THE TOOLS FOR ROOM DISINFECTION
Choose them based on the tests

UV light is a reliable and well-researched antimicrobial technology. It mainly works by destroying the DNA inside bacteria, viruses, and fungi. The high-energy portion of the UV spectrum called UV-C is the most effective (200-280 nm). UV-C light has been used for decades to disinfect industrial surfaces and disinfect drinking water. It is particularly beneficial for use in hospitals because it kills the spore-forming bacterium Clostridium difficile, which is a major source of hospital-acquired infections.
Indoor UV disinfection systems were first introduced in US hospitals around 2007. Since then, popularity has increased because they disinfect virtually all surfaces in a room at once, with minimal labor and no hazardous chemicals. Companies with roots in chemical disinfection have also entered the whole room UV disinfection market.
Several companies manufacture and sell room UV disinfection devices. The machines are available in a variety of configurations. Most are designed to be carried around a room, used, then taken outside; some have recently introduced a fixed UV device designed to be mounted on a wall. Many devices produce UV light using either mercury UV bulbs that run continuously or pulsing xenon UV bulbs. Mercury UV bulbs mainly emit light at 254 nanomers, while pulsed xenon UV bulbs emit UV light at different germicidal wavelengths. The most efficient and modern, use Germicidal LEDs, without mercury and therefore more respectful of the environment.
The shapes, sizes and features of UV environmental disinfection devices vary. Most are the size of a small refrigerator or office water cooler. Some work for short periods of time while others last longer (the life span of a germicidal LED is about 100,000 hours, while for a bulb lamp about 10,000 - 13,000 hours). Some devices work as long as the UV sensors placed in the room measure a particular UV dose. Some have mirrors that focus UV light as the beam rotates around the room. Some are digitally controlled by touch screens, while others are simpler analog devices. Many have motion sensors that automatically turn off the device if a person enters the room during treatment. All UV-C devices kill microorganisms to some degree, but with so many different configurations, features, run times, and UV wavelengths it can be difficult for buyers to determine their effectiveness. The purpose of this short document is to help users and buyers understand how to properly evaluate the effectiveness of UV devices.

How are the uv disinfection devices for environments regulated?
In the US, the United States Environmental Protection Agency (EPA) is the primary regulator of chemical pesticides and pesticide devices, although the FDA and several US states also participate. The EPA defines microorganisms as parasites, disinfectants as pesticides, and disinfectant devices as pesticide devices. Pesticide devices are not subject to pre-market approval by the EPA, although the EPA requires that data supporting efficacy be kept on file. Companies that manufacture UV devices must register with the Agency, then report how many units are sold each year thereafter. The EPA typically does not review or approve data to support the performance of UV devices before they are sold, so it is up to infection control professionals and hospital buyers to ensure that the machines are killing microorganisms as promised. Careful consideration of the manufacturer's claims is needed to ensure that UV devices offer the real benefit: reduction of contracted infections.

How are the performance of a uv disinfection device determined?
Listed below are the main ways UV device companies confirm performance:
· Dose-response models, in which the dose of UV is measured, then used to estimate the efficacy of the device in hospitals.
· Tests conducted in microbiology laboratories, where the kill rate is measured for various pathogens under strictly controlled conditions.
· Environmental effectiveness test, in which the environments are buffered before and after the UV treatment.
· Clinical outcome studies, in which the reduction in infection rates resulting from the use of the UV device is calculated.

Not all efficacy data are equally reliable. The remainder of this paper describes each category in detail, as it relates to the marketing and use of UV room disinfection devices.

DOSE-RESPONSE MATHEMATICAL MODELS AND UV DOSE METERS (dosimeters)

In general, UV disinfection is a function of the UV dose. The correlation is "logarithmic", which means that a line is formed when microbial populations are plotted on a logarithmic scale at various treatment intervals. For example, if a study were to start with one million microorganisms on a test surface, it could show 100,000, then 10,000, then 1,000 viable cells after being treated with UV light for 10, 20, and 30 minutes.

The direct relationship between UV dose and disinfection is good and bad: it allows smart UV companies to build accurate dose response models for their machines, but causes less sophisticated UV companies to think that laboratory tests are not needed until they have a way to measure or estimate the dose of UV.

UV dosimeters have found a variety of uses in UV disinfection of rooms. Some companies use UV dosimeters to "prove" that their device has disinfected a room. Other companies use UV dosimeters to tell the device when to turn off.

Predictions based on UV dose measurements are only as accurate as the dose response model used to make the prediction. Using data from even slightly dissimilar studies (different device, different bulb, different surface type, etc.) can make predictions unreliable. Therefore, an additional check should be applied to efficacy claims based solely on dose-response models, especially if the source data serving as the basis for the model were taken from previous unrelated studies.

DATA FROM CONTROLLED LABORATORY STUDIES

Controlled laboratory studies are probably the most common type of data presented to potential UV device buyers, and for good reason. Well-conducted laboratory studies provide an excellent indication of the capabilities of a UV device and allow comparison between devices. These studies are designed to mimic the actual use of the device in an environment, but under controlled conditions and using high concentrations of pathogenic microorganisms. Such studies are sometimes referred to as in vitro, which roughly means "in the test tube" in Latin.

Basic UV disinfection studies in environments are conducted by NOOR TEKNOLOJI laboratory as follows.

Settings:

- The customer chooses the microorganisms to be tested (VRE, MRSA, C. difficile, etc.).
- The customer specifies the type of test surface and the positioning / orientation within the room.
- The customer decides whether or not to include an organic soil load in the inoculum.
- Microbiologists inoculate the test surfaces in a separate section of the laboratory.

- The inoculated test surfaces are dried under strictly controlled environmental conditions, creating a thin film on each test surface that houses approximately one million viable cells.
- Test surfaces are carefully transported to the test room.
- The device is positioned in the center of the dedicated test room.
- Test surfaces are positioned and oriented according to the sponsor's instructions.
- The control surfaces are placed in a separate area, not subject to UV treatment·

Execution

- The device is activated.
- The room is evacuated.
- The UV treatment takes place for the specified contact time.
- The treatment is filmed or viewed from the observation window, as appropriate.
- The UV treatment cycle ends.
- Microbiologists enter in the room and aseptically transfer the test surfaces into sterile containers containing a neutralizing medium.
- Microbiologists collect untreated control surfaces.
- Microbiologists return to the main laboratory, where they use ordinary techniques to enumerate the microorganisms that may have survived the UV treatment.

Calculations and report

Concentrations of surviving microorganisms are calculated.
The concentrations of microorganisms on the control surfaces are calculated.
The percentage and log reductions resulting from the UV treatment are calculated.
A full study report is published.
When controlled laboratory studies are conducted by experienced microbiologists, they are very reliable.
Potential buyers should be aware, however, that not all laboratories are experts in antimicrobial testing.
Those labs sometimes make mistakes that can give the impression of antimicrobial efficacy for UV devices. Common mistakes made by labs that can make results unreliable include:
They check for microbial populations that are not treated in the same way as test microorganisms.
Initial microbial populations determined based on the population in the liquid culture used to inoculate the test surfaces, not the dried surfaces themselves. *
Initial microbial populations are not large enough to adequately challenge the device.
Selective agar used to enumerate surviving cells, which can be inhibitory to damaged cells.

Contact time, distance and positioning / vector positions are not recorded.
Calculations performed incorrectly

*In the laboratory, the drying process of microorganisms on test surfaces naturally results in a 90-99% reduction as sensitive microbes are killed by drying and other environmental stresses. If a laboratory calculates the microbial reductions relative to the number of microorganisms applied to the test surface rather than the number of viable microorganisms after drying, the microbial reductions will be increased. artificially.

Buyers should be skeptical of companies that are unwilling to share their lab test results, including detailed testing procedures. Buyers may ask themselves the following questions when evaluating the laboratory data relating to the performance of the UV disinfection device of the environment:

- Was the test performed in a compliant and certified laboratory?
- Does the company share the entire laboratory report?
- Were the microorganisms tested relevant?
- Were the initial microbial populations greater than 100,000 cells per surface?
- Was the initial microbial population determined after the cells were dried on the surface?
- Does the contact time tested correspond to the treatment time proposed by the manufacturer?

In summary, lab tests have several strengths that make them useful for UV device buyers. If the test is performed by a reputable laboratory that is experienced in testing antimicrobial devices, the laboratory tests provide an excellent estimate of the effectiveness of the UV device's effect on microorganisms in "real" use.

ENVIRONMENTAL EFFECTIVENESS DATA

An obvious way to test the effectiveness of a room UV system is to dab the surfaces of a room before treatment, then dab them after treatment and compare the results. Such studies have the advantage of being relatively easy to conduct and measuring performance in the real-world environment in which the device is used.

Unfortunately, environmental swab studies are confused by several problematic technical factors, detailed below. Taken together, these factors make environmental swab studies one of the least reliable means of testing the effectiveness of UV rays.

The first major confounding factor of environmental swab studies on UV efficacy determinations is mathematical. Initial microbial populations in indoor or hospital settings are often low. There are often only about 100 total bacteria per 10 square centimeters of surface area. This is not a major challenge for many UV systems, which means that the magnitude of UV effects may not be fully measurable. Additionally, laboratory techniques used to enumerate microorganisms on swabs often result in a low limit of detection, meaning viable cells on the surface may not be detected if they are present in small numbers.

The second problematic aspect of environmental swab studies is related to microbiological technique. Populations of microorganisms often vary widely from point to point, even on the same surface. If the exact same location were swabbed before and after treatment, this wouldn't be a problem, but the act of swabbing a surface or sampling it with a pressure plate effectively cleans the surface, removing microorganisms in the process. Pad pressure and surface area are also variable. Even the best researchers find it difficult to tap different surfaces, maintaining the same pressure and covering the same surface. Door handles and sink handles, for example, are more demanding than a section of a table

The third major problem with environmental studies is the impact of spore-forming and non-pathogenic bacteria on the total bacterial count. About 50% of the bacteria present on a surface at any given time are spore-forming organisms such as the species of the genus Bacillus. These types of bacteria are almost never pathogenic, so they are largely irrelevant. However, they appear on virtually every agar plate with total bacterial count in large numbers. These non-pathogenic endospores make it difficult for researchers to separate disinfection trends in studies from background microbial "noise".

CLINICAL RESULT DATA

As described above, dosimetry can validate claims when used carefully with dose-response data generated for the particular device under realistic conditions, in vitro laboratory studies are an excellent means of validating claims and environmental efficacy data they are generally in short supply due to the technical problems come with it.

Studies designed to evaluate reductions in infection rates in actual use are called clinical outcome studies and are the latest type of data that UV room disinfection device manufacturers use to confirm claims. These studies are challenging to conduct because they require a lot of time, planning and resources. When done correctly, they provide an excellent indication of the effectiveness of the device.

UV device companies have reported several cases of reduced infection rate that are well correlated with the implementation of UV room disinfection. Many of these studies have been peer-reviewed. Potential buyers of UV devices should focus on peer-reviewed scientific studies because it is easy for companies to cite anecdotes, but usually only "real" results withstand critical review by a panel of technical experts.

The impact that a UV room disinfector will have on infection rates depends on several factors:

- Nature of infections (person-to-person or surface-mediated).
- Frequency of room disinfection.
- Effective effectiveness of the device (function of contact time, technology, positioning, etc.).

The introduction of UV disinfection in an environment does not prevent all infections acquired in that same, but a good system introduced to solve a problem related to environmental contamination can reduce infection rates by up to 70% or more. Infections that are not prevented are likely to spread in ways that do not involve environmental surfaces as a reservoir of pathogens. For example, in the case of hospitals, by doctors who forget to wear gloves or wash their hands after touching patients.

SUMMARY

The category of UV disinfection devices for environments is booming. Many different companies now manufacture and sell UV devices, which have varying levels of effectiveness. The different devices are based on one of the two main UV technologies, mercury UV or UV pulsed xenon, but LedS technology is entering the professional market, which has enormous advantages in terms of duration, number of starts, and eco-friendliness. Potential buyers of UV devices will benefit from learning the four types of data used by companies to confirm claims about UV efficacy: dosimetry, in vitro studies, environmental studies, and clinical outcome data. Dosimetry is acceptable when used carefully, laboratory studies are excellent, environmental studies are full of technical problems, and peer-reviewed clinical outcome studies are fantastic, albeit expensive and relatively rare.

Noor Teknoloji Laboratory is a leader in the UV device testing industry with a dedicated and customized testing room and a long track record of conducting device tests for virtually every leading UV brand. If your company has any questions on this topic or is interested in conducting tests of a UV room disinfector, contact the lab today.