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CLINICAL ARTICLE

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A descriptive audit of healthcare workers exposed to COVID-19 at a tertiary care center in India

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Abstract

Objective: To provide a descriptive audit of healthcare workers (HCWs) exposed to COVID-19, and their contacts, to understand the dynamics of transmission among HCWs.

Methods: Retrospective analysis of contact tracing data of infected HCWs was done from March 1, 2020 to July 31, 2020 at a tertiary care center in New Delhi, India. Contacts were categorized according to the nature of contact and followed for 14 days.

Results: Qualitative RT-PCR testing was performed on 106 HCWs (from a total of 257) owing to exposure or development of symptoms. Positive results were found in 16 HCWs (6.2%) who were exposed to 120 other HCWs, generating 197 exposure incidents. Of these, 30 (15.2%) exposure incidents were high risk with multiple exposures in 48 (40.0%) HCWs. Exposure to infected HCWs was noted in 3 (18.8%) of 16 positive cases. Of the 197 exposure incidents, 54 (27.4%) were deemed avoidable exposures. Infection prevention and control policies were periodically reviewed, and the department implemented mitigating steps to minimize the risk to healthcare providers.

Conclusion: Instituting appropriate infection prevention and control policies and use of adequate precautions by HCWs is vital to minimize high-risk exposure to COVID-19.

KEYWORDS
contact tracing, COVID-19, healthcare workers, India, infection prevention and control, qualitative RT-PCR, transmission

1 | INTRODUCTION

Low- and middle-income countries have a severe dearth of healthcare providers within the existing healthcare infrastructure. According to data provided by the National Sample Survey (NSS), the density of healthcare workers (HCWs) per 10 000 population in India is 20.6, which is well below the minimum set criteria for low-resource countries.[1] Coronavirus disease 2019 (COVID-19) has had an enormous impact on the health and well-being of healthcare personnel. The entire healthcare system hinges on the well-being of its workers. Therefore, it is of utmost importance to safeguard their health. Until the time that definitive treatment becomes available, primary preventive strategies, such as case identification, isolation, supportive medical management, social distancing, and hygiene

measures are extremely important. The challenges are greatly increased in the field of obstetrics where imposing strict policies for use of facemasks by women in labor may not be feasible. Limited data are available on the impact of short duration use of masks on maternal and fetal profile in pregnancy, with a lack of safety evidence on long duration use.[2,3]

The aim of the present study was to provide a descriptive audit of HCWs exposed to COVID-19 positive cases in a hospital setting and elaborate the necessary steps taken to curb further spread in a crowded tertiary healthcare facility in a populous country like India.

2 | MATERIALS AND METHODS

All HCWs involved directly or indirectly in the care of patients admitted to any of three wards (labor room or operating room, obstetric ward or gynecology ward) of the Department of Obstetrics and Gynecology, All India Institute of Medical Sciences, from March 1, 2020 to July 31, 2020 were included in the study. All doctors, interns, nurses, operating room attendants, hospital attendants, and sanitation workers posted in these wards were considered as HCWs. "Direct care" included activities requiring one-to-one patient interaction while "indirect care" implied work not requiring contact with the patient.

A survey was carried out in all areas to determine the total number of HCWs who had tested positive for COVID-19 by RT-PCR test. Permission to undertake the study was obtained from the Institute's Ethics Committee. Confidentiality of records was maintained, the contact tracing list was analyzed, and some careful observations were made after obtaining written informed consent from the participants.

Contact tracing was done in the form of a semi-structured interview of all HCWs who came into contact with a positive case within 48 hrs prior to the onset of symptoms or a positive test result, whichever came earlier. Contacts were asked for information including date, type and distance of contact, duration of exposure, nature of contact (based on the patient care activities they were involved in), type of personal protective equipment (PPE) worn, and whether they had experienced any symptoms. Based on this information, they were categorized as "high-risk exposure" or "low-risk exposure" contact groups. Both groups were asked to monitor their symptoms over the next 14 days and report to the hospital in case of suspicion. In addition, the high-risk group was advised to home isolate for 14 days, while the low-risk group could continue their work with appropriate PPE and precautionary measures.

By definition, high-risk exposure contacts included all direct contacts involved in performing an aerosol-generating procedure without an N95 mask, eye/face protection, or gloves; those involved in contact with a patient's respiratory tract or other bodily secretions with nonintact skin; or those in close proximity (within 1-m distance) of a confirmed case without a mask for a duration of more than 15 min.[4] Household contacts of a positive case also fell under the same category, while low-risk exposure contacts included all other contacts.

3 | RESULTS

During the 22-week study period from March 1, 2020 to July 31, 2020, the total number of HCWs posted in the different wards was 257, of whom 106 underwent qualitative RT-PCR testing because of exposure to a COVID-19 positive patient (n = 90) or the development of symptoms (n = 16). Positive results were reported for 16 HCWs, accounting for an infection rate of 6.2% in the department. A gradual increase was noted in the number of positive cases among HCWs in April, May, and June reflecting the increasing number of cases in the community.[5] However, a sharp decline was observed in July (Figure 1) although cases were still on the rise in the community.

Contact tracing for each of these 16 cases within 24 h showed that there were 197 separate incidents of exposure among 120 HCWs to these 16 cases. Out of these, 72 (60.0%) had a single exposure while 48 (40.0%) had multiple episodes of exposure.

The age of infected HCWs ranged from 20 to 40 years with a mean age of 36.35 years. Some of the common symptoms reported were sore throat (n = 10), fever (n = 6), and malaise (n = 3). Duration of exposure qualifies as an important criterion in classifying contacts into high-risk or low-risk exposure. It was observed that 88 (44.7%) contact incidents had an exposure time of more than 15 min, while 109 (55.3%) incidents involved a contact of less than 15 min. On further investigation of the type of exposure and nature of activity involved, the majority (n = 183, 92.9%) of contact incidents were direct exposures, while the rest constituted indirect exposures. Out of these 197 contact incidents, 54 (27.4%) could have been avoided (Figure 2). The use of inappropriate PPE at the time of exposure was the most common cause of avoidable exposure, accounting for 29.6% (n = 16) of exposures.

Exposure to COVID-19 patients was reported by 11 (68.8%) of the 16 positive HCWs, of whom three had previously served in the COVID-19 designated care facility 14 days, 10 days, and 1 month,

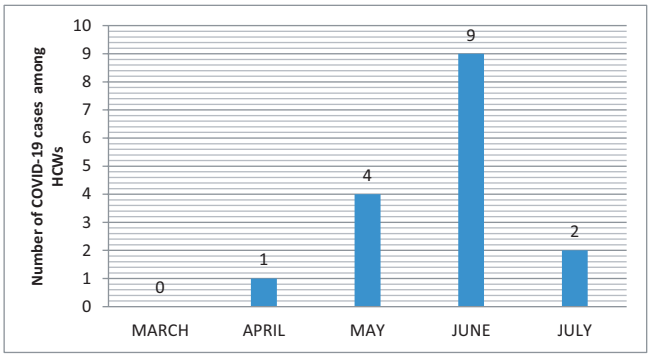

FIGURE 1 Monthly distribution of COVID-19 positive healthcare workers in the obstetrics and gynecology department

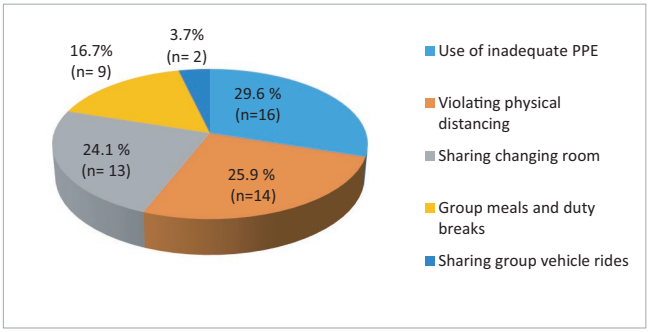

FIGURE 2 Avoidable causes of exposure among healthcare workers who tested positive for COVID-19

respectively, before they tested positive. Out of eight HCWs, three served in the labor room, three in wards and two in the operating room. These HCWs were exposed to asymptomatic patients who eventually developed symptoms during their hospital stay and tested positive on RT-PCR.

Of the HCWs not exposed to COVID-19 patients, 1 (6.3%) had been exposed to a symptomatic family member, 3 (18.8%) had been exposed to an infected HCW in the same shift. The remaining 1 (6.3%) HCW had been exposed to both a COVID-19 positive patient and a positive family member. None of the HCWs had a history of travel or contact with any traveler from a foreign country.

On analysis of the timing of onset of symptoms, three clusters were identified. The first cluster comprised a resident doctor and an operating room assistant whose RT-PCR tests were positive within 24 h of each other. Both had shared the same duty shift and worked in the same operating room. The exposure duration was 45 min, with each of them wearing an N95 mask. The second cluster consisted of three nursing officers in the labor room. All tested positive within 48 h of each other. All three had worked on the same duty shift 3 days prior. Per hospital rules, all three had worn N95 masks, water resistant gowns, and gloves while on duty. The third was a family cluster, consisting of a resident doctor who tested positive 1 week after one family member became symptomatic with fever and diarrhea.

Based on the above data, the departmental contact tracing team categorized the contacts into high-risk and low-risk groups. Thirty contact exposures (15.2%) were labelled high-risk and mandatory home quarantine for 14 days was advised, while the remaining 167 (84.8%) were deemed low-risk and the HCWs were allowed to work with precautionary measures and use of PPE. All contacts were asked to report to the hospital in case of any symptoms.

Of the 120 HCW contacts, 16 (13.3%) HCWs developed symptoms over a course of 14 days. They were labelled as "suspects" and tested. Of these 16 contacts, 4 HCWs tested COVID-19 RT-PCR positive. On analysis, 5 (31.3%) had high-risk exposure, among which 1 (20.0%) tested positive. The remaining 11 (68.8%) suspects had previously been labelled as low-risk. Out of these, 3 (27.3%) tested positive.

The primary reason for categorization of suspects into the high-risk group was inappropriate or no PPE during interaction with each other. While exposed to a positive case, 3 (18.7%) high-risk cases shared group meals, 1 (6.3%) shared a changing room, and 1 (6.3%) shared a group ride without an N95 mask. In contrast, 11 suspects—despite prolonged exposure—were categorized as low-risk because of the use of PPE during exposure. Invariably, all four positive COVID-19 suspects had multiple exposures making them more prone to becoming infected.

4 | DISCUSSION

The provision of safe and sustained care during a pandemic depends largely on the physical and mental well-being of HCWs. Therefore, understanding the dynamics of infection in the setting of a tertiary care facility is necessary for the implementation of strategies for infection prevention and control. HCWs are not only exposed to infection from patients, but also from their family members and from one another. India saw a sharp increment in the number of cases early in the pandemic, a few months after the outbreak. This was also reflected in the number of COVID-19 cases in the hospital.

In the present study the departmental infection rate was 6.2%. Ye et al.[6] reported that the infection rate among medical staff in University Hospital, Wuhan, was 9%. In an overall survey involving 551 Chinese hospitals, the general staff infection rate was 2.06%.[7] Another cross-sectional study, conducted by Sikkema et al.[8] across three different general hospitals in The Netherlands on the burden of COVID-19 infection in symptomatic HCWs, showed hospital infection rates ranging from 2% to 8%.

Compliance with infection prevention and control policies is a key factor in decreasing the rate of infection. Therefore, the Institute undertook the decision to provide a mandatory online training course for all HCWs involved in different job categories. The online modules trained them in selecting the correct and appropriate PPE, general infection prevention and control policies, and patient triaging. This greatly increased awareness of COVID-19 among HCWs.

The identification of clusters prompted hospital authorities to probe into the cause. Policies were reviewed and revised once every 3–4 weeks. Identified wards were thoroughly sanitized per the standard protocols. It was made mandatory for HCWs to wear level I PPE at all times during their duty hours and maintain social distancing. Separate donning and doffing areas were allocated for each ward to prevent transmission of infection within and between the wards.

On analyzing the exposure profile of the 16 positive cases, it was observed that a significant proportion of positive HCWs (n = 11, 68.8%) had a history of exposure to symptomatic or test-positive patients on their duty. Of these 9 (81.8%) HCWs were wearing adequate PPE, which classified them as low-risk exposure and their exposure was not temporally related to a positive test result.

Hospital authorities emphasized the importance of patient awareness and education. HCWs were instructed to offer their

patients facemasks on their visit to department premises. LED screens were installed in the patient screening area displaying videos on hand hygiene, physical distancing, and the necessary use of face masks. History of exposure to a symptomatic family member was seen in 2 (12.5%) of the 16 infected HCWs, which could be an important source of infection for other HCWs sharing the same duty shift. Maintenance of physical distance between HCWs was emphasized repeatedly.

Contact tracing history revealed 197 incidents of exposure involving 120 HCWs. Of these, 88 (44.6%) were more than 15 minutes duration. Forty-eight (40.0%) of the 120 exposed HCWs had multiple exposures. These figures suggest that a significant proportion of HCWs were exposed to each other on their duty. This compelled the authorities to reduce the number of medical staff per shift without affecting patient care. Each HCW could enter the wards only after proper donning of PPE.

Out of 197 exposure incidents, 167 (84.8%) were low-risk and 30 (15.2%) were high-risk. Avoidable exposures constituted 27.4% (54/197) of the total exposures. The use of inappropriate PPE was the most common cause accounting for 29.6% (16/54) of avoidable exposures. The department reiterated the use of appropriate PPE by HCWs per the risk assessment for their jobs. Posters were displayed

TABLE 1 Descriptive data of index cases, contacts, and mitigating steps implemented to prevent COVID-19 infections

Month	Index case (IC)	Job profile	Total contact exposures	High risk	Low risk	Follow-up of contacts	Mitigating strategies implemented
April	IC 1	Ward nursing officer	21	9	12	Dry cough (1)	Mandatory lectures for HCWs on IPC by Department of Hospital administration
May	IC 2	Resident doctor	4	4	0	Asymptomatic	Mandatory online training for HCWs Resident doctors distributed to screening, suspect, and COVID team for risk assessment of patients Distribution of face masks and instalment of wall mounted alcohol-based hand rub in wards
	IC 3	Hospital attendant	12	0	12	Sore throat (1)	
	IC 4	Hospital attendant	21	7	14	Body ache (1)	
	IC 5	Sanitation worker	4	0	4	Asymptomatic	
June	IC 6[a]	Resident doctor	24	0	24	Sore throat and fever (2, 1 was RT-PCR positive), Sore throat (1)	Number of HCWs reduced per shift Mandatory donning of level 1 PPE during entire duty shift in wards No sharing of closed spaces like changing rooms Group meals and sharing food strictly prohibited Posters displayed in wards and screening area for education of HCWs and patients LEDs installed in donning and doffing area for display of videos emphasizing correct protocols Timely and repeated disinfection of high touch surface areas
	IC 7[a]	Operating room attendant	7	0	7	Sore throat (1) (turned RT-PCR positive) Malaise (1)	
	IC 8	Hospital attendant	4	0	4	Body ache (1)	
	IC 9	Sanitation worker	11	1	10	Asymptomatic	
	IC 10[b]	Nursing officer	12	0	12	Sore throat and fever (1, turned RT-PCR positive)	
	IC 11[b]	Nursing officer	26	3	23	Sore throat and fever (2, 1 turned RT-PCR positive)	
	IC 12[b]	Nursing officer	21	2	19	Sore throat and cough (1), Headache (1)	
	IC 13	Nursing officer	10	3	7	Rhinorrhea (1)	
	IC 14[c]	Resident doctor	10	0	10	Asymptomatic	
July	IC 15	Nursing officer	5	0	5	Asymptomatic	Universal testing of COVID-19 made mandatory before patient admission
	IC 16	Office attendant	5	1	4	Sore throat (1)	
Total			197	30	167		

Abbreviations: HCWs, healthcare workers; IPC, infection prevention and control.

[a]Cluster 1

[b]Cluster 2

[c]Cluster 3 (family cluster).

in the wards and social media was used to circulate information regarding the different types of PPE to be used per the various job requirements of HCWs. Furthermore, every consultant on daily rounds was asked to reinforce the infection prevention measures by going through the posters with the staff on duty. This was an attempt to fill the knowledge and practice gap regarding the use of proper PPE. Another avoidable factor that contributed to HCW-to-HCW spread was sharing group meals during duty breaks. During this time, PPE was doffed and the chances of transmission greatly increased. Hospital authorities strictly prohibited interaction without PPE and group meals taken together. HCWs were advised to have meals one by one in the designated area.

After following the 120 contacts over 14 days, it was observed that 16 (13.3%) developed symptoms. They were labelled as "suspect" and isolated at home. Out of these 16 suspects, 5 (31.3%) HCWs were high-risk while 11 (68.8%) were labelled low-risk. The importance of exposure assessment and categorization was crucial in maintaining the continuity of care during these difficult times. It is for this reason that our facility did not need to close despite facing a heavy burden of positive COVID-19 cases. Four (25.0%) contacts out of 16 were RT-PCR positive. These HCWs were admitted to our COVID-designated hospitals and treated. The recovery rate was 100%. It is important to stress that a significant proportion of cases (62.5%, n = 10) were asymptomatic and hence a potential source of infection for others. Therefore, HCWs must wear proper PPE and maintain physical distance at all times. The follow-up profile of cases along with the mitigating steps taken by the department are given in Table 1.

The major strength of the present study is that it highlights various aspects that need to be strengthened to prevent HCW-to-HCW transmission, such as personal attitude toward the disease, need for periodic training of HCWs, provision of PPE, hospital sanitation measures, and a good surveillance system to audit the implementation of these measures at timely intervals. The setting described here is a tertiary care obstetric facility that has a rapid turnover and was under pressure to maintain services throughout the pandemic. The limitations are that this study does not consider the other probable modes of infection in HCWs. The department has several patients with prolonged hospital stay, which could be one of the potential sources of infection for HCWs. In addition, many of the HCWs commute to hospital via public transport, exposing them to the possibility of infection from outside the hospital setting.

Worldwide reported data on COVID-19 infection among HCWs is dynamic and it is difficult to estimate how many HCWs have been infected with COVID-19. Continued adherence to infection prevention and control protocols is essential to prevent infection among HCWs. Early case identification, isolation, exhaustive contact tracing, and sanitation measures are essential for safeguarding HCWs.

CONFLICTS OF INTEREST

The authors have no conflicts of interest.

AUTHOR CONTRIBUTIONS

SM, KAS, NB and PR contributed to planning, conduct, data analysis, and manuscript writing. SK, SS, AR, JM, AK, RK, NV, and SK contributed to planning and conducting the study and data collection.

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