Toward healthier air in schools

The state of indoor air quality programs in K-12 schools in the U.S. & findings to guide action, 2024

Authors:

Kyleigh Gunn

M. Pilar Botana Martinez

M. Patricia Fabian

With contributions from:

Muskaan J. Khemani

Rebecca Pearl Martinez

Joseph Pendleton

The Clean air, Health and

School Sustainability (CHESS) team

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Boston University

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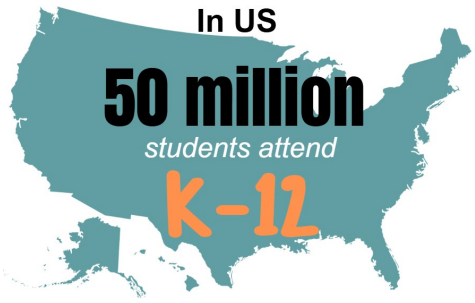
The health and learning impacts of indoor air quality in schools

Poor indoor air quality (IAQ) is a leading environmental concern that threatens public health. Consistent exposure to indoor pollutants leads to a myriad of poor health outcomes, such as acute respiratory infections, asthma, decreased lung function, and cognitive deficits, for which children are at a higher risk because of their developing respiratory systems, brain, and immune systems.



Fifty million children in the U.S. attend school in grades K-12 each day, ultimately spending about 6-10 hours inside school buildings. This adds up to approximately 3 years of a student's life. **Figure 1** shows examples of the pollutants and other environmental stressors that can be found at high levels inside classrooms. They include pollen, mold, respiratory viruses (V), carbon dioxide (CO_2), extreme temperatures (T) and relative humidity (RH), volatile organic compounds (VOCs), and particulate matter (PM). The figure also shows the potential connections between exposure to these indoor environmental factors and student and school staff health (e.g., allergies, asthma, headache, respiratory illness, mind health), absences and ultimately impacts on student learning.

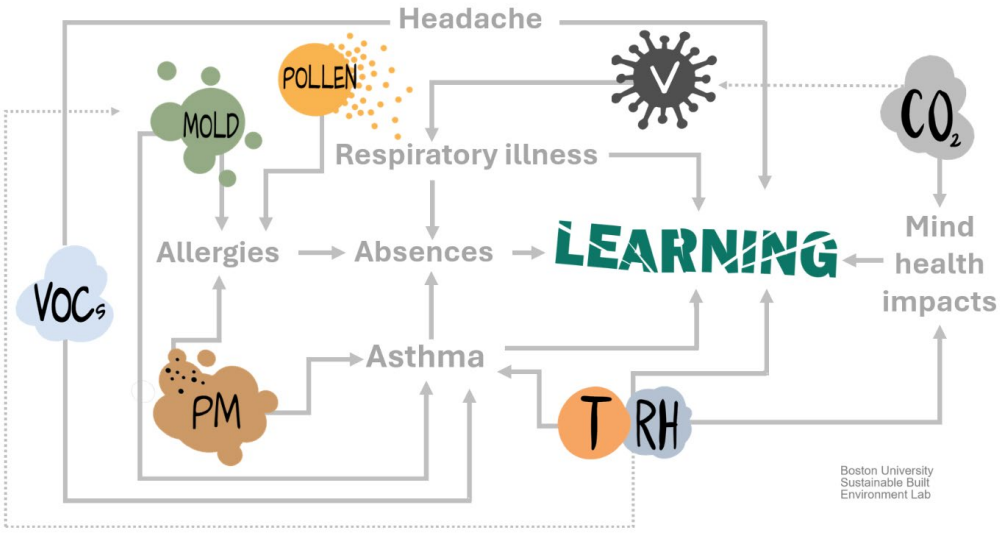


Figure 1. Potential pathways to reduced health and learning in schools due to poor indoor air quality in school classrooms. V=airborne viruses, CO2=carbon dioxide, T=temperature, RH=relative humidity, PM=particulate matter, VOCs=volatile organic compounds (adopted from Botana et al (2025), Indoor Environmental Quality and Learning in Schools).

Good indoor air quality contributes directly to students' health and learning by providing a clean environment where learning can be optimized. However, **very few policies or standards exist to regulate indoor air quality inside school buildings, and most indoor air quality investments are formulated as voluntary commitments. As a result, school decision makers often face competing priorities when allocating resources. With limited IAQ policies and constrained budgets, improvements in indoor air quality in schools progress slowly** (USGBC, 2023) **.**

Methods to characterize the IAQ landscape in K-12 schools

We conducted a manual web search using a series of guiding questions regarding IAQ policies in schools about school IAQ assessment policies, IAQ monitoring, and alignment with national programs with best IAQ practices for schools, focusing on a sample of representative public school districts across the U.S. The search was conducted during Summer 2024.

To select a representative sample, we identified the two largest public school districts in each of the 9 climate regions in the U.S. (National Center for Environmental Information (NCEI, NOAA). These climate zones are Northwest, Northern Rockies and Plains, West coast, Southwest, South, Upper Midwest, Ohio Valley, Southeast, and Northeast, defined by their unique climate and challenges. If the two largest districts were in the same state, we looked for the next largest district in a different state in the same climate zone. Data from a 2001 survey from the National Center for Education Statistics (NCES, 2001) was used to identify the largest school districts. We also included the Washington, DC school district, as well as the largest school districts in Alaska, Hawaii, and Puerto Rico, which are not part of the continental climate zones. Boston Public Schools District was also included as the first adopter of district-wide IAQ monitoring in the U.S., **for a total of 23 K-12 districts**. See the location of each of the school districts and general size based on student population in **Figure 2.**

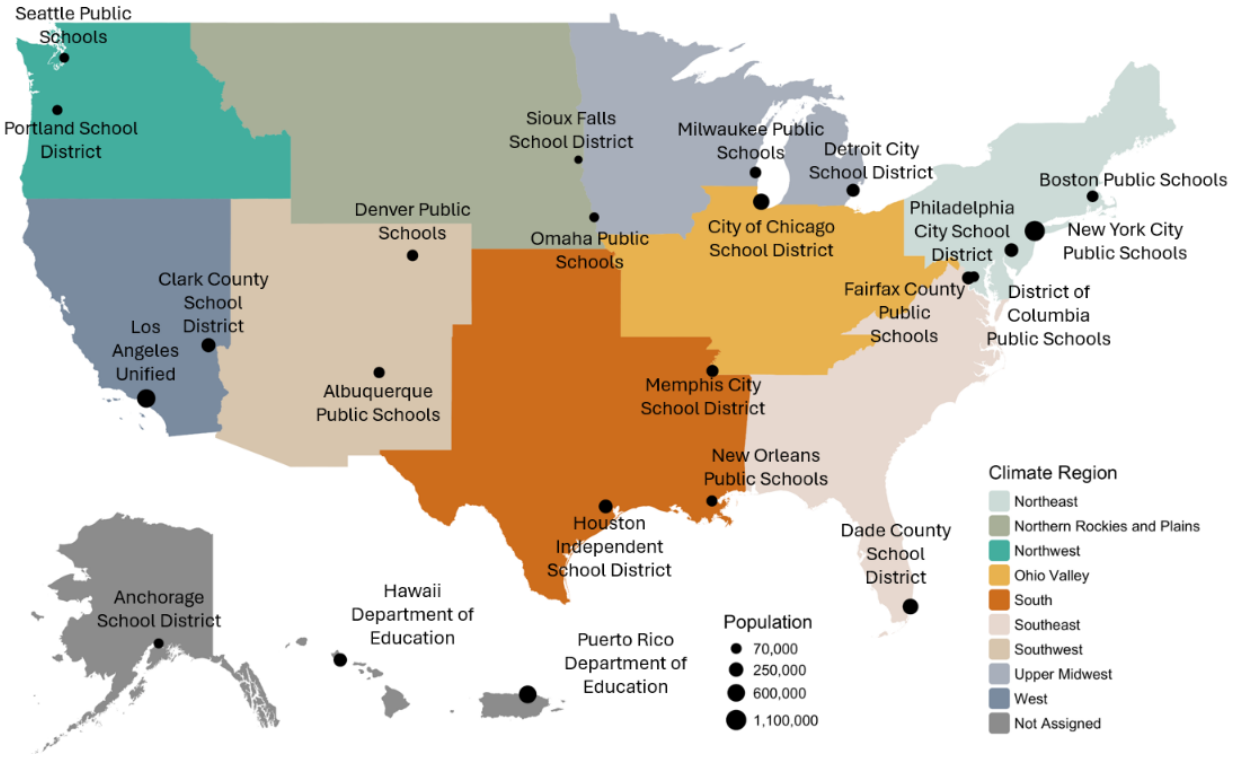


Figure 2. Map showing the public school districts included in this study, with student population information.

Through the manual web search, we looked to answer the following nine questions, organized in three domains: **a)** IAQ assessments, **b)** Alignment with organizations or programs promoting IAQ in schools, **c)** Comprehensive IAQ monitoring.

IAQ assessments:

1. **Is there a state or local mandate to assess IAQ in schools?**
2. **Does the district monitor classroom ventilation systematically?**
3. **Does the district conduct systematic IAQ inspections?**

Alignment with national organizations or programs promoting IAQ in schools:

4. **Does the district website mention the *EPA Tools for Schools* program?**
5. **Is the district part of the *EPA IAQ Champions* program?**
6. **Is the district part of the *Healthy Green Schools* program?**

Comprehensive IAQ monitoring

7. **Has the district installed a significant number of permanent IAQ monitors?**
8. **Does the district use an IAQ sensor dashboard?**
9. **If so, is the IAQ dashboard data posted publicly?**

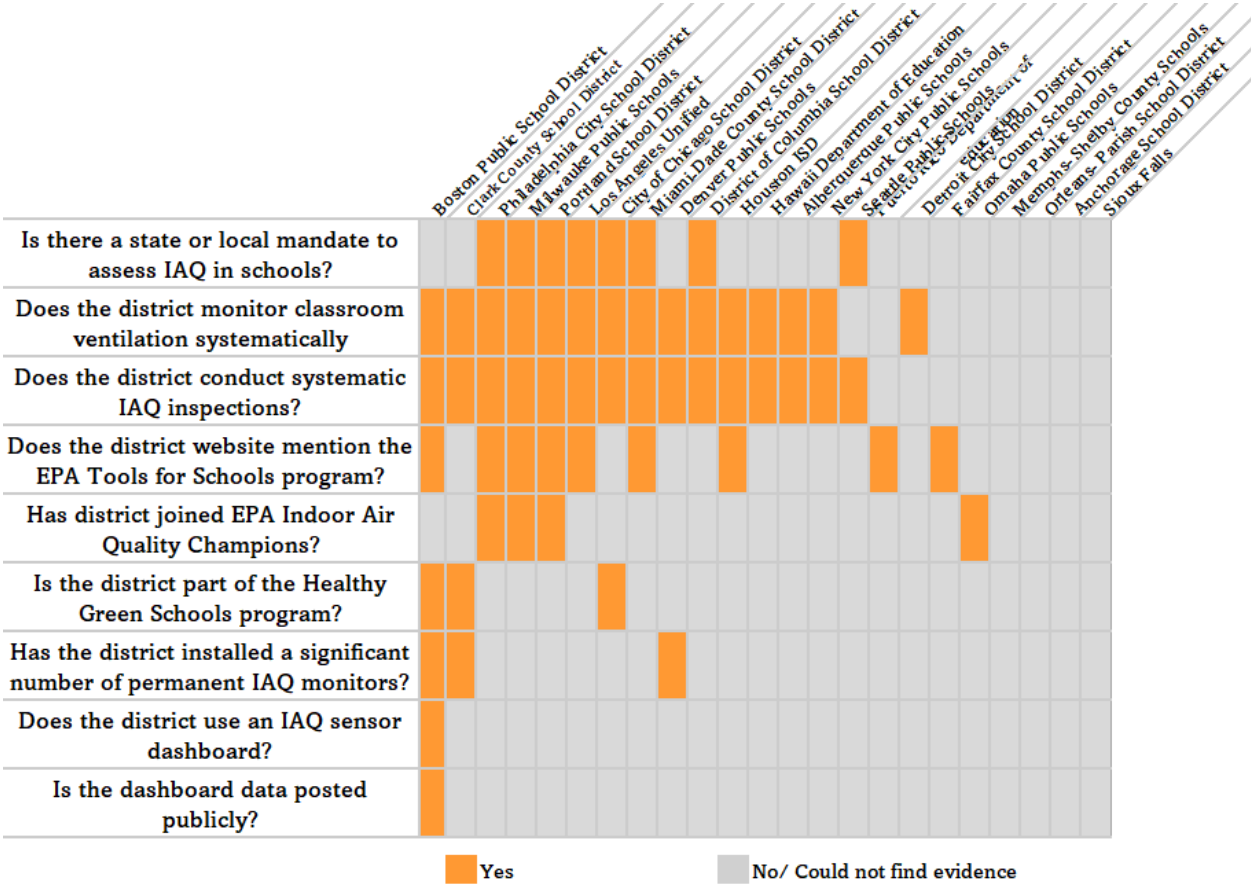
We investigated participation in the EPA and Healthy Green Schools programs because they are national in scope and freely available to school districts. The EPA Tools for Schools "shows schools how to carry out a practical plan to improve indoor air problems at little- or no-cost using straightforward activities and in-house staff. The Action Kit provides best practices, industry guidelines, sample policies, and a sample IAQ management plan" (EPA tools for schools). The EPA IAQ Champions program "consists of individuals, schools and school districts that have been recognized by EPA for their achievements in improving IAQ (EPA IAQ Champions). The Healthy Green Schools program "gives facility management professionals the tools to make a big difference in indoor air quality without major capital investments" (Healthy Green Schools).

We looked for online information on the school district websites as well as gray literature, news articles, and other publicly available online materials. We used a mixed methods approach to analyze the data, including quantitative summaries of the questions investigated, and qualitative analysis conducted from online content. For the nine questions posed above, answers were classified as "Yes" if there was evidence found online, and "No or could not find evidence" otherwise. We summarized the responses by school and conducted content analysis on news articles and other online materials to identify emerging barriers and facilitators to the development and implementation of IAQ policies in schools. Our findings are summarized in 7 key themes supported with data summaries and/or quotes.

Findings: Emerging barriers and facilitators to adopt and implement programs to improve IAQ in U.S. schools

A summary of how many school districts were classified as "Yes" or "No or evidence not found" for the nine questions investigated is presented in **Table 1**.

Table 1. Answers to questions about IAQ program participation, classified by school district (n=23).



Key themes:

1. School districts are demonstrating limited participation in national programming that supports IAQ best practices

While school IAQ best practices and recommendations are available at no cost, their adoption is slow. There were only **5** schools with positive responses to at least half of the questions in the study. Referencing EPA Tools for Schools, joining EPA Indoor Air Quality Champions, or the Healthy Green Schools program had low adoption rates within the sample (**41%, 18%, 14%** respectively). Availability of permanent IAQ monitoring in classrooms is also low (**14%**).

2. School administrations are wary of the impact of IAQ data transparency on public image

Concerns surrounding the impact of data transparency prevent school districts from publicizing indoor air quality information

At the time of the study, only **14%** of the schools in the sample had installed a significant number of permanent IAQ monitors in classrooms. However, only **one** of the schools shared the data publicly – Boston Public Schools. Based on web content analysis we found that school districts may be concerned about public air quality data interfering with enrollment rates and public image. Fears surrounding the impact of data transparency may prevent staff at schools from publicizing information from CO_2 sensors and indoor air quality inspection reports. This concern is a barrier to implementing IAQ monitoring practices in school classrooms.

[Supporting quote]

"There's a possibility that schools might not want these data about the indoor air quality, the outdoor air quality right outside the school to be made publicly available. Because if a school potentially had some bad indoor air quality, they wouldn't want that to affect who chooses to go to the school."

-Beia Spiller, Director of Resources for the Future Transportation Program
Resource Magazine, 2022

3. Limited resources are a significant barrier to adopting and implementing IAQ policies in schools

Schools with limited resources and funding may not be able to afford to pursue all areas of IAQ management, such as IAQ monitoring. Even if schools can finance IAQ monitoring, they might not have the staff to internally coordinate preventive action. In some cases, it might be more beneficial for schools to invest in other programs, such as integrated pest management, filtration, or ventilation system upgrades.

[Supporting quote]

"It's up to each individual school district to make sure that they implement the indoor air quality requirements put out by the New Mexico Public Education Department (NMPED), said Antonio Ortiz, NMPED's finance and operations director, in an interview Monday." "We don't have the staff or capacity at NMPED to go out there and go verify every single building [ ],"

-Antonio Ortiz, *Finance and Operations director of the New Mexico Public Education Department.*
Source NM magazine, 2022

4. Mechanical ventilation improvements and good IAQ management practices are a good alternative to IAQ monitoring for some schools

Air quality monitoring is not the only pathway to good IAQ. For schools/districts with fewer resources, investing in HVAC (heating, ventilation, and air conditioning) maintenance and upgrades may be the best approach.

Based on EPA Tools for Schools recommendations, IAQ monitoring would be included in a school district's IAQ management plan. However, funding and staff limitations restrict school districts' capacity to maximize EPA recommendations. It is possible for schools to make strides in how they manage indoor air quality without meeting these federally recommended approaches. Rather than investing in comprehensive IAQ monitoring, some schools may choose to put their money into interventions that directly address IAQ in classrooms. For example, Sioux Falls school district, with 25,000 students in 2021, has very little IAQ infrastructure in place. However, after receiving federal grant following the COVID-19 pandemic, they invested the funding in new air filtration systems to improve IAQ in classrooms, and installed high-tech ionizing air filtration in systems in 37 buildings as of 2022 (Argus Leader, 2021).

5. Capacity for implementation and coordination of IAQ programs is scarce

Lack of effective staff coordination is a barrier to implementing preventative IAQ policy.

Organizations such as the EPA, American Lung Association, and the local public health agencies offer schools a myriad of recommendations and good practices to promote good IAQ in schools; however, schools need an IAQ coordinator to internally organize staff and implement guidelines and policies. We did not find information specific to the existence of an IAQ coordinator for most of the schools in this sample. The disconnect between agency recommendations and school operations' structure and resources may hinder implementation of recommended best practices. In the absence of a formal IAQ coordinator, schools could leverage existing resources such as the EPA Indoor Air Quality in Schools to guide the process of identifying a potential IAQ coordinator among the existing staff, or contract services to implement IAQ policies.

[Supporting quote]

" We have internal environmental staff….we do our own investigations for asbestos, mold, through work order system… my recommendation to you if you don't have that internal staff, is [ ] use the Green School Standard to figure out how you can identify potential staff in the district already that can implement that standard and then supplement that with professional services, you know environmental contractors that can come in and help you get that program going."

-Lori Olson, *Director of Environmental Services at Clark County Public Schools. Green Healthy Schools Panel.*

6. Community science efforts can support IAQ initiatives

Community science initiatives are another workaround enabling school districts to address indoor air quality.

Advances in air quality sensing, and the availability of low-cost IAQ monitors, are enabling community science initiatives to address environmental health issues in their schools. For instance, an initiative to measure air quality in Denver Public Schools helped raise student awareness and understanding of the importance of IAQ in their classrooms (PBS, Colorado Voices, 2021). Despite these benefits, such initiatives may encounter resistance from organizations with conflicting interests. However, community-driven advocacy can play a crucial role in overcoming these hurdles.

[Supporting quotes]

"being indoors, indoor air quality plays a huge role preventing transmission, how can our knowledge keep us and our staff and family as safe as possible? [ ] the monitors [] are measuring CO2 and we can see now that when these levels are going above 800 your ventilation and filtration may not be what you want it to be, so we learn if levels go above 800 what we can do to change that…add filtration, increment air ventilation, what do we have in our power, that will not cost schools a million dollars and can contribute to safety? [ ] what we found is that our building is phenomenal [ ] what can we be doing as a district, and as an individual schools so that everyone has the luxury to feeling as safe as possible here?".

***-Sarah Peterson, 11th** Grade Science Teacher,* "Colorado voices", 2021 PSB

"I get teary-eyed because for me, it's been a lifetime of trying to find this kind of technology (mobile air monitoring vehicles) that communities could have," [ ]"(Lawmakers) are making one hurdle after another to stop communities and discourage them from collecting any data by saying even if you collected it, we're not going to count it; it's not going to be important".

-MaryLee Orr, Louisiana Environmental Action Network (LEAN) executive director, *Luisiana Illuminator Newsroom, 2024*

7. Local IAQ regulations can have a positive impact on school IAQ practices

School districts under state laws that address school indoor air quality had a considerably larger number of positive answers to our study questions than districts in schools without these regulations, as shown in **Figure 3,** suggesting that state-wide IAQ requirements may cultivate the awareness on the importance of classroom IAQ, and facilitate the implementation of good IAQ practices.

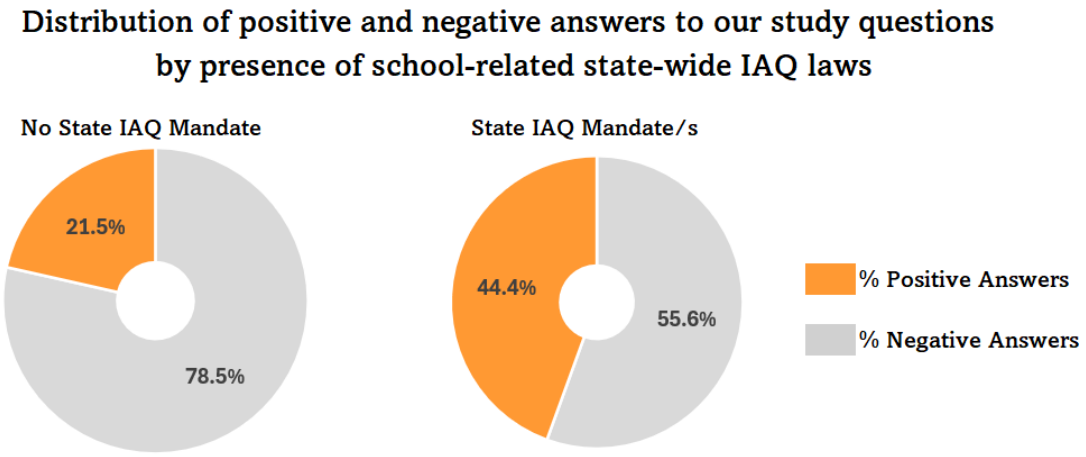


Figure 3. Percentage positive answers by local school indoor air quality (IAQ) mandate status. Presence of state IAQ laws is based on the Environmental Law Institute (ELI) Database of State IAQ laws, Schools Excerpt (ELI, y2024).

Closing comments

At the time of this report, the EPA was launching a $34 million dollar initiative to support development of IAQ monitoring programs in K-12 schools across the U.S. Five grants were awarded to U.S. Green Building Council's Center for Green Schools, American Lung Association, University of Utah, New York State Department of Health and Health Research Inc. and Go Green Initiative (EPA. IAQ Schools. Funding). Additionally, school districts like Montgomery County, Denver Public Schools and others were in the process of installing thousands of real-time IAQ monitors. We anticipate that this scale of investment and new attention to IAQ will catalyze expanding IAQ monitoring and management in schools. This document will be updated regularly to capture the changing landscape.

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