

Comparative analysis of anti-fogging agents and their combination for protective eyewear in COVID-19 intensive care units

Dear Editor,

Since the COVID-19 pandemic started, numerous guidelines have been released to protect health care workers (HCWs), who are at a threefold higher infection risk.^[1] Recognizing conjunctival infection routes, protective goggles, and face shields have been recommended in personal protective equipment (PPE).^[2] However, invariable fogging-up of protective eyewear due to perspiration and exhaled humid air causes an early, sharp reduction in visual acuity, significantly limiting functionality. It also makes HCWs prone to physical injuries. Cleaning this moisture is impossible without PPE-breach.

Methods like taping the mask's upper edge, making holes on the goggle's sides, and placing eyewear in warm water help little.^[3] Liquid soap, iodophor, hand sanitizer,^[4] commercial anti-fogging agents,^[3] and anti-fogging films have been individually reported to be variably effective, with fog-free time, when mentioned, ranging from 1 to 8 hours, and usually tested up to 2 hours.^[5] Cleansing agents and sanitizers have been hypothesized to work by lowering the surface tension, which causes water molecules to spread out evenly into a transparent layer.^[6]

The study followed the tenets of the Declaration of Helsinki. Ten HCWs in COVID-19 intensive-care units used five anti-fogging methods for polycarbonate-based protective goggles. The agents were applied evenly on both surfaces of the goggles using a gauze piece followed by air drying. Methods used were as follows. A: Application of a liquid mixture of propan-1-ol and propan-2-ol (75%) (Sterillium™); B: Sodium lauryl-ether sulfate + sodium chloride solution (Baktolin 5.5™), a nonsoap handwash lotion containing surfactants; C: Spray-application of dimethyl carbinol + isopropyl alcohol (Colin™), a household surface cleaning agent. D: Sterillium™ followed by Baktolin 5.5™. E: A novel 3-agent sequence of Sterillium™, Baktolin 5.5™, and Colin™. These methods required <5 minutes for application. All HCWs had normal visual acuity (0 LogMAR, Snellen 6/6) after donning PPE; 50% used spectacles. Time taken for reduction in distance visual acuity to 1 LogMAR (Snellen 6/60) was named "complete fogging time" [Table 1]. A control group of 10 residents was taken without application of any anti-fogging agents. All groups (including controls) taped exposed edges of their masks and the eyewear using similar ways to ensure airtightness and reduced exposure to COVID-19 infection. Fogging time was compared using related samples Friedman's ANOVA test with a Bonferroni correction using SPSS software version 26 (IBM, NY, USA). $P < 0.05$ was considered significant. Methods B, D, and E were significantly better than controls and methods A and C ($P < 0.05$). No cutaneous or ocular irritation was reported.

The 3-agent combination showed a consistent fog-free effect for up to 6 hours of active work [Fig. 1]. We could not

Table 1: Time to complete fogging of protective eyewear in controls and with different anti-fogging methods

Method	<i>n</i>	Median time to fogging (minutes)	Interquartile range (minutes)
Controls	10	15	15-41.5
A - Sterillium™ (hand sanitiser)	10	15	15-67.5
B - Baktolin 5.5™ (washing liquid)	10	180	60-210
C - Colin™	10	60	52.5-105
D - Sterillium™, then Baktolin™	10	300	210-360
E - Sterillium™, then Baktolin™ followed by Colin™	10	360	270-360



Figure 1: (a) Fogging seen within 30 minutes of donning. (b) Agents used in combination. (c) Negligible fogging at the end of a 6-hour shift after use of the novel combination on goggles after 6 hours of use in COVID-19 ICU

test the efficacy beyond 6 hours due to shift change. Washing liquid soap alone or when applied following sanitizer could also be effective for up to 6 hours but inconsistently so. Larger studies can be done for further evaluation. These anti-fogging methods can significantly improve ergonomics for HCWs in this COVID-19 pandemic.

Photographic Consent

Photographic consent was not necessary as the subject is not identifiable and was one of the authors themselves.

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Conflicts of interest

There are no conflicts of interest.

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