



## 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, swirl 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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## References

- [1] Z. Zheng, Z. Yao, K. Wu, J. Zheng, The diagnosis of pandemic coronavirus pneumonia: a review of radiology examination and laboratory test, *J. Clin. Virol.* 128 (2020) 104396.
- [2] R. Wölfel, V.M. Corman, W. Guggemos, M. Seilmaier, S. Zange, M.A. Müller, et al., Virological assessment of hospitalized patients with COVID-2019, *Nature* 581 (7809) (2020) 465–469.
- [3] W. Wang, Y. Xu, R. Gao, R. Lu, K. Han, G. Wu, et al., Detection of SARS-CoV-2 in different types of clinical specimens, *JAMA* 18 (323) (2020) 1843–1844.
- [4] L. Zou, F. Ruan, M. Huang, L. Liang, H. Huang, Z. Hong, et al., SARS-CoV-2 viral load in upper respiratory specimens of infected patients, *New Engl. J. Med* 382 (2020) 1177–1179.
- [5] P. Trémeaux, et al., Evaluation of the Aptima™ transcription-mediated amplification assay (Hologic®) for detecting SARS-CoV-2 in clinical specimens, *J. Clin. Virol.* 129 (2020) 104541.
- [6] C. McCormick-Baw, et al., Saliva as an alternate specimen source for detection of SARS-CoV-2 in symptomatic patients using Cepheid Xpert Xpress SARS-CoV-2, *J. Clin. Microbiol.* (2020).
- [7] S. Iwasaki, et al., Comparison of SARS-CoV-2 detection in nasopharyngeal swab and saliva, *J. Infect.* (2020).
- [8] L. Azzi, et al., Saliva is a reliable tool to detect SARS-CoV-2, *J. Infect.* 81 (2020) e45–e50.
- [9] E. Pasomsab, et al., Saliva sample as a non-invasive specimen for the diagnosis of coronavirus disease 2019: a cross-sectional study, *Clin. Microbiol. Infect.* (2020).
- [10] J.H.-K. Chen, et al., Evaluating the use of posterior oropharyngeal saliva in a point-of-care assay for the detection of SARS-CoV-2, *Emerg. Microbes Infect.* 9 (2020) 1356–1359.
- [11] K.K.-W. To, et al., Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study, *Lancet Infect. Dis.* 20 (2020) 565–574.
- [12] K.K.-W. To, et al., Consistent detection of 2019 novel coronavirus in saliva, *Clin. Infect. Dis. Off. Publ. Infect. Dis. Soc. Am.* (2020).
- [13] S. Cheuk, Y. Wong, H. Tse, Posterior oropharyngeal saliva for the detection of SARS-CoV-2, *Clin. Infect. Dis.* (2020).
- [14] N.V.V. Chau, et al., The natural history and transmission potential of asymptomatic SARS-CoV-2 infection, *Clin. Infect. Dis.* (2020).

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