Nasal swab sampling for SARS-CoV-2:
A convenient alternative in time of nasopharyngeal swab shortage

Hélène Péré1,2,3, Isabelle Podglajen3,4, Maxime Wack5,6, Edouard Flamarion7, Tristan Mirault2,8, Guillaume Goudot2,8, Caroline Hauw-Berlemont9, Laetitia Le10,11, Eric Caudron10,11, Sophie Carrabin7, Julien Rodary1, Tatiana Ribeyre1, Laurent Bélec1,3,4, David Veyer1,3,12,#

1Laboratoire de Virologie, Hôpital Européen Georges Pompidou, Assistance Publique-Hôpitaux de Paris, Paris, France;
2INSERM U970, PARCC, Hôpital Européen Georges Pompidou, Faculté de Médecine, Université de Paris, Paris, France;
3Service de Microbiologie, Hôpital Européen Georges Pompidou, Assistance Publique-Hôpitaux de Paris, Paris, France;
4Faculté de Médecine Paris Descartes, Sorbonne Paris Cité, Université de Paris, Paris, France;
5Département d’Informatique Médicale, Biostatistiques et Santé Publique, Hôpital Européen Georges Pompidou, Assistance Publique–Hôpitaux de Paris, Paris, France;
6Centre de Recherche des Cordeliers, INSERM, UMRS 1138, Université de Paris, Paris, France;
7Département de Médecine Interne, Hôpital Européen Georges Pompidou, Assistance Publique-Hôpitaux de Paris, Paris, France;
8Département de Médecine Vasculaire, HYPERVASC, Hôpital Européen Georges Pompidou, Assistance Publique-Hôpitaux de Paris, Paris, France;
9Service de Médecine Intensive-Réanimation, Hôpital Européen Georges Pompidou, Assistance Publique-Hôpitaux de Paris, Paris, France;
10Laboratoire de Chimie Analytique Pharmaceutique, EA7357, Université Paris Sud-Paris-Saclay, Châtenay-Malabry, France;
11Département de Pharmacie, Hôpital Européen Georges Pompidou, Assistance Publique-Hôpitaux de Paris, Paris, France;
12Unité de Génomique Fonctionnelle des Tumeurs Solides, Centre de Recherche des Cordeliers, INSERM, Université de Paris, Paris, France.

Running title: Nasal swab for SARS-CoV-2 molecular detection

#Corresponding author: Dr David Veyer, Pharm D, PhD, Laboratoire de virologie, Hôpital Européen Georges Pompidou, 20 Rue Leblanc 75015 Paris France, Tel: (33)1 56 09 39 59; fax: (33)1 56 09 24 47; electronic address: david.veyer@aphp.fr
Nasopharyngeal swab is the reference sampling method to detect SARS CoV2, as recommended by world Health Organization (WHO) (1). However, the collection of nasal specimens may have a slightly lower sensitivity than nasopharyngeal specimens (2, 3). We herein validated an alternative procedure to collect nasal secretions with swab routinely used in medical bacteriology for which there is no risk of supply disruption, in order to perform the molecular diagnosis of SARS-CoV-2 infection.

Patients who were suspected of COVID-19 attending the Hôpital Européen Georges Pompidou, Paris, France, were for their own care according to medical decision prospectively included and subjected to SARS-CoV-2 molecular testing using nasopharyngeal swab [Xpert® Nasopharyngeal Sample Collection Kit, Cepheid, Sunnyvale, CA, USA] and nasal swab (Copan Transystem®, Copan, Brescia, Italy).

Nasal and nasopharyngeal swabs were inserted in the nostril until they hit an obstacle (the inferior concha and the back of the nasopharyngeal cavity, respectively), rotated 5 times and removed. The test was conducted in only one nostril per patient. After sampling, nasopharyngeal swab was inserted into a vial containing 3 mL of virus transport medium (Xpert® Viral Transport medium, Cepheid), and nasal swab was placed in a 15 mL tube containing 3 mL of saline solution (NaCl 0.9%). SARS CoV-2 was detected using Allplex™ 2019-nCoV Assay (Seegene, Seoul, Korea).

A total of 44 patients were prospectively included up to the end of March 2020. Their median age was 63.0 years, ranging from 18 to 94 years. There were 23 (52.3%) male and 21 female patients. A total of 37 (84.1%) patients showed laboratory-confirmed SARS-CoV-2 infection using nasopharyngeal swab, 7 remaining negative (15.9%) (Table 1).

Out of 37 patients that were positive for SARS-CoV-2 by nasopharyngeal swab testing, 33 were also tested positive with nasal sampling. All SARS-CoV-2-negative patients with nasopharyngeal swabs (n=7) tested negative using nasal swabs (Table 1).
By reference to nasopharyngeal sampling, the detection of SARS-CoV-2 by nasal sampling provided 7 (15.9%) true SARS-CoV-2-negative specimens, 4 (9.1%) false negative specimens and 33 (75.0%) true SARS-CoV-2-positive specimens. Thus, the sensitivity of SARS-CoV-2 RNA detection by multiplex real-time PCR from nasal secretions was 89.2% [95% confidence interval (CI); 75.3-95.7] and its specificity was 100.0% (95% CI; 94.6–100.0). The κ index was 0.72, indicating substantial concordance between nasal and nasopharyngeal swabbing to detect SARS-CoV-2 according the Landlis and Koch’s rank. The Youden’s J index was calculated at 89.2%, demonstrating good efficiency to detect SARS-CoV-2 RNA.

Ct (mean±SD) values for E, RdRP, and N genes by nasopharyngeal (E: 23.9±4.9; RdRP: 26.3±5.5; N: 28.9±6.1) and nasal (E: 22.3±5.2; RdRP: 24.6±5.9; N: 27.9±6.1) swabs testing were of similar levels. Differences in Ct values for the E, RdRP, and N genes were not statistically significant (p = 0.56, 0.84, and 0.57 respectively).

We herein report that the molecular detection of SARS-CoV-2 using nasal swab specimens was nearly equivalent to the detection using nasopharyngeal swab considered as the gold standard. SARS-CoV-2 detection from nasal samples showed high sensitivity and specificity. Agreement and accuracy of test results using nasal sampling by reference to gold standard nasopharyngeal sampling were estimated as substantial and good, respectively. Taken together, these observations demonstrate that nasal sampling could be used to screen SARS-CoV-2 in times of nasopharyngeal swab shortage.
Acknowledgments. We thank the patients, the nurses and clinical staff who are providing care for the patients.

Conflicts of interest: None.

Funding statement: None.
References


Table 1. Comparison of nasopharyngeal versus nasal sampling for SARS-CoV-2 detection by molecular biology.

<table>
<thead>
<tr>
<th>Nasopharyngeal sample/Nasal sample results</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concordant results</td>
<td></td>
</tr>
<tr>
<td>Positive/Positive</td>
<td>33 (75.0%)</td>
</tr>
<tr>
<td>Negative/Negative</td>
<td>7 (15.9%)</td>
</tr>
<tr>
<td>Discordant results</td>
<td></td>
</tr>
<tr>
<td>Positive/Negative*</td>
<td>4 (9.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>44 (100.0%)</td>
</tr>
</tbody>
</table>

* Out of the 4 discordant results, 2 had very low viral loads (Ct=38 on the N gene).