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Can we reuse P2/N95 respirators? Current evidence and urgent research questions

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Abstract

Respirator reuse is proposed as one solution to the COVID-19 pandemic-driven potential shortage in respirator supplies. Several decontamination methods have been shown to have little impact on respirator particle penetration and can significantly reduce viral contamination. Urgent research is required to identify novel solutions to this emerging health resource crisis.

The ongoing pandemic of COVID-19 is placing increasing pressure on the health care resources of nations. Particular concern is held for supplies of P2/N95 respirators and surgical masks, personal protective equipment (PPE) designed to achieve close facial fit and protection from >95% of very small (0.3 micron) test particles. The use of these masks is recommended for routine care of patients on airborne precautions with current guidelines indicating that P2/N95 respirators are single use[1]. Further highlighting the importance of P2/N95 masks in protecting health-care workers (HCW) during the current COVID-19 pandemic, a recent study of SARS-CoV2 infection rates amongst medical staff in Zhongnan Hospital of Wuhan University showed that no staff (0/278) that wore N95 respirators and followed frequent disinfection and handwashing became infected during the period of 2nd to 22nd January 2020 compared to 4.7% (10/231) of staff that did not wear masks, despite the fact that the latter group worked in lower risk areas[2].

Previous outbreaks of respiratory viruses, including the 2004 SARS outbreak and 2009 H1N1 influenza pandemic, have highlighted the risks of shortages of N95 respirators at the hospital level during these events[3]. If demand for P2/N95 respirators outstrips the current supplies, what options will be available for HCWs in Australia and elsewhere? During the 2009 H1N1 pandemic, reuse of masks was reported to be an extremely common practice in Californian hospitals in response to shortages[4]. In the health care setting, reuse involves health-care workers donning the same respirator for multiple close patient contacts and doffing it at the end of each patient contact before eventually being discarded[3]. To support reuse of respirators, a small number of studies have investigated the use of decontamination[5-8]. A comparison of

decontamination methods has found that physical decontamination methods (e.g. ultraviolet germicidal irradiation; UVGI) are less destructive to the respirator filter than chemical methods (e.g. bleach)[8]. UVGI exposure at high doses has been shown to have only a very small impact on particle penetration, however, had a variable effect on mask structural integrity[7]. It was suggested that the rate-limiting step for repeated disinfection cycles would be the physical degradation of the respirator material, however, this could also be used as a visual cue to determine when the respirator should be discarded. A study into the efficacy of UVGI decontamination of H1N1 influenza-contaminated N95 masks has also shown that significant reductions in influenza viability could be seen when N95 masks contaminated with viable H1N1 influenza virus and soiled with saliva or skin oils were treated with 1 J/cm^2 UVGI for approximately 1 min[6]. In terms of useability, after UVGI treatment, differences in the fit, odour, discomfort or increased difficulty in donning of respirators were also found to be minimal[9].

In the absence of equipment to perform effective UVGI-irradiation, what other options are available? While moist heat appears to have some potential[10], it is safe to say that the answer is currently unclear and may need novel solutions. For example, could solar disinfection, a method that has been shown to be effective for decontaminating RNA virus-contaminated water in polyethylene terephthalate (PET) bottles at high temperatures (e.g. 40°C), be an effective solution to disinfecting P2/N95 respirators for reuse in the Australian climate?[11] Urgent research is needed to validate current methods and investigate novel solutions for the potential decontamination of P2/N95 respirators to support protection of HCWs and patients

during the COVID-19 pandemic outbreak and in preparation for any future respiratory viral outbreaks.

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