UV ANGEL AIR™ PRODUCT OVERVIEW

UV Angel Air Background:

UV Angel Air is an environmental treatment system in a traditional light fixture design. In the arsenal of infection prevention, ultraviolet lights are used throughout healthcare and other environments to neutralize microorganisms on surfaces, in water and in the air. Unlike other devices, UV Angel Air may be safely used in occupied rooms, allowing for 24 hours per day of shielded ultraviolet germicidal irradiation (UVGI). This patented device uses fans to draw room air through a filter into a hidden UV-C neutralization chamber (also known as an infection control chamber) mounted inside a standard ceiling panel light fixture. The treated air is then returned to the room as the cycle continues. Laboratory tests and mathematical modeling show elimination rates approaching 100% against more than 80 serious disease-causing pathogens.

UV Angel Air Suitable Applications:

UV Angel Air is suitable for healthcare facilities or other locations where clean air is vital. Ideal locations include: hospitals, urgent care centers, outpatient surgery centers, physicians' offices, dental clinics, plastic surgery centers, long-term care facilities, cancer centers, dialysis centers, schools, prisons, food processing plants, animal research facilities, commercial buildings, airport isolation rooms, border quarantine stations, and compounding pharmacies.

Airborne Pathogens:

Pathogens may become aerosolized (made airborne) a number of ways, including coughing, sneezing, HVAC operation, staff moving room to room or even shaking of bed linens. A number of medical procedures are also prone to the creation of airborne particles. Most microorganisms eventually settle on surfaces, creating the risk of transmission by touch. A presentation from Paul Baron, Division of Applied Technology, NIOSH, CDC, titled "Generation and Behavior of Airborne Particles (Aerosols)," lists the settling time for particles by various unit density spheres. Most infection -causing bacteria and viruses take between 1.5 hours to more than 41 hours (nearly two days) to settle five feet in still air. Any fan-driven HVAC system creates turbulence which keeps these pathogens in the air for longer periods of time. In addition, resuspension of surface microorganisms may occur through any activity that disturbs room air, such as walking or surface cleaning. Research has shown that reducing contamination in the air also reduces bacteria and fungus on settled surfaces. Hospital air samples, on average, are up to 8 times more contaminated than surfaces.[1]

Surface Recontamination from the Air:

Surface treatment is an excellent weapon in the fight against healthcare-associated infections (HAIs). However, according to a 2012 study by the University of Leeds, coughing, sneezing or simply shaking bed linens can contaminate the air and in turn, recently cleaned surfaces. UV Angel Air continually treats the air and eliminates pathogens at the source. In another study conducted by the University of Leeds, it was found that air samples collected around patients being treated for Clostridium difficile with active symptoms showed that 70% of the samples tested positive for C. difficile. This study also found that 90% of the care environments tested positive for surface contamination and 60% tested positive for both air and surface contamination.[2]

1Lee, Linda D, DrPH, MBA, LV-17-C042, Can using active air UV-C technology reduce the amount of bacteria and/or fungus in the air and improve indoor air quality? ASHRAE Conference (2017)
2 https://www.ncbi.nlm.nih.gov/pubmed/20415567?dopt=Abstract

Prior Room Occupancy Increases Risk

Study	Healthcare associated pathogen	Likelihood of patient acquiring HAI based on prior room occupancy (comparing previously 'positive' room with a previously 'negative' room)
Martinez 2003 [7]	VRE - cultured within room	2.6x
	VRE - prior room occupant	1.6x
Huang 2006 [8]	MRSA - prior room occupant	1.3x
Drees 2008 [9]	VRE - cultured within room	1.9x
	VRE - prior room occupant	2.2x
	VRE - prior room occupant in previous two weeks	2.0x
Shaughnessy 2008 [10]	C.difficile - prior room occupant	2.4x
Nseir 2010 [11]	A.baumannii - prior room occupant	3.8x
	P. aeruginosa - prior room occupant	2.1x

Pathogen Survival Rate Chart

Organism	Survival period
Clostridium difficile	35 - >200 days
Methicillin resistant Staphylococcus aureus (MRSA)	14 - >300 days
Vancomycin-resistant enterococcus (VRE)	58 - >200 days
Escherichia coli	>150 - 480 days
Acinetobacter	150 - >300 days
Klebsiella	>10 - 900 days
Salmonella typhimurium	10 days - 4.2 years
Mycobacterium tuberculosis	120 days
Candida albicans	120 days
Most viruses from respiratory tract (eg, corona, coxsackie, influenza, SARS, rhino virus)	Few days
Viruses from the gastrointestinal tract (eg, astrivirus, HAV, polio- or rota virus)	60 - 90 days
Blood-borne viruses (eg, HBV or HIV)	>7 days

SCIENTIFIC ITEMS

Performance/Validation Studies:

UV Angel has conducted two separate laboratory protocol tests by an independent third party against surrogate pathogens including Escherichia coli (gram negative), Staphylococcus aureus (gram positive), Cladosporium cladosporioides (fungus spore formers) and MS2 Bacteriophage (MS2) (virus surrogate). The use of surrogates in laboratory testing helps to support UV Angel's claims to treat bacteria, fungi and viruses in the air. The gram-negative surrogates support the claim that UV Angel Air can effectively treat organisms such as pseudomonas, klebsiella and acinetobacter. Gram negative pathogens can cause pneumonias, bloodstream infections, wound and surgical site infections. The gram-positive surrogates include staphylococcus, streptococcus, enterococci and listeria. Spore forming fungal surrogates include both vegetative and spore forming organisms and are quite hardy. Examples of these include aspergillus, yeasts, and histoplasmosis. UV Angel strategically chose MS2 as a viral surrogate as it can be safely aerosolized in a test chamber, captured in impingement flasks and cultured. The MS2 bacterial phage is closely related to single strand RNA viruses such as influenza, polio and measles. The UV Angel Air showed elimination rates ranging from 90% to 99.99% against the four test surrogate pathogens.

HVAC Comparison:

Most pathogens come into the room by way of people and their possessions. Healthcare workers go room to room and can carry pathogens with them. Patients bring their personal items to the hospital from home. Most pathogens are not being delivered to the room from the HVAC system. Due to the very high velocity of air in most commercial HVAC systems (e.g. 400 to 1,000 cfm) it is difficult to design UV systems for high-volume air handlers. It is impractical to effectively treat the air-stream and produce very high elimination rates against airborne pathogens for each individual room. As such, UV in air handlers is generally not an effective method for eliminating pathogens shed by infectious patients or from environmental sources found in commercial building air streams. Properly installed UV light systems, along with a strict filter change regimen, reduce the potential for growth from occurring within the air handler. Conversely, UV Angel Air was designed to provide the intensity of UV-C light for sufficient duration (i.e. 50 CFM air flow) to eliminate pathogens where they are being generated in the room or at the bed side.

HEPA Filtration Comparison:

HEPA filters are used in conjunction with the HVAC system. As a result, to be effective the air must pass through the filter, either via the supply or return ductwork. To be clear, filtration is one of the four hierarchies of defense recommended by the CDC in combating HAIs and certainly should be used in healthcare environments. Pathogens are introduced to a space in two primary ways: through outside air, or by humans shedding pathogens, either by breathing or contact by peoples clothing, fomites or their belongings. UV Angel Air treats the air within the space and is independent of the HVAC system. As a result, UV Angel Air can reduce pathogens before they enter the air filtration system.

Listing:

All versions of UV Angel Air are UL listed.

EPA FIFRA:

UV-C devices are subject to EPA establishment registration and labeling requirements of a pesticide device. UV Angel Air device is produced in an EPA registered facility and meets the EPA labeling device requirements of 40 CFR 156.

TECHNICAL/ENGINEERING

Differential Pressure:

The fan array in UV Angel Air creates differential pressure to draw an average of 50 cubic feet per minute through the system. UV Angel Air does not affect existing HVAC operation in any way. It simply treats air in the neutralization chamber and returns the air to the room, having no impact on positive or negative room pressure. For optimum efficiency, the UV Angel Air unit shouldn't be placed too close to the supply or return of the HVAC system.

Cycle Times:

UV Angel Air works 24/7, constantly circulating and treating the air. The fans move the air at 50 cubic feet per minute (cfm), providing a 10' x 10' room with an 8-foot ceiling the theoretical equivalent of almost four air cycles per hour (i.e. 800 cf of air every 16 minutes) equivalency.

Installation:

UV Angel Air replaces standard 2' x 4' fluorescent or LED fixtures. A second dedicated circuit, independent of the room light switch, is required. This circuit allows the unit's 24-hour operation of the infection control treatment chamber. Please refer to the installation manual for detailed instructions.

Maintenance:

The UV-C lamp and the MERV 6 filter should be changed annually. The UV-C Lamp has a nominal life of 9,000 hours. Intensity depreciation at the rated life for the UV-C lamp is 15%. Therefore, it is recommended to change the lamp annually to maintain UV-C efficiency and avoid any end-of-life failures. Please refer to the maintenance section within the installation manual for detailed instructions.

Filter:

The UV Angel Air fixture uses a MERV 6 filter to capture dust ahead of the infection control chamber. The dust-free air helps maintain the efficiency and intensity of the UV-C lamp. The MERV 6 filter and UV-C bulb should both be changed annually. The MERV 6 filter collects dust but allows most smaller particles such as pathogens to pass through to the UV-C chamber or infection control chamber to be neutralized. In environments that create or generate high dust loads, the filter may require semi-annual or quarterly changes.

UV-C Lamp:

The Ultraviolet lamp produces 27 Watts of UV-C energy at a wavelength of 254 nanometers, the ideal wavelength to neutralize microorganisms by inactivating their DNA. Pathogens are neutralized based on the time and intensity of exposure to UV-C radiation.

Energy Usage:

UV Angel Air comes standard in LED downlight configuration. The UV chamber and fans consume approximately 120 watts. Total system wattage is about 170 watts for UV Angel Air including the LED downlight. By comparison, a standard 4 lamp T8 fluorescent lighting fixture consumes about 120 watts.

Kelvin Temperature:

The standard Kelvin temperature for UV Angel Air is 4000K. The UV lamp is not designed as a lumen-producing lamp and is not visible during operation.

Decibels:

The UV Angel Air system has been tested to 42 decibels. The fans are above the ceiling line and enclosed within the system, behind a doorframe and filter, lowering the overall noise level. A recent study found the average sound level at hospitals to be 48 decibels.

Filter Disposal:

The MERV 6 filter (Minimum Efficiency Reporting Value) is a high-airflow filter, designed to trap dust and large air particulates. Most pathogens have much smaller micron sizes and are intended to flow through the filter. This filter should be disposed of with the same protocol that facilities dispose of any other high airflow filter currently in use. This filter is similar to the filters that are currently used in HVAC systems.

UV-C Lamps Disposal:

Disposing of UV-C lamps requires following local, state and federal requirements for universal waste. Most healthcare and commercial buildings have recycling programs in place for the fluorescent lamps they use. The lamp recycling vendor can provide containers to collect and recycle the UV-C lamps.

Another option is to contact your commercial disposal service, as waste removal procedures vary by municipal code. They will either tell you how to recycle the lamps or instruct you on where to dispose of them.

Power Options:

The system is designed for universal input voltage. The fixture can be operated from a single power source that currently operates the existing lighting system, with the required addition of a separate power input to power the 24/7 UV Chamber.

Electrical Requirements:

UV Chamber

Input Voltage:	120-277 VAC
Power Ratings:	120 VAC @ 1.1 Amps
	277 VAC @ .46 Amps

LED Lighting

Input Voltage:	120-277 VAC
Power Ratings:	120 @ .52 Amps
	277 @ .23 Amps

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