Overview of UVC Dosimeters for Healthcare Applications

INTELLEGO TECHNOLOGIES

About Intellego

- Founded in 2011
- Headquarters in Solna, Sweden
- All products manufactured in Sweden and validated by RISE – Research Institute of Sweden
- Member of the International Ultraviolet Association (IUVA)
- IUVA Healthcare/UV Working Group (ANSI standards, N95 Mask decontamination task force)
- Recipient of the 2020 C. Diff Foundation Award for Innovations in Infection Prevention

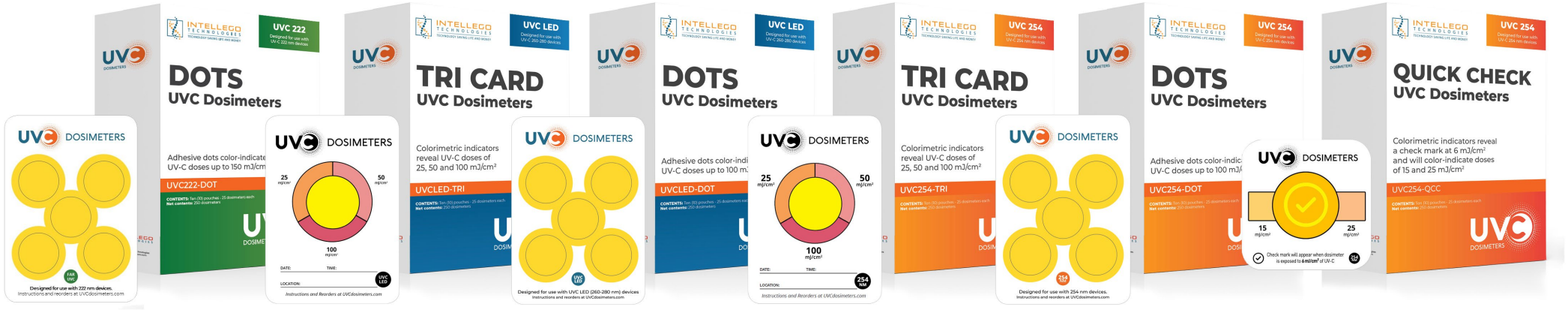
INTELLEGO TECHNOLOGIES

- We support the Safe, Effective and Efficient use of UV-C
- Our patented photochromic ink technology brings the invisible benefits of UV-C into focus to create safer environments and better outcomes
- UVC Dosimeters by Intellego are trusted by the world's leading UV-C manufacturers to visibly demonstrate the power, performance and proof of their disinfection systems

When it comes to UV-C disinfection, Seeing is Believing #SeeYourSuccess

UVC Dosimeters by Intellego Technologies

We manufacture the #1 colorimetric ultraviolet indicator in the world.
Our dosimeters allow you to see and confirm the benefits of UV-C disinfection.



- Trusted, recommended and utilized by leading researchers, manufacturers, healthcare facilities and businesses around the world
- Provides visible evidence of the safety, efficacy and efficiency of UV-C disinfection systems.
- Designed for use with 254 nm, 260-280 nm, and 222 nm.

UVC Dosimeters Product Overview

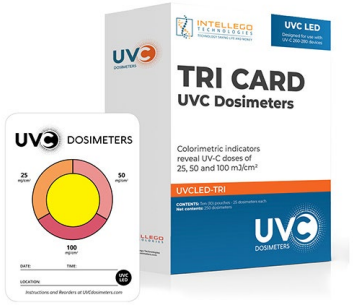
254 nm

254 TRI Cards

254 Dots

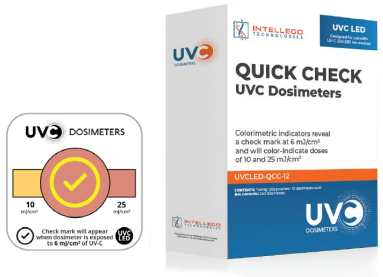
254 Quick Check

260-280 nm



LED TRI Cards

LED Dots



LED Quick Check

222 nm

222 Dots

UVC Dosimeters Trusted by UV-C Manufacturers & Industry Leaders Worldwide

surfacide®

USHIO

UVD ROBOTS
INFECTION PREVENTION

PURE LIGHTING

PURO®
UV Disinfection Lighting

OSRAM

cleanslate UV

rzero

Transportation Security Administration

PROXIMITY UV-CLEAN

UBTECH

REGENCY LIGHTING

UVsmart

PHONESOAP

SAFE SPACE TECHNOLOGIES

American Ultraviolet
Insightful Solutions. Remarkable Results.
SINCE 1960

XtraLight®
LED Lighting Solutions

FinsenTech
INNOVATION IN DISINFECTION

Prescient^{x}

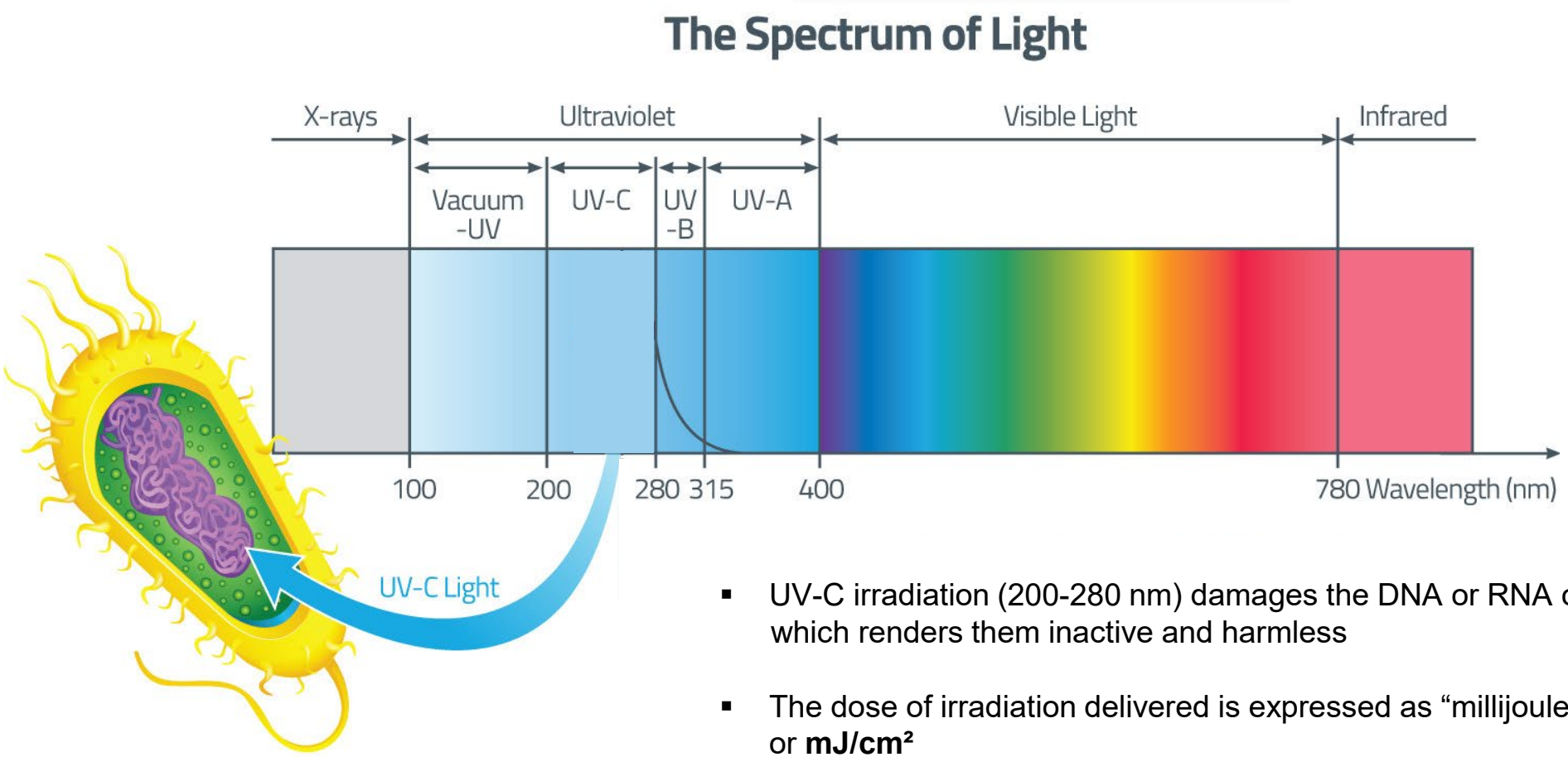
lumicide™
by SteriLumen

Heraeus

WOOJUNGBiO

STONEX

What is UV-C and how does it work?



- UV-C irradiation (200-280 nm) damages the DNA or RNA of pathogens which renders them inactive and harmless
- The dose of irradiation delivered is expressed as “millijoules per centimeter squared” or **mJ/cm²**
- There are no known pathogens that are resistant to UV-C inactivation.
- Sufficient doses of UV-C can kill any pathogen, which is why visible validation of the dose delivered is critical for success.

Types of UV-C devices used in Healthcare Environments

Mobile or Autonomous Towers

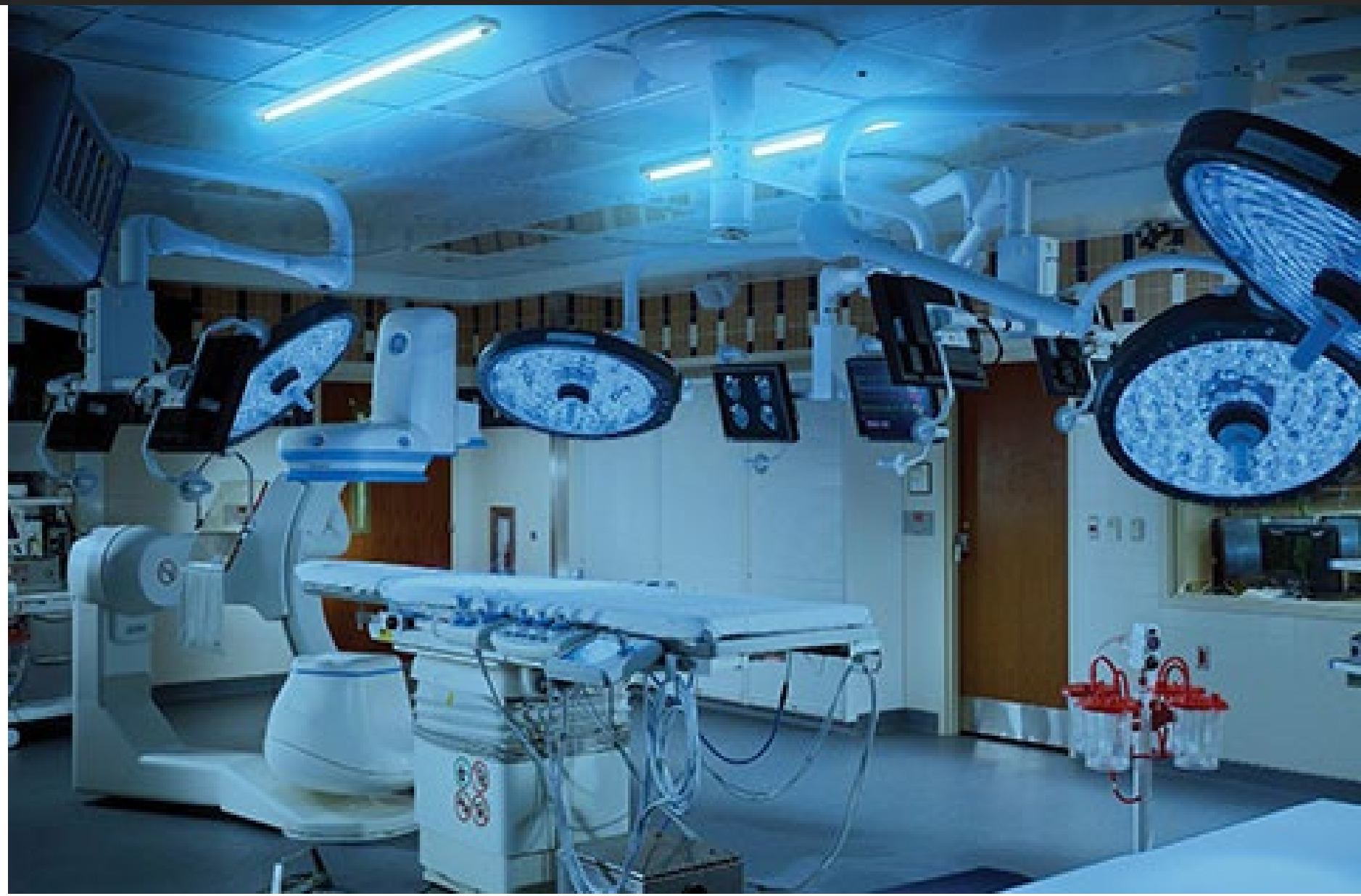
Types of UV-C devices used in Healthcare Environments

Upper Air UV-C

Cabinet UV-C

Types of UV-C devices used in Healthcare Environments

Fixed Mount UV-C

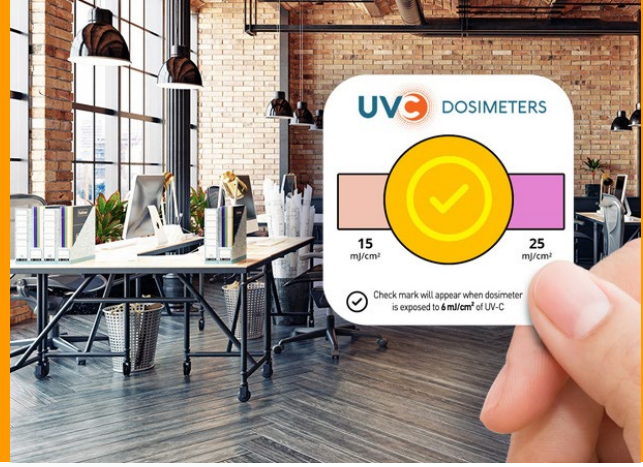


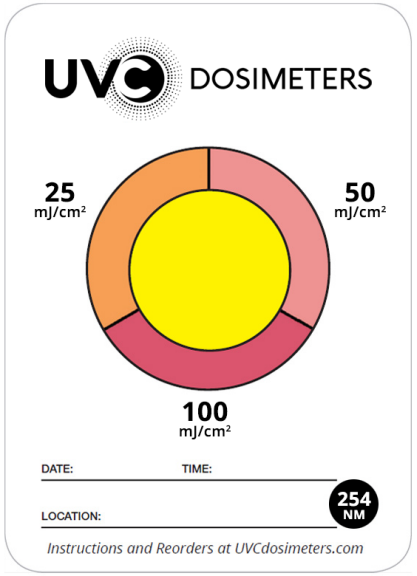
Types of UV-C devices used in Healthcare Environments

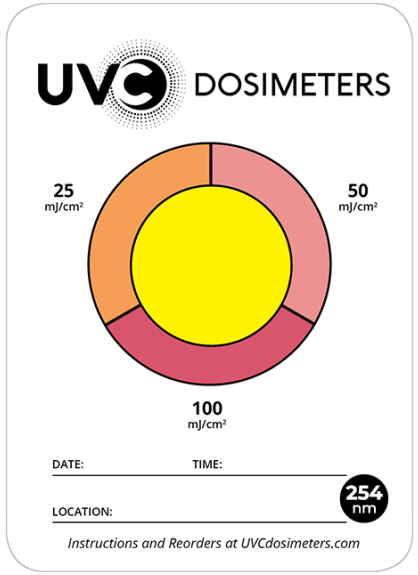
UV-C for Computer Workstations, Monitors and Touchscreens

How It Works

Using a patented, UV-sensitive material, UVC Dosimeters change color when exposed to UV-C energy so you can independently validate your devices and procedures to SEE if an optimal dose of UVGI has been delivered to a surface.







When exposed to UV-C, our colorimetric dosimeters visibly change color from the starting yellow, to orange to deep pink. The color change correlates to levels of accumulated UV irradiation, which helps users determine if surfaces have received enough UV-C to kill bacteria, viruses and spores.

How UVC Dosimeters help

- Validating UV-C lamp performance
  - Bulb degradation
  - Reflector degradation
- Validating proper positioning of mobile UV-C towers
  - During implementation
  - Staff training
  - Weekly/Monthly QA/Auditing
- Ensuring sufficient UV-C doses are reaching target areas
  - High-touch areas
  - Identifying shadowed areas
- Determining optimal run times to increase efficiency
- Providing assurance of safety that UV-C does not penetrate glass

Research confirms the need for measuring and monitoring UV-C devices

- "There is a need for practical tools for monitoring doses delivered by UV-C devices."
- "Our results suggest that colorimetric indicators could be useful tools to compare different devices, assess delivery of UV-C to different sites in patient rooms, and confirm that in-use devices are operating correctly."
- "Use of the indicators by EVS personnel would provide immediate visual feedback on optimal placement of the UV-C devices..."
- "In patient rooms, colorimetric indicator results provided rapid and easy-to-interpret information on UV-C delivery to specific sites. Such information could be useful for healthcare facilities seeking to optimize efficiency of UV-C devices and train personnel in their use."

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SHEA The Society for Healthcare Epidemiology of America

Original Article

Ultraviolet-C (UV-C) monitoring made simple: Colorimetric indicators to assess delivery of UV-C light by room decontamination devices

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Abstract

Objective: To evaluate the use of colorimetric indicators for monitoring ultraviolet-C (UV-C) light delivery to sites in patient rooms.

Methods: In laboratory testing, we examined the correlation between changes in color of 2 commercial colorimetric indicators and $\log_{10}$ reductions in methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridioides difficile* spores with exposure to increasing doses of UV-C from a low-pressure mercury room decontamination device. In patient rooms, 1 of the colorimetric indicators was used to assess UV-C dose delivery to 27 sites in the room.

Results: In laboratory testing, the manufacturer's reference colors for MRSA and *C. difficile* reduction corresponded with doses of ~10,000 and 46,000 μJ/cm^2; these doses resulted in >3 $\log_{10}$ reductions in MRSA and *C. difficile* spores, respectively. In patient rooms, the colorimetric indicators demonstrated suboptimal delivery of UV-C dosing to shadowed areas, which was improved by providing cycles on each side of the patient bed rather than in a single position and altering device placement. Increasing duration of exposure increased the number of sites achieving adequate dosing to kill *C. difficile* spores.

Conclusions: Commercial colorimetric indicators provide rapid and easy-to-interpret information on the UV-C dose delivered to sites in patient rooms. The indicators may be useful for training environmental services personnel and optimizing the effectiveness of UV-C room decontamination devices.

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Ultraviolet-C (UV-C) light room decontamination devices are increasingly used as an adjunct to standard cleaning and disinfection in healthcare facilities.[1] Manufacturers typically provide recommendations for device placement and cycle duration. However, patient rooms and contents may vary considerably and the UV-C dose delivered to different locations can be dramatically affected by distance from the light source, shading (ie, indirect exposure to UV-C), and orientation of surfaces.[2–4] Thus, it would be useful to have practical tools to monitor UV-C delivery to different sites and to provide comparative data for different devices.[1] Radiometers can be used to measure UV-C delivery, but measurement of irradiance is not practical for routine monitoring.

Commercial colorimetric indicators have recently become available as tools to assess UV-C delivery.[5–7] The indicators provide only rough estimates of UV-C delivery, but they have the advantage of being inexpensive and easy to use. Results from colorimetric indicators have been shown to correlate reasonably well with irradiance measured using a radiometer.[5–7] However, limited data are available on the correlation between colorimetric indicator results and microbial reductions. Here, we evaluated 2 commercially available colorimetric indicators. The color changes of the indicators were correlated with irradiance measurements and $\log_{10}$ reductions in methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridioides difficile* spores. We also assessed use of the colorimetric indicators in patient rooms being decontaminated with a UV-C device.

Methods

Colorimetric indicators

Two commercial colorimetric indicators were studied (Fig. 1). UVC 100 dosimeter cards (Intellego Technologies AB, Gothenburg, Sweden) have a central circular indicator that is yellow in the absence of UV-C exposure. For reference, an outer circle shows orange and pink colors that indicate UV-C doses of ~50 and 100 mJ/cm^2, respectively. According to the manufacturer, a change of the central circular indicator to the orange color indicates a UV-C dose adequate to kill MRSA and other vegetative bacteria, whereas a change to the pink color indicates a dose adequate to kill *C. difficile* spores.

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UVC Dosimeters are proven to be as reliable as a radiometer

- "Our methodology establishes that color-changing dosimetry can achieve the necessary **accuracy** (>90%), **uncertainty** (<10%), and **UV-C specificity** (>95%) required for UV-C dose measurements."

- "Our workflow quantified performance specifications and revealed that while performance was highly PCI model-dependent, **one indicator model* met all specifications for informed design of UV-C N-95 treatment systems**"

*Intellego Technologies' dosimeter (noted in the study as "PCI1")

Source: https://doi.org/10.1371/journal.pone.0243554

PLOS ONE

RESEARCH ARTICLE

Quantitative UV-C dose validation with photochromic indicators for informed N95 emergency decontamination

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Abstract

With COVID-19 N95 shortages, frontline medical personnel are forced to reuse this disposable–but sophisticated–multilayer respirator. Widely used to decontaminate nonporous surfaces, UV-C light has demonstrated germicidal efficacy on porous, non-planar N95 respirators when all surfaces receive $\geq$1.0 J/cm^2 dose. Of utmost importance across disciplines, translation of empirical evidence to implementation relies upon UV-C measurements frequently confounded by radiometer complexities. To enable rigorous on-respirator measurements, we introduce a photochromic indicator dose quantification technique for: (1) UV-C treatment design and (2) in-process UV-C dose validation. While addressing outstanding indicator limitations of qualitative readout and insufficient dynamic range, our methodology establishes that color-changing dosimetry can achieve the necessary accuracy (>90%), uncertainty (<10%), and UV-C specificity (>95%) required for UV-C dose measurements. In a measurement infeasible with radiometers, we observe a striking ~20× dose variation over N95s within one decontamination system. Furthermore, we adapt consumer electronics for accessible quantitative readout and use optical attenuators to extend indicator dynamic range >10× to quantify doses relevant for N95 decontamination. By transforming photochromic indicators into quantitative dosimeters, we illuminate critical considerations for both photochromic indicators themselves and UV-C decontamination processes.

Introduction

Ultraviolet (UV) light in the UV-C wavelength range is one of three promising methods identified by the United States Centers for Disease Control and Prevention (CDC) for N95 respirator (N95) decontamination as a shortage mitigation strategy during the COVID-19 pandemic [1]. Building upon years of literature evidence demonstrating that specific UV-C doses inactivate viruses while preserving respirator fit and filtration [2–5], UV-C decontamination of N95

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UVC DOSIMETERS

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