OHMNILABS

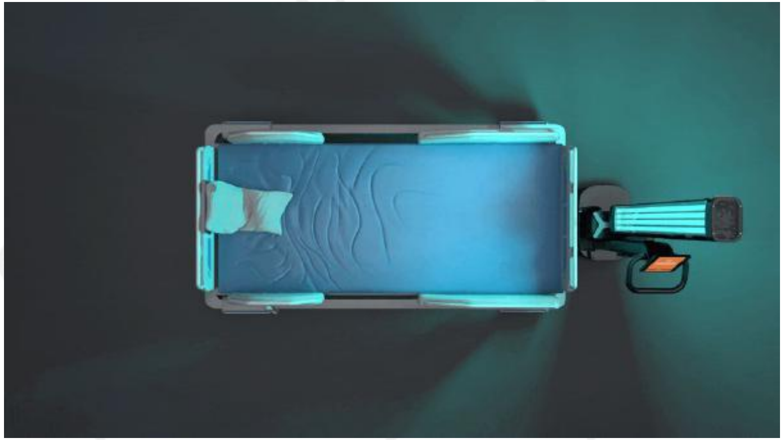
OhmniClean™

Autonomous UV-C Disinfection Solution

UV-C Efficacy and Microbiology Brief

How does OhmniClean Disinfect?

OhmniClean delivers **UV-C light** to high-touch surfaces through **8 powerful UV-C bulbs**.



Cover multiple surfaces in a room through **autonomous disinfection**.

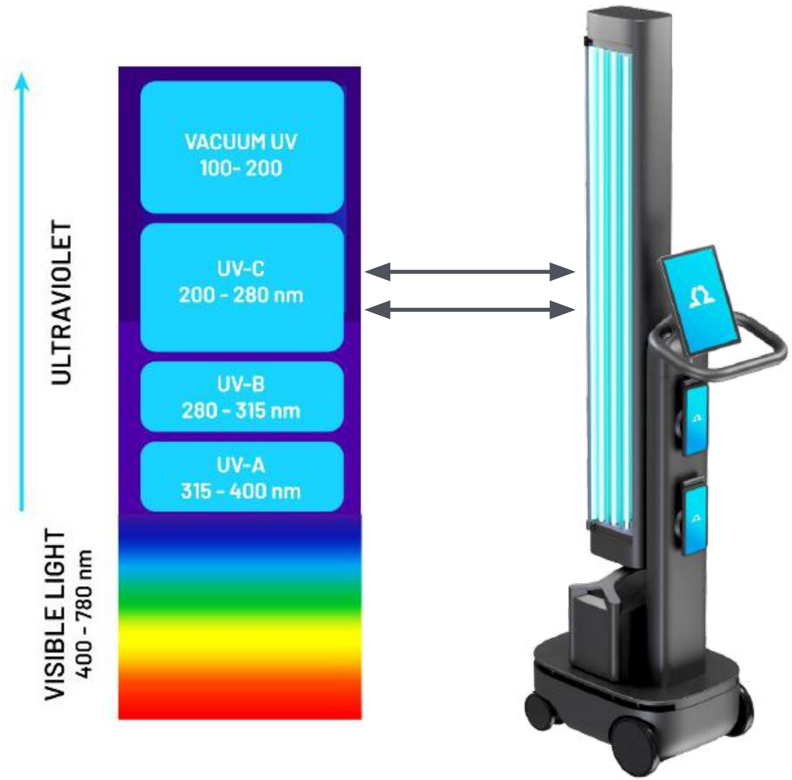
What is UV-C disinfection?

UV-C is ultraviolet light with a wavelength from 200-280 nanometers

Destroys or inactivates bacteria and viruses by deactivating the molecular bonds of their DNA and RNA.

Used to disinfect water, air and surfaces for over a century.

Valuable technique used to reduce Hospital Acquired Infections (HAIs).

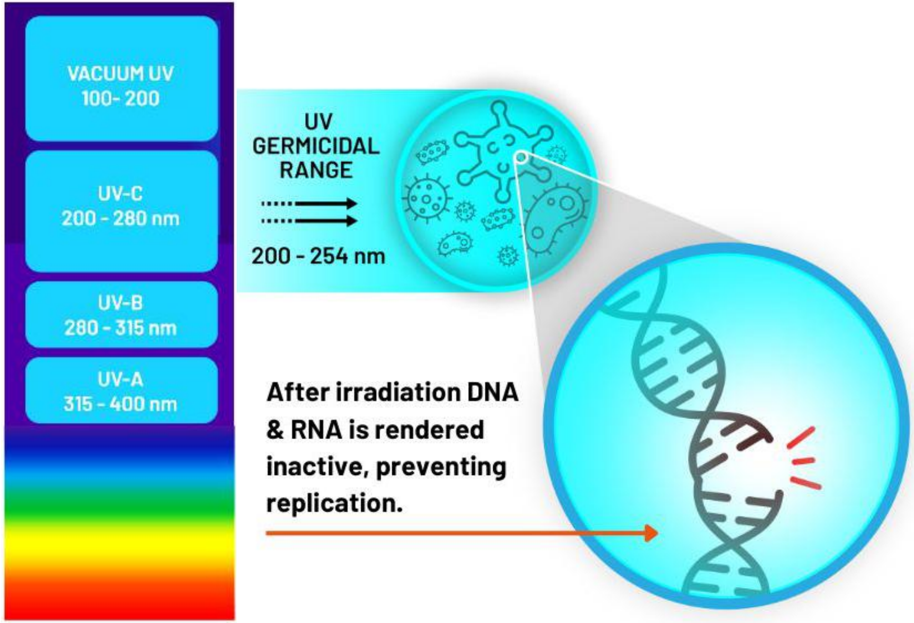


How does UV-C disinfection work?

1. The UV-C device emits UV-C light and hits the surface being disinfected.

2. Continued electromagnetic radiation from the UV-C light modifies the microorganism's genetic material and renders DNA/RNA inactive.

3. Once enough UV-C light is delivered, the ability of the microorganism to reproduce is limited, and prevents its continued spread on the surface.



How Much UV-C Light is Needed to Disinfect Microorganisms?

Every microorganism requires certain levels of ***UV-C dose*** to be significantly disinfected (measured through Log Reductions).

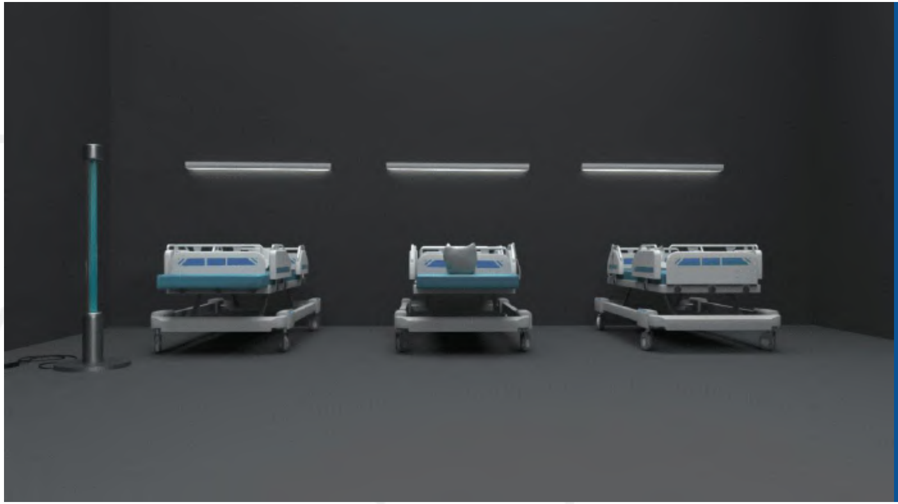
Received UV-C Dose = **UV-C Light Power** x **UV-C Exposure Time**

UV-C Light Power = (UV-C Bulb Power , Distance from Surface)

Resistant pathogens require ***more UV-C Dose*** and require **more *Time*** to be disinfected.

Getting ***closer*** to surfaces ***increases Power*** and allows disinfection to be done in ***less Time***.

How Effective is OhmniClean?



OhmniClean provides a more powerful UV-C dose by moving close to all target surfaces when compared to other emitters.

The strength of disinfection by UV-C light follows the **Inverse Square Law** (a surface **twice as far** from the light source receives **25% of the original UV-C strength**).

How Effective is OhmniClean?

OhmniClean has been independently tested with microbiology lab <u>EMSL Analytical Inc.</u> to prove disinfection efficacy:

- **E.Coli:** Log6 reduction
- **C.Diff:** > Log4 reduction
- **MRSA:** Log6 reduction
- **VRE:** > Log6 reduction
- **P. aeruginosa:** Log7 reduction

***Results achieved by OhmniClean in under 3 min**

EMSL ANALYTICAL, INC.

What other Microorganisms is UV-C Effective Against?

- UV-C has been used for hospital-based disinfection for over 15 years.
- A summary of UV-C thresholds for relevant microorganisms is shown in the table below:

Pathogen	Disinfection Thresholds (254nm UV-C)	Sources
Vaccina Virus (Poxvirus)	Log 2 reduction (99%) **0.3mJ/cm^2**	McDevitt et al. 2007 - Applied and Environmental Microbiology
SARS-CoV-2 (all variants)	Log 3 reduction (99.9%): **4-7 mJ/cm^2** Log 4 reduction (99.99%): **16-32 mJ/cm^2**	Ma et al. 2021 - Journal of Applied and Environmental Microbiology Storm et al. 2020 - Nature, Scientific Reports Biasin et al. 2020 - Nature, Scientific Reports Sabino et al. 2020 - Elsevier Journal of Photodiagnosis and Photodynamic Therapy, September 2020
Staphylococcus Aureus	Log 4 reduction (99.99%): **10mJ/cm^2**	McKinney et al. 2012 - Environmental Science and Technology
Methicillin-resistant Staphylococcus Aureus (MRSA)	Log 4 reduction (99.99%): **31 mJ/cm^2** Log 5 reduction (99.999%): **50 mJ/cm^2**	Ploydaeng et al. 2020 - Photodermatology, Photoimmunology, Photomedicine Wong et al. 2015 - American Journal of Infection Control Yang et al. 2019 - Journal of Microbiology, Immunology and Infection

Pathogen	Disinfection Thresholds (254nm UV-C)	Sources
Clostridioides difficile (C. Diff)	Log 3 reduction (99.9%): **46 mJ/cm^2** Log 5 reduction (99.999%): **~100 mJ/cm^2**	Liscynesky et al. 2017 - Infection Control & Hospital Epidemiology Cadnum et al. 2019 - Open Forum Infectious Diseases Yang et al. 2019 - Journal of Microbiology, Immunology and Infection
Candida Auris (C. Auris)	Log 3 reduction (99.99%) **~45 mJ/cm^2** Log 4 reduction (99.99%) **~60 mJ/cm^2**	Mariita et al. 2022 - MicrobiologyOpen Rutala et al. 2022 - Infection Control & Hospital Epidemiology) Lemons et al. 2019 - American Journal of Infection Control Groot et al. 2019 - Mycoses, Diagnosis, Therapy and Prophylaxis of Fungal Diseases

What other Microorganisms is UV Effective Against?

- Log Reduction thresholds for other Microorganisms can be referenced with the comprehensive peer-reviewed paper:

Fluence (UV Dose) Required to Achieve Incremental Log Inactivation of Bacteria, Protozoa, Viruses and Algae

Mayaleri et al. 2016, International Ultraviolet Association

Spore	Lamp Type	Fluence (UV dose) (mJ/cm²) for a given log reduction without photoreactivation: 1	2	3	4	5	Proto-col?	Notes	Reference
Aspergillus brasiliensis (previously known as ***Aspergillus niger***) ATCC 16404 (dark culture)	LP	122	226	293			yes		Taylor-Edmonds et al. 2015
Aspergillus niger									
ATCC 32625	LP	116	245	370	560		yes		Clauß 2006
ATCC 32625	Excimer 222 nm	90	220	325	430		yes		Clauß 2006
Bacillus anthracis									
Sterne	LP	28	37	52			yes		Nicholson & Galeano 2003
Sterne	LP	23	30				yes		Blatchley III et al. 2005
Ames	LP	25	~40	>120 with tailing			yes		Rose & O'Connell 2009
34F2 (Sterne) method: soil extract-peptone-beef extract agar	LP	23	~40	>120 with tailing			yes		Rose & O'Connell 2009
34F2 (Sterne) method: Schaeffer's sporulation medium	LP	23	36	80			yes		Rose & O'Connell 2009
Bacillus atrophaeus									
ATCC 9372	LP	22	38	55	71		yes		Zhang et al. 2014
	LP	10	16	26	39		yes		Sholtes et al. 2016
	UV-LED 260 nm	6	10	14	19	31	yes		Sholtes et al. 2016

Bacterium	Lamp Type	Fluence (UV dose) (mJ/cm²) for a given log reduction without photoreactivation: 1	2	3	4	5	6	Proto-col?	Notes	Reference
Aeromonas hydrophila ATCC7966	LP	1.1	2.5	4.0	5.5	6.9	8.4	yes		Wilson et al. 1992
Aeromonas salmonicida AL 2017	LP	1.5	2.7	3.1	5.9			yes		Liltved & Landfald 1996
Arthrobacter nicotinovorans										
ATCC 49919	LP	8	10	12	14			yes		Clauß 2006
ATCC 49919	Excimer 222 nm	10	15	18	20			yes		Clauß 2006
***Bacillus cereus* (veg. bacteria)**										
ATCC 11778	LP	6	7	9	12			yes		Clauß 2006
ATCC 11778	Excimer 222 nm	9	11	14	18			yes		Clauß 2006
Bacillus megaterium (veg. cells) QMB 1551	265 nm	*4.6*						no		Donnellan & Stafford 1968
Burkholderia mallei										
M9	LP	1.0	2.4	3.8	5.2			yes		Rose & O'Connell 2009
M13	LP	1.2	2.7	4.1	5.5			yes		Rose & O'Connell 2009
Brucella melitensis										
ATCC 23456	LP	2.8	5.3	7.8	10.3			yes		Rose & O'Connell 2009
IL195	LP	3.7	5.8	7.8	9.9			yes		Rose & O'Connell 2009
Burkholderia pseudomallei										
ATCC 11688	LP	1.7	3.5	5.5	7.4			yes		Rose & O'Connell 2009
CA650	LP	1.4	2.8	4.3	5.7			yes		Rose & O'Connell 2009
Brucella suis										

Virus	Host	Lamp Type	Fluence (UV dose) (mJ/cm²) for a given log reduction without photoreactivation: 1	2	3	4	5	6	Proto-col?	Notes	Reference
Adenovirus											
Type 1 method: MPN	PLC/ PRF/5 and HeLa cell line	LP	35	69	103	138			yes		Nwachuku et al. 2005
Type 2	PLC/ PRF/5	LP	40	78	119	160	195	235	yes		Gerba et al. 2002
Type 2	Human lung cell line	LP	35	55	75	100			yes		Ballester & Malley 2004
Type 2	A549 cell line	LP	20	45	80	110			yes		Shin et al. 2005
Type 2	A549 cell line	LP	~30	~60					yes		Linden et al. 2007
Type 2	A549 cell line	MP	~10	~20	~30	~40	~50		yes		Linden et al. 2007
Type 2	A549 cell line	MP <240 nm blocked	~15	~30	~45	~60			yes		Linden et al. 2007
Type 2	A549 cell line	LP	8	31	50	80	117		yes		Eischeid et al. 2009
Type 2 method: TCID50	A549 cell line	LP	35	78	126	168			yes		Linden et al. 2009
Type 2 method: TCID50	A549 cell line	MP	14	29	44	80	120		yes	(3)	Linden et al. 2009
Type 2 method: cell culture	HEK293 cells human embryonic kidney	LP	37	88	120				yes		Baxter et al. 2007
Type 2 adenoid 6 (VR-846)	A-549 cell line (CCL-185)	LP	42	83	124	166			yes		Sirikanchana et al. 2008

Which Microorganisms are more Susceptible to UV-C?

- **Viruses** are generally the **most susceptible** to UV-C disinfection and require the **least UV-C dose.**
- **Spores** are generally the l**east susceptible** to UV-C disinfection and require the **most UV-C dose.**

Viruses	Vegetative Bacteria	Mycobacteria	Vegetative Fungi	Bacterial Spores
EASIER TO DISINFECT →				HARDER TO DISINFECT
Coronavirus Influenza viruses Measles Norovirus Smallpox	***Staphylococcus aureus*** *Escherichia coli* *Pseudomonas aeruginosa* *Serratia marcescens*	***Mycobacterium tuberculosis*** *Mycobacterium Abscessus* *Mycobacterium bovis*	***Candida Auris*** *Fusarium Species* *Aspergillus Species*	***Clostridioides difficile*** *Bacillus species*

How does OhmniClean target different Microorganisms?

- Staff can easily adjust a **Disinfection Intensity** for **any** target pathogen
- **Disinfection intensities can be set hospital-wide** for easier staff operation

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Simplified To

How fast does OhmniClean disinfect different Microorganisms?

- Disinfection Time depends on the: **Size of the room, Disinfection path, Disinfection intensity**
- OhmniClean provides an accurate **estimated disinfection time** before every cycle

Example Disinfection Times for ~200sqft Patient Rooms

Viruses	Vegetative Bacteria	Mycobacteria	Vegetative Fungi	Bacterial Spores
Coronavirus	*Staphylococcus aureus*	*Mycobacterium tuberculosis*	*Candida Auris*	*Clostridioides difficile*
EASIER TO DISINFECT				HARDER TO DISINFECT
1-3min	4-6min	*7-9min*	*8-12min*	*9-15min*

4.6 min 1x 200sqft

7.2 min 3x 265sqft

8.0 min 4x 300sqft

Example Disinfections in Other Hospital Areas

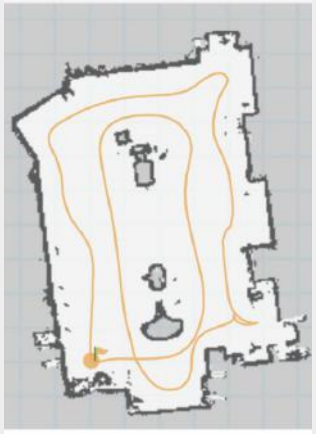
PACU Hallway

9.0 min 1x 1176sqft

PACU

5.5 min 1x 610sqft

Cath Lab



15.5 min 2x 637sqft

EVS Breakrooms

13.3 min 5x 383sqft

OhmniClean - Additional Academic References

Haag et al. 2022 - Comparing UV-C dosages of emitter placement strategies in a community hospital setting.

OhmniClean's Autonomous UV-C applied a much larger UV-C dose throughout an entire room compared to Manual UV-C.

Raggi et al. 2018 - Clinical, operational, and financial impact of an ultraviolet-C terminal disinfection intervention at a community hospital

Routine UV-C resulted in 19% lower HAI, and a direct cost savings of $1,219,878 over a 12-month period.

Wong et al. 2015 - Postdischarge decontamination of MRSA, VRE, and Clostridium difficile isolation rooms using … ultraviolet-C–emitting devices.

UV-C use reduced MRSA, VRE, and C.Diff bioburden in Patient Rooms 8-10x more than regular Manual Disinfection.

Anderson et al. 2017 - Enhanced terminal room disinfection … caused by multidrug-resistant organisms and Clostridium difficile …

UV-C use in high-risk rooms led to a hospital-wide decrease in C. Diff and VRE patient exposure over 28 months.