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New style for nasopharyngeal swab with a mask: image-evaluation

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COVID-19, caused by SARS-CoV-2, is rapidly spreading worldwide and has become a threat to humankind. Respiratory infectious viruses such as SARS-CoV-2 are transmitted via contact and droplets and have a high secondary attack rate ranging from 3.0%–11.2% in households (Wiersinga et al., 2020). Diagnosis of respiratory infectious virus is performed by collecting specimens from the surface of the respiratory mucosa using nasopharyngeal swabs (Föh et al., 2020; Marty et al., 2020). However, it is a high-risk procedure for healthcare workers because it causes pharyngeal reflexes or sneezing. We have developed a new mask that patients can wear when undergoing nasopharyngeal swab collection to reduce the infectious risk for healthcare workers. The mask was originally developed for use in endoscopy. It has a 10-mm-slit in the center to insert the bronchoscope and a 6-mm-slit on both sides for the suction catheter (Figure 1A). The patient (the mannequin) wore this mask slightly above the usual level, and the examiner inserted a pharyngeal swab through the 10-mm hole (Figure 1B). This method is thought to be effective in preventing airborne droplets exposure. We evaluated the protective effect of

the mask using a highly sensitive camera and a high-power light source (ViEST system) that can visualize airborne particles over 80 nm in size, and visually confirmed the protective effect of the mask (Figure 1C and supplementary video). Moreover, for the precise evaluation of the protective effect with the mask, we did the visualization 3 times. Quantification of the pixels of airborne particles from the visualizations indicated significant reduction of airborne particles with the mask ($P = 0.0132 < 0.05$, Student's t-test). This mask has several other advantages. First, the patient does not feel uncomfortable while wearing this mask because its basic structure is similar to that of surgical masks. Second, it is disposable and thus contributes to the prevention of sample contamination. However, there is a concern that because the mask inhibits the visualization of the proper swab collection, the swab collector would have to be trained.

In conclusion, this mask is a valuable and straightforward protective tool. The use of this mask by patients, together with conventional infection prevention measures, has preventative benefits during nasopharyngeal swab collection.

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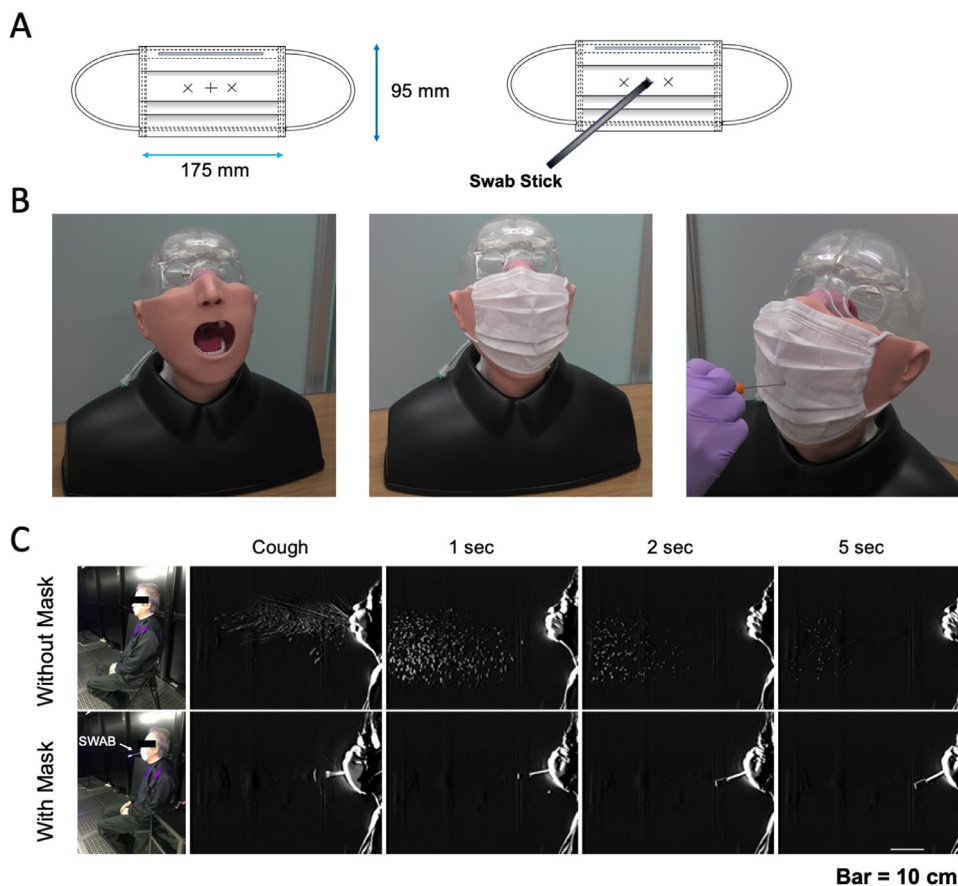


Figure 1. (A) Scheme of a mask for nasopharyngeal swab (left). The mask had a 10-mm-slit in the center for swab stick insertion and a 6-mm-slit on both sides for the suction tube (right).

(B) The appearance of the swab-test-mannequin with or without the mask (left and center pictures). Nasopharyngeal swab can easily insert through the slit (right picture).

(C) High-speed sensitive camera images (ViEST system) of splashes during coughing without and with the swab mask (See Supplementary Video 1). The mask can prevent splashes and droplets.

Declaration of Competing Interest

S.O., H.Y., and K.S. have a patent pending.

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Author Contributions

All authors are equally contributed to this work. K.T., S.O., H.Y., T.I., and K.S. conducted the experiment and wrote the manuscript, N.F. and S.T., performed image analysis. K.S. supervised, designed, conceived, and conducted the project.

Ethical Approval

The research protocol was reviewed and approved by the Ethics Committee of the Nagoya University Clinical Research Committee (Approval No. 2020-0127). This article does not contain any studies with human participants performed by any of the authors.

Consent

Not applicable.

Availability of data and materials

Not applicable.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.ijid.2021.06.039](https://doi.org/10.1016/j.ijid.2021.06.039).

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