

# How Light can Help to Fight Against Covid-19

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## Abstract

The novel coronavirus (SARS-CoV-2) is contaminating individuals and spreading effectively from individual to individual. The infection has spread to almost all the countries in the world. To slow the expanding worldwide spread of the SARS-CoV-2 infection, proper disinfection procedures are required. Ultraviolet radiation (UV) technology has a notable antiviral impact. UVC is another part of the range comprised of a shorter, more vivacious frequency of light. It is especially acceptable at decimating hereditary material – regardless of whether in people or viral particles. This paper discusses utilizing UV frameworks for its disinfection as a possible adjunctive methodology for patients experiencing extreme COVID 19 diseases and the idea of Ultraviolet germicidal illumination (UVGI) to make the N95 mask reusable. This paper also discusses various kind of techniques for how UV light can be used to fight against COVID-19 diseases. It can ensure that we can avoid liquid damages by using UV techniques.

**Keywords:-** Ultra-violate technology, Coronavirus 2, 4-log virus inactivation, N95 face mask.

## INTRODUCTION

A coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is wreaking havoc as it infecting people and rolls through our communities, cities, countries, and continents. Extreme social isolation and various precautions measures have been able to slow the spread of the disease according to the guidelines of WHO. Fig. 1 shows the representative image of the COVID-19 virus. Coronaviruses are enveloped and composed of single-stranded RNA. Genetically, coronaviruses can be quite different from one another. Two of the most well-known of the deadly types are responsible for SARS and MERS, whereas scientists are calling it SARS-CoV-2 when these deadly viruses were encountered.

In December 2019, the World Health Organization (WHO) named the disease COVID-19 on February 11. In India, 11, 18,094 confirmed cases and 27,490 confirmed deaths due to COVID-19 were accounted for as of

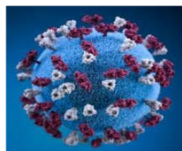
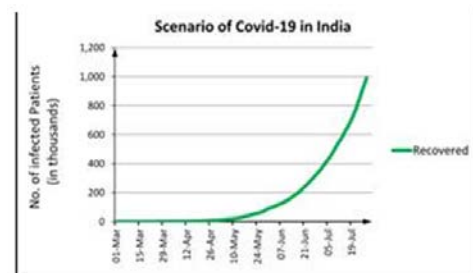


Fig. 1: Representative image of COVID-19

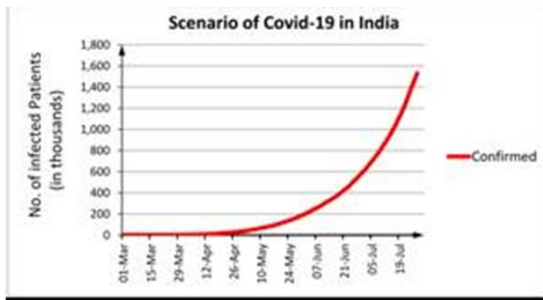
(Taken from the source <https://pxhere.com/en/photo/1608799>)

July 19, 2020, while 2,218 has been recovered. Studies reported that with the current rate of spread of the disease, the number of infected cases in India would rise extravagantly by October 2020, which may surpass the infrastructural limit with respect to giving the essential treatment to every single contaminated person. (Fig 2) [1].

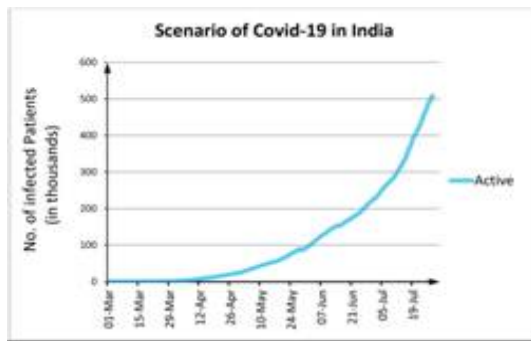
Thus, critical exploration and utilization of new and creative methods of rewarding COVID 19 pulmonary infection (PI) will be required. In corresponding to pharmacological and steady administration techniques, nearby use of antiviral medicines may give a conceivably significant road in our battle against SARS CoV 2. The current article investigates the idea of a formerly portrayed antimicrobial treatment modality, [2, 3] a direct UVC illumination of the tracheobronchial tree of tracheal intubated COVID 19 patients.



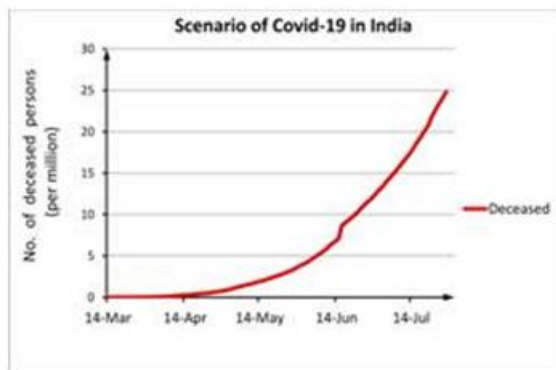
(1)



(ii)



(iii)



(iv)

**Fig. 2: The rise of (i) Confirmed, (ii) Active, (iii) Recovered, (iv) Death cases in India**

Ultra-violet (UV) technology is an elective way to deal with various techniques for sterilization by uncovering microscopic organisms, infections, and protozoa to UV light by interpreting them as incapable of reproducing or further influencing water supplies. Pathogenic viruses such as norovirus, adenovirus, hepatitis and rotavirus, regularly happen in both surface and groundwater sources [4-6]. UV can offer successful inactivation by uncovering bacteria, viruses, and protozoa to UV light [7].

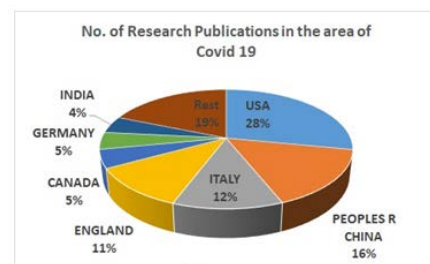
Viruses are supposed to be little that 500 million rhinoviruses could fit on the top of a pin. Viruses are made out of a center of nucleic acid (DNA or RNA; double-stranded or single-stranded) encased in a protective coat called protein capsid, which is comprised of protein. However,

the capsid is encased in an extra lipid spikey coat, called envelop. In all cases, the viruses are

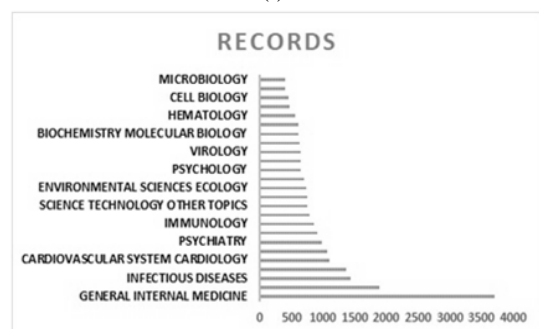
equipped for locking onto cells and entering inside them. If the number of publications is looked at during the recent times, especially in the area of Covid 19 related research, it has been found out that the USA leads at the top position with around 6781 publications amounting to around 28.1% of the global publications followed by China at 15.8%. India stands at 7th position with around 1115 publications till date, which amounts to around 4.6% (As per Fig.3 (i) obtained from Web of Science analyze results feature dated Sept 3rd, 2020). Most of the research publications were reported in the areas of general internal medicine (15.3%), followed by Public environmental, occupational health (7.8%). Science, Technology & other topics contribute to just around 3.1% (Fig. 3 (ii)). So brief attention must also be given in this area of developing suitable technologies to fight Covid 19, and using lights like UV can help a lot in this fight [8].

**FACTORS AFFECTING VIRUS SURVIVAL**

The major factor that has been universally demonstrated is temperature. It has been reported that higher temperatures mean quicker popular inactivation. Viruses may survive for broadened periods, frequently longer than the span of the investigation at low temperatures above freezing, [8], and sometimes for several years [9]. Few studies focus on sunlight that is another noteworthy factor conveying viral inactivation, by revealing UV radiation.



(i)



(ii)

**Fig.3: Graphs representing (i) Countries and their contribution in global research output via publications related to Covid 19, (ii) Research areas in which the publications were made (As per Web of Science Analyze Results feature accessed Sept 3rd, 2020)**

Ultraviolet (UV) irradiation is an electromagnetic disinfection method that strategy that utilizes short-frequency wavelength ultraviolet (ultraviolet C or UV-C) light, the wavelength of (100–400 nm) shorter than that of visible light (400–700 nm) but longer than x-rays (<100 nm) to slaughter or inactivate microorganisms by wrecking nucleic acids and disturbing their DNA, leaving them unfit to perform essential cell functions [2].

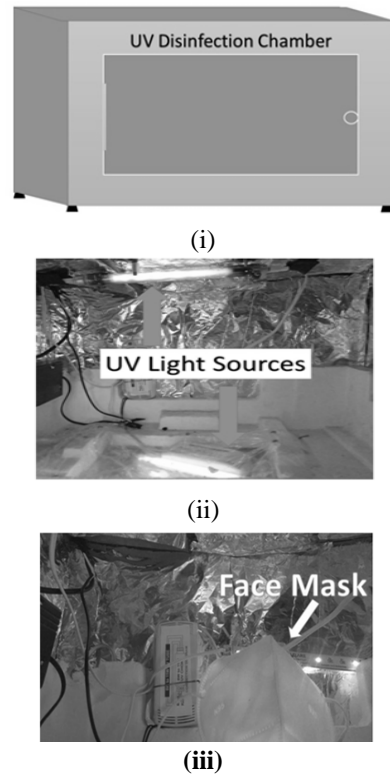
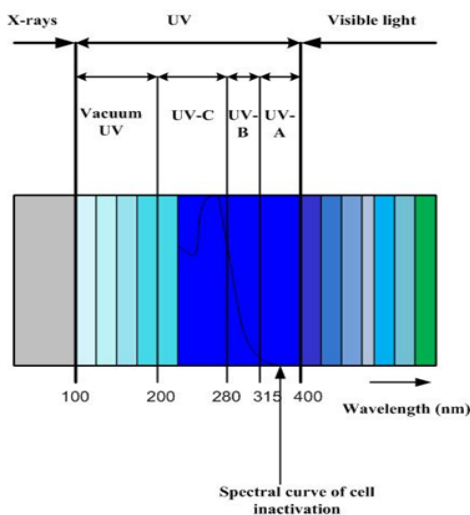
UV illumination is separated into four unmistakable spectral zones, including vacuum UV (100–200 nm), UVC (200–280 nm), UVB (280–315 nm) and UVA (315–400 nm) (Figure 4). When exposed to sunlight, viruses survive less than when in the dark. As per its essential features, the affectability of infection to UV illumination can be generally anticipated. [1]

The type of nucleic acid may also be an important factor in UV sensitivity. Few studies have been demonstrated that single-stranded RNA (ssRNA) viruses tend to be more sensitive than double-stranded DNA (dsDNA) viruses [10] due to the stability of the double-stranded structure and the lack of a repair mechanism in most RNA viruses [11].

Virus inactivation by UV is performed by the most familiar mechanism, which leads to direct damage to the nucleic acid into the virus [1].

The UVC spectrum, especially the range of 250–270 nm, is firmly consumed by the nucleic acids of a microorganism and, this is the most savage scope of frequencies for microorganisms.

In the paper [2], this range, with 262 nm, has been reported as the peak germicidal wavelength, known as the germicidal spectrum. Due to the dimerization of the pyrimidine molecule, the light-prompted harm to the DNA and RNA of the microorganism.



**Fig. 5: The setup process of virus decontamination (i) The decontamination box, (ii) The position of UV light source, (iii) The object need to be decontaminated**

Monochromatic low pressure (LP) UV lamps, A wavelength of approximately 260 Nanometers (nm), is emitted that is effective at generating pyrimidine dimers; thus, the virus resistance to such UV inactivation can be increased by the repair mechanism. In recent studies, it has been demonstrated that by damaging both DNA and proteins [12] and generating oxygen radicals [13], polychromatic UV systems (e.g., MP, 200-415 nm) can inactivate microorganisms and results that viruses can be unable to enter the host by monochromatic LP lamps.

Researchers have also been reported that for 4-log virus in- activation, atlantium’s medium pressure (MP) Hydro-Optic™ (HOD) UV technology using real adenovirus was validated per the U.S. EPA guidelines. For the U.S. EPA exacting administrative models of 4-log (99.99 %) virus inactivation, this infection was picked as a base because adenoviruses, presently said to be the most UV-safe class of infections, and utilized as the highest quality level for viral inactivation necessities and the assurance of biosecurity.

**INACTIVATION OF SARS-COV-2**

**A. Inactivation by UV radiation technology**

The transmission of microorganisms happens through different methods, which are not restricted to guide the individual to individual contagion.

Several studies have been reported SARS inactivation by monochromatic UV technology with a wavelength of 254 nm mainly. In literature [14-16], it has found that the required standard UV dose is closer to 100 mJ/cm<sup>2</sup> or even as high as 200 mJ/cm<sup>2</sup> to achieve 4-log inactivation to estimate that SARS-CoV-2 will have the same UV sensitivity while it is needed typically approximately 40 [17] to 60 mJ/cm<sup>2</sup> for inactivation of pathogens.

An enclosed box may be designed where a UV source will be there; the thing which needs to be decontaminated can be placed inside the box. Fig. 5 illustrates the setup of the decontamination process by UV light source from both top and bottom side, ensuring even distribution of UV light over the surface to be decontaminated. This model offers an advantage to avoid any liquid damage while disinfecting particles. The only thing is that one must ensure that the light inside the box should not leak out; otherwise, it may be harmful to human skin or eye area.

### **B. Inactivation by FFR face mask**

Eric Schnell et al. presented a locally-implemented FFR decontamination pathway based on ultraviolet-C germicidal irradiation (UVGI). N95 respirators and surgical masks (face masks) are instances of personal defensive implement intended to accomplish an extremely close facial fit and extremely filtration of airborne particles. The edges of the respirator are intended to frame a seal around the nose and mouth. But due to the increasing nature of global demand, N95 FFRs (Filtering Facepiece Respirators) are currently critically short, which is currently recommended by the Centres for Disease Control and Prevention (CDC) [18].

UVGI decontamination is the possibility that it may cause N95 masks to lose their efficacy because of degradation, and various investigations have addressed this question [20-23].

Recent studies [19-24], [10] state that N95 FFRs can be purified and become a symbol in the fight against the violent coronavirus offers the best safety and are earnestly popular, ought to be saved for human service workers who are working for severe patients.

Prof. Ajay Basil Varghese et al. obtained the UV Sanitizer kit using Ultraviolet germicidal irradiation (UVGI) to make the N95 mask reusable. By applying proper heat and UV light at a certain time, the N95 mask can be re-used up to 3 times. The above process is achieved by Hydrogen Peroxide Vaporization. In the paper [25]

reported and created one viable methodology, N95 FFR disinfecting includes UV-C germicidal irradiation (UVGI) streamlined protocols.

N95 FFRs are made out of different layers of material that are not completely vulnerable by that UV-C portion and contain uneven surfaces that UV-C light may not reach viably because of shadowing. In this manner, the viability of UV-C light in slaughtering viruses associated with mask material was assessed autonomously. The research and engineering firm Applied Research Associates (ARA) performed UV-C validation concentrates on N95 FFRs using the influenza H1N1 virus, similar to SARS-CoV-2, which is an ssRNA wrapped virus. They showed that 1 J/cm<sup>2</sup> was required to decrease the H1N1 virus to an imperceptible range on N95 FFRs [24].

UV-C light is all around approved to give viable decontamination without debasing mask functions. UV-C exposure at portions up to 950 J/cm<sup>2</sup> didn't expand molecule infiltration beyond the 5 % limit for an assortment of N95 FFR models analysed in an earlier investigation [19], and For different FFRs, mask strap strength remained practically flawless at dosages up to 2500 J/cm<sup>2</sup>. In spite of the fact that mask filtration execution isn't fundamentally influenced by UV presentation, various patterns of utilization and purification (>10) reduce strap performance in a certain pattern [24].

According to CDC (The Centres for Disease Control and Prevention) guidelines, the public may not have to use an N95 face mask to shield themselves from respiratory sicknesses, including (COVID-19). Those are basic supplies that must keep on being saved for health care workers. The CDC advised that the general public must use simple cloth face coverings for reducing the transmission of the COVID-19 [26].

### **EFFECTS OF UV IRRADIATION ON HUMAN TISSUE AND CELL**

It is well known that UV irradiation is harming human tissue and especially skin [2]. UVB illumination of skin has been especially all-around considered and is acknowledged as the main cause of skin cancer [27]. Exposure of skin to prolonged UVB irradiation is recommended to maintain a strategic distance by proper utilization of sunscreen and choice of lifestyle [28, 29]. However, it has been noticed that UVB therapy is a viable restorative choice with an excellent safety profile and well-documented side effects [30, 31].

UVC radiation of human skin has been substantially less examined, but at the same time,

is known to cause a similar sort of harm [32]. In proposing to utilize UVC radiation to treat confined contaminations, it is essential to test the impact of UVC to guarantee that unacceptable harm isn't delivered.

## CONCLUSION

At the point when confronted with a pandemic, for example, SARS-CoV-2, ideal hazard evaluation and activity are required to prevent the spread of the infection. Until this point, UVC radiation has been compelling against all coronaviruses. Additionally, these circumstances highlight the importance of alternative technology, ultra-violet (UV) technology, for disinfection by exposing bacteria, viruses, and protozoa to UV light. An approved UV technology, for example, the Atlantium's HOD UV with the 4-log virus inactivation, is a reasonable non-chemical treatment option to secure water sources from SARS-CoV-2. This paper also outlines a concept of Ultraviolet germicidal irradiation (UVGI) to make the N95 mask reusable.

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