Abstract 124 (J)

Comparison of Protection against Ocular Contamination with Disposable Eyewear Products

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ABSTRACT

Background: Current CDC recommendations for medical first responders call for use of disposable N95 respirator and eye protection (e.g., goggles; eye shield) when coming into close contact with a patient with suspected swine-origin influenza. Easy to store, inexpensive and disposable face shields, eye shields and safety eyeglasses are now widely available for eye protection. We sought to compare the efficacy of 3 types of protective eyewear in preventing mucosal surface contamination.

Methods: Life size mannequin heads were outfitted with N95 masks and either safety eyeglasses (SE), combination surgical mask with eyeshield (CME) or full face shield (FFS), or with FFS alone. Approximately 820 mg of an oil based orange dye that fluoresces at UV light was sprayed from a distance of 50 cm directly toward each mannequin. Penetration beyond the protective equipment to contaminate mucosal surfaces (eyes, nares and labial surfaces) was assessed by visual inspection at ambient and UV light. Experiments were performed in triplicate.

Results: Eye contamination visible at ambient light was observed with SE. Eye contamination visible at UV light was observed with SE and CME but not FFS. Labial and nares contamination was not observed in any of the groups.

Conclusions: Compared with eyeglasses and combination surgical mask/eyeshield, a full facial shield provides superior protection to against ocular contamination.

BACKGROUND

Health care facilities should consider implementation of measures to reduce or eliminate exposure to highly contagious respiratory viruses

CDC recommends the use of respiratory protection that is at least as protective as a disposable, fit-tested N95 respirator

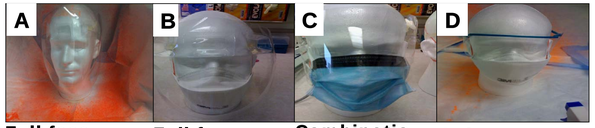
Several personal protective equipments, including surgical masks, face shields and eye glasses are commonly used; however data regarding their efficacy is sparse

Given the high likelihood that N95 respirators will become unavailable during a respiratory virus pandemic or unaffordable in developing countries; evaluation of alternative, low cost personal protective equipments is needed.

METHODS

The efficacy of four different personal protective equipments (PPE) to prevent mucosal contamination was evaluated using a two step simulation model. Life size mannequin heads were outfitted with the following PPE (Figure 1):

Figure 1: Personal Protective Equipments Tested



Full face shield (FFS) | **Full face shield + N95 respirator (FFS+N95)** | **Combination surgical mask + eyeshield (CME)** | **Safety eyeglasses +N95 respirator (SE)**

Step 1:
Approximately 820 mg of an oil based, liquid, orange, fluorescent dye (Glogerm; DMA International, Moab, UT) was sprayed onto each mannequin from a distance of 50 centimeters. Dye particles were approximately 5 μm in diameter. Mucosal contamination (eyes, nares and labial surfaces) was assessed visually at ambient and UV light. Experiments were done by triplicate

Step 2:
8 plastic 1x1cm decals were placed over the eyes, nares and labial folds of a mannequin which was then outfitted with each of the PPE to be tested. Approximately 820 mg of Glogerm was sprayed from a distance of 50 cm. Each sticker was immediately placed in a standard white sheet, which was taken into a charged couple device integration illumination camera and exposed to 1 second of epi-UV illumination. Fluorescence was measured using Kodak Gel Logic software. Positive (decal with 1μl of dye) and negative (unexposed decal) controls were included in each run to assess quality.

RESULTS

- At ambient light, eye contamination was only visualized with eye glasses in combination with N95 respirator. No contamination was noted with any PPE in either nares or mouth folds (Table 1).
- With UV light, eye contamination was visualized with eye glasses in combination with N95 respirator and with combination surgical mask and eye shield. Nares or mouth folds contamination was not observed with any PPE (Table 1).
- Using epi-uv illumination, contamination in all mucosal surfaces (eye, mouth and nares) was observed with eye glasses in combination with N95 respirator (Table 2).
- Using epi-uv illumination, FFS + N95 respirator provided the best protection against mucosal contamination

Table1: Mucosal surface protection amongst different personal protective equipments

PPE	EYE VISUAL	EYE UV	NARES VISUAL	NARES UV	MOUTH VISUAL	MOUTH UV
FFS(1)	-	-	-	-	-	-
FFS (2)	-	-	-	-	-	-
FFS (3)	-	-	-	-	-	-
FFS+N95(1)	-	-	-	-	-	-
FFS+N95(2)	-	-	-	-	-	-
FFS+N95(3)	-	-	-	-	-	-
CME(1)	-	+	-	-	-	-
CME(2)	-	+	-	-	-	-
CME(3)	-	+	-	-	-	-
SE+N95(1)	+	+	-	-	-	-
SE+N95(1)	+	+	-	-	-	-
SE+N95(1)	+	+	-	-	-	-

CONCLUSIONS

- **With regards to mucosal contamination we found that protection with:**
  - **Full face shield +N95 > Full face shield > combination eyeshield + surgical > safety glasses+N95**
- **Future studies should assess the performance of these PPE in real life settings**

Table2: Fluorescence levels according to different personal protective equipments

PPE	POSITIVE CONTROL	NEGATIVE CONTROL	EYES	NARES	MOUTH
FFS	59,39	None	36,77	None	None
FFS+N95	57,79	None	None	None	None
CME	65,53	None	26,80	None	27,79
SE+N95	65,53	None	57,58	47,58	32,27
SE+ surgical mask	63,55	None	26,89	33,99	29,42

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