Essential Microbiology

UV-C light and Coronavirus Statement

Professor Val Edwards-Jones, PhD, CSci, FIBMS
Emeritus Professor of Medical Microbiology, Manchester Metropolitan University
Director, Essential Microbiology Ltd

Personal statement:

Having worked in microbiology laboratories for over forty years and using UV light to disinfect the air and surfaces in defined areas as part of aseptic techniques, I am a great advocate of UV disinfection. I have personally undertaken a number of environmental and laboratory studies on the efficacy of UVC on surfaces as an independent consultant, for a number of commercial companies supplying UVC devices. I have been very impressed with how quickly undetectable levels of bacteria, fungi and surrogate viruses (over a 6 log) can be achieved (usually between 5-30mins depending upon the bacterium and whether it is in a vegetative state or spore).The UVD Robot from Denmark is most impressive because of its ability to move autonomously and get within 1m of the surface to be disinfected and also it is capable of moving around objects that can potentially cause shadowing. I have personally witnessed a 3 log reduction in numbers of MDR Klebsiella pneumoniae whilst the robot was driving past loaded samples (with light soil). This was a 3 log reduction within 10 seconds. Although studies have not been undertaken against the new coronavirus Covid-19 strain, UVC in general has a proven efficacy against MERS CoV and MHV-A59 (coronavirus mouse hepatitis virus), showing over 6 log reductions in viral particles within 30minutes.

Short report

Coronaviruses (CoVs) are enveloped positive-sense RNA viruses and currently Covid-19 is causing a global epidemic, originating from China. The exact nature of the survival of these organisms in the environment are currently unknown but previous studies on a related strain (the severe acute respiratory syndrome coronavirus (SARS-CoV) it is estimated to survive several days in the environment, and the Middle East respiratory syndrome-related coronavirus (MERS-CoV) can withstand more than 48 hours at average room temperature (20 °C) on different surfaces [van Doremalen et al 2013; Otter et al 2016; Lai et al 2005; Dowell et al 2004). Although disinfection of the environment is achievable through a variety of fogging devices and typical cleaning methods, these are time consuming and can be expensive. UV-C light provides an alternative method of decontaminating the environment during this epidemic period. UV-C destroys viruses by high energy electrons passing through or diffusing through the protein coat into the nucleic acid core, resulting in damage of the viral RNA (Vatansever et al 2013).The length of time taken to kill the microorganism depends upon exposure time and the range of the UV-C emitter from the microorganism, in line with the inverse square law.

There are a number of UV-C devices commercially available however, there are subtle operational differences between them. Production of UV-C light is usually between 180-280nm, achieved by using UV lamps. However, most commercial manufacturers use a device which requires manual placement within an area. Shadowing effects (which

drastically reduces UV-C intensity) and distance from potential contaminated surfaces can vary enormously.

UVD Robots are the only device available capable of autonomously repositioning its UV-C emitter, mounted on the top of the robot platform within a defined area, negating shadowing and closeness to a surface. This repositioning can be repeated numerous times ensuring the maximum UV-C intensity possible is radiated on to all surfaces and cubic metre of air. The UV-C emitter is equipped with 8 x Philips UV-C lamps (wavelength (254nm) giving a 360 degree coverage. Each lamp generates 5 joules of UV-C energy per second. There is always a minimum of 4 lamps facing any given surface (within 1m) totalling a minimal intensity of 20 joules per sq. metre per second.

Studies undertaken on the disinfecting ability of a UV-C emitter on MHV-A59 and MERS-CoV- showed that viral titres of MHV-A59 were reduced by 2.71 log10 in 5 minutes and 6.11 log10 in 10 minutes of exposure, resulting in undetectable levels of MHV-A59 virus. An exposure time of only 5 minutes resulted in undetectable levels of MERS-CoV, and this remained undetectable following 30 minutes of total exposure for a 5.9 log10 reduction (Bedell et al 2016).

Other UV-C emitters, using the same wavelength have also shown similar data against a range of different bacteria, fungi and viruses (Vatansever et al 2013), therefore the lamps used on the UVD robot should produce very similar data. The UV-C produced is not notably different only the method of delivery.

Health and Safety note

UV radiation (photons) has sufficient energies to break chemical bonds so can be useful in chemical processing but it can also cause severe damage to materials and cellular tissues, therefore any commercial UVC emitter must be used in vacated areas.

References

Bedell, K., Adam BS., Buchaklian, H and Perlman, S. (2016) Efficacy of an Automated Multiple Emitter Whole-Room Ultraviolet-C Disinfection System Against Coronaviruses MHV and MERS-CoV. *Infect Control Hosp Epidemiol*;37:598–59.

Dowell S, Simmerman J, ErdmanD, Wu J, Chaovavanich A, Javadi M, et al. (2004) Severe acute respiratory syndrome coronavirus on hospital surfaces. *Clin Infect Dis* ;39:652-7.

Lai MY, Cheng PK, Lim WW (2005). Survival of severe acute respiratory syndrome coronavirus. *Clin Infect Dis* ;41;:e67-71.

Otter JA, Donskey C, Yezli S, Douthwaite S, Goldenberg SD, Weber DJ. (2016) Transmission of SARS and MERS coronaviruses and influenza virus in healthcare settings: the possible role of dry surface contamination. *J Hosp Inf*; 92; 235-50.

van Doremalen N, Bushmaker T, Munster VJ. (2013) Stability of Middle East respiratory syndrome coronavirus (MERSCoV) under different environmental conditions. *Eurosurv*. 19;18(38).

Vatansever F, Ferraresi C, de Sousa MV, Yin R, Rineh A, Sharma SK, Hamblin MR. (2013) Can biowarfare agents be defeated with light? *Virulence*. ;4:796-825.

Report produced by:-
Professor Valerie Edwards-Jones, PhD, CSci, FIBMS

Emeritus Professor of Medical Microbiology, Manchester Metropolitan University , UK
Visiting Professor Skin Integrity and infection Prevention Institute, University of Huddersfield, UK
Honorary Professor of Medical Microbiology, Perm Medical University, Perm, Russia
Director, Essential Microbiology Ltd, UK.
Clinical Director, MelBec Microbiology Ltd, UK

Signed V Edwards-Jones Dated 25th February 2020.