Reusing N95 (or P2) masks: current evidence and urgent research questions

To the Editor: The coronavirus disease 2019 (COVID-19) pandemic is placing increasing pressure on the health care resources of nations. Particular concern is held for supplies of N95 (or P2) masks and surgical masks — personal protective equipment designed to achieve close facial fit and protection from more than 95% of 0.3 μm test particles. These masks are recommended for routine care of patients on airborne precautions, with current guidelines indicating that N95 masks are single use.[1] Further highlighting the importance of N95 masks in protecting health care workers during the COVID-19 pandemic, a recent study of severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) infection rates among medical staff in Zhongnan Hospital of Wuhan University showed that none of the staff (0/278) who wore N95 masks and followed frequent disinfection and handwashing became infected during the period of 2–22 January 2020 compared with 4.7% (10/231) of staff who 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 the 2009 H1N1 influenza pandemic, have highlighted the risks of shortages of N95 masks during these events.[3] If demand for N95 masks outstrips the current supplies, what options will be available for health care workers in Australia and elsewhere? During the 2009 H1N1 pandemic, reusing masks was common practice in Californian hospitals in response to shortages.[4] The reuse of masks involves health care workers donning the same mask for multiple close patient contacts and doffing it at the end of each patient contact before eventually discarding it.[3] To support the reuse of masks, a growing number of studies have investigated decontamination practices.[5–8] A comparison of decontamination methods has found that physical decontamination methods (eg, ultraviolet germicidal irradiation [UVGI]) are less destructive to the mask filter than chemical methods (eg, bleach).[7] UVGI exposure at high doses has been shown to have only a very small impact on particle penetration, but it had a variable effect on mask structural integrity.[6] It was suggested that the rate-limiting step for repeated disinfection cycles would be the physical degradation of the mask material; however, this could also be used as a visual cue to determine when the mask 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 about one minute.[5] In terms of useability, after UVGI treatment, differences in the fit, odour, discomfort, or increased difficulty in donning of masks were also found to be minimal.[9]

In the absence of equipment to perform effective UVGI-irradiation, what other options are available? While steam 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 bottles at high temperatures (eg, 40°C) — be an effective solution to disinfecting N95 masks for reuse in the Australian climate?[11] Urgent research is needed to validate current methods and investigate novel solutions for the potential decontamination of N95 masks to protect health care workers and patients. Quality assurance systems to evaluate the performance of a decontaminated mask are an obvious concern. In terms of the efficiency of biological decontamination, available data show that indicator organisms such as *Bacillus* spores[12] or influenza virus substitutes (eg, MS2 bacteriophage[13]) can be indicators of disinfection. Measuring filter performance, particular particle penetration is less straightforward and may require specialised equipment. In these circumstances, ensuring that published protocols are used only on the N95 masks they have been evaluated on may be important, given that different N95 masks are affected differently by the same decontamination method.[8]

Furthermore, avoiding the unnecessary use of N95 masks when the use of surgical masks is recommended and improving the potential for local production and sourcing of personal protective equipment will also assist in reducing Australia's reliance on dwindling international stockpiles during the COVID-19 pandemic and in preparation for any future respiratory viral infection outbreaks.

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