Journal of Hospital Infection 105 (2020) 474–476

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevier.com/locate/jhin

Practice points

Lack of SARS-CoV-2 RNA environmental contamination in a tertiary referral hospital for infectious diseases in Northern Italy

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ARTICLE INFO

Article history:
Accepted 13 March 2020
Available online 19 March 2020

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https://doi.org/10.1016/j.jhin.2020.03.018

The World Health Organization defined Coronavirus Disease 2019 (COVID-19) as the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a betacoronavirus belonging to the same subgenus as the severe acute respiratory syndrome Coronavirus (SARS-CoV). Human coronaviruses (HCoVs) spread in a similar fashion as Rhinoviruses, by direct contact with infected secretions or large aerosol droplets [1]. Healthcare workers are at increased risk of acquiring COVID-19 infection, possibly due to direct contact with the patients. Indeed, transmission of HCoVs through environmental contamination has been reported in healthcare settings [2]. Understanding which are the potentially contaminated surfaces in a healthcare environment is crucial to protect healthcare workers from this virus which is showing an unprecedented exponential trend with a doubling time of 3.6–4.1 days [3]. In this regard, studies suggest that surfaces and suspensions can carry HCoVs, increasing the risk of contact transmission that could lead to hospital-acquired HCoVs infections [4,5]. Otter *et al*. found that other coronaviruses (SARS-CoV, MERS-CoV) can be found on plastic, metal and cloths for up to 6 days [6]. Thus, monitoring environmental contamination of SARS-CoV-2 can support investigation of the current outbreak and benefit the management of COVID-19 infection. In addition, it may help in assessing the effectiveness of disinfection procedures and safety of personal protective equipment (PPE).

Since 21 February 2020, when the first autochthonous case in Italy was confirmed, an overwhelming number of SARS-CoV-2 infections are continuously being detected, exceeding 8000 cases at the time of writing. Fondazione IRCCS Policlinico San Matteo, Pavia, is a 1300-bed tertiary teaching hospital in Northern Italy and a national SARS-CoV-2 referral center. The hospital houses 23 ICU beds and 44 Infectious Diseases (ID) beds, the latter being distributed over two floors. In the ID ward, each room has a buffer zone to allow safe donning and disposal of PPE. Healthcare workers involved in the direct care of patients use the following PPE: liquid-repelling gowns, double gloves, a class 2 filtering face-piece respirator (FFP2) and eye protection (goggles or face shield). Cleaning procedures have been standardized [7], in particular ward surfaces are cleaned with sodium hypochlorite at the concentration of 1000 ppm of free chlorine (0.1%) daily and 5000 ppm of free chlorine (0.5%) in terminal sanitization.

From 21 to 29 February, 580 cases of SARS-CoV-2 were identified by the Virology laboratory, and those with interstitial pneumonia were admitted. Samples were collected on 28 February; by that day 100% of admitted patients were COVID-19 positive with pneumonia, and were treated with C-PAP or high flux oxygen.

Surfaces in areas considered virus free were swabbed to search for COVID-19 RNA. Table I indicates which surfaces and objects were subjected to swabbing and Figure 1 illustrates the map of the ward where the test was carried out. Environmental samples were obtained using a sterile flexible nasopharyngeal nylon flocked premoistened swabs (FLOQSwabs™, Copan Italia, Brescia, Italy) dipped in 3 mL universal transport medium (UTM™, Copan Italia, Brescia, Italy). Total nucleic acids (DNA/RNA) were extracted from 200 μL of UTM™ using the QIAsymphony® instrument with QIAsymphony® DSP Virus/Pathogen Midi Kit (Complex 400 protocol) according to the manufacturer's instructions (QIAGEN, Qiagen, Hilden, Germany). Specific real-time reverse transcriptase–polymerase chain reaction (RT-PCR) targeting RNA-dependent RNA polymerase and E genes were used to detect the presence of SARS-CoV-2 according to WHO guidelines [8] and Corman *et al*. protocols [9].

Table I
List of objects and surfaces swabbed for SARS-CoV-2 RNA

High risk of contamination area	Inanimate surfaces
Buffer zone of patients' rooms	Door handles
	Waste container covers
	Sink handles
	Wall surfaces
Doctors' and nurses' lounge	Kitchen table and sink
	Desks
	Computer keyboards
	Medical charts and parameters
	Tabs
	Door handles
	Therapy trolleys
Staff personal belongings	Mobile phones

Sixteen swabs were collected from inanimate surfaces at high risk of contamination inside the wards. All inanimate surfaces and materials at high risk of contamination were free of SARS-CoV-2 RNA. At the time of writing no cases of COVID-19 have been detected in the staff involved in patient care. While this of course does not exclude the risk of transmission, it does provide evidence that the protective measures implemented in our setting significantly decrease the risk of environmental contamination and reduce concerns over healthcare workers' contamination and infection, at least from inanimate surfaces in areas that are either preserved as clean or decontaminated. Our findings therefore validate our cleaning and disinfection policies and confirm an adequate use of PPE.

These data are in keeping with very recent findings reporting that anterooms, corridors and post-cleaning samples were negative for SARS-CoV-2 RNA, suggesting that current protections and decontamination procedures are sufficient despite extensive contamination of inanimate surfaces in patients' rooms and toilet sites [8]. In any case, environmental contamination with SARS-CoV-2 through respiratory droplets and faecal shedding suggests that the environment is indeed a potential medium of transmission [10]. Our study has limitations because virus viability was not investigated and the sample size was small, due to difficulty to run more tests during a time of emergency. A more precise evaluation of the infectious potential of the environment could be undertaken by collecting droplets from patients' sputum on inanimate surfaces and measuring SARS-CoV-2 infectious potential *in vitro* as a function of time. However, the emergency of the outbreak required a fast assessment of the current situation. While the pandemic still shows no sign of ending, further studies are underway to more comprehensively determine the potential of the environment as a transmission medium.

Figure 1. Map of the ward where swabs for SARS-CoV-2 RNA were obtained. Red dots indicate the sites where swabs were applied.

Acknowledgements

We thank the nurses for their collaboration.

Conflict of interest statement
None.

Funding sources
None

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