COVID-19 infection among health care workers in a tertiary care teaching hospital in Kerala – India

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Abstract

Health care workers are at the frontline for management and containment of COVID-19 infection which has put them at additional risk of the disease. Infection and subsequent quarantine of contacts among HCW may produce considerable strain on the health care system. It is essential that we study the modes by which HCW may get infected in the work environment. **Methods:** All HCW testing positive for SARS-CoV-2 from 1st March 2020 to 31st Jan 2021 were included in the study. Data regarding possible source of infection, details of symptoms along with demographic details were collected. **Results:** A total of 390 health-care workers tested positive for SARS-CoV-2 in the institution. The mean age of affected health-care workers was 32.82 (±10.6) years (range 20–65 years), and 61.3% were female. 33% of the positive HCW were doctors and 19.5% nurses. 29% of the infections occurred during patient care of which majority were from the non-COVID areas of the hospital. Interactions with infected colleagues constituted 27.4% of the infections. Symptomatics constituted 67% and the predominant symptoms included Fever, myalgia and severe headache. 57.2% of those followed up reported persistence of symptoms, commonly fatigue (53%), dyspnea on exertion (48%) and myalgia (18%). **Conclusion and Recommendation:** Infection control practices in non-COVID areas of the hospital needs to be stepped up. Adherence to masking and personal protection during clinical interactions and with colleagues needs to be maintained. Physical distancing at workplace and during mealtimes needs to be ensured by the system.

Keywords: COVID-19, health care workers, SARS CoV-2, transmission

Introduction

A cluster of patients with pneumonia of unknown cause was reported in Wuhan, China in January 2020, the disease was subsequently named COVID-19, caused by a novel coronavirus which was named Severe acute respiratory syndrome Coronavirus - 2 (SARS-CoV-2) by the World Health Organization. The clinical spectrum of COVID-19 varies from asymptomatic or mild symptomatic infections to severe respiratory symptoms and death, with older age groups generally presenting with more severe disease and higher death rates. Since its identification, SARS-CoV-2 has rapidly spread across the globe evolving into a pandemic of huge proportions challenging the health systems of countries it has affected.

Health Care workers (HCWs) at all levels of health care system are at the forefront of the Covid-19 outbreak response and consequently are exposed to hazards that put them at risk of infection. Repeated exposures during patient care and exposure to asymptomatic patients and caregivers put them at an increased risk of contracting the disease. For MERS-CoV, which is also a coronavirus, approximately 50% of confirmed cases were caused by hospital outbreaks 40% of which were in health-care workers. A similar situation of nosocomial transmission among the workers was expected in COVID-19 also.

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During the WHO–China Joint Mission on COVID-19,[10] 2055 laboratory-confirmed cases were reported in health-care workers from 476 hospitals in China, mostly (88%) from Hubei province. Most health-care workers were thought to have been infected within household settings rather than in a health-care setting, although conclusive evidence was lacking.[3] As early as February 2020, experts had established that transmission of the disease among HCWs is associated with overcrowding at workplace, absence of isolation room facilities, and environmental contamination.[4] Not only at the tertiary level, during periods of increased transmission and with reliance on non-pharmaceutical measures, HCW at the primary care level in COVID-19 response is gaining more importance. As a significant proportion of COVID cases are at home care, a strong primary care system with interactions of HCW and communities is essential for COVID response. HCW at the primary care level also ensure delivery of essential services during the pandemic and therefore are at risk of infection from asymptomatic or pauci-symptomatic cases.

On 30th January 2020, the first COVID positive case in India was reported from the state of Kerala – a student returning from Wuhan. The first COVID-19 case in our institution and district was reported on 20th March 2020. Our institution is a tertiary care center and a designated COVID Hospital in the public health sector and caters to non-COVID cases also during the pandemic. Isolation facility and infection control measures were in place from mid-January 2020 in anticipation of the pandemic. Universal masking was instituted inside the institution with staggering of duty days for health care providers. An understanding of the sources and modes of transmission of SARS-CoV-2 among health-care workers is essential for formulating infection control practices and improving the working conditions at all levels of health care not only with respect to COVID but in anticipation of future infectious disease outbreaks.

Methodology

The institution caters to both COVID and non-COVID cases in separate buildings and all HCW were under surveillance from March 2020. Symptomatic HCW were asked to report to triage for COVID testing. Daily reports from COVID triage were scrutinized for any HCW testing COVID positive. Positive HCW were contacted telephonically and details regarding possible source of infection and contacts collected. A follow-up call was made at 2-3 weeks after testing negative to enquire regarding any persistence of symptoms.

Health care worker

Any person working in our institution and who had contact with patients or patient care materials was considered to be an HCW, including doctors, nurses, hospital cleaners, ambulance drivers, laboratory workers, and ancillary health care staff. Office staff and students were also included as they are an integral part of the institution.

COVID area

COVID areas of the hospital included – triage area, COVID isolation wards, COVID Intensive care Units. HCW in these areas of the hospital were in full PPE kits while providing medical care to patients. They were under active surveillance for a period of 14 days after completion of their duty period and symptomatic were tested for COVID-19 by RTPCR.

Non COVID area

The non-COVID areas of the hospital catered to patients with medical conditions other than COVID. As per the institutional guidelines for use of PPE, workers in these areas are required to wear N95 mask, face shield, gloves and apron. HCW being exposed to a COVID positive case from these areas were assessed for type of exposure and risk categorization was done as per Government of Kerala guidelines.[8] High-risk contacts were quarantined and tested for SARS-CoV-2 by RTPCR between 8-14 days of exposure.

Ethical concerns

Ethics approval was obtained from the Institutional Ethics Committee (GMCKKD/RP2020/IIEC/455). Verbal informed consent was obtained from all health-care workers for data collection. Data were de-identified before analysis.

Statistical analysis

Data obtained from telephonic interviews were entered in MS Excel worksheet. All analyses were done with SPSS version 25.0 (IBM, Armonk, NY, USA). Because of the descriptive nature of our study, sample size calculations and analyses of significance were not done. Results were reported following STROBE guidelines for observational studies.

Results

During the period between 1st March 2020 and 31st January 2021, a total of 390 health-care workers tested positive for SARS CoV-2 in the institution, the first positive HCW being reported on 18th July 2020. Infection among the health care workers increased in September 2020 with the maximum infected being reported in October 2020 corresponding to the peak of the epidemic in the state of Kerala [Figure 1].

Sociodemographic profile of HCW

Socio-demographic profile of the COVID positive HCW are shown in the table [Table 1]. The mean age of affected health-care workers was 32.82 (±10.6 years (range 20–65 years), and 61.3% were female, reflecting the high proportion of female health care workers among the total health care workforce. 33% of the positive HCW were doctors followed by nurse (19.5%). Office staff included personnel working at the hospital offices and administrative office. Of the 51 students who tested positive majority (80%) were in the months of December 2020 and January 2021 when the college reopened in a phased manner for students.
Source of infection of COVID

Of the 390 positive HCW, 113 (29%) of the infections occurred during patient care interactions either in the COVID areas (10%) or non-COVID areas (19%) [Figure 2]. A definite breech in PPE could be elicited in only 5 of the HCW. Household transmission contributed to 59 (15%) of the infections and community transmission 63 (16%). The source of infection in 48 (12.3%) of the HCW could not be identified [Figure 2]. Interactions with positive colleagues at workplace and campus constituted 107 (27.4%) of the infections and included sharing room, duty areas, taking refreshments and performing procedures together and occurred mostly during the asymptomatic phase of illness.

Symptoms of COVID-19 among HCW

Majority of the HCW 262 (67%) reported symptoms of which the predominant symptoms included Fever, myalgia and severe headache [Figure 3]. Sore throat or discomfort of throat dry cough, fatigue, anosmia and aguesia were reported less frequently. Other manifestations like symptoms of acute respiratory infection (rhinitis, nasal congestion, sneezing), chills, giddiness, vomiting, breathlessness were rare. The mean duration of hospital stay was 9.8 days as majority of the HCW tested negative by the 10th day of onset of symptoms/initial test positivity and could resume duty after 7 days of testing negative. Only two required intensive care support due to dyspnea and subsequent fall in SPO2 and only one among them required prolonged hospital isolation for 16 days.

HCW were followed up between 2-3 weeks after testing negative to elicit any long-term persistence of symptom. Only 339 of the 390 (87%) HCW could be contacted for follow-up. 194 (57.2%) of those followed up reported persistence of symptoms. Most common symptom was fatigue (53%) followed by dyspnea on exertion (48%) and myalgia (18%) [Figure 4]. 40.6% of COVID positive HCW who were asymptomatic at the time of diagnosis reported symptoms of fatigue and myalgia beyond 3 weeks.

Reinfection following COVID

2 HCW tested positive twice. In one case the second test positivity (RTPCR and Antigen test) was after 3 months of the first infection while in the second case it was one and a half months after the first infection (RTPCR positive). In both cases CT value was low indicating infectious phase of the illness. One of the HCW was asymptomatic during the second infection.

COVID Vaccination for the HCW was initiated in our institution by mid-January 2021, and surveillance of HCW is still ongoing to detect breakthrough infections.

Discussion

Anticipating the effects of the pandemic among HCW, infection prevention and control (IPC) activities and use of personal protective equipment were initiated in COVID areas of the hospital in March 2020. Universal masking for HCW was also practiced in other areas of the hospital. Even though the first COVID positive case in our institution was reported on 20th March 2020, the first positive HCW was reported after nearly 4 months on 18th July 2020. As of January 2021, 390 HCW had tested positive for COVID-19 which constituted 5.7% of the total health workforce in our institution.

| Table 1: Profile of COVID-19 Positive HCW |
|-----------------------------------------|
| Age group (yrs) | No. (%) | Designation of HCW | No. (%) |
|-----------------|---------|---------------------|---------|
| 20-29           | 196 (50.3) | Doctors | 129 (33) |
| 30-39           | 102 (26.2) | Nurses | 76 (19.5) |
| 40-49           | 45 (11.5) | Nursing Attenders/Cleaning staff | 54 (13.8) |
| 50-59           | 41 (10.5) | Technicians | 30 (7.7) |
| 60-69           | 6 (1.5) | Pharmacist | 6 (1.5) |
| Gender distribution | | Office staff | 20 (5.1) |
| Females | 239 (61.3) | Students | 51 (13.1) |
| Males | 151 (38.7) | Security personnel | 11 (2.8) |
| Others | | | 13 (3.3) |

Figure 1: Time trend of COVID Positive HCW

Figure 2: Source of COVID Infection among HCW

Figure 3: COVID-19 Symptoms among HCW*
has been reported from Mumbai (11%).\(^7\) High prevalence of COVID positivity among health care providers was a source of concern among countries like Spain (11.1%), UK (44%) and USA (18.8%), especially during the initial phase of the pandemic, contributed to a great extent by interrupted supply of personal protective equipment.\(^8\)-\(^10\)

Most of the infections (46%) have occurred in younger HCW aged less than 30 years. Institutional policy of younger group of workers at the frontline could be one of the reasons for highly reduced rate of HCW needing intensive care and no mortality being reported so far in our institution. Mortality among HCW in the United States ranged from 0.3-0.6% as per CDC report during the initial period of the pandemic with 2.5% of the HCW requiring intensive care.\(^10\)

Doctors and nurses constituted a major proportion of COVID positives possibly due to their prolonged interactions with patients during duty time (4–6 hr/day) and also interactions with colleagues during duty hours. January 2021 saw a spike among students who rejoined the institution after a period of eight months as clinical teaching was on hold due to the pandemic. Compulsory COVID testing for rejoining the institution, enforcement of social distancing measures, masking and quarantining of high-risk contacts ensured that the chain of transmission was interrupted early. University campuses have emerged as potential sites for cluster infections attributed to student gatherings and congregate living conditions.\(^11\) Security staff tested positive due to their interactions with patients/caregivers in outpatient departments and emergency areas which usually sees a huge number of footfalls. In a study conducted in China by Wang et al.\(^12\) nurses were predominantly affected (60%) followed by clinicians (30%).

As per our observations 56.4% of the exposures are related to the hospital environment (patient care and colleague interactions) while 31% were from community settings (household and community exposures). Even though 29% of the infections occurred during patient care interactions of the HCW with a COVID positive case, only 10% of the total infections were contracted from the COVID areas of the hospital indicating fairly good infection control practices and use of personal protective equipment. Most of these infections from the COVID areas were during the month of October 2020 which saw the state witnessing the peak of the pandemic resulting in our COVID Isolation facility being overwhelmed with large number of admissions. Even though PPE kit offers adequate protection against COVID infection, HCWs who cared for patients with COVID-19 are at increased risk and breakdown may occur during doffing/donning especially in isolation facilities with high burden of cases.\(^13\) Wang et al.\(^4\) have demonstrated positive association between increased work pressure and COVID infection. The importance of ensuring availability of quality PPE and adherence to correct infection control practices needs to be highlighted. Infections contracted from the non-COVID areas of the hospital constituted 19% of the infections among HCW. This was due to exposure to unrecognized cases of COVID in these areas. Also use of Personal protective equipment in these areas was restricted to mask and face shields which may have contributed to transmission. Higher exposures during patient care to HCW (55%) have been reported in the United states.\(^14\)

An equally large share of infections (27.4%) to have been contracted from interaction with positive colleagues in the institution. Practice of universal masking at all times is challenging and inevitable breakdown have occurred during mealtimes and in shared accommodations. Similar observations were made by Advani et al.\(^15\) where unmasked exposure to another HCW rather than exposure to infected patients resulted in COVID infections among HCW. Protection afforded by Personal protective equipment cannot be undermined, even for HCW at the primary care level adequate and proper use of PPE needs to be stressed and the possibility that an unmasked encounter with a colleague, household member or community contacts may result in transmission of infection rather than a patient encounter needs to be stressed.

COVID positive Household members transmitting infection to HCW formed only 15% of the infections. Transmission from the community included getting the infection from public gatherings like marriages, funerals, market places and travelling. Household transmission constituted 27% of the infections in the United states and 13% community transmission.\(^16\) Contrary to this a Chinese study has noted that infection among HCW was more from household setting rather than patient interactions.\(^9\)

The percentage of symptomatic infection among HCW was 67%. A higher proportion of symptomatic HCW has been reported from the United states (92%)\(^13\) and 85% in Mumbai.\(^7\) Our study was able to detect 33% asymptomatics due to the enhanced surveillance and reporting mechanisms in place in the institution. Surveillance and isolation of the asymptomatics is equally important to break the chain of transmission and prevent cluster infections especially in workplaces. Similar to other studies fever, myalgia and headache were the predominant symptoms reported.\(^14\) A study conducted in Oman reported ARI with fever as the predominant symptom\(^17\) which is in contrast to our finding where ARI symptoms were observed in only a small percentage of the cases.

### Figure 4: Post COVID Symptoms

![Image](https://example.com/figure4.png)

| Symptom            | Percentage |
|--------------------|------------|
| Cough              | 10.7       |
| Chest congestion   | 3.9        |
| Agonisia           | 4.5        |
| Anosmia            | 5.2        |
| Sleep disturbances | 3.9        |
| Difficulty breathing | 1.9      |
| Myalgia            | 17.6       |
| Intermittent HA    | 12.2       |
| GI symptoms        | 7.8        |
| Cardiac symptoms   | 5.8        |
| Intermittent fever | 3.6        |
| Dyspnoea on exertion | 48.1      |
| Fatigue            | 53.4       |

The table above represents the percentage of post COVID symptoms among HCW.
Persistence of symptoms post-recovery pose challenges for the health care workforce delaying their returning to work. Higher percentage of post COVID symptoms was observed in Italy (87%), Spain (62%) while a study from England reported only 32% of HCW reporting persistence of any one symptom.[16-20] Fatigue and dyspnea as the predominant post COVID symptoms have been reported from multiple studies as seen in our study also.[19,20,21]

**Conclusion and Recommendations**

Doctors and nursing staff were predominantly infected. Exposure to infected colleagues played a significant role in transmission in addition to patient interactions. Reduced severity of infection and low mortality may be due to the younger age group being at the frontline. Breakdown of personal protective measures like masking and social distancing during interactions among colleagues is an area of concern. Continued surveillance of HCW is essential for early detection of asymptomatic and symptomatic cases to break the chain of transmission at workplace. Interactions at workplaces should be with caution and due precautions should be taken in refreshment areas and changing areas. Adequate support to ensure adherence to masking and ensuring physical distancing at workstations should be made available by the system.

**Key message**

COVID-19 infection among HCW is more in Non COVID areas of hospitals possibly due to suboptimal use of PPE. Unmasked Interactions among colleagues at workplace contributes significantly to transmission among HCW. Surveillance of HCW and prompt isolation and quarantine of high risk contacts helps breaking the chain of transmission.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.
2. Kluytmans-van den Bergh MFQ, Buiting AGM, Pas SD, Bentvelsen RG, van den Bijlpaardt W, van Oudheusden AJG, et al. Prevalence and clinical presentation of health care workers with symptoms of coronavirus disease 2019 in 2 Dutch hospitals during an early phase of the pandemic. JAMA Netw Open 2020;3:e209673.
3. WHO. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). https://www.who.int/publications/i/item/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(covid-19). Date: Feb 28, 2020. [Last accessed on 2020 Jun 11].
4. WHO Regional Office for the Eastern Mediterranean MERS situation update. Available from: http://www.emro.who.int/pandemic-epidemic-diseases/mers-cov/mers-situation-update-january-2020.html. Date: January, 2020. [Last accessed on 2021 Jun 11].
5. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese center for disease control and prevention. JAMA 2020;323:1239-42.
6. Health Care worker Resource management guidelines for centres providing COVID-19 care. No. 3.1/F2/2020. Health dt 20th June 2020. COVID-19 outbreak control and prevention State cell. Health and Family Welfare. Government of Kerala.
7. Mahajan NN, Mathe A, Patokar GA, Bahirat S, Lokhande PD, Rakh V, et al. Prevalence and clinical presentation of COVID-19 among healthcare workers at a dedicated hospital in India. J Assoc Physicians India 2020;68:16-21.
8. Suárez-García I, Martínez de Aramayona López MJ, Sáez Vicente A, Lobo Abascal P. SARS-CoV-2 infection among healthcare workers in a hospital in Madrid, Spain. J Hosp Infect 2020;106:357-63.
9. Houlihan CF, Vora N, Byrne T, Lower D, Kelly G, Heaney J, et al. Pandemic peak SARS-CoV-2 infection and seroconversion rates in London frontline health-care workers. Lancet 2020;396:e6-7.
10. CDC COVID-19 Response Team. Characteristics of health care personnel with COVID-19-United States, February 12-April 9, 2020. MMWR Mortal Wkly Rep 2020;69:477-81.
11. Wilson E, Donovan CV, Campbell M, Chai T, Pittman K, Serna AC, et al. Multiple COVID-19 clusters on a university campus-North Carolina, August 2020. MMWR Mortal Wkly Rep 2020;69:1416-8.
12. Wang J, Zhou M, Liu F. Reasons for healthcare workers becoming infected with novel coronavirus disease 2019 (COVID-19) in China. J Hosp Infect 2020;105:100-1.
13. Nguyet LH, Drew DA, Graham MS, Joshi AD, Guo C-G, Ma W, et al. Risk of COVID-19 among front-line health-care workers and the general community: A prospective cohort study. Lancet Public Health 2020;5:e475-83.
14. Wang X, Jiang X, Huang Q, Wang H, Gaurdie D, Nidelio-Mbah M, et al. Risk factors of SARS-CoV-2 infection in healthcare workers: A retrospective study of a nosocomial outbreak. Sleep Med X 2020;2:100028.
15. Advani SD, Yarrington ME, Smith BA, Anderson DJ, Sexton DJ. Are we forgetting the “universal” in universal masking? Current challenges and future solutions. Infect Control Hosp Epidemiol 2020;1-2. Published online 2020 Jul 16. doi: 10.1017/ice.2020.333.
16. Lan F-Y, Filler R, Mathew S, Buley J, Iliaki E, Bruno-Murtha LA, et al. COVID-19 symptoms predictive of healthcare workers’ SARS-CoV-2 PCR results. PLoS One 2020;15:e0235460.
17. Al Maskari Z, Al Blushi A, Khamis F, Al Tai A, Al Salmi I, Al Harti H, et al. Characteristics of healthcare workers infected with COVID-19: A cross-sectional observational study. Int J Infect Dis 2021;102:32-6.
18. Carfi A, Bernabei R, Landi F, Gemelli Against COVID-19 Post-Acute Care Study Group. Persistent symptoms in patients after acute COVID-19. JAMA 2020;324:603-5.
19. Rosales-Castillo A, de Los Ríos CG, Mediavilla García JD. Persistent symptoms after acute COVID-19 infection:
Importance of follow-up. Med Clin (Bari) 2021;156:35-6.

20. Gaber TA-ZK, Ashish A, Unworth A. Persistent post-covid symptoms in healthcare workers. Occup Med (Lond) 2021;71:144-6.

21. Goertz YMJ, Van Herck M, Delbressine JM, Vaes AW, Meys R, Machado FVC, et al. Persistent symptoms 3 months after a SARS-CoV-2 infection: The post-COVID-19 syndrome? ERJ Open Res 2020;6:00542-2020.