



A Randomized Crossover Study to Evaluate Interventions to Reduce Contamination during Reuse of N95 Respirators

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Introduction

- During the COVID-19 pandemic, shortages of personal protective equipment (PPE) have forced many healthcare facilities to require personnel to reuse N95 respirators
- We hypothesized that the use of improved technique such as changing gloves after N95 contact or providing rapid decontamination between each use would reduce the risk for contamination

Methods

- Twelve healthcare personnel each performed 4 standardized simulations of patient care interactions in a randomized order
- N95 respirators exteriors were contaminated with bacteriophage MS2 with sampling recovery of $\sim 10^6$ plaque-forming units (PFU)
- Simulations involved:
 - Donning a N95 respirator (3M 8210) contaminated with bacteriophage MS2 and additional PPE (gloves, cover gown, face shield)
 - Maneuvering the patient's table and bedrail and auscultating the chest and palpating the abdomen
 - Doffing PPE after examination and placing N95 respirator into paper bag for storage
- Four simulation protocols were used:
 - Control:** Simulation without glove change except at completion of doffing after the examination
 - Change gloves:** Glove change after any N95 contact
 - UV:** Control + 1 minute UV-C light treatment of respirator prior to donning
 - Steam:** Control + 30 second steam treatment of respirator prior to donning
- A second trial was conducted with simulation protocols 1-3 using a 100-fold lower bacteriophage MS2 inoculum
- Participant and environmental surfaces were sampled after each simulation and frequencies of contamination were compared.

Figure 1A. Sites positive for contamination with bacteriophage MS2 in 4 groups with a higher level of contamination

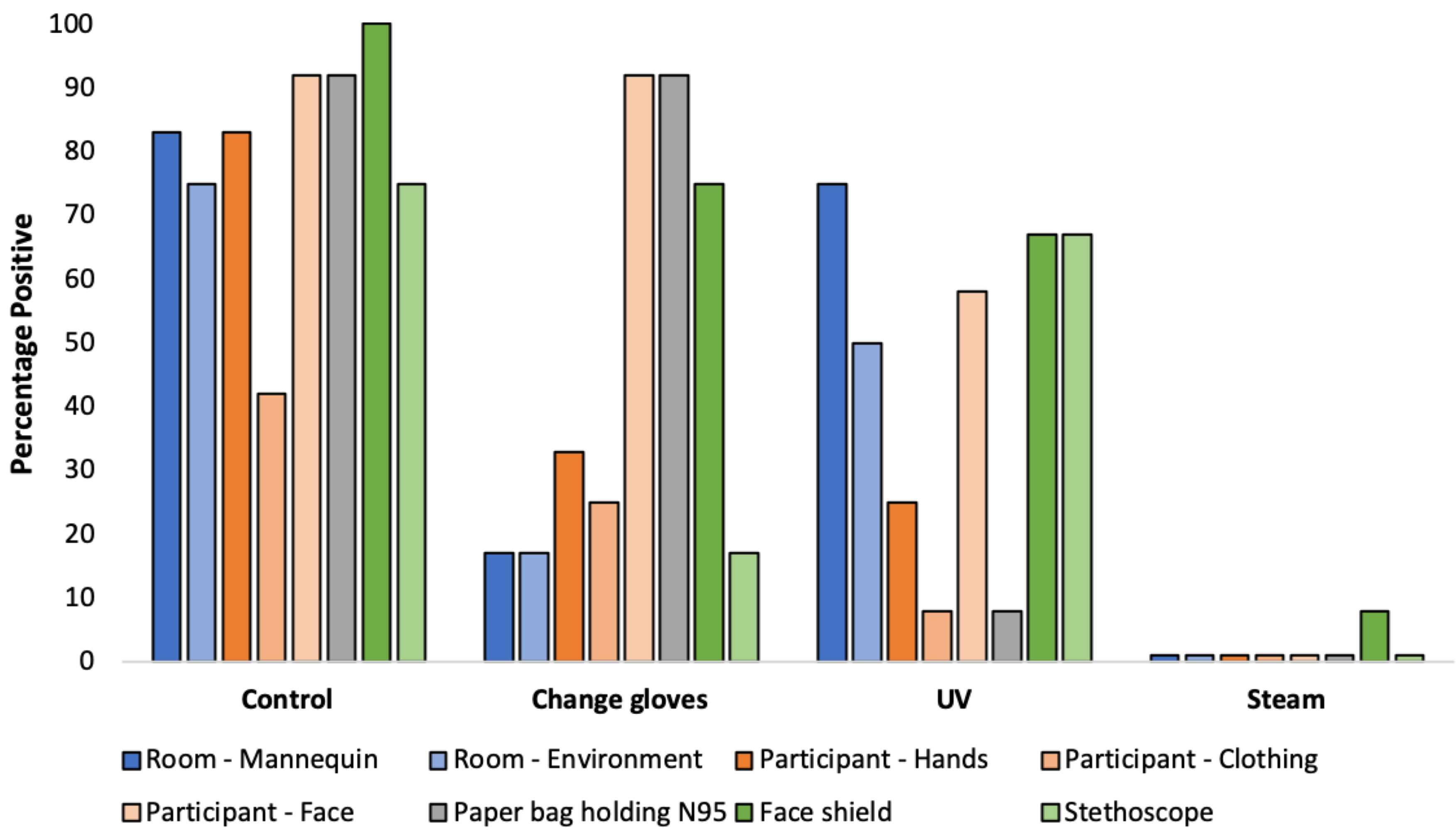
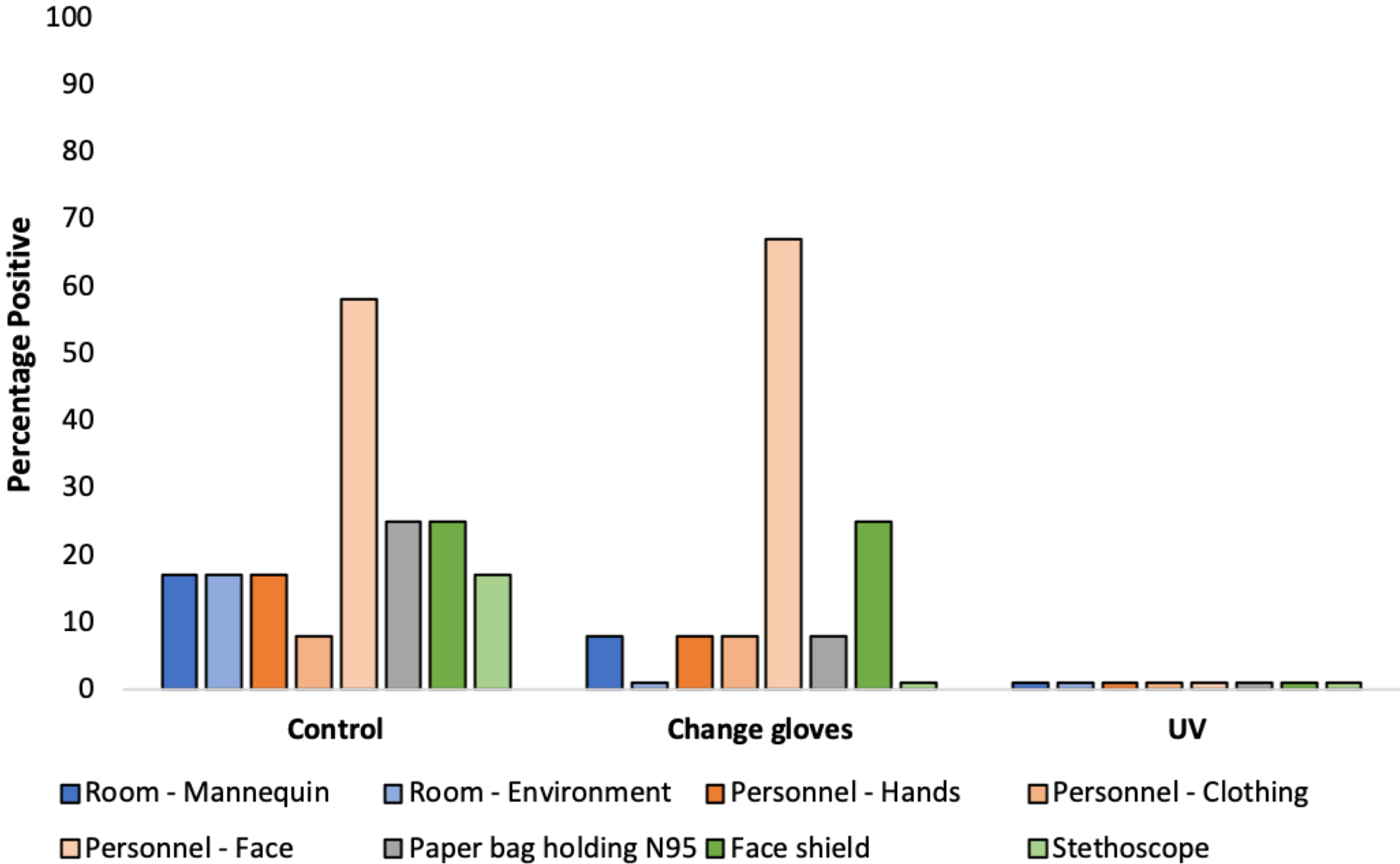


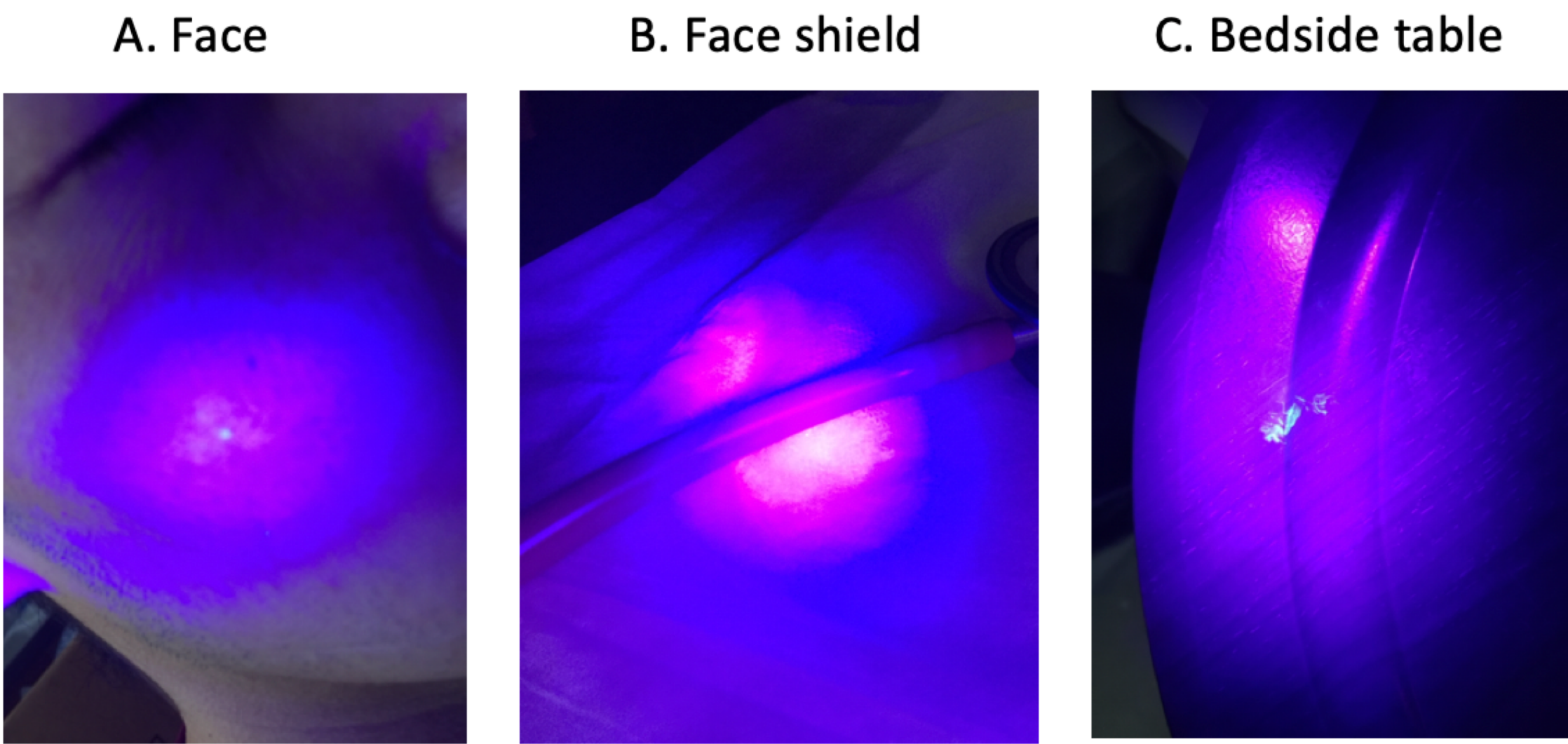
Figure 1B. Sites positive for contamination with bacteriophage MS2 in 3 groups with a lower level of contamination



Results

- Use of a highly contaminated N95 respirator resulted in frequent MS2 contamination in the Control, Glove change, and UV-C groups, but was dramatically reduced with steam treatment of the N95 ($P < 0.01$) (Figure 1A)
- With the lower level of contamination, MS2 contamination occurred less frequently across all groups, and was significantly reduced in the UV group, compared to the Control ($P < 0.01$) (Figure 1B)
- Common observed routes of contamination included:
 - Direct transfer from contaminated portion of N95 respirator to skin, face shield, and stethoscope
 - Direct transfer to paper bag holding N95 respirator

Figure 2. Photos showing fluorescent lotion transferred from the external facepiece of an N95 respirator to various sites



Conclusions

- Reuse of contaminated N95 respirators resulted in contamination of personnel and the environment even when correct technique was used
- Rapid decontamination technologies can reduce the risk for transmission.

Acknowledgements

- We thank the healthcare and environmental management services personnel who participated in the study.
- We thank the CWRU School of Engineering and Sears think[box] for support with the UV-C device design.

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