



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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Short Report

COVID-19 among healthcare workers in a specialist infectious diseases setting in Naples, Southern Italy: results of a cross-sectional surveillance study

F.M. Fusco^{a,*}, M. Pisaturo^a, V. Iodice^a, R. Bellopede^b, O. Tambaro^a, G. Parrella^a, G. Di Flumeri^a, R. Viglietti^a, R. Pisapia^c, M.A. Carleo^d, M. Boccardi^c, L. Atripaldi^e, B. Chignoli^f, N. Maturo^b, C. Rescigno^c, V. Esposito^d, R. Dell'Aversano^g, V. Sangiovanni^a, R. Punzi^h

^a UOC Infezioni Sistemiche e dell'Immunodepresso, AORN Ospedali dei Colli, P.O. 'D. Cotugno', Naples, Italy

^b UOC Pronto Soccorso Infettivologico ed Accettazione, AORN Ospedali dei Colli, P.O. 'D. Cotugno', Naples, Italy

^c UOC Malattie Infettive ad Indirizzo Neurologico, AORN Ospedali dei Colli, P.O. 'D. Cotugno', Naples, Italy

^d UOC Immunodeficienze e Malattie Infettive di Genere, AORN Ospedali dei Colli, P.O. 'D. Cotugno', Naples, Italy

^e UOC Microbiologia e Virologia, AORN Ospedali dei Colli, P.O. Monaldi, Naples, Italy

^f UOSD Medicina del Lavoro, AORN Ospedali dei Colli, Naples, Italy

^g UOC Direzione Medica di Ospedale, AORN Ospedali dei Colli, P.O. 'D. Cotugno', Naples, Italy

^h UOC Malattie Infettive ed Urgenze Infettivologiche, AORN Ospedali dei Colli, P.O. 'D. Cotugno', Naples, Italy

ARTICLE INFO

Article history:

Received 5 May 2020

Accepted 15 June 2020

Available online 18 June 2020

Keywords:

COVID-19

SARS-CoV-2

Healthcare workers

Surveillance

Infection control

SUMMARY

A coronavirus disease 2019 (COVID-19) surveillance study was performed in March–April 2020 among asymptomatic healthcare workers (HCWs) at a specialist infectious diseases hospital in Naples, Italy. All HCWs underwent two rounds of molecular and serological testing for severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). One hundred and fifteen HCWs were tested; of these, two cases of infection were identified by reverse transcriptase polymerase chain reaction and two HCWs were SARS-CoV-2 immunoglobulin G seropositive. The overall prevalence of current or probable previous infection was 3.4%. The infection rate among HCWs was reasonably low. Most of the infected HCWs had been asymptomatic for the preceding 30 days, which supports the need for periodic screening of HCWs for COVID-19.

© 2020 The Healthcare Infection Society. Published by Elsevier Ltd. All rights reserved.



* Corresponding author. Address: UOC Infezioni Sistemiche e dell'Immunodepresso, P.O. 'D. Cotugno', Azienda Ospedaliera dei Colli, Naples, Italy. Tel.: +390817067408.

E-mail address: francescomaria.fusco@ospedaliideicolli.it (F. M. Fusco).

Introduction

Since the beginning of the coronavirus disease 2019 (COVID-19) epidemic, hospital-associated transmission has been recognized as an important route of spread [1,2]. According to

preliminary data from China, healthcare workers (HCWs) facing COVID-19 represent a high-risk category [1,3]. This was also confirmed in early reports from Italy, where HCWs have represented 9% of total cases [4].

Few data are available about the number of asymptomatic patients and their role in disease transmission. Recent data suggest that transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) occurs before the onset of symptoms [5]. These data are even more important in HCWs, where knowledge about transmission dynamics is scanty. In particular, understanding the rate of infected HCWs, including asymptomatic cases, is essential to reduce nosocomial spread.

A serological test for immunoglobulin G (IgG) and IgM for anti-COVID-19 determination became available in March 2020. Antibody tests, while not useful for diagnostic purposes because of the time needed for the immune response, may reveal patients who have had very mild or asymptomatic infections [6]. Thus, these tests can be useful for seroprevalence studies among at-risk populations, such as HCWs.

This paper reports the results of a cross-sectional surveillance study conducted from 23rd March to 2nd April 2020 among HCWs working in a specialist infectious diseases setting, the 'D. Cotugno' hospital in Naples, Italy. The aim of the study was to understand the prevalence of active and asymptomatic infection among HCWs, and to verify the appropriateness of infection control measures in place.

Methods

A cross-sectional surveillance study was conducted among HCWs working with suspected and confirmed cases of COVID-19.

Study setting

This study was undertaken in the emergency department (ED) and two medical divisions ('first' and 'third' divisions) at 'D. Cotugno' Hospital. 'D. Cotugno' Hospital is a specialist infectious diseases hospital dedicated to the care of suspected and confirmed cases of COVID-19. The infectious diseases ED is open on a 24-h basis. At the time of the study, approximately 150 cases of suspected and confirmed COVID-19 had already been managed within the hospital. The first and third medical divisions were selected because they were the first to be dedicated to COVID-19, admitting the first confirmed cases on 26th and 29th February 2020, respectively.

Inclusion criteria and study period

All HCWs (medical doctors, nurses, other careworkers) working in the ED, and the First and Third Divisions during the COVID-19 epidemic between 26th February and 23rd March were included. Moreover, given the high workload in the ED, medical doctors from other divisions performed some shifts in the ED in order to support their colleagues. As such, all medical doctors from other divisions who performed at least one shift in the ED over the study period were included. Inclusion criteria were: completed a surveillance test according to the study protocol;

Table 1

Characteristics of 115 healthcare workers in the emergency department, and First and Third Medical Divisions at 'D. Cotugno' Hospital during the coronavirus disease 2019 (COVID-19) outbreak, February–March 2020

Gender	
Male (N, %)	59 (51%)
Female (N, %)	56 (49%)
Age in years (median, interquartile range)	43 (32–51.5)
Role	
Medical doctor (N, %)	26 (23%)
Nurse (N, %)	57 (50%)
Other careworker (N, %)	32 (27%)
Place of work	
Emergency department (N, %)	59 (51%)
Medical divisions (N, %)	56 (49%)
Type of exposure to patients with COVID-19	
Direct care (N, %)	107 (93%)
Contact with patient or patient's environment without direct care (N, %)	8 (7%)
Duration of exposure to patients with suspected/confirmed COVID-19	
>30 days (N, %)	46 (40%)
<30 days (N, %)	69 (60%)
Working time at 'D. Cotugno' Hospital	
>1 year (N, %)	69 (60%)
<1 year (N, %)	46 (40%)
Participation in training event on PPE	
Yes (N, %)	102 (89%)
No (N, %)	13 (11%)

PPE, personal protective equipment.

asymptomatic at the time of surveillance; and gave consent for the use of personal data. No exclusion criteria were applied.

Surveillance methods and data source

The surveillance tests were performed between 23rd March and 2nd April 2020 (surveillance period). Participants underwent two nasopharyngeal swabs for reverse transcriptase polymerase chain reaction (RT-PCR) of SARS CoV-2 RNA, and two serological tests for SARS-CoV-2-specific IgM and IgG. All HCWs underwent these tests between 23rd and 26th March 2020, and again between 30th March and 2nd April 2020. For each HCW, the two tests were performed 6–7 days apart. A standardized form was completed by all participants regarding their role, level and duration of exposure to patients with COVID-19, years of experience, and participation in training events about the use of personal protective equipment (PPE). Participants were also asked about the occurrence of any symptoms over the previous 30 days.

Outcomes

Outcomes were the presence of COVID-19 infection, defined as a positive molecular RT-PCR on nasopharyngeal swab, irrespective of serological results, and the presence of a probable

Table II

Factors associated with coronavirus disease 2019 (COVID-19) positivity (current infection and probable previous infection) among 115 healthcare workers (HCWs) at 'D. Cotugno' Hospital, Naples, Italy

	COVID-19 positive HCWs (N, %)	COVID-19 negative HCWs (N, %)	P-value
No. of HCWs	4	111	
Gender			0.344
Male (N, %)	3 (75%)	56 (50.4%)	
Female (N, %)	1 (25%)	54 (49.6%)	
Age in years (median, interquartile range)	44 (34–55)	43 (32–51.5)	0.143
Role			
Medical doctor (N, %)	1 (25%)	25 (22.5%)	0.921
Nurse (N, %)	2 (50%)	55 (49.5%)	0.986
Other careworker (N, %)	1 (25%)	31 (28%)	0.898
Place of work			0.931
Emergency department (N, %)	3 (75%)	56 (50%)	
Medical divisions (N, %)	1 (25%)	55(50%)	
Type of exposure to patients with COVID-19			0.578
Direct care of patient (N, %)	4 (100%)	103 (92.8%)	
Contact with patient or patient's environment without direct care (N, %)	0	8 (7.2%)	
Duration of exposure to patients with suspected or confirmed COVID-19			0.678
>30 days (N, %)	2 (50%)	44 (39.6%)	
<30 days (N, %)	2 (50%)	67 (60.4%)	
Working time at 'D. Cotugno' Hospital			0.096
>1 year (N, %)	4 (100%)	65 (58.5%)	
<1 year (N, %)	0	46 (41.5%)	
Participation in training event on PPE			0.467
Yes (N, %)	4 (100%)	98 (88.3%)	
No (N, %)	0	13 (11.7%)	
Presence of symptoms in preceding 30 days			0.149
Yes (N, %)	1 (25%)	7 (6.3%)	
No (N, %)	3 (75%)	104 (93.7%)	

PPE, personal protective equipment.

previous infection, defined as positivity for IgG, with negative RT-PCR on nasopharyngeal swab.

Laboratory methods

Molecular tests were performed using RT-PCR targeted at specific SARS-CoV-2 ORF-1a/b and E-gene regions (cobas 6800/8800 systems, Roche, Basel, Switzerland), and IgM/IgG serological tests were performed using chemiluminescence testing (MAGLUM 2000 Plus 2019-nCov IgM and IgG assays, Snibe, China).

Statistical methods

Descriptive analysis of the data was performed. The outcomes were correlated with different variables using Chi-squared test and Student's *t*-test, where appropriate, with $P < 0.05$ taken to indicate significance. Stat Calc Version 9 was used for statistical analysis.

Results

Of 120 eligible participants, 115 HCWs were included in the study. The remaining five patients underwent surveillance tests but did not complete the standardized form and did not give

their consent for use of personal data. The main characteristics of the study population are summarized in [Table I](#). Most HCWs had >1 year of work experience at 'D. Cotugno' Hospital. Among those who had worked at the study hospital for <1 year, many had been hired very recently in response to the COVID-19 epidemic. Almost all of the HCWs had participated in institutional training events on the use of PPE. Among those who did not participate in the training events, most (8/13, 62%) were medical doctors and the others had been recruited very recently (See [Table II](#)).

A few HCWs reported mild symptoms in the 30 days preceding the surveillance period: six (5%) reported a mild influenza-like illness and two (1.7%) reported other symptoms (sore throat, rhinitis). All HCWs included in the study were asymptomatic at the time of specimen collection.

Two of 115 (1.7%) HCWs had a positive molecular test in the first round of testing. After 6–7 days, all 113 initially negative HCWs were negative on repeat molecular testing. Two of the 115 HCWs had IgG antibodies at a significant titre (>30, upper normal value=1). All HCWs were negative for IgM antibodies. Both of the HCWs with positive molecular tests were seronegative, and no HCWs seroconverted between the first and second rounds of testing.

Overall, two cases of COVID-19 and two probable previous cases were identified, giving an overall prevalence of 3.4%.

None of the explored variables were significantly associated with current or probable previous infection. All HCWs with confirmed or probable COVID-19 (4/4, 100%) had worked at the study hospital for >1 year, compared with 65 of 111 (58.5%) HCWs without COVID-19; this difference was not significant ($P=0.096$).

A brief epidemiological investigation was conducted among the positive cases. The two HCWs with probable previous infection were a nurse and a careworker working in the ED. One reported mild flu-like symptoms some weeks previously. The HCWs with positive results on molecular testing were a medical doctor working in the Medical Division and the ED, and a nurse working in the Third Medical Division. After diagnosis, one of the HCWs developed mild symptoms and the other remained asymptomatic. No clear exposure event occurred, and no significant breaches of infection control procedures were reported. According to the epidemiological investigation, no close contacts occurred between cases, except for the two probable previous infections who constantly worked together on the same shifts.

Discussion

This study found an overall prevalence of COVID-19 in the study population of 3.4%. To the best of the authors' knowledge, this is the first study to report the prevalence of COVID-19 among asymptomatic HCWs in a specialist setting. Recent studies from the Netherlands and the UK reported prevalence rates in HCWs of 9% and 18%, respectively. However, both studies were performed in general hospital settings using molecular testing alone to test symptomatic staff [7,8].

In the absence of comparative data from similar settings, it is considered that the prevalence of COVID-19 in HCWs is acceptably low. The fact that some infected HCWs had been asymptomatic for the preceding 30 days supports the need for periodic screening for COVID-19 among HCWs, in order to promptly remove potentially infectious HCWs from the workplace. The epidemiological investigation failed to identify the modes of exposure. Accordingly, the possibility that the infection was acquired in the community instead of within the hospital cannot be excluded. In at least one case, family members of the HCW were affected by COVID-19 over the same period, making intrafamilial transmission likely. The absence of detection of any new cases between the two rounds of testing may help to define an appropriate retesting interval in hospitals considering periodic sampling of HCWs. This also provides assurance about the reliability of a single nasopharyngeal sample at a point in time as a proxy for the individual's true COVID-19 status.

A limitation of this study was the small sample size, meaning that the study was not powered to identify risk factors for infection of HCWs. HCWs from the ED, and the First and Third Medical Divisions were included because they shared the same level of exposure and faced similar organizational and logistical challenges in the initial phases of the epidemic. Another limitation was the performance of diagnostic tests. Currently, nasopharyngeal swabs are used most frequently to obtain

samples for molecular testing, but false-negative results are known to occur; as such, the prevalence of COVID-19 among HCWs may have been underestimated [8]. Limited data are available on the accuracy of serology tests, meaning that the number of probable previous infections may have been under- or overestimated [6,9].

In conclusion, even in a setting heavily involved in the management of patients with COVID-19, the prevalence of infection among HCWs was reasonably low, which is presumably a testament to the infection control measures. The observation that the majority of HCWs with evidence of COVID-19 reported no symptoms in the preceding 30 days points to the need for surveillance protocols to identify asymptomatic and potentially infectious HCWs so that they can be removed from the workplace. Currently, molecular testing of nasopharyngeal swabs represents the only means of assessing current infection. While serological tests may have a role in identifying past infections, there remains uncertainty around their diagnostic performance. The authors believe that there is a place for periodic testing of HCWs, and that the frequency of testing by molecular methods should be determined on a case-by-case basis, depending on the level of exposure, feasibility of screening and laboratory capacity. The use of serological tests is also promising, but some uncertainties about their diagnostic performance remain.

Acknowledgments

The authors wish to thank Ms Emilia Mauriello and Ms Carmela Di Martino for their efforts in supporting this work.

Conflict of interest statement

None declared.

Funding sources

None.

References

- [1] Zhou P, Huang Z, Xiao Y, Huang X, Fan XG. Protecting Chinese healthcare workers while combating the 2019 novel coronavirus. *Infect Control Hosp Epidemiol* 2020;41:745–6.
- [2] Koh D. Occupational risks for COVID-19 infection. *Occup Med (Lond)* 2020;70:3–5.
- [3] Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk factors of healthcare workers with corona virus disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China. *Clin Infect Dis* 2020. <https://doi.org/10.1093/cid/ciaa287>.
- [4] Livingston E, Bucher K. Coronavirus disease 2019 (COVID-19) in Italy. *JAMA* 2020;323:1335.
- [5] He X, Lau EHY, Wu P, Deng X, Wang J, Hao X, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nat Med* 2020;26:672–5.
- [6] Center for Infectious Disease Research and Policy. Antibody tests may hold clues to COVID-19 exposure, immunity — but it's complicated. CIDRAP; 2020. Available at: <https://www.cidrap.umn.edu/news-perspective/2020/04/antibody-tests-may-hold-clues-covid-19-exposure-immunity-its-complicated> [last accessed July 2020].

- [7] Tostmann A, Bradley J, Bousema T, Yiek WK, Holwerda M, Bleeker-Rovers C, et al. Strong associations and moderate predictive value of early symptoms for SARSCoV-2 test positivity among healthcare workers, the Netherlands, March 2020. *Euro Surveill* 2020;25:pii=2000508.
- [8] Keeley AJ, Evans C, Colton H, Ankcorn M, Cope A, State A, et al. Roll-out of SARS-CoV-2 testing for healthcare workers at a large NHS foundation trust in the United Kingdom, March 2020. *Euro Surveill* 2020;25:2000433.
- [9] Yan Y, Chang L, Wang L. Laboratory testing of SARS-CoV, MERS-CoV, and SARS-CoV-2 (2019-nCoV): current status, challenges, and countermeasures. *Rev Med Virol* 2020;30:e2106.