Summary of Features

UVAS

(Ultraviolet Area Sanitizer)

Summary of features

This document describes briefly a method and device for bacterial, fungal and/or viral sterilization, and is more particularly directed to a method and device for sterilizing rooms and similar enclosed areas. The information enclosed is confidential and the exclusive property of UVAS, LLC.

Background of the Invention

Nosocomial, or hospital acquired, infections are common, costly, and sometimes lethal. The nature of bacteria acquired in the hospital setting differs significantly from bacteria found in a community setting primarily in their resistance to antibiotic therapy.

> "Historically, staphylococci, pseudomonads, and Escherichia coli have been the nosocomial infection troika; nosocomial pneumonia, surgical wound infections, and vascular access-related bacteremia have caused the most illness and death in hospitalized patients; and intensive care units have been the epicenters of antibiotic resistance. Acquired antimicrobial resistance is the major problem, and vancomycin-resistant Staphylococcus aureus is the pathogen of greatest concern.

> The shift to outpatient care is leaving the most vulnerable patients in hospitals. Aging of our population and increasingly aggressive medical and surgical interventions, including implanted foreign bodies, organ transplantations, and xenotransplantation, create a cohort of particularly susceptible persons. Renovation of aging hospitals increases risk of airborne fungal and other infections.[1]"

Significant morbidity, mortality, and costs are associated with these infections. Many factors contribute to these dangerous infections. Most notably are the overuse of antibiotics and poor personal hygiene such as hand washing. Abundant evidence exists, however, that the hospital environment itself contributes to the problem by harboring virulent strains of bacteria, fungi, and viruses, and that many methods commonly used are ineffective and may actually spread contaminants. **Additional need exists for remediation of biological contamination, both accidental and as a result of acts of war or terrorism.**

Attempts to eradicate surface contaminates from the hospital setting have varied greatly in strategy and success. These have ranged from antiseptic soaps to fumigation with formaldehyde gas. Topical antiseptics are problematic for several reasons. First, they have recently been shown to actually induce antibiotic resistances and thus may be adding to the problem. Secondly, many surfaces such as keyboards, television sets, and monitoring controls are difficult if not impossible to decontaminate with liquid

[1] Nosocomial infection update.
Weinstein RA
Cook County Hospital, Division of Infectious Diseases, Chicago, IL 60612
Emerg Infect Dis 1998 Jul-Sep;4(3):416-20

disinfectants without harming the electronics. **Gas disinfection, while effective, is time consuming, hazardous to workers, and environmentally unwise**[2].

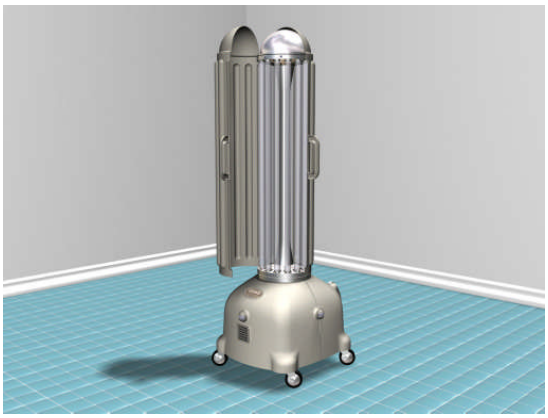
Ultraviolet (UV) light has been long used for disinfection and sterilization. Recently, the widespread availability of low to medium pressure mercury bulbs has led to the development of devices that use UV-C (also called UVGI) to decontaminate water supplies. UV-C is a high frequency wavelength of light within the ultraviolet band and has been shown to be the most bactericidal type of ultraviolet light. UV-C is primarily generated in this case at 254 nanometers. UV-C differs significantly from other forms of ultraviolet light in both its hazardous potential for human exposure and its germicidal activity. To date, there are no published efforts to use UV-C to decontaminate or disinfect larger areas such as operating rooms. The only recent availability of the appropriate bulbs as well as significant safety concerns regarding worker exposure to UV-C likely contribute to the lack of efforts to use UV-C outside of self-contained water purification systems.

Summary of the Invention

The ultraviolet area sterilizer of the present invention (UVAS) is a mobile, automated room sterilizer or decontamination device. Stationary units would use the same techniques and strategy and could be built into the room itself. The UVAS is positioned in a room, such an operating room or intensive care unit or a space which has been the target of a biological warfare attack. A wireless remote control is used to

[2] ***Performing surface and room disinfection in the hospital.*** Durchfuhrung der Flachen- und Raumdesinfektion im Krankenhaus. Rehork B; Martiny H; Weist K; Ruden H. Institut fur Hygiene der Freien Universitat Berlin. Gesundheitswes 1990 Jan;52(1):36-45 "Area disinfection methods under dispute were discontinued for medico-toxicological and environmental hygiene reasons."

activate the device. For an initial interval after actuation, motion detectors sense movement, to assure that personnel have evacuated the space to be sterilized. Subsequently, a bank of mercury bulbs activates and generates intense levels of UV-C.



After the bulbs are activated, an array of UV-C sensors scans the room, and determines the darkest area, or the area reflecting the lowest level of UV-C back to the sensors. An onboard CPU in the device calculates the time required to obtain a bactericidal dose of UV-C reflected back from darkest area. The UVAS transmits the calculated dose of UV-C, as well as other monitoring information, to the remote control where it is displayed to the user. Once a bactericidal dose has been reflected to all the sensors, the unit notifies the user and shuts down. **By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an exposed wall or ceiling. This strategy provides for decontamination of areas in relative shadow and not in direct line of sight of the device.**

The first prototype of this patent pending device was built in 1997. A device patent was awarded in December, 2004. Patents are pending the method of area sterilization.

The dosing time is dependent upon the species and room qualities such as size and reflectivity. Vegetative organisms can be eradicated in some rooms in less than ten minutes. Spore forming organisms such as anthrax take longer. The device adapts itself to practically any size or configuration of rooms. In some situations, more than one unit will

be required to decontaminate a large or geometrically complex space. Also, additional remote sensors can be attached for special situations where concern exists that the permanently attached sensors may provide inadequate information to predict germicidal levels of UVC. These sensors communicate with the main unit and may be placed in the area of greatest concern. The device then will be able to measure levels to this area and therefore assure adequate dosing of UVC.

Power output from the UVAS is around 3000 microwatts/cm^2 at one meter and is the greatest amount of UV-C that can be generated from a single twenty amp circuit. Greater intensity can be generated in spaces with special, higher amperage circuits or by the use of multiple units drawing from separate electrical circuits.

Upon completion of the cycle, the unit has sterilized all the exposed surfaces within the room, including the primary shadows such as the back or wall side of all rails, cabinets which are not against the wall, and tables.

Trials of the UVAS in actual operating rooms and endoscopy suites and exam rooms as well as simulated trials have been performed. At direct exposure from two meters, the unit is able to reduce colony counts of common hospital pathogens by a minimum of 99.9% in one minute and achieved sterilization of most bacteria species in less than 10 minutes. Other trials have demonstrated sterilization of areas in relative shadow (not in line of sight of the device) in less than 15 minutes in an actual patient examination rooms and Intensive Care Units. Recently completed trials at the Armed Forces Radiobiological Research Institute have demonstrated this ability of this device to

decontaminate against anthrax spores in a form such as would be found in a bioterror attack.[3]

The Ultraviolet Area Sterilizer self monitors bactericidal levels. Reflected doses of UV-C are measured, and the device remains activated until bactericidal levels are received. This ensures that areas in relative shadow and not in direct line of sight with the unit are sterilized or decontaminated. Also, the unit can be set to deliver whatever dosing is required to decontaminate against whatever species is suspected.

Without adequate safety features, daily use of intense UV-C is dangerous and impractical. The device may be fitted with motion detectors which assure the room is vacant of personnel prior to activation. Wireless sensors are available (recommended) for additional door, window, or other entry monitoring devices that special situations may dictate. Once activated, the unit shuts down instantly when motion occurs anywhere in the room being sterilized. If the UVAS loses two-way communication with the remote control it also shuts down

The UVAS is able to sanitize or sterilize all exposed surfaces in a room. It is able to do so safely, leave no residual toxins or radiation, and generates no adverse environmental side products. In addition, the UVAS is able to notify the user of the time required to perform this task and automatically shuts down upon completion of sterilization. UVAS, LLC and an independent laboratory have performed tests to prove the efficacy of the UVAS, all of which have been successful.

[3] High-Dose Ultraviolet C Light Inactivates Spores of Bacillus Atrophaeus and Bacillus Anthracis Sterne on Non-Reflective Surfaces'. Marie U. Owens, Michael O. Shoemaker, Gregory B. Knudson, Janet E. Meszaros, Jeffery L. Deal. November 2005, *Applied Biosafety.*

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