

# Ultraviolet Light can “Kill”/Sterilize/ inactivate this % of Flu Viruses:



UVR Rating	%Viruses Killed/Sterilized/Inactivated
6- (75mw)	4.4%
7- (100mw)	5.8%
8- (150mw)	8.5%
10- (500mw)	25.7%
13- (2000mw)	69.5%
15- (4000mw)	90.7%
16- (5000mw)	94.9%

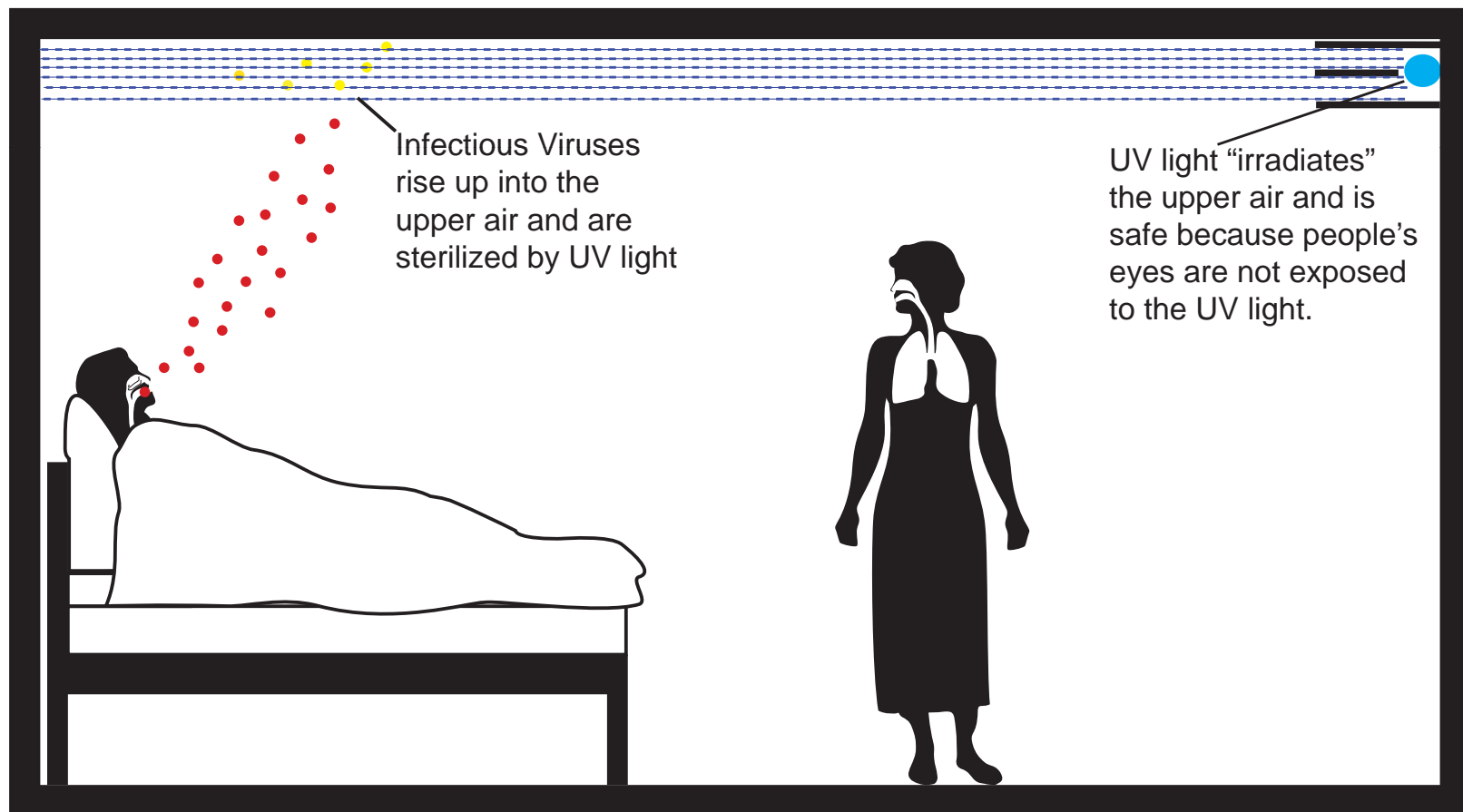
mw=Microwatt

# What is Ultraviolet Light and how does it work?



- **Ultraviolet Germicidal (germ-killing) light is UV light in the “C” band (254 nanometers). It is invisible and is mostly filtered out of sunlight before it reaches earth’s surface. UV-C light Sterilizes germs by destroying the “T” bonds in their DNA or RNA. This prevents them from reproducing and they die soon after.**
- **UV was artificially created in the 1890’s and later commercially used to kill waterborne viruses & bacteria in France in 1909 for safe drinking water in Paris and other cities.**
- **By the 1930’s Duke University surgeons were using in in operating rooms to reduce airborne bacterial and viral infections. In the 1930’s and 1940’s UV light was used in schools to successfully prevent airborne measles epidemics and in hospitals to prevent airborne disease transmission in the nurseries.**

# How Upper UV Room works to prevent airborne virus transmission



# Veteran's Hospital 1957 Flu Pandemic Upper Room UV Study-100% Effective

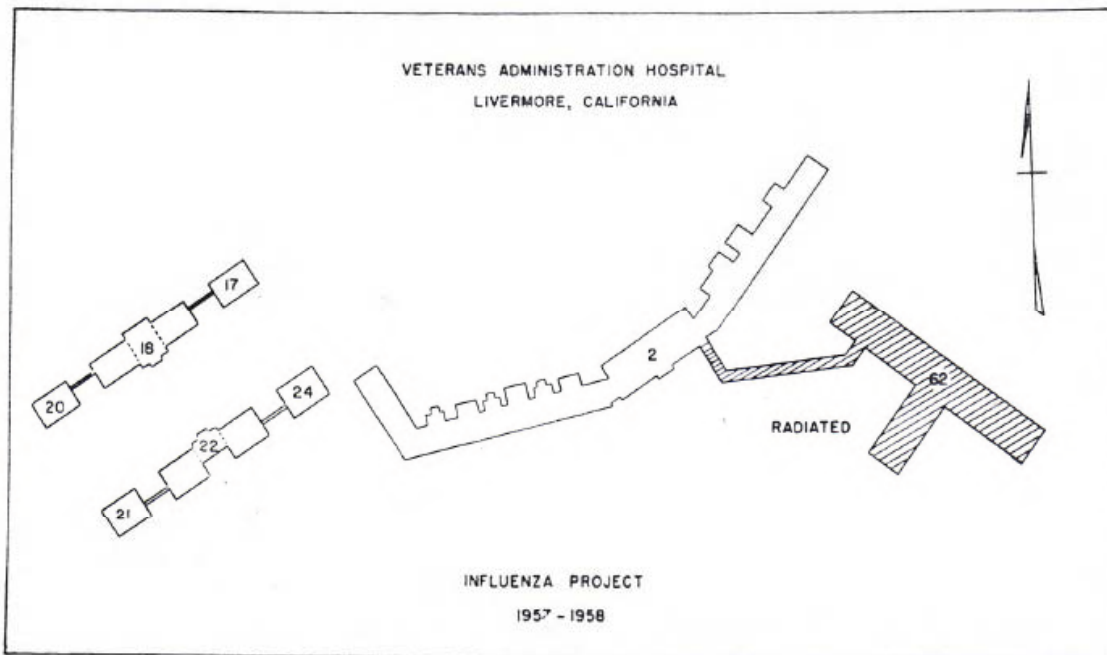


FIG. 4. Illustrates the plan of the hospital grounds and depicts the area which was isolated from the rest of the hospital by radiant disinfection of the upper air of all rooms and corridors.

TABLE 9  
NUMBER OF PATIENTS WITH ACUTE  
RESPIRATORY SYMPTOMS  
Phase 2, November 16, 1957-March 16, 1958

Week of	Radiated		Nonradiated	
	Influenza	Other	Influenza	Other
12/15	0	0	2	0
12/22	0	1	1	5
12/29	0	0	0	8
1/5	0	2	7	4
1/12	0	0	18	6
1/19	0	0	10	4
1/26	0	1	1	1

0

39

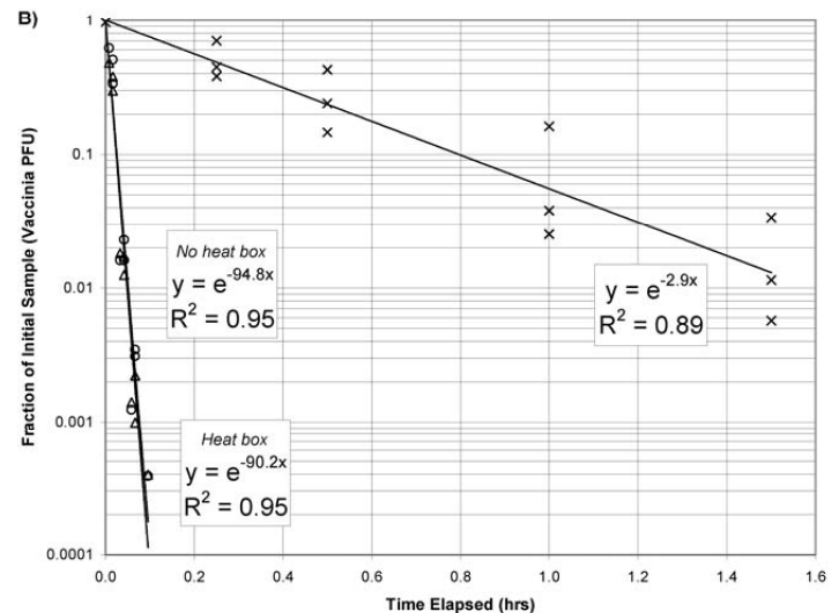
# Harvard Professor James McDevitt 2008 upper room UV virus Experiment



Professor McDevitt installed upper room UV lights to replicate the success of the 1957 Flu pandemic.

“Air disinfection using upper-room (UV) light can lower the airborne concentrations of infective organisms in the lower part of the room, and thereby control the spread of airborne infections among room occupants.

These data demonstrate that upper-room UVC has the potential to greatly reduce exposure to susceptible viral aerosols. These data may also be relevant to influenza, which also has improved aerosol survival at low RH.”



99.9% of airborne viruses were killed (inactivated) in just 6 minutes (.1 hour).

Inactivation of Poxviruses by Upper-Room UVC Light in a Simulated Hospital Room Environment McDevitt, James 2008 PloS ONE v3 e-page 3186.

This open source study is available @ [GreenCleanAir.com](http://GreenCleanAir.com)

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# Harvard Professor James McDevitt 2012 upper room UV virus Experiment



**Again in 2012, Professor McDevitt published the results of installing upper room UV lights to replicate the success of the 1957 Flu pandemic experiment by Dr. RL McLean and this time he used airborne influenza viruses.**

**“Using our experimental system, we measured influenza reductions as low as 98.2% by comparing samples with the UV light on to subsequent samples control samples with the UV light off.**

**This work provides an essential scientific basis for designing and utilizing effective upper-room UV-C light installations for the prevention of the airborne transmission of influenza.”**

# UCLA School of Medicine UV Experiment to kill Influenza-100% Effective



## Inactivation of Airborne Viruses by Ultraviolet Irradiation

MARCUS M. JENSEN

*Department of Medical Microbiology and Immunology, School of Medicine, University of California, Los Angeles, California*

Received for publication 11 May 1964

TABLE 1. *Inactivation of viral aerosols during passage through a helical baffled UV cell\**

Virus	Concn of virus suspension†	Amt of viral suspension dispensed per min	Air-flow rate through UV cell	No. of virus PFU collected per ft <sup>3</sup> of air with		Percentage of virus inactivated by UV light
				UV off	UV on	
Adenovirus . . .	$3.4 \times 10^8$	ml 0.144	ft <sup>3</sup> /min 100	29,235	913	96.88
			200	28,016	2,436	91.31
Coxsackie B-1.	$4.0 \times 10^7$	0.143	100	10,755	5	99.95
			200	9,000	225	97.50
Influenza A . . .	$1.0 \times 10^7$	0.145	100	920	0	>99.90
			200	690	0	>99.86
Sindbis . . . . .	$7.5 \times 10^6$	0.150	100	5,644	26	99.53
			200	3,793	124	96.73
Vaccinia . . . . .	$1.0 \times 10^8$	0.128	100	27,522	0	>99.99
	$2.0 \times 10^7$	0.142	200	2,265	0	>99.96

**0 Infectious Flu Viruses at 100 & 200 cubic feet per min (cfm)**

# Viruses can be captured & sterilized with a combination of MERV Filters & URV rated UV-C Light



- Adding filters and UV together in successive layers can provide a lethal force to both prevent the recirculation and reduce the levels of airborne viruses in occupied spaces.
- A MERV 10 filter alone captures only 10% of flu viruses whereas adding a Ultraviolet rating of URV 10 triples that total single pass capture/sterilization to 35%.
- A MERV 13 filter plus a URV 13 UV light rating can have an 84% capture/sterilize rate for influenza. That is a very achievable goal for any indoor space.
- Adding additional UV lamps to an URV 16 level combined with a MERV 16 rated filter can achieve a total single pass capture/sterilize/inactivation rate of 98.8% for influenza.



# MERV rated filters & UV lights prevent airborne influenza



**Table 1.** Filtration Rates of Design Basis Biological Weapon Agents

Pathogen	Mean size, $\mu\text{m}$	Filter Model and Removal Rates, Fraction						
		MERV 6	MERV 7	MERV 8	MERV 10	MERV 13	MERV 15	MERV 16
Influenza	0.098	0.062	0.07	0.11	0.12	0.46	0.71	0.76

**Table 2.** Ultraviolet Germicidal Irradiation Kill Rates of Design Basis Biological Weapon Agents

Pathogen	Rate constant ( $\text{cm}^2/\mu\text{W}\cdot\text{s}$ )	ULTRAVIOLET GERMICIDAL IRRADIATION KILL RATES, FRACTION						
		URV 6	URV 7	URV 8	URV 10	URV 13	URV 15	URV 16
		$75 \mu\text{W}/\text{cm}^2$	$100 \mu\text{W}/\text{cm}^2$	$150 \mu\text{W}/\text{cm}^2$	$500 \mu\text{W}/\text{cm}^2$	$2000 \mu\text{W}/\text{cm}^2$	$4000 \mu\text{W}/\text{cm}^2$	$5000 \mu\text{W}/\text{cm}^2$
Influenza	0.001187	0.044	0.058	0.085	0.257	0.695	0.907	0.949

**Table 3.** Combined Removal Rates for Biological Weapon Agents

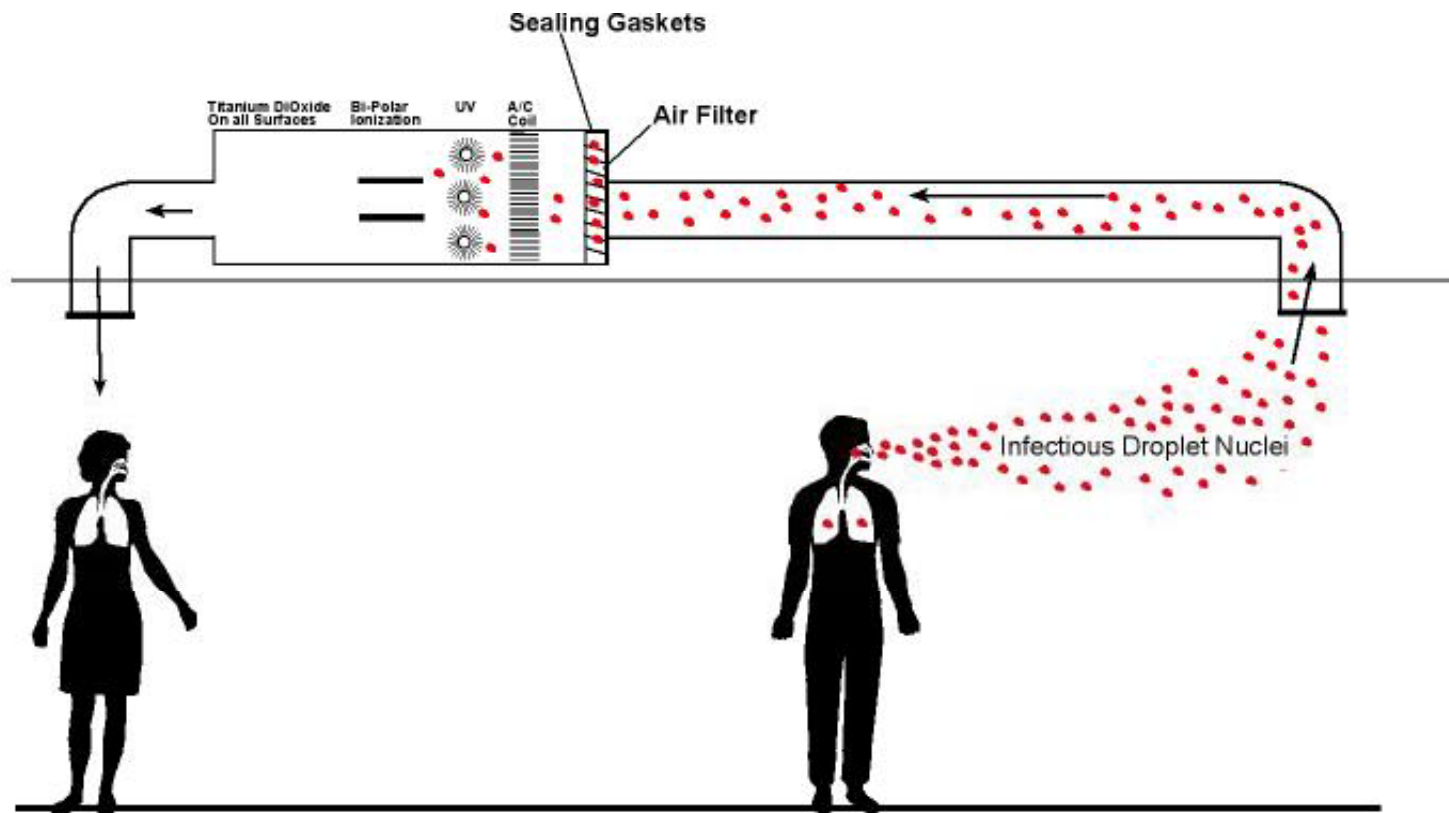
Pathogen	FILTRATION AND ULTRAVIOLET GERMICIDAL IRRADIATION REMOVAL RATES, FRACTION						
	MERV 6 URV 6	MERV 7 URV 7	MERV 8 URV 8	MERV 10 URV 10	MERV 13 URV 13	MERV 15 URV 15	MERV 16 URV 16
Influenza	0.10	0.12	0.19	0.35	0.84	0.97	0.988

# Combined UV Light & Filtration Capture/ Kill/Sterilize this % of Flu Viruses:



MERV & UVR Combined	%Viruses Killed/Sterilized
6	10%
7	12%
8	19%
10	35%
13	84%
15	97%
16	98.8%

# Air Filters, UV Lights, P.C.O. and Cold Plasma/Bi-Polar Ionization Can Kill, Sterilize & Capture Viral Droplet Nuclei



The % of Influenza captured, sterilized or killed will depend upon the Air Filter's MERV rating, intensity of Ultraviolet Output, the total surface area coated with Titanium Dioxide and the Bi-Polar Ionization Output.

# Cases of Ultraviolet Lights Preventing Indoor Virus transmission and infection



1. Germantown Friend's School 1942. Am J Public Health Nations Health. 1943 (Measles)
2. Livermore Veterans Hospital-1957. American Review of Respiratory Diseases. 1961 (1957 Flu Pandemic)