

Infection Transmission Factors and their Perception amongst Healthcare Workers infected with SARS-CoV-2 in a Tertiary Care Hospital

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Abstract:

Purpose: It is important to take stock and learn from previous pandemic experiences to make informed organisational strategies to improve the wellness of frontline workers. This study generates primary data on the incidence and contributing factors of SARS-CoV-2 infection and their perception amongst Healthcare Workers (HCWs) in India.

Methods: A structured questionnaire to assess the demographics and course of COVID-19 infection was sent out to 800 HCWs (19 - 65 years) who tested positive between March 2020 and June 2021. Descriptive statistics were used to analyse the data.

Results: A total of 453 participants aged 36.11 ± 11.12 years responded to the questionnaire. Out of these, 11% reported reinfection. Ninety-two per cent of participants had a symptomatic presentation with an average loss of 10 - 17 work-days. Factors associated with higher rate of hospitalisation were the presence of Type 2 Diabetes (25%) and the lack of use of any prophylactic agent (16%), compared to an overall rate of 11%. Only 40% of the infected HCWs were on COVID-19 duties. Nearly half (49%) perceived that they got their first COVID-19 infection from a contact with a patient while 68% of those who were infected the second time reported transmission from a social contact. Around 54% of them did not feel that they transmitted the disease to others.

Conclusion: Most HCWs missed work for 10 - 17 days. No co-morbidities, other than Type 2 Diabetes, seemed to have impacted the severity of infection in this relatively young population. Use of any prophylactic measure was associated with a lower rate of hospitalisation compared to no prophylaxis. Most of the HCWs did not perceive themselves as a source of SARS-CoV-2 transmission to the community.

Key words: Infection, transmission, perception, healthcare workers, SARS- CoV-2.

Introduction

Coronavirus pandemic, caused by the novel coronavirus (SARS-CoV-2), wreaked havoc across the world snuffing out millions of lives¹. The Coronavirus was originally identified from Wuhan, Hubei province, China in December 2019 following Pneumonia cases of unknown aetiology². The first case of SARS-CoV-2 in India was detected on January 30, 2020 in Kerala, in a student who had travelled from Wuhan with symptoms of respiratory discomfort^{3,4}. The first death in India was reported on March 12, 2020. Infections with COVID-19 accelerated quickly, reaching 1,000 cases on March 28, 2020⁵. As of January 31, 2022, a total of 4,14,69,499 cases were reported with 4,97,975 deaths spread across 28 states and 8 union territories of India^{6,7}.

As seen across the globe, the novel coronavirus (SARS-CoV-2) has infected a large number of HCWs in India also⁸. Recent studies have concluded that HCWs who were

SARS-CoV-2 positive constituted a significant proportion of all COVID-19 patients but the severity and mortality were lower amongst them compared to the general population⁹. HCWs are at increased risk of contracting COVID-19 due to direct or indirect exposure to COVID-19 patients and thereby require special attention. Though direct transmission in hospitals cannot be ruled-out, currently available data does not support widespread nosocomial transmission as a source of infection among patients or HCWs¹⁰. Also, secondary transmission from HCWs is a possibility among patients, family members and the community. Therefore, it is important to investigate the infection risk of HCWs, the clinical characteristics of the affected cases and the possible source of infection¹¹. In India, there is lack of data regarding prevalence of COVID-19 amongst HCWs due to the absence of routine screening programmes within the hospital settings¹². Many doctors, nurses, allied HCWs and support staff contracted COVID-19 at our hospital, a tertiary

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care government hospital catering to both COVID-19 and non-COVID patients since February 2020. Some HCWs also had reinfection during this period. Therefore, we studied the factors associated with SARS-CoV-2 infection and reinfection amongst HCWs and its impact. The objectives of the study were:-

1. Assessment of the association between demographics, co-morbidities, and exposure to COVID-19 patients with incidence of SARS-CoV-2 infection among HCWs.
2. To determine the efficacy of prophylactic measures for COVID-19 among HCWs.
3. To assess the impact of COVID-19 on HCWs in terms of loss of work days.
4. To identify the perceived source of SARS-CoV-2 infection in HCWs and to study the probability of community transmission of SARS-CoV-2 from HCWs.

Methodology

Ethical approval was obtained from The Institutional Ethics Committee, ABVIMS, Dr RML Hospital, New Delhi (500{36/2021}/IEC/ABVIMS/RMLH/627). Eight hundred HCWs who tested positive by RT-PCR testing between March 1, 2020 and June 30, 2021 were included in the study. A questionnaire in the form of a Google form was sent to all the participants by email. Those who had difficulty in filling the form were asked to answer the questions telephonically. This form included three sections; the first section covered the demographic details while the second section had questions regarding relevant medical history, level of baseline physical activity, use of any prophylactic measures, course of the disease and its severity, perception of the source of infection and onward transmission and absence from work. The third section was to be filled by only those HCWs who had contracted COVID-19 infection twice during the study period.

Responses were obtained from 453 participants. Among the non-responders some had left their job, some were not posted in the hospital during the study period while others did not want to participate in the study. For classification of our participants into those suffering from mild, moderate, or severe disease, we used lowest recorded SpO₂ as our criterion. Patients with a SpO₂ ≥ 94% were classified as mild, 90 - 93% as moderate while patients having SpO₂ <90% were categorised as having severe disease, in accordance with the national guidelines for India issued by the Ministry of Health and Family Welfare¹³.

All the demographic, clinical and other parameters were analysed using appropriate statistical tests. All data was entered in MS Excel. After cleaning, analysis was done in SPSS version 16.0 for statistical analysis. Descriptive

tabulations were drawn and categorical data was mentioned as percentage and proportions.

Results

Demographics

A total of 453 healthcare workers who tested positive by RT-PCR during the study period, of which 273 (60%) were males and 180 (40%) were females. Their age ranged from 19 - 65 years with mean age of 36.11 ± 11.12 years. Among the participants 181 (40%) were doctors, 98 (21.6%) were support staff, 85 (18.7%) were nurses, 21 (4.6%) were sanitation workers, 36 (8%) were administrative staff and 32 (7.1%) allied HCWs as listed in Table I.

Table I: Demographics and detailed description of the study population.

Characteristics	1st COVID-19 Infection N = 453	2nd COVID-19 Infection N = 50
Age in years [Mean ± SD (Range)]	36.11 ± 11.12 (19 - 65)	31.36 ± 7.95 (23 - 57)
Gender - No. (%)		
Males	273 (60.26)	35 (70)
Females	180 (39.74)	15 (30)
BMI [Mean ± SD (Range)] (Kg/m ²)	25.42 ± 4.42 (15.57 - 44.43)	26.12 ± 6.09 (15.78 - 43.21)
> 30 Kg/m ² (Obese) - no. (%)	58 (12.80)	10 (20)
Work Profile - no. (%)		
Doctor	181 (39.96)	19 (38)
Support Staff	98 (21.63)	14 (28)
Nurse	85 (18.76)	7 (14)
Administrative Staff	36 (7.95)	3 (6)
Allied Health Professional	32 (7.06)	3 (6)
Sanitation Worker	21 (4.64)	4 (8)
Onset of COVID-19 illness with respect to time of Vaccination - no. (%)		
Prior to vaccination	323 (71.30)	31 (62)
After first dose of vaccination	65 (14.35)	13 (26)
15 days or more days after second dose of vaccination	65 (14.35)	6 (12)
Presence of Co-morbidities - no. (%)		
None	300 (66.23)	35 (70)
Obesity	58 (12.8)	10 (20)
Hypertension	53 (11.7)	3 (6)
Diabetes Mellitus	32 (7.06)	1 (2)
Hypothyroidism	22 (4.86)	1 (2)
Others	31 (6.84)	4 (8)
Multiple	38 (8.39)	3 (6)
Level of Physical Activity as per WHO Criteria (> 150 min/week) - no. (%)		
Inadequate	339 (74.83)	37 (74)
Adequate	114 (25.17)	13 (26)
COVID-19 duty status 15 days prior to testing positive - no. (%)		
Not involved	269 (59.58)	27 (54)
Involved	184 (40.62)	23 (46)

Clinical profile

Only 35 (7.7%) participants were asymptomatic. The majority of participants experienced fever, followed by bodyache, cough, loss of smell, loss of taste and other symptoms; the details of the same are shown in Table II.

Table II: Distribution of symptoms during 1st and 2nd episodes of COVID-19 infection amongst HCWs.

Symptoms	1st COVID-19 infection (%) n = 453	2nd COVID-19 infection (%) n = 50
Asymptomatic	35 (7.73%)	2 (4%)
Fever	350 (77.26%)	34 (68%)
Bodyache	263 (58.06%)	29 (58%)
Cough	228 (50.33%)	25 (50%)
Loss of smell	213 (47.02%)	21 (42%)
Loss of taste sensation	193 (42.6%)	21 (42%)
Sore throat	184 (40.62%)	21 (42%)
Running nose/cold	110 (24.28%)	11 (22%)
Breathlessness	77 (17%)	9 (18%)
Diarrhoea, vomiting	60 (13.25%)	7 (14%)
Headache	6 (1.32%)	1 (2%)
Weakness/fatigue	4 (0.88%)	1 (2%)
Backpain	4 (0.88%)	0
Restlessness, depression, anxiety	2 (0.44%)	1 (2%)
Loss of appetite	2 (0.44%)	1 (2%)
Vertigo	1 (0.22%)	0

Out of 453, 50 (11%) required hospitalisation for an average duration of 10.5 days (1 - 45 days). Among those admitted 21 (42%) required oxygen support while 1 (2%) required ICU care. A total of 291 participants recorded SpO₂, 222 (76%) were categorised as mild, 43 (15%) moderate and 26 (9%) as severe SARS CoV-2 infection, based on the SpO₂ criterion.

Among the participants, 300 (66.2%) did not have any comorbidity while 38 (8.3%) had multiple comorbidities. The common co-morbidities noted among infected HCWs are detailed in Table I.

Only 27 (9%) of those who did not have any associated comorbidity required hospitalisation. Among the comorbidities, hypothyroidism did not have any significant effect on the severity of the disease and was not associated with an increased incidence of hospitalisation, but hypertension and obesity marginally increased hospitalisation rate. However, 11 (34%) of those suffering from diabetes alone or along with other co-morbidities suffered moderate-to-severe disease and 8 (25%) of those diabetics required hospitalisation.

Three hundred and thirty-nine (75%) participants had

inadequate levels of physical activity (i.e., less than 150 minutes/week as per WHO criteria) but it was not associated with the severity of illness or hospitalisation requirement.

No significant relationship was found between the severity of disease and gender, blood group or job profile of the participants. However, it is noteworthy that among different professionals, most nurses 87.5% had mild illness and only 4.7% of them required hospitalisation.

Factors related to COVID-19 infection

269 (60%) HCWs who contracted SARS CoV-2 were not posted in COVID-19 areas of the hospital. However, the other 184 (40%) of these workers were posted for COVID-19 duty within 15 days prior to testing positive, of which 30 (6.6%) reported not following hand hygiene properly, 17 (3.8%) reported breach in PPE, 15 (3.3%) reported use of insufficient PPE as the probable reason for contracting infection. Half of the participants felt that contact with COVID-19 positive patients in-hospital was the source of infection. The perceived sources of infection for the other HCWs are detailed in Table III.

Table III: Perceived source of infection amongst HCWs.

Possible source of COVID-19 infection	1st COVID-19 infection (%) n = 453	2nd COVID-19 infection (%) n = 50
Contact with COVID-19 positive patient in hospital	223 (49.23%)	7 (14%)
Contact with COVID-19 positive colleague in the hospital	162 (35.76%)	0
Contact with COVID-19 positive friend/relative/social contact	55 (12.14%)	34 (68%)
Contact with COVID-19 positive family member	37 (8.17%)	1 (2%)
Visit to crowded place market/social gathering etc	21 (4.64%)	1 (2%)
Travel outside city	1 (0.22%)	0
Not sure	105 (23.18%)	7 (14%)

It was observed that 323 (71%) HCWs were infected prior to vaccination and 130 (29%) were infected after partial or full vaccination. Among those hospitalised, 42 (84%) were unvaccinated and only 8 (16%) were partially or fully vaccinated.

Majority of the participants, i.e., 244 (54%) HCWs felt that they did not transmit the disease to the community, while 126 (28%) felt that they were the source of infection for family members, 76 (16.8%) for colleagues, 98 (10.6%) for patients and 30 (6.6%) for social contacts and neighbours.

Prophylactic measures

Even though the majority (79%) of participants were taking multiple prophylactic medications in the form of Allopathic, Ayurvedic or Homeopathic preparations or home remedies they still contracted infection. Hospitalisation rate was 16.2%

in participants not taking any prophylaxis but was markedly reduced in those taking different preparations alone or in combination, as listed in Table IV.

Table IV: Hospitalisation rate among HCWs taking different types of prophylaxis.

Prophylaxis	Number of participants who took prophylaxis	Hospitalisation Rate
Ivermectin	125	12 (9.6%)
HCQS	98	10 (10.2%)
Ayurvedic medication/kadha	187	12 (6.41%)
Homeopathic	18	3 (16.66%)
Home remedies	174	17 (9.77%)
None	86	14 (16.2%)

Absence from work

Majority of the participants, i.e., 314 (70%) were absent from work for 10 - 17 days, 97 (21%) were absent for 17 - 29 days, 29 (6%) were absent for more than a month and only 13 (3%) were absent for less than 10 days.

Presentation of COVID-19 re-infection

Out of 453 participants, 50 acquired COVID-19 infection for a second time during the study duration. Of these 35 (70%) were males and 15 (30%) were females with a mean age of 31.36 ± 7.95 years (23 - 57 years). Among the re-infected participants 19 (38%) were doctors, 14 (28%) were support staff, 7 (14%) were nurses and other professionals 10 (20%) as listed in Table I. Similar to the trends in first infection, only 2 (4%) were asymptomatic; while the majority experienced fever, followed by bodyache, cough and other symptoms as detailed in Table II. Only 6 (12%) participants required hospitalisation for an average duration of 13.7 days (8 - 30 days). Among those admitted, only 4 patients required oxygen support and 1 patient required ICU care. During reinfection, the trend for mild illness remained similar at 26 (79%), while it reduced to 3 (9%) for moderate and increased to 4 (12%) for severe disease. 35 (70%) HCWs who had COVID-19 infection for the second time did not have any co-morbidities while 3 (6%) had multiple co-morbidities.

As during the first infection, most of HCWs, 27 (54%) who contracted COVID-19 the second time, were not posted in COVID-19 areas of the hospital. Twenty-three (46%) were posted for COVID-19 duty within 15 days prior to testing positive, of which 6 (12%) reported not following hand hygiene properly, 5 (10%) reported breach in PPE, 1 (2%) reported use of insufficient PPE as a probable cause for contracting infection. Unlike the first infection, majority of participants (34, i.e., 68%) felt that interaction with a COVID-

19 positive social contact was the source of infection. The other perceived sources are detailed in Table III.

It was observed that 31 (62%) of the 50 re-infected individuals were not vaccinated, 13 (26%) were partially vaccinated and only 6 (12%) were fully vaccinated. The rate of hospitalisation was significantly lower among fully vaccinated (16.5%) and partially vaccinated (16.5%) as compared to unvaccinated 4 (67%) during the second episode of COVID-19 illness.

Majority of participants 20 (40%) felt that they did not transmit the disease to the community, 14 (28%) felt they were a source of infection for family members, 12 (24%) for colleagues, 9 (18%) for patients and 5 (10%) for social contacts and neighbours. Though most of the participants were taking prophylactic medications, yet they contracted infection, though the hospitalisation rate was significantly reduced among them.

Discussion

This study included 453 HCWs who were infected with SARS-CoV-2 over a period of one year and three months and included 50 participants who were reinfected during this period.

Thirty-three percent of the participants had co-morbidities^{9,10}. Among the co-morbidities, Diabetes Mellitus was associated with a higher hospitalisation rate and severity of disease, as was found in many preceding studies. It is well known that both the innate and adaptive arms of the immune system are compromised in diabetes mellitus¹⁴.

There was no significant difference between demographic profiles of participants who were infected once or twice during the course of study in terms of gender, age or nature of work. Most of the participants suffered from mild illness and symptoms present during the first and second infection were very similar.

Previous studies have concluded that consistently meeting physical activity guidelines was strongly associated with a reduced risk for severe COVID-19 outcomes¹⁵ but in our study we did not find a correlation between physical activity and severity of the disease. However, it was observed that inadequate physical activity was associated with high-risk of infection and reinfection.

Posting of HCWs in high-risk areas was on a rotation basis, followed by quarantine and RT-PCR testing. It was observed that the risk of both first and repeat infection among people posted on COVID-19 duty was not higher compared to those who were posted in the other areas. This was likely as most HCWs working in high-risk zones were aware of exposure risk and hence followed infection control practices. Previous studies have reiterated that though

SARS-CoV-2 is a burden on HCWs, nonetheless, the use of PPE and infection control training are associated with decreased risk⁸.

During the first infection, most HCWs attributed the source of infection as contact with a positive patient/colleague in the hospital while during the second episode most HCWs attributed social contacts as a source of infection. This can possibly be explained as most HCWs who contracted SARS-CoV-2 twice were first infected between March 2020 to September 2020. During this period there was a lockdown imposed in the country for a long duration and HCWs were not intermingling with the society. However, most HCWs, were reinfected during February 15, 2021 to April 15, 2021. During this time period there were fewer COVID-19 related restrictions and lockdown had not been imposed, so HCWs were intermingling in the community¹¹. In both the COVID-19 infections, majority of participants reported not infecting their family members, colleagues or social contacts. This indicates that HCWs were cautious and followed COVID-19 protocols to prevent community spread.

Unvaccinated individuals were more likely to get infected and re-infected. Previous studies have also indicated that vaccination after SARS-CoV-2 infection increased T-cell immunity, antibody-secreting memory B-cell response to the spike protein, and neutralising antibodies are present even after the first dose of vaccination¹⁶.

Most HCWs perceived that they were at a higher risk of exposure and thus the majority of them were taking prophylactic preparations to reduce the chances of infection. As there were no proven measures, various approaches were adopted. In our study, the hospitalisation rate was much lower among participants taking Ivermectin, Hydroxychloroquine and Ayurvedic preparations. The doses and duration varied. Most had taken more than one prophylactic preparation. So, it cannot be decisively concluded that the low hospitalisation rate was the result of any particular prophylactic preparation. This could also have resulted because these HCWs were more cautious to take extra precautions making them more compliant to covid-appropriate behaviour.

The MOHFW guidelines recommended isolation for 17 days for Covid positive cases which was later reduced to 10 days. As most of the HCWs suffered mild illness, the average days of absenteeism was 10 - 17 days in line with government guidelines for quarantine¹².

Limitations of the study

Only 64% of the participants recorded SpO₂ because of which, all the participants could not be classified into mild,

moderate or severe categories. It is likely that the remaining 36% suffered from a milder form of illness. In addition to this, the clinical presentation of HCWs who had very severe disease and died because of COVID-19 could not be accounted for in this study¹³, hence there could be a bias in the study, including a greater number of HCWs with milder disease.

Conclusion

It was seen that the majority of participants had mild illness, symptomatology of which was similar in character during the first and the second infection.

Amongst the HCWs, the presence of Type 2 Diabetes was associated with an increased severity and hospitalisation, while other comorbidities were not found to be related to the disease severity, either during the first or second episode of infection. Inadequate physical activity levels were associated with a high-risk of infection and reinfection but not with the severity of disease.

The use of Allopathic and Ayurvedic formulation as prophylactic measures may contribute to a reduction in the hospitalisation rate. However, larger studies are required for a definite conclusion.

The average loss of work days due to COVID-19 illness was 10 - 17 days.

Majority of the participants felt that they contracted the first infection from a COVID-19 positive patient and the second infection from a social contact. Both the infections were seen, mostly, before complete vaccination. Vaccination was also associated with a reduced rate of hospitalisation.

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