VIEWPOINT

SARS-CoV-2 Nasopharyngeal Swab Testing—False-Negative Results From a Pervasive Anatomical Misconception

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A qualitative real-time polymerase chain reaction of nasopharyngeal secretions is the criterion standard for identifying respiratory viruses, including severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1] However, major concerns have been raised regarding the rates of false-negative results in community testing locations.[2] In an early retrospective review of community hospital testing in China, a sensitivity of only 71% was reported.[3] Although there are many sources of false-negative results—including laboratory errors, patient misidentification, and inadequate collection of secretions—improper technique resulting in swabs not reaching the target site of the nasopharynx is a pervasive but modifiable error.

The trajectory from the nostril to the nasopharynx is often presumed to be along the dorsum of the nose, likely because of the visual appearance of the external nose. In reality, the correct trajectory is along the floor of the nose in the direction *back* toward the ear (**Figure**). As otolaryngologists, we have long provided education to patients, nurses, and doctors about this false anatomical presumption in treating epistaxis. There is a tendency to place packing "*up*" the nose where it may not only fail to reach the intended location but also be uncomfortable for the patient because the packing is wedged against the middle turbinate.

The Centers for Disease Control and Prevention provides an accurate description of the technique to reach the nasopharynx, stating[1]:

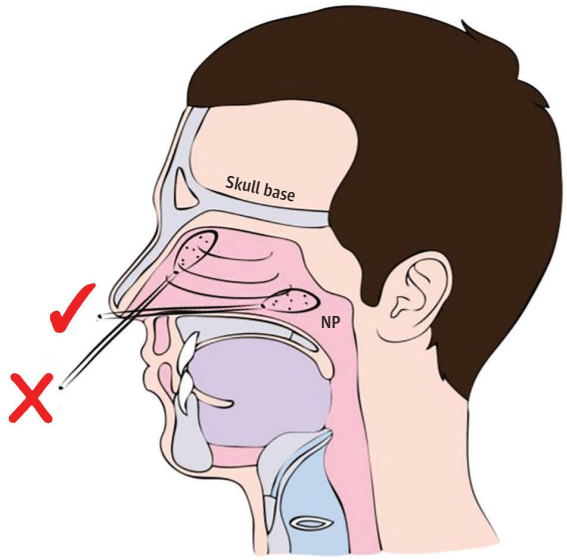
> Insert minitip swab with a flexible shaft (wire or plastic) through the nostril parallel to the palate (not upwards) until resistance is encountered or the distance is equivalent to that from the ear to the nostril of the patient, indicating contact with the nasopharynx. Swab should reach depth equal to distance from nostrils to outer opening of the ear. Gently rub and roll the swab. Leave swab in place for several seconds to absorb secretions. Slowly remove swab while rotating it. Specimens can be collected from both sides using the same swab, but it is not necessary to collect specimens from both sides if the minitip is saturated with fluid from the first collection. If a deviated septum or blockage create [*sic*] difficulty in obtaining the specimen from one nostril, use the same swab to obtain the specimen from the other nostril.

Although lower respiratory tract samples, such as bronchoalveolar lavage and sputum specimens, demonstrate higher viral loads in patients with SARS-CoV-2 infection, nasopharyngeal swab (NPS) testing is the best alternative to oropharyngeal swabs or examination of blood or stool.[4] An NPS is widely used to test for other respiratory viral infections and has supplanted nasopharyngeal aspiration for its accuracy and convenience in this setting.[5] However, poor technique in NPS testing may convert this test to a simple nasal swab. The NPS is inherently uncomfortable even with good technique, and a patient or the NPS operator may retract prematurely before the swab reaches the correct location and is saturated with mucus. Limited attention has been paid to the effect of proper technique on accuracy of results in NPS testing even with regard to testing for influenza or jother respiratory viruses. Of note, more tests are performed in drive-through settings to provide convenience, increase throughput, and adhere to social distancing recommendations. Despite the rapid adoption of this modality, a substantial review of its effect on testing accuracy has not been done, and patient and operator positioning may not be optimized for proper NPS technique. Even more concerning is the observation of facilities opting for patients to self-administer swabs designed to reach the nasopharynx. Few laypersons could be expected to understand the depth and trajectory required to perform the test.

Three points need to be stressed to frontline health care workers performing NPS: trajectory angle, depth, and patient expectations. The swab should be angled to follow the floor of the nose, and the depth required to reach the nasopharynx is often surprising to nonotolaryngologists: approximately 9 to 10 cm in adults. For many swabs, this means that almost the entire length is inserted into the nasal cavity, with only a small portion left to be held outside the nose. Both the patient and the operator should have proper expectations for the procedure: the NPS is uncomfortable but should not cause severe pain. Such discomfort should indicate to the operator that an anatomical obstruction, such as a deviated septum, is occluding the pathway, and a modified trajectory or contralateral approach should be attempted.

Given our subspecialty focus on nasal anatomy, we have been involved in training personnel at our respective institutions on the proper techniques for NPS collection for SARS-CoV-2 testing, and we have noticed pervasive misperception about the location of the nasopharynx. Although many sites around the world are likely providing proper training, we are concerned that inadequate NPS collection may continue to lead to false-negative results. The rate of false-

Figure. Diagram of Nasal Anatomy Showing the Correct (✓) and Incorrect (X) Trajectory for a Swab Directed Into the Nasopharynx (NP)



The NP is back, not up.

negative results in reverse transcriptase polymerase chain reaction testing is a great concern because it underestimates the prevalence of SARS-CoV-2 infection, gives a false sense of security to patients and the health care workers caring for them, and limits public health efforts in identifying and tracing the spread of the virus. We hope highlighting that the nasopharynx is back, not up, can help limit false-negative results in testing for SARS-CoV-2 and other respiratory viruses.

ARTICLE INFORMATION

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REFERENCES

1. Centers for Disease Control and Prevention. Interim guidelines for collecting, handling, and testing clinical specimens for COVID-19: interim guidelines for collecting, handling, and testing clinical specimens from persons for coronavirus disease 2019 (COVID-19). Coronavirus Disease 2019 (COVID-19) website. Accessed May 14, 2020. https://www.cdc.gov/coronavirus/2019-ncov/lab/guidelines-clinical-specimens.html

2. West CP, Montori VM, Sampathkumar P. COVID-19 testing: the threat of false-negative results. *Mayo Clin Proc*. 2020;95(6):1127-1129.doi:10.1016/j.mayocp.2020.04.004

3. Fang Y, Zhang H, Xie J, et al. Sensitivity of chest CT for COVID-19: comparison to RT-PCR. *Radiology*. 2020;296(2):E115-E117.doi:10.1148/radiol.2020200432

4. Wang W, Xu Y, Gao R, et al. Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA*. 2020;323(18):1843-1844. doi:10.1001/jama.2020.3786

5. Tunsjø HS, Berg AS, Inchley CS, Røberg IK, Leegaard TM. Comparison of nasopharyngeal aspirate with flocked swab for PCR-detection of respiratory viruses in children. *APMIS*. 2015;123(6):473-477. doi:10.1111/apm.12375