Risk factors and outcome among COVID-19 exposed and quarantined healthcare workers: A study on the status of existing practices of standard precautions

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Abstract

Context: Health care workers (HCWs) are at high risk of COVID-19 infection but data on the risk factors for exposure and infection rate among Indian HCWs are limited. Aims: Our study aims to identify the risk factors and behavior of HCWs which make them high risk for COVID-19 infection and the infection rate among them. Settings and Design: This is a retrospective study conducted at All India Institute of Medical Sciences, New Delhi. Methods and Material: Fifty HCWs quarantined at our institute in April and May 2020 following exposure to confirmed or suspected COVID-19 cases, or due to development of Influenza-Like Illness (ILI) were included. Data was collected from medical records in a predesigned proforma and analyzed. Results: Thirty-eight (76%) of the 50 quarantined HCWs had high-risk exposure and there was a significant breach in personal protective measures. N-95 masks were worn by 59.6%, gloves by 61.7%, and goggles or face shields by 2%. Exposures were more common in non-COVID areas of the hospital. Hydroxychloroquine pre-exposure prophylaxis was taken by 7 (14%). 3 (6%) were confirmed to be COVID-19 positive during the quarantine period. Conclusions: Our study has shown leniency among HCWs in adhering to infection control and personal protective measures resulting in an increased quarantine and infection rate and loss of manpower. The safety of our HCWs must be given paramount importance during this pandemic and should be ensured by educating them about infection control, and persistently reinforcing and strictly adhering to standard precautions.

Keywords: COVID-19, exposure, health care workers, pandemic, personal protective equipment

Introduction

Healthcare workers (HCWs) have been a vulnerable category during all pandemics that have plagued mankind. This is true for the ongoing COVID-19 pandemic also. The high-risk nature of HCWs is due to the close proximity and prolonged contact with cases/suspects, the need to do life-saving aerosol-generating procedures like endotracheal intubation, lack of training regarding hand hygiene, and other infection control practices.

On May 15th 2020, the Ministry of Health and Family Welfare of India released “Advisory for managing healthcare workers..."
working in COVID and non-COVID areas of the hospital,” based on which institutional policies were created. It included guidelines like the mandatory use of N-95 masks in all hospital areas, appropriate use of personal protective equipment (PPE) as per designated work areas, cleaning of hospital beds, floors and other surfaces, and social distancing at the workplace. This document also provides guidelines for risk stratification and management of COVID-19 exposed HCWs. High-risk exposure is defined as any HCW having close contact/direct care of a patient without the use of mask/goggles/PPE. Close contact is defined as contact for >15 min, at a distance of <1 m. Such high-risk contacts are to be quarantined for 14 days. Five to seven days after last date of exposure, they are tested for COVID-19 infection by means of a nasal/nasopharyngeal and oropharyngeal swab for RT-PCR. Low-risk contacts are not quarantined but should self-monitor for development of symptoms while continuing their work, and are tested if they develop symptoms.

Though there is rising awareness among HCWs regarding the growing number of cases among them, there is insufficient data regarding the same, especially in an Indian setting. Our study on quarantined HCWs aims to evaluate their risk factors and behavior which make them high risk for COVID-19 infection, and find the infection rate among the quarantined HCWs. Knowledge about this will help us in promoting behavior change practices and creating awareness among HCWs about the importance of protective measures and infection control practices like PPEs, hand hygiene, social distancing, etc., at the workplace.

**Subjects and Methods**

**Place and time**

Our study was conducted at the All India Institute of Medical Sciences, New Delhi, COVID isolation/quarantine facility. The study was conducted between April and May 2020.

**Ethics**

The study was approved by the Institutional Ethical Committee (Ref. No. IECPG-278/22.07.2020)

**Study design**

This is a retrospective study. Fifty HCWs, who were quarantined following exposure to confirmed or suspected COVID-19 cases at their workplace/home, or quarantined due to the development of symptoms suggestive of Influenza-Like illness (ILI) were included in the study. All subjects underwent testing by RT-PCR of oropharyngeal and nasal/nasopharyngeal swabs between day 5 and 7 from the day of last exposure, or on the development of symptoms, whichever was earlier. COVID-19 positive cases in the isolation ward were not included. Data regarding demographic details, details of exposure, PPE worn, use of Hydroxychloroquine (HCQ) pre-exposure prophylaxis, was collected in a predesigned proforma from the medical records and analyzed.

**Statistics**

Baseline characteristics of the study participants were summarized, and categorized in two groups based on the COVID-Positive Status on RT-PCR. Kolmogorov–Smirnov and Shapiro–Wilk test of normality were applied to understand the distribution of data. Continuous data was reported as mean (SD) for normally distributed variables, and median (Inter Quartile Range) for skewed distributions. Categorical variables were reported as frequency (percentages). Continuous data in two groups were compared by Welch-t-test or Wilcoxon Rank sum test depending upon the distribution of data. Association between categorical data was assessed by Fisher’s exact test. Correlation between two continuous variables was performed using Spearman’s rank correlation test. A P value of less than 0.05 was considered statistically significant at 95% confidence level. Statistical analysis was done using R software version 3.5.2

**Results**

Fifty HCWs quarantined at our centre following exposure to COVID-19 positive/suspected cases, or development of suggestive symptoms were included in the study. The demographic data and exposure characteristics are depicted in Table 1. The mean age of the study population was 28.7 ± 6.56 years, and 56% were females.

Doctors and nursing officers contributed to 46% and 42% of the study population, respectively. 96% of the quarantined had a definite history of contact with confirmed cases. The rest were admitted because they were symptomatic, though they couldn’t recall definite exposure history. General wards were the most common setting for accidental exposures (63.3%), and exposure was more common among HCWs working in non-COVID areas (98%). The distribution of high-risk exposure among the different categories of HCWs is shown in Figure 1. There was no history of international travel among the quarantined HCWs, and none of them were residing or had visited any COVID hotspot areas in the country. 20 (40%) HCWs were involved in aerosol-generating procedures like endotracheal intubation and tracheal suctioning, but protective face shields or goggles were not worn by any.

Table 2 depicts the differences between the study subjects who tested COVID positive and those who tested COVID negative. A Wilcoxon rank sum test showed a significantly higher number of COVID negative subjects with history of contact with a positive patient (P = 0.001). 3 among the quarantined 50 HCWs tested positive for COVID-19, giving an infection rate of 6%.

**Discussion**

Our study found that the COVID-19 infection rate at our tertiary care centre among the 50 quarantined HCWs was 6%. 76% of
Kumar, et al.: Risk factors for COVID‑19 among healthcare workers

Table 1: Demographic and other characteristics with details of exposure of the subjects

| Characteristic                        | Details            | Frequency (%) |
|---------------------------------------|--------------------|---------------|
| Sex                                   | Male               | 22 (44.0)     |
|                                       | Doctor             | 23 (46.0)     |
|                                       | Nurse              | 21 (42.0)     |
|                                       | Health assistant   | 3 (6.0)       |
|                                       | Student            | 2 (4.0)       |
|                                       | Laboratory technician | 1 (2.0)   |
| Place of exposure                     | Ward               | 31 (63.3)     |
|                                       | Emergency          | 7 (14.3)      |
|                                       | ICU                | 1 (2.0)       |
|                                       | Outside workplace  | 10 (20.4)     |
| Contact with a confirmed case         |                    |               |
| Working in COVID area                 |                    | 48 (96.0)     |
| Working in a non-COVID area           |                    | 1 (2.0)       |
| Goggle/face shields worn              | No mask            | 10 (20.0)     |
|                                       | N95                | 29 (58.0)     |
|                                       | Surgical mask      | 11 (22.0)     |
| Gloves worn                           | <1 metre           | 47 (95.9)     |
|                                       | 1-2 metres         | 1 (2.0)       |
|                                       | 2-3 metres         | 0 (0.0)       |
|                                       | >3 metres          | 1 (2.0)       |
| Aerosol generating procedure done     |                    | 20 (40.8)     |
| Duration of contact with the patient during exposure | <5 min | 6 (12.0) |
|                                       | 5-15 min           | 5 (10.0)      |
|                                       | >15 min            | 39 (78.0)     |
| Symptomatic                           |                    | 8 (16.0)      |
| Risk stratification                   | High risk          | 38 (76.0)     |
| HCQ pre-exposure prophylaxis          | Not taken          | 43 (86.0)     |
|                                       | Incomplete course  | 6 (12.0)      |
|                                       | Complete course    | 1 (2.0)       |
| COVID positive among the quarantined  |                    | 3 (6.0)       |

Figure 1: Bar graph depicting frequency of the categories of healthcare workers among the high-risk exposures

HCWs are at high risk during pandemics but studies on COVID-19 infection among HCWs are limited. To the best of our knowledge, there are only two studies on the risk of COVID-19 among Indian HCWs. One is a case-control study conducted by ICMR COVID-19 research team conducted in May 2020 which showed that 1,073 HCWs had been infected to date, accounting for 0.82% of the total cases in India.[1] The second was a questionnaire-based survey of health workers conducted at Max hospital, Delhi which showed an infection rate of 1.8% among HCWs.[2] In a single-center case series conducted by Lai et al. on the COVID-19 infection among 9,684 HCWs at a tertiary care centre in China from January 1 to February 9 2020, 110 HCWs came positive, giving an infection rate of 1.1%, and this infection rate among first-line HCWs was higher when compared to non-first line HCWs.[3] The infection rate shown by our study was much higher compared to these studies and this may be due to the fact that our study had a small sample size and study subjects included only admitted HCWs.

Our study has shown poor compliance in following personal protective measures in early phase of pandemic (as current observation is of an improving trend). Despite policies advising the quarantined had high-risk exposure. N-95 masks were worn by 59.6%, gloves by 61.7%, and goggles or face shields by 2%. There was a significantly higher number of COVID-negative subjects with history of contact with a positive patient.
the mandatory use of N-95 masks in all hospital areas and PPE as per designated work areas, N-95 masks were worn by only 59.6%, gloves by 61.7%, and goggles/face shields by 2.1%. 20 (40%) HCWs were involved in aerosol-generating procedures like endotracheal intubation and tracheal suctioning, but protective face shields or goggles were not worn by any, making them high-risk exposures. Majority of the quarantined also had significant close contact, defined as contact for >15 min (78%) at a distance of <1 m (96%). In a prospective cohort study conducted by Nguyen et al. on the risk of COVID-19 among front line HCWs in the United States and United Kingdom, COVID-19 infection was highest among HCWs who reused PPE and had prolonged contact with patients.[4] However, reuse of PPE was not reported by our HCWs.

According to the advisory released by National Task Force for COVID-19 constituted by the ICMR, HCQ prophylaxis is recommended for HCWs involved in the care of confirmed/suspected COVID-19 cases and asymptomatic household contacts of laboratory-confirmed cases.[5] A case-control study conducted by ICMR also showed that consumption of four or more maintenance doses of HCQ was associated with a significant decline in the odds of getting infected.[6] 14% of our study population reported taking HCQ prophylaxis. The main reason for non-compliance was cited as apprehension about the cardiac side effects of the drug, even by those with no previous comorbidities and cardiac conditions. It is prudent to mention here that prophylactic role of HCQ still needs robust evidence.

We found no statistically significant differences in the demographic characteristics between the COVID-19 positive and negative groups. The 3 quarantined HCWs who were positive in our study were all doctors, working in non-COVID areas. Two of them had exposure in the general ward and the emergency room. These exposures were to patients who later turned out to be COVID positive. The third person had exposure to a suspected case of COVID-19 (spouse working in COVID ICU, who later tested negative) and was quarantined as he was symptomatic in the form of fever and sore throat. In our study, 63.3% of the exposures happened in the ward setting, 14.3% in the emergency.

Table 2: Comparison of characteristics of COVID positive and negative subjects

|                      | COVID-19 negative n=47 | COVID-19 positive n=3 | P       |
|----------------------|------------------------|-----------------------|---------|
| Age (mean)           | 28.72                  | 28.33                 | 0.922   |
| Sex (%)              |                        |                       | 0.157   |
| Male                 | 19 (40.4)              | 3 (100)               | 0.441   |
| Occupation (%)       |                        |                       |         |
| Doctor               | 20 (42.6)              | 3 (100.0)             |         |
| Nurse                | 21 (44.6)              | 0 (0.0)               |         |
| Health assistant     | 3 (6.4)                | 0 (0.0)               |         |
| Student              | 2 (4.3)                | 0 (0.0)               |         |
| Laboratory technician| 1 (2.1)                | 0 (0.0)               |         |
| Place of contact (%) |                        |                       | 0.228   |
| Ward                 | 30 (65.2)              | 1 (33.3)              |         |
| Emergency            | 7 (15.2)               | 1 (33.3)              |         |
| ICU                  | 1 (2.2)                | 0 (0.0)               |         |
| Outside workplace    | 8 (17.4)               | 1 (33.3)              |         |
| Contact with confirmed case (%) | 46 (97.9) | 2 (66.7) | 0.001 |
| Working in COVID ward/ICU (%) | 1 (2.1) | 0 (0.0) | 1 |
| Working in non-COVID ward/ICU (%) | 46 (97.9) | 3 (100) | 1 |
| HCQ pre-exposure prophylaxis taken (%) | 7 (14.9) | 0 (0.0) | 1 |
| Symptomatic (%)      | 7 (14.9)               | 1 (33.3)              | 0.947   |
| Goggles or face shields (%) | 1 (2.1) | 1 (33.3) | 0.248 |
| Gloves (%)           | 29 (61.7)              | 0 (0.0)               | 0.135   |
| Mask (%)             |                        |                       | 0.105   |
| No                   | 8 (17.0)               | 2 (66.7)              |         |
| N95 mask             | 28 (59.6)              | 1 (33.3)              |         |
| Surgical mask        | 11 (23.4)              | 0 (0.0)               |         |
| Distance between self and patient (%) | 44 (95.7) | 3 (100) | 0.934 |
| <1 metre             |                        |                       |         |
| 1-2 metre            | 1 (2.2)                | 0 (0.0)               |         |
| 2-3 metre            | 0 (0.0)                | 0 (0.0)               |         |
| >3 metre             | 1 (2.2)                | 0 (0.0)               |         |
| Duration of exposure (%) | 5 (10.6) | 1 (33.3) | 0.663 |
| <5 min               |                        |                       |         |
| 5-15 min             | 5 (10.7)               | 0 (0.0)               |         |
| >15 min              | 37 (78.7)              | 2 (66.7)              |         |
| Involved in aerosol-generating procedures (%) | 20 (43.5) | 0 (0.0) | 0.38 |
2% in the ICU. 98% of those quarantined were not working in a COVID designated area, but in general wards, ICUs, emergency where they had accidental exposure. This is in contrast to the study conducted at Max hospital which showed no difference in infection between those posted in high risk and low-risk zones. In the setting of dynamic changes in infection during a pandemic, it becomes important to also consider the stage of the pandemic during which the studies are conducted. Notably, the study at Max hospital was conducted in the months of March and April. This period was the beginning of the lockdown in the country with no community spread. Our study was conducted in the months of April and May when the lockdown was slowly eased. While the number of cases in the city of Delhi was about 1,000 in April, it had crossed over 15,000 by the end of May. This might explain the discrepancies in the results between the studies.

In our study, a much larger number of subjects who tested negative had an exposure to a COVID-19 positive patient. While this result is statistically significant, the implications of the same are doubtful. The history of exposure is prone to recall bias, especially when considering that the status of patients following some exposures may not be known. This could also be in part due to the small number of our study population. Though less likely, it becomes important for us to consider the possibility of a community spread through asymptomatic contacts that cannot be traced. This should be seen in light of 20% of our population being exposed outside the workplace (infected family members, social gatherings).

As per institute policy, only HCWs with high-risk exposure need quarantine. However, our study has shown that, of the 50 quarantined, only 76% had high-risk exposure. Reasons for quarantine of remaining 24% was mainly fear among exposed HCWs regarding possibility of infection, fear of transmitting infection to household members (especially among those staying with elderly parents and children), inability to maintain social distancing or quarantine at home, improper risk stratification done post-exposure. Due to the high rate of quarantine among exposed HCW amongst whom actual infection rate was low, institute policies were revised making more stringent the guidelines for high-risk categorization.

Our study is limited by its small sample size. Being reliant on the history given by the study population, this study is also prone to recall bias. The definition of high-risk exposure changed midway through the study, but we stratified patients as per initial guidelines to ensure uniformity. As per revised guidelines, a smaller percentage would have been categorized as high-risk exposure (56%), the number of positive cases remaining the same.

Studies on reasons for accidental exposure, adherence to institutional or national infection control practices, infection rate are all limited regarding Indian HCWs in the setting of this COVID-19 pandemic. The main aim of our study was to highlight how our institute as a tertiary care centre is dealing with this pandemic with respect to catering to our HCWs, trying to enforce infection control practices among them, providing quarantine services to those who were exposed during their line of work, and isolation and treatment facilities to those infected. Our study has shown leniency among HCWs, particularly doctors and nursing officers, in adhering to infection control and personal protective measures resulting in high risk exposures (76%) especially in non-COVID designated parts of the hospital like general wards, emergency, and ICU. High risk exposure led to quarantining them, resulting in absence of HCWs at workplace as well as consumption of hospital resources in managing them which could have been avoided. There was a significant breach in personal protective measures (N-95 masks, gloves and goggles/ face shields were worn by 59.6%, 61.7%, and 2%, respectively) and hesitancy in taking HCQ pre-exposure prophylaxis (as per policy).

In the dynamic setting of a pandemic, revising and re-revising policies becomes important as new information is emerging daily. The safety of our HCWs must be given paramount importance during this pandemic and this can be ensured by educating them about infection control, persistent reinforcement of standard precautions, and strict adherence to them.

Key Messages
- HCWs are at high risk of COVID-19 Infection.
- Educating HCWs regarding COVID-19 infection control practices, continuous reinforcement, and strict adherence to the same can prevent accidental exposures and unnecessary quarantine. This avoids wastage of health care resources and loss of manpower.

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Conflicts of interest
There are no conflicts of interest.

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