Assessment of exposure risk among healthcare workers exposed to confirmed cases of COVID-19 working in non-COVID zones of a teaching hospital in Northeast India: A cross-sectional study

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ABSTRACT

Introduction: Healthcare workers (HCWs) are at increased risk of acquiring the COVID-19 disease, if there is a breach in the personal protection while managing patients. Objectives: 1. To estimate the pattern of risk exposure among healthcare workers exposed to confirmed cases of COVID-19 working in non-COVID zones of a Teaching Hospital, North-East India. 2. To determine the association between pattern of exposure with their COVID-19 status. Materials and Method: This was a hospital-based cross-sectional study conducted among all HCWs who had occupational exposure to laboratory confirmed COVID-19 cases between July and September 2020 in non COVID zones of a major tertiary care hospital in Tripura. Results: The present study showed that 215 HCWs were exposed to confirmed cases of COVID-19 while working in non-COVID zones of the hospital. Among the exposed, 39.5% of HCWs had high-risk exposure and 8.8% of HCWs were detected as COVID-19 positive. A majority of the study subjects experienced exposure in the hospital wards (66.0%), in surgical departments (19.5%), had close contact (less than one meter distance) with positive COVID-19 cases (73.5%), and had an exposure of more than 15 minutes (51.2%). The COVID status of the exposed HCWs was significantly associated with no source control (P = 0.016), close contact with COVID-19 positive cases (P = 0.026), more duration of exposure (P < 0.05), use of any PPE (P = 0.000). COVID status was also significantly associated with the high-risk exposure of the participants (P = 0.000). Conclusion: Strict enforcement of the infection control measures like universal precautions should be practiced by HCWs to prevent hospital-acquired infections.

Keywords: COVID-19, non-COVID zones, risk assessment

Introduction

The risk of acquiring COVID-19 disease is maximum in those who are in contact with or involved in the care of patients with COVID-19. This inevitably places healthcare workers (HCWs) at risk of infection. In several Asian countries, HCWs constituted >20% of presumptive occupational COVID-19 cases during the early outbreak. HCWs are at an increased risk of acquiring the COVID-19 disease if there is a breach in the personal protection while managing patients. A large number of health personnel working in non-COVID zones in various hospitals of India are getting infected with COVID-19 during outpatient or early inpatient management in routine healthcare practice while being unaware of the COVID status of the patients. This, in part, has related to challenges in acquiring adequate personal protective equipment, resulting in a great

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deal of anxiety and distress amongst healthcare providers due to concern for self-infection with COVID-19 and family exposure.[9] Again, within the limited workforce, infected HCWs are being isolated every day, and their close contact HCWs are undergoing quarantine, which in turn affects the health/hospital service delivery.[6]

Understanding how a HCW’s exposure to the COVID-19 virus translates into risk of infection is critical for informing infection prevention and control recommendations. Hence the present study was conducted with the objective to assess the pattern of exposure among healthcare workers exposed to confirmed cases of COVID-19 during routine health practices in non-COVID zones and to study the factors associated with high-risk exposure among them. This study may highlight the gap in infection prevention and control, and define policies that will mitigate HCW exposure and nosocomial infection.

**Materials and Method**

This was a hospital-based cross-sectional study conducted among all healthcare workers who had occupational exposure to laboratory confirmed COVID-19 cases, between July and September 2020 in non-COVID zones of Agartala Government Medical College and GBP Hospital, a tertiary care hospital in Tripura, Northeast India. The study included all 215 healthcare workers who had occupational exposure to laboratory confirmed COVID-19 cases.

Information was collected from the exposed HCWs after they reported to the risk assessment committee of the medical college-hospital after taking written informed consent from them. Information was collected by using a questionnaire adapted from the “COVID-19 Virus Risk Assessment Form for Health Care Workers” developed by the ICMR and recommended by the MOHFW.[5] The exposure risk categorization was based on the “SOP to be followed in case HCW reports exposure/breach of PPE” given under “Advisory for Managing Health Care Workers Working in COVID and Non-COVID Areas of the Hospital”.[3] The exposure risk was categorized as follows: **High risk exposure:** a) HCW or other person providing care to a COVID-19 case or lab worker handling respiratory specimens from COVID-19 cases without recommended PPE or with possible breach of PPE. b) Performed aerosol generating procedures without appropriate PPE. c) HCWs without mask/face-shield/goggles having face to face contact with COVID-19 case within one meter distance for more than 15 minutes or having accidental exposure to body fluids. **Low risk exposure:** Contacts who do not meet the criteria for high-risk exposure. **COVID status** was determined using RT-PCR test or rapid antigen test following 5th day of exposure. A **healthcare worker** was defined as a person serving in a healthcare setting who had the potential for direct or indirect exposure to patients or to their infectious secretions and materials, including, for example, doctors, nurses, laboratory workers, housekeeping staff, etc.

Data analysis was done using SPSS version 25.0 and expressed in frequency and percentage. Statistical analysis was done using Chi-squared test or Fisher’s exact test and $P < 0.05$ was considered as statistically significant. The study was approved by the Institutional Ethics Committee of Agartala Government Medical College.

**Results**

A total number of 215 healthcare workers were included in this study with 51.2% of the study participants being men. Majority of the participants (36.7%) belonged to the age group of 21–30 years and 7.4% of the participants were aged more than 50 years. Mean age of the study subjects was $35.58 \pm 8.94$ years. Majority of the exposed HCWs were doctors (104, 48.4%) followed by nursing staff (77, 35.8%). Among the doctors, a majority of the exposures was experienced by postgraduate trainees (17.2%) [Table 1].

Regarding the pattern of exposure, a majority (66.0%) of the study subjects had exposure to positive cases of COVID-19 in the hospital wards followed by other places like in departments from their colleagues (18.6%). Majority of the exposure happened in surgical departments (19.5%), followed by chest and tuberculosis, and emergency and trauma care center. More than half of the confirmed COVID-19 cases (58%) had no source control, that is, they were not wearing any face covering or face mask at the time of contact. A majority (73.5%) of the study participants had close contact (less than one meter distance) with positive COVID-19 cases and 60.5% had direct exposure.

**Table 1: Demographic profile of healthcare workers who had occupational exposure to COVID-19 cases in non-COVID zones**

| Age of the respondents (35.58 ± 8.94 years) | Frequency (%) |
|--------------------------------------------|---------------|
| 21–30 years                                 | 79 (36.7%)    |
| 31–40 years                                 | 77 (35.8%)    |
| 41–50 years                                 | 43 (20%)      |
| >50 years                                   | 16 (7.4%)     |

| Gender | Frequency (%) |
|--------|---------------|
| Man    | 110 (51.2%)   |
| Woman  | 105 (48.8%)   |

| Type of health care workers | Frequency (%) |
|-----------------------------|---------------|
| Doctors                     | 104 (48.4%)   |
| Nurse                       | 77 (35.8%)    |
| Technician                  | 18 (8.4%)     |
| Others                      | 16 (7.4%)     |

| Category of Doctors | Frequency (%) |
|---------------------|---------------|
| Postgraduates       | 37 (17.2%)    |
| Junior Resident     | 18 (8.4%)     |
| Assistant Professor/Associate Professor/Professor | 16 (7.4%) |
| Medical Officer     | 12 (5.6%)     |
| Senior Resident/Tutor | 11 (5.1%)    |
| Intern              | 10 (4.7%)     |
physical contact with COVI-19 cases. Regarding the duration of exposure to COVID-19 cases, overall, 51.2% of the study participants had an exposure of more than 15 minutes. Among the study participants, only 7.9% had exposure to body fluids with confirmed COVID-19 cases whereas aerosol generating procedures were performed for 11.2% of the COVID-19 positive cases [Table 2].

Of the total number of exposed HCWs, 39.5% (n = 85) of the study subjects were categorized as a high-risk exposure while 8.8% (n = 19) of the HCWs were detected as a COVID-19 positive [Figure 1].

Bivariate analysis of the pattern of exposure with COVID-19 status showed that those who had been exposed to confirmed COVID-19 cases in other places, like different academic departments and administrative sections, were found to be more COVID-positive than compared to places of exposure like wards, operation theatres, outpatient departments, and labor rooms; but it was not statistically significant. The present study revealed that HCWs exposed to confirmed COVID-19 cases who had no face covering or face mask had significantly more COVID-19 positive status following exposure (P = 0.016). Again, HCWs who had close contact (less than one meter of distance) (P = 0.026) with COVID-19 positive cases or who had higher duration of exposure (P = 0.002) with positive cases of COVID-19 were observed to have significant association with COVID-19 status. Pattern of exposure like direct contact (P = 0.801) and type of healthcare workers (P = 0.309) were not found to have significant association with positive COVID-19 status. Whereas among the study subjects, those who were categorized as having high-risk exposure were found to be more positive compared to those categorized as low risk, and it was statistically significant (P = 0.000). In the present study, there is also significant association observed between the use of any personal protective equipment (PPE) and COVID-19 status (P = 0.000) [Table 3].

The present study did not show any association of demographic parameters like age, sex, type of HCWs with their COVID status following exposure.

### Discussion

The present study included 215 healthcare workers (HCWs) who were exposed to confirmed cases of COVID-19 in non-COVID zones of a medical college-hospital. The exposure rate to COVID cases was found to be similar among men and women, and gender had no association with the COVID status of the HCWs. A similar finding was observed in a study conducted

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**Table 2: Pattern of exposure among healthcare workers exposed to COVID-19 cases in non-COVID zones**

| Place of exposure                  | Frequency (n=215) | Percentage |
|-----------------------------------|------------------|------------|
| Ward                              | 142              | 66.0%      |
| Others                            | 40               | 18.6%      |
| OT                                | 19               | 8.8%       |
| OPD                               | 12               | 5.6%       |
| Labor room                        | 2                | 0.9%       |
| Department                        |                  |            |
| Surgery/Neurosurgery/orthopedics  | 42               | 19.5%      |
| Biochemistry, pathology & radiology| 32              | 14.9%      |
| Emergency and trauma care center  | 31               | 14.4%      |
| Chest and Tuberculosis            | 30               | 14.0%      |
| Pediatrics                        | 28               | 13.0%      |
| Obstetrics and gynecology         | 15               | 7.0%       |
| Medicine and Psychiatry           | 14               | 6.5%       |
| ENT & dentistry                   | 11               | 5.1%       |
| Others                            | 10               | 4.7%       |
| Anesthesia                        | 2                | 0.9%       |
| Source control                    |                  |            |
| No                                | 125              | 58.1%      |
| Yes                               | 90               | 41.9%      |
| Distance from the patient         |                  |            |
| ≥1 meter                          | 58               | 27.0%      |
| <1 meter                          | 157              | 73.0%      |
| Direct contact                    |                  |            |
| No                                | 85               | 39.6%      |
| Yes                               | 130              | 60.5%      |
| Duration of exposure              |                  |            |
| <15 min                           | 105              | 48.8%      |
| 15-59 min                         | 64               | 29.8%      |
| 1-6 h                             | 30               | 14.0%      |
| >6 h-1 day                        | 8                | 3.7%       |
| >1 day                            | 8                | 3.7%       |
| Aerosol generating procedure performed |        | 81.2%      |
| No                                | 191              | 88.8%      |
| Yes                               | 24               | 11.2%      |
| Exposure to body fluids           |                  |            |
| No                                | 198              | 92.1%      |
| Yes                               | 17               | 7.9%       |
| Use of any PPE                    |                  |            |
| No                                | 16               | 7.4%       |
| Yes                               | 199              | 92.6%      |

**Figure 1**: Risk category and COVID-19 status among the subjects (n = 215)
A majority of the exposed HCWs were doctors (48.4%) followed by nursing staff (35.8%). Among the doctors, a majority were postgraduate trainees followed by junior residents and senior faculties. This suggests that doctors of all levels were being exposure to COVID-19 cases during their routine work in non-COVID zones. The present study showed that 39.5% of the exposed HCWs had high-risk exposure to COVID-19 cases. This suggests that almost 2/5th of the exposures in the non-COVID zones were high-risk exposure. A study conducted in Ethiopia by Atnafie SA et al.\(^6\) showed that 39.2% of HCWs in government hospitals had exposure to COVID-19 patients.

Regarding the COVID-19 status, 8.8% of exposed HCWs were detected as COVID-19 positive. A similar finding was obtained from a study conducted by Rafi AM et al.\(^9\) and Goenka M et al.\(^7\) where 8.75% and 11.09% of HCWs in non-COVID zones tested COVID-19 positive, respectively. However, the study finding is low compared to a study done among HCWs in Italy where a seroprevalence of 14.4% was reported.\(^{11}\) This may be due to the fact that the study was conducted in an Italian COVID-19 forefront hospital. Again, the high-risk exposure was significantly affecting the positive COVID status \((P = 0.000)\). This finding is consistent with a study conducted in Oman by Maskari ZA et al.\(^{12}\) where high risk of exposure was significantly associated with positive COVID-19 status.

Regarding the pattern of exposure, the major place of exposure was in the hospital wards during daily rounds, sample collection following admission, or while performing life-saving procedures in patients who were either initially asymptomatic for COVID or awaiting RT-PCR report. This was followed by exposure in other places like departmental rooms from their colleagues. This finding is consistent with a study conducted in Oman by Maskari ZA et al.\(^{12}\) where 35% of hospital-acquired infections were a result of contact with another infected colleague, particularly during ‘break’ times, as the HCWs were unable to practice social distancing and universal masking when eating. This suggests that patients alone were not only sources of exposure for HCWs. In fact, HCWs who turned positive following exposure to a COVID-19 patient poses a serious threat to other HCWs working with them and sharing common environment.

Again, a majority of the exposure happened in surgical and orthopedic departments (19.5%), followed by chest and tuberculosis, and emergency and trauma care center. This suggests, that a majority of exposure is occurring during handling of emergency cases of surgery, fracture, road traffic accidents, and of casualty. In studies conducted by Goenka M et al.\(^7\) in India, and Atnafie SA et al.\(^6\) in Ethiopia, emergency and trauma care are the major sites of exposure. However, a study conducted in Bangladesh showed that the possibility of being infected with COVID-19 was higher among HCWs working in the intensive care unit (ICU).\(^{13}\)

The present study showed that the majority of the confirmed COVID-19 patients had no source control at the time of exposure.
contact with HCWs, that is, they were not wearing any face covering or face mask and it was significantly affecting the COVID-19 positive status following exposure ($P = 0.016$). Again, close contact (less than one meter distance) with positive COVID-19 cases and higher duration of exposure was observed to have significant association with the positive COVID-19 status in the present study.

In the present study, there is also significant association observed between the use of any personal protective equipment (PPE) and COVID-19 status ($P = 0.000$). A study of HCWs at 12 hospitals with more than 75,000 employees found that the SARS-CoV-2 test positivity rate among HCWs decreased linearly from 14.65% to 11.46% during a three-week period after implementation of universal masking.[14] In a complementary analysis of the same hospital system, researchers found no convincing cases of in-hospital transmission among more than 9,000 admitted patients after implementation of universal masking for staff and patients.[13]

This study has several limitations: First, the actual number of infected HCWs might be underestimated due to under-reporting of exposure; second, COVID status following exposure was estimated with RT-PCR tests and rapid antigen tests, which have sensitivity and specificity issues. Besides, few patients may develop infection late in the incubation period and remain asymptomatic and undiagnosed in the present study.

The present study revealed that HCWs are at a high risk of acquiring COVID-19 even while working in non-COVID zones of hospitals during routine practice. Regarding the pattern of exposure, the major place of exposure was in the hospital wards followed by departmental rooms and in surgical departments, emergency and trauma care centre. No source control, close contact or prolonged duration of contact and use of PPE were significantly affecting the COVID status. Strict enforcement of the infection control measures for COVID-19 like universal precautions should be applied meticulously in the hospital among HCWs to prevent hospital-acquired infections.

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Conflicts of interest
There are no conflicts of interest.

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