Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

SARS-CoV-2 antibodies in healthcare workers in a large university hospital, Kerala, India

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To the editor

The COVID-19 pandemic is posing a severe challenge to the fragile healthcare systems of low- and middle-income countries like India. The state of Kerala was the first to report COVID-19 in India, on 30th January 2020, in a medical student who had returned from Wuhan, China [1]. The quantum of cases reported, even after 5 months (as on 14th July 2020) is only 8930 with 36 deaths. The 'Kerala model' of response to the COVID-19 pandemic was to trace, quarantine, test, isolate and treat all travellers from foreign countries as well as neighbouring states, coupled with lockdown. We hypothesize that, because of this practice, the state has succeeded in preventing community spread in the last 5 months. This is evidenced by the fact that there has been no surge in hospital admissions due to influenza-like illness or COVID-19 clusters or outbreaks in occupational settings.

In the background of community transmission, there is always a high risk of transmission to the healthcare worker (HCW) from pre-symptomatic and asymptomatic patients reporting with non-COVID illness, especially in non-COVID-19 hospitals [2]. Identifying infected HCWs, including asymptomatic ones, is important to reduce nosocomial spread [2]. Seroprevalence of SARS-CoV-2 antibodies in HCWs in non-COVID-19 hospitals can act as a surrogate marker for community transmission in the populations for which they cater. Our study aims to understand the prevalence of asymptomatic infection among HCWs in our university hospital to verify the existence of community transmission in the population.

Between 11th and 24th July 2020, healthcare workers in a 1200-bed university teaching hospital were recruited in this prospective, cross-sectional, monocentric study. Ours being a non-COVID-19 hospital, all patients diagnosed with COVID-19 were transferred to the government-designated COVID-19 hospital. All participants completed a standardized form regarding their role, duration of exposure, nature of work, use of personal protective equipment, and signs and symptoms suggestive of COVID-19 over the previous 5 months, and were grouped into high-, intermediate- and low-risk groups. Serum samples from consenting HCWs were tested for SARS-CoV-2 IgG/total antibodies on either the ElecsysR Anti-SARS-CoV-2 total antibodies assay (Roche Diagnostics, Rotkreuz, Switzerland) on a Cobas e 411 analyser or Abbott SARS-CoV-2 IgG (Abbott Laboratories, Chicago, USA) on ARCHITECTR i2000sr platform, according to the manufacturers' instructions. All HCWs who were positive for IgG/total antibodies were interviewed using an extended questionnaire to determine how they acquired the infection. All positive samples were tested by Abbott IgG, Roche total antibody and VITROS Anti-SARS-CoV-2 IgG and total antibody assay (Ortho-Clinical Diagnostics, Rochester, NY, USA), to rule out false-positive results. The positive HCWs were retested for IgG and total antibodies after 14 days, and their nasopharyngeal swabs were tested by reverse transcriptase polymerase chain reaction (RT-PCR) for SARS CoV-2 targeting RdRP and E-gene regions (ViroQ SARS-CoV-2 Kit, BAG Diagnostics, GmbH, Germany). A descriptive analysis of the data was performed. Fisher's exact test was used wherever applicable.

Overall, 635 HCWs consented to participate in the study. All HCWs included in the study were asymptomatic at the time of

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Table 1
Characteristics of 635 healthcare workers at the Amrita Institute of Medical Sciences and Research Centre, Kerala, India

Characteristics	High risk ($n = 281$)	Intermediate risk ($n = 319$)	Low risk ($n = 35$)	Overall ($n = 635$)
Age, years:				
Mean (range)	33.641 (19–67)	35.655 (19–70)	36.4 (23–56)	34.8 (19–70)
Median	30	33	37	32
Sex, F:M ratio	2.08:1	2.97:1	3:2	2.43:1
Nature of job:				
Doctor	136 (48.3%)	22 (6.89%)	0	158 (24.88%)
Nurse	67 (23.8%)	65 (20.37%)	0	132 (20.7%)
Allied health	40 (14.2%)	29 (9.09%)	0	69 (10.8%)
Health care/GSA	11 (4%)	86 (26.95%)	5 (14.28%)	102 (16.06%)
Ancillary	1 (0.3%)	14 (4.38%)	5 (14.28%)	20 (3.1%)
Others	26 (9.2%)	103 (32.28%)	25 (71.42%)	154 (24.2%)
Presence of signs and symptoms suggestive of COVID-19	13 (4.6%)	2 (0.62%)	1 (2.8%)	16 (2.5%)
Social contact with COVID-19 patients	28 (9.9%)	2 (0.62%)	1 (2.8%)	31 (4.88%)
Always wore mask at hospital	273 (97%)	299 (93.73%)	32 (91.42%)	604 (94.11%)
Wore gloves while performing procedures	281 (100%)	238 (74.60%)	12 (34.28%)	531 (83.6%)

High risk, direct contact with influenza-like illness/COVID-19 patients or performing aerosol-generating procedures; intermediate risk, direct contact with patients without influenza-like illness or exposure to all types of patient samples; low risk, no direct contact with patients or their samples; GSA, General Services Administration.

Table 2
Epidemiological characteristics of antibody-positive cases

Subject ID	Occupation/risk category	IgG 1 (Abbott) 1st assay/2nd assay[a]	Total Ab (Roche) 1st assay/2nd assay[a]	Total Ab/IgG (OCD)	RT-PCR nasopharyngeal swab	Symptoms of influenza-like illness	Exposure to COVID-19 patient	Final Interpretation
CAb 138	Emergency technician/high risk	2.41/2.85	0.08/0.09	0.09/0.00	Negative	NO	NO	False positive
CAb 362	Anaesthetist, doctor/high risk	2.66/2.51	0.07/0.08	0.03/0.00	Negative	NO	NO	False positive
CAb 609	Nurse, isolation ward/high risk	0.15/0.18	1.56/1.48	0.03/0.00	Negative	NO	NO	False positive
Positive control	COVID-19 patient	7.62/ND	52.23/ND	ND	Positive	Yes	Yes	True positive

OCD, ortho-clinical diagnostics; ND, not done.
Abbott cut-off S/CO-value = 1.4; Roche cut-off S/CO-value = 1; OCD cut-off S/CO-value = 1.
[a] Second assay done on sample collected 10 days after first sample.

enrolment. The various characteristics of the study population are summarized in Table 1. Although SARS-CoV-2 IgG/total antibodies were detected in three HCWs, all of them were considered falsely positive due to low signal cut-off values All three positive cases were epidemiologically investigated to determine the validity of our results. A repeat serum sample after 14 days from the three HCWs (two positive only by the Abbott IgG assay and one positive only by the Roche assay) yielded the same results. Although all three were categorized as high risk, they denied any episode of influenza-like illness or contact with laboratory-confirmed COVD-19. RT-PCR of a nasopharyngeal swab was also negative. Overall, the seroprevalence of SARS-CoV-2 antibody was found to be 0% (see Table 2).

Even after 5 months of the report of the first case of COVID-19, our study found no prevalence of the SARS-CoV-2 antibody in HCWs in our institution. This may be partly due to the 'Kerala model' for the response to the COVID-19 pandemic, which has also been acknowledged by the WHO [3]. The robust implementation of infection control protocols and strict adherence to personal protective equipment guidelines evidenced by the high adherence rates (Table 1) also had a significant role to play in preventing infection in HCWs. Recent studies from high-income countries like the Germany, Italy, England and Belgium reported prevalence rates of 1.6%, 3.4%, 6% and 6.4% respectively [4–6].

The main limitation of our study is that it was done in a single private centre, which was a designated non-COVID-19 hospital with a manageable patient load, good infrastructure and robust infection control practices. The same may not be true in COVID-19 and non-COVID-19 public sector hospitals with a large patient burden, limited staff, inadequate personal protective equipment and frequent breaches in infection control practices. The data on adherence to infection control protocol is limited by the fact that the staff might have felt pressured to say they were strictly adhering to it, in terms of personal protective equipment, even if they did not. Another major limitation is the overall low prevalence of COVID-19 in the general population, as the epidemiological peak in Kerala has yet to be reached, leading to false positives in our serological assays which had specificities of <100%. The findings of our study should be considered an exception, as similar studies in other high-burden India states is sure to reveal higher seroprevalence.

Ethical approval

This study was approved by the institutional review board of Amrita Institute of Medical Sciences & Research Centre (IRB-AIMS-2020-230).

Author contributions

AK: conceptualization, resources, project administration, supervision, validation, investigation, data curation, formal analysis, writing—original draft. DS: resources, supervision, investigation, project administration, writing—review & editing. AR: data curation, formal analysis, investigation. KS: data curation, formal analysis, investigation. LB: resources, investigation, validation, writing—review & editing. BKV: resources, supervision, project administration, writing—review & editing.

Transparency declaration

We certify that there is no entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. No funding was received for this work.

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