



Questions and Answers on School Ventilation

Maryland Department of Health
Environmental Health Bureau

August 19, 2021



Maryland Update on School Ventilation -- August, 2021

Purpose

CORONAVIRUS

Maryland hospital beds for kids are filling up with COVID and other virus cases. When school starts, doctors say it could get worse.

By HALLIE MILLER
BALTIMORE SUN | AUG 18, 2021 AT 3:07 PM



- Practical update and guidance on COVID-19 and school ventilation to local school system chiefs, operating officers, and facilities managers as school reopen
- Practical answers to ventilation questions from local school systems
 - ❖ Short term questions on operation as schools reopen
 - ❖ Longer term questions related to building systems changes
- How to assess your facility, decide what needs to be corrected, what kind of corrective actions (mitigation) to take

Overview

- Ventilation one part of layered COVID-19 prevention strategy:
- ❖ Vaccination
 - ❖ Facial Masking
 - ❖ Screening Testing
 - ❖ VENTILATION (today's topic)
 - ❖ Handwashing and Respiratory Etiquette
 - ❖ Staying Home when Sick and Getting Tested
 - ❖ Contact Tracing in Combination with Quarantine and Isolation
 - ❖ Social Distancing
 - ❖ Cleaning and Disinfection







Improve Indoor Ventilation in K-12 Schools to Help Reduce COVID-19 Transmission

Ensuring that K-12 schools have healthy air to breathe is a no-regret investment and a cost-effective public health measure to reduce SARS-CoV-2 transmission, provide a safer environment, and improve learning.

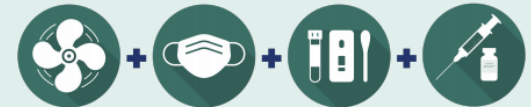
Airborne transmission of SARS-CoV-2 can be reduced by improving ventilation in school buildings and classrooms.

Ventilation improvements are a cost-effective public health measure. We can and should act to ensure good, safe indoor air quality for all students, educators, and school staff.

School administrators should:

-  Use funding provided by the American Rescue Plan to improve school ventilation and upgrade air filtration, so that the heating, ventilation, and air conditioning system can bring in as much outdoor air as it will safely allow.
-  Purchase or build HEPA air filtration units to be placed in classrooms and commonly occupied spaces.
-  Use only proven technologies for improving indoor air quality: appropriate ventilation, filtration, or ultraviolet germicidal irradiation.
-  NOT USE unproven technologies such as ozone generators, ionization, plasma, and air disinfection with chemical foggers and sprays.

Improved Ventilation, Mask Wearing, Routine Testing, and Vaccination Help Reduce SARS-CoV-2 Transmission in Schools

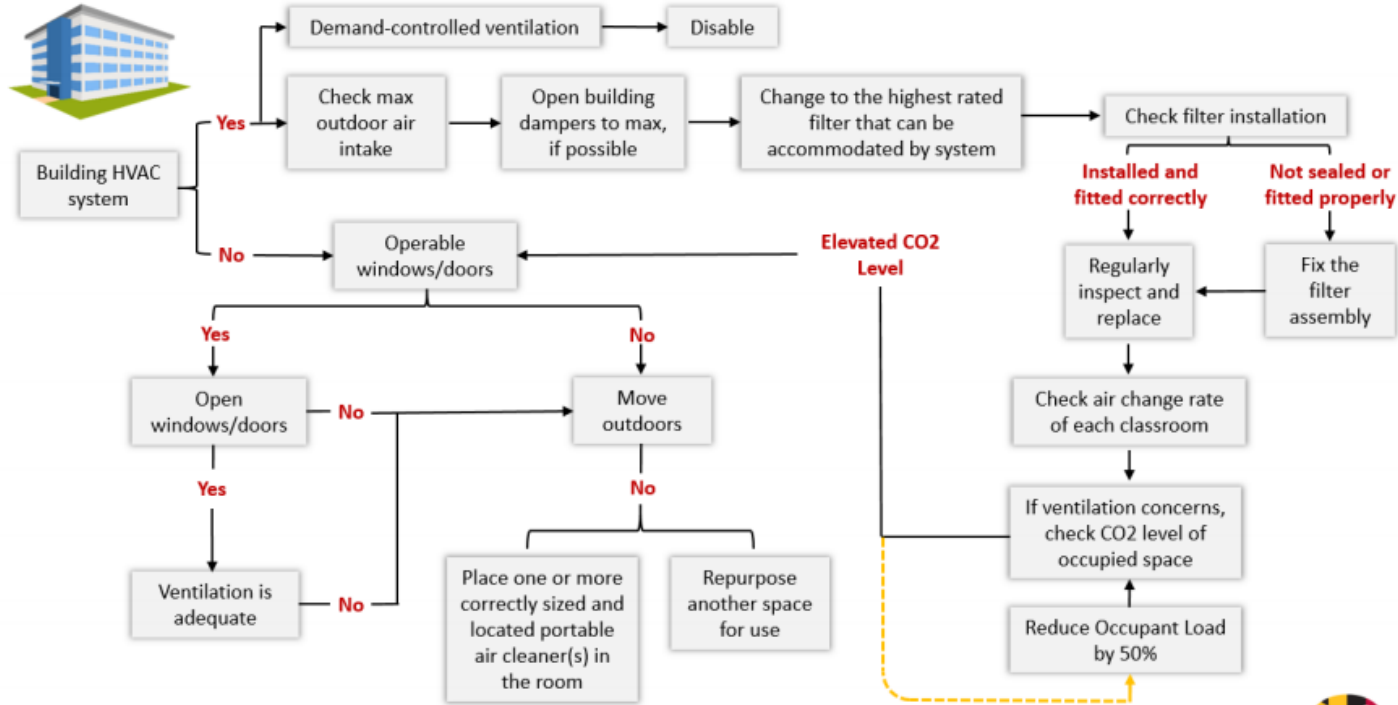


Read more: [School Ventilation: A Vital Tool to Reduce COVID-19 Spread](#)

Outline

- **What have we learned about COVID-19, ventilation, and schools since last year, and how does it affect mitigation strategies?**
 - ❖ **Key Finding: Ventilation Decreases COVID-19 Transmission**
 - ❖ **Ventilation, Filtration, and Air Quality**
 - ❖ **Non-Filter Based Air Purifying Systems: Ionization, Ultraviolet**
 - ❖ **Barriers**
- **Questions**

What is New Since 2020 IAC Guidance?



Ventilation is Protection by Dilution and/or Removal of Viral Particles

Jelena Srebric, MSc, PhD

Professor, A. James Clark School of Engineering

University of Maryland

Update: Simple but Effective Strategies

- Maintenance and walkthroughs (many problems are not high tech, but low tech -- blocked grills, reconfigured spaces with poor air circulation, non-working exhaust fans, etc.)
- When possible reduce the number of occupants and remove them from the areas close to the air exhaust or add filtration
- Special attention -- gyms, bathrooms, kitchens, health suites, etc. -- as these should have working exhaust fans (bathrooms, kitchens, etc.), or may need additional ventilation or local filtration because they have increased risk
- Support natural ventilation with at least two fans, one for supply and another one for exhaust

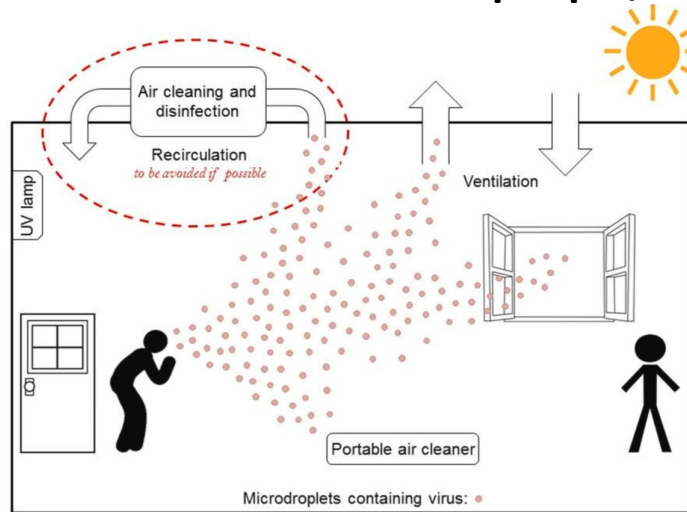
Dilution - Increasing Air Flow

CDC School Ventilation Guidance

Bring in as much outdoor air as possible.

- **If safe to do so, open windows and doors.**
- **Use child-safe fans to increase the effectiveness of open windows.**
- **Consider having activities, classes, or lunches outdoors when circumstances allow.**

Move fresh air TOWARDS people, and move exhaled air AWAY from people



Source: Morawska, L et al.
2020. How can airborne
transmission of COVID-19
indoors be minimised?
Environment International 142
(2020) 105832.
<https://doi.org/10.1016/j.envi.2020.105832>

Update: Complement to IAC Guidance

Air Changes per Hour (ACH) - Recommended ~3-5 per hour

- Volume of the room = 5 m x 3 m x 3 m = 45 m³
- Clean air delivery rate (CADR) of the HEPA unit = 200 m³ / hr
- ACH = 200/45 = 4.4 h⁻¹ (which is pretty close to 5)

CO₂ monitor for ventilation in occupied spaces

- Can show a change in CO₂ levels, but must take baseline measurement prior to implementing air quality changes
- Air Filtration will remove respiratory droplets, but not CO₂. So opening a window will change the CO₂ level, but adding air purifiers will not.



Update: DIY ACH Estimator for Classrooms

This estimator serves as a tool for calculating the ventilation rate of classroom. The yellow highlighted buttons above each listed input can be click to provide you with more information on what data is required. All values must be entered as numbers for the calculator to work!

Date (MM/DD/YYYY)	Time in (Hour : Minute)	Time out (Hour : Minute)
/ /	: AM	: AM
Number of People	CO ₂ in (ppm)	CO ₂ out (ppm)
Stories (1 or 2)	Length (ft or m)	Width (ft or m)
	ft	ft

Deployed by Facility Managers for UMD classrooms:

Ventilation Rate (ACH):

Calculate Ventilation Rate

Reset Calculator



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Improvement in Indoor Air Quality Decreases COVID-19 Transmission

Surbhi Leekha, MBBS, MPH

Associate Professor of Epidemiology & Public Health, Medical Director, Infection
Prevention and Hospital Epidemiology

University of Maryland and University of Maryland Medical Center



Impact of Ventilation Improvement in Schools

- ❖ **39% lower incidence** in schools that improved ventilation
- ❖ **48% lower incidence** in schools that combined ventilation and air cleaning (HEPA filtration/germicidal UV)
 - 169 K–5 schools in Georgia surveyed on prevention strategies, reported COVID-19 cases Nov–Dec 2020
 - COVID-19 incidence 3.08 cases per 500 enrolled students
 - Results adjusted for county-level incidence

Gettings MMWR May 2021

Efficacy of Portable Air Cleaners

- ❖ **Portable HEPA cleaners reduced aerosol exposure by up to 65%**
 - Simulated meeting of infected and uninfected individuals, with two HEPA air cleaners close to infected individual source --
 - Combination of HEPA air cleaners and universal masking reduced exposures by up to 90%

- ❖ **HEPA air cleaners in occupied high school classrooms reduced aerosol concentrations by > 90% in less than 30 minutes**
 - Tested 4 HEPA air cleaners in while classes were occurring, compared with classroom without HEPA
 - While classes conducted with windows and door closed

Lindsley, MMWR July 2021

Curtius, Aerosol Science and Technology 2021

Non-Filtering Air Sanitation Systems: Germicidal Ultraviolet

Donald Milton, MOH, MD, DrPH

Professor of Environmental Health

Maryland Institute for Applied Environmental Health,

University of Maryland School of Public Health



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Other Air Systems - Germicidal Ultraviolet Light

Consider using [upper room germicidal ultraviolet light \(UR-GUV\) air sanitation](#) (also known as UVGI) to inactivate the airborne virus that causes COVID-19 in schools and non-home-based child care programs.

80-years of experience. Proven protection against airborne infection. Because it can deliver very high rates of air sanitation, it is especially suitable for areas where masks cannot be worn (e.g. cafeterias). It is a good option when ability for increasing ventilation and filtration are limited.

Consult a qualified professional to help design and install any UR-GUV system.

[CDC Ventilation in Schools and Child Care Programs](#)



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Other Air Systems - Germicidal Ultraviolet Light

Adding GUV to a HEPA filter unit provides NO ADDED PROTECTION.

GUV in duct systems need to be properly designed and installed, require very high powered GUV lamps, but may provide energy savings relative to high efficiency filtration.

GUV in duct is not as effective as UR-GUV.



So-Called Air Purification Systems: Ions, Plasmas, Oxidation etc.

Donald Milton, MOH, MD, DrPH

Professor of Environmental Health

Maryland Institute for Applied Environmental Health, University of Maryland



So-called Air Purification Systems - Ionizers etc.

Air Cleaners (Ions, Plasmas, Oxidation etc.)

- Not tested to EPA or ASRHAE standards
- Chemical by-products from their reaction
- **Increasing air flow and filtration are simpler and more efficient**

Do not use ozone generators in occupied spaces.

Some products sold as air cleaners intentionally generate ozone. These products are not safe to use when people are present because ozone can irritate the airways. **Do not use ozone generators in occupied spaces.** When used at concentrations that do not exceed public health standards, ozone applied to indoor air does not effectively remove viruses, bacteria, mold, or other biological pollutants.

[EPA Air Cleaners, HVAC Filters, and Coronavirus \(COVID-19\) | Coronavirus \(COVID-19\)](#)

Physical Barriers Block Ventilation Air Movement

Jelena Srebric, MSc, PhD

Professor, A. James Clark School of Engineering

University of Maryland



Plexiglass and Other Physical Barriers

- ❖ Are plexiglass barriers helpful in schools?
 - No. They are most useful at places where close contact can't be achieved, such as checkout counters.
- ❖ What are the drawbacks of physical barriers?
 - They don't protect against fine aerosols
 - At a certain point, they can actually impede airflow in a space
 - They may provide a false sense of security

Summing Up

- ❖ Ventilation an integral component of layered strategy for COVID-19 prevention, regardless of other measures -- even more with Delta
- ❖ Moving air in the classroom is critical -- IAC guidance from last year is still good, regarding lower CO₂ levels (the lower the better)
- ❖ Local air filtration can be very protective, especially in rooms without a lot of moving air, and especially in the short run
- ❖ Ultraviolet effective longer term solution, especially in cafeterias, gyms
- ❖ So-called air purification technologies (ionization, plasma,oxidation) not proven to reduce transmission in schools, likely of varying effectiveness in reducing airborne virus
- ❖ Barriers -- particularly smaller barriers on desks -- are ineffective

Questions

For follow up questions about the presentation, contact
Clifford Mitchell, MS, MD, MPH at Maryland Department of Health
cliff.mitchell@maryland.gov



Other Online Resources

[CDC K-12 Schools COVID-19 Mitigation Toolkit](#)

[EPA Indoor Air Quality in K-12 Schools](#)

[Harvard Healthy Buildings Program: 5-Step Guide to Checking Ventilation Rates in Classrooms](#)

[Berkley - FAQs on Protecting Yourself from COVID-19 Aerosol Transmission](#)

[Johns Hopkins Center for Health Security - School Ventilation: A Vital Tool to Reduce COVID-19 Spread](#)