Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

222-nm ultraviolet light inactivates dried inocula of human rhinovirus and human coronavirus on a glass carrier

Sir,

Narita *et al.* demonstrated strong germicidal effects of 254-nm and 222-nm ultraviolet C (UVC) light against various suspensions of pathogenic bacteria, yeasts, an enveloped virus (influenza A) and a non-enveloped virus [feline calcivirus (FCV), a surrogate of the human norovirus] [1]. UVC light strongly inactivated influenza A, but inactivation was less pronounced on the non-enveloped or naked FCV. Dried inocula of other naked viruses have been shown to be infectious for weeks, whereas the dried inocula of the enveloped viruses influenza A and herpes simplex type 1 were infectious for <5 days [2]. This study explored the germicidal impact of different amounts of far-UVC irradiation (222-nm) against dried inocula of a naked human rhinovirus (HRV type 37) and an enveloped human coronavirus (HCoV 229E) on a glass carrier.

Study parameters were HRV type 37 (ATCC, VR-1147, Manassas, VA, USA), MRC-5 human embryonic lung fibroblasts (ATCC), temperature (21.2–22.0°C), humidity (15.0–19.5%), organic soil load (1% fetal bovine serum), and test medium (Minimal Essential Medium; Life Technologies, Carlsbad, CA, USA) supplemented with 10% [v/v] heat-inactivated fetal bovine serum (Life Technologies), 100 units/mL penicillin (Sigma-Aldrich, St. Louis, MO, USA), 10 μg/mL gentamicin (Thermo Fisher, Ward Hill, MA, USA) and 2.5 μg/mL amphotericin B (Sigma-Aldrich). The study parameters for HCoV 229E (ATTC, VR-740) were the same except WI-38 human lung cells (ATCC) were the indicator cell culture, and the fetal bovine serum of the test medium was 2% (v/v). Test and control carriers were run in duplicate. Treated carriers were placed 101.6 cm directly below a 250-W far-UVC excimer lamp (Sterilray Luminaire, Somersworth, NH, USA) and irradiated at three different dosages (Table I). Dosages were measured using the ILT2400 radiometer (International Light Technologies, Peabody, MA, USA). Following exposure, test carriers were resuspended, serial 10-fold dilutions were made, and dilutions were assayed for infectivity [median tissue culture infectious dose ($TCID_{50}$)]. Control carriers were exposed to ambient air for the same amounts of time as treated carriers. A test-substance cytotoxicity control was run concurrently and exposed to ambient air for 243 s. Infectivity of controls was determined using the same method as test carriers.

Dried inocula of HRV and HCoV on glass carriers were inactivated increasingly in response to higher dosages of 222-nm UVC light (Table I); however, the naked HRV may be more stable at low dosages (i.e. 0.9 mJ/cm^2). HRV accounts for 50–66% of common colds, and HCoV is the second leading cause of this illness [3,4], resulting in billions of indirect and direct costs each year [5]. Paradoxically, the common cold may protect people from contracting coronavirus disease 2019 [6] and influenza [7] through viral competition. Although excimer far-UVC lamps that emit 222-nm light are now commercially

Table I
Virucidal effect of 222-nm ultraviolet C (UVC) light on dried inocula of human rhinovirus (HRV) type 37 and human coronavirus (HCoV) 229E on glass carriers

Virus	Control		Treatment			
	Exposure to ambient air (s)	Viral titre ($TCID_{50}$/100 μL)[a]	Exposure to 222-nm UVC (mJ/cm^2)	Viral titre ($TCID_{50}$/100 μL)	Log_{10} reduction	Percent reduction
HRV type 37	11	$1 \times 10^{4.82}$	0.93	$1 \times 10^{4.57}$	0.25	43.80%
	34	$1 \times 10^{4.64}$	2.72	$1 \times 10^{3.64}$	1.00	90.00%
	241	$1 \times 10^{4.50}$	19.35	$1 \times 10^{2.14}$	2.36	99.60%
HCoV 229E	12	$1 \times 10^{4.50}$	0.95	$1 \times 10^{3.39}$	1.11	92.20%
	33	$1 \times 10^{4.32}$	2.69	$1 \times 10^{3.07}$	1.25	94.40%
	243	$1 \times 10^{4.64}$	19.42	$1 \times 10^{1.32}$	3.32	99.95%

Viral titres are mean values of samples run in duplicate.
[a] Stock solutions for HRV type 37 and HCoV 229E contained $1.0 \times 10^{5.5}$ $TCID_{50}$/100 μL and $1.0 \times 10^{5.0}$ $TCID_{50}$/100 μL, respectively. The cytotoxicity control for RHV type 37 and HCoV 229E contained $\leq 1 \times 10^{0.50}$ $TCID_{50}$/100 μL.

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available and can be a powerful prophylactic against HRV and HCoV, additional research is needed to optimize the use of 222-nm UVC light for the best health outcomes.

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Conflict of interest statement
None declared.

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References

[1] Narita K, Asano K, Naito K, Ohashi H, Sasaki M, Morimoto Y, et al. Ultraviolet C light with wavelength of 222 nm inactivates a wide spectrum of microbial pathogens. J Hosp Infect 2020;105:459—67.
[2] Firquet S, Beaujard S, Lobert P-E, Sane F, Caloone D, Izard D, et al. Survival of enveloped and non-enveloped viruses on inanimate surfaces. Microbes Environ 2015;30:140—4.
[3] Arruda E, Pitkäranta A, Witek TJ, Doyle CA, Hayden FG. Frequency and natural history of rhinovirus infections in adults during autumn. J Clin Microbiol 1997;35:2864—8.
[4] Mäkelä MJ, Puhakka T, Ruuskanen O, Leinonen M, Saikku P, Kimpimäki M, et al. Viruses and bacteria in the etiology of the common cold. J Clin Microbiol 1998;36:539—42.
[5] Fendrick AM, Monto AS, Nightengale B, Sarnes M. The economic burden of non-influenza-related viral respiratory tract infection in the United States. Arch Intern Med 2003;163:487.
[6] Aran D, Beachler DC, Lanes S, Overhage JM. Prior presumed coronavirus infection reduces COVID-19 risk: a cohort study. J Infect 2020;81:923—30.
[7] Greer RM, McErlean P, Arden KE, Faux CE, Nitsche A, Lambert SB, et al. Do rhinoviruses reduce the probability of viral co-detection during acute respiratory tract infections? J Clin Virol 2009;45:10—5.

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