



# Soluciones de Ingeniería COVID19

Sector Educativo



# Reconocimiento de transmisión por aerosoles o vía aérea

En el mes de julio, la [Organización Mundial de la Salud](#) reconoce la transmisión aérea en lugares cerrados y con una ventilación inadecuada.

El 5 de octubre del 2020, [los Centros para el Control y Prevención de Enfermedades de EU \(CDC\)](#) actualizó sus guías, y reconocen que el virus Sars-CoV-2 no solo se trasmite por gotas respiratorias sino que también puede transmitirse vía aerosoles y es capaz de viajar mas de 6 pies y permanecer suspendido en el aire por largos periodos de tiempo.



# Recomendaciones de CDC

## Ventilación en escuelas y programas de cuidados infantiles

Cómo usar las recomendaciones edilicias de los CDC en su entorno

Actualizado el 26 de feb. del 2021

[Imprimir](#)



Abrir las ventanas, utilizar purificadores de aire portátiles y mejorar la filtración en todo el edificio son formas de aumentar la ventilación en su escuela o programa de cuidados infantiles.

Escuelas y COVID: <https://espanol.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/operation-strategy.html>



## Cómo usar las recomendaciones edilicias de los CDC en su entorno

La ventilación es uno de los componentes para mantener entornos saludables, y es una estrategia de prevención del COVID-19 importante para las escuelas y programas de cuidados infantiles. Usar una  mascarilla con buen ajuste y de varias capas ayuda a evitar que las partículas de virus se propaguen por el aire o sean inhaladas por la persona que lleva puesta la mascarilla. Una buena ventilación es otra medida que puede ayudar a reducir la cantidad de partículas de virus en el aire. Junto con otras medidas preventivas, la ventilación puede reducir las probabilidades de propagación de la enfermedad. A continuación encontrará formas de mejorar la ventilación en su escuela o programa de cuidados infantiles, ya sea en un edificio grande o en una casa:

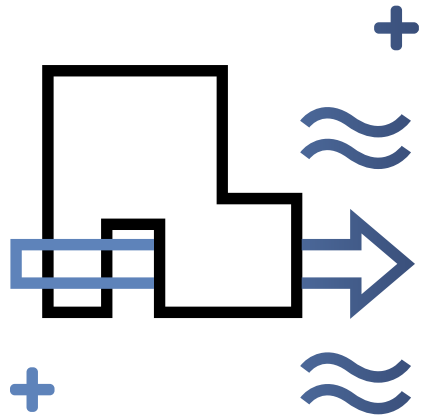


Es importante contar con buena ventilación especialmente en las áreas donde los estudiantes podrían no ser capaces de usar mascarillas. Lo mejor sería comer al aire libre. Si es necesario que los estudiantes coman en la cafetería, use métodos como abrir las ventanas, aumentar al máximo la filtración tanto como lo permita el sistema y usar purificadores de aire portátiles con filtros HEPA.

Filtre y/o purifique el aire de su escuela o programa de cuidados infantiles.

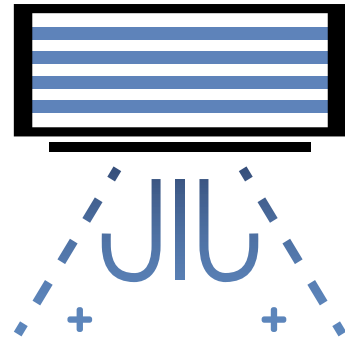
- Mejore el nivel de filtración del aire tanto como sea posible sin reducir significativamente el flujo de aire.
- Asegúrese de que el tamaño de los filtros sea el adecuado, y de que sean instalados y reemplazados según las instrucciones del fabricante.
- Considere utilizar purificadores de aire portátiles con filtros de aire de alta eficiencia para partículas (HEPA) para mejorar la purificación del aire, especialmente en áreas de riesgo más alto, como la enfermería o la sala de aislamiento/habitación para personas enfermas.
- Considere utilizar irradiación germicida ultravioleta (UVGI) en escuelas y programas de cuidados infantiles que no se ofrecen en casa como tratamiento complementario para inactivar el virus que causa el COVID-19, especialmente si las opciones para mejorar la ventilación y la filtración son limitadas. Consulte a un profesional calificado para que le ayude a diseñar e instalar un sistema de UVGI.

# Recomendaciones del CDC y ASHRAE\*



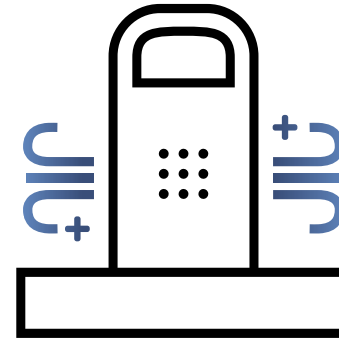
**Ventilación**

DILUIR CONTAMINANTES  
AEREOS



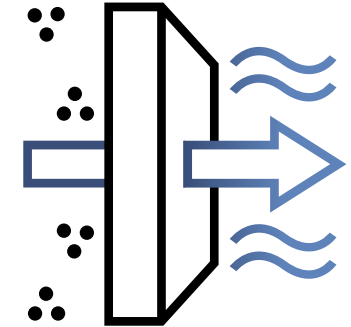
**Luz UVC**

INACTIVA  
MICROORGANISMOS  
AEROTRANSPORTADOS



**Purificadores  
de aire**

REMUEVE O ATRAPA  
CONTAMINANTES AEREOS



**Filtros de aire**

REMUEVE O ATRAPA  
CONTAMINANTES AEREOS

ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers

\*Más de 57,000 socios en 132 países

\*Hay un capítulo en Monterrey

# Estándares para medir la eficiencia/ guías o recomendaciones

	Estándar	CDC y/o EPA	OMS	
Ventilación	ASHRAE 62.1, 62.2, 170	si	si	OMS tiene guías para el control de TB y Covid-19
Filtración mecánica	ASHRAE 52.2 (MERV), 170	Si	si	CDC y OMS refieren a ASHRAE
UVGI parte alta	ASHRAE 185.1 y 185.2	Si	Si	CDC y OMS tienen guías para control TB, CDC menciona Covid-19
UVC equipos HVAC	ASHRAE 185.1 y 185.2	si		CDC para Covid-19
Purificadores de aire	AHAM AC-1-2019	si	si	EPA guías para purificadores de aire
Ionizadores, fotocatalisis, plasma	<b>NO EXISTE</b>	no		Solamente miden que no generen ozono

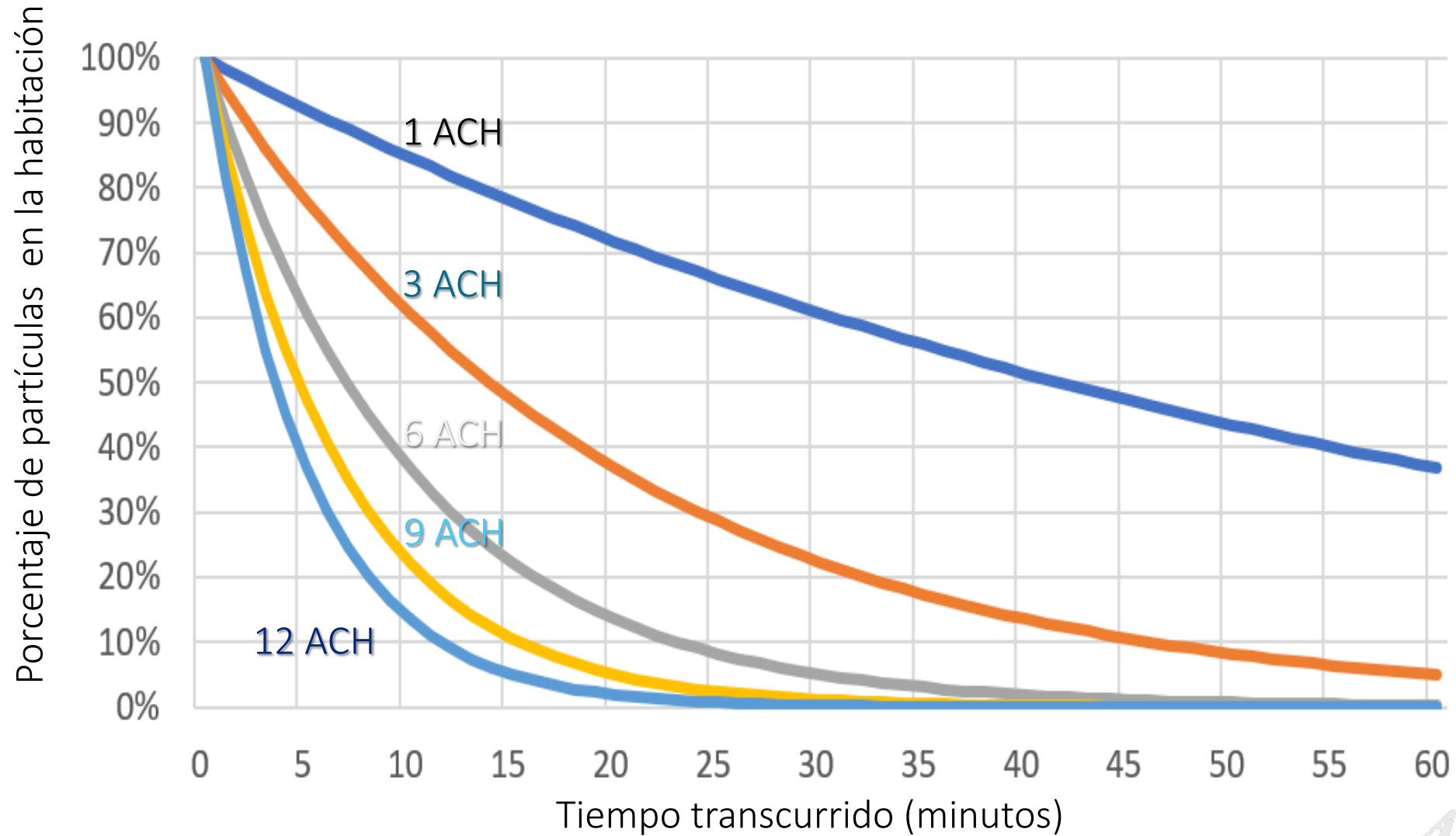
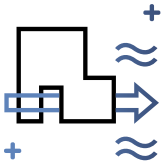
<https://www.ashrae.org/technical-resources/ashrae-standards-and-guidelines> (gratis online)

<https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html>

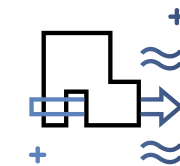
<https://www.who.int/es/news-room/q-a-detail/q-a-ventilation-and-air-conditioning-in-public-spaces-and-buildings-and-covid-19>

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/media-resources/science-in-5/episode-10---ventilation-covid-19>

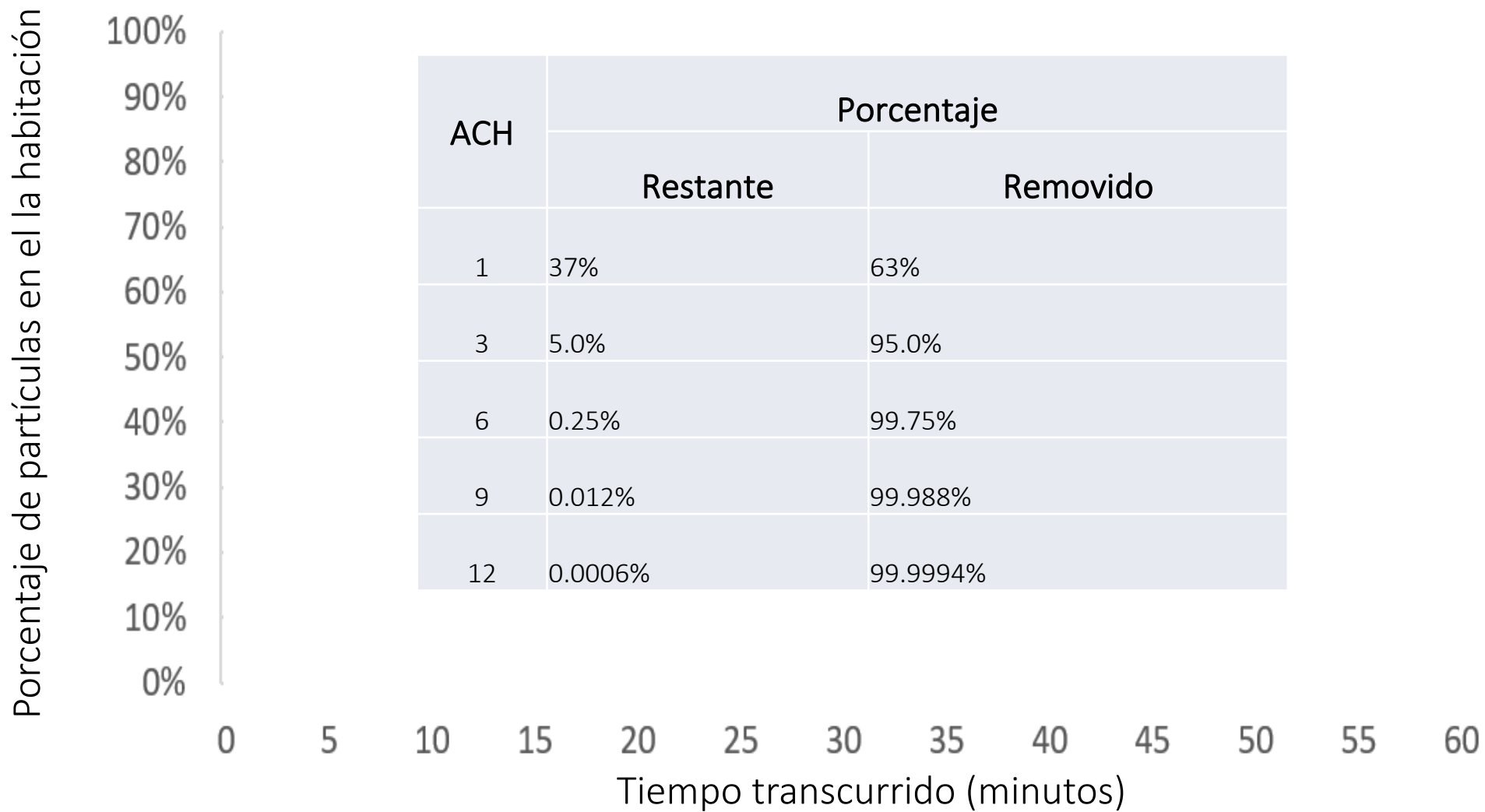
# Ventilación General (Dilución)



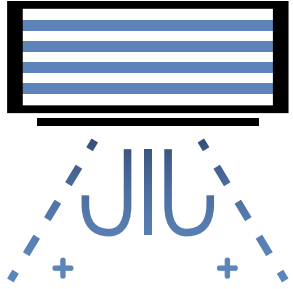




# Ventilación General (Dilución)

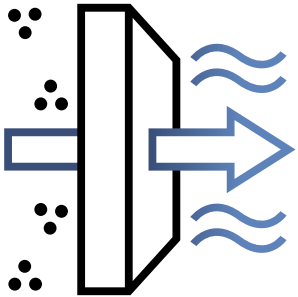


# Equivalentes ventilación



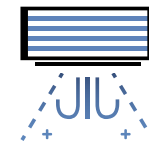
UVGI

- Inactivación de microorganismos aerotransportados por medio de luz germicida ultravioleta. Daña el ARN o ADN de los microorganismos a una tasa mucho mayor que otras tecnologías de ventilación.



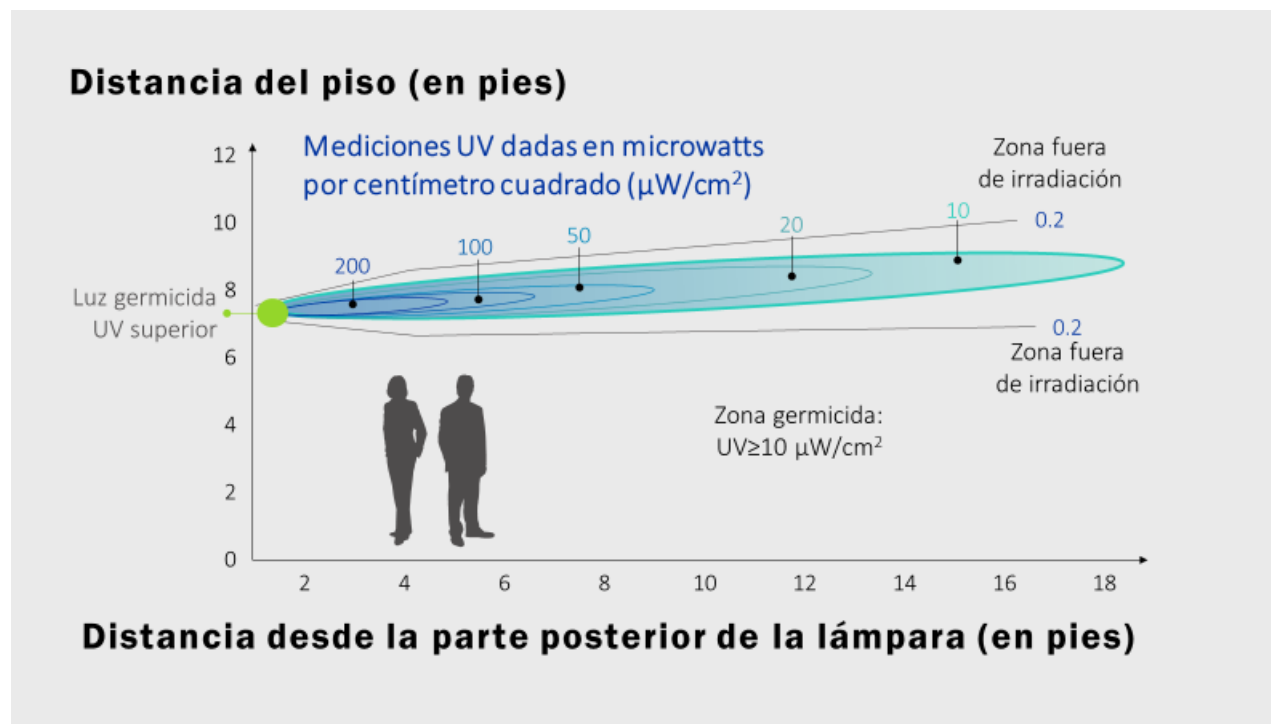
Filtración

- Puede remover microorganismos a una tasa igual que la ventilación dependiendo de la eficiencia del filtro.



# Luz Germicida Ultravioleta Instalación Superior

Aplicaciones: lugares públicos, salones de clase, consultorios, restaurantes, etc.



<https://apps.who.int/iris/bitstream/handle/10665/311259/9789241550512-eng.pdf>  
<https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf>

e



# ESTO ERA ANTES (1930's)

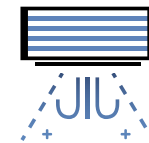


Fig. 2. Class room, Swarthmore Public Schools—side wall fixtures.

# ESTO ES AHORA (2020)

Escuelas y guarderías

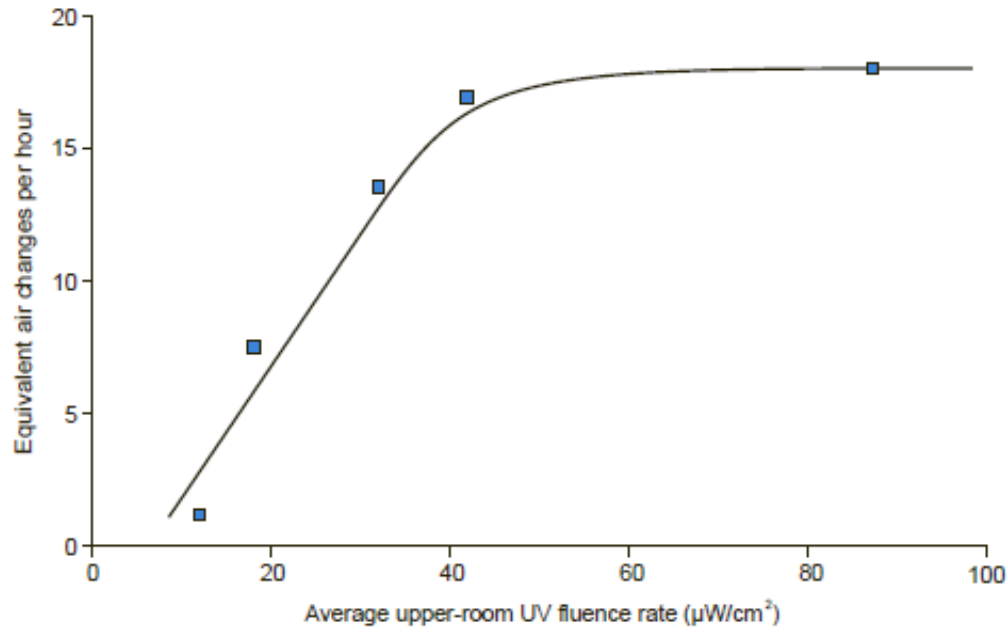




# Luz Ultravioleta Germicida UVC superior- Upper UV (GUV) Soluciones seguras para áreas ocupadas



# Dilución de microorganismos



**Figure 3.** UVGI-induced inactivation of *M. parafortuitum* in a test room under well-mixed conditions at 50% relative humidity. Adapted from Miller et al. [2002].

between 25 and 74% for *B. subtilis* spores, 78–90% for *M. parafortuitum* and 70–93% for *M. Bovis* BCG cells. Increasing the ventilation rate from 7 to 20 air changes per hour decreased the relative inactivation efficacy of the UVGI system provided 17 equivalent air changes per hour or 17 A.C.H.s of Z value (equivalent air exchange rate normalized against UVGI efficacy for *Mycobacterium parafortuitum*). UVGI efficacy can be affected by air mixing conditions (A.C.H.), and air mixing conditions by measuring UVGI efficacy from 20% to 100%, through RH (75–100%) decreased equivalent air-exchange rate by half. UVGI effectiveness was highest at 50% RH. The UVGI efficacy decreased by as much as 80% with incomplete mixing by wintertime ventilation conditions (34 °C supply air temperature, 20 °C room air temperature). The inter-zonal airflow rate between the low and high zones was an important factor in determining UVGI efficacy; under conditions such as relative humidity and temperature were well mixed to poorly mixed by 30–45% and the optimal value of this inter-zonal airflow

**PERGAMON** Atmospheric Environment 37 (2001) 405–419 **ATMOSPHERIC ENVIRONMENT**  
www.elsevier.com/locate/atmosenv

Efficacy of ultraviolet germicidal irradiation of upper-room air in inactivating airborne bacterial spores and mycobacteria in full-scale studies

Peng Xu<sup>a</sup>, Jordan Peccia<sup>a</sup>, Patricia Fabian<sup>a</sup>, John W. Martyny<sup>b</sup>, Kevin P. Fennelly<sup>c</sup>, Mark Hernandez<sup>a</sup>, Shelly L. Miller<sup>d,e</sup>

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Received 11 February 2002; received in revised form 14 September 2002; accepted 25 September 2002

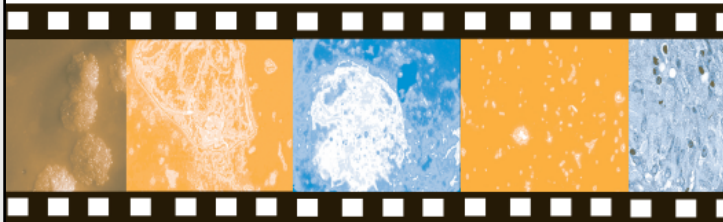
PA Jensen

PA Jensen

# Instalación segura de luz germicida para la parte superior



## Environmental Control for Tuberculosis: Basic Upper-Room Ultraviolet Germicidal Irradiation Guidelines for Healthcare Settings



Department of Health and Human Services  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



**NIOSH**

Guías CDC y OMS un buen diseño: fluencia de 30  $\mu\text{W}/\text{cm}^2$  a 50  $\mu\text{W}/\text{cm}^2$ .

## WHO guidelines on tuberculosis infection prevention and control

2019 update

### Environmental controls

**Recommendation 5:** Upper-room germicidal ultraviolet (GUV) systems are recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission. (Conditional recommendation based on moderate certainty in the estimates of effects)

**Recommendation 6:** Ventilation systems (including natural, mixed-mode, mechanical ventilation and recirculated air through high-efficiency particulate air [HEPA] filters) are recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission. (Conditional recommendation based on very low certainty in the estimates of effects)

<https://apps.who.int/iris/bitstream/handle/10665/311259/9789241550512-eng.pdf>  
<https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf>





# Luz germicida ultravioleta superior o parte alta



Fotografías de instalaciones





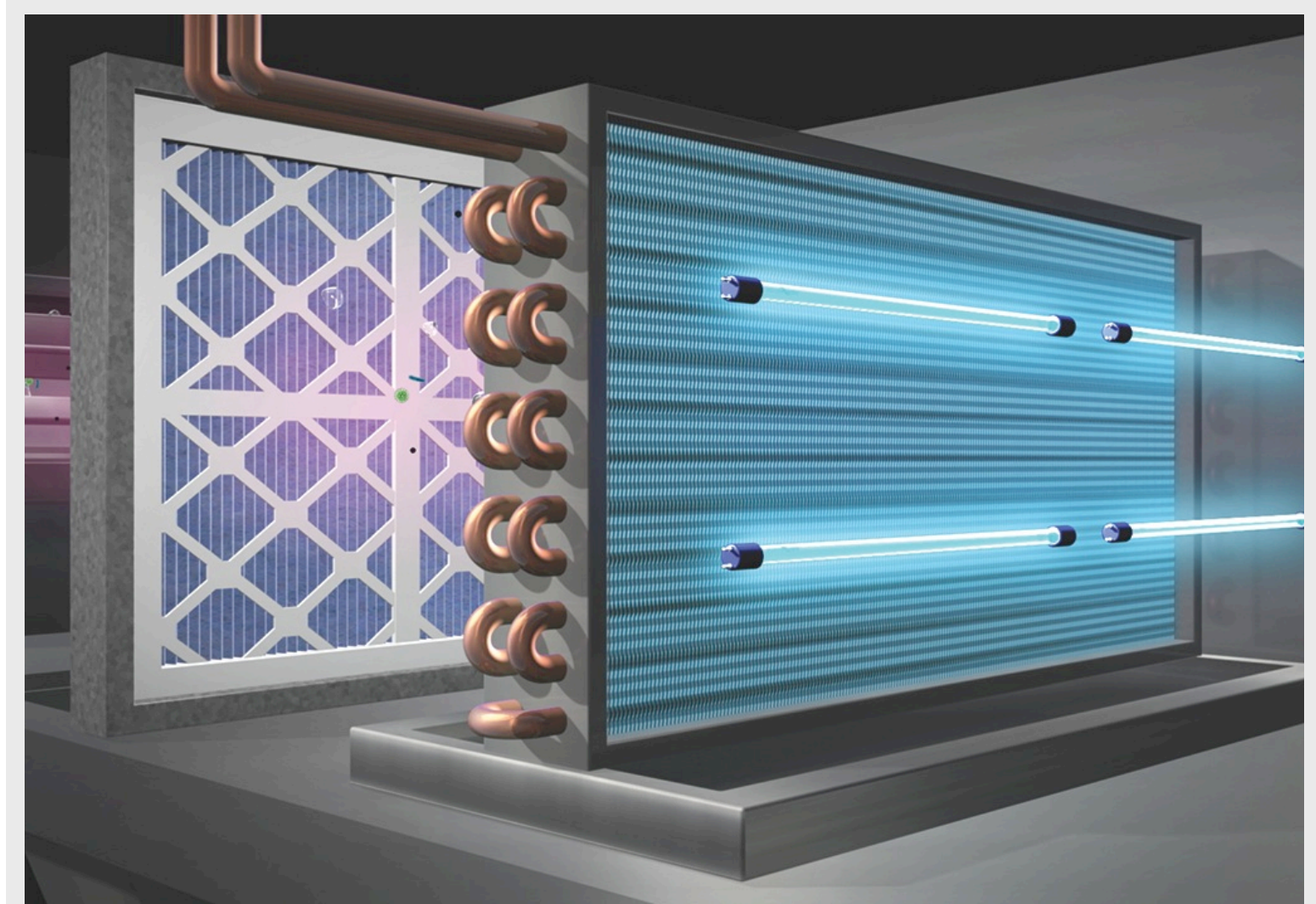
# Lámparas Ultravioleta para HVAC de Alta Intensidad

## Beneficios

Mejora la calidad del aire interior

- Elimina hongos, bacterias y virus.
- Reduce costos de mantenimiento
- Protección de la vida útil del equipo
- Ahorra hasta un **15%** en costos de energía
- Instalación fácil y rápida en equipos nuevos o usados
- Aplicaciones: hospitales, oficinas, bancos, lugares públicos, salones de clase, consultorios, restaurantes, etc.

**STERIL-AIRE**





## CASE STUDY

# UVC Goes to School

## UVC Emitters™ enhance the hygiene, and reduce illness and absenteeism at a California preschool

**A**t the Crescent Avenue Christian Preschool in Buena Park, Calif., director Marcia Sevilla is proud of their conscientious approach to health and hygiene.

"Illness prevention is a very high priority for us," Sevilla explains. "We have a book on germs that we review with the children, we talk about it a lot, and we're always making sure they wash their hands properly."

In addition to these traditional precautionary measures, this preschool uses another, more hi-tech tool for ensuring a healthy environment: ultraviolet-C, or UVC lights, installed in the air-handling system. Since installing the lights in the summer of 2002, Sevilla reports an estimated 20 percent drop in absenteeism among students and a 50 percent drop among teachers.

"Last winter was an especially bad flu season for Southern California schools," Sevilla recalls. "I can say very confidently that throughout this season, our students and teachers have had some colds, but not the humdinger fevers and flus that the other schools in our area have

consistently experienced."

Sevilla first learned about the UVC lights from a parent who had installed the devices in her home air-conditioning system in the hope of alleviating her young daughter's severe allergy-asthma symptoms. When she found that the lights were indeed effective, she suggested that Sevilla consider using the devices at the school.

**UVC benefits**

Ultraviolet-C energy has a germicidal effect on all types of microbes, including bacteria, mold and even the tiniest viruses, which are far too small to be captured by regular air filters. For many years, UV light has been used for water disinfection, but the older technology did not work effectively in air-handling systems.

The mid-1990s marked the arrival of a new-generation UVC device engineered specifically for hvac systems, capable of delivering the high output needed to perform in cold and moving air. By killing or deactivating a very high percentage of the infectious disease particles that



would otherwise circulate through the Crescent Avenue preschool classrooms, the lights can greatly reduce the spread of colds, flu, chicken pox, measles and other common illnesses.

Sevilla notes that another reason for installing the lights was mold prevention — a huge concern for school administrators everywhere. When an hvac system is in the cooling mode, its cold and dark environment provides a fertile breeding ground for mold.

These microbes grow and multiply on coil and drain pan surfaces and are then ventilated through the building, potentially causing allergic reactions that can range from sneezing and watery eyes to serious upper respiratory conditions. As long as the system runs, this vicious cycle continues. UVC energy ends the cycle by stopping mold at the source.

"We have a number of asthmatic students who bring breathing apparatus to school, so it's very important for us to make sure the air is as healthful as possible," Sevilla explains. "We feel the UVC devices have made a real difference. We've also found that some of the children who are borderline asthmatic are not tipping in that direction because of the cleanliness of the environment."

In addition, Sevilla says a teacher who has been with the school for many years has noticed that her chronic cough subsides during her hours spent at school, an improvement that has coincided with the installation of the UVC lights.

Sevilla adds, "The air even smells fresher and cleaner since installing the lights. I have many friends who direct schools. Sickiness is everywhere, but you can limit it by practicing good hygiene and by using devices like this."

The lights are installed in an air-handling unit serving the school's five classrooms. They require virtually no maintenance, she notes, except for an annual changeout of the tubes, a procedure much like changing a light bulb.

### Absenteeism and cost issues

The Crescent Avenue Christian Preschool is a year-round school with 70 students ranging in age from 2½ to 5½ years. As a tuition-based preschool, funding comes from the enrollment and from supplementary fundraising efforts for special needs such as playground improvement. Absenteeism, though a concern, is not a financial issue.

In the public school arena, however, funding is related directly to attendance. High absenteeism ultimately means less money for the school. Many studies have found that poor IAQ leads to greater absenteeism and lower productivity. Thus, educators need to recognize that good school IAQ isn't just a good idea for health reasons, it's also essential to the bottom line.

Many studies have found that poor IAQ leads to greater absenteeism and lower productivity

UVC devices are a win-win proposition for schools, because they help achieve this goal, as we've seen with Crescent Avenue Preschool and many others. The lights also offer further savings through reduced operational expenses. UVC devices have a proven track record in helping users reduce energy consumption and operational costs. By keeping coils free of mold and organic build-up, the lights bring hvac systems back to peak efficiency. Benefits include improved airflow, temperature and humidity control, the elimination of coil cleaning programs and significant energy savings. ♦

For further information, contact Steril-Aire Inc., 2840 N. Lima Street, Burbank, CA 91504; call 800-2STERIL or 818-565-1128; fax 818-565-1129; e-mail sales@steril-aire.com; or visit www.steril-aire.com

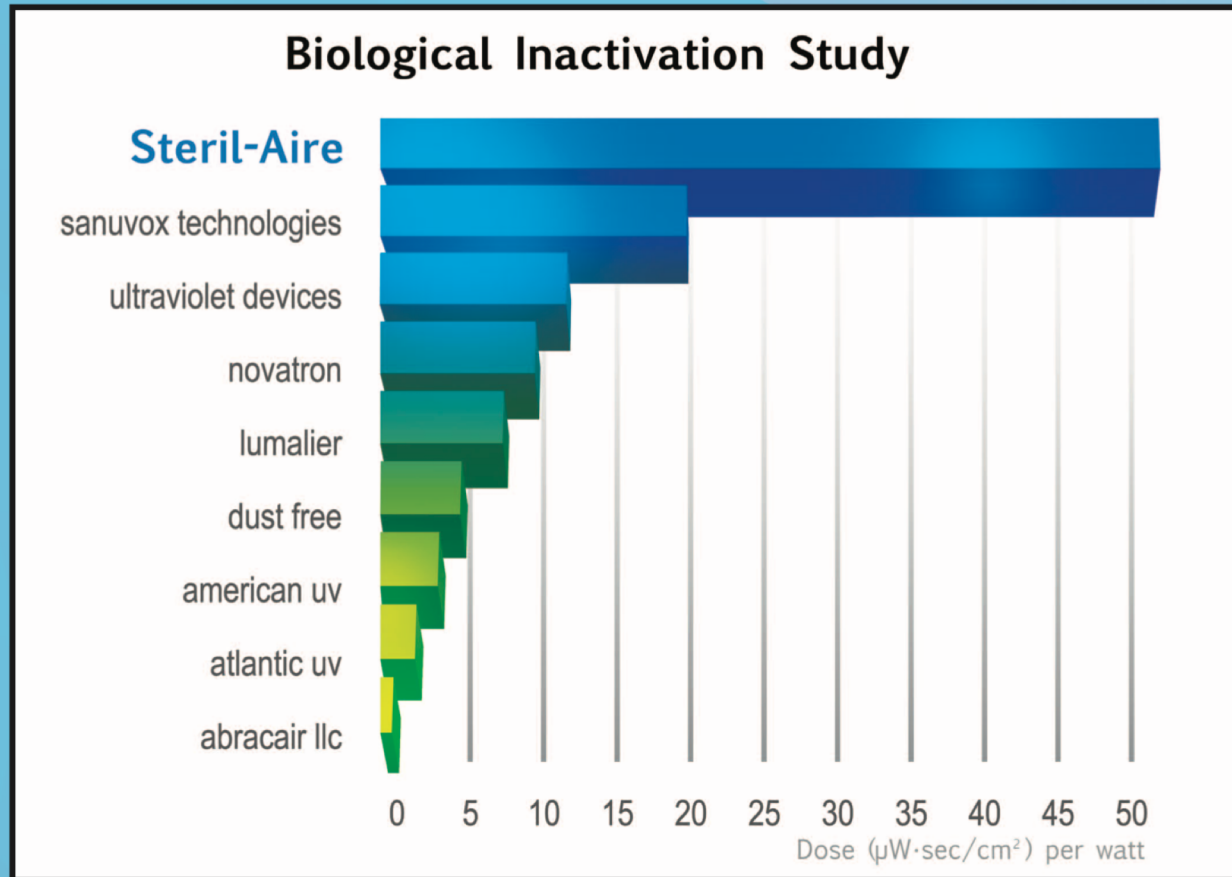


# Steril-Aire la mejor en el mercado



## U.S. HOMELAND SECURITY RESEARCH:

Homeland Security/EPA tests confirm that on average, Steril-Aire Emitters™ are 6 times more effective than the tested competition lamps, on a Kill/Watt basis.



Coils Before Steril-Aire UVC

Coils After Steril-Aire UVC



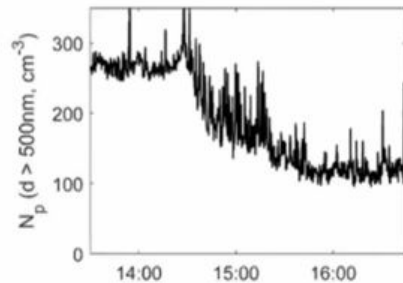
Características/Beneficios	Deventaja	Generan ozono o químicos	Estándares de la Industria / Recomendaciones por organizaciones
<b>Luz UVC de pared (AeroMed®)</b> - Desinfectan grandes volúmenes de aire con ventilación mecánica, natural o híbrida - Rayo de UVC ilumina horizontalmente la parte superior del espacio, a una altura completamente segura para los ocupantes inactivando y desinfectando virus y bacterias emitidas por personas - Inactiva el COVID19, virus y bacterias interactuando fotoquímicamente con moléculas de ARN y ADN evitando su reproducción con 99.99% eficiencia - Desinfecta y limpia desde la fuente - Independiente al sistema HVAC - Equivalente hasta 17 cambios de aire por hora o más según estudios - Recomendado para espacios con alta densidad de personas - Cambio de emisor cada 9,000 horas o una vez al año	- Mantenimiento, cada 3 – 4 meses hay que limpiar el emisor y retirar polvo que se acumula	No generan ozono ni químicos	CDC recomienda luz de pared (upper UVGI) <a href="#">CDC Guías COVID19 para Escuelas</a> <a href="#">CDC Guía COVID19 para Edificios y Oficinas</a> <a href="#">CDC Environmental Control for Tuberculosis with Upper-Room Ultraviolet Germicidal Irradiation in Healthcare Settings</a> ASHRAE <a href="#">Guidance for Building Operations During COVID-19 Pandemic</a> <a href="#">ASHRAE Epidemic Task Force</a> <a href="#">Position Document on Infectious Aerosols</a> World Health Organization <a href="#">Who Guidelines on Tuberculosis Infection Prevention and Control</a> IES <a href="#">IES Committee Report Germicidal Ultraviolet</a> NAFA <a href="#">COVID 19 and Air Filtration</a> HARVARD GLOBAL HEALTH INSTITUTE: <a href="https://ghdcenter.hms.harvard.edu/keeping-public-spaces-safe">https://ghdcenter.hms.harvard.edu/keeping-public-spaces-safe</a>
<b>Luz UVC en HVAC (Steril-Aire®)</b> - Inactiva virus, bacterias y moho con 99.99% de eficiencia - Instalado en el serpentín de enfriamiento - Ahorro de energía de hasta el 15% y ahorro en mantenimientos del equipo ya que mantiene el serpentín de enfriamiento limpio del “biofilm” - No requiere mantenimiento, solamente el cambio de emisor una vez al año o cada 9,000 hrs - Trata el aire recirculado	- Depende de los cambios de aire por hora del sistema HVAC	No genera ozono ni químicos	CDC <a href="#">CDC Guías COVID19 para Escuelas</a> <a href="#">CDC Guía COVID19 para Edificios y Oficinas</a> ASHRAE <a href="#">ASHRAE Epidemic Task Force</a> NAFA <a href="#">COVID 19 and Air Filtration</a>
<b>Ionizadores, Plasma, etc.</b> - Se generan iones provocando la atracción electrostática para precipitar partículas y depositarlas en las superficies “cargadas” mas cercana	- Algunos emiten ozono (irritante y contaminante) - <a href="#">Estudios</a> encontraron que generan compuestos químicos al ambiente dañinos a la salud de los ocupantes - <a href="#">Estudios</a> en salones han demostrado que no bajan el nivel de partículas en el ambiente - No es recomendado por la <a href="#">Fundación de Alergia y Asma de America</a> - No es recomendado por el departamento de <a href="#">Salud Pública de California en E.U.</a>	- Ozono y compuestos químicos como formaldehído, acetaldehído, acetona, butanal y tolueno - No hay estudios hechos por terceros que demuestre que funcionan, todos son de proveedor y no en escenarios reales	<b>No existe hasta la fecha ningún Estándar de la industria o estudios hechos por terceros.</b> <b>ASHRAE, CDC y EPA alertan por falta de estudios</b> <a href="#">CDC y AHRAE Position on Bipolar Ionizations</a> “Although some have suggested that these devices provide a benefit by rectifying a hypothesized ion imbalance, no controlled studies have confirmed this effect.” <a href="#">EPA link</a>

# Estudio en salón de clase

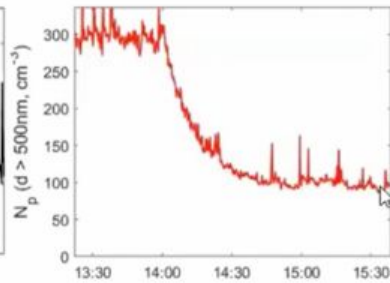
## In-Room BPI v. Proven Approaches

Classroom: 363 m<sup>3</sup>; NaCl aerosol particles (mean  $d_p = 2 \mu\text{m}$ ); SS to intervention

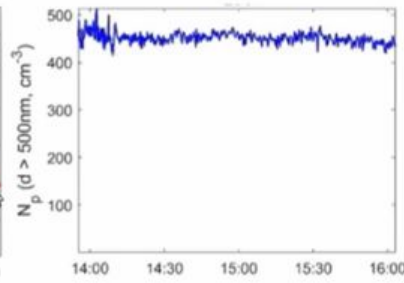
**Test 1:** Increase ventilation from 1.1 ACH – 4.6 ACH.



**Test 2:** Add in-room HEPA filtration equivalent to 1.1 ACH – 4 ACH.



**Test 3:** Add in-room bipolar ionizer

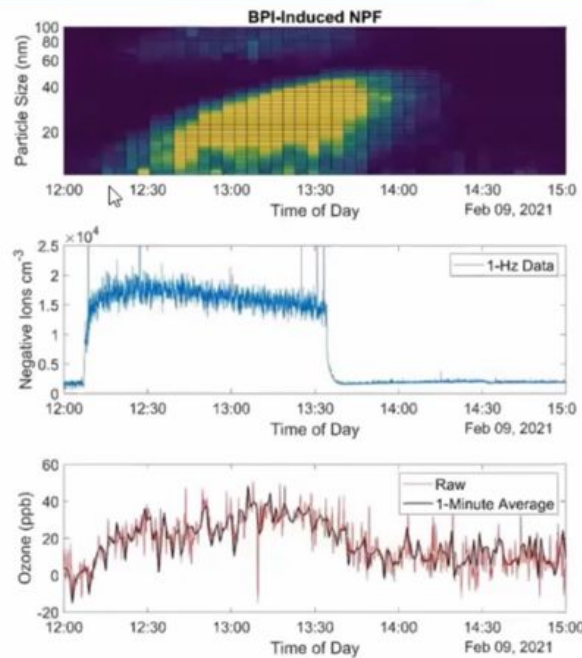


Plots/findings courtesy of Bertram Research Group, U of Wisconsin-Madison

they put in the classroom. And these are the results you get. so you don't see a nice bouquet and particle concentration when you use the bipolar annotation system.



## BPI in Classroom: UFP, Ions, Ozone



1. Strong UFP formation driven by ion-induced nucleation + in room VOC
2. UFP =  $fn(\text{ion gen rate, existing aerosol } A_{\text{surf}}, \text{ VOCs } \dots)$
3. In room ion lifetime < 1 min (**Ion Decay rate > 110 h<sup>-1</sup>**)
4. Rapid ion loss rates make in-duct ion delivery prohibitive
5. BPI can sustain in-room ion concentrations of 1-2 x 10<sup>4</sup> ions cm<sup>-3</sup> with strong spatial gradients (ventilation 1 ACH)
6. No evidence of enhanced particle deposition by charging
7. BPI O<sub>3</sub> production

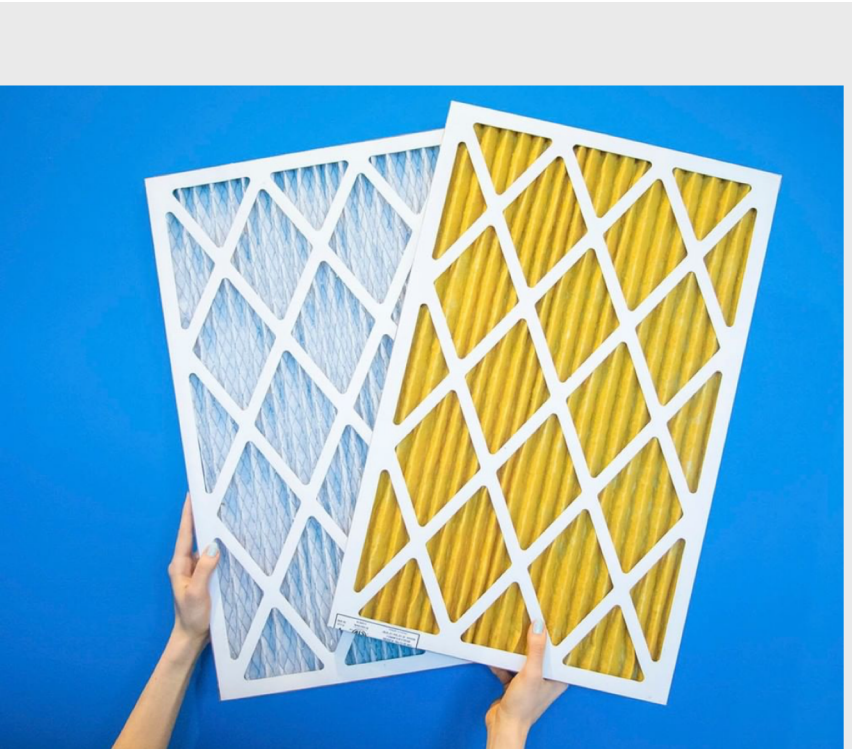
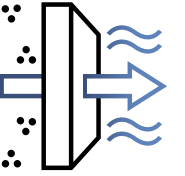
Red text added

Plots/findings courtesy of Bertram Research Group, U of Wisconsin-Madison

Essentially it's very similar to the results I just showed you from a previous study that is essentially no particle removal when the bipolar ionization systems being used some great plots here by Tim Tims team, showing on the top plot particle size versus



# Mejorar los sistemas de filtración en equipos HVAC



Mejorar eficiencia de los sistemas de filtración a través de los filtros Air-Care Pleated MERV 11 o 13 para remover partículas suspendidas en el aire con un diámetro aerodinámico de 2.5 micrómetros o menores (PM 2.5)

La filtración de partículas de alta eficiencia en los sistemas centralizados de HVAC reduce la carga aérea de partículas infecciosas.

Catálogo completo de filtros [aquí](#)



# Purificadores de aire con filtros HEPA



Purificadores de aire ayudan a diluir contaminantes que están en el aire dejando aire libre de virus, moho, bacterias, olores, polen, etc.

5 cambios de aire por hora

Podrán instalarse en:

- Oficinas
- Recepción
- Salones
- Auditorio
- Salón de cómputo
- Cafetería
- Enfermería
- Caseta de seguridad



# OTROS SERVICIOS/PRODUCTOS QUE OFRECEMOS

- Sanitización y desinfección de áreas completas y superficies con Tecnología Nebulizadora de ultra bajo volumen
- Filtros de aire (cualquier eficiencia y medida)
- Descontaminación y desinfección de ductos de aire
- Monitor de calidad de aire
- Monitor de CO2



# Beneficios de una buena calidad de aire en escuelas

Table 1. Additional benefits of higher ventilation and improved air quality in schools beyond airborne infectious disease transmission.

Impact of Ventilation	Context	Findings	Reference
↑ Test scores	Ventilation renovations were completed to improve IAQ in all school buildings within a single Texas school district.	Math and reading test scores significantly improved, with an increased probability of passing by 2% and 3%, respectively.	42
↑ Cognitive function	CO <sub>2</sub> concentrations were measured as a proxy for ventilation rates in classrooms.	Cognitive testing of students shows a 5% decrease in 'power of attention' in poorly ventilated classrooms. Researchers equate this to the effect of a student skipping breakfast.	38
↑ Math, reading, and science scores	Classroom ventilation rates were measured in 140 fifth grade US classrooms.	Mean mathematics scores increased by up to 0.5% per each liter per second per person increase in ventilation rate, with similar effects on reading and science scores.	43
↓ Asthma symptoms	Exposure factors were measured in 100 primary and secondary school classrooms with and without new ventilation systems.	Pupils who attended schools with new ventilation systems reported fewer asthmatic symptoms.	44
↓ Respiratory symptoms	Over 4,000 sixth graders from 297 schools participated in a survey of indoor environmental quality in schools.	Lower ventilation rates, moisture, and dampness were all independently associated with a higher incidence of respiratory symptoms. Inadequate ventilation was also associated with more missed school days.	45
↓ Missed school days			
↓ Child absenteeism	Increased ventilation rates and child sick days were studied for 635 children attending 20 day-care centers in Denmark.	A 12% decrease in sick days was found per hour increase in the air exchange rates.	46
↓ Missed school days	CO <sub>2</sub> as a proxy for ventilation was studied in 60 naturally ventilated primary school classrooms in Scotland.	For each 100 ppm increase in time average CO <sub>2</sub> concentration, student attendance decreased by about 0.4 days per year.	47
↓ Illness absence	CO <sub>2</sub> concentration was measured continuously over two years in 162 US primary school classrooms with a mixture of mechanical and natural ventilation.	For each 1 L/s (2.2 cfm) per occupant increase in ventilation rate, illness absence decreased 1.6%.	26

# NUESTRAS SOLUCIONES NO GENERAN OZONO

El ozono es un contaminante y un irritante de las mucosas, que al combinarse con otros elementos del medio ambiente (eje: compuestos encontrados en productos de limpieza) pueden multiplicar las partículas ultra finas contaminantes.

ASHRAE y la EPA no recomiendan el uso de generadores de ozono como un limpiador de aire, ni ninguna tecnología que emita ozono como subproducto. Incluso en el estado de California esta prohibida la venta de generadores de ozono.

Referencias:

[https://www3.epa.gov/airnow/elozono/air-quality-guide\\_ozone\\_SPA.pdf](https://www3.epa.gov/airnow/elozono/air-quality-guide_ozone_SPA.pdf)

<https://www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners>



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