General review • DOI: 10.2478/pneum-2022-0004 • 70 • 2021 • 11-17

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Pneumologia

SARS-CoV-2 epidemiological surveillance of healthcare professionals working in an inpatient rehabilitation facility

Carlo Tomino[1], Dolores Limongi[2,*], Paola Checconi[2], Cecilia Ambrosi[2], Lucia Gatta[1], Laura Vitiello[3], Carla Prezioso[4], Stefania Proietti[5], Federica Marcolongo[5], Neda Soltan Pour[6], Anna Teresa Palamara[2,7], Stefano Bonassi[5,8], Patrizia Russo[5,8]

[1]*Department of Scientific Direction, IRCCS San Raffaele Roma, Rome, Italy*
[2]*Department of Human Sciences and Promotion of the Quality of Life, IRCCS San Raffaele Roma, San Raffaele Roma Open University, Rome, Italy*
[3]*Department of Scientific Direction, Laboratory of Flow Cytometry, IRCCS San Raffaele Roma, Rome, Italy*
[4]*Department of Public Health and Infectious Diseases, IRCCS San Raffaele Roma; Sapienza University of Rome, Rome, Italy*
[5]*Unit of Clinical and Molecular Epidemiology, Department of Scientific Direction, IRCCS San Raffaele Roma, Rome, Italy*
[6]*Department of Pharmacy, University of 'Tor Vergata' Rome, Italy*
[7]*Department of Public Health and Infectious Diseases, Laboratory affiliated to Istituto Pasteur Italia-Fondazione Cenci Bolognetti, Sapienza University of Rome, Italy*
[8]*Department of Human Sciences and Quality of Life Promotion, San Raffaele Roma Open University, Rome, Italy*

Abstract

English:

Background: *Healthcare Workers (HCW) represent one of the most vulnerable subject groups to be infected by severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2).*
Aims: *Between March 2020 and May 2020, we decided to implement a surveillance programme for HCW that aimed to (1) strengthen the safety of the employees; (2) estimate the punctual prevalence of SARS-CoV-2 infection in asymptomatic operators; (3) use the results to train personnel and to strengthen surveillance for applying and validating preventive strategies; and (4) compare the observed prevalence and the infection characteristics with a real-life (RL) sample from non-healthcare settings.*
Methods: *A nasopharyngeal (NP) swab in HCW, representative of all mansions, and RL subjects was performed after informed consent signing (T0), then after 6 d ± 24 h (T1) and after 12 d ± 24 h (T2). The presence of SARS-CoV-2 mRNA was tested by commercially available real-time PCR.*
Results: *A total of 219 HCW and 100 RL subjects were enrolled; and among all the subjects, only 1 HCW resulted positive at the swab testing throughout the study period. The positive subject was an asymptomatic nurse without any comorbidities or risk factors.*
Conclusions: *Our experience supports the utility of implementing dedicated surveillance programmes for the HCW. The efficiency in keeping low the number of the infection, maintaining the psychological well-being of the personnel and the availability of a tool which in case of infection may allow the early identification of clusters are critical issues which encourage the planning and implementation of such programmes NIH clinicaltrials.gov (NCT04913701).*

Keywords

SARS-CoV-2 • COVID-19 nucleic acid testing • healthcare workers • surveillance • prevalence • prevention

Supravegherea epidemiologică SARS-CoV-2 a profesioniștilor din domeniul sănătății care lucrează într-o unitate de reabilitare intraspitalicească

Rezumat

Romanian:

Introducere: *Personalul medical reprezintă unul dintre cele mai vulnerabile grupuri de subiecți care pot fi infectați cu virusul SARS-CoV-2.*
Obiective: *Între martie 2020 și mai 2020 am decis să implementăm un program de supraveghere a personalului medical care vizează (1) consolidarea siguranței angajaților; (2) estimarea prevalenței punctuale a infecției cu SARS-CoV-2 la operatorii asimptomatici; (3) utilizarea rezultatelor pentru instruirea personalului și pentru consolidarea supravegherii în scopul aplicării și validării strategiilor preventive; (4) compararea prevalenței observate și a caracteristicilor infecției cu un eșantion din viața reală din medii non-sanitare.*

**Corresponding author: Dolores Limongi*
E-mail: dolores.limongi@sanraffaele.it

Metoda: *La personalul medical precum si la subiectii non personal medical s-a utilizat un tampon nazofaringian, reprezentativ, efectuat după semnarea consimțământului informat (T0), apoi după 6 zile ± 24 ore (T1) și după 12 zile ± 24 ore (T2). Prezența mRNA SARS-CoV-2 a fost testată prin real time PCR disponibil comercial.*
Rezultate: *au fost înrolați 219 subiecți din randul personalului medical și 100 subiecti din viata reala – non personal medical. Dintre toți subiecții, pe toată perioada studiului, doar la un subiect din randul personalului medical rezultatul a fost pozitiv la testarea cu tampon. Subiectul pozitiv a fost o asistentă medicala asimptomatică, fără comorbidități sau factori de risc.*
Concluzii: *Experiența noastră susține utilitatea implementării programelor de supraveghere dedicate pentru personalul medical. Eficiența în menținerea unui număr scăzut de infecții și menținerea bunăstării psihologice a personalului, precum și disponibilitatea unui instrument care, în caz, poate permite identificarea timpurie a clusterelor, sunt aspecte critice care încurajează planificarea și implementarea unor astfel de programe NIH clinicaltrials.gov (NCT04913701).*

Cuvinte-cheie

SARS-CoV-2 • testarea acidului nucleic COVID-19 • personalul medical • supraveghere • prevalență • prevenire

Introduction

At the end of December 2019, a novel Coronavirus, named severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2), emerged; it was reported first in the city of Wuhan, China, causing a severe outbreak of unusual pneumonia later named COronaVIrus Disease 2019 (COVID-19) (1). Italy was the first country in Europe to face the pandemic and the first patient was diagnosed on 20th February 2020 in Lombardy (2,3). Consequently, on 8th March 2020, the Italian Government made extraordinary measures for Lombardy and Veneto (North, North-East Italy), such as containment restriction to limit viral transmission. Then, on 11th March 2020, all the measures were extended to all national territory (rigid lockdown, Italian Phase I), followed by a mitigation phase (4th May–14th June; Italian Phase II), and finally, from 15th June, by a coexistence phase, the last of which was followed in November 2020 by new restrictive measures caused by a second outbreak. From March 2020 to the end of May 2020, 169 Italian physicians died of COVID-19, for a global total of 359 casualties as on 5th June 2021 (4). On 24th March 2020, the Italian Ministry of Health and the Union of health workers, social and health services signed a protocol to guarantee adequate levels of protection for all personnel operating in the health and social assistance services, adequate personal protective equipment and the conduction of periodic tests for medical and paramedical personnel to detect any COVID-19 contagions (5).

According to the circular 0011715 – 03/04/2020-DGPRE-DGPRE-P of the Ministry of Health, Directorate-General for Health Prevention Office 5 Prevention of Transmissible Diseases and International Prophylaxis, the execution of the diagnostic test should be given priority in clinical cases, symptomatic/pauci-symptomatic cases and symptomatic family and/or residential risk contacts, focusing on the identification of contacts at risk in the 48 h before the onset of the symptoms for the cases that are positive or clinically suspect, as indicated in circular No. 9774 of 20/03/2020. The execution of the tests must be ensured for health professionals and those at similar higher risk, according to the definition made by health companies, which are required to carry it out as employers.

Objectives

The IRCCS San Raffaele Roma (specialised health facility for rehabilitation) in the period between March 2020 and May 2020 (first wave of COVID-19) decided to implement a surveillance programme aimed to (1) strengthen the safety for the employees; (2) estimate the punctual prevalence of SARS-CoV-2 infections in asymptomatic operators; (3) use the results obtained from the steps in the previous points to train personnel, strengthen surveillance in a rehabilitation facility and apply and validate preventive strategies; and (4) compare the observed prevalence and characteristics of the infection with a real-life (RL) sample from non-healthcare settings. The results of these interventions and their effectiveness in implementing preventive strategies for healthcare professionals and inpatients will be discussed thereafter.

Materials and methods

Study design and setting

A surveillance programme was launched on 26th March 2020 and closed on 1st June 2020. At the end of the study, 219 healthcare workers (HCW) and 100 control subjects recruited in the RL setting and referring to the IRCCS San Raffaele Roma for routine screening, were recruited and subjected to nasopharyngeal (NP) swab test for the molecular detection

of SARS-CoV-2. All subjects were asked to provide socio-demographic information and to report indicators of potential risk, i.e. the presence of any diseases or ongoing therapies (47% did not respond or provided partial responses). They were eventually requested to confirm their acceptance to participate in the study by signing the informed consent form. The NP swab in healthcare professionals was performed after signing the informed consent (T0), then after 6 d ± 24 h (T1) and after 12 d ± 24 h (T2). NP swabs (both nostrils) were collected by trained medical personnel, according to Istituto Superiore di Sanità (ISS) recommendations and Centre for Disease Control and Prevention (CDC) guidelines (6,7). All subjects, after performing the NP swab test, remained isolated at home until the result of the test was available and showed a negative outcome.

The research was performed in accordance with the 1964 Declaration of Helsinki standards and its later amendments, and was approved by the Institutional Review Board. The study was registered to NIH clinicaltrials.gov (NCT04913701). On 2nd June, the admission of a SARS-CoV-2 positive patient, sent to our hospital without a proper diagnostic assessment, determined the outbreak of a cluster of positive cases involving inpatients and healthcare workers. The cluster was immediately notified to the local health authority, which was in charge of the cluster management. This event ended the surveillance programme.

Extraction and real-time reverse transcriptase-polymerase chain reaction (rRT-PCR)

Swabs were tested for the presence of SARS-CoV-2 mRNA by commercially available real-time PCR, SeegeneAllplexTM2019-nCoV Assay (Seegene, Seoul, South Korea), according to manufacturer protocols. Automated RNA extraction and PCR setup were carried out using Seegene NIMBUS, a liquid-handling workstation. Real-time PCRs were run on a CFX96TMDx platform (Bio-Rad Laboratories Inc., Hercules, CA, USA) and interpreted by Seegene's Viewer software. The Seegene assay identified the virus by a multiplex real-time PCR targeting three viral genes (*E, RdRP* and *N*), complying with international testing protocols. Validation of the results was performed as recommended by the National Reference Laboratory of ISS, and the Seegene Assay has been used for COVID-19 diagnosis (8). The limit of detection for the assay was 4.8 copies/mL (8,9).

Results

A total of 319 people were enrolled on a voluntary basis in the study; 219 were HCW not in front-line for SARS-CoV-2 potential exposure and 100 were a control group recruited in the RL setting, who underwent the NP swab test for the molecular detection of SARS-CoV-2. All subjects were followed for at least 3 weeks and received three swab examinations once a week. The proportion of HCW that refused to repeat the swab was around 10%. For privacy reasons, the list of these subjects could not be recorded. Gender (F/M% ratio was 42/58 in RL subjects and 70.3/29.7 among HCW) and mean age (49.5 *vs*. 41.4) differed across groups (Table 1). HCW professional qualifications were representative of all mansions, with a prevalence of nurses, doctors and physiotherapists amounting to 42.9%, 21.0% and 14.6%, respectively (Table 1). Symptomatic subjects were 6.7% (RL) and 14% (HCW), while subjects with comorbidities were 22% (RL) and 17.4% (HCW). The most common comorbidities were respiratory diseases, i.e. asthma and allergy (9 subjects), hypertension (21 subjects)

Table 1. Demographic and characteristics of the analysed sample of subjects.

Variables	Subjects RL (*n* = 100)	Healthcare workers (*n* = 219)	*P*-value*
Females/males	42 (42%) 58 (58%)	154 (70.3%) 65 (29.7%)	<0.001
Mean age ± SD	49.5 ± 12.5	41.4 ± 10.9	<0.001
Non-smokers	60 (60%)	74 (33.8%)	
Current smokers	33 (33%)	54 (24.6%)	NS
Ex-smokers	7 (7%)	12 (5.5%)	
Not responders	–	79 (36.1%)	
Occupation			NS
Administrative staff		2 (0.9%)	
Pharmacist		1 (0.5%)	
Physician		46 (21%)	
Nurse		94 (42.9%)	
Physiotherapist		32 (14.6%)	
O.S.S.		30 (13.7%)	

continued

Table 1. continued

Variables	Subjects RL (*n* = 100)	Healthcare workers (*n* = 219)	*P*-value*
Technical assistant		4 (1.8%)	
Others		10 (4.6%)	
Close contact of COVID-19 case (14 d)	2 (2.0%)	4 (1.8%)	
Symptomatic	14 (14%)	10 (6.7%)	NS
- Headache	1	2	
- Cough	6	1	
- Temperature	2	–	
- Cold	1	1	NS
- Sore throat	–	1	
- More symptoms	4	2	
- Others	–	3	
Comorbidity**			
Yes	22 (22.0%)	38 (17.4%)	
No	78 (78%)	115 (52.5%)	NS
Not responders	–	66 (30.1%)	
Prescribed drugs			
Yes	23 (23%)	48 (22%)	
No	77 (77%)	105 (47.9%)	NS
Not responders	–	66 (30.1%)	

**P*-values were computed by Student's *t*-test or the Chi-squared test. Significant results are highlighted in bold. 'NS' indicates a *P*-value > 0.05.
**Minor Respiratory diseases i.e. asthma and allergy (9 subjects), hypertension (21 subjects) and diabetes (3 subjects).
COVID-19, CoronaVIrus Disease 2019; HCW, healthcare workers; O.S.S., Healthcare Member Operator; RL, real-life; SD, standard deviation, NS, not significant.

and diabetes (3 subjects). Smokers were 33% (RL) and 24.6% (HCW), respectively (Table 1).

Among all subjects, only 1 out of a total of 319 RL + HCW or 219 among HCW resulted positive for the NP swab testing throughout the study period (Figure 1). The positive subject was an asymptomatic nurse without any comorbidities or risk factor such as smoking. For the limited number of positive cases, only descriptive statistics were performed as described in Table 1. The study was interrupted following the identification of the San Raffaele cluster on 2nd June 2020.

Discussion

The extremely low overall positivity rate among HCW, 1 case over 219 workers (0.46%), which is much lower than findings reported in other studies performed in Italy, for instance in the University of Brescia, where the swab positivity rate in low-risk HCW reached 9% (10), was the main outcome of the present study. Similar studies run in rehabilitation centres both in Central Europe (The Netherlands – Amsterdam, and Luxembourg) and in Northern Italy (Milan, Reggio Emilia and Venice) on 15,000 physical therapists from April to May 2020 revealed that 13.1% of subjects resulted positive with a peak in March 2020. The infection rate was 3.6%, 10 times higher than the 0.38% reported in the Italian general population (updated on 30th May 2020) (11). A third study conducted in the Milan area, in a large public healthcare organisation between 25th February and 7th April 2020 in HCW, reported 10% positive NP swabs (12). The critical role of HCW in spreading the infection is confirmed by Italian official reports, which showed that in April 2020 11.7% of all COVID-19 cases were diagnosed in HCW (13). The proportion of positive workers observed at the IRCCS San Raffaele Roma (0.46%) was perfectly in line with the Italian general population (0.38%) (11). It is important to bear in mind that our Institute is located in Central Italy, Rome, and started this programme of surveillance when the number of cases was not very high in Rome. Indeed, in Rome, the number of COVID-19 patients started to grow: on 25th February, there were 3 patients, and the number continued to ascend until a peak was reached on 28th May 2020 with 5614 new cases (14), a lower rate than in the north of Italy, when in Lombardy on 21st March over 3200 new cases were reported in a single day (15). It is therefore important to reiterate that early surveillance made us capable of limiting the number of cases when the incidence of the pandemic began to increase. The experience built with this surveillance programme on HCW allowed our group to acquire the necessary expertise to extend these procedures to hospitalised patients, an initiative which started close to the first peak of the pandemic in Rome. Although the sample is relatively small in our study, lessons can be learned. First

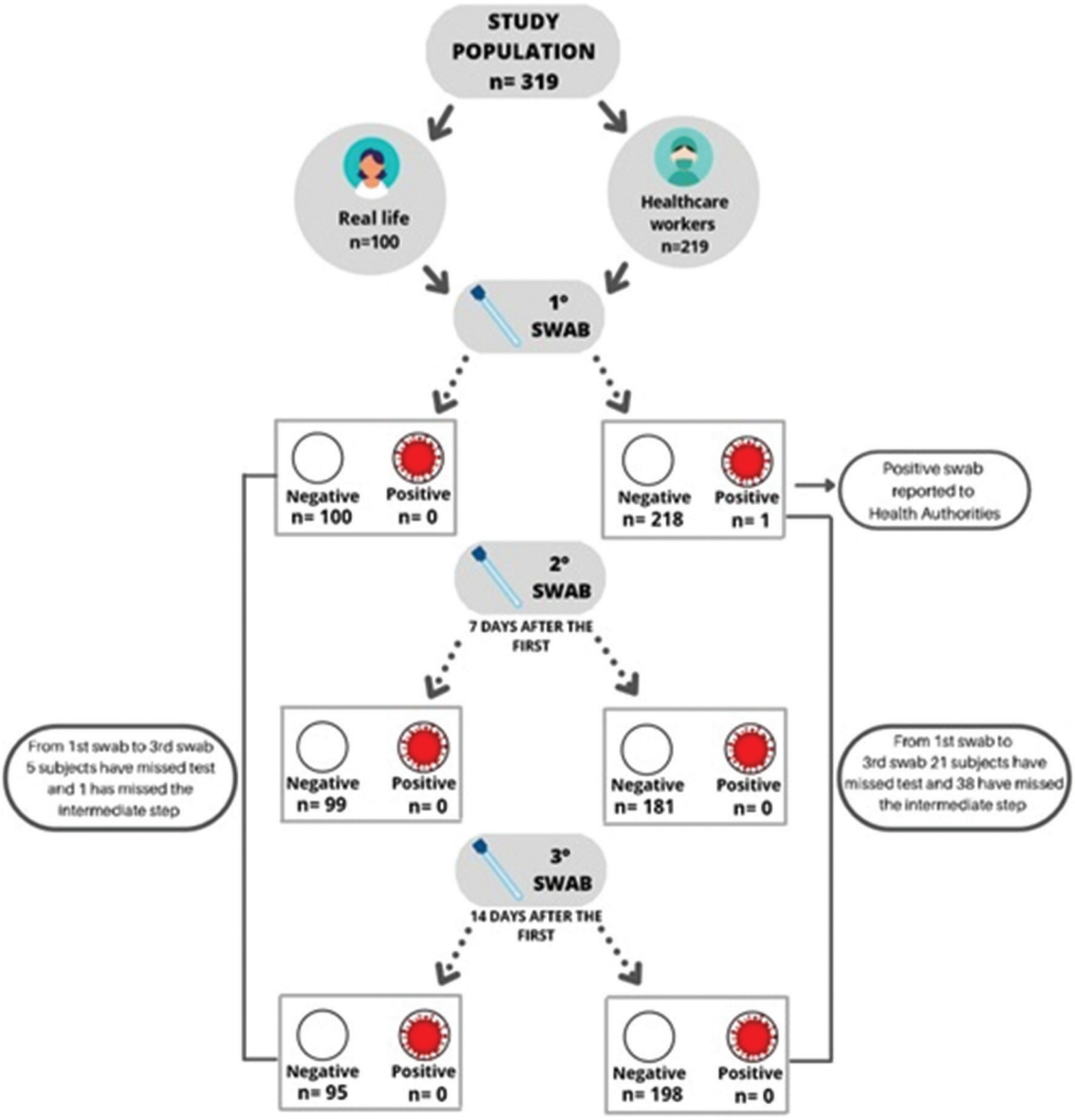

Figure 1. Results of swabs analysis.

of all, HCW working in hospitals, as well as those working in nursing homes, should be tested for COVID-19 regardless of the presence of symptoms. Even when symptoms are absent, this procedure has a positive cost-benefit ratio, since it may help to prevent the severity of clusters. The ratio became even more advantageous with the introduction of antigenic testing. Moreover, complete and adequate disposable personal protective equipment should be made immediately available. Thus, a wide screening of all HCW may produce not merely epidemiological evidence of SARS-CoV-2 infection, but also solid data for interventions to prevent nosocomial SARS-CoV-2 infection. After the decline of the epidemic during summer 2020, and with the re-opening of the San Raffaele hospital after the end of the all activities' block mandated by the local health authority during the cluster commenced at the beginning of June, all HCW of San Raffaele Roma, starting September 2020, underwent a weekly swab to early detect asymptomatic subjects. The surveillance went on until all HCW had undergone a complete immunisation (second dose of Pfizer-Biontech vaccine on 2nd February 2021). In addition, the experience with the pandemic containment acquired with the planning and management of the surveillance programme

allowed us to safely open a COVID-19 Unit on 16th November 2020 with 84 beds.

Strengths and weaknesses of the study

The surveillance programme described in this paper has several limitations, including the incomplete coverage of healthcare workers and lack of complete description of comorbidities and risk factors, such as smoking, for all participants. Despite this major limitation, the prompt and efficient detection of positive cases represents strengths, as demonstrated by the very low number of positive cases, and the efficiency of the system in identifying the cluster of cases. An additional result of the programme was revealed later on when we ran a cross-sectional observational study investigating the psychological well-being of our HCW during pandemics. In our hospital, the percentage of workers with anxious or depressive symptoms was lower compared to those who did not receive any surveillance as reported by several published studies (16). The positive influence of receiving a swab once a week, we believe, may have positively reduced mental distress.

Currently, all HCW working in our hospital are tested once a week with a molecular swab test, allowing the early detection of asymptomatic subjects and thus preventing new outbreaks.

In conclusion, the experience at the IRCCS San Raffaele Roma supports the utility of implementing dedicated surveillance programmes for the HCW. The efficiency in keeping low the number of secondary infections, and maintaining the psychological well-being of the personnel, with the availability of a tool which may allow the early identification of clusters, are critical issues which encourage the planning and implementation of such programmes in rehabilitation facilities.

Conclusions

What is already known about this subject:

- 172 million SARS-CoV-2 confirmed cases worldwide since the start of the outbreak and 3.7 million deaths attributed to COVID-19.
- Italy was the first country in Europe to face the pandemic.
- SARS-CoV-2 infection may generate a range of different responses in patients, ranging from completely asymptomatic virus shedding to a severe inflammatory response, including cytokine storm-like outcomes that are accompanied by high mortality.
- COVID-19 is a systemic disease.
- Healthcare Workers (HCW) represent 10% of overall cases, and often >10% of hospital personnel get infected.

What this study adds:

- Early surveillance could contribute to limit the number of cases when the incidence of the pandemic begins to increase.
- HCW should be tested for COVID-19 regardless of the presence of symptoms.
- A wide screening of all HCW in the pandemic period may produce not merely epidemiological evidence of SARS-CoV-2 infection, but also solid data for interventions to prevent the spread of nosocomial SARS-CoV-2 infection.

What impact this may have on practice or policy:

- The essential novelty of this strategy is the introduction of an active and specific intervention in addition to the standard hygienic procedures, to prevent hospital outbreaks and improve HCW well-being.
- The percentage of workers with anxious or depressive symptoms that periodically performed swab control was lower compared to those who did not receive any surveillance as reported by several published studies.

Authors' contributions

CT, DL, PC, ATP, SB and PR designed the study. DL, CA, CP, NSP performed and analyzed RT-PCR. LG, LV, SP, FM analyzed data. CT, LG, LV, SP, PR and SB wrote the manuscript. All authors contributed to the article and approved the submitted version.

Acknowledgments

Not applicable.

Conflict of interests

None.

Funding

This work was partially supported by 'Ricerca Corrente' awarded by the Italian Ministry of Health.

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