Knowledge and Perception of COVID-19 Pandemic During the First Wave (Feb-May 2020): a Web Based Survey Among Italian Healthcare Workers

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Research

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Abstract

Background

Italy was the first country in Europe to face the coronavirus pandemic. Healthcare workers (HCWs) were at higher risk of contracting COVID-19, because of their closer contact with patients. The present study aimed to analyze HCWs' knowledge, practices, and attitude towards COVID-19.

Methods

We set up a cross-sectional survey through SurveyMonkey® and circulated the link in Facebook and Whatsapp closed groups. It was conducted in Italy from the end of February to the first week of May 2020. The study participants were general practitioners, pediatricians and other health professionals. Data were collected using a well-structured questionnaire including demographic, scope of knowledge, awareness and practice assessment section.

Results

A total of 958 participants were included. Of these, 320 (33.4%) were general practitioners, 248 (25.9%) were pediatricians and 390 (40.7%) were other health professionals. The highest response rate was from Northern Italy (48.1%), followed by the Center (29.9%) and Southern Italy (22.0%). The reported risk of having contact with a patient affected by Covid-19 was higher in the lockdown period than the pre-lockdown period (19.4% vs 10.2%, p=0.002). Respondents reported to have changed their clinical practice, more during lockdown period (81.1%) than in the pre-lockdown (46.3%). Particularly, they increased the use of masks (87.1%, p<0.001), disinfection and sanitization of doctors' offices (75.8%, p<0.001), the use of protective glasses (71.2%, p<0.001), alcoholic hand solution (71.2%, p<0.001), and hand washing (31.8%, p=0.028).

Conclusions

The majority of HCWs felt prepared to face the pandemic, and increased significantly their knowledge on infection prevention and control measures less known in the routine clinical practice (such as use of protective glasses and alcoholic hand solution), compared to other well-known measures (such as hand washing). HCWs are at high risk of infection and need extensive knowledge and awareness of the disease to take adequate precautionary measures and they are crucial to disseminate good practices.

Introduction

On December 31, 2019, the World Health Organization (WHO) received reports from the Chinese health authorities about the presence of pneumonia cases of unknown cause detected in the city of Wuhan, in the Chinese province of Hubei [1]. Subsequently, the Chinese health authorities identified a new Coronavirus, Acute Severe Respiratory Syndrome - Coronavirus 2 (SARS-CoV-2) as responsible for the CoronaVirus Disease 2019 (COVID-19) [2].
The first two cases of the COVID-19 pandemic in Italy, which tested positive for the SARS-CoV-2 Virus in Rome, were confirmed on January 30th, both with a travel history to Wuhan, China. On February 21st, 2020, the Italian National Institute of Health confirmed the first autochthonous case in Northern Italy (Codogno city-Lombardy region) in a critically ill, hospitalized young man with no travel history to known areas of viral circulation or links to a probable or confirmed COVID-19 case [3-5].

This unexpected finding unveiled ongoing transmission in several municipalities in the Lombardy Region [6]. In subsequent days and weeks, case counts and death tolls increased rapidly, first in Northern Italy, and then in the rest of the country. The Italian government imposed increasingly strict physical distancing measures, starting with the closure of 10 municipalities in the Lodi Province (Lombardy) and one in the Padua Province (Veneto) on the 22nd of February 2020 [5;7]. This culminated in a national lockdown declared on March 10th, 2020 and ended on May 3rd, 2020. COVID-19 is spread by human-to-human transmission through droplets and direct contact; it has an incubation period of 2-14 days [8-13].

The clinical presentation of the Sars-CoV-2 infection varies from asymptomatic to very severe pneumonia with acute respiratory distress syndrome, septic shock and multi-organ failure, which can cause death [14-16]. To date, applying preventive measures to control COVID-19 infection is the most critical intervention.

Healthcare workers (HCWs) are at high risk of infection and they may also contribute to the spread of the disease. Infection prevention and control (IPC) during health care practices when COVID-19 is suspected or confirmed is crucial in order to protect HCWs and fragile patients [17]. The rate of infection reported in HCWs varies across countries [18-21]. In China, HCWs accounted for 3.8% of all cases, with 14.8% of these having severe/critical disease despite their young age and few comorbidities [22-23]. Other studies however, reported lower illness severity in HCWs, and identified PPE use as the main factor associated with decreased infection risk [24].

Measuring scope of knowledge, attitudes and practices in regards to IPC helps to predict HCWs’ behaviors in applying preventive and control measures.

Even though the Italian Ministry of Health published guidelines and developed strong initiatives for IPC in healthcare facilities to prevent the spread of the disease, it is crucial to understand if those guidelines were really applied, particularly among HCWs [25].

In order to investigate the knowledge and the practice of HCWs in applying SARS-CoV-2 non-pharmaceutical preventive measures, we conducted a cross-sectional survey at the very beginning of the autochthonous circulation of SARS-CoV-2 in Italy.

**Methods**

*Study design*
This cross-sectional survey was coordinated by Bambino Gesù Children’s Hospital and conducted in Italy from the end of February to the first week of May 2020.

The survey was set up using SurveyMonkey® and the link to the survey was circulated online through Facebook and Whatsapp closed groups. The study participants were HCWs, including general practitioners, paediatricians, consultants, postgraduate trainees, and other health professionals (nurses, midwives, physiotherapists etc.).

Data was collected using a structured questionnaire that comprised 31 predefined responses, including the demographic, scope of knowledge (K), awareness (A) and practice (P) assessment sections.

The first section of the questionnaire consisted of 6 questions regarding demographic details and professional profile. Section two consisted of 2 questions about the risk perception of HCWs and patients. Section three consisted of 7 questions focusing on the knowledge level of HCWs. Section four had 15 questions regarding attitudes and practices, precautions and procedures to contain the virus.

**Sample size**

The sample size for the survey was calculated according to the formula adopted in the Raosoft software (http://www.raosoft.com/samplesize.html). Setting the expected proportion of the outcome found in each question of the study at 50% with an accepted margin of error of 5%, we obtained a total sample of 377 individuals, with a confidence level of 95%.

**Definitions**

Knowledge was defined as at least an affirmative response to one of the following four questions:

- Do you believe that information released by international health authorities regarding the epidemic from COVID-19 in China has been clear enough?

- Do you believe that information disseminated by national and regional health authorities regarding the risks associated with COVID-19 for the Italian population has been sufficiently clear?

- Do you think that the definition of a suspected case of COVID-19 infection is sufficiently clear?

- Do you think you have been sufficiently informed by the national health authorities on how to behave if you are faced with a suspected case of COVID19?

Behavior change was defined as at least an affirmative response to one of the following three questions:

- Since the start of the COVID-19 epidemic, have you changed the way you work?

- Since the start of the COVID-19 epidemic, has there been any impact in the organization of visits?
Since the beginning of the COVID-19 epidemic, has there been any impact in your relationship with patients?

Questions on the risk perception for being in contact with COVID-19 for HCWs and their patients were measured using the Likert scale ranging from 0 to 10 (no risk and high risk respectively); the answers were then categorized into five groups according to the percentile distribution to better show the results in the graph.

For the two questions based on the Likert scale, we categorized the variables into five groups (from 20° to 80° percentile), according to the percentile distribution. The first question (“Are the patients you come in contact with, scared of the COVID-19 epidemic?”) was categorized as follows: group 1 (0-20°) was from 0 - 5 points of the Likert scale; group 2 (21°-40°) was from 6-7 points of the Likert scale; group 3 (41°-60°) corresponded to 8 points of the Likert scale; group 4 (61°-80°) corresponded to 9 points of the Likert scale; group 5 (81°-100°) corresponded to 10 points of the Likert scale.

The second question (“Based on your views, what is the risk of visiting a patient with SARS-CoV-2 in the coming weeks?”) was categorized as follows: group 1 (0-20°) was from 0 - 5 points of the Likert scale; group 2 (21°-40°) corresponded to 6 points of the Likert scale; group 3 (41°-60°) was from 7- 8 points of the Likert scale; group 4 (61°-80°) corresponded to 9 points of the Likert scale; group 5 (81°-100°) corresponded to 10 points of the Likert scale.

We considered the pre-lockdown period from February 26th to March 10th, 2020 and the lockdown period from March 12th to May 3rd, 2020 [26].

Statistical analysis

Univariate differences were tested using the Chi-squared test for categorical variables and t test for independent samples for continuous variables. We carried out multivariable ordered logistic regression to investigate the association between the socioeconomic characteristics, the variables investigated in the questionnaire and two outcomes (knowledge and behavior change).

We carried out multiple imputation with chained equations [27] to generate values for missing data points such as sex, age, region and attitude to face the epidemic. All variables included in the models as predictors of outcomes were used to predict missing values [27-28]. Data were assumed to be “missing at random” [27]. Twenty-five datasets were imputed. Outcomes were not imputed. Data analysis was performed with STATA 13.0 SE (Stata Corporation, College Station, Texas).

At the end of the questionnaire we asked for open comments. We obtained 182 comments. We used the Word Cloud (WC) to visualize the frequencies of keywords. A WC is generated by counting the frequency at which each word appears. WC generation was performed using R packages tm and word cloud. Prepositions like ‘for’, ‘or’ and ‘in’ were excluded from the WC. Combination word concepts such as ‘general practitioner’, ‘front line’, ‘I would like to’, ‘mildly symptomatic’, ‘too much’, ‘public health’, ‘Local
Health Authority', 'National Health System' and 'Health Protection Agency' were all entered as single words. We showed the words with a frequency greater than or equal to 3.

Results

A total of 958 participants were included. Of these, 320 (33.4%) were general practitioners, 248 (25.9%) were pediatricians and 390 (40.7%) were other health professionals. Most responders filled in the questionnaire during the pre-lockdown period (72.4%). The characteristics of the participants are shown in Table 1. Medical doctors were older than other health professionals, with a mean age of 56.8 versus 38.2 years, respectively. The majority of respondents were female (61.8%).
Table 1
Characteristics of the Survey recruited sample (n = 958)

|                                | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) | p     |
|--------------------------------|-----------------|------------------------|--------------------|-------|
| n                              | %               | n                      | %                  | n     | %  |
| **Type of survey**             |                 |                        |                    |       | 0.022 |
| Non medical staff              | 390 40.7        | 267 38.5               | 123 46.6           |       |
| Medical staff                  | 568 59.3        | 427 61.5               | 141 53.4           |       |
| **Profession**                 |                 |                        |                    | < 0.001 |  
| Healthcare Professional        | 390 40.7        | 267 38.5               | 123 46.6           |       |
| General Practitioner           | 320 33.4        | 216 31.1               | 104 39.4           |       |
| Pediatricist                   | 248 25.9        | 211 30.4               | 37 14.0            |       |
| **Age (in years)**             |                 |                        |                    | 0.030 |     |
| Mean (SD)                      | 49.1 (13.7)     | 48.5 (13.9)            | 50.7 (13.0)        |       |
| Median (Range)                 | 52.0 (19.0–76.0)| 51.0 (22.0–76.0)      | 54.0 (19.0–69.0)   |       |
| **Age (in years)**             |                 |                        |                    | 0.041 |     |
| ≤ 35                           | 215 24.1        | 170 26.2               | 45 18.7            |       |
| 36–45                          | 150 16.8        | 111 17.1               | 39 16.2            |       |
| 46–55                          | 136 15.3        | 87 13.4                | 49 20.3            |       |
| 56–65                          | 312 35.0        | 227 34.9               | 85 35.3            |       |
| ≥ 66                           | 78 8.8          | 55 8.5                 | 23 9.5             |       |
| **Sex**                        |                 |                        |                    | < 0.001 |  
| Male                           | 341 38.2        | 221 34.0               | 120 49.6           |       |
| Female                         | 551 61.8        | 429 66.0               | 122 50.4           |       |
| **Area**                       |                 |                        |                    | 0.545 |     |
| North Italy                    | 427 48.1        | 318 48.9               | 109 45.8           |       |

*only for healthcare professional
◊ only for medical staff
|                      | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|----------------------|----------------|------------------------|-------------------|
| Central Italy        | 266            | 195                    | 71                |
|                      | 29.9           | 30.0                   | 29.8              |
| South Italy          | 195            | 137                    | 58                |
|                      | 22.0           | 21.1                   | 24.4              |
| **Structure***       |                |                        | 0.828             |
| Hospital             | 222            | 155                    | 67                |
|                      | 57.2           | 58.1                   | 55.4              |
| Residential Care Facility | 60          | 39                     | 21                |
|                      | 15.5           | 14.6                   | 17.4              |
| Private institution  | 36             | 27                     | 9                 |
|                      | 9.3            | 10.1                   | 7.4               |
| Community healthcare centre | 33         | 22                     | 11                |
|                      | 8.5            | 8.2                    | 9.1               |
| Other                | 37             | 24                     | 13                |
|                      | 9.5            | 9.0                    | 10.7              |

**In which type of environment do you work?** 0.435

|                      | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|----------------------|----------------|------------------------|-------------------|
| Rural                | 80             | 58                     | 22                |
|                      | 14.4           | 14.0                   | 15.7              |
| Suburban             | 133            | 105                    | 28                |
|                      | 24.0           | 25.3                   | 20.0              |
| Urban                | 342            | 252                    | 90                |
|                      | 61.6           | 60.7                   | 64.3              |

*only for healthcare professional

◊ only for medical staff

Most respondents were from Northern Italy (48.1%), followed by the Center (29.9%) and lastly, Southern Italy (22.0%).

Patients were reportedly more afraid of COVID-19 during the lockdown period (15.8%) than in the pre-lockdown period (8.4%) (p < 0.001) (Table 2). Health professionals reported a higher level of perceived risk of contracting COVID-19 from their patients than pediatricians (Fig. 1).
Table 2
Main questions answers proportion by survey study period (Pre-lockdown and Lockdown) in Italy, Univariable analysis

| Question                                                                 | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) | p       |
|--------------------------------------------------------------------------|-----------------|------------------------|--------------------|---------|
| Are the patients you come in contact with, scared of the Covid-19 epidemic? |                 |                        |                    | < 0.001 |
| Not at all frightened                                                     | 237 (25.2%)     | 197 (28.9%)            | 40 (15.4%)         |         |
| A little scared                                                          | 274 (29.1%)     | 219 (32.1%)            | 55 (21.2%)         |         |
| Neutral                                                                  | 221 (23.5%)     | 149 (21.8%)            | 72 (27.8%)         |         |
| Quite frightened                                                         | 111 (11.8%)     | 60 (8.8%)              | 51 (19.7%)         |         |
| Very scared                                                              | 98 (10.4%)      | 57 (8.4%)              | 41 (15.8%)         |         |
| Have you come into contact with SARS-CoV2 positive patients in recent weeks? |                 |                        |                    | 0.002   |
| No risk                                                                  | 264 (31.1%)     | 216 (33.5%)            | 48 (23.3%)         |         |
| Minimal risk                                                             | 87 (10.2%)      | 69 (10.7%)             | 18 (8.7%)          |         |
| Neutral                                                                  | 290 (34.1%)     | 219 (34.0%)            | 71 (34.5%)         |         |
| High risk                                                                | 106 (12.5%)     | 66 (10.2%)             | 40 (19.4%)         |         |
| What containment measures have been taken, in your place of work?         |                 |                        |                    |         |
| Isolation of the patient (yes)                                           | 72 (85.7%)      | 29 (96.7%)             | 43 (82.7%)         | 0.063   |
| Contact quarantine (yes)                                                 | 40 (47.6%)      | 18 (60.0%)             | 22 (40.7%)         | 0.090   |
| Administration of nasal swabs for close contacts                         | 35 (41.7%)      | 15 (50.0%)             | 20 (35.2%)         | 0.185   |
| Healthcare worker quarantine (yes)                                       | 25 (29.8%)      | 12 (40.0%)             | 13 (24.1%)         | 0.126   |
| Social containment measures (yes)                                        | 21 (25.0%)      | - (--)                 | 21 (25.0%)         | < 0.001 |
| Use of PPE (yes)                                                         | 4 (4.8%)        | 2 (6.7%)               | 2 (3.7%)           | 0.143   |
| Since the start of the Covid-19 epidemic, have you changed the way you work? |                 |                        |                    | < 0.001 |
| Yes, absolutely                                                          | 519 (55.8%)     | 313 (46.3%)            | 206 (81.1%)        |         |
| Response                     | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|------------------------------|-----------------|------------------------|--------------------|
| Yes, moderately              | 335 36.0        | 291 43.1               | 44 17.3            |
| No, not really               | 51 5.5          | 49 7.2                 | 2 0.8              |
| No, not at all               | 21 2.3          | 19 2.8                 | 2 0.8              |
| I don't know                 | 4 0.4           | 4 0.6                  | -                  |

What have you changed in your clinical practice?

| Response                                | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|-----------------------------------------|-----------------|------------------------|--------------------|
| Increased frequency of handwashing (yes) | 256 26.7        | 172 24.8               | 84 31.8            |
| Increased office disinfection (yes)     | 624 65.1        | 424 61.1               | 200 75.8           |
| Increased use of masks (yes)            | 628 65.6        | 398 57.4               | 230 87.1           |
| Increased use of protective glasses (yes) | 440 45.9        | 252 36.3               | 188 71.2           |
| Increased use of alcohol based hand solution (yes) | 467 48.8        | 279 40.2               | 188 71.2           |

Do you believe that the information released by international health authorities regarding the COVID19 epidemic in China has been clear enough?

| Response                     | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|------------------------------|-----------------|------------------------|--------------------|
| Yes, absolutely              | 152 18.0        | 111 18.2               | 41 17.7            |
| Yes, moderately              | 330 39.2        | 255 41.7               | 75 32.3            |
| No, not really               | 283 33.6        | 191 31.3               | 92 39.7            |
| No, not at all               | 71 8.4          | 49 8.0                 | 22 9.5             |
| I don't know                 | 7 0.8           | 5 0.8                  | 2 0.9              |

Do you believe that the information disseminated by national and regional health authorities regarding the risks associated with Covid19 for the Italian population have been sufficiently clear?

| Response                                | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|-----------------------------------------|-----------------|------------------------|--------------------|
| Yes, absolutely                          | 174 20.9        | 122 20.1               | 52 23.2            |
| Yes, moderately                          | 354 42.5        | 271 44.6               | 83 37.1            |
| No, not really                           | 222 26.7        | 163 26.8               | 59 26.3            |
| No, not at all                           | 78 9.4          | 49 8.1                 | 29 12.9            |
|                                           | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|-------------------------------------------|----------------|------------------------|-------------------|
| **I don't know**                          | 4              | 3                      | 1                 |
| **Do you think that the definition of a suspected case of a Covid19 infection is sufficiently clear?** |                |                        |                   |
| Yes, absolutely                           | 185            | 133                    | 52                |
| Yes, moderately                           | 353            | 265                    | 88                |
| No, not really                            | 235            | 170                    | 65                |
| No, not at all                            | 48             | 32                     | 16                |
| I don't know                              | 4              | 3                      | 1                 |
| **Do you think you have been sufficiently informed by the national health authorities on how to behave if you are faced with a suspected Covid19 case?** |                |                        |                   |
| Yes, absolutely                           | 195            | 147                    | 48                |
| Yes, moderately                           | 375            | 276                    | 99                |
| No, not really                            | 204            | 138                    | 66                |
| No, not at all                            | 59             | 43                     | 16                |
| I don't know                              | 3              | 2                      | 1                 |
| **Which of the following protective devices is most suitable to avoid the risk of transmission of Sars-CoV-2?** |                |                        |                   |
| Surgical mask                            | 63             | 24                     | 39                |
| FFP1 mask                                 | 17             | 13                     | 4                 |
| FFP2 mask                                 | 16             | 7                      | 9                 |
| FFP3 mask                                 | 642            | 510                    | 132               |
| Gas-masks                                 | 1              | 1                      | -                 |
| All the above                             | 107            | 59                     | 48                |
| **How do you keep yourself informed about operational guidelines?** |                |                        |                   |
| Emails sent by health authorities (yes)   | 595            | 450                    | 145               |

*Significant at p < 0.05.*
| Study Question                                                                 | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) | p-value |
|--------------------------------------------------------------------------------|-----------------|------------------------|--------------------|---------|
| Proactive search for information on official institutions’ websites (yes)     | 521 54.4        | 360 51.9               | 161 61.0           | 0.011   |
| Proactive search for information through Ministry of Health toll-free number (yes) | 156 16.3        | 113 16.3               | 43 16.3            | 0.998   |
| Emails received from scientific companies (yes)                                | 262 27.4        | 190 27.4               | 72 27.3            | 0.974   |
| Exchange of information with other colleagues (yes)                           | 496 51.8        | 339 48.8               | 157 59.9           | 0.003   |
| Medical-scientific publications (yes)                                          | 291 30.4        | 203 29.2               | 88 33.3            | 0.220   |
| Social networks (yes)                                                          | 151 15.8        | 116 16.7               | 35 13.3            | 0.189   |
| From patients (yes)                                                            | 7 0.7           | 4 0.6                  | 3 1.1              | 0.363   |
| Which of the following social networks do you find most reliable to follow updates on the Covid-19 epidemic? |                |                        |                    |         |
| Facebook (yes)                                                                 | 111 13.2        | 89 14.6                | 22 9.6             | 0.055   |
| Linkedin (yes)                                                                 | 22 2.6          | 10 1.6                 | 12 5.2             | 0.004   |
| Instagram (yes)                                                                | 16 1.9          | 12 2.0                 | 4 1.7              | 0.829   |
| Twitter (yes)                                                                  | 28 3.3          | 18 2.9                 | 10 4.3             | 0.315   |
| They are not reliable for updates (yes)                                        | 684 81.4        | 495 81.1               | 189 82.2           | 0.733   |
| Do you think that the measures put in place by the health authorities to contain the spread of the epidemic in Italy are appropriate? |                |                        |                    | 0.380   |
| Yes, absolutely                                                                | 211 25.0        | 149 24.3               | 62 27.1            |         |
| Yes, moderately                                                                | 395 46.9        | 284 46.2               | 111 48.5           |         |
| No, not really                                                                 | 181 21.5        | 141 23.0               | 40 17.5            |         |
| No, not at all                                                                 | 44 5.2          | 30 4.9                 | 14 6.1             |         |
| I don’t know                                                                   | 12 1.4          | 10 1.6                 | 2 0.9              |         |
| Now that the Covid19 epidemic has arrived in Italy, do you feel ready to face it? |                |                        |                    | 0.234   |
| Yes, absolutely                                                                | 61 7.3          | 40 6.6                 | 21 9.3             |         |
| Yes, moderately                                                                | 308 37.0        | 216 35.6               | 92 40.7            |         |
|                                      | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|--------------------------------------|-----------------|------------------------|--------------------|
| No, not really                       | 351 (42.1)      | 266 (43.8)             | 85 (37.6)          |
| No, not at all                       | 94 (11.3)       | 69 (11.4)              | 25 (11.1)          |
| I don't know                         | 19 (2.3)        | 16 (2.6)               | 3 (1.3)            |

With reference to the Covid-19 epidemic, do you think that the importance given to, and spread by, the media and society in general is excessive?

|                                      | Total (n = 958) | Pre-lockdown (n = 694) | Lockdown (n = 264) |
|--------------------------------------|-----------------|------------------------|--------------------|
| Yes, absolutely                      | 131 (16.0)      | 107 (18.0)             | 24 (10.6)          |
| Yes, moderately                      | 216 (26.3)      | 167 (28.1)             | 49 (21.7)          |
| No, not really                       | 265 (32.3)      | 186 (31.3)             | 79 (35.0)          |
| No, not at all                       | 199 (24.3)      | 126 (21.2)             | 73 (32.3)          |
| I don't know                         | 9 (1.1)         | 8 (1.4)                | 1 (0.4)            |

According to respondents, the risk of having contact with a patient affected by COVID-19 was far higher in the lockdown period than the pre-lockdown period (19.4% vs 10.2%, p = 0.002) (Table 2). This risk was higher for general practitioners than for pediatricians and other health professionals, but this difference was not statistically significant (Fig. 2).

Respondents reported having changed their clinical practice, more in the lockdown period (81.1%) than in pre-lockdown (46.3%) (Table 2). Particularly, they increased the use of masks (87.1%, p < 0.001), disinfection and sanitization of doctors' offices (75.8%, p < 0.001), the use of protective glasses and alcoholic hand solution (71.2%, p < 0.001) and hand washing (31.8%, p = 0.028) (Table 2).

Among participants, pediatricians were those who felt most well informed by health authorities (96.4%).

The multivariate model analyzing knowledge showed that, in the older age groups, knowledge increases with age, particularly in respondents aged over 66 (OR 2.03, p = 0.040). Pediatricians are the most well informed (OR 1.78, p = 0.015) and institutional e-mails are the most reported method for them to be informed (OR 1.81, p < 0.001). Participants who declared not to feel ready to face the COVID-19 emergency also reported less knowledge (OR 0.13, p < 0.001) (Table 3).
|                | Knowledge   | Behaviour change |
|----------------|-------------|------------------|
|                | aOR  | p     | CI 95%  | aOR  | p      | CI 95%     |
| **Age**        |      |       |         |      |       |         |
| ≤ 35           | Ref  |       | Ref     |      |       |         |
| 36–45          | 0.89 | 0.614 | 0.56–1.42 | 1.71 | 0.027 | 1.06–2.76 |
| 46–55          | 1.10 | 0.701 | 0.67–1.80 | 1.81 | 0.024 | 1.08–3.04 |
| 56–65          | 1.60 | 0.061 | 0.98–2.62 | 1.81 | 0.023 | 1.09–3.02 |
| ≥ 66           | 2.03 | 0.040 | 1.03–4.00 | 1.49 | 0.241 | 0.76–2.93 |
| **Sex**        |      |       |         |      |       |         |
| Male           | Ref  |       | Ref     |      |       |         |
| Female         | 1.23 | 0.225 | 0.88–1.70 | 1.26 | 0.184 | 0.90–1.78 |
| **Profession** |      |       |         |      |       |         |
| Healthcare Professional | Ref  |       | Ref     |      |       |         |
| General practitioner | 1.03 | 0.886 | 0.67–1.58 | 0.54 | 0.008 | 0.35–0.85 |
| Pediatrician   | 1.78 | 0.015 | 1.12–2.85 | 0.64 | 0.083 | 0.39–1.07 |
| **Region**     |      |       |         |      |       |         |
| North Italy    | Ref  |       | Ref     |      |       |         |
| Central Italy  | 1.35 | 0.078 | 0.97–1.88 | 0.73 | 0.066 | 0.51–1.02 |
| South Italy    | 1.41 | 0.076 | 0.93–2.08 | 0.67 | 0.049 | 0.46–1.00 |
| **Period**     |      |       |         |      |       |         |
| Pre-lockdown   | Ref  |       | Ref     |      |       |         |
| Lockdown       | 1.16 | 0.377 | 0.84–1.59 | 6.22 | <0.001 | 4.22–9.17 |
|                                      | Knowledge | Behaviour change |
|--------------------------------------|-----------|------------------|
| **Email sent by health authorities** |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 1.81 < 0.001 | 1.32–2.50      |
|                                       | 1.28 0.153 | 0.91–1.79       |
| **Official institutions’ websites**  |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 0.89 0.423 | 0.67–1.18       |
|                                       | 1.11 0.484 | 0.83–1.49       |
| **Ministry of Health toll-free number** |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 1.21 0.304 | 0.84–1.73       |
|                                       | 2.03 0.001 | 1.35–3.06       |
| **Emails received from scientific companies** |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 1.02 0.900 | 0.75–1.40       |
|                                       | 0.96 0.828 | 0.69–1.35       |
| **Exchange of information with other colleagues** |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 0.93 0.634 | 0.70–1.24       |
|                                       | 1.31 0.073 | 0.98–1.77       |
| **Medical-scientific publications**  |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 1.20 0.234 | 0.89–1.62       |
|                                       | 1.00 0.989 | 0.73–1.38       |
| **Social network**                   |           |                  |
| No                                   | Ref       | Ref              |
| Yes                                  | 0.85 0.382 | 0.59–1.22       |
|                                       | 1.09 0.663 | 0.74–1.60       |

Now that the epidemic from Covid-19 has arrived in Italy, do you feel ready to face it?

Yes, absolutely  Ref       Ref
The multivariate model analyzing behavior change showed that general practitioners changed their behavior less than health professionals (OR 0.54, p = 0.008). Participants from Southern Italy changed their behavior less than those from Northern Italy (OR 0.67, p = 0.049). Age positively affected behavior change, and respondents ranging from 46 to 55 years (OR = 1.81, p = 0.024) of age showed more willingness to change their behavior, as did those aged 56–65 (OR = 1.81, p = 0.023) (Table 3).

Respondents declared to have changed their behavior more during the lockdown period than pre-lockdown (OR 6.22, p < 0.001). Moreover, those who used the ministry toll-free number to inform themselves, reported the greatest behavior change (OR 2.03, p = 0.001).

When analyzing the open comments (n° 182), the most frequent words were PPE (n° 30), provide (n° 27), sanitary (n° 23), information (n° 19), lack (n° 17), doctors (n° 15), masks (n° 14), COVID-19 (n° 9) (Fig. 3).

**Discussion**

COVID-19 is a global health problem, especially among HCWs. Italy was the first European country to face COVID-19, with considerable differences in terms of organization and management strategies throughout the country, resulting in heterogeneous levels of performance across regional health systems.

Healthcare professionals, being in contact with patients, play a crucial role in the transmission of COVID-19; thousands of HCW’s, mainly general practitioners, were affected by COVID-19 and died while caring for COVID-19 positive patients [26]. This could be due to several factors: lack of personal protective equipment (PPE), poor knowledge of the virus containment measures, especially in the first pandemic wave, and heavy workloads. For this reason, we investigated HCWs' knowledge and perceptions of the prevention and control of COVID-19 pandemic.

It is crucial for HCWs to be prepared and to apply all IPC in facing COVID-19 [29–31] considering that the prevalence of the infection among HCWs exceeded 10% in Italy [32–34] with a consequent loss of capacity for hospitals to respond adequately to pandemic.
Knowledge and perceptions of COVID-19 varied across different categories of HCWs.

Other studies have shown that the majority of HCWs had good knowledge on COVID-19 and showed a positive attitude related to their sense of readiness to confront the disease and implemented good practices towards COVID-19 [30, 35–37].

Our study shows that HCWs have a sufficient level of knowledge about COVID-19. Moreover, participants frequently reported a change in their behavior in clinical practice during the pandemic. Doctors had a higher level of knowledge and, amongst those, pediatricians were those better informed.

Moreover, doctors declared they had significantly modified their clinical practice during the pandemic period compared to other health professionals, showing a higher impact of the epidemic on medical doctor’s daily routine.

Doctors were also much more confident in the information coming from the Italian National Health Authorities compared to other health professionals. This indicates that the COVID-19-related updates posted by official health authorities had positive implications for improving doctors’ knowledge levels. Obtaining information from institutional sources is crucial for disseminating reliable data about the emerging COVID-19 infection and is essential for HCWs’ preparedness and response.

During the pre-lockdown and lockdown periods, all health professionals were informed about the best IPC to be adopted for the containment of COVID-19. Most respondents received their information from institutional channels, while 38.5% had obtained information from other colleagues and 15.8% from social networks.

The findings of this study suggest a significant gap between the amount of information available on COVID-19 and the depth of knowledge among HCWs, particularly regarding disinfection of doctors’ offices and contact surfaces, use of protective glasses and use of alcoholic solution for hand hygiene. All these practices were not extensively applied in the pre-lockdown period, also because they were not routinely used by HCWs before the pandemic; yet their use significantly increased during lockdown. This could be due to a low penetration of information and trust in the messages of the health authorities at the beginning of the pandemic, which were perceived only later as important and vital to fight the pandemic. However, it is important to note that, as expected, the change in IPC measures was mainly driven by those measures less used in the clinical routine (such as use of protective glasses, and use of alcoholic solution for hand hygiene), while well known IPC measures (such as hand washing) increased less.

Other studies, investigating scope of knowledge, attitude and practices, showed that doctors exhibited higher knowledge scores than nurses and paramedics [30]. Knowledge, attitude, and practice of HCWs regarding the use of face masks were found to be inadequate. HCWs showed a positive attitude but moderate-to-poor level of knowledge and practice regarding the use of face masks [35;38–39].

Two interesting results in our study were that the majority of respondents declared to have radically changed their work habits in the lockdown period; moreover, the use of surgical masks among
respondents increased much more in the lockdown period compared to the use of FFP1 or FFP3 masks.

However, this study has some limitations that should be considered. The developed questionnaire was tested among different HCW’s in the Bambino Gesù Children’s Hospital and open-ended questions were limited to reduce information bias. Moreover, the survey was conducted through the use of an online platform and disseminated through social networks, therefore the type of sampling used may not be representative of all Italian HCWs and could be biased towards respondents with a positive knowledge, attitude and practice.

**Conclusions**

The majority of respondent HCWs felt to be adequately prepared to deal with pandemic. Healthcare professionals are at high risk of COVID-19 transmission to and from patients and need extensive knowledge and awareness of the disease to take adequate precautionary measures, because they play a crucial role in lowering morbidity and mortality and in disseminating good practices.

**Abbreviations**

HCW: Healthcare workers

IPC: Infection prevention and control

COVID-19: CoronaVirus Disease 2019

PPE: Personal protective equipment

**Declarations**

*Ethics approval and consent to participate*

The study was approved by Bambino Gesù Children Hospital’s Ethical Committee (Prot n. 2116/2020).

*Availability of data and materials*

All data generated or analysed during this study are included in this published article

*Competing interests*

The authors declare that they have no competing interests.

*Funding*

None to declare

*Consent for publication*
Authors' contributions

CR, IC and EP contributed to the study design and to the first draft of the manuscript; LR, SC, FC and AET contributed to drafting and reviewing the manuscript; LR, MR, and MLCDA contributed to the study conceptualization and reviewed the final draft of the manuscript. All authors read and approved the final manuscript.

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Figures
Figure 1

Proportion of HCWs reporting patients afraid of the novel coronavirus pandemic

Figure 2

Perception of the risk to visit a Covid-19 patient by type of HCWs
Figure 3

Most frequent words reported from participants