



# Study on Coronavirus (COVID-19) and how UVC Light helps to Destroy it and its Applications

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**Abstract – The novel corona virus that causes coronavirus disease 2019 or also called COVID-19 is a kind of positive-sense single-stranded RNV virus, same as the SARS and MERS virus. This is a highly infectious disease and spreads rapidly in the community worldwide. On 30 January 2020, Coronavirus outbreak was declared a Public Health Emergency of International Concern. In this pandemic situation where the novel corona virus continuously spreading day by day worldwide, the researcher are focused on finding new ways to destroy the coronavirus. Because airborne transmission appears to plays an important role in the spread of coronavirus, UV light would be able to destroy the novel corona virus when exposure to UVC irradiation stronger than  $90 \mu\text{W}/\text{cm}^2$ . Devices using UV light, emits high-intensity rays could help to kill the novel coronavirus. In order to kill the novel corona virus, very high levels of ultraviolet light is required ranges from 200 to 300 nanometer. In this paper we will highlight the various application of UV light to kill the viruses and protect from disinfection areas contaminated from the novel corona virus (COVID-19). We will also highlight the basic study on coronavirus and how it was outbreak worldwide in the year 2020.**

**Keywords-** Covid-19, types of human viruses, symptoms, structure, prevention, UVC Light, various applications.

## I. INTRODUCTION

Coronavirus is not new. It is a common type of virus that causes an infection in human nose, sinuses, or upper throat. Some type of corona viruses are not dangerous but some types of coronaviruses are dangerous. It is a group of RNA virus. It causes diseases in birds and mammals. Corona virus is from the family of *Coronaviridae* and subfamily of *Orthocoronavirinae*.

On 31 December 2019, a pneumonia of unknown cause detected in Wuhan, China was first reported to the WHO Country Office in China. On 30 January 2020, the outbreak was declared a Public Health Emergency of International Concern. On 11 February 2020, WHO announced a name for the new coronavirus disease as “coronavirus disease (COVID-19)” [1].

In this pandemic situation where the corona virus (COVID-19) can be transmitted directly from person to person by respiratory droplets, evidence suggested that it is transmitted through contact and fomites [2].

Droplets which are generated when an infected person coughs, sneezes, or exhales that are too heavy to hang in the air, and these droplets quickly fall on floors, surfaces and other areas. Person can be infected within close proximity or by touching a contaminated surfaces and then touching the eyes, nose or mouth.

In the event of the pandemic spread of highly infectious disease , which has shown a confirmed cases of COVID-19 as on 26 June 2020 are 9,473,214 including 484,249 deaths, reported to WHO [3]. For these reasons, new technologies are needed to prevent the transmission of COVID-19, in which one of the most effective technology is Ultraviolet (UV) irradiation. It would be able to destroy the novel corona virus when exposure to UVC irradiation stronger than  $90 \mu\text{W}/\text{cm}^2$ . In order to kill the novel corona virus, very high levels of ultraviolet light is required ranges from 200 to 300 nanometer. Therefore, the aim of this research paper is to highlight the various application of UVC light to kill the viruses and protect from disinfection areas contaminated from the novel corona virus (COVID-19). We will also highlighted the basic study on coronavirus and how it was outbreak worldwide in the year 2020.

## II BASICS INTRODUCTION OF VIRUSES



Viruses are very minute infectious agents, which are made up of genetic materials such as DNA or RNA. Viruses work by hijacking cells in the body. They enter host cells. They can then spread to new cells around the body. There are two groups of viruses are DNA virus and RNA virus.

DNA Viruses include herpesvirus, parvovirus and papillomavirus. These viruses use DNA as their genetic material whereas human diseases causing RNA viruses include Orthomyxoviruses, Hepatitis C Virus (HCV), Ebola disease, SARS, influenza, polio measles and retrovirus including adult Human T-cell lymph tropic virus type-1 (HTLV-1) and human immunodeficiency virus (HIV). These viruses have RNA as their genetic material and they are also known as retrovirus. Usually when these viruses enter host cells they convert RNA into DNA and uses enzyme to insert retroviral DNA into genome of host cell.

### III Corona virus

Corona virus is a group of RNA virus. It causes diseases in birds and mammals. Corona virus is from the family of *Coronaviridae* and subfamily of *Orthocoronavirinae*.

#### III.I Human Corona virus

Human corona virus was discovered in between 1960s to 1970s. These viruses had a common appearance when visualized with the electron microscope.

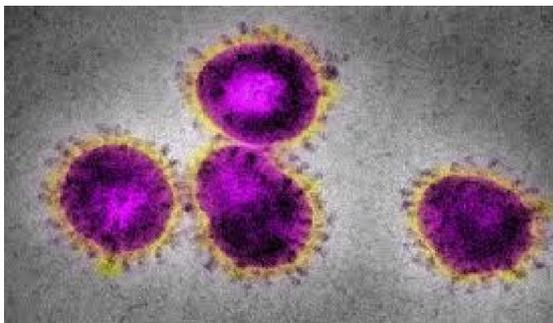


Fig 1- Corona virus under microscope  
Source- <https://www.newscientist.com/term/coronavirus>

They were enveloped viruses, approximately 120 nm in diameter, and showed that they had large (20 nm), club shaped surface projections (spike protein, S) [4].

#### III.II Human Corona virus Types

Mainly four type of human coronaviruses through which people infected around the world are [5]: 229E (alpha coronavirus), NL63 (alpha coronavirus), OC43 (beta coronavirus), HKU1 (beta coronavirus). But sometimes coronaviruses that infect animals can evolve and make people sick and become a new human coronavirus that can infect people are: 1. MERS-CoV is

the Middle East Respiratory Syndrome corona virus. 2. SARS-CoV is the severe acute respiratory syndrome corona virus. SARS-CoV-2 is the novel corona virus that causes corona virus disease (COVID-19) [5].

#### III.III What is (COVID-19)?

Corona virus disease (COVID-19) is an infectious disease caused by a newly discovered corona virus.

Many of the people who are affected with this diseases will either not have any of the symptoms or will have very mild symptoms, that can be cured without any special medical treatment. Elder people or those who have severe illness such as cancer, cardiovascular diseases, diabetes and chronic respiratory diseases are most likely to suffer from a serious illness and this virus can also become the reason of death in them. In humans; COVID-19 virus has symptoms such as fever, shortness of breath, coughing, sore throat.

#### III.IV Structure of corona virus

SARS-CoV2 has a spherical structure and contains proteins called spikes which are protruding from their surface, which attach with human cells and then further their structure changes, which allow the viral membrane to fuse with cell membrane. The viral cells then produce more viruses. SARS-Cov-2 spikes bind with the receptors on human cell surface. The average size of virus particle is about 125nm.

#### III.V (COVID-19) OUTBREAK

In December, 2019 first case of a respiratory infection was reported in Wuhan, China. The source of that infection was identified as a novel corona virus, related to those that had caused outbreaks of Severe Acute Respiratory Syndrome (SARS) from 2002-2004 and Middle East Respiratory Syndrome (MERS) in 2012 [6]. By early March 2020, novel corona virus, also known as SARS-CoV2 was declared a pandemic outbreak which had infected over 90,000 people worldwide and caused deaths of at least 3,000 peoples.

On 26 June 2020, WHO reported 9,473,214 confirmed cases of COVID-19 including 484,249 deaths [6].





Fig 2-Dashboard of covid-19 outbreak  
Source: <https://covid19.who.int/>

#### IV. IMPORTANCE OF UVC LIGHT TO KILL THE CORONA VIRUS

The corona virus is single stranded RNA virus. This virus is same as SARS and MERS viruses. Previous researches on SARS virus have found that it is sensitive to UVC light and heat radiation and can be diminished when exposure to UVC irradiation stronger than  $90 \mu\text{W}/\text{cm}^2$  [7]. So we can say that UV light can help to destroy nCoV-2019.

UV light would be able to kill germs, bacteria and viruses by destroying nucleic acids of microorganisms and disrupting their DNA. This light is a short-wavelength light ranges from 200-280 nm, that breaks DNA, which can't able to be further reproduce the virus.

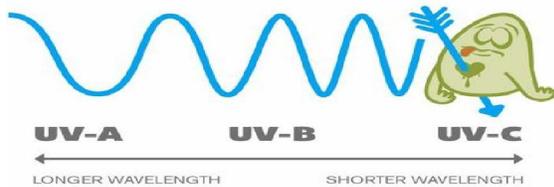


Fig 3 – UVC light kills corona virus  
Source: <https://www.phonesoap.com/pages/faq-uv-c-light-technology>

The UV radiation is in between 200 to 300 nm range which can destroy the virus. So as in current pandemic situation this UV light is in demand but it requires more sources/dosages of light that works fastly or efficiently in this situation.

Based on the available scientific evidence it is found that the UVC light can destroy various viruses. The National Academies of Sciences, Engineering and Medicine reported that ultraviolet light can almost kill the corona virus. This includes the Middle Eastern respiratory syndrome corona virus, (MERS-CoV). So MERS can further act as respiratory syndrome or SARS. [8].

By testing we can identify the dose that how much requirement of UV-C from which we kill the virus. The type of light as a disease-fighter, recommending the light UVC.

#### V. WHAT IS UV LIGHT?

UV light is a type of electromagnetic radiation that makes black-light poster glow and it comes under region of visible light and x-rays.

Sun produce UV light which is of only 10% and rest of the light goes in atmosphere to reach ground the UV radiation that reaches the earth, in which 95 percent is UVA and five percent is UV-B (320-400 nm), which are less harmful and closer to the visible spectrum of light are what pass through. These rays are responsible for giving you sunburn. UV-C light of specifically 254 nm in wavelength has been used to sanitize devices and kits for a while. However, exposure to humans for a long period can cause skin cancer. UVC light is germicidal, so the atmosphere blocks this because it is harmful for eyes also.

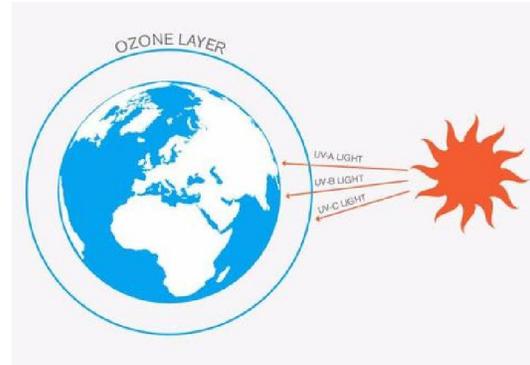


Fig 4 – UVC light blocked by ozone layer  
Source: <https://www.phonesoap.com/pages/faq-uv-c-light-technology>

UV Light spectral ranges from 100 nm to 400 nm is divided into four different UV band are: long-wave, medium-wave, short-wave and Vacuum UV band (as shown in fig.). long-wave are used for UVA band from 315 to 400 nm, medium-wave are used for UVB band from ranges from 280 to 315 nm, short-wave are used for UVC band ranges from 200 to 280 nm and the Vacuum UV band is used for ranges from 100 to 200 nm. In these bands, only UVC range from 200-280 nm are used for light is used for disinfection.

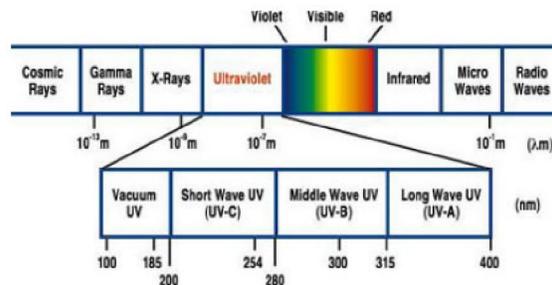


Fig 5-Electromagnetic spectrum falls in region between visible light and X-Rays

#### VI. VARIOUS APPLICATIONS OF UVC LIGHT TO DESTROY CORONA VIRUS

In the situation of COVID-19, where the researchers are finding new ways to kill coronavirus ultraviolet light seems to be a strong contender. The Ultraviolet light ranges between 200-280



nm wavelength which is known as UV-C light and is able to kill coronavirus.

Given this effectiveness of deactivating viruses and bacteria, many companies are building many devices that uses UV-C light to sanitize spaces. In New York, the government is sanitizing buses and trains at depots using UV lights. Hospitals plan to install UV-C lights at ceiling height and install fans that draw up air from below to that height to destroy viruses and bacteria. Other companies are making boxes and cupboards with UV-C light in them to sanitize personal protective equipment and other items [9].

Some applications to kill the coronavirus with the help of UV-C light ranges from 200-280 nm are:

1. Using UV light robots and lamps could help protect against corona virus

UV light can helps to kill the corona virus. Like in hotels, robot creates a high-energy pulse of UV light which create very high intensity which gets into the DNA and the RNA, the genetic material of viruses and bacteria, and basically makes it so they can't replicate anymore". After few seconds viruses and bacteria will kill which is of very high energy photons.



Fig 6- A Xenex ultraviolet light robot patrols the halls of a hospital in this undated photo.

Source:<https://abcnews.go.com/Health/hotels-uv-light-robots-lamps-protect-coronavirus/story?id=71205829>

The San Antonio-based company Xenex Disinfection Services make their own robot named KENNEDY [10]. Using these robots, after two minutes of exposure to the UV light at one-meter distance, about three feet, the virus was eliminated by 99.999%.

2. Using ultraviolet light emitting diode (UV led's)

Ultraviolet (UV) LEDs have many applications in the field of water treatment, optical data storage, communications, biological agent detection and polymer curing [11]. The UVC region uses in the case of disinfection, the optimum wavelength

between 260 nm to 270 nm, with germicidal efficacy falling exponentially with longer wavelengths.

UVC LEDs offer many advantages such as: more durable, lower heat consumption, they contain no hazardous material, they can be switched on and off instantaneously and directed heat extraction.

With improved development in LED technology, UV led tunable wavelengths are expected to be the next generation disinfection products for medical uses because tunable LEDs can deliver UV lights with specific wavelengths.[12].

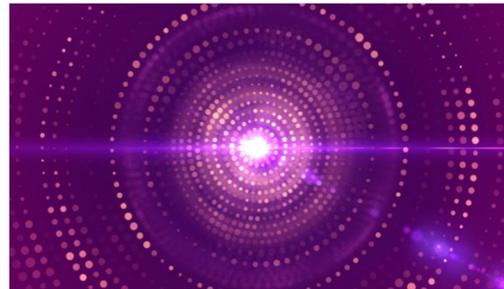


Fig-7 UV LIGHT EMITTING DIODE

Source:[https://www.ledinside.com/news/2020/2/uvled\\_coronavirus](https://www.ledinside.com/news/2020/2/uvled_coronavirus)

3. Using Autonomous Robots in Hospitals

Robots that can efficiently disinfect hospitals using UV light could slow corona virus infections



Fig 8- UVD Robots

Source:[https://www.google.co.in/search?q=uvd+robots&source=lnms&tbm=isch&sa=X&ved=2ahUKEwizq5C6\\_p7qAhWWf30KHUTjDkUQ\\_AUoAnoECA4QBA&biw=1366&bih=667#imgrc=ym7vVh27ht\\_m\\_WM](https://www.google.co.in/search?q=uvd+robots&source=lnms&tbm=isch&sa=X&ved=2ahUKEwizq5C6_p7qAhWWf30KHUTjDkUQ_AUoAnoECA4QBA&biw=1366&bih=667#imgrc=ym7vVh27ht_m_WM)

Hundreds of these ultraviolet disinfection robots are being shipped to China to help fight the corona virus outbreak.



UVD Robots is a Danish company who makes robots that disinfects patient rooms and operating theaters in hospitals. Robots disinfects everything which you touch the things or anywhere you point out the thing it disinfects, in which every robot is a mobile array of powerful short wavelength ultraviolet-C (UVC) lights which emit enough energy to literally shred the DNA or RNA of any microorganisms.

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The robot's UV array emits 20 joules per square meter per second (at 1 meter distance) of 254-nanometer light, which will utterly wreck 99.99 percent of germs. The process of robot disinfecting is more consistent than human sterilizing.

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