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Fogging of goggles in PPE during COVID-19 pandemic. A practical problem with multiple possible solutions

To the Editor

The COVID-19 pandemic poses an unequivocal occupational risk to the health care community [1]. This risk is even higher in intensive care settings [2]. Meticulous, efficient and stringent use of personal protective equipment (PPE) cannot be overemphasized in such times. However, there are many practical problems faced while using PPE; fogging of goggles being a common one.

A recent article, by Pandey and colleagues, noted that using Sterillium™, an alcohol-based sanitizer, prevents fogging [3]. However, there are certain easier and safer methods to prevent fogging. An extensive search was performed on PubMed using search items: ("Anti-fog" OR "anti-fog" OR "fog" OR "mist" OR "spray" OR "fogging") AND ("goggle" OR "glasses"), ("condensation" AND ("goggle" OR "glasses"), ["prevent" AND "fog" AND ("goggle" OR "glasses")], ["adhesive" AND ("prevent" AND "fog") OR ("antifog" OR "anti-fog")], [("soap" OR "gel" OR "spray" AND ("fog" OR "antifog" OR anti-fog")]. The search returned 9 results that were relevant to the context of this review. We present the methods to prevent fogging of goggles, their mechanism along with benefits and potential harms in Table 1.

Thus, there are various methods to tackle the problem of fogging of goggles in the COVID-19 pandemic era, the most important being tight-fitting mask, which is necessary to prevent the occupational risk of COVID-19. In view of unclear benefit, potential toxicity, cost and restricted availability in limited resource conditions, the use of sterillium for antifogging should not be encouraged currently. The fear of COVID-19 sparks novel safety measures which can lead to more harm than the possible good they can do. The safety and efficacy studies recording all outcomes — benefits, toxicity and the method of use must be the path ahead.

Conflict of interest

None declared.

Table 1. Methods to prevent fogging of eye goggles, with their mechanism, advantages and caveats

Antifogging measure	Mechanism	Advantages	Caveats
Reversing the mask-tie around the ear [4]	Better seal around the nasal ridge	Simple and effective method	Air may leak along the lateral margins of the mask (near the ears). Undue pressure on the skin of the ears
Tightly "sealed" face mask	A correct size and properly fit mask will, by itself, prevent the exhaled air from escaping around the nasal ridge	It is easily the most important and practical measure, and should be applied in addition to any other method	Can lead to face marks, but they are temporary and cannot justify compromising with safety
Application of adhesive strip on the nasal ridge -mask junction [5]	Blocks air leakage superiorly around the nasal ridge, preventing entry of air into goggles	Adhesive strips are readily available in all hospitals	Skin damage can be caused, if hypoallergenic adhesive is not used

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Table 1 cont. Methods to prevent fogging of eye goggles, with their mechanism, advantages and caveats

Antifogging measure	Mechanism	Advantages	Caveats
Antifogging spray/gels	These provide a coating on the goggles that reduce surface tension and prevent fogging	Used widely by scuba divers, and on motor vehicle windshields in cold weather	Expensive alternative in a resource constrained country
Soapy water/shampoo application [6, 7]	Applying soapy water or shampoo, followed by drying with a cotton cloth, has shown to leave a thin surfactant film which reduces surface tension. The reduced surface tension causes water molecules to spread out into a continuous and thin layer, which leads to less scattering of light and hence prevents fogging	Age-old practice, cheap, available at even primary health care level	May cause a slightly distorted vision if goggles are not properly wiped
Application of hydrogel patches on the upper surface of N95 [8]	Tighter fit of the respirators preventing air leak through the superior margin, around the nasal ridge	Easy to apply and comfortable to use	Better used as an adjunct to other antifogging measures
Filtered eye mask (airtight) [9]	Airtight, protects against COVID-19 infection as well as against fogging	Novel approach	Not easily available, and may be costly
Alcohol-based sanitizer	A single letter from a tertiary care centre at Delhi, India	Claimed to decrease fogging and maintain cleanliness	In smaller centers with limited resources, using Sterillium for eye goggles may not justify the cost-benefit ratio. Besides, limited availability is an issue. Most importantly, sterillium is an alcohol-based solution [10], which can cause a burning sensation in the eyes and further worsening of vision, probably by the droplets of sterillium that spread over the surface of the goggles [11, 12]. Upon exposure of the eye to them, alcohol and alcohol-based products carry the risk of conjunctivitis, keratitis, and corneal scarring [11–13]

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Should emergency medical service staff use respirators with filtered valves during the COVID-19 pandemic?

To the Editor

Performing medical procedures with the use of personal protective equipment may reduce the efficiency of medical procedures performed. This can be exemplified currently with the use of respiratory protection devices such as N95 or surgical masks [1–3]. Healthcare workers (HCWs) using N95 respirators or medical masks may experience discomfort associated with wearing a mask when performing medical procedures. This is particularly true for those procedures associated with increased physical activity causing increased respiratory effort. As shown by Macintyre *et al.* [4], the rates of infection in the medical mask group were double those in the N95 group. Other authors also point to the advantage of N95 respirators compared with medical masks in reducing the risk of viral infection (OR = 1.05; 95%CI: 0.88, 1.24; Figure 1) [4–7]. However, both N95 and med-

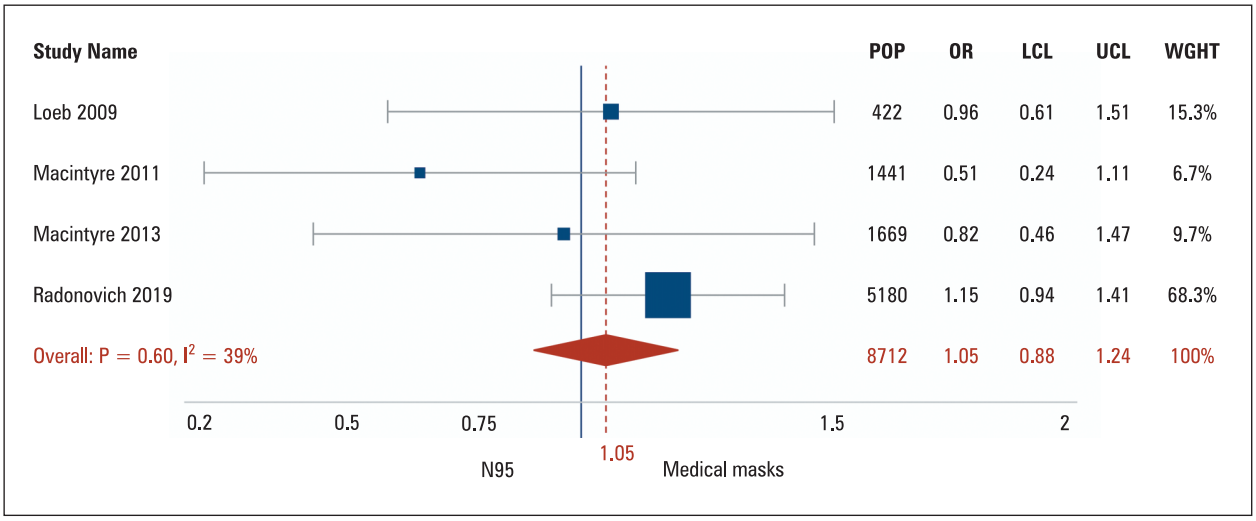

Figure 1. Forest plot of laboratory-confirmed respiratory viruses in N95 respirators *vs* medical masks. The center of each square represents the relative risk for individual trials and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results

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Table 1. Mask using complications (based on [4])

Complication type	N95 respirators	Medical masks	OR (95%CI)
Headaches	1.3%	3.9%	3.80 (2.00, 7.21)
Skin rush	5.0%	4.6%	1.08 (0.56, 2.08)
Difficulty breathing	19.4%	12.5%	1.69 (1.13, 2.53)
Allergies	7.1%	9.3%	0.75 (0.46, 1.24)
Pressure on nose	52.2%	11.0%	8.81 (5.90, 13.16)
Other	8.3%	0.7%	12.54 (3.04, 51.70)

CI — confidence interval; OR — odds ratio

ical masks have disadvantages. Le *et al.* showed that N95 and surgical facemasks could induce different temperatures and humidity in the microclimates of facemasks which have profound influences on heart rate and thermal stress and can cause a subjective perception of discomfort [3]. MacIntyre *et al.* described complications reported by HCWs using masks (Table 1) [4].

As shown by Hayashi *et al.*, when comparing masks both with and without an exhaust valve (EV), masks with an EV are more effective in reducing the temperature and humidity inside the mask and speed up dry and wet heat loss through the nose [8]. However, it is important to remember that respirators with an EV do not offer others protection against infection with COVID-19. The goal of the valve on these masks is to allow the user to breathe out more comfortably. The concept is that, on an outward breath, the valve opens to allow the exhalated air to escape and prevent the buildup of heat and bacteria on the inside of the mask.

In conclusion, medical personnel should use respirators with an EV when performing procedures related to increased physical activity (i.e., cardiopulmonary resuscitation) in order to reduce the adverse effects of using protective masks or N95 respirators. However, it should be noted that we should not recommend this type of personal protective equipment for routine wear by the public because of the risk of spreading the infection by people asymptomatic with COVID-19 who are not aware that they are infected.

Conflict of interest:

None declared.

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