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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Journal of Hospital Infection 126 (2022) 78–80

Available online at www.sciencedirect.com

Journal of Hospital Infection

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

Practice Points

SARS-CoV-2 detection on healthcare workers' hands caring for COVID-19 patients

C. Legeay [a], W. Peron [a], C. Le Bihan [b], A. Pivert [b,c], C. Lefeuvre [b,c,*]

[a] Infection Control and Prevention Unit, CHU Angers, F-49000 Angers, France
[b] Laboratoire de virologie, Département de Biologie des Agents Infectieux, CHU Angers, F-49000 Angers, France
[c] Univ Angers, HIFIH, SFR ICAT, F-49000 Angers, France

ARTICLE INFO

Article history:
Received 23 March 2022
Accepted 6 May 2022
Available online 17 May 2022

Despite the fact that hand hygiene is considered an important issue in preventing SARS-CoV-2 transmission, very few studies have documented the detection or survival of the SARS-CoV-2 on human skin [1,2]. None, to our knowledge, has been conducted under real-life conditions.

We conducted an observational study from May to October 2021 (mainly variant delta spread) in a university hospital to assess the detection of SARS-CoV-2 RNA on healthcare workers' (HCW's) hands involved in COVID-19 patients' care.

We included any type of care delivered to hospitalized isolated COVID-19 cases (i.e. patients within 10 days of symptom onset, or 20 days if immunocompromised or on the intensive care unit (ICU)). Data relating to the care provided were collected prospectively: patient characteristics, time of sampling, HCW job role and type of care provided by the HCW and practices with their hands. Early and late COVID-19 were defined as $<$7 days and $\geq$7 days after symptom onset. A single sterile premoistened swab with universal transport medium (regular floq swab, UTM® 346C; Copan, Brescia, Italy) was used for each sampling of HCWs' hands; sampling was across the entire surface area of both hands (palm, fingers, back of the hand, interdigital spaces). Each HCW was sampled on three occasions: (i) before care (and any glove wearing); (ii) immediately after care before any hand hygiene, but after glove removal (if used); and (iii) immediately after hand hygiene using a hydro-alcoholic hand rub. Samples were analysed using a reverse transcription–quantitative polymerase chain reaction assay (laboratory developed test) running on the Panther Fusion® module on the Panther® system (Hologic®; San Diego, CA, USA) using primers (nCoV_IP2 and nCoV_IP4) targeting two regions on the RNA-dependent RNA polymerase (RdRp) gene (National Reference Center of respiratory viruses; Institut Pasteur, Paris, France). A sample was considered positive if one or both sequences on the RdRp gene were detected. Cycle threshold (C_T) values, i.e. number of cycles of quantitative PCR, estimate viral load. The study was approved by the ethics committee of the University Hospital of Angers (agreement 2021-110).

One hundred and ninety-four samples were collected, respectively 62, 66, and 66 samples before care, after care and after hand hygiene relating to 54 patients (more than one contact was observed for seven patients). Table I summarizes the characteristics of patients and the care episodes. Thirty and 36 contacts were with early (median: 3 (range: 1–6) days post-symptom onset) and late (median: 11 (range: 7–20) days post-symptom onset) COVID-19, respectively.

Two samples were positive (C_T $>$37 for both), both after care of early COVID-19 patients (6.7% of after care of early patients' samples). The first positive sample was from a nurse after several interactions with an ICU patient's environment (no direct patient contact) with no gloves worn. The patient was intubated, non-immunocompromised, and unvaccinated. The patient had been symptomatic for two days; Charlson score was 6 and treatment was with dexamethasone. The second positive sample was from a nursing assistant after bathing a patient on a general ward. The patient was not immunocompromised, had a three-day history of symptoms

* Corresponding author. Address: Virology Department, Angers University Hospital, University of Angers, HIFIH Laboratory EA 3859, 4, rue Larrey, F-49000, Angers, France. Tel.: +33 02 41 35 47 09.
E-mail address: caroline.lefeuvre@chu-angers.fr (C. Lefeuvre).

https://doi.org/10.1016/j.jhin.2022.05.005
0195-6701/© 2022 The Healthcare Infection Society. Published by Elsevier Ltd. All rights reserved.

Table I
Characteristics of patients and their care

Characteristics and care group	No.	%	Median	IQR
Healthcare worker category				
Medical doctor	0	0		
Resident/medical student	11	16.7		
Nurse	32	48.5		
Nurse assistant	20	30.3		
Physiotherapist	0	0		
Occupational therapist	0	0		
Others[a]	3	4.5		
Type of care				
No direct contact with the patient or biological matters	9	13.6		
Direct contact with the patient, short duration (<5 min), no contact with biological matters	25	37.9		
Direct contact with patient, long duration (>5 min) and/or contact with biological matters[b]	32	48.5		
Care with gloves	51	77.3		
Patient age (years)			65.7	51.9–74.5
Delay between symptom onset and sampling (days)			7.5	3–11.8
Hospitalized in ICU	22	40.7		
Immunocompromised	8	14.8		
Oxygen therapy				
None	20	37.0		
<6 L	14	25.9		
>6 L	6	11.1		
Intubated	14	25.9		
Katz score			3.5	0–9
Charlson score			3	1–6
Coughing (40 patients assessed)	12	30.0		
Wearing mask during care (39 patients assessed)	6	15.4		
Treatment				
Dexamethasone	34	63.0		
Tocilizumab	13	24.1		
Monoclonal antibodies	1	1.9		
Convalescent plasma	0	0		
Others	0	0		
Vaccination status (51 available)				
1 dose	8	15.7		
2 doses	15	29.1		
3 doses	1	2.0		
Unvaccinated	27	52.9		

IQR, interquartile range; ICU, intensive care unit.
[a] Two midwives and one radiology technician.
[b] Including 13 care involving contact with stools or sputum.

and had received one dose of vaccine. Katz and Charlson scores were 5 and 10, respectively; the patient was receiving neither specific treatment for COVID-19, nor oxygen; he was not coughing, but not wearing a mask.

To our knowledge, our study is the first to characterize SARS-CoV-2 RNA detection on HCW hands in 'real life' conditions. SARS-CoV-2 has been shown to survive for several hours on skin [2]. HCW hand contamination may be associated with viral load, type of care, duration of care, exposure to droplets and environmental conditions (humidity, temperature, etc.). However, our study was not powered to assess these variables. It has been suggested that SARS-CoV-2 may be present on patients' skin, from where it might be transferred to HCWs' hands [3].

Our study has some limitations. We did not perform viral cultures and cannot exclude the possibility that the SARS-CoV-2 RNA that we detected represents non-viable virus. The few studies that have looked for viable virus on environmental samples have mostly reported negative results [4–6]. The high C_T-values that we found suggested low viral loads or non-viable virus. We did not sample the HCWs to exclude them asymptomatically shedding virus; however, neither HCW's 'before care' sample was positive. Finally, an alternative sampling method, e.g. a 'glove-juice' sampling method, might have been more appropriate [7].

Nevertheless, we showed that, although infrequent, SARS-CoV-2 RNA could be found on HCWs' hands after delivering

direct and indirect care to early COVID-19 patients. Further studies are needed to assess the significance of SARS-CoV-2 hand carriage by HCWs.

Acknowledgements

The authors thank Virology laboratory team and Infection Control and Prevention Unit team.

Conflict of interest statement
None declared.

Funding sources
None.

References

[1] Harbourt DE, Haddow AD, Piper AE, Bloomfield H, Kearney BJ, Fetterer D, et al. Modeling the stability of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on skin, currency, and clothing. PLoS Negl Trop Dis 2020;14:e0008831. https://doi.org/10.1371/journal.pntd.0008831.

[2] Hirose R, Ikegaya H, Naito Y, Watanabe N, Yoshida T, Bandou R, et al. Survival of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and influenza virus on human skin: importance of hand hygiene in coronavirus disease 2019 (COVID-19). Clin Infect Dis 2021;73:e4329—35. https://doi.org/10.1093/cid/ciaa1517.

[3] Redmond SN, Li DF, Haq MF, Jones LD, Nguyen AM, Tiktin M, et al. Frequent detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA on hands and skin of patients with coronavirus disease 2019 (COVID-19). Infect Control Hosp Epidemiol 2021:1—2. https://doi.org/10.1017/ice.2021.403.

[4] Abbas M, Robalo Nunes T, Martischang R, Zingg W, Iten A, Pittet D, et al. Nosocomial transmission and outbreaks of coronavirus disease 2019: the need to protect both patients and healthcare workers. Antimicrob Resist Infect Control 2021;10:7. https://doi.org/10.1186/s13756-020-00875-7.

[5] Rickman HM, Rampling T, Shaw K, Martinez-Garcia G, Hail L, Coen P, et al. Nosocomial transmission of coronavirus disease 2019: a retrospective study of 66 hospital-acquired cases in a London teaching hospital. Clin Infect Dis 2021;72:690—3. https://doi.org/10.1093/cid/ciaa816.

[6] Zhou J, Otter JA, Price JR, Cimpeanu C, Meno Garcia D, Kinross J, et al. Investigating severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) surface and air contamination in an acute healthcare setting during the peak of the coronavirus disease 2019 (COVID-19) pandemic in London. Clin Infect Dis 2021;73. https://doi.org/10.1093/cid/ciaa905. e1870—7.

[7] Casanova LM, Weaver SR. Evaluation of eluents for the recovery of an enveloped virus from hands by whole-hand sampling. J Appl Microbiol 2015;118:1210—6. https://doi.org/10.1111/jam.12777.