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Original Research Article

SARS CoV-2 infection in health care workers first wave and second wave characteristics: a retrospective study from a tertiary care center

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ABSTRACT

Background: The Coronavirus disease (COVID-19) is a global pandemic that threatens lives and livelihoods. Healthcare workers (HCWs) fight the pandemic. The severe acute respiratory syndrome Coronavirus 2 (SARSCoV-2) pandemic has killed many HCWs worldwide.
Methods: The study included all HCWs who tested positive for SARS-CoV-2. Data collection focused on demographics, job roles, disease presentation, and transmission risks, with statistical analysis performed using SPSS version 21.0 to evaluate infection trends and control efficacy.
Results: The 2020 1st wave infected 93 HCWs and the 2021 second wave 145. The most affected were 25-35, with rates plummeting from 38-29%. Female infections rose 58-66%. Peak months were September to October 2020, April to May 2021. Nursing workers were 36% vulnerable, while technical staff infections jumped from 3% to 11%. COVID hospital staff had more infections in 1st wave, while non-COVID staff had more in second. Direct patient care threatened 36% in 1st wave and 42% in second. ICU infection rates fell from 10% to 6% with air filters. Hospital-acquired infections were 30%. Better personal protective equipment (PPE) management reduced risks from 10-3%.
Conclusions: The study underscores the dynamic nature of the COVID-19 impact on HCWs, highlighting how effective vaccination and stringent infection controls can mitigate risks. Ongoing training in infection control, continuous adaptation of policies based on current data, and maintaining high vaccination rates are essential to protect HCWs in future waves or similar pandemics.

Keywords: COVID-19, HCWs, Infection control, Vaccination, SARS-CoV-2

INTRODUCTION

In India, as in the rest of the world, HCWs have been the cornerstone of the response to the COVID-19 pandemic, often at considerable risk to their own health. Serving on the front lines, these dedicated professionals have contended with the dual challenge of providing care to patients while confronting the threat posed by SARS-CoV-2, the virus responsible for COVID-19.[1]

HCWs have been at the epicenter of this global health crisis, bearing the brunt of exposure to the virus. They have faced an elevated risk of infection due to their proximity to patients with COVID-19 and their environment, which potentially includes high concentrations of the virus, particularly in areas like emergency departments and intensive care units. This exposure is compounded by the high transmissibility of SARS-CoV-2, especially in closed settings such as hospitals.[2]

As a result, HCWs have been susceptible not only to the physical effects of the virus but also to the psychological stresses of the pandemic, including long working hours

and the emotional toll of patient care under extraordinary circumstances.

India's healthcare system, with its unique challenges, including resource constraints and population density, has had to adapt rapidly to the evolving situation. Infection control practices such as the use of PPE, social distancing, and hand hygiene have been critical in protecting healthcare staff.[3] Additionally, the implementation of regular screening and testing has been essential for early detection and containment of hospital-associated SARS-CoV-2 outbreaks.

The introduction of vaccines has been a turning point in the fight against COVID-19. HCWs were among the first in India to receive vaccinations, given their high-risk status.[4] Vaccination campaigns across the nation have been instrumental in reducing the incidence of infection among HCWs, as well as the severity of the disease and the consequent mortality when breakthrough infections do occur. Despite vaccination, breakthrough infections-where fully vaccinated individuals test positive for the virus-have underscored the need for ongoing vigilance and adherence to infection control measures even after immunization.

India's healthcare workforce has shown remarkable resilience and adaptability during the pandemic. The commitment of HCWs has been unwavering, even as they have faced personal risk.[5] As the pandemic has progressed, the experiences of these workers have informed public health strategies, including the need for mental health support for HCWs and the recognition of the importance of safe work environments.

Looking forward, lessons learned from the experiences of HCWs during the pandemic will undoubtedly shape future responses to similar crises, with the aim of safeguarding those who serve on the front lines of public health.

The study aims to retrospectively analyze the differences in SARS-CoV-2 infection patterns among HCWs during the first and second waves, with a focus on evaluating the efficacy of infection control methods implemented to mitigate transmission risks.

METHODS

Study design

It was a retrospective descriptive study.

Study setting

The study was conducted at KoIMS teaching hospital, Madikeri. Data pertaining to confirmed SARS-CoV-2 cases among HCWs and hospital staff, encompassing roles in fever clinic, triage, wards, and ICU across both COVID and non-COVID hospital areas, were collected from March 2020 to December 2021.

Participants

The study population included all healthcare personnel affiliated with Kodagu Institute of Medical Sciences Teaching Hospital and Medical College.

Inclusion and exclusion criteria

Inclusion criteria encompassed all HCWs and hospital staff members affiliated with KoIMS teaching hospital and medical college who tested positive for SARS-CoV-2 during the specified study period. Exclusion criteria included individuals not meeting the inclusion criteria or lacking sufficient data for analysis.

Bias

Potential biases were minimized by ensuring comprehensive data collection from all relevant departments and adhering to standardized procedures for recording demographic information, travel history, disease presentation, and transmission risk factors during the quarantine period of infected HCWs.

Variables

Variables recorded included demographics (age, gender), job role, departmental affiliation, travel history, nature of disease presentation, and potential transmission risks associated with each case.

Data collection and procedure

Data collection occurred during the quarantine period of infected HCWs and involved meticulous documentation of demographic details, travel history, clinical symptoms, and potential sources of exposure. Interventions such as quarantine duration, clinical management, preventive measures, contact tracing, and testing protocols were monitored and implemented by the infection prevention unit in accordance with established guidelines.

Statistical analysis

Statistical analysis was conducted using SPSS version 21.0. The descriptive statistics was done to characterize the demographic and clinical profiles of infected HCWs and hospital staff. Chi-square tests and logistic regression analysis were employed to assess associations between demographic variables, job roles, and infection outcomes.

RESULTS

The study provides a comprehensive analysis of COVID-19 infection trends among HCWs during two distinct waves.

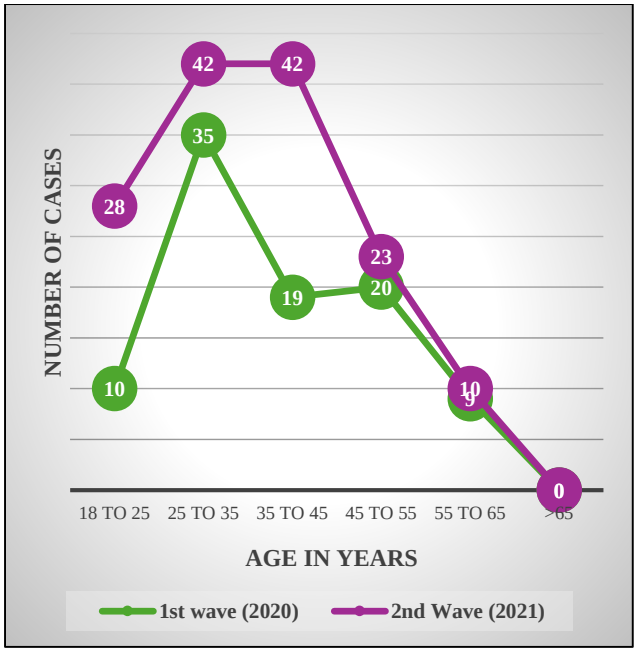

Figure 1: Age wise comparison of COVID positive cases in 1st and 2nd wave.

There was a notable increase in infections among younger HCWs aged 18-25 during the second wave, rising from 11% to 19%. Other age groups also showed changes, but these were not statistically significant. Gender-wise, females accounted for a higher percentage of infections in the second wave (66%) compared to the first wave (58%), although the difference was not statistically significant, with a p=0.204.

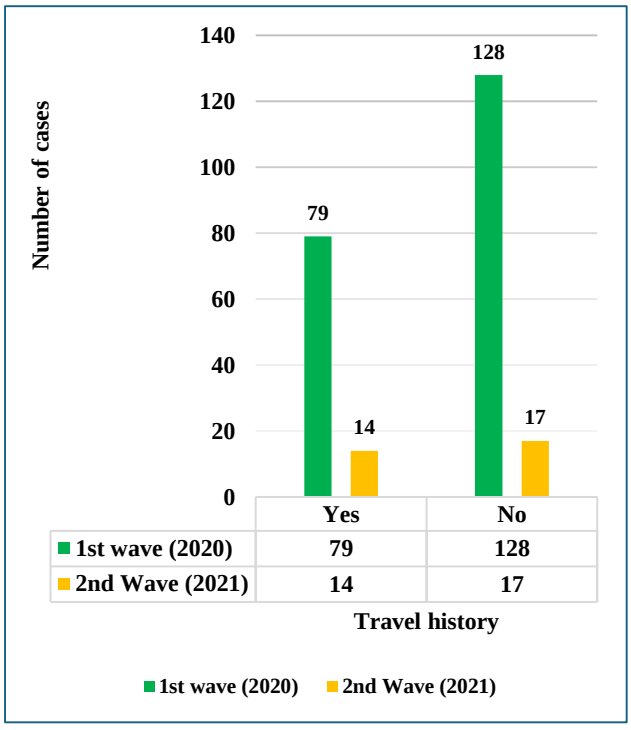

Figure 2: Travel history Madikeri and other than Madikeri.

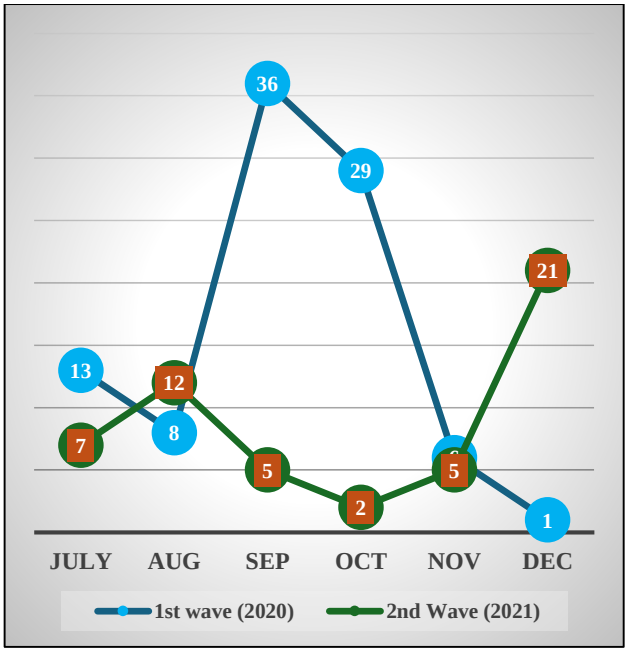

Figure 3: Month wise COVID infection in 1st and 2nd wave.

Certain months exhibited significant differences in infection rates. For instance, December of the second wave saw a significant spike in cases compared to the first wave (21 cases vs. 1 case), with a p value of less than 0.00001. Similarly, September and October also showed significant decreases in infections during the second wave, indicating possible improvements in infection control or changes in HCW exposure.

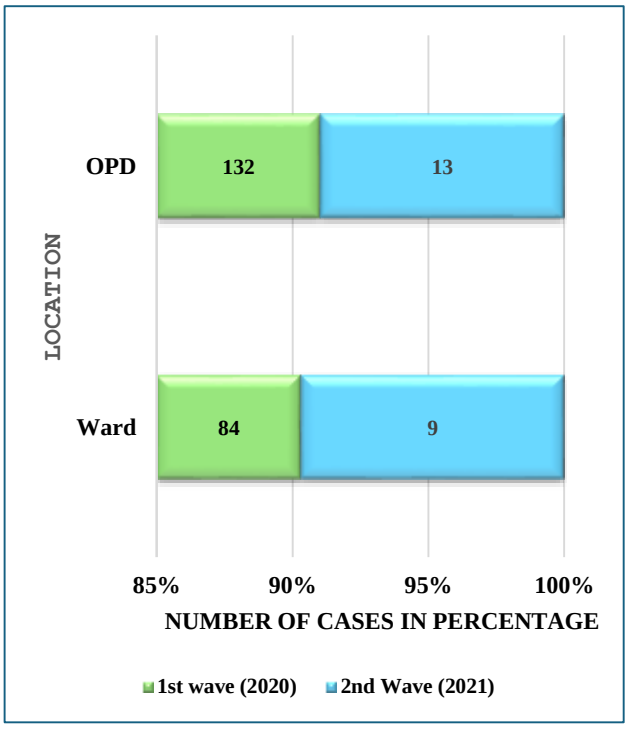

Figure 4: Location wise comparison of COVID positive cases in 1st and 2nd wave.

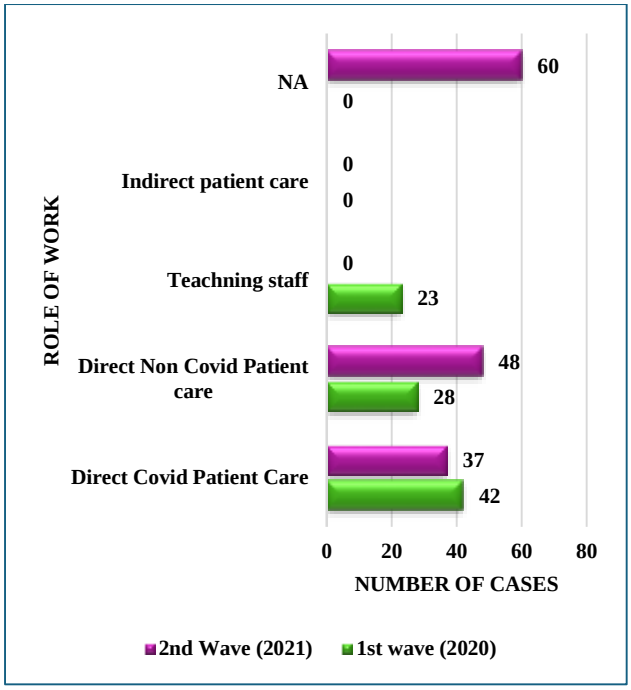

Figure 5: Role of wise comparison of COVID positive cases in 1st and 2nd wave.

There were significant differences in hospital-acquired infections, with the second wave showing a decrease in COVID-attributed cases and an increase in non-COVID attributed cases, both with a p=0.0022. Additionally, the role involving direct COVID patient care saw a significant reduction in the number of cases from the first to the second wave, with a p=0.00168, suggesting improved protective measures.

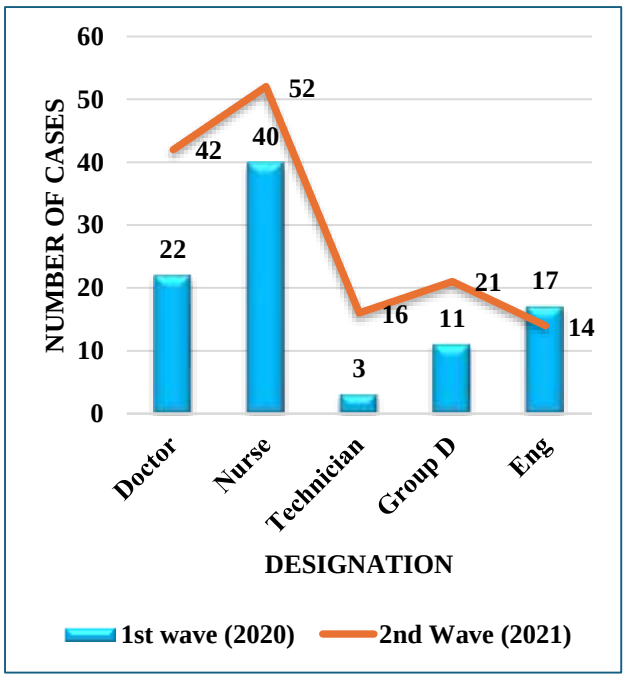

Figure 6: Designation wise comparison of COVID positive cases in 1st and 2nd wave.

Percentage of HCWs with hospital-acquired infections decreased from 46% in first wave to 31% in the second, which was statistically significant with a p=0.0177.

The study also provides detailed information on various sources of COVID-19 infection among HCWs, their duration of contact with the source, severity of disease, COVID-19 vaccination status at the time of infection, and whether the infection was acquired in the hospital.

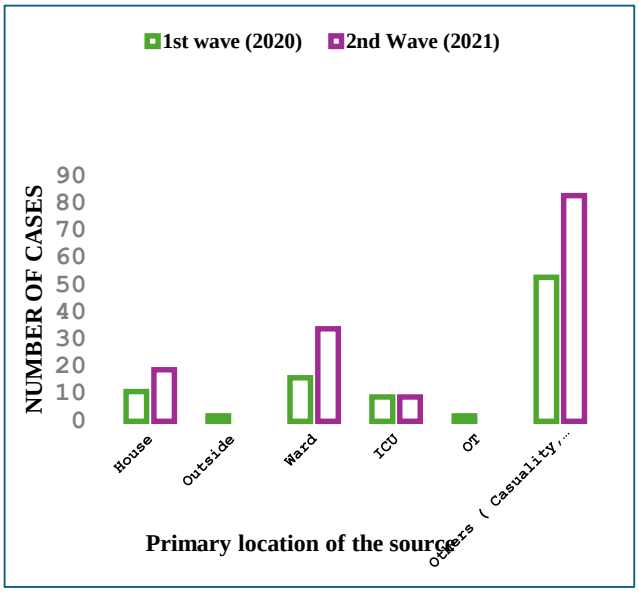

Figure 7: Primary location wise COVID cases in 1st and 2nd wave.

The primary locations where HCWs contracted the virus varied, with the majority (57%) acquiring the infection from "others" such as causality, fever clinic, and outpatient departments. Other notable sources included the ward (17%) and the house (12%). However, there were no significant differences observed between the two waves in terms of the primary source of infection, as indicated by non-significant Z test values and p values.

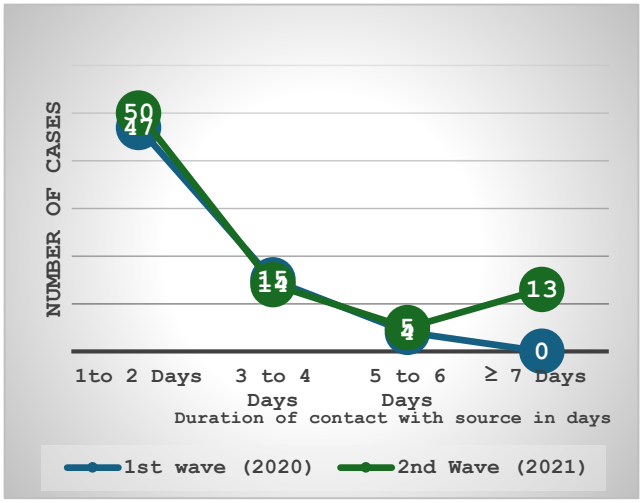

Figure 8: Day wise contact in 1st and 2nd wave.

The duration of contact with the source varied among HCWs, with significant differences observed between the two waves. Notably, a higher percentage of HCWs in the first wave had a duration of contact ranging from 1 to 2 days (51%), whereas in the second wave, a higher percentage had contact for 3 to 4 days (34%). This difference was statistically significant (Z test=2.4594, p=0.0139).

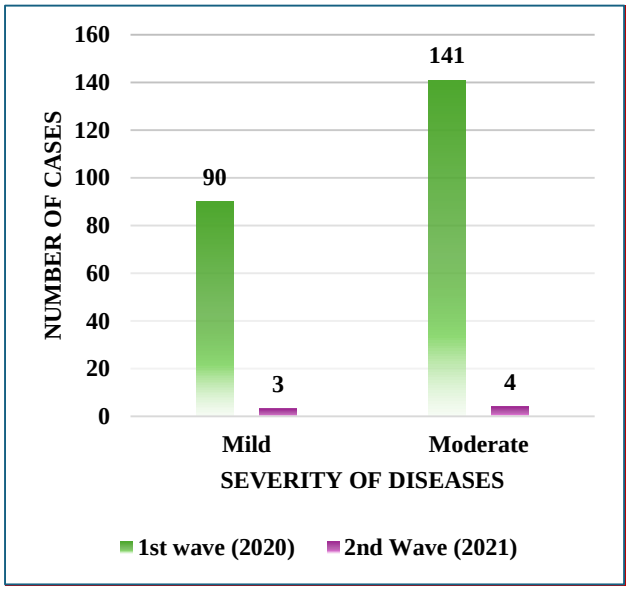

Figure 9: Severity of disease.

The vast majority of HCWs experienced mild symptoms of COVID-19, with 97% in both waves reporting mild severity. Only small percentage reported moderate severity, with no statistically significant difference between the waves.

A significant difference was observed in the vaccination status of HCWs between the two waves. In the first wave, all HCWs had not taken the vaccine at the time of infection, while in the second wave, a majority (72%) had received their second dose. This difference was highly significant (Z test=12.355, p<0.00001).

Percentage of HCWs with hospital-acquired infections differed between the two waves, with 46% in the first wave and 31% in the second wave. This difference was statistically significant (Z test=2.3704, p=0.0177), indicating an improvement in infection control measures in hospital environment during second wave.

Study provides a detailed analysis of healthcare workers' contact with COVID-19 positive patients and associated risk factors across two waves of the pandemic (Table 1).

The percentage of healthcare workers reporting contact with body fluids of COVID-19 positive patients was 10% in the first wave and 15% in the second wave. However, this difference was not statistically significant (Z test=-1.1796, p=0.238).

Table 1: Contact assessment.

Questions	Yes	Percent	Yes	Percent	Z test	P value
Contact with body fluids of the COVID-19 positive person/patient (Respiratory tract secretions, blood, vomit, saliva, urine, faeces)	14	10%	22	15%	-1.1796	0.238
Had direct physical contact with the body of the patient including physical examination without PPE or triple layer mask or N95 mask for more than 15 minutes and less than 3 feet	11	8%	7	5%	1.1441	0.2542
Exposure to an aerosol-generating procedure to a patient without PPE and N95 mask	3	2%	4	3%	-0.2795	0.7794
PPE not removed or replaced according to guideline during the patient interaction or exposure to an aerosol-generating procedure	18	13%	4	3%	3.2981	0.0009
Touched or cleaned the linens, clothes, or dishes of the COVID-19 positive person / patient	11	8%	19	13%	-1.3216	0.1868
Lives in the same household as the COVID-19 positive person/ patient	14	10%	22	15%	-1.1796	0.238
Anyone in close proximity (within 3 feet) of the confirmed case without precautions (Triple layer mask, N95 mask, hand hygiene, social distancing)	14	10%	11	7%	0.8309	0.4065
Shared the same space without wearing triple layer mask or N95 (worked in same room and not having a high risk exposure to confirmed or suspect case of COVID-19)	9	7%	14	9%	-0.895	0.3734
Any other: please mention in detail:	0	0%	0	0%		
Hospital acquired Infection	43	31%	45	30%	0.1792	0.8571
Total	137	100%	148	100%		

HCWs who reported direct physical contact with COVID-19 positive patients without proper protective equipment for more than 15 minutes and within 3 feet accounted for 8% in the first wave and 5% in the second wave. The difference was not statistically significant (Z test=1.1441, p=0.2542).

The percentage of HCWs exposed to aerosol-generating procedures without adequate PPE was 2% in both waves, with no significant difference observed.

A significant difference was observed in this factor, with 13% of HCWs in the first wave not removing or replacing PPE according to guidelines during patient interaction or exposure to aerosol-generating procedures, compared to only 3% in the second wave (Z test=3.2981, p=0.0009).

The percentages were 8% in the first wave and 13% in the second wave, but the difference was not statistically significant (Z test=-1.3216, p=0.1868).

HCWs living in the same household as COVID-19 positive individuals accounted for 10% in the first wave and 15% in the second wave, with no significant difference observed (Z test=-1.1796, p=0.238).

HCWs in close proximity to confirmed cases without appropriate precautions represented 10% in the first wave and 7% in the second wave, with no significant difference observed (Z test=0.8309, p=0.4065).

The percentages were 7% in the first wave and 9% in the second wave, with no significant difference observed (Z test=-0.895, p=0.3734).

The percentages of hospital-acquired infections were 31% in the first wave and 30% in the second wave, with no significant difference observed (Z test=0.1792, p=0.8571).

DISCUSSION

The study provides a comprehensive analysis of COVID-19 infection trends among healthcare workers (HCWs) during two distinct waves.

In the second wave, there was a notable increase in infections among HCWs aged 18-25, rising from 11% to 19%. However, these changes were not statistically significant. Females accounted for a higher percentage of infections in the second wave (66%) compared to the first wave (58%), but the difference was not statistically significant (p=0.204).

December of the second wave saw a significant spike in cases compared to the first wave (21 cases vs. 1 case), with a highly significant p value of less than 0.00001. September and October also showed significant decreases in infections during the second wave, with highly significant p values of less than 0.00001.

Hospital-acquired infections showed a significant decrease from the first to the second wave, with a statistically significant p=0.0177. The percentage of HCWs with hospital-acquired infections decreased from 46% in the first wave to 31% in the second wave, which was statistically significant (p=0.0177). Direct COVID patient care roles saw a significant reduction in the number of cases from the first to the second wave, with a p=0.00168.

Regarding contact with COVID-19 positive persons/patients, significant differences were observed in PPE not removed or replaced according to guidelines, with a highly significant p=0.0009. Other factors such as contact with body fluids, direct physical contact, exposure to aerosol-generating procedures, and living in the same household did not show statistically significant differences between the two waves.

The study highlights the key trends and areas of improvement in infection control measures among HCWs during the two waves of the COVID-19 pandemic.

The SARS-CoV-2 pandemic highlighted significant differences in healthcare challenges across its waves, especially concerning healthcare workers and hospital systems. During the initial waves, healthcare settings saw a consistent mortality rate despite differences in treatment strategies, such as an increased use of high-dose glucocorticoids in the second wave. Improved discharge processes led to more patients being transferred to rehabilitation facilities, indicating some progress in patient management over time.[6]

Additionally, another Swiss study observed consistent in-hospital mortality rates in the first two waves with a decrease in the third, identifying age, immunocompromising conditions, and male sex as persistent predictors of mortality.[7] Moreover, healthcare workers faced increased SARS-CoV-2 infection rates from the first to the second wave, with rising levels of C-reactive protein, suggesting a greater risk and burden as the pandemic progressed.[8]

Specific departments, like orthopedic trauma, experienced heightened challenges with significant increases in infection rates among both patients and healthcare workers during the second wave, underscoring the disproportionate impact on different healthcare sectors.[9] Furthermore, the transmission dynamics within hospitals evolved; while staff-to-staff transmission decreased, patient-to-patient transmission became more prevalent in second wave, reflecting the shifting nature of risks and need for adaptive infection control measures.[10]

A study on healthcare workers in Quebec, Canada, examining the evolution of SARS-CoV-2 infection

sources across three pandemic waves. They found that the perceived source of infection among healthcare workers shifted significantly from the workplace during the first wave (91%) to more household-acquired infections in subsequent waves, rising from 4% in the first wave to 33% in the third wave. Additionally, the overall household secondary attack rate was 30%, which was associated with the presence of symptoms and the predominance of the alpha variant during certain periods.[11]

Another study conducted at a tertiary care center in Assam, India, during the second wave of the pandemic analyzed the demographic and clinical characteristics of 1,110 SARS-CoV-2 patients. The study found that younger individuals, particularly those aged 18-30 years, were significantly more affected. There was also a gender difference in symptom presentation; females more frequently experienced nausea, bodily aches, and abdominal pain, while males were more likely to report chest pain and diarrhea. The delta variant was identified as the most common strain during the second wave.[12]

Research reported on the clinical characteristics and outcomes of SARS-CoV-2 infection in pediatric oncology patients across two pandemic waves in a tertiary care oncology center. The study observed that the rate of SARS-CoV-2 positivity was much higher during the second wave (95.4%) compared to the first wave (2.7%). Most pediatric cancer patients experienced mild to moderate symptoms, with fever and cough being the predominant presentations. The study also noted significant delays in cancer treatment delivery due to COVID-19, with 42.2% of patients experiencing up to a four-week delay.[13]

The ENE-COVID study in Spain analyzed SARS-CoV-2 infection during the first two waves, using data from the Spanish national sero-epidemiological survey. It found that 6.0% of Spain's population was infected by June 2020, and an additional 3.8% by November 2020. The study highlighted significant differences in seroprevalence across age groups and socioeconomic strata, with healthcare workers experiencing higher infection rates than other essential workers. The risk of infection was notably higher among those living with an infected person, increasing from 22.1% during the first wave to 35.0% in the second wave.[14]

A cross-sectional study was conducted on healthcare workers in Montreal during the first wave of the pandemic. The study highlighted significant disparities in access to PPE and training among healthcare workers, particularly affecting women and those working evening or night shifts. It was found that 52% of participants reported insufficient access to PPE, and 30% reported no training related to infection prevention, underscoring the need for equitable access to resources during health crises.[15]

A limitation of this study is its retrospective design, which may lead to biases in data collection and interpretation. The reliance on previously recorded data could result in incomplete or inaccurate information, especially regarding the specifics of healthcare workers' exposure and the exact circumstances of infection transmission. Additionally, the study was conducted at a single tertiary care center, which limits the generalizability of the findings to other settings with different patient populations, healthcare practices, or infection control measures. This narrow scope might not fully capture the diversity of COVID-19 impacts on healthcare workers across different regions or healthcare systems.

CONCLUSION

The present study suggests that healthcare workers are easily infected compared to the general population but that often infection could equally occur in hospital and non-hospital settings. Safety of HCWs in counteracting the COVID-19 pandemic must be strengthened in hospital with adequate provision of PPE, optimization of human resources, implementation of closed and independent groups of HCWs, creation of traffic control and dedicated areas in every healthcare, adequate nutrition and family support.

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REFERENCES

1. World Health Organization. Coronavirus disease (COVID-19) technical guidance: Healthcare workers. 2020. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/health-workers. Accessed on 20 August 2024.
2. Indian Council of Medical Research. Advisory on COVID-19 testing during the second wave of the pandemic. 2021. Available at: https://www.icmr.gov.in/. Accessed on 20 August 2024.
3. Chatterjee P, Anand T, Singh K, Rasaily R, Singh R, Das S, et al. Healthcare workers and SARS-CoV-2 infection in India: A case-control investigation in the time of COVID-19. Indian J Med Res. 2020;151:459-67.
4. Gupta R, Dwivedi T, Gajendra S, Sahoo B, Gupta S, Vikas H, et al. Seroprevalence of antibodies to SARS-CoV-2 in healthcare workers & implications

of infection control practice in India. Indian J Med Res. 2021;153(1 and 2):207-13.
5. Sharma P, Chawla R, Bakshi R, Saxena S, Basu S, Bharti P, et al. Seroprevalence of antibodies to SARS-CoV-2 and predictors of seropositivity among employees of a teaching hospital in New Delhi, India. Osong Public Health Res Perspect. 2021;12(2):88-95.
6. Wolfisberg S, Gregoriano C, Struja T, Kutz A, Koch D, Bernasconi L, et al. Comparison of characteristics, predictors and outcomes between the first and second COVID-19 waves in a tertiary care centre in Switzerland: an observational analysis. Swiss Med Wkly. 2021;151:w20569.
7. Diebold M, Martinez A, Adam K, Bassetti S, Osthoff M, Kassi E, et al. Temporal trends of COVID-19 related in-hospital mortality and demographics in Switzerland - a retrospective single centre cohort study. Swiss Med Wkly. 2021;151:w20572.
8. Singh A, Panigrahi M, Pradhan S, Pal D, Subba S, Patro B, et al. Clinico-Epidemiological Characteristics of Healthcare Workers with SARS-CoV-2 Infection during the First and Second Waves in a Teaching Hospital from Eastern India: A Comparative Analysis. Hosp Top. 2024;102(2):84-5.
9. Patel S, Khan S, Aggarwal S, Kumar V, Sharma S, Dhillon M. The Increased Burden of SARS-CoV-2 Infection in Orthopaedic Trauma Patients: Comparison of Demographics of Both the Waves of the Pandemic-An Indian Tertiary Center Experience. Indian J Orthop. 2021;56(3):479-84.
10. Lindsey B, Villabona-Arenas C, Campbell F, Keeley A, Parker M, Shah D, et al. Characterising within-hospital SARS-CoV-2 transmission events: a retrospective analysis integrating epidemiological and viral genomic data from a UK tertiary care setting across two pandemic waves. Nat Commun. 2022;13(1):671.
11. Carazo S, Denis G, Padet L, Deshaies P, Villeneuve J, Paquet-Bolduc B, et al. SARS-CoV-2 infection among healthcare workers: the role of occupational and household exposures during the first three pandemic waves in Quebec, Canada. Antimicrob Steward Healthc Epidemiol. 2023;3(1):e180.
12. Alam ST, Biswas S, Begum S, Pathak M, Roy JS, Baishya P, et al. A retrospective clinico-demographic study of SARS-CoV-2 patients at a tertiary care centre, Assam, North-East India during the second wave of the pandemic. J Clin Experimental Immunol. J Clin Exp Immunol. 2023;8(3):641-8.
13. Alkharouby R, Aljehani N, Alsubaie N, Alqarni A, Hariri M, Elimam N, et al. The characteristics and follow-up of SARS-CoV-2 infection in pediatric oncology patients. Cureus. 2023;15(9):e46149.
14. Pérez-Gómez B, Pastor-Barriuso R, Fernández-de-Larrea N, Hernán M, Pérez-Olmeda M, Oteo-Iglesias J, et al. SARS-CoV-2 infection during the first and second pandemic waves in Spain: the ENE-COVID study. Am J Public Health. 2023;113(5):533-44.
15. Fortin G, Saucier A, Munoz-Bertrand M, Yuan M, Ante Z, Narasiah L, et al. Portrait of Montréal healthcare workers infected with SARS-CoV-2 during the first wave of the pandemic: a cross-sectional study. Can J Public Health. 2023;114(4):534-46.

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