Filtration evaluation of expired elastomeric P-100 filter cartridges after months of real-world use during the coronavirus disease 2019 (COVID-19) pandemic

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To the Editor—Complicating the frontline healthcare worker (HCW) response to the COVID-19 pandemic has been the widespread shortage of personal protective equipment (PPE), including disposable single-use N95 filtering facepiece respirators (FFRs). To that end, the Centers for Disease Control and Prevention (CDC) has provided guidance on strategies that healthcare facilities may use to conserve N95s. This guidance includes extended use and reuse of previously single-use N95 FFRs coupled with various modalities of decontamination and augmenting respirator supplies with reusable devices like elastomeric respirators.1,2

In the healthcare setting, there is consensus that elastomeric filter cartridges should be replaced if they become visibly soiled, wet, damaged, or notably harder to breathe through.3 Otherwise, the recommended timing for replacing elastomeric filter cartridges varies from every 30 days to annually.3,4

We previously determined that unopened P100 elastomeric filter cartridges received from the strategic national stockpile (SNS), which were 6 years past their shelf-life, offered similar filter cartridges received from the SNS, which were 6 years past their shelf-life, offered similar filtration efficiency to the N95 respirator.5 Our current study evaluates how these filters performed following use in the real-world (ie, healthcare) setting. Information pertaining to this topic is lacking.

Three pairs of P100 filter cartridges that had been in use for 5 and 6 months were obtained from frontline healthcare workers: 1 respiratory therapist (P100 RT 4-2020), 1 progressive care nurse (P100 RN 8MPLM 3-2020), and 1 medical intensive care nurse (P100 RN 8MICU 3-2020). The used cartridges were compared to an unopened and unused filter cartridge (P100- control) from the same SNS batch.

The cleaning protocol for the outer casing of the filters consists of wiping it down with premoistened quaternary ammonium/iso-propyl alcohol wipes between patients. This procedure could be repeated up to 10 times per day. At the end of the shift, the wiped filter pair is disassembled from the mask, which then undergoes further cleaning.4

There was no subjective feeling that the filters were difficult to breathe through by any of the users. No external damage apart from the expected “wear and tear” of the filter cartridge label, likely due to multiple episodes of wiping and cleaning, was noted with the used filters.

Filtration efficiency of the used filters and the control P100 filters from our expired stock was quantified using the methodology described by Patolia et al.5 The pair of filter cartridges from each user was tested with the testing run in duplicate.

The filtration efficiencies of the control, RT 4-2020, and RN 8MPLM 3-2020 cartridges were mostly >95% across different particle sizes. The filtration efficiency of the P-100 RN 8MICU 3-2020 cartridge was ~90%–95% but was not significantly different from that of the control (Fig. 1).

Elastomeric filters that were in good condition but long past their shelf life remained effective at filtering out aerosol-sized particles after being used in the “real-world” healthcare setting. We saw a small but nonsignificant decrease in filter efficiency in 1 of the 2 filter pairs that had been in use for 6 months. Our findings suggest that similar SNS supplies of well-kept but expired P100 filters may be used in the healthcare setting for at least 6 months, in contrast to other published literature regarding the duration of use of filter cartridges.2,3

The quantitative data demonstrated in our study is a strength, although the small sample size is a limitation. Tests were performed in duplicate to address this issue. We were unable to test the same exact filter cartridges before and after use because the testing process renders the filter device unusable. We caution that these findings may not be applicable to nonexpired filters, but we intuitively suspect that the duration of use could be longer.

With the continued coronavirus disease 2019 (COVID-19) pandemic and the possible surge in recently described highly transmissible variants, we anticipate that the use of elastomeric respirators will remain a key component in HCW protection.

12. Seneviratne CJ, Balan P, Ko KKK, et al. Efficacy of commercial mouthrinses on SARS-CoV-2 viral load in saliva: randomized control trial in Singapore. *Infection 2020. doi: 10.1007/s15010-020-01563-9.*

13. Frank S, Cipriotti J, Brown SM, Tessema B. Povidone-iodine use in sinonasal and oral cavities: a review of safety in the COVID-19 era. *Ear Nose Throat J* 2020;99:586–593.

14. Kirk-Bayley J, Combes J, Sunkaraneni V, Challacombe S. The use of povidone-iodine nasal spray and mouthwash during the current COVID-19 pandemic may reduce cross infection and protect healthcare workers. *SSRN 2020. doi: 10.2139/ssrn.3563092.*

15. Kissler SM, Tedijanto C, Goldstein E, Grad YH, Lipsitch M. Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science 2020;368:860–868.*
Our findings may offer other health systems guidance on the duration of use of expired elastomeric filters received from the SNS. Further studies should be conducted in the healthcare setting to determine the optimal duration of the use of nonexpired filters.

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References

1. The National Institute for Occupational Safety and Health. Recommended guidance for extended use and limited reuse of N95 filtering facepiece respirators in healthcare settings. Centers for Disease Control and Prevention website. https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html. Published 2020. Accessed October 18, 2020.
2. Elastomeric respirators: strategies during conventional and surge demand situations: conventional, contingency, and crisis strategies. Centers for Disease Control and Prevention website. https://www.cdc.gov/coronavirus/2019-ncov/hcp/elastomeric-respirators-strategy/index.html. Updated April 20, 2020. Accessed October 9, 2020.
3. National Academies of Sciences, Engineering, and Medicine. Reusable elastomeric respirators in health care: considerations for routine and surge use. Washington, DC: The National Academies Press; 2019. doi:10.17226/25275.
4. Technical bulletin. Cleaning and disinfecting 3M reusable elastomeric half and full facepiece respirators following potential exposure to coronaviruses. St. Paul, MN: 3M; 2020.
5. Patolia H, Pan J, Harb C, Marr LC, Baffoe-Bonnie A. Filtration evaluation and clinical use of expired elastomeric P-100 filter cartridges during the COVID-19 pandemic. Infect Control Hosp Epidemiol 2020. doi: 10.1017/ice.2020.257.