Photobiomodulation, Photomedicine, and Laser Surgery
Volume 39, Number 2, 2021

Pp. 83–85
DOI: 10.1089/photob.2020.4968

Letter to the Editor

Conversion of Existing UVB Phototherapy Units to UVC Germicidal Chambers for N95 Decontamination: Lessons Learned

Bina Kassamali, BS,[1–3,*] Zizi Yu, BA,[1–3,*] Christopher Davis, BS,[1,4] Mary Carmack, BS,[1,5] Ai-Tram N. Bui, BA,[1–3] Jordan T. Said, BA,[1–3] Deborah Plana, BS,[1,2,6] Helen Yang, BS,[1,7] Peter Sorger, PhD,[1,7,8] Nicole R. LeBoeuf, MD, MPH,[1,3,†] and Avery H. LaChance, MD, MPH[1,3,†]

To the Editor:

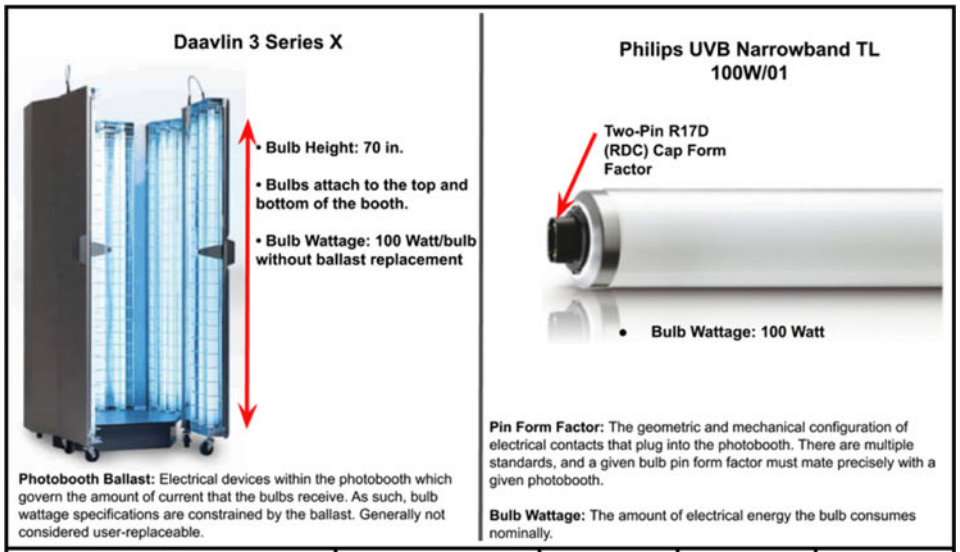
Shortages of personal protective equipment (PPE) during the COVID-19 pandemic have necessitated development of novel decontamination procedures to facilitate N95 mask reuse.[1] Ultraviolet (UV) germicidal irradiation has demonstrated efficacy against viruses, including SARS-CoV-2, at 1 J/cm^2 and a peak UVC germicidal wavelength of 254 nm.[2] The following question arises: how can UVC best be delivered in the field to enable mask reuse? UVA and UVB phototherapy units are available in dermatology clinics worldwide, making UVC conversion an attractive option for N95 decontamination. Daavlin 4Series phototherapy units have been successfully converted into a UVC device currently under FDA consideration for commercial purchase for $4,000 per unit.[1] Even if approved, this device is limited by cost, size, and its ability to deliver UV irradiation from one side only. Efforts to convert existing phototherapy units into UVC devices are, therefore, warranted, particularly in times of high demand or in low-resource settings. We explored direct conversion of a full body phototherapy unit for UVC decontamination by replacement of UVB bulbs with UVC bulbs currently available in the United States.

Between May and June 2020, we conducted a systematic search of existing phototherapy units available in dermatology practices in the United States based on manufacturers listed by the National Psoriasis Foundation.[3] Based on its market share, we focused on converting the wavelength of the Daavlin 3SeriesX UVB photobooth. We then conducted a systematic search for existing UVC bulbs from major lighting manufacturers that closely matched specifications of the UVB bulb used in the Daavlin 3SeriesX booth (Philips® UVB NarrowBand TL 100W/01).[4,5] Specific search criteria included bulb length, pin form factor, and wattage (Fig. 1).

Our search identified the Philips TL-D 95W HO bulb as the most promising replacement option currently marketed in the United States based on the aforementioned criteria. However, lack of concordance in some key parameters poses challenges. The first is a difference in bulb length, with the Daavlin 3SeriesX requiring 70 inch (177.8 cm) bulbs and the closest UVC substitute bulb measuring 60 inches (152.4 cm). The second is a difference in electrical pinout (R17D recessed double contact vs. G13 medium bipin). A third challenge is that Daavlin 3SeriesX booths use special ballasts, making it difficult to establish the electrical compatibility of substitute bulbs. An adapter could be fabricated to interconvert pins and extend shorter bulbs, but this likely voids electrical safety/product certifications, precluding simple UVB to UVC conversion.

Our investigation suggests that there is no convenient solution for retrofitting UVC bulbs into the Daavlin 3SeriesX UVB photobooth using inventories of commercially available bulbs. Given the likelihood of lasting PPE shortages throughout the pandemic, maximizing the utility of these pre-existing UV devices requires one or more of the following (1) manufacturing germicidal UVC bulbs compatible with existing phototherapy units, (2) developing engineered solutions for retrofitting available UVC bulbs into the existing sockets on Daavlin phototherapy units, and (3) identifying phototherapy units from other manufacturers that might more easily accomodate UVC

[1]Greater Boston Pandemic Fabrication Team (PanFab) c/o Harvard-MIT Center for Regulatory Science, Harvard Medical School, Boston, Massachusetts, USA.
[2]Harvard Medical School, Boston, Massachusetts, USA.
[3]Department of Dermatology, Brigham and Women's Hospital, Boston, Massachusetts, USA.
[4]Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.
[5]Columbia University Vagelos College of Physicians and Surgeons, New York, New York, USA.
[6]Harvard-MIT Division of Health Sciences & Technology Program, Cambridge, Massachusetts, USA.
[7]Harvard-MIT Center for Regulatory Science, Harvard Medical School, Boston, Massachusetts, USA.
[8]Harvard Program in Therapeutic Science, Harvard Medical School, Boston, Massachusetts, USA.
*These authors contributed equally.
†Co-senior authors.



Light Bulb Model/Vendor	Vendor	Length	Pin Form Factor	Wattage
UVB NarrowBand TL 100W/01*	**Philips**	**70 in (177.8 cm)**	2-pin R17D	**100 W**
TUV TL-D 95W HO	Philips	60 in (152.4 cm)	2-pin G13	90 W
G64T5L/4 4 Pin	Ultraviolet.com	60 in (152.4 cm)	4-pin (B16)	75 W
G64T5VH/4 UV Lamp	Ultraviolet.com	60 in (152.4 cm)	4-pin (B16)	75 W
GHO64T5L	Ultraviolet.com	60 in (152.4 cm)	4-pin (B16)	155 W
GPH893T5VH/HO	Ultraviolet.com	35 in (88.9 cm)	4-pin (B16)	95 W
GHO36T5VH	Ultraviolet.com	33 in (83.8 cm)	4-pin (B16)	87 W
GPH436T5L/HO	Ultraviolet.com	33 in (83.8 cm)	4-pin (B16)	48 W
GPHA357T5L	LightTech Light Sources	14 in (35.6 cm)	4-pin (B16)	42 W
GPHA843T5L	LightTech Light Sources	33 in (83.8 cm)	4-pin (B16)	110 W
GPHA1000T5L	LightTech Light Sources	39 in (99.1 cm)	4-pin (B16)	127 W
GPHA1554T5L	LightTech Light Sources	61 in (154.9 cm)	4-pin (B16)	190 W
GPHA357T6L	LightTech Light Sources	14 in (35.6 cm)	4-pin (B16)	57 W
GPHA843T6L	LightTech Light Sources	33 in (83.8 cm)	4-pin (B16)	127 W
GPHA1000T6L	LightTech Light Sources	39 in (99.1 cm)	4-pin (B16)	150 W
GPHA1554T6L	LightTech Light Sources	61 in (154.9 cm)	4-pin (B16)	240 W
GPHHA357T6L	LightTech Light Sources	14 in (35.6 cm)	4-pin (B16)	65 W
GPHHA843T6L	LightTech Light Sources	33 in (83.8 cm)	4-pin (B16)	172 W
GPHHA1000T6L	LightTech Light Sources	39 in (99.1 cm)	4-pin (B16)	207 W
GPHHA1554T6L	LightTech Light Sources	61 in (154.9 cm)	4-pin (B16)	320 W
TUV PL-S 9W/4P	Philips	9.3 in (23.6 cm)	4-pin (B16)	9 W

FIG. 1. The parameters, and their respective definitions, of the Daavlin 3SeriesX UVB4 photobooth and its original bulb, the Philips® UVB NarrowBand TL 100W/013. Search of UVC bulb candidates. Commercially available bulb parameters compatible with our design requirements are depicted in green, and incompatible ones are depicted in red. The original bulb corresponding to the Daavlin 3SeriesX UVB photobooth is shown in the top row, with all valid parameters. The most promising candidate bulb with the closest matching parameters is highlighted in orange.

bulbs. In all three cases, collaboration with manufacturers is required; we call on them to collaborate with interested academic medical centers.

References

1. Hamzavi IH, Lyons AB, Kohli I, et al. Ultraviolet germicidal irradiation: possible method for respirator disinfection to facilitate reuse during the COVID-19 pandemic. J Am Acad Dermatol 2020;82:1511–1512.
2. Mills D, Harnish DA, Lawrence C, Sandoval-Powers M, Heimbuch BK. Ultraviolet germicidal irradiation of influenza-contaminated N95 filtering facepiece respirators. Am J Infect Control 2018;46:e49–e55.
3. Moderate to Severe Psoriasis: Home UVB Equipment. National Psoriasis Foundation. 2019. Available at: web.archive.org/web/20200423064125/www.psoriasis.org/about-psoriasis/treatments/phototherapy/uvb/home-equipment (Last accessed October 15, 2020).
4. TL F72T12 100W/01 UV-B. Philips. Available at: www.lighting.philips.com/main/prof/conventional-lamps-and-tubes/special-lamps/phototherapy/uv-b/uv-b-narrowband-tl/927978500130_EU/product (Last accessed October 15, 2020).
5. UV series: full body surround. Daavlin. 2020. Available at: www.daavlin.com/patients/phototherapy-products/uv-series-full-body-surround/ (Last accessed October 15, 2020).

Address correspondence to:
Nicole R. LeBoeuf, MD, MPH
Department of Dermatology
Brigham and Women's Hospital
221 Longwood Avenue
Boston, MA 02115
USA

E-mail: nleboeuf@bwh.harvard.edu

Received: October 17, 2020.
Accepted after revision: December 11, 2020.
Published online: January 20, 2021.