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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Saliva sampling for diagnosing SARS-CoV-2 infections in symptomatic patients and asymptomatic carriers

In a recent review of laboratory tests for diagnosing SARS-CoV-2 infection, Zheng et al. concluded that the detection rate of real-time quantitative PCR was lower than that of computed tomography [1]. But the authors did not discuss the possibility of using saliva sampling. Nasopharyngeal (NP) swabs are the preferred collection vehicles in France and many other countries and several studies have indicated that this method is more sensitive than sampling other sites [2–4]. Saliva sampling is less invasive for patients, less hazardous for health care workers, requires fewer experimented staff and is less expensive for mass testing. However, little is known about any differences in the sensitivities of saliva and NP sampling or how any differences vary with presence or absence of clinical symptoms.

We compared the sensitivities of saliva and NP swab samples for detecting SARS-CoV2 in hospitalized and ambulatory patients. Saliva was collected by asking patients to salivate, swill the saliva around their mouth for at least 30 s and then spit into a sterile container. Samples were assayed by real-time RT-PCR on a Panther Fusion™ module (Hologic®) [5]. The target was the SARS-CoV-2 RNA-dependent polymerase gene (IP2, IP4, Institut Pasteur, Paris, France). We assayed saliva and NP swab samples, collected on the same day, from 123 individuals (median age: 43 years, male/female ratio: 49/74).

The 123 individuals with paired samples included 44 (35.8 %) with at least one positive specimen. Of these, 17 were asymptomatic and 27 were symptomatic, 9 of whom were hospitalized. The 44 infected individuals comprised 34 (77.3 %) with both samples positive, 3 (6.8 %) with only positive saliva, and 7 (15.9 %) with only positive NP swabs (Table 1). Thus the saliva samples detected 37/44 (82.2 %) patients, while the NP swabs detected 41/44 (93.2 %) patients ($p = 0.34$). The sensitivity of saliva samples was 88.2 % (15/17) for asymptomatic carriers, 94.7 % (18/19) for symptomatic patients tested early (< 1 week) after symptom onset, and 50 % (4/8) for symptomatic patients with saliva collected late after symptom onset (Table 1).

The paired samples had median IP4 Ct values, reflecting virus load, of 29.5 (IQR 27.6–33.3) for saliva samples and 24.9 (IQR 21.9–30.9) for NP swabs ($p < 0.01$). The median IP4 Ct value for the NP swabs from patients with negative saliva tests (35, IQR 26.3–37.1) was higher than those with positive saliva test (24.9, IQR 21.9–30.9 ; $p = 0.01$). The Ct values for the IP2 target gave similar results.

Several reports have suggested using saliva samples to detect SARS-CoV-2 in symptomatic patients [6–13] but few data are available on their use for testing asymptomatic carriers [14]. Our results show that saliva samples provide relevant, reliable data, especially for asymptomatic individuals and symptomatic patients detected early, although the virus loads in saliva are lower than in NP swabs. The rare discrepancies between the saliva and NP samples occurred in low virus load patients, who were, perhaps, not very contagious. Suitably supervised saliva collection is undoubtedly simpler and more comfortable than using NP swabs. It could therefore improve workflow, lower cost, and reduce the risk of infection for healthcare professionals.

Declaration of Competing Interest

The authors declare no conflict of interest.

Table 1
Saliva and nasopharyngeal data for symptomatic patients and asymptomatic carriers.

	Saliva + ve/NP + ve N patients (%)	Saliva + ve/ NP-ve N patients (%)	Saliva-ve/ NP + ve N patients (%)
Overall (N = 44)	34 (77.3)	3 (6.8)	7 (15.9)
Asymptomatic (N = 17)	15 (88.2)	0	2 (11.8)
Symptomatic ≤1 week (N = 19)	18 (94.7)	0	1 (5.3)
Symptomatic > 1 week (N = 8)	1 (12.5)	3 (37.5)	4 (50)

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Marion Migueres[a,b,c,*]
[a] *Department of Virology, CHU Purpan, Toulouse, France*
[b] *INSERM UMR1043/CNRS UMR5282, Center for Pathophysiology of Toulouse Purpan, France*
[c] *Toulouse III University Paul Sabatier, Toulouse, France*
E-mail address: migueres.m@chu-toulouse.fr.

Catherine Mengelle
Department of Virology, CHU Purpan, Toulouse, France

Chloé Dimeglio[a,b,c]
[a] *Department of Virology, CHU Purpan, Toulouse, France*
[b] *INSERM UMR1043/CNRS UMR5282, Center for Pathophysiology of Toulouse Purpan, France*
[c] *Toulouse III University Paul Sabatier, Toulouse, France*

Alain Didier
Department of Pulmonology, CHU Toulouse, France

Muriel Alvarez
Department of Tropical and Infectious Diseases, CHU Toulouse, France

Pierre Delobel[a,b,c]
[a] *INSERM UMR1043/CNRS UMR5282, Center for Pathophysiology of Toulouse Purpan, France*
[b] *Toulouse III University Paul Sabatier, Toulouse, France*
[c] *Department of Tropical and Infectious Diseases, CHU Toulouse, France*

Jean-Michel Mansuy
Department of Virology, CHU Purpan, Toulouse, France

Jacques Izopet[a,b,c]
[a] *Department of Virology, CHU Purpan, Toulouse, France*
[b] *INSERM UMR1043/CNRS UMR5282, Center for Pathophysiology of Toulouse Purpan, France*
[c] *Toulouse III University Paul Sabatier, Toulouse, France*

[*] Corresponding author at: Laboratoire de Virologie – Institut Fédératif de Biologie, CHU de Toulouse – Purpan, 330 Avenue de Grande-Bretagne, TSA 40031, 31059 Toulouse Cedex 9, France.