

Which Eye Protection is Most Effective against Covid-19 Transmission?

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ABSTRACT

Eye protection is critical to reduce transmission of COVID-19. In this article, we provide our perspective on eye protection strategies including new lessons learned.

Keywords: Coronavirus; Eye protection; Filtered Eye Mask (FEM)

STUDY DESCRIPTION

Just over 100 years ago, Maxcy and colleagues proposed that the eye can be an entry route for infectious particles [1]. Given the worldwide pandemic, this well-known entry route is of particular interest [2,3]. There remains little doubt that COVID-19 can spread via airborne transmission [4]. As a result, many people worldwide are wearing eye protection. In this article, the authors will provide their perspective on the question "what type of eye protection is most effective at preventing transmission of COVID-19?"

The authors have been researching eye protection for 6 months and contend that an effective eye precaution against COVID-19 transmission must provide a clean, virus free chamber in front of the eyes. Sealed goggles provide such a virus free chamber, however, a well-known problem with sealed goggles is fog formation, which causes poor compliance [5]. Moisture in the air (e.g., inside the goggles) has the tendency to precipitate out near colder surfaces (e.g., the inner side of the lens). This is because lenses are commonly colder (e.g., since they touching 72 degree room air) rather than near warmer skin on face (98.6 degrees). Simply put, users cannot perform activities of daily living (e.g., going to grocery store) if their eye protection keeps fogging up and they can't see anything.

To combat fog, a well-practiced technique is the application of chemical, anti-fog coatings to the inner surface of the lenses [6-8]. Kumar and colleagues found that detergent based surfactant coatings tended to form a more uniform layer of moisture as compared to a modified polyethylene terephthalate (PET) plastic film and therefore provided usable eye protection for a longer duration [6].

A novel technique recently introduced was the filtered eye mask (FEM), which includes goggles with hole(s) covered by air filter(s) [9]. The FEM has two seals. The first seal is between the edges of the air filter(s) and the goggles and is of critical importance because it prevents air from the external environment (which potentially harbors COVID-19) from passing in between the filter and the goggles and entering the goggles. The second seal is between the goggles and the user's face and is equally important for preventing entry of COVID-19. Note the goggles, which were used cover the eyes, not the nose or mouth. The first FEM was constructed with a circular hole 1 cm in diameter covered by an N95 filter, which was sealed to the goggles, and found that there was little to no fog build up at 1 hour and was easy to read a book. Since that the diameter of a water molecule is over 1000 time smaller than a COVID-19 virus, this method allows for passage of water molecules through the filter, but provides a barrier against airborne virus. Kumar and colleagues build a FEM and found that the time to loss of clear visibility was 23 minutes and time to loss of workable visibility 27 minutes, which was significantly longer than the standard goggles [6]. Thus, both Douglas and Kumar found improvement with the FEM as compared to standard goggles.

The optimum eye mask is one that is comfortable to wear and provides a COVID-19 free chamber with fog free viewing. In pursuit of this goal, the authors would like to share with readers additional lessons learned from more recent experiments performed the authors. First, the FEM provides a cooler temperature of the face as compared to the sealed goggles, which is beneficial because the user is less prone to overheating and sweating, which is not only causes usage to be uncomfortable, but also exacerbates fog formation. Second, the use of FEM in

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combination with chemical, anti-fog coatings provides a synergistic effect. Third, larger vent sizes (e.g., 3 × 1 cm rectangular vent and 5 × 1.5 cm rectangular vents) and multiple vents allow for an increased rate of passage of water vapor and further fog reduction. Fourth, it is of critical importance that the edges of the filter are sealed to the mask so as to prevent COVID-19 entry into the mask (Figure 1). Fifth, it is of critical importance that the mask is sealed to the face so as to prevent COVID-19 entry into the mask.

In conclusion, the authors believe that having adequate eye protection is important not only for preventing the spread of infection, but also to reduce fear and stress associated with going out in public [10]. The authors believe that now is the time to garner lessons learned and begin manufacturing of filtered eye masks to mitigate spread.

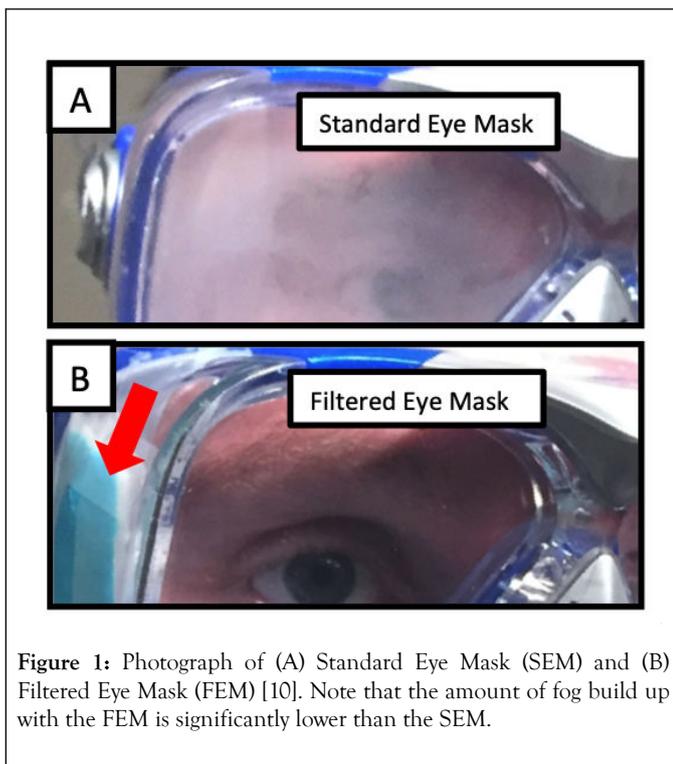


Figure 1: Photograph of (A) Standard Eye Mask (SEM) and (B) Filtered Eye Mask (FEM) [10]. Note that the amount of fog build up with the FEM is significantly lower than the SEM.

CONFLICTS OF INTEREST

Author Dr. David Douglas is a medical doctor and his father, Dr. Robert Douglas is an engineer. They have filed 4 patents pending including a variety of designs disclosed in patent pending, and would be more than happy to collaborate with any and all parties in efforts to try and mitigate the spread of COVID-19.

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