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Short Communication

Considerations in Using Consumer Ultraviolet and Artificial Light Products for Decontamination of Facemasks

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ABSTRACT

The COVID-19 pandemic led to nationwide shortages in a variety of Personal Protective Equipment (PPE) especially those items used in a healthcare setting. These shortages impacted communities in every part of the country leaving healthcare, law enforcement and public safety personnel, without critically needed PPE to protect themselves and their families. Methods to conserve critical PPE through extended use or reuse were provided as options for healthcare personnel with decontamination being one approach used to enable reuse of PPE. Decontamination for reuse of N95 Filtering Facepiece Respirators (FFRs) focused on the use of Vapor Phase Hydrogen Peroxide (VPHP), moist heat and Ultraviolet Germicidal Irradiation (UVGI) which are effective in inactivating coronaviruses and other microbes.

Keywords: Personal protective equipment; Healthcare; Decontamination; Coronaviruses

INTRODUCTION

In February of 2021, there were 15 Emergency Use Authorizations (EUAs) issued by the FDA with 13 using VPHP, one using UVGI and one using moist heat; though, all of these EUAs are no longer active as N95 supplies have recovered [1-3]. However, employees in the law enforcement and public safety community, who necessarily had direct and frequent interaction with the public to perform their jobs, faced additional challenges. If they had a supply of FFRs to protect them while doing their jobs:

- They were not generally prioritized for replenishment of those supplies, if they had supplies of FFRs.
- They were less able to benefit from the Emergency Use Authorizations for decontamination and reuse of the FFRs since the EUAs applied only to health care personnel.
- The members of these communities often found themselves too distant from the decontamination infrastructure to make use of it.

As a result, the department of homeland security was interested in identifying low-cost and low-resource methods that might provide these communities options for extending the limited supply of FFRs. The idea of using artificial sun lamps for decontamination of N95 FFRs started with publications showing the efficacy of artificial sunlight against SARS-CoV-2 on surfaces and in aerosols [4,5]. Recognizing that artificial sun lamps exist for home and commercial tanning and that these resources were less likely to be impacted by collapsing supply chains, it was decided to verify the feasibility of using these light sources for decontamination.

DESCRIPTION

Artificial sunlight is different than UVGI which consists of UV-C light (200 nm to 290 nm) by being composed of UV-B (290 nm to 320 nm) and UV-A (320 nm to 400 nm) light as the atmosphere prevents UV-C light from reaching the earth [6,7]. Aside from our investigation, no others have examined the use of artificial sun lamps as a potential mechanism for decontamination. One study shows that UV-A and UV-B radiation can inactivate SARS-CoV-2 though the doses required are greater than that required for UV-C light as UV-A and UV-B have less energy and may not impact the virus in the same manner [8,9]. Additionally, the efficacy of sunlight and temperature for decontaminating SARS-CoV-2 was examined on

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beach sand to demonstrate that further disinfection of sand would not be necessary [10]. Aside from these efforts, there has been extensive discussion of the role that sunlight might play in the spread of COVID-19 with outbreaks showing dependency on seasons at moderate latitudes which have reduced spread during the summer months [11]. Otherwise, the potential for artificial sunlight to be used as a disinfection treatment has not been extensively explored despite the use of UV-B and UV-A light being potentially easier to address from a safety perspective and options of these light sources being more abundant for consumers than is the case for sources of UV-C light.

All of the systems approved in the EUAs were commercial systems specifically designed for the purpose of decontaminating PPE. Many of these systems would be too expensive and perhaps technically challenging to be established or operated in many rural communities. The public's interest in obtaining easy to use decontamination devices for home use was evidenced by the many different products sold for that purpose. In fact, Khazova et al. reviewed 48 different UV decontamination devices sold in the UK for home use and found deficiencies in all of them such as the device not producing light in the advertised range (e.g., UV-C), not producing enough light to effect inactivation (due to the use of windows opaque to light in the UV spectrum), or that could be used in an unsafe manner resulting in adverse exposures [12]. With public demand for in decontamination devices for home and small office use, our previous work demonstrating the efficacy of artificial sun lamps and multicookers shows that smaller more readily available decontamination systems are possible and could be affordable for home or small office settings to implement [13,14]. However, even for the artificial sun lamps we tested, we have only demonstrated feasibility as there are many technical and safety considerations that should be addressed before such items are used for decontamination in the home or office. This includes ensuring proper illumination of the items being decontaminated and appropriate precautions to prevent harmful exposure to the users. Furthermore, the tests we performed only tested efficacy for SARS-CoV-2 while many other pathogens may also be present and hence further testing is still needed.

CONCLUSION

Finally, these methods should only be considered for FFRs when critical shortages exist such as a future pandemic and the process should be submitted for official review and approval to comply with U.S. OSHA regulations. In any case, the COVID-19 pandemic demonstrated that there was demand for smaller more accessible decontamination options and while there were products offered to fill that demand, their efficacy and safety were shown to be variable. Thus, it could prove beneficial in the future for there to be some standards and an approval process that would provide potential users some confidence that the product is effective and safe.

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