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Extending Usability of N95 Masks and other PPE

What practices can be utilized to extend the usability of N95 masks and other PPE for healthcare workers who are in direct contact with COVID environments?

Key Findings:

- CDC guidelines outline principles for extending usage and reuse of filtering facial respirators (FFRs).¹
 - Effective decontamination must reduce pathogenic burden, retain functionality, and present no residual chemical hazard.
 - Ultraviolet germicidal irradiation (UVGI), vaporous hydrogen peroxide (VHP), and moist heat have shown the most promise for decontamination.
 - Vaporous hydrogen peroxide shows promise for high capacity throughput.
 - UVGI efficacy is dependent upon dosage; treatment levels of 0.5–950 J/cm² were found to preserve performance of the filter.
 - Moist heat has varied efficacy levels for different pathogens.
 - Autoclaves, dry heat, isopropyl alcohol, soap, dry microwave irradiation, and bleach caused filter degradation.
- The University of Nebraska Medical School has developed a decontamination protocol for N95 respirators.^{2,3}
 - Used N95 FFRs are collected from healthcare workers and sent to a decontamination site. The decontamination site was a room that was repurposed for decontamination. The Room setup included 2 UV torches, a UV light sensory and a hanging rack for the N95s.
 - 90 masks were able to be decontaminated in one round.
 - Masks are subjected to UVGI and are decontaminated in rooms that are rigged with UV light systems. UV sensor readings of 60 mJ/cm² translated to a total mask exposure dose of 180 mJ/cm² to 240 mJ/cm². Similarly, a sensor reading of 300 mJ/cm² translated to a total exposure dose of 900 mJ/cm².
 - These exposure doses were dependent on how masks were placed on hanging lines. Cycles of UVGI were run until the minimum dose was not less than 300 mJ/cm² and ran for a duration of approximately 15 minutes.
 - Successfully decontaminated masks are marked and returned to healthcare workers.
- The Washington University School of Medicine has implemented a VHP protocol that is capable of decontaminating 200 N95 respirators within 24 hours.⁴

- Used N95s are collected from healthcare workers and placed in Tyvek pouches before being sent to a decontamination site. The decontamination site is comprised of a 288 sq ft room, common workspace, aeration room for off-gassing, and a soiled utility area. Rooms were sealed to prevent leakage of VHP.
- The Bioquell C-2 was used to provide a 4.5 hour cycle of VHP that achieved a dose of at least 700 parts per minute (PPM). Biological indicators were run with each cycle of VHP to confirm successful decontamination.
- Following disinfection, the masks are transported to the aeration room to allow for levels of VHP to fall to 0 PPM.
- With the urgent need for decontamination protocols, multiple studies are underway to evaluate the efficacy of decontamination protocols designed by health systems with results pending.

Recommendations:

- Though FFRs are not approved for routine decontamination and reuse, decontamination for reuse may be used as a crisis capacity strategy during the COVID-19 pandemic.
- UVGI, VHP, and moist heat showed the most promise as a potential method for use in decontamination procedures.
- Manufacturers of FFRs should be contacted for guidance on the best methods for decontamination for each FFR.
- UVGI and VHP have been used at large academic medical centers for decontamination of large numbers of N95 respirators. Existing protocols have been developed during the time of the pandemic and show promise for implementation within the healthcare setting.

References:

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