Unmasking Safety: Innovations in Validating PPE Doffing Protocols with Bacteriophages

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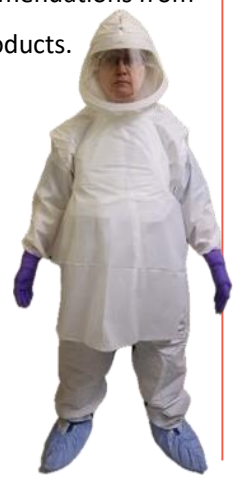
Introduction

- Personal protective equipment (PPE) is central to minimizing exposure to high-consequence infectious diseases (HCIDs) using layers of barrier precautions.
- Donning and doffing protocols are essential to prevent contamination and provide safety to healthcare workers (HCWs).
- PPE ensembles and the associated donning and doffing protocols generally aren't empirically validated and are based on recommendations from the manufacturer of individual products.

Our goal was to improve PPE protocols and ensembles to minimize the risk of cross contamination to HCW.



Methods

Video Analysis — Videos of the original doffing protocol were examined for potential contamination pathways.

Fluorescein Testing — Protocols were tested using fluorescein to reveal contamination pathways.

Bacteriophage — Protocols were tested using three distinct genetically marked λ bacteriophage sprayed on critical areas of HCWs that then completed the doffing protocol (Burke et al.).

Analysis — Bacteriophages were identified by PCR and quantified by plaque forming units.

Revision — Donning and doffing equipment and protocols were revised and retested via bacteriophage.

Results

Fluorescein testing revealed the sites on PPE that contribute to contamination pathways: critical triangle, coverall cuffs, and back hood.

With the original protocol, all HCWs were found to have viable and high-density phages on their hands, arms, or scrub attire. This highlights that contamination was not avoidable with the original methods.

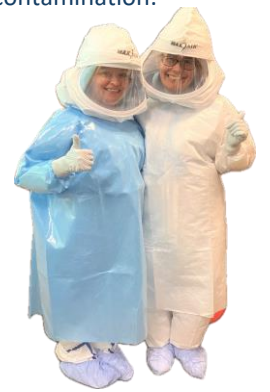
Phage Origin	Original Protocol Recovery			
Critical Triangle	25% (3.6E4)	0%	25% (2.5E3)	50% (2.72E4)
Coverall Cuffs	0%	0%	25% (1.8E3)	0%
Back Hood	25% (3.6E4)	50% (1E3)	50% (3.75E3)	25% (5E4)
	Scrubs	Hands	Forearms	Inside PAPR
	Recovery Location			

To address the high recovery of viable phages, donning and doffing protocols were changed by changing the equipment, reordering the steps, and adding new techniques.
With the revised protocol, no viable phages were found on any HCWs.

Phage Origin	Revised Protocol Recovery			
Critical Triangle	11% (X)	0%	22% (X)	0%
Coverall Cuffs	22% (X)	11% (X)	33% (X)	44% (X)
Back Hood	67% (X)	33% (X)	11% (X)	44% (X)
	Scrubs	Hands	Forearms	Inside PAPR
	Recovery Location			

Conclusion

- Even with well-trained HCWs and a trained observer, self-contamination during the doffing process can occur.
- With the revised protocol and equipment, we were able to prevent any viable self-contamination.
- Medical units that treat HCIDs should empirically test the donning and doffing procedures used.



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References

Burke, K., Berryhill, B. A., Kraft, C. S., Smith, A., Morgan, J., Tarabay, J., ... & Carag, J. (2023, December). 746. A Bacteriophage-Based Validation of a Personal Protective Equipment Doffing Procedure to be Used with High Consequence Pathogens. In *Open Forum Infectious Diseases* (Vol. 10, No. Supplement_2, pp. ofad500-807). US: Oxford University Press.