices in resource-limited healthcare settings (Lofthus et al., 2019). In accordance with current reports, hand hygiene, a vital element of infection prevention and control, is frequently neglected by healthcare workers in both developed and developing countries (Allegranzi, Nejad, & Pittet, 2017).
Along with other infection control activities, hand hygiene may be compromised because personnel may be too occupied or unsure of how to employ hand hygiene in this outbreak setting, not because it is not a priority (Gon, Dancer, Dreibelbis, Graham, & Kilpatrick, 2020). This study finding conveys the recommendation of the WHO (2020) that the review of IPC training must be reinforced and provided.

Accidents with biological material were reported, particularly regarding splashes of biological fluid in the eyes. One possible reason for this current result could be that nurses are pressured both with work and with the situation that they are facing regarding the pandemic. Indeed, there have been reports that healthcare workers who worked overtime are likely at risk for both biological and nonbiological hazards (Gershon et al., 2009). Likewise, pressures at work are characterized as resulting in a negative effect that diminishes the quality of life for the health workers as well as the patients (Anargh, Singh, Kulkarni, Kotwal, & Mahen, 2013). In general, these current results are similar to earlier studies done in low- and middle-income countries (e.g., Nigeria, Uganda, Philippines, and Iran) where biological hazard related injuries and stress were the foremost health related hazards experienced by healthcare workers (Ndejjo et al., 2015). This present finding indicates that training is a particularly important aspect of staff protection. Guidelines must be offered on effective measures for containing, controlling, and preventing the spread of infectious diseases both at work and among nurses.

5. Study limitations

The researchers acknowledge the limitations of this study. First, other healthcare workers who could have provided a more comprehensive scenario of the risk of exposure to COVID-19 were excluded. Unquestionably, the inclusion of all of the healthcare workers is important to creating policies that help healthcare workers. The second limitation is in the small number of participants, which affects the generalization of the results. This can be addressed by including other hospitals in the neighboring region.

6. Conclusion

Despite the strict guidelines, frontline nurses remain at a high risk of contracting COVID-19. This study highlights practices that were identified as needing improvement in combatting this virus. As such, through revisiting the policies and determining where the problem resides, the results will serve as an opportunity for improvement in the precautionary measures of the hospitals. Since policies and guidelines may not always be optimal in all settings, a tailor-fitted guideline is appropriate. Nurse leaders, for example, need to establish an infection control system that provides real-time monitoring and facilitates immediate correction for nurses. This will provide the nurses with a continuous awareness of potential activities predisposing themselves to acquiring the virus.

CRediT authorship contribution statement

HMA and EAP: Conceptualization, Methodology, Software RMJ and HMA.: Data curation, Writing-Original draft preparation. SV: Visualization, Investigation. EAP: Supervision::RMJ and SV: Software, Validation.: All authors: Writing- Reviewing and Editing.

Declaration of competing interest

The researchers declare no conflict of interest.

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