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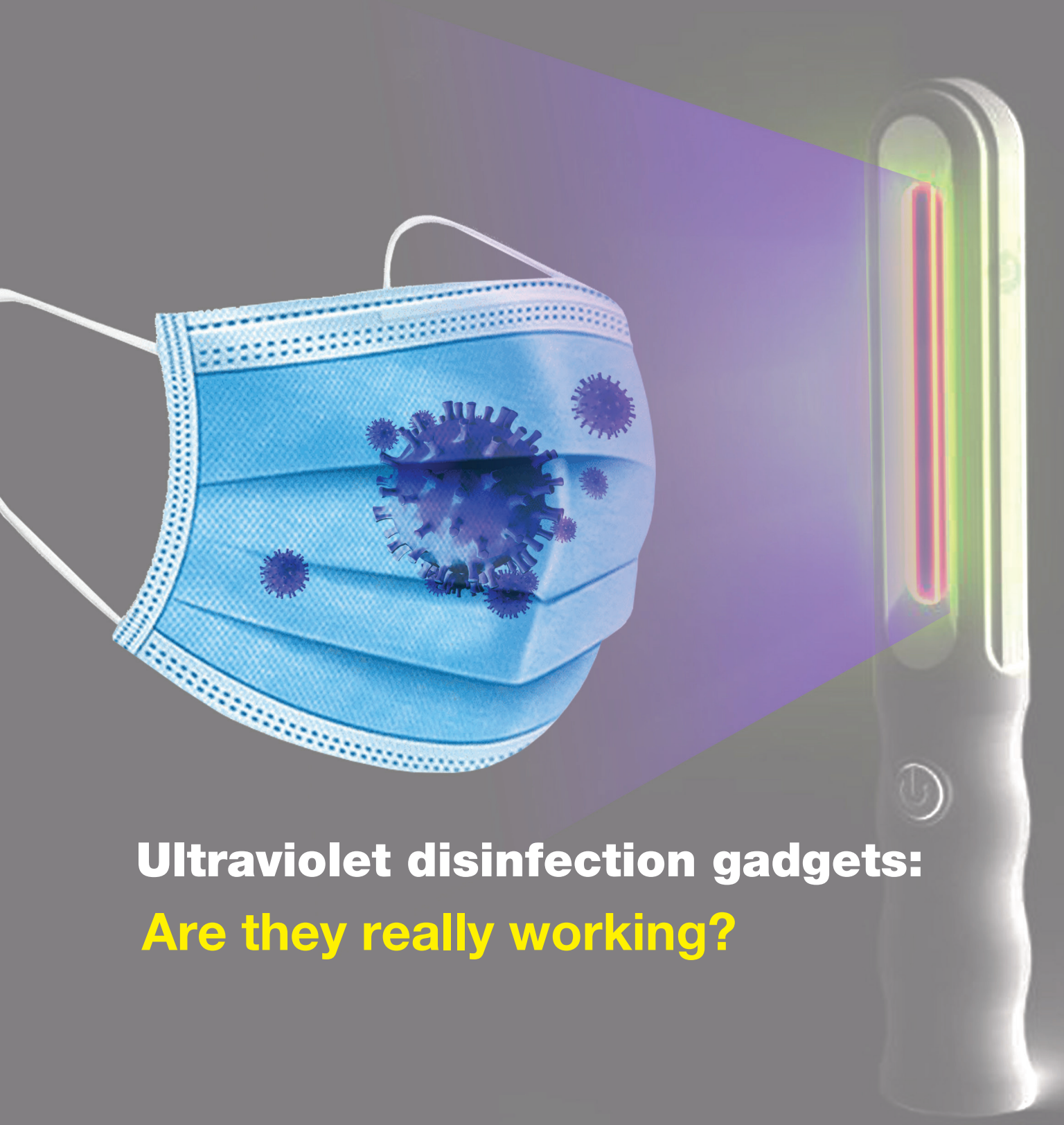
LIGHTING SOLUTIONS



Ultraviolet disinfection gadgets:
Are they really working?

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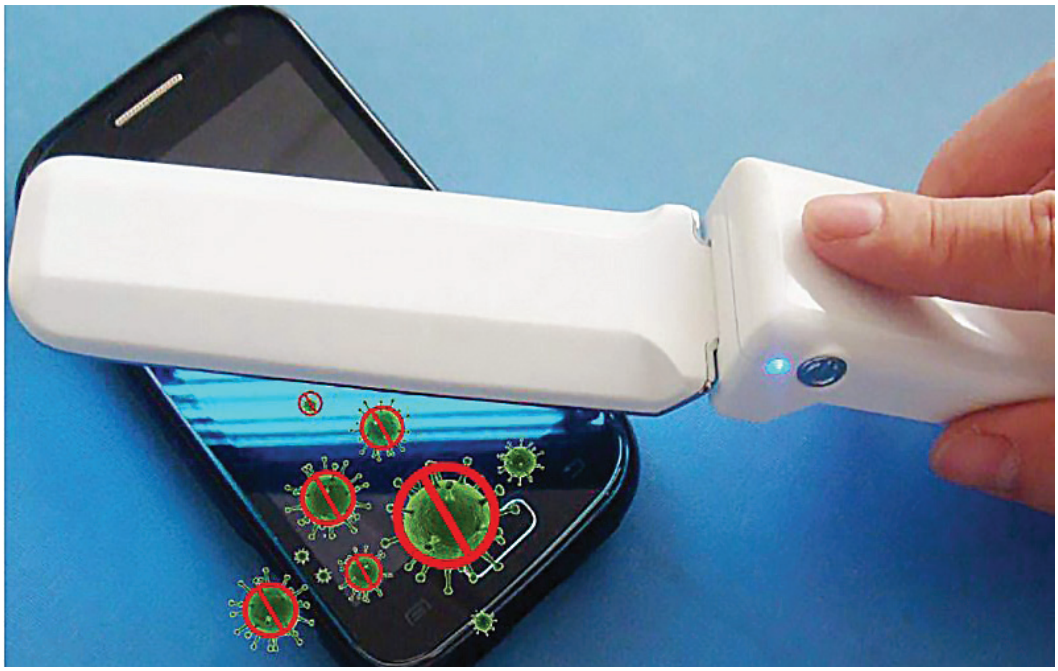
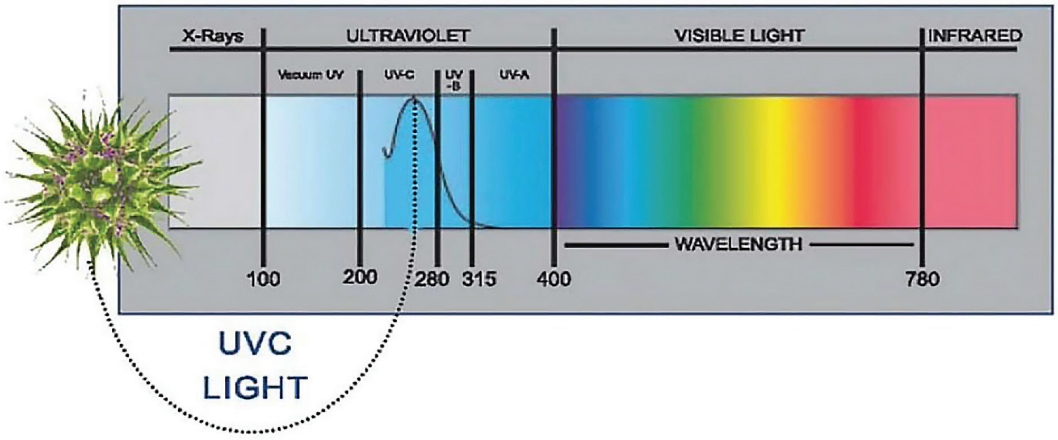
Rise of the infection cases in recent months (due to COVID19) has led to a significant, yet predictable, increase in the sales of ultraviolet-based disinfection gadgets. Usefulness of Ultraviolet (UV) rays to disinfect (killing bacteria or deactivating viruses) has been known for more than 70 years. UV-based disinfection is being commonly used in healthcare facilities; specifically, for disinfecting equipment. However, using a UV-based disinfecting handheld device, requires a more thorough investigation and one cannot rely on the promotional information provided by the manufacturer.

A study done by researchers at Penn State, shows that “a personal, handheld device emitting high-intensity ultraviolet light to disinfect areas by killing the novel coronavirus is now feasible”; however, “You have to ensure a sufficient UV light dose to kill all the viruses”. This means that proper UV light emitting adequate amount of UV light dose is required to ensure that disinfection is done correctly. Otherwise, an improper disinfection might be more dangerous than not disinfecting, due to the false sense of safety for the users. As most consumers do not have the lighting knowledge or equipment required to find out if a gadget is producing sufficient UV light dose, finding a practical and useful gadget is not as easy as one might think.





Issues with commonly-purchased gadgets

Common issues of the available products for household usage includes:

- Wavelength: Not all UV lights are showing disinfecting behavior. The main UV wavelength which is known for its germicidal effect is called UV-C and includes the light ways within 200-280 nanometers (nm), with the peak germicidal effect at 254 nm. There are fewer available gadgets which are mentioning their wavelength ranges, and even for those which are it is not easy to investigate the existence of UV-C wavelength without sophisticated measuring equipment. One way to test these products is a test called the banana test (yes, banana!). Place the light over a green banana for 15 minutes. Any UV-C lamp will turn the skin brown. It is worth mentioning that the test is not for specific wavelengths in the vicinity of 254 nm; but it can show that the light is actually working, and it is emitting UV-C.

- UV light dosage: The dosage of UV-C is the power of light times the exposure time; and both parameters are very important. You cannot simply scan a surface using a gadget (as many products are advertising) and assume that the surface is disinfected, unless the source is very powerful. Also, not only the power of the light bulb is important, but also the distance from the gadget and the surface plays an important role in disinfection. Placement of the lamp at a longer distance will increase the exposed area but will reduce the power of light following the inverse square law. This means that doubling the distance (say from 10cm to 20cm), will make the power to be a quarter of its original value; therefore, an exposure time of 4 times larger is required to get to the same level of disinfection.

Price of the UV gadget can be a great pointer to see if it is a useful device or not. One single powerful UV-C LED light can cost about $15; and for a complete wand-type gadget (for surface cleaning), the device might have multiples of these (maybe even tens of LEDs). You can see that a simple device under $25 simply does not make sense to be an effective disinfectant.

- Line of sight: Using UV-based disinfectant is limited by the limitations of light. The main one is that non-transparent objects can obscure the light

and prevent it from doing a complete scan of the area. Therefore, for a full disinfection, shadowed areas need to be identified and the same amount of UV dosage should reach those areas, to ensure complete disinfection.

- Safety concerns: Not only the products being used as UV disinfectants need to be used correctly for proper disinfection, but also the user might employ many levels of protection to ensure that their usage is not a safety threat for themselves. As a rule-of-thumb, if a product is advertised as safe for human, it cannot be easily trusted as UV-C light ways are hazardous for skin and eye (especially in the disinfecting region of the wavelength); for the obvious reason that UV light rays do not differentiates between skin cells and infectious viruses. Therefore, handling gadgets needs proper caution and one cannot simply use them without thinking about how to protect themselves.

The issues mentioned above do not mean that there cannot be an effective handheld gadget to perform surface disinfection in households. However, they demonstrate different factors that affect the performance of such devices and how all the factors need to be considered before one decides on purchasing a gadget.

References

[1] Penn State. "Killing coronavirus with handheld ultraviolet light device may be feasible.", ScienceDaily, June 2020.

[2] G. Byrns, et al., "The uses and limitations of a hand-held germicidal ultraviolet wand for surface disinfection", Journal of Occupational and Environmental Hygiene, June 2017.

[3] "Potential Risks Associated with The Use of Ozone and Ultraviolet (UV) Light Products for Cleaning CPAP Machines and Accessories: FDA Safety Communication", U.S. Food and Drug Administration (FDA), February 2020.

[4] J. Erdmann, "UV Light Wands Are Supposed to Kill Viruses. But Do They Really Work?", Discover Magazine, August 2020