

# **The Effects of Longtime Exposure of Ultraviolet-B Light on Germs and Viruses**

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The effects of long time exposure of ultraviolet-B light to germs and viruses are investigated in reference to a prior study.<sup>1</sup> Ultraviolet-B is one of the bands (A, B, and C) of ultraviolet light emitted by the Sun. Although ultraviolet-C is the band of ultraviolet light known for its germicidal benefits, ultraviolet-C is blocked by the ozone of our upper atmosphere. Therefore its benefits only occur under artificial conditions such as applications of UVC lamps used to sanitize hospitals, airline passenger cabin maintenance, water sanitization, and the UVC lamps and sanitizing-wands available for personal use in home and travel.

There are general notions that the sun's intensity during the seasonal summer months subdue the threat of the common flu virus. If this has shown true, then it could also hold true for other viruses, such as the novel Coronavirus of 2019-20.

The interest in understanding ultraviolet band B (and also band A) - as it is emitted by natural sunlight - is the longtime exposure that these bands may have as a germicidal benefit to the natural outside environment. This is of interest especially since findings may verify that viruses lurk in the outside environment more than we expect. Some indication of airborne viruses that leap to-and-from objects (including organic medium) - and then back to the air again - are the mass cases of viruses occurring in open-air nautical vessels, such as cruise ships and aircraft carriers. Although a virus is known to be suspended in air for only 3 hours, it usually finds a landing spot within that time - be it the floor or other hard surface - where it can survive for up to 3 days. Within that time period, air currents can whisk it away and land on a human. Also, if a virus lands on any plant, bacteria, or fungus, it may exist for any length of time (although not known to replicate) and then, again with the help of wind currents, find its way to a human. If birds are thought to be culprit in carrying viruses, then to what extent can this occur? There are approximately 12,000 species of birds in the world accounting for approximately 300 billion individual birds. If the world's population is 7.8 billion people, then there are 500 birds to every 13 people (or 38 to 1) indicating an obvious out-numbering of avians to humans, and demonstrating what we perhaps didn't realize: an environment with vulnerable odds for disease-spreading. With the number of ways a virus can relay

itself from medium to medium, it should not come as a surprise that a virus is present in the atmosphere enveloping the entire Earth during a declared pandemic, explaining the phenomenal rapid spreading during such event. Other than esoteric prophecy, no other explanation seems to better describe this pattern.

The wavelength of ultraviolet light spans between 100 nm (nanometers) and 400 nm, and falls between visible light and x-rays on the electromagnetic spectrum (EM). Within this broader UV spectrum lies three types of sub-bands: UV-A, UV-B, and UV-C. UV-A at 400-315 nm is sometimes commonly referred to as “black light” since UV rays cannot be seen by the unaided eye. It has the longest wavelength region and lowest energy. UV-B at 315-280 nm causes sunburn. UV-C (280-100 nm) is said to be effective in microbial control, and often referred to as the “germicidal UV light”.

Because UV-C reacts with the ozone layer high in the atmosphere, it never reaches the ground. UV-A has the lowest energy and at worst may cause skin wrinkles to a human over time. UV-B, however, are the main rays that cause sunburn, and can directly damage the DNA in skin cells. It should also follow that ultraviolet-B can have DNA-altering, and even RNA-altering, effects on viruses. UV radiation kills viruses by chemically modifying their genetic material. It is said that the most effective wavelength to inactivate a virus is 260nm, which lies on the UVC band. But this is not so mathematically distant to its neighboring ultraviolet-B which begins at 280nm. Keeping in mind that these bands of ultraviolet light lie on a spectrum, it should follow that for each of these bands of ultraviolet light that there is some sharing of characteristics, especially in areas where the bands make their transition. Between the bands of UV-C and UV-B this transition occurs at 280 nm. Therefore, it is normal to assume that there are germicidal benefits to UV-B the same as UV-C, just at a lower efficiency.

In following this theory, data was compiled in a [study](#)<sup>1</sup> concerning how to disable viruses using a low-pressure mercury vapor lamp, with primary emission at 254nm. This wavelength, of course, never reaches the Earth, and it is said that ground-level virucidal solar UV wavelengths fall above 290 nm. But the study notes that the primary photochemical processes that damage the viral DNA or RNA

“occur at all the solar UV wavelengths, varying only in the efficiency of the different wavelengths.”

Another issue is how well the nucleic acid within the virus particle itself absorbs the UV radiation to cause inactivation. This is why claims currently profess that “there is no proof that sunlight will extinguish the threat of the Coronavirus”. This is because there simply hasn’t been enough studies performed on COVID-19 to make a conclusion. However, previous studies account for the varied aspects of other viruses, such as the number of bases in the RNA and DNA in determining the sensitivity of UV inactivation. This is part of making an *intelligent extrapolation* using current data in lieu of other viruses. The extrapolation is made using wavelength dependent “action spectrum” data. If we attempt to compare the sensitivities of viruses at different sizes, then these can be used to predict the sensitivities of other viruses, and we have a baseline study to work with. In fact, these results have been applied to smallpox, Ebola, Marburg, Congo Crimean, Junin and other hemorrhagic viruses, the Venezuelan equine encephalitis, and other encephalitis viruses. Referring to this “slew” of viruses, there is no reason why our current knowledge of the *behavior of viruses* cannot be applied to the Coronavirus; after all, COVID-19 is a virus too.

An *action spectrum* is a graph of the rate of biological effectiveness plotted against wavelength of light, and is related to the absorption spectrum. It mathematically describes the inverse quantity of light required to evoke a constant response. Action spectra show which wavelength of light is most effective in a specific chemical reaction since some reactants are able to use specific wavelengths of light more effectively to complete their reactions. In the study, action spectra of virus inactivation were found to be similar for all viruses regardless of genome type, and one composite action spectrum was used to represent all viruses.

While strong steady sunlight is gradually extinguishing a virus, another event taking place is sometimes referred to as “herd immunity”. Herd immunity is the immunity built-up in the masses of people from either persons recovering from a virus (therefore becoming immune) or those administered a vaccine (when becoming

available). There is also another sector of persons who are somehow immune to a disease, and yet another sector of persons who seem to know how to avoid a disease (“avoidance immunity”). This sector may be practicing cleanliness, physical distancing, PPE (personal protective equipment), and good nutrition with exercise (to maintain a strong immune system); and their persistence pays off such that it is equivalent to a type of immunity.<sup>3</sup> When the population is growing in their immunity - attempting to approach 100% - at the same time the virus is gradually being extinguished by sunlight. However, an immune population does not merely rid a disease because the virus can still be present in the outdoor environment until natural causes eventually take it down to near-exhaustion. By “near-exhaustion” it means there is still a chance a virus can be “lurking in the shadows”, that is, places where sunlight never reaches and the virus has somehow sustained itself on shaded plant or vegetation (although not replicating or spreading).

By longtime exposure to UV radiation, it is implied day-to-day sunlight approaching midsummer-like intensities that endure 12 - 14 hours or more. In comparison, artificial UV-C lamps designed for hospital or personal-use can incorporate a 3W low-pressure mercury or LED lamp exposing surfaces from a distance of 1 inch for 5-20 seconds to sanitize against germs.

The amount of overall sunlight radiation will depend on geographical location, and the regions that will have the most benefit from constant sunlight are those located nearest the equator. However, all parts of the Earth get a fair dose of the Sun’s radiation, varying from a constant 12 hours at the equator to an intermittent 24 hours at the poles (midnight sun). There are other factors to consider, since steady rain can clear the air of viruses and eventually send them down the drain. Rain effects are thought to be temporary, but any break in the spread of a virus is a chance for herd immunity to gain momentum.

From the above development of ideas, it is theorized that more likely than not, the effects of longtime exposure of the environment to ultraviolet-B from the Sun will have a similar biodefense on the Coronavirus as in previous viruses. This means the natural occurrence of sunlight, as in other epidemics, will have a natural

righting-force on the Coronavirus to stable and subdue its spread, and allow for its gradual dissipation when accompanied by herd immunity.

1. [\*Predicted Inactivation of Viruses of Relevance to Biodefense by Solar Radiation\*](#), Lytle and Sagripanti, Journal of Virology, Nov 2005, 79(22):14244-52.
2. 'Herd immunity' used in this paper may be defined differently than other usages. (Entymol: rel. to stampede, or stamp out, e.g., *a herd stampeded the prairie of unwanted cactus*).
3. An emphasized practice of *avoidance immunity* could play a key role towards the contribution of herd immunity, and resolving the coronavirus pandemic.