JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

*Coronavirus Pandemic*

# "Swab Team" in the SARS-CoV-2 outbreak containment among healthcare workers

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## Abstract

Introduction: To analyze the virus spread among Sassari Hospital staff in the first Covid-19 wave and the impact of the Swab Team, a multidisciplinary task force entitled of nasopharyngeal swab collection and testing.

Methodology: Nasopharyngeal swabs from HCWs between March 6 and May 28 2020 are evaluated.

Results: 4919 SARS-CoV-2 tests were performed on 3521 operators. Nurses and doctors are the categories at highest risk. After the Swab Team institution, the average number of swabs raised from 47/day to 86/day ($p = 0.007$). Positive samples decreased from 18.6% to 1.7% ($p < 0.0001$).

Conclusions: The Swab Team is effective in increasing the cases tested and in reducing the reporting time. Procedure standardization reduces the risk for all the subjects involved (no transmission among swab team members, nor during the sample collection).

**Key words:** Nasopharyngeal swab; COVID-19; healthcare workers; SARS-CoV-2; preventive measure.

*J Infect Dev Ctries* 2021; 15(11):1640-1645. doi:10.3855/jidc.15067

(Received 23 March 2021 – Accepted 14 April 2021)



## Introduction

The high incidence of COVID-19, which was initially reported in the city of Wuhan, China, in December 2019 and, then, in South Korea, Italy, Iran, and Japan in February 2020, prompted the World Health Organization (WHO) to declare the presence of a pandemic on March 11 2020 [1,2].

To date, on March 17 2021, 120,164,106 cases and 2,660,422 deaths occurred worldwide [3]; in particular, the incidence has been highest in all European countries during the fall after a late-spring/summer decrease [4,5].

The Italian healthcare system was significantly stressed before and after the summer period [6], with a depletion of medical resources and a high infection rate of healthcare workers (HCWs) [7, 8].

Early detection and isolation of infected HCWs can protect other susceptible colleagues and patients, minimizing the risk of loss of the workforce [7,9,10].

Several differences can be found in the policies on screening and testing of HCWs (e.g., symptomatic/asymptomatic; oropharyngeal/nasopharyngeal swab or serological tests, etc.) [11-15].

The standard of care for the diagnosis of SARS-CoV-2 infection is represented by a real-time reverse transcriptase polymerase chain reaction (rRT-PCR) on

a biological sample collected through a nasopharyngeal swab [16, 17].

Nasopharyngeal swabs have been performed by nurses and medical doctors. However, swab teams led by Otolaryngologists can improve the quality of the diagnostic process in the pre-analytical phase and, then, the diagnostic yield.

Aim of the present study was to assess the role of a Swab Team on the containment of the COVID-19 outbreak in a tertiary care university hospital located in Italy.

## Methodology

This retrospective study was carried out in a university hospital located in Sassari, Italy.

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Independent Ethics Committee, University Hospital of Cagliari (Prot. PG/2020/14171, Cagliari 07/29/2020) and informed verbal consent was obtained from all subjects involved in the study for swab collection.

The Swab Team is a multi-disciplinary group of HCWs including otolaryngologists, microbiologists, occupational medicine specialists, public health specialists, maxillofacial surgeons, and nurses.

Ad hoc rooms were set up to perform the nasopharyngeal swabs under safe conditions for HCWs and patients. Precise time frames, with an adequate distribution of subjects to avoid concourses and deriving risks, agreed with the laboratory, were established for the collection of nasopharyngeal swabs. The largest the number of planned samples, the longest the time required and preliminarily planned.

Occupational medicine specialists prescribed nasopharyngeal swabs for symptomatic cases and close contacts during the initial phase of the pandemic on March 2020; however, after a few weeks, a complete screening of the healthcare personnel was implemented. Otolaryngologists, maxillo-facial surgeons, and nurses collected nasopharyngeal samples following a standardized procedure based on the appropriate use of the personal protective equipment (PPE) [18]. A tutorial [19] aimed at training other HCWs was released online.

Flocked swabs were inserted in 2ml COPAN UTM® 306C and delivered to the Clinical Virology and Molecular Biology Lab of the University Hospital, where they were stored at 4°C for 4-16 hours before processing

Collected samples (in a previously agreed number) were delivered, at fixed hours, to the laboratory, to fully exploit the processivity of the diagnostic platforms and, at the same time to reduce the reporting time. A total of 94 samples underwent nucleic acids (RNAs) automated extraction with the Versant kPCR molecular system platform (Siemens). The Versant kPCR consists of a sample preparation (SP) module designed for automated sample preparation and an amplification/detection (AD) module designed for real-time PCR and detection of E and S target genes with RealStar® SARS-CoV-2 RT-PCR Kit 1.0 (Altona Diagnostics). Two platforms are used to process at least 188 samples daily. Nasopharyngeal swabs of HCWs collected between March 6 to May 28 2020 were considered for the present study. Demographic and epidemiological data were collected.

The primary study objective was to assess the difference between the period March 6th – March 19, and March 20 – May 28, that is after the implementation of the Swab Team on March 16.

Qualitative variables were summarized with absolute and relative (percentage) frequencies, whereas quantitative variables were described with medians (interquartile ranges, IQR) for their non-parametric distribution.

A chi-squared or Fisher exact test was used to compare qualitative variables. A Mann-Whitney test was used to compare non-normally distributed quantitative variables.

A two-tailed p-value less than 0.05 was considered statistically significant.

All statistical computations were performed using the statistical software STATA version 16 (StatsCopr, Texas, USA).

## Results

Between March 6 and May 28 2020, 4,919 molecular tests for the identification of SARS-CoV-2 in the HCWs were performed at the university hospital of Sassari, Italy.

A total of 136 samples were excluded because of missing data (i.e., date of birth, ID, job).

3,521 HCWs were tested, with 1,342 (38.1%) males and a median (IQR) age of 48 (37-56) years; 804 were tested at least twice, until they converted from positive to negative.

Overall, SARS-CoV-2 infection was found in 150/4,783 (3.1%) tests. The positivity rate of the HCWs was 3.5% (122/3,521; with 41, 33.6%, males).

The mean number of swabs collected daily increased from 47 before March 20 to 86 after the implementation of the Swab Team ($p$-value = 0.007).

On the contrary the positivity rate decreased from 18.6% (78/419) to 1.7% (72/4,364) before and after March 20th (*p*-value < 0.0001), respectively (Figure 1).

Few days after the implementation of the Swab Team the epidemic curve flattened, after an initial spike (Figure 2).

Although > 91% (4,364/4,783) of swabs were performed after March 20, about half of positive swabs (78/150) were found in a short period before, where the spread of the infection was limited to a few hospital wards (Cardiology, Nephrology, and Urology) (Table 1).

To explore the occupational roles of staff that underwent testing, we cross-referenced virological data with a prospectively maintained Occupational Health database.

Nurses and medical doctors showed a high positivity rate (49 and 37 cases out of 122 positives, respectively): nurse had an OR (95% CI) of 1.6 (1.1-2.3; p-value: 0.02), whereas medical doctor had an OR (95% CI) of 2.0 (1.4-3.0; p-value: 0.001) (Tables 2, 3, 4).

Most of positive swabs became negative within 20 days (Table 5).

**Figure 1.** Comparison of SARS-COV-2 detection rate before (78 positive swabs out of 419, 18.6%) and after March 20th 2020 (72 positive swabs out of 4,364, 1.7%), with a highly statistically significant decrease (p-value <0.0001).

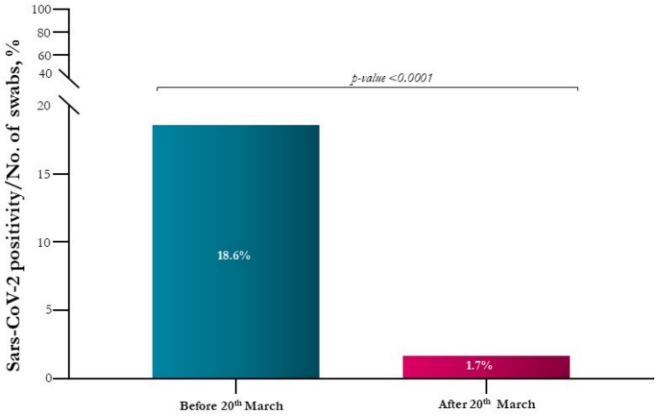


**Figure 2.** Epidemic curve shows an initial spread (March 20th, 2020). After March 20th, 2020, a few days after the institution of the Swab Team, the curve flattened.

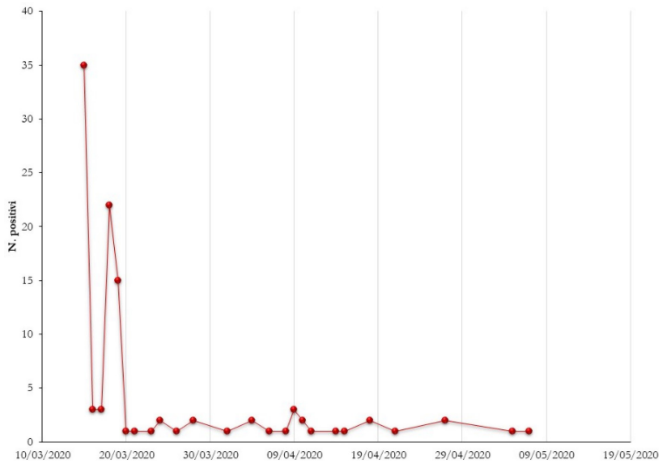


**Table 1.** SARS-CoV-2 positive cases before and after 20th March, 2020, at the university hospital of Sassari, Italy.

| Hospital ward | Positive before 20th March 2020 (n = 78) | Positive after 20th March 2020 (n = 44) |
|---|---|---|
| Cardiology | 33 (42.3) | 7 (15.9) |
| Nephrology | 18 (23.1) | 0 (0.0) |
| Urology | 8 (10.3) | 2 (4.6) |
| Emergency department | 6 (6.7) | 1 (2.3) |
| Geriatrics | 0 (0.0) | 6 (13.6) |
| Intensive care unit | 2 (2.6) | 5 (11.4) |
| Cardiac surgery | 2 (26) | 2 (4.6) |
| Gynecology and Obstetrics | 3 (3.9) | 1(2.3) |
| Neurology | 0 (0.0) | 4 (9.1) |
| Anesthesia | 0 (0.0) | 2 (4.6) |
| Pediatrics | 0 (0.0) | 3 (6.8) |
| Administration (services) | 1 (1.3) | 2 (4.6) |
| General surgery | 2 (2.6) | 0 (0.0) |
| Cardioanesthesia | 2 (2.6) | 0 (0.0) |
| Pulmonology | 1 (1.3) | 1 (2.3) |
| Rheumatology | 0 (0.0) | 2 (4.6) |
| General surgery 2 | 0 (0.0) | 1 (2.3) |
| Vascular surgery | 0 (0.0) | 1 (2.3) |
| Internal Medicine | 0 (0.0) | 1 (2.3) |
| Oncology | 0 (0.0) | 1 (2.3) |
| Surgical pathology | 0 (0.0) | 1 (2.3) |
| Radiology | 0 (0.0) | 1 (2.3) |

**Table 2.** Proportion of SARS-CoV-2 positive cases stratified by job category.

| Occupational role (Total: 122) | Positive cases (Proportion among positives, %) |
|---|---|
| Nurse | 49 (40.2) |
| Staff doctor | 37 (30.3) |
| Hospital porter | 15 (12.3) |
| Resident | 10 (8.2) |
| Healthcare assistants | 8 (6.6) |
| Worker | 1 (0.8) |
| Midwife | 1 (0.8) |
| Technician | 1 (0.8) |

**Table 5.** Time to conversion of SARS-CoV-2 positive cases.

| Time to conversion of SARS-CoV-2 positive cases | |
|---|---|
| Median (IQR) time to SARS-CoV-2 negativity, days (n= 87) * | 20 (17-29) |
| Negativity achieved within 20 days, n (%) | 53/87 (60.9) |
| Negativity achieved after30 days, n (%) | 17/87 (19.5) |
| Negativity achieved between 20 and 30 days, n (%) | 17/87 (19.5) |

*35 cases not evaluable for negativity: 19/35 (54.3%) false positives (16 on 07/Apr/2020), 7/35 (20.0%) operators did not repeat the swab before the end of our analysis (28/May/2020), 6/35 (17.1%) false negatives, 3/35 (8.6%) persistently positive up to 28/May/2020.

**Table 3.** Comparison of SARS-CoV-2 positivity before and after the implementation of the Swab Team (Sars-CoV-2 positivity/no. of swabs, %).

| Staff role | Total (150) | Before 20th March | After 20th March | p-value |
|---|---|---|---|---|
| Nurses | 54/1,565 (3.5%) | 35/191 (18.3%) | 19/1,374 (1.4%) | < 0.0001 |
| Medical Doctors | 42/999 (4.2%) | 22/106 (20.8%) | 20/893 (2.2%) | < 0.0001 |
| Workers | 3/425 (0.7%) | 0/1 (0.0%) | 3/424 (0.7%) | - |
| Residents | 10/409 (2.4%) | 3/34 (8.8%) | 7/375 (1.9) | 0.01 |
| Hospital porter | 23/406 (5.7%) | 12/34 (35.3%) | 11/372 (3.0%) | < 0.0001 |
| Healthcare Assistants | 15/306 (4.9%) | 5/26 (19.2%) | 10/180 (5.6%) | 0.01 |
| Technicians | 1/225 (0.4%) | 1/15 (6.7%) | 0/210 (0.0%) | 0.0002 |
| Midwives | 2/49 (4.1%) | - | 2/49 (4.1%) | - |

**Table 4.** Comparison of SARS-CoV-2 positivity before and after the implementation of the Swab Team (Sars-CoV-2 positivity/no. of HCWs tested, %).

| Staff role | Total (122) | Before 20th March | After 20th March | p-value |
|---|---|---|---|---|
| Nurses | 49/1,062 (5.6%) | 35/175 (20.0%) | 14/887 (1.6%) | < 0.0001 |
| Medical Doctors | 37/634 (5.8%) | 22/100 (22.0%) | 15/534 (2.8%) | < 0.0001 |
| Workers | 1/419 (0.2%) | 0/1 (0.0) | 1/418 (0.2%) | - |
| Residents | 10/279 (3.6%) | 3/32 (9.4%) | 7/247 (2.8%) | 0.06 |
| Hospital porter | 15/318 (4.7%) | 12/33 (36.4%) | 3/285 (1.1%) | < 0.0001 |
| Healthcare Assistants | 8/213 (3.8%) | 5/24 (20.8%) | 3/189 (1.6%) | < 0.0001 |
| Technicians | 1/199 (0.5%) | 1/15 (6.7) | 0/184 (0.0%) | 0.0004 |
| Midwifes | 1/44 (2.3%) | - | 1/44 (2.3%) | - |

## Discussion

The COVID-19 pandemic was associated with the implementation of several lockdown measures worldwide. However, frontline HCWs faced key professional challenges, including a higher risk of infection.

According to the report of national official sources, 3,654 (8.6% of confirmed cases) HCWs were infected and 19 died until March 20 2020 [20,21].

A nosocomial COVID-19 outbreak in the university hospital of Sassari, Italy, played a role in the change of the local policies: attention was posed on the systematic and standardized execution of sampling procedures, mainly on the swab collection. An increased activity of the microbiology laboratory and an extensive and safe sample collection was implemented. The implementation of the Swab Team was key.

The organizational change, with the help of the standardization [18,19], shows several advantages:

-Increased number of collected samples (the mean number of tests for HCWs increased from 47 per day to 86 per day).

-Sampling of the nasopharynx is performed by experts familiar with nose and nasopharynx anatomy (i.e., otolaryngologists, maxillofacial surgeons). It prevents the occurrence of false negative reports, which have a negative impact on the control of the viral spread. Four symptomatic patients with negative RT-PCR at the first nasopharyngeal swab became positive when sample collection was performed a few hours later by an otolaryngologist [18]. Nasopharyngeal swab collection could be tricky or inadequate when carried out by untrained personnel (e.g., recent nasal trauma or surgery, nasal obstruction from chronic rhinitis and/or deviated nasal septum, severe coagulopathy, non-collaborative subjects, etc.).

-Standardization of the sampling procedures and adequate use of PPE reduces the risk of infection for HCWs and subjects undergoing the procedure [18]. No infections correlated to the Swab Team activity have been reported since March 16th up to now.

-Optimization of human and financial resources, as well as PPE, mainly when shortages occur (e.g., first phase of the SARS-CoV2 epidemic).

-Close coordination with the microbiology laboratory with an improved management of local resources.

The rate of positive HCWs was 3.5% (122/3,521).

In England 14% positive tests were found but they were performed only for symptomatic subjects [12]. Our screening was extended in the later phase to asymptomatic HCWs based on the risk of presymptomatic and asymptomatic transmission [15,22,23], leading to a significant decrease of the positivity rate over time [10].

A study on extended screening for HCWs described a positivity rate of 4.8%, and ~3% in those without symptoms [15]. Similar rates (2.7%) were also found in another Italian study [14]; however, higher rates (11% and 18%) were shown in other clinical centres [11,13].

The trend of the epidemic curve in our study suggests an initial outbreak which occurred in a few wards, whereas the lower rates can be attributed to potential infection acquired in the community setting.

The retrospective analysis showed a key change on March 20, 2020, a few days after the implementation of the Swab Team, indirectly proving its effectiveness on the control of the nosocomial outbreak.

## Conclusions

The Swab Team is effective in increasing the cases tested and in reducing the reporting time. Procedure standardization reduces the risk for all the subjects involved (no transmission among swab team members, nor during the sample collection).

The comprehensive implementation of preventive and control measures, including the establishment of the Swab Team, can help address the nosocomial spread of SARS-CoV-2.

### Acknowledgements

This work was supported by a Rapid Response award for COVID-19, Canadian Institutes of Health Research (SR). This research received no external funding.

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**Conflict of interests:** No conflict of interests is declared.