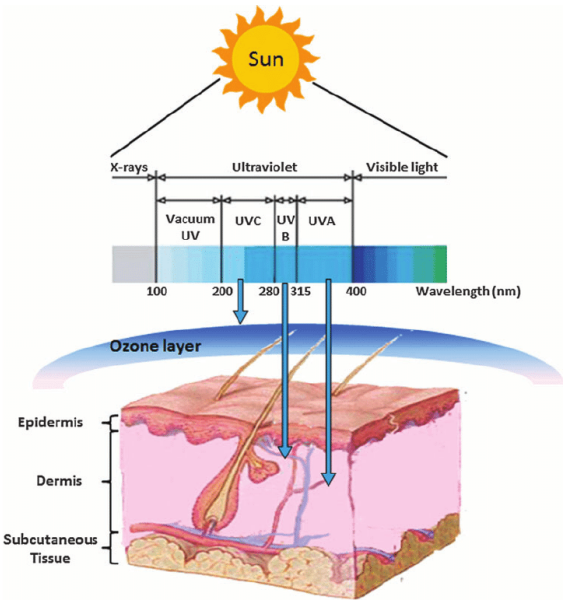
FAR-UVC LIGHT DISINFECTION TECHNOLOGY

Scientific Overview



What is Far-UVC Light ?

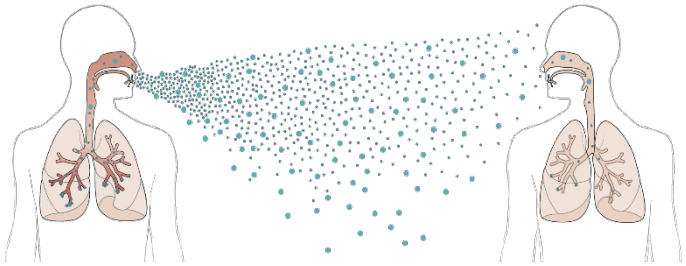
Far-UVC light is a specific wavelength of light within the ultraviolet spectrum. The three primary ranges of UV light are UVA, UVB, and UVC. Of the three, UVC is the only one that cannot pass through the ozone layer, so does not naturally occur on Earth.[1] It is made in light fixtures by using electricity to stimulate certain gases that then emit these specific wavelengths.

While all UV light has some ability to "kill" (inactivate) viruses and bacteria, UVC is by far the most potent. It does so anywhere that it directly shines – on surfaces, in water, and in the air. Where Far-UVC light (222 nm wavelength from Krypton-chloride) differentiates itself from other UVC light (254 nm wavelength from Mercury) is that it cannot penetrate human skin or eyes, therefore making it safe for people and allowing its use in occupied spaces.

How Does Far-UVC Technology Work ?

To understand how UV light disinfection ("UVGI") works to curb the spread of COVID-19 and other viruses and bacteria, we must first define our problem:

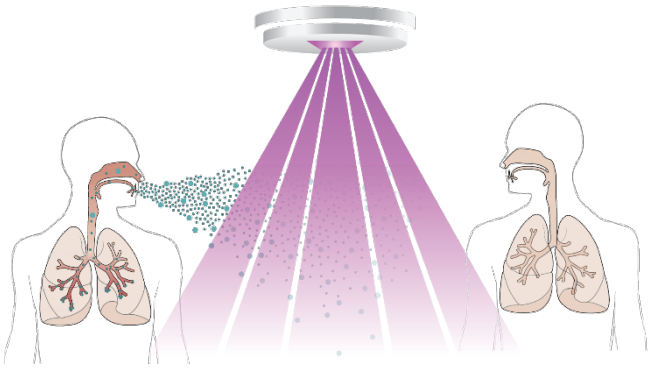
Question: What is our problem?
Answer: Infectious viruses, such as COVID-19, influenza, RSV, cold viruses, and bacteria SPREADING from person-to-person and making people ill.



Question: How do these diseases spread?
Answer: By traveling through the air in indoor public spaces in tiny aerosol particles and spreading from person to person.

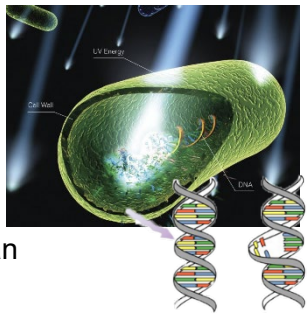
This airborne route from tiny aerosol particles – as opposed to droplets and surfaces - has been stressed as the vast majority of, and primary, route of spread by over 200 pre-eminent scientific experts from around the world – including letters to public health agencies and journal articles from former heads of OSHA, NIOSH directors, and Deans of Schools of Public Health.[2,3] Among their recommendations to OSHA was to "require employers to follow the hierarchy of controls (see below), including engineering controls, to provide clean indoor air involving ventilation, filtration, and/or application of (UVGI) technology…"[3]

What Far-UVC does at the microscopic level is "kill" any/all types of viruses and bacteria in the air in these tiny aerosol particles – in real time - *before* people breathe them in. The main mechanism it uses to achieve this is by first penetrating the cell wall of the virus or bacteria, then effectively "melting" sections of DNA/RNA of the organism. If you imagine those as gears, what it basically does is weld those "gears" together which effectively "kills" that virus or bacteria. (see graphics below)



And now to put it all into perspective, and knowing those basic premises, one can easily understand what Far-UVC technology will do for *any* indoor space where people congregate, including buses, school spaces, restaurants, or any other: it simply *stops the spread* … *where* it spreads.

What Recognition & Benchmarks are Available for Far-UVC's Effectiveness ?



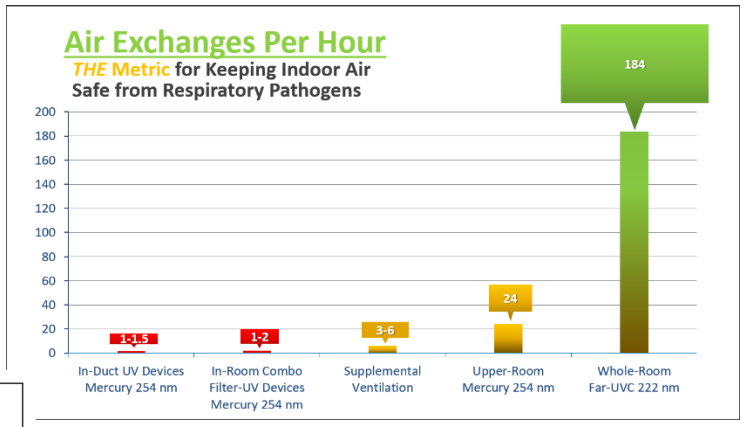
It has long been known by health experts that the #1 goal of public health policy is the prevention of disease.[4] In the CDC/NIOSH/OSHA's *Hierarchy of Controls*,[5] as you go up the ladder, the more effective those measures are at preventing exposure.

https://www.cdc.gov/niosh/topics/hierarchy

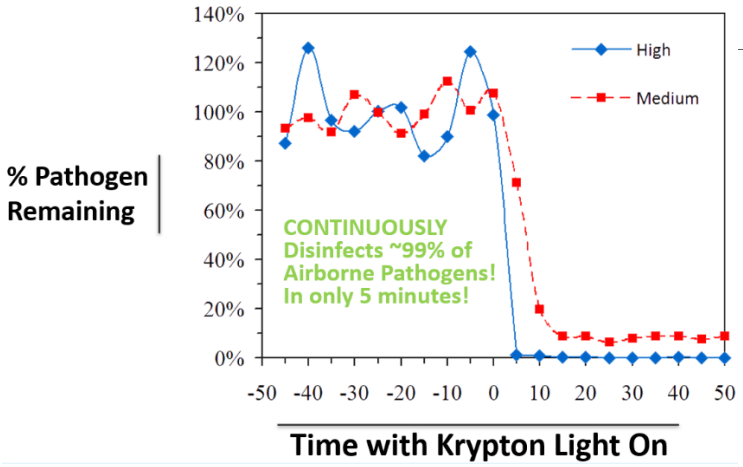
Far-UVC light disinfection fits perfectly within the *Hierarchy of Controls*, and is recognized as an engineering control.

In the CDC's guidance *Ventilation in Buildings*,[6] they "recommend a layered approach to reduce exposures to SARS-CoV-2," which includes improvements to ventilation to "reduce the spread of disease and lower the risk of exposure." Furthermore, the CDC's guidance on UVGI written specifically for COVID-19,[7] they describe that "Ventilation interventions can help reduce the number of infectious viral particles (e.g. SARS-CoV2) in the air." – that's the basic premise for improving the ventilation of buildings – you are essentially replacing the viral particles that people have breathed out into the space for fresh air.

This key concept of ventilation is measured in terms of air exchanges per hour (ACH). Each ACH removes about 63% of the particles in the air (due to "backmixing"). So 1 ACH = 63% removed over 1 hour, 2 ACH = 63% removed + 63% of the remaining 37% (23%), and so forth. With that established, how do we equate between the air exchanges of UVGI and an HVAC system, or opening windows, for instance? As UVGI effectively "removes" the dangerous pathogens from the space, it has the same effect. This is recognized by the CDC who says "Ventilation interventions include opening windows, using fans, adding HEPA fan/filter systems, and adding (UVGI)." Further, they note: "For airborne viral particles, (UVGI) systems provide air changes per hour that are similar to the introduction of clean air into the space."[7] With that established, how do they stack up against one another?



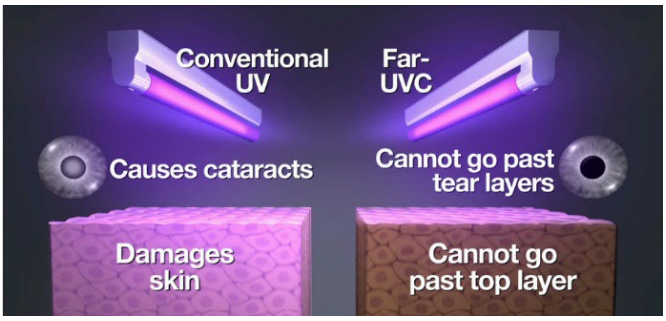
Previous recommendations would advise any indoor public space to have a minimum of 3 Air Exchanges per Hour. Far-UVC has been proven to provide over 3 Air Exchanges per MINUTE, or 184 Air Exchanges per HOUR. This incredibly led to a continuous decrease in the microbe load in the air of ~99%.[8]



But from the graph above, one might wonder *why* Far-UVC works so much better than every other option at cleaning the air of microbes? Basically, because the light hits the air directly around and in-between people continuously – and within seconds kills any microbes in the aerosol that may come out through a person's breath. All other devices rely on the air moving from one area of the room to another (where the devices are situated) – meaning that the infected aerosol may expose all of the occupants in the room before it gets "cleaned" across the room in a HEPA Fan/Filtration system, or in an enclosed UVGI device in the HVAC system, for example.

Safety Information & What Separates Far-UVC from Traditional UVC Devices:

While it is a popular belief that all UV light is dangerous, this is absolutely not true for Filtered Far-UVC 222 nm light. Mercury-based 254 nm “Conventional” UVC does penetrate deep into the skin and eye, causing sunburn, keratitis (inflammation of the eyes), and can potentially cause skin cancer over time. This is the reason that its use was appropriately confined to water treatment plants, HVAC systems, and other applications where it would not shine directly on people.



Meanwhile, the newly-developed Krypton-Chloride-based Far-UVC cannot get past the most superficial layers of dead skin cells or the tear layer of the eye and have been shown to be much safer than sunlight.[9,10] Many studies of Filtered Far-UVC 222 nm light have been completed - including long term studies up to 66 weeks,[11] and studies giving doses that were over 30X the current limit.[12] None of these studies have been able to harm humans or animals – not even create so much as a sunburn. Studies performed on mice that are genetically predisposed to get skin cancer at a rate 10,000X the rate of normal mice, still did not show any harm.[13]

Far-UVC lights have had over 1,000 installations over the last 4+ years. There have been zero reports of any adverse effects to anyone in those spaces, including the Santee-Lynches school districts, where they have been installed on 331 buses for over 3 years now. In fact, in the lab, as well as in the real-world, there has not been one known adverse effect to the many tens of thousands of people that have been protected by Far-UVC light disinfection. Additionally, we are not aware of even one known case of transmission in those spaces – a truly incredible, world-changing technology.

Background, Development, & History of Use

Ultraviolet light’s ability to kill microbes, including viruses and bacteria, was discovered in 1892.[14] Artificial UV light disinfection technology (aka UVGI) was first used to disinfect drinking water in 1906.[15] It has been in continuous use in various applications ever since - in water treatment plants, food processing plants, on surfaces, and for indoor air (including HVAC systems). UVGI has been consistently effective at irradicating microbes for over 100 years.

Recent decades have seen U.S. and international health agencies give increasing support for the use of UV disinfection technology. Recommendations include: the World Health Organization (WHO) in 1999 – UVGI lights shined in the upper part of rooms - for control of the worldwide spread of TB; the US Army (2000) for disease isolation; and FEMA (2003) advocating UVGI as an option as defense from bioweapons.[16] The CDC/NIOSH published guidelines (2009) also advocating for using UVGI to combat the spread of TB.[17]

During the pandemic, there has been renewed interest in the use of UVGI to combat the spread of airborne microbes. In 2022, the White House’s Office of Science and Technology Policy (OSTP) has released multiple publications regarding the importance of indoor air quality (IAQ) and its role in the spread of COVID-19 and all other airborne microbes - with UVGI included in these recommendations to combat not only the current, but future pandemics as well.[18]

Far-UVC has been researched for more than 10 years, with over 100 scientific articles and studies published in just the last 5 years. This research has been done by the preeminent scientists from around the world, including at Columbia University, Harvard, University of Colorado Boulder, University of Leeds (UK), and many more. Additionally, Boeing’s Ultraviolet Team of Aerospace Engineers have been studying, developing, and deploying this technology since 2015.

This world-changing technology is more than ready for “prime-time.” Far-UVC light disinfection should kill each and every virus, variant, and bacteria – present and future. It is truly the epitome of public health policy – a proactive solution that is not only the most powerful, but is also sustainable into perpetuity. Moving us from always behind the next pandemic, to always ahead of the next threat to the safety of our communities.

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