

# The risk of COVID-19 infection among nurses working with COVID-19 patients

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## Abstract

Working with 2019 coronavirus disease (COVID-19) patients is currently considered one of the main fears and challenges that face healthcare workers (HCWs), especially nurses. This challenge can jeopardize the quality of health care services for those patients and cause a serious mental burden to HCWs. To understand and estimate the risk of COVID-19 infection among HCWs who directly serve COVID-19 patients. Before the community spread of the disease, 270 nurses who worked with COVID-19 wards were followed for 11 weeks to report the COVID-19 cases. On the other hand, during the community spread of the disease, 981 registered nurses (300 worked in COVID-19 wards and 681 worked in non-COVID wards) were followed for up to 16 weeks to report the COVID-19 cases. Before the community spread of COVID-19, none of the nurses who worked with the COVID-19 patients got the infection. On the other hand, during the community spread of the COVID-19 infection, 30% of the 300 nurses who worked in the COVID-19 wards got the COVID-19 infection, while 64% of the 681 HCWs who worked in the non-COVID wards got the infection. The relative risk of getting COVID-19 infection among HCWs who worked in the COVID-19 wards was reduced to about half in comparison to other HCWs who worked in the non-COVID wards (RR = 0.469). HCWs should not fear working with COVID-19 patients. Considering appropriate personal protective measures and infection control standards, the risk of infection transmission from the community is higher than that of COVID-19 patients, if any.

**Abbreviations:** COVID-19 = 2019 coronavirus disease, HCWs = Healthcare workers.

**Keywords:** COVID-19, fear, health care workers, infection risk, Jordan

## 1. Introduction

The 2019 coronavirus disease (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus 2 has caused a global health crisis<sup>[1]</sup>; that was characterized as a pandemic by the World Health Organization on the 11th of March 2020.<sup>[2]</sup> Healthcare workers (HCWs) have played an essential role in the containment of previous waves of this pandemic. On the other hand, maintaining their physical and mental health is crucial to successfully overcome future waves.<sup>[3]</sup> Regarding COVID-19 infection, HCWs are considered a vulnerable population.<sup>[4]</sup> More specifically, some studies have found that nurses are at greater risk of getting infected by COVID-19,<sup>[5,6]</sup> and facing mental stresses related to working in a COVID-19 environment.<sup>[7]</sup>

Despite the altruistic attitudes of the HCWs and especially the nurses as frontliners,<sup>[7]</sup> many of them were terrified of working

in the COVID-19 dedicated wards or hospitals<sup>[8]</sup>; as they feared getting infected and threatening the lives of themselves and their relatives.<sup>[7]</sup> This fear has caused psychological distress and higher rates of burnout and job resignation.<sup>[7,9,10]</sup>

In this study, we compared the rates of positive COVID-19 PCR tests between nurses who have worked in the dedicated COVID-19 wards and nurses who have worked in non-COVID wards, to further understand and assess the risk difference between both groups.

## 2. Methods and study design

The protocol of this study was approved by the institutional review board of Jordan University of Science and Technology (Approval # 130/136/2020). This was a retrospective cohort study, in which the nurses at King Abdullah University Hospital

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were followed up and screened in terms of being infected with COVID-19. The nurses were divided into 2 groups. The first group represented those nurses who did not work in COVID-19 wards and did not encounter confirmed cases of COVID-19, and the second group represented those nurses who worked in COVID-19 dedicated wards.

The study follow-up period was divided into 2 intervals as well. The first period started on the 19th of March 2020 (when the first COVID-19 case was admitted to the country and the hospital) and continued until the 10th of June 2020 when the last case was discharged from the hospital. During this period, the number of cases was limited in the country, and it was considered that there was no community spread of the disease, where most of the cases originated from outside Jordan and all the contacted people were screened for transmission and were hospitalized if infected. The second period started on the 20th of Sep 2020 (when the first case of COVID-19 was admitted again to the hospital after the second wave of the disease) and continued until the 13th of January 2021, when the vaccination program of the HCWs inside the hospital has started.

During both periods and according to the hospital policy, COVID-19 PCR tests were done for all nurses working in the COVID-19 dedicated wards and the non-COVID wards when they felt any flu-like or COVID-19 symptoms with a low threshold, and when they encountered a confirmed COVID-19 case.

The records for the nurses in both groups were reviewed and the number of COVID-19 cases was reported along with the total number of nurses. Only records for registered nurses with full-time Jobs (40 h/wk) were reviewed. Frequencies of positive PCR tests among both groups were recorded in a table and the relative risk of having a positive PCR test among the group working in COVID-19 wards was subsequently calculated. Finally, volunteer participants from both groups were interviewed for thematic behavioral analysis.

### 3. Results

During the first period, there were around 187 admitted cases of COVID-19 during 11 weeks. At the same period, 270 nurses worked on those COVID-19 cases while 711 did not. 2 cases got infected with COVID-19 and these cases were from the group who didn't work in the COVID-19 wards with the COVID-19 patients. As the numbers of infected cases were very low (0 and 2) for both groups, no statistical analysis was done for this period. However, it gives a clear indication that under a normal hospital setting with general precautions like hygiene, masks, gloves, gowns, distancing, and careful contact, the likelihood of getting COVID-19 infection from COVID-19 patients was very low if any.

During the second period, the hospital started accepting COVID-19 cases again on the 20th of Sep 2020 and we continued the study period until the 13th of Jan 2021 (before the starting date of vaccination in the hospital). Around 300 nurses worked in the COVID-19 wards and all of them were recruited within 2 weeks and the average follow-up period was  $14 \pm 1$  weeks. For those nurses (681) who did not work with COVID-19 patients, the follow-up period was for 16 weeks.

Among the 300 nurses who have worked in the dedicated COVID-19 wards, 90 had at least 1 documented positive PCR test result. On the other hand, among 681 nurses who have worked in the non-COVID wards, 435 had at least 1 documented positive PCR test result (Table 1).

The relative risk of nurses working in the COVID-19 wards to get infected with COVID-19 (i.e., have a positive nasopharyngeal PCR test) as compared to nurses working in other wards was 0.469. In other words, the risk of getting COVID-19 infection among nurses who are not working with COVID-19 patients was approximately 2 folds higher than that of the nurses who work with COVID-19 patients.

**Table 1**

**Comparison of frequencies of positive PCR tests between nurses working in dedicated COVID-19 wards and nurses working in non-COVID wards.**

Nurses' workplace	At least one documented positive PCR	No documented positive PCR	Total number of nurses
COVID-19 wards	90	210	300
Non-COVID wards	435	246	681
Total	525	456	981

### 4. Discussion

Analysis of the data obtained during the second period of this study showed that the relative risk of nurses working in the COVID-19 wards to getting infected with COVID-19 (i.e., have a positive nasopharyngeal PCR test) as compared to nurses working in other wards was 0.469. This means that the risk of getting infected with COVID-19 among nurses working in the COVID-19 wards was reduced by at least 50% as compared to the risk of nurses working in the other wards. Interestingly, this number possibly could have been greater, as more positive PCR results among nurses in non-COVID wards may have been picked up if all nurses had done a PCR test instead of the screening protocol mentioned before, keeping in mind that all nurses in the COVID-19 wards have taken PCR tests. This finding should be interpreted in the context of previous studies and the thematic behavioral analysis we performed by interviewing volunteers from both groups.

Our results support and reinforce the findings of previous studies; in which a study in Milan showed that HCWs (including nurses) in non-COVID departments (such as internal medicine, surgery, intensive care, etc.) had significantly higher rates of positive PCR tests as compared to dedicated COVID-19 departments,<sup>[3]</sup> and a study in Madrid found no differences in the proportion of positive PCR detection between HCWs from high-risk wards involved in close contact with COVID-19 patients, in comparison with intermediate or low-risk wards.<sup>[11]</sup> Furthermore, a study in Kashmir reported a significantly lower risk of seropositivity for severe acute respiratory syndrome coronavirus 2-specific immunoglobulin G among HCWs working in COVID-19 dedicated as compared to HCWs in non-COVID dedicated hospitals.<sup>[12]</sup>

Our results along with the findings of these studies can be explained by multiple interplaying factors. Firstly, HCWs generally and nurses specifically tend to be more cautious and adherent to protective measures during patient interactions in COVID-19 dedicated wards or hospitals as compared to non-COVID dedicated wards or hospitals. This is due to hospital regulations which could be stricter for nurses working in COVID-19 wards,<sup>[5,12,13]</sup> and due to the cautious behavior when dealing with patients and being more self-aware regarding proper personal protective equipment usage.<sup>[12]</sup> Furthermore, HCWs in COVID-19 dedicated wards are specifically trained on proper donning and doffing of personal protective equipment and get regularly tested for COVID-19, which might help to limit COVID-19 spread.<sup>[12]</sup> In some conditions, prioritizing COVID-19 wards in terms of protective equipment may cause equipment shortages in non-COVID wards.<sup>[12]</sup>

Remember that COVID-19 infection could have a long incubation period where the infected person can transmit the disease.<sup>[14,15]</sup> Also, it can present with mild or atypical symptoms.<sup>[16]</sup> Many of these patients visit the non-COVID departments of the hospital before being definitively diagnosed, and when coupled with "loose" protective measures of HCWs, may lead to more spread of COVID-19 among HCWs in non-COVID wards. For instance, the number of HCWs infected by COVID-19 cases was found to be higher in the Internal

medicine, surgical, and emergency medicine departments than in the dedicated COVID-19 department in San Paolo Hospital.<sup>[3]</sup> Interestingly, the prevalence of asymptomatic COVID-19 infection among non-first-line COVID-19 HCWs was greater when compared to the spread among first-line COVID-19 HCWs.<sup>[5]</sup>

Secondly, the different attitudes of nurses and HCWs when interacting with their colleagues during breaks, and when interacting with family members and friends after work is an important factor. Nurses and HCWs working in COVID-19 dedicated departments tend to be more cautious when interacting with peer colleagues, especially in centers that apply the buddy approach.<sup>[12]</sup>

This theme was repeatedly found during interviews with nurses working in the COVID-19 wards in which some nurses stated “*I was extremely cautious when interacting with peer colleagues, and I even ate alone...*” while other nurses said “*I stopped seeing all my colleagues and friends outside work hours; No parties, No gatherings, No social events... Nothing at all!*”

One study has found that the highest rates of COVID-19 infection were among HCWs in non-COVID wards in which there was a history of unprotected socializing with loose protective measures during break times outside working hours; which was much higher than the rates of COVID-19 infection among HCWs in COVID-19 wards and non-COVID wards with no history of unprotected socializing.<sup>[17]</sup> These findings made researchers state that HCW-HCW transmission during spare time may pose a greater risk than interaction with patients.<sup>[17]</sup> In this context, researchers found higher percentages of infected HCWs who had a history of unprotected contact with colleagues in non-COVID departments as compared to dedicated COVID-19 departments.<sup>[3,5]</sup>

Furthermore, HCWs in COVID-19 wards tend to isolate themselves from family members and friends to protect their loved ones,<sup>[12]</sup> which in fact, protects them from getting a community-acquired infection. This theme was also recurrently expressed by different nurses during the interviews. One male nurse, who was a father of 3 children said: “*Once I reach my house, I take a shower and put all clothing in a sealed bag and isolate myself in a closed room. I only use social media applications and Facetime to see my wife and children. I was afraid to transmit the virus to them as I have heard about the possibility of being infected without symptoms*” and another mother nurse stated “*I even stopped cooking for my husband and children. I was afraid to transmit the disease to them, so I stayed in a room alone. We depended on the cooking of our neighbors and relatives. Many times we ordered food deliveries from restaurants.*” Other nurses reported similar scenarios as well.

It was reported that the number of HCWs who got infected with COVID-19 with a history of close contact with a positive family member was higher in non-COVID departments compared to HCWs in COVID-19 departments.<sup>[3,5]</sup> This protection is arguably even more important than COVID-19 nosocomial transmission from patients, after comparing the evolution of COVID-19 cases between HCWs and non-HCWs in the community, it was found that both groups were driven by the same dynamics.<sup>[11,12]</sup> This supports the idea that community-acquired COVID-19 is a major factor in COVID-19 spread among HCWs, and could be as important as or even more important than the occupational risk of COVID-19.<sup>[11]</sup> Other studies, including a report of the WHO-China joint mission, have also reported that the community-acquired route of COVID-19 infection could be a major route of HCWs infection when compared to the nosocomial transmission route.<sup>[12,18,19]</sup> Administrative measures in COVID-19 wards, including visitor restrictions and environmental sanitation are additional aspects that could limit community-acquired COVID-19 infection.<sup>[12]</sup>

Our results, strengthened with findings from other studies, can be interpreted in a 2-dimensional fashion. The first one is to highlight that working in COVID-19 wards per se is not an

adequate risk factor for getting infected with COVID-19, as it seems that adherence to protective measures both during interaction with patients during work hours, and interaction with colleagues, family members, and friends outside work hours is enough to protect HCWs to a certain level, which could even provide more protection than HCWs working in other departments with “loose” measures. This take-home message is encouraging to HCWs who may fear and be hesitant to work in COVID-19 wards and may help to relieve the fear and stress associated with working in dedicated COVID-19 hospitals.

Secondly, we want to emphasize that HCWs in non-COVID departments should also adhere to protective measures inside and outside the hospital, as it seems that their false sense of security, especially during COVID-19 waves, may make them liable to higher rates of COVID-19 infection,<sup>[3]</sup> and interestingly, even probably a more severe infection as noted by the higher serum ESR and IL-6 levels.<sup>[5]</sup>

## 5. Limitations of the study

The current study is a surveillance/screening study focusing on including all working nurses in the hospital without exception and without missing anyone. The data related to all participants was treated as aggregates and the identity of the participants was anonymous, confirmed and recovered from the hospital records, except for those who accept to be interviewed. Therefore, we were not able to consider the clinical characteristics of the nurses,<sup>[20]</sup> and any attempt to do that will significantly reduce the number of the studied cases and may jeopardize the validity, generalizability, and the main aim of the study.

## Author contributions

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