

Effects of Vaporized Hydrogen Peroxide Reprocessing on Quantitative Fit Performance of N95 Filtering Facepiece Respirators

To the Editor: COVID-19 has created a shortage of N95 filtering facepiece respirators (N95 FFRs). The Centers for Disease Control and Prevention permit reprocessing and reuse of N95 FFRs in an emergency situation when new N95 FFRs are not available.¹ A report indicated that reprocessing with 1 or 2 cycles of vaporized hydrogen peroxide (VHP) did not negatively affect the quantitative fit factor of model 1870+ N95 FFRs (3M) following a small-scale extended use/reuse experiment.² In this letter, we extend that work to additional respirator models and additional VHP cycles, reporting that up to 22 VHP reprocessing cycles do not affect the quantitative fit of N95 FFRs.

More than 13,000 staff members at our institution are fitted to N95 FFR model 1870+ or to the Moldex 1500 series. VHP reprocessing was evaluated as a contingency for future N95 FFR shortages. Five of each respirator type underwent up to 22 VHP reprocessing cycles. As the COVID-19 pandemic progressed, the 3M model 1860 respirator was added to buffer against

shortages of the 3M model 1870+ and the Moldex 1500 series FFRs. The 3M model 1860 N95 FFRs have undergone 8 reprocessing cycles to date.

The N95 FFRs collected after a single clinical use were repeatedly reprocessed with a Bioquell VHP generator. The N95 FFRs with visible damage or soil were discarded. Each VHP cycle included a conditioning phase, a gassing phase with an injection rate of 10.3 g/m³, a dwell time of at least 10 minutes, and an aeration phase. Bioquell biological and chemical indicators were used to quality control each cycle.

After each reprocessing cycle, quantitative fit testing was performed according to the Occupational Safety and Health Administration standard method³ using a PortaCount (TSI Incorporated) tester. A minimum fit factor pass level of 100 is required for a passing score. Seven staff participated in fit testing, demonstrating that results were replicated by more than a single user.

All biologic indicators passed after each VHP cycle, demonstrating that the process is reproducible and capable of producing a 6-log reduction in bioburden. The quantitative fit test data presented in the Table complement filtration efficiency results reported by Cai and Floyd⁴ and demonstrate that reprocessing of N95 FFRs up to 22 times with VHP does not have an impact on the ability of health care staff to obtain the

required fit after repeated reprocessing. Some N95s were removed from reprocessing at various cycles because of physical wear-and-tear that resulted from repeated donning and doffing during repeated fit testing. Issues encountered were the elastic strap's pulling out from under the staple on 1 respirator and chin or nose piece loosening (4 respirators at 8, 17, 14, and 14 cycles).

It has been reported that N95 filtration efficiency is not compromised by 1 cycle of hydrogen peroxide reprocessing.⁴ However, the face-to-mask seal is where nearly all inward leakage occurs, rather than leakage directly through degraded filter material. The quantitative fit testing data provided in this letter extend previous reports, demonstrating that a variety of N95 FFR models can be reprocessed up to 22 times using VHP without negatively affecting the integrity and fit of the N95 FFR. Physical wear from repeated donning and doffing of the N95 FFR during fit testing occurred, but this can be readily appreciated by the user through a visual inspection and seal check before use of the reprocessed N95 FFR.

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TABLE. Quantitative Fit Testing Data for Reprocessed N95 FFRs^a

Manufacturer	Model	No. of respirators tested	Average No. of VHP reprocessing cycles completed (range)	Total No. of reprocessing cycles completed for each respirator	Average quantitative fit test score, ≥ 100 is acceptable (range)
3M	1870+	5	18 (8-22)	22, 22, 8, 17, 19	185 (136-200)
3M	1860	5	8 (8)	8, 8, 8, 8, 8	176 (102-200)
Moldex	Small	5	15 (2-22)	22, 14, 14, 21, 2 ^b	183 (122-200)

^aFFR, filtering facepiece respirator; VHP, vaporized hydrogen peroxide.

^bStrap pulled out from under the staple holding it to the respirator.

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Grant Support: This study was supported by Mayo Clinic, Rochester, Minnesota.

Potential Competing Interests: The authors report no competing interests.

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<https://doi.org/10.1016/j.mayocpiqo.2021.02.006>

Patient Satisfaction of Telemedicine Visits in an Advanced Prostate Cancer Clinic During the COVID-19 Pandemic

To The Editor: Telemedicine is the use of communication technologies to provide patient care remotely.¹ Before March 2020, telemedicine was

gaining attention in medicine, but widespread utilization was low. In March 2020, the global public health faced a crisis with the COVID-19 pandemic.² Cancer patients in particular were at a higher risk of becoming infected and having severe complications.³ Moreover, Montopoli et al⁴ reported that prostate cancer patients were at an increased risk of severe acute respiratory syndrome coronavirus 2 infection and constituted 28% of COVID-19—positive cancer patients, followed by kidney/bladder cancer (17%) and colorectal cancer (15%). As a result of COVID-19 and the risks it posed to both patients and providers, a global decrease in urology service volumes was observed. According to an international multicenter survey of 1004 urology service providers in April 2020, 37% of respondents reported outpatient clinic volume reductions of between 81% and 100% and delays of more than 8 weeks in 28% of outpatient clinics.⁵

Given the significant risks to patients in our advanced prostate cancer clinic, we rapidly implemented telemedicine in our practice to continue care of oncology patients without jeopardizing the patients' health. This use of telemedicine was ultimately consistent with guidelines released in 2020 on the management of prostate cancer during the COVID-19 pandemic, including avoiding in-person clinic visits.⁶⁻⁹ Herein, we report our patients' telemedicine experience in an advanced prostate cancer clinic during the COVID-19 pandemic.

Our advanced prostate cancer clinic at Mayo Clinic Rochester provides high-volume care to patients with advanced prostate cancer in a multidisciplinary approach that includes radiation therapy, surgery, and systemic treatments. The clinic serves approximately 5000 patients annually. We included advanced prostate cancer patients located in the United States who were seen by a single urologist

(Dr Eugene D. Kwon) through teleconsultation between April 1, 2020, and May 1, 2020, during the COVID-19 pandemic. Teleconsultation included phone visits and any form of video visits (Zoom, Skype, FaceTime, other).

During April 2020, there were 350 scheduled in-person visits. Following the announcement of the national stay-at-home order due to the COVID-19 pandemic, patients were contacted and offered telemedicine consultations; 103 (30%) patients agreed to transition their next visit to teleconsultation with their physician to avoid any interruption of their care. These patients represented our target population (n=103). After their teleconsultation, patients were contacted by phone about participation in the study. Of 103 patients, 52 (50.49%) patients electronically signed the consent form and were sent a unique link to the Research Electronic Data Capture system (REDCap). Study data were recorded and managed using this system.

We adopted a survey that has been used previously to assess telemedicine in radiation oncology.¹⁰ Some changes have been made to customize it to our study.

Patients' demographic and clinical characteristics are shown in [Table 1](#). Most of the patients denied any hearing or vision difficulty. Almost 60% (n=31) of patients presented with progressive disease and rising prostate-specific antigen (PSA) concentration; the remaining 40% (n=21) returned to follow up on their treatment plans. Patients reported the average cost to travel for their appointment to be 250 (125 to 350) US dollars. Most of the telemedicine consultations were done over the phone (n=41; 78.85%) because of the patient's accessibility, whereas the remaining (n=11; 21.15%) were done through Zoom video conference.

Before each virtual visit, patients were asked to undergo PSA testing