

Prevalence of Seropositivity to SARS-CoV-2 among Health Care Workers in Tertiary COVID-19 Hospital, Ahmedabad, Gujarat

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ABSTRACT

Introduction: Healthcare Workers (HCW) are at increased risk of Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) infection due to occupational exposure to infected patients and contaminated surfaces.

Aim: To determine the prevalence of seropositivity against SARS-CoV-2 among HCW in a tertiary COVID-19 designated hospital in Ahmedabad, Gujarat.

Materials and Methods: This cross-sectional study was conducted between 1st July to 31st July, 2020 on 1333 HCWs. HCWs included doctors, nurses, lab personnel, general service assistants and ancillary staff who work in hospital. Anti SARS-CoV-2 total antibodies were measured in serum sample by chemiluminescent technique.

Results: Prevalence of seropositivity was found in 27.76% (370 out of 1333). It was highest among general service assistant 34.76% (especially among house keeping staff, 43.44%) and lowest among doctors (19.33%). The percentage of seropositivity among asymptomatic HCWs was 24.84%.

Conclusion: The percentage of seropositivity among asymptomatic HCWs indicates that a large amount of infection passes asymptotically. The discrepancy between various job categories might be due to differential occupational exposure and risk, lack of awareness and seriousness regarding transmission and risk of getting infection, various demographic factors like literacy, residential environment, community prevalence etc.

Keywords: Coronavirus-2, Severe acute respiratory syndrome, Seroprevalence

INTRODUCTION

The Healthcare Workers (HCWs) are at a high risk of contracting the highly contagious COVID-19 virus. The source of exposure includes contact with patients and their bodily fluids, as well as contaminated surfaces while managing COVID-19 patients. In India, Ahmedabad was one of the severely affected city with respect to total number of cases and deaths. A wide spectrum of disease severity of COVID-19 has been observed which includes asymptomatic or minimally symptomatic to severe or critical cases. The virus spreads readily from person-to-person or possibly from environmental exposure to affected surfaces. The proportion of asymptomatic SARS-CoV-2 infected patients is unknown, which still remains an important epidemiological puzzle [1].

A study done in a tertiary hospital in Wuhan, China showed an infection rate of 1.1% [2]. One such study done in India between 23 March to 30 April, 2020 involved HCWs from five different hospital and showed that 14.7% had flu-like symptoms while 1.8% tested positive for the virus [3]. The rate of asymptomatic infection was not determined in above study and also it remains unclear whether an asymptomatic infection can lead to seropositivity or not. Diagnosis of current infection with SARS-CoV-2 relies primarily on molecular testing for viral Ribonucleic Acid (RNA) using a throat/nasal swab [4]. Serology testing is essential for identifying individuals with exposure to SARS-CoV-2 and understanding viral prevalence, as most infections cause mild or no symptoms. Assessment of antibodies to SARS-CoV-2 virus aids in understanding of disease spread and may support the assessment of immunity and presence of antibodies which may be protective [5].

The rate of asymptomatic infection and development of immunity among HCWs is unknown. So, such cross-sectional studies that determine the prevalence of seropositivity for anti-SARS-CoV-2 antibodies can assist in defining prior exposure to the virus. It identifies HCWs who had overcome an infection in the

past and developed an immune response or not. It also helps to formulate and assess effectiveness of infection prevention control measures. When such studies are followed longitudinally, the potential effectiveness of serum antibody status as a protection against future COVID-19 disease may be known. Also, such data can help to shape policies for need of vaccination among HCW. So, this study was done with an aim to determine the prevalence of seropositivity against SARS-CoV-2 among HCWs in a tertiary COVID-19 designated hospital.

MATERIALS AND METHODS

The hospital based cross-sectional study was conducted at Sardar Vallabhbhai Patel Institute of Medical Sciences and Research (SVPIMSR), Ahmedabad between 1st July to 31st July 2020. The Institution Review Board's approval was obtained, dated 05/08/2020. SVPIMSR is a large comprehensive Tertiary Care Public Hospital in Ahmedabad (Run by Ahmedabad Municipal Corporation) with more than 1500 beds and over 3000 staff members. It was designated for the treatment of patients with COVID-19 only during this epidemic outbreak, since 20th March 2020.

The study was conducted on HCWs that included doctors, nurses, laboratory technicians and assistants, house-keeping, Security, Guest Relationship Executives (GRE), Pharmacy, biomedical engineer, billing, Information Technology (IT), administrative and food supplying staff etc., who are working in SVPIMSR. Those HCWs who joined within last 15 days were excluded from study. The nature of job was categorised into five groups: Doctors, Nurses, Allied health professionals (those who come in contact with biological specimen of COVID-19 patients which includes laboratory technicians, laboratory assistants), General service assistants (those were directly involved with the daily needs of patients like cleaning, dressing, guiding etc., which includes house keeping staff, security, food supplying staff, GRE, pharmacy etc.), and ancillary staff (those who are involved in administration of hospital

which includes administrative office staff, IT staff, biomedical engineer etc.,).

A 2 mL of venous blood was drawn in plain tube using a disposable vacutainer system. It was allowed to clot at room temperature and then centrifuged at 3000 rpm for 10 minutes to separate serum samples. A qualitative analysis of Anti-SARS-CoV, total antibody was done within two hour of collection. It was carried out in fully automated immunoassay analyser, Centaur XPT, by sandwich immunoassay using acridinium ester chemiluminescent technology (Mfg: Siemens). COV2T assay detects total antibody (including IgM and IgG) against the S1-RBD (Receptor Binding Domain of spike protein subunit 1) antigen. Previous validation work with this assay demonstrated 100% sensitivity (14 days post Polymerase Chain Reaction (PCR), 99.8% specificity and no cross reactivity with other viral and microbial antibodies. Kit has been approved by The United States Food and Drug Administration (USFDA) for use as an aid in identifying individuals with an adaptive immune response to SARS-CoV-2, indicating recent or prior infection [6].

Each subject's demographic information like age, gender, HCW categories, symptomatic or not in past, earlier RT-PCR result if done and SARS-CoV-2 antibody index was analysed. An antibody index of <1 was considered as seronegative or non-reactive and >1 was considered as seropositive or reactive [6].

STATISTICAL ANALYSIS

The data obtained were analysed by measuring prevalence as percentages which was calculated using Microsoft Excel 2010.

RESULTS

A total of 1333 HCWs were analysed. Out of these, 370 were found seropositive (27.76%) [Table/Fig-1]. Among all HCWs, 57 (4.28% of total) were diagnosed positive by Reverse Transcription Polymerase Chain Reaction (RT-PCR) earlier. Out of them 93% (53/57) were found seropositive during the study. Out of 1333 total HCWs, 1276 (95.72%) were healthy or asymptomatic (did not seek medical help, so previous RT-PCR was not done), out of them seropositivity was found among 24.84% (317/1276) [Table/Fig-2].

Serological result	Antibody results	Number (1333)
Seronegative	Non-reactive with Index <1	963 (72.24%)
Seropositive	Reactive with Index >1	370 (27.76%)

[Table/Fig-1]: Overall proportion of Healthcare Workers (HCW) showing seropositivity.

Result	Previous RT-PCR positive (Previously diagnosed)	Previous RT-PCR not done (Asymptomatic)
Seronegative	04 (07%)	959 (75.16%)
Seropositive	53 (93%)	317 (24.84%)
Total	57	1276

[Table/Fig-2]: Seropositivity among previous RT-PCR positive and among asymptomatic Healthcare Workers (HCW).

RT-PCR: Reverse transcription polymerase chain reaction

Among study participants, mean age was 30.7±8.15 years. Among all participants, 783 were male (58.74%) and 550 were female (41.26%). Out of 1333 study participants, 300 (22.5%) were doctors, 332 (24.91%) were nurses, 116 (8.7%) were allied HCW, 420 (31.51%) were general service assistant and 165 (12.38%) were ancillary staff [Table/Fig-3].

DISCUSSION

This study aimed at determining the prevalence of seropositivity against SARS-CoV-2 among HCW, from a large COVID designated

General characteristics		Total (1333)	Seropositive (370)	Seronegative (963)
Mean age (SD) (Years)		30.7±8.15	30.51±7.88	30.77±8.24
Age groups (Years)	<30	780 (58.5%)	219 (28.08%)	561 (71.92%)
	30-50	505 (37.9%)	142 (28.12%)	363 (71.88%)
	>50	48 (3.6%)	9 (18.75%)	39 (81.25%)
Gender	Male	783 (58.74%)	212 (27.08%)	571 (72.92%)
	Female	550 (41.26%)	158 (28.73%)	392 (71.27%)
Job categories				
Doctors		300 (22.50%)	58 (19.33%)	242 (80.67%)
Nurses		332 (24.91%)	105 (31.63%)	227 (68.37%)
Allied health professionals (Laboratory technicians and assistants)		116 (8.70%)	23 (19.83%)	93 (80.17%)
General service assistants		420 (31.51%)	146 (34.76%)	274 (65.24%)
1. Housekeeping staff		122 (9.15%)	53 (43.44%)	69 (56.56%)
2. Food supplying staff		21 (1.58%)	03 (14.29%)	18 (85.71%)
3. Securities staff		93 (6.98%)	36 (38.71%)	57 (61.29%)
4. Guest relationship Executives (GRE)		141 (10.58%)	43 (30.50%)	98 (69.50%)
5. Pharmacy staff		43 (3.22%)	11 (25.58%)	32 (74.42%)
Ancillary staff		165 (12.38%)	38 (23.03%)	127 (76.97%)
1. Administrative staff		115 (8.63%)	25 (21.74%)	90 (78.26%)
2. Biomedical engineers		18 (1.35%)	06 (33.33%)	12 (66.67%)
3. Information Technology (IT) staff		32 (2.40%)	07 (21.88%)	25 (78.12%)

[Table/Fig-3]: Baseline Characteristics of Healthcare Workers (HCW).

SD: Standard deviation

SVPMSR hospital in Ahmedabad. Although SVPMSR hospital took measures to protect all HCWs with a risk-stratified strategy for prevention and control, still the rate of asymptomatic infection and development of immunity among staff was unknown. So, the seropositivity was estimated 100 days after first case was admitted in hospital (on 23rd march 2020). Total 1333 participants were studied during month of July 2020, out of them 370 (27.76%) were found seropositive. This was the cumulative prevalence of seropositivity against SARS-CoV-2 infection which includes presence of antibodies in asymptomatic or healthy and past RT-PCR positive cases. The seropositivity was found higher than infection rate among studies done in China and India which was on basis of RT-PCR positive cases in HCWs [2,3]. Consistent with the efficient transmissibility of SARS-CoV-2, this serological analysis in the hospital setting highlighted a higher percentage of asymptomatic or sub-clinical SARS-CoV-2 infection which does not require medical help.

One such study in Nanjing Drum Tower Hospital, China showed, 17.14% of seropositivity among HCWs. Antibody against two SARS-CoV-2 proteins, recombinant spike protein, Receptor-Binding Domain (RBD) protein and recombinant nucleocapsid protein were measured by enzyme immunoassay [7]. Another such study measured antibodies against SARS-CoV-2 in 578 staff members working at Hospital Clinic, Spain during 28th March to 9th April 2020 and found positivity in 11.2%. They were seropositive for IgM and/or IgG and/or IgA against SARS-CoV-2 [8]. A cross-sectional study was conducted among 100 HCWs in dedicated COVID hospital at the RNT Medical College, Udaipur, India, over a period of two months from April 2020 to May 2020. They found 16% had seropositive response by Antibody based Card Testing, based on principle of Immune chromatographic assay (provided by SIDAK Lifecare Pvt., Ltd.) [9].

The discrepancy among study results could be explained by geographical factors and community prevalence. Other factors could be participants' eligibility criteria, timing of study, testing

method etc., as mentioned in various study [7-9]. The percentage of seropositivity among HCW with prior symptomatic illnesses, confirmed by previous RT-PCR positive results, was significantly higher than asymptomatic individuals (93% versus 24.84%). Out of total 1333 HCW studied, 57 (4.28%) HCW were already diagnosed by RT-PCR previously. The percentage of seropositivity among these was found to be 93%. The 7% seronegativity among previous RT-PCR positive cases were difficult to explain due to novelty of the virus, but it might be due to inadequate antibody production among certain individual or more time required for seroconversion or low sensitivity of test.

The rest 1276 (95.72%) HCW are asymptomatic or minimal symptomatic where RT-PCR was not required previously and so not done. Among them seropositivity was found to be 24.84%, which suggest that there was a past or current infection, which passes asymptomatic or with minimal symptoms, which indicating that large percentage were passes undetected. Also, it suggests that, a large proportion of HCW with past or present infection had not been previously diagnosed with COVID-19, does not seek medical care. This is an indication for requirement of early detection or screening programs to be timely implemented in HCW to decrease in hospital transmission as well as to reinforce the critical role of Infection Preventive Control (IPC) measures, including Personal Protective Equipment (PPE) usage [10]. This study measures seropositivity among various HCW categories according to their job profile. There was considerable heterogeneity in serological response across occupation types. Among all categories, highest seropositivity was found in general service assistants (34.76%) and lowest prevalence was found in doctors (19.33%).

Among general services assistant, highest percentage of seropositivity was found among house keeping staff (43.44%). The explanation for this remains unclear; but exposure to the virus is necessary for seroconversion and it is plausible that exposure to the virus is greater in these employees through respiratory droplets, contaminated surfaces and material while cleaning. It might be due to lacunae in Infection Prevention and Control (IPC) including use of Personal Protective Equipment (PPE), lack of awareness may be due to low literacy level among this category. Numerous studies have stressed the critical importance of strict adherence to IPC measures to prevent infection to HCW infections [11,12]. Many HCWs under this category might be ignoring seriousness of COVID-19 infection due lack of knowledge, which is responsible for higher infection rate among them.

A lower percentage of seropositivity among doctors might be due to strict adherence to IPC measures, appropriate PPE usage, and greater awareness regarding risk and transmission, which protects them from contracting the infection while treating patients. Seropositivity among laboratory staff was 19.83%, which is relatively lower than general seropositivity because they did not come in direct contact with patients, instead they are mainly concerned with processing of patient's sample, which might carry low risk. Regarding the laboratory environment, all samples are considered potentially infectious and aerosols can be generated during routine laboratory procedure like processing and analysing of samples [13]. The nursing staff remains in close contact with COVID-19 patients, which might have put them at high risk of getting infection which reflects in present study with seropositivity of 31.63%, relatively higher than others. It might be due to higher level of patient interaction and higher risk of infection [14]. Among ancillary staff (includes administrative staff), seroprevalence was 23.03%, which

indicating that working in hospital environment increase risk of infection.

A study was done to assess the seroprevalence of antibodies against SARS-CoV-2, among 801 HCW from designated COVID-19 hospitals (400) and non-COVID-19 facilities (401). The analysis was done using Anti-SARS-CoV-2 assay (Roche Diagnostics). Seroprevalence was 11.1%. It was significantly higher among ancillary workers (18.5%) than doctors (7%) and nurses (6.8%) [15]. The discrepancy among seropositivity between various job categories postulated by this study could be multifactorial. Such difference in prevalence of seropositivity raises the possibility of differential occupational exposure and risk, also lack of awareness and seriousness regarding transmission and risk of getting infection. Also, it is affected by various demographic factors includes literacy, residential environment, community prevalence etc., [13-15].

Limitation(s)

Non-generalizability is a drawback of the study. The detection of anti-SARS-CoV-2 antibody in a single sample may potentially miss HCW, yet to seroconvert.

CONCLUSION(S)

This study suggests a higher percentage of seropositivity among asymptomatic COVID-19 infection in healthcare setting. The percentage of seropositivity appears variable depending on job categories of HCW, reason could be multifactorial. The adequacy of PPE equipment and strict adherence to IPC measures offers considerable protection during contact with COVID-19 cases and should be ensured to prevent future nosocomial transmission. Longitudinal studies involving serial sampling will be necessary to provide updated assessments of seroconversion, monitoring antibody level and the longevity of antibody responses.

REFERENCES

- [1] Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun.* 2020;109:102433.
- [2] Xiaoquan L, Minghuan W, Chuan Q, Li T, Lusen R, Daiqi C, et al. Coronavirus Disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary hospital in Wuhan, China. *JAMA Network Open.* 2020;3(5):e209666.
- [3] Jha S, Soni A, Siddiqui S, Batra N, Goel N, Dey S, et al. Prevalence of flu-like symptoms and COVID-19 in healthcare workers from India. *Journal of Association of Physicians of India.* 2020;68(7):01-04
- [4] Jin YH, Cai L, Cheng ZS, Cheng H, Deng T, Fan YP, et al. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (COVID-19) infected pneumonia (standard version). *Mil Med Res.* 2020;7(1):4.
- [5] Zhao J, Yuan Q, Wang H, Liu W, Liao X, Su Y, et al. Antibody responses to SARS-CoV-2 in patients of novel coronavirus disease 2019. *Clin Infect Dis.* 2020;344.
- [6] Siemens SARS-CoV-2 Total (COV2T), Assay for the detection of Total Antibodies to SARS-CoV-2, 11206926_EN Rev. 01,2020-05. Siemens Healthcare GmbH c2021. Available from: <https://doclib.siemens-healthineers.com/document/710513> [Accessed 23 December 2020].
- [7] Yuxin C, Xin T, Jian W, Weijin H, Shengxia Y, Rui H, et al. High SARS-CoV-2 antibody prevalence among healthcare workers exposed to COVID-19 patients. *Journal of Infection.* 2020. Available from: <https://doi.org/10.1016/j.jinf.2020.05.067> [Accessed 23 December 2020].
- [8] Alberto LG, Gemma M, Marta T, Marta V, Caterina G, Alfons J, et al. Seroprevalence of antibodies against SARS-CoV-2 among health care workers in a large Spanish reference hospital. *Nature Communications.* 2020;11:3500.
- [9] Dave M, Vijayvargiya R, Poswal L, Bedi V, Sharma M, Deval N. Study of COVID-19 Seroprevalence Among Healthcare Workers at Dedicated COVID Hospital in Southern Rajasthan. *Indian Journal of Clinical Practice.* 2020;31(2):107-11.
- [10] Ong SWX, Tan YK, Chia PY, Lee TH, Ng OT, Wong MSY, et al. Air, surface environmental, and personal protective equipment contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA.* 2020;323(16):1610-12.
- [11] Canova V, Lederer SH, Piso RJ, Droll A, Fenner L, Hoffmann T, et al. Transmission risk of SARS-CoV-2 to healthcare workers -observational results of a primary care hospital contact tracing. *Swiss Medical Weekly.* 2020;150:w20257.
- [12] Long HN, David AD, Mark SG, Amit DJ, Chuan-Guo G, Wenjie M, 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.

- [13] Giuseppe L, Khosrow A, Maurizio F, Andrea RH, David K, Sunil S, et al. Biosafety measures for preventing infection from COVID-19 in clinical laboratories: IFCC Taskforce Recommendations. *Clin Chem Lab Med.* 2020;58(7):1053-62.
- [14] Shu CC, Yeur HL, Shioh LT. Nursing perspectives on the impacts of COVID-19. *The Journal of Nursing Research.* 2020;28(3):e85.
- [15] Kumar N, Bhartiya S, Desai S, Mutha A, Beldar A, Singh T, et al. Seroprevalence of antibodies against SARS-CoV-2 among health care workers in Mumbai, India. *Asia Pacific Journal of Public Health.* Online 2020. Available from: <https://doi.org/10.1177/1010539520977307> [Accessed 24 December 2020].

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