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.

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Letter to the Editor

Detection of SARS-CoV-2 RNA on surfaces in a COVID-19 hospital ward indicates airborne viral spread

Sir,

Most respiratory viruses, including coronaviruses, are conventionally associated with mainly droplet and contact transmission. This has affected recommendations regarding infection prevention precautions for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. However, it is now demonstrated that SARS-CoV-2 can be detected in air samples in hospital environments, and that the airborne route plays a role in the transmission [2–4]. Virus particles transported in air will most likely be deposited on surfaces and viable SARS-CoV-2 have been detected for up to 72 h on surfaces in experimental settings [5].

In this study we investigated the distribution of SARS-CoV-2 RNA on surfaces in a COVID-19 hospital ward through swabbing surfaces as an indicator for airborne transfer of SARS-CoV-2. We also investigated whether the detection rate of SARS-CoV-2 RNA was impacted after terminal cleaning of the ward.

The samples were collected from a medical ward with 17 patient rooms in a tertiary care hospital in Sweden (Skåne University Hospital), which had been designated as a COVID-19 ward four weeks earlier. The patient rooms had a negative pressure (−1 to −4 Pa) with ∼2.7 air changes per hour. Staff and storage rooms had a positive pressure (+2 to +4 Pa). At sampling on day 1, in January 2021, there were 17 patients in the ward (one room was empty and there were two patients in one room). Most patients received supplemental oxygen or oxygen through high-flow nasal cannula (HFNC). Movable high-efficiency particulate air (HEPA) filters had been placed in six rooms, where patients were treated with HFNC. At the time of sampling, there were no known COVID-19 cases among the healthcare workers. The last known case of SARS-CoV-2-positive staff was 15 days prior to sampling.

Swabbing of 75 surfaces was performed on day 1. Later that day, patients with ongoing isolation precautions were transferred to other locations. The terminal cleaning of the ward included alcohol-based disinfectant on surfaces (Liv DES + 72% ethanol, Clemondo, Helsingbord, Sweden; or DAX isopropanol 45%, KiiltoClean, Stockholm, Sweden), and an oxidizing compound on floors (Virkon Rely-On 1%, Viroderm, Solna, Sweden). Subsequently, non-COVID-19 patients were admitted to the ward. On day 2, samples were collected from the same 75 surfaces on adjacent areas. The surfaces were divided into three categories: low (on the floor or a surface <10 cm above), medium-high (∼1 m above the floor), and high (>1.4 m above the floor). Surfaces were sampled with flocked swabs (SRK 906 C, Copan, Brescia, Italy) and samples were stored at −80 °C until analysis. The areas of the sampled surfaces, which were made of plastic, painted wood, or metal, ranged from approximately 20 to 50 cm^2. RNA was extracted using the MagNA Pure 96 DNA and Viral NA Small Volume Kit (Roche Molecular Systems, Inc., Plesanton, CA, USA) in a MagNA Pure 96 system (Roche Diagnostics Scandinavia AB, Solna, Sweden). Reverse transcription–quantitative polymerase chain reaction was performed as described by Thuresson *et al.* [6]. All samples were run in duplicate, and samples were considered positive if one of the duplicates had a cycle threshold (C_T) value <40.

In total, 43 of 150 samples (29%) were positive for SARS-CoV-2 RNA (Table I). Of the positive samples, 25 (58 %) were from high surfaces and 16 (37 %) were from low surfaces. Eleven patient rooms (69%) had at least one positive surface. SARS-CoV-2 RNA were detected in four of the six rooms where portable HEPA filters had been placed and in seven of the ten rooms without HEPA filters. The mean C_T value for all positive samples was 39 (range: 33–40).

It is likely that viral RNA found on high surfaces was deposited through an airborne route, since these surfaces are not contact surfaces or exposed to large droplets. Other routes of transportation (droplets or direct contact) could also be involved in the spread of virus to medium-high and low surfaces. Many surfaces were positive after cleaning on day 2. There might be several reasons for this. First, not all surfaces that were sampled were routinely cleaned. Second, surfaces that were disinfected properly may still have levels of detectable SARS-CoV-2 RNA left on them (and not RNA from viable viruses). Another possibility is deposition of SARS-CoV-2 to surfaces from unknown COVID-19 cases. The presence of a HEPA filter in a patient room did not seem to reduce the chance of detecting SARS-CoV-2 RNA on surfaces. Our findings suggest that airborne spread is a transmission route for COVID-19. Also,

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Table I
Summary of sampled surfaces in the ward with proportion of positive samples per category and day

Surface	No. of surfaces for both days	Proportion of positive samples, day 1 (%)	Proportion of positive samples, day 2 (%)
High surfaces			
In patient rooms			
On top of cabinet	32	1/16 (6%)	6/16 (38%)
On top of wall panel	32	2/16 (13%)	4/16 (25%)
Air vent outlet	32	0/16	6/16 (38%)
Outside patient rooms			
On top of door frames	12	3/6 (50%)	2/6 (33%)
On top of white board	2	0/1	1/1 (100%)
On top of cabinet	2	0/1	0/1
Total high surfaces	112	6/56 (11%)	19/56 (34%)
Medium-high surfaces			
Bench	4	0/2	2/2 (100%)
Computer keyboard	4	0/2	0/2
Copy machine	2	0/1	0/1
Door	2	0/1	0/1
Blood pressure monitor	2	0/1	0/1
Total medium-high surfaces	14	0/7 (0%)	2/7 (29%)
Low surfaces			
Floor in hallway	16	7/8 (88%)	4/8 (50%)
Floor in staff rooms	6	2/3 (67%)	1/3 (33%)
Monitor stand	2	1/1 (100%)	1/1 (100%)
Total low surfaces	24	10/12 (83%)	6/12 (50%)
Total all surfaces	150	16/75 (21%)	27/75 (36%)

though the infection control implications are uncertain, our results suggest that cleaning may not be sufficient to eradicate SARS-CoV-2 RNA from the environment.

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Conflict of interest statement
None declared.

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