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Ultraviolet germicidal irradiation: Possible method for respirator disinfection to facilitate reuse during the COVID-19 pandemic

To the Editor: The ability to disinfect and reuse disposable N95 filtering facepiece respirators is urgently needed during the current COVID-19 pandemic because supplies are running low in hospitals throughout the United States and abroad. Ultraviolet (UV) germicidal irradiation (UVGI) is one possible method for respirator disinfection to facilitate the reuse of dwindling supplies. Dermatology offices often use narrow-band UVB to treat skin diseases. If necessary, we propose a possible repurposing of phototherapy devices, including these UVB units, to serve as a platform for UVC germicidal disinfection.

UVGI is a disinfection method that uses UVC radiation to inactivate microorganisms by causing DNA damage and preventing replication. Previous studies have shown that UVC can inactivate coronaviruses, including severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV).[1] One study of respirators contaminated with H1N1 influenza A found significant reductions (≥3-log reduction) in viable influenza virus under substantial artificial soiling conditions after being treated for 60 to 70 seconds at an irradiance of 17 mW/cm^2, resulting in a UVGI dose of ~1 J/cm^2 measured at 254 nm.[2] The efficacy of this dose has been verified in additional studies, and higher doses (up to 2 J/cm^2) have been shown to provide diminished benefit after 1 J/cm^2.[3,4] It is recommended to treat used masks, but not visibly soiled, to allow the 3-log reduction reported in the literature to be sufficient to achieve safe reuse levels.[5]

It is important to note that the time to deliver 1 J/cm^2 depends on the irradiance; hence, it can be longer or shorter depending on the delivery device's capabilities. In a prototype model that has been developed (Fig 1), this dose can be delivered in 1 minute and 40 seconds at an irradiance of 10 mW/cm^2. The distance from the lamp to the top of the table in Fig 1 is approximately 14 cm.

However, UV radiation does degrade polymers, which presents the possibility that UVGI exposure, while decontaminating, may also reduce the efficacy of the respirator and decrease protection to workers. Lindsley et al[6] exposed 4 different models of N95 filtering facepiece respirators to UVGI doses of 120 to 950 J/cm^2. Results of the study showed that UVGI exposure led to a small increase in particle penetration (up to 1.25%) and had little effect on the flow resistance. However, at higher UVGI doses, the strength of the layers of the respirator material was substantially reduced (in some cases, >90%), but this significantly varied among the different models. UVGI had less of an effect on the respirator straps: a dose of 2360 J/cm^2 reduced the breaking strength of the straps by 20% to 51%.[6] It should be noted that the dosages used in the study above are 100- to 1000-times higher than those shown to disinfect H1N1 influenza A–contaminated respirators. Therefore, considering that many of our health care providers are using substitutes for N95 filtering facepiece respirators that offer very limited degree of protection, using UVGI and repurposing phototherapy devices could be the best practical solution at this time.

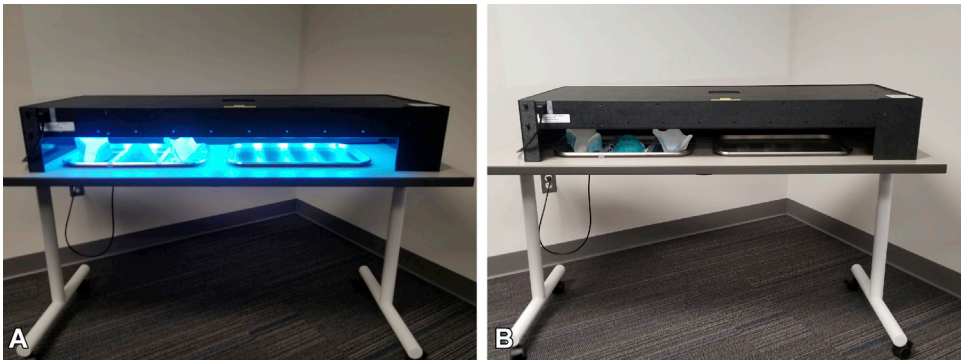

Fig 1. Image of prototype being developed by Daavlin. The field of irradiation is approximately 15 inches × 45 inches, and depending on the manufacturer of the mask, this would allow for the treatment of ~18 to 27 masks (2 minutes per side). (**A**) With ultraviolet light on and (**B**) ultraviolet light off. (Photographs used with permission of Bob Golding, Daavlin, Byron, Ohio.)

We would like to thank Bob Golding and his team at Daavlin (Byron, OH) for leading the reengineering of a phototherapy device that can be used to disinfect N95 masks.

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Conflicts of interest: Drs Lyons and Narla are subinvestigators and Dr Ozog is an investigator for Biofrontera. Dr Lim has participated as a speaker in general educational sessions for Ra Medical System. Drs Hamzavi and Lim are investigators and Dr Gelfand is principal investigator for the Light Treatment Effectiveness (LITE) study, which is funded by the Patient-Centered Outcomes Research Institute and for which the home phototherapy machines are provided by Daavlin. Dr Kohli and Ms Parks-Miller have no relevant conflicts of interest to report.

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Additional supplemental material will be available on Mendeley after publication.

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Intralesional *Candida* antigen versus intralesional tuberculin in the treatment of recalcitrant genital warts: A comparative study

To the Editor: Despite the existence of numerous therapeutic modalities, the treatment of genital warts is still largely unsatisfactory. Intralesional antigen immunotherapy has been investigated for genital warts in a few studies enrolling small numbers of patients and has shown promising efficacy, safety, and low recurrence rates compared with traditional ablative therapies.[1-3]

The study included 64 adult patients with multiple recalcitrant genital warts, defined as warts that persisted for more than 2 years and showed a failure of response to at least 2 different modalities. Patients were randomly assigned by flipping a coin to 2 groups, each containing 32 patients. A written informed consent was taken from each patient before enrollment into the study that was approved by the Zagazig University Institutional Review Board. The largest wart was directly injected, without presensitization, with intralesional tuberculin or *Candida* antigen (1/1000) at a dose of 0.1 mL at 2-week intervals until complete clearance or for a maximum of 5 sessions. Response to treatment was evaluated by decrease in the size of the warts and photographic comparison at baseline and at each visit. The results were assessed by 2 blinded dermatologists (Supplemental Methods, available at Mendeley, doi: 10.17632/w46xsffbp9.1).

There were 57 patients (8 men, 49 women) who completed the study, and 7 patients discontinued due to failure to follow-up (n = 2), lack of response (n = 2), and adverse effects (n = 3). Details of the baseline characteristics of the studied patients are presented in Table I.