

Redesign Full-face Protective Glasses for Medical Staff During COVID-19 Pandemic

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Abstract— Full-face protective glasses was redesigned and tested their aerosol protective capability and usability in medical operations. With better face coverage and protective angle adjustment, the new design can significantly improve aerosol protective capability.

Clinical Relevance— General full-face protective glasses may risk the medical staff.

I. INTRODUCTION

Personal protective equipment (PPE) becomes one of the essential equipment to prevent contamination during COVID-19 pandemic [1] that can be categorized into two types: 1) face and eye protection and 2) respiratory protection [2]. Face shield has recently been adopted during COVID-19 to improve the effectiveness of protection besides the N-95 or surgical masks. It covers the face, eyes, nose, and mouth, thereby protecting the hands touching their face, nose, and mouth by accident. This physical touch leads to a high risk of virus contamination. However, the traditional face shield is not suitable for medical staff due to lacking full-face coverage capability. In this study, the general full-face protective glasses was redesigned and evaluated under the daily medical operation environment.

II. METHODS

The design Thinking process was used to modify the traditional face shield from collecting issues from stakeholders, generating ideas, consolidating into key solutions, producing a rapid prototype, testing, and evaluating under the real-case scenario. The aerosol protection capability was tested under three scenarios: 1) head phantom without protective equipment, 2) general full-face protective glasses with a surgical mask and 3) new design full-face protective glasses with a surgical mask. The luminescence analysis from fluorescent was tested using the air gun at a distance of 100 cm from the target. The air gun wind speed of 10.6 – 15.3 m/s and the fluorescent agent size of 10 microns were applied. The average value of green color from RGB images were measured using Adobe Photoshop CC 2017.

Besides the aerosol protection capability experiment, the usability test from 10 medical personnel providing the medical services at Chulabhorn Hospital, Bangkok, Thailand,

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was set up. This survey with 7 Likert scales was based on four key elements: usefulness, ease of use items, satisfaction/intention of use, and ease of learning.

III. RESULTS

Figure 1 shows the results of aerosol protection capability tests. The average green pixel values were 60.7, 44.8, and 27.1 for head phantom without protective equipment, the general full-face protective glasses with a surgical mask, and the new design full-face protective glasses with a surgical mask. The new design can reduce the fluorescent pigments on the head phantom from 18.3% to 11.6% compared to the general full-face protective glasses.

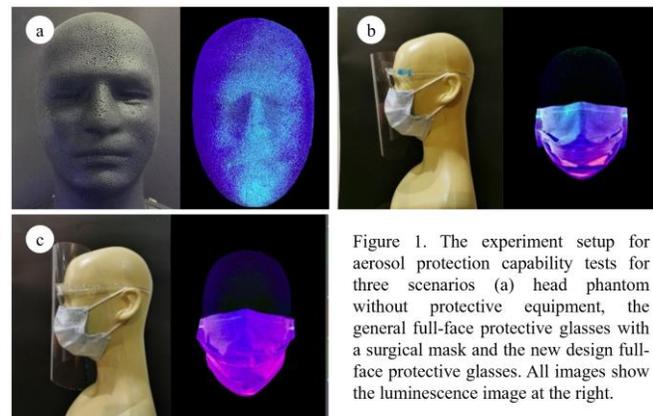


Figure 1. The experiment setup for aerosol protection capability tests for three scenarios (a) head phantom without protective equipment, the general full-face protective glasses with a surgical mask and the new design full-face protective glasses. All images show the luminescence image at the right.

For the usability test, the new design full-face protective glasses, the dimension of usefulness is the highest (average score = 6.39) following the ease-of-use items (6.17), satisfaction (6.01) and ease of learning (5.09). This survey concludes that the new design of full-face protective glasses has a high benefit for daily medical operations in the hospital.

IV. DISCUSSION & CONCLUSION

The general full-face protective glasses may not be suitable for medical staff. This equipment was redesigned and tested to improve the aerosol protective capability and usability in daily medical operation.

REFERENCES

- [1] World Health Organization. (2020). *Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19): interim guidance, 19 March 2020* (No. WHO/2019-nCoV/IPC PPE_use/2020.2). World Health Organization.
- [2] Ranney, M. L., Griffeth, V., & Jha, A. K. (2020). Critical Supply Shortages—The Need for Ventilators and Personal Protective Equipment during the Covid-19 Pandemic. *New England Journal of Medicine*.