Role of Mask/Respirator Protection Against SARS-CoV-2

To the Editor

Since its outbreak on December 31, 2019, in Wuhan, a central city in China, Coronavirus Disease 2019 (COVID-19) has now spread to almost all countries in the world. It has been declared a pandemic, and it has infected over 1,041,126 people in a very short time, with 55,132 deaths as of April 3, 2020. Wearing masks/respirators and practicing self-isolation at home have been recommended as guidelines for the public. However, the problem is the number of cases among medical personnel. Interestingly, a higher risk of infection was noticed in male professionals.[1] There are currently many types of masks/respirators available, ranging from simple surgical masks designed to protect wearers from microorganism transmission and fit loosely to the user's face, through N95 masks used to prevent users from inhaling small airborne particles. These must fit tightly to the user's face.[2] Masks differ primarily in their maximum internal leakage rate limit. Surgical masks are designed to protect against droplets or particles with a diameter of >100 μm, whereas severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus is essentially spherical, albeit slightly pleomorphic, with a diameter of 60–140 nm and 100 times smaller than the pore diameter. Thus, surgical masks cannot prevent inhalation of small airborne particles; however, both can protect users from large droplets and sprays.[3,4] The PN-EN 149:2001 standard defines 3 protection classes for half masks: filtering face piece 1 (FFP1), filtering face piece 2 (FFP2), and filtering face piece 3 (FFP3). The maximum internal leakage limit is 25% for FFP1, 11% for FFP2, and 5% for FFP3. Class FFP1 masks retain about 80% of particles smaller than 2 μm, FFP2 ones retain 94% of particles smaller than 0.5 μm, and FFP3 ones retain 99.95% of particles smaller than 0.5 μm (Table).

At the moment, we may meet divergent recommendations for the use of masks. While the Centers for Disease Control and Prevention recommend the use of masks in low-risk and high-risk situations, the World Health Organization advises applying masks in low-risk situations and respirators in high-risk situations. Long et al[5] conclude in their meta-analysis that the use of N95 respirators compared with surgical masks is not associated with a lower risk of laboratory-confirmed influenza. They suggest that N95 respirators should not be recommended for the general public and non–high-risk medical staff who are not in close contact with influenza patients or suspected patients.

The potential of face masks to reduce the spread of respiratory infections could be useful. Wang et al[1] indicated that 10 of 213 medical professionals with no mask were infected by COVID-19 as compared with 0 of 278 wearing N95 respirators.

It is also worth noting that the respirator increases resistance to inhalation. The longer they are used, the more difficult breathing becomes because of more absorbed dust. What is more, the effectiveness decreases with the increase of carbon dioxide and water vapor between the respirator and face (the so-called dead space). The concentration of carbon dioxide in the dead space increases with each subsequent exhalation. Therefore, masks should be replaced frequently. Additionally, to improve the comfort of use, masks use 1-way exhalation valves, which accelerate the circulation of gases.[6]

To conclude, the use of protective masks can and should be the first protection against SARS-CoV-2 transmission to medical personnel. Medical personnel should use class FFP3 masks. Additionally, the application of visors to cover the entire face during contact with the patient is worth considering.

Table. Filtration Efficiency for Each Class of Masks

Test	FFP1	FFP2	FFP3
Concentration of harmful substances	Till 4 × NDS	Till 10 × NDS	Till 30 × NDS
Leakage	<22%	<8%	<2%
Penetration	<20%	<6%	<1%
Initial expiration resistance at 95 L/min	<210 Pa	<240 Pa	<300 Pa

Abbreviations: FFP1, filtering face piece 1; FFP2, filtering face piece 2; FFP3, filtering face piece 3; NDS, the highest acceptable concentration of the harmful factor.

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