MEETING OF THE DISTRICT OF COLUMBIA STATE BOARD OF EDUCATION
Public Meeting on Indoor Air Quality in Schools
Statement of Corey Metzger
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Good evening, Members of the D.C. State Board of Education. Thank you for your work to improve the quality of public schools in the District of Columbia for the thousands of students, educators, and staff that occupy these facilities each day.

I am honored to be invited to speak today on the important issue of indoor air quality, or IAQ, in D.C. schools. I serve as a Director-At-Large on ASHRAE's Board of Directors, as Chair of ASHRAE Technical Committee 9.7 – Educational Facilities, and as a member of ASHRAE's Environmental Health Committee. ASHRAE is a global technical and professional society of over 54,000 members dedicated to advancing the arts and sciences of heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world.

One of ASHRAE's key areas of focus is development of consensus-based voluntary standards and guidelines for the built environment. ASHRAE has over 100 active standard and guideline project committees, addressing such broad areas as indoor air quality, energy efficiency, refrigerant safety, building decarbonization, and risk management for building water systems. The people who serve on these committees are volunteers, and their work guides the industry. ASHRAE Standards are written with mandatory, enforceable language while ASHRAE Guidelines provide information, recommendations, or other content not intended to be incorporated into laws, codes, or ordinances.

While significant evidence suggests that improved indoor air quality results in positive benefits for occupant health, performance, and satisfaction, I intend to let other panelists address these benefits and will focus on technical resources available for improving IAQ.

ASHRAE Standard 62.1 – Ventilation and Acceptable Indoor Air Quality, provides multiple pathways for design and operation of ventilation systems for commercial buildings to maintain acceptable indoor air quality. ASHRAE has published multiple iterations of Standard 62 since 1973, which eventually became two separate standards; Standard 62.1 applies to commercial buildings and Standard 62.2 applies to residential buildings. Standard 62.1 is intended to "…provide indoor air quality (IAQ) that is acceptable to human occupants and that minimizes adverse health effects." Standard 62.1 does not address health care facilities and is not intended to address significant spread of airborne pathogens.

ASHRAE Standard 241 – Control of Infectious Aerosols, provides guidance for mitigating transmission of airborne pathogens. This standard does not directly address indoor air quality, though compliance with Standards 62.1, 62.2, or 170 is a requirement. The standard is intended to address long-range transmission of infectious aerosols, but transmission risk may still vary due to "diversity of infectious agents and personal susceptibility." This Standard is the first consensus-based standard to establish minimum requirements to reduce the risk of disease transmission in indoor environments. This Standard was created in response to the COVID

Pandemic on an accelerated schedule at the request of White House Personnel, and the development was chaired by Dr. William Bahnfleth, who also served as Chair of the ASHRAE Epidemic Task Force during the pandemic.

ASHRAE Guideline 42 – Enhanced Indoor Air Quality in Commercial and Institutional Buildings provides guidance for design and operating strategies that exceed minimum requirements of Standard 62.1 to achieve enhanced IAQ. This Guideline was authored by the Standard 62.1 Committee.

ASHRAE Guideline 44 – Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events was just published in November of 2024. This document is intended to address the operation of buildings with the increased prevalence of wildfires creating unacceptable outdoor air conditions. ASHRAE has temporarily made this Guideline available for free viewing in response to the devastating wildfires in the Los Angeles, California area.

Each of the standards and guidelines above provides information related to the design and operation of facilities to address concerns associated with IAQ. Taken together, the implementation of these standards and guidelines can be used to create and maintain resilient facilities that provide enhanced indoor air quality during normal operations, while reducing potential for transmission of airborne pathogens and being prepared to address issues with poor outdoor air quality. With proper planning, many facilities may be able to be designed and operated in accordance with Standard 62.1, Guideline 42, and the Infection Risk Management Mode requirements of Standard 241 under all normally occupied periods without significant impacts to operating costs or energy use.

A key factor for the successful implementation of any of these standards or guidelines is operations and maintenance. Standard 62.1, Standard 241, and Guideline 42 all include detailed requirements for operation and maintenance, intended to ensure that systems don't just operate properly when initially commissioned, but that they continue to provide appropriate IAQ throughout their operating lives.

ASHRAE publishes several other standards and guidelines related to IAQ, along with additional related resources. Technical Committee 9.7 developed a document titled Design Guidance for Education Facilities: Prioritization for Advanced Indoor Air Quality. This document is currently under revision and a new version, addressing alignment with the previously referenced standards and guidelines, should be published in the next few months.

Again, I would like to recognize your commitment to providing suitable educational environments for the students, educators, and staff throughout D.C. schools. The information I have presented is not intended to suggest that you don't have existing facilities that meet some or all of the standards and guidelines presented, and it is also not intended to suggest that your facilities aren't maintained properly. That said, Standard 241, Guideline 42, and Guideline 44 have all been released in the past two years, so many existing systems may not meet the requirements or recommendations of these documents.

Adoption of some or all of these documents as design and operation standards for D.C. school facilities could help to ensure that proper IAQ is provided for all building occupants.

I have included several ASHRAE Public Policy Issue Briefs and Fact sheets as attachments to this testimony. Additionally, ASHRAE Position Documents, which are typically longer with more significant technical detail, are available for reference at:

https://www.ashrae.org/about/position-documents

Thank you for the opportunity to speak to you today. I would be happy to answer any questions you may have.

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ANSI/ASHRAE Standard 62.1-2022
Ventilation and Acceptable Indoor Air Quality

Purpose
Specifies minimum ventilation rates and other measures intended to provide indoor air quality that is acceptable to human occupants, and minimizes adverse health effects, such as breathing difficulties and sick building syndrome due to poor indoor air quality. In addition to ventilation, this standard contains requirements related to certain contaminants and contaminant sources, including outdoor air, construction processes, moisture, and biological growth. The standard is written to be used for new buildings, additions to existing buildings, and certain changes to existing buildings. Additionally, Standard 62.1 can be used to guide the improvement of IAQ in existing buildings, through its operation and maintenance requirements.

Significance

Standard 62.1 is uniquely qualified to address ventilation and acceptable IAQ in the built environment and will enable stakeholders to make a conscientious effort to improve the indoor environment while maintaining a minimum standard for ventilation.

The standard is the basis for ventilation-related requirements in the International Code Council's (ICC) International Mechanical Code and the International Association of Plumbing and Mechanical Officials' (IAPMO) Uniform Plumbing Code. Many state and local building codes also include Standard 62.1 when addressing building ventilation, although the O&M requirements are not generally included. This could result in buildings having the right equipment and systems installed, but not running properly.

Scope

Standard 62.1 applies to all indoor or enclosed spaces that people may occupy, except where other applicable standards and requirements dictate larger amounts of ventilation. The standard does not apply to dwelling units (e.g., homes, apartments, condos), which are covered by ASHRAE Standard 62.2, *Ventilation and Acceptable Indoor Air Quality in Residential Buildings*, or healthcare occupancies, which are addressed by ASHRAE Standard 170, *Ventilation of Health Care Facilities*. However, Appendix D does include ventilation rates for outpatient facilities where an authority having jurisdiction (AHJ) determines Standard 170 is not applicable.

Additional Facts:

- Cost-benefit analyses have estimated the health and economic benefits of improved IAQ to be far greater than the costs of implementing strategies that yield IAQ improvements.[1]
- Guideline 42, *Enhanced Indoor Air Quality in Commercial and Institutional Buildings*, supplements Standard 62.1 by providing to a global audience of engineers, designers, hygienists, air quality practitioners, and building owners a roadmap of varied, evidence-based best practices for improving ventilation and acceptable IAQ beyond minimum requirements. The guideline steps users through concepts, research, and processes that have proven useful when effectively designed, installed, and operated. Learn more and get your copy at https://bit.ly/3GOEGs5.
- Recognized in GSA Publication P100, *Facilities Standards for Public Building Service* as the consensus standard prescribing ventilation requirements in the United States.
- Standard 62.1 is referenced in 18 state codes.
- Referenced by the CDC's National Institute for Occupational Safety and Health (NIOSH)
- Its compliance is a prerequisite for Leadership in Energy and Environmental Design (LEED™) certification.
- Covers wide-ranging topics related to IAQ, including outdoor air

[1] ASHARE. June 28, 2023. *ASHRAE Position Document on Indoor Air Quality*: https://www.ashrae.org/file%20library/about/position%20documents/pd_indoor-air-quality-2023-06-28.pdf

quality, HVAC system designs, natural ventilation, envelope design and construction, and operations and maintenance.
- Offers three methods of compliance, a prescriptive approach (Ventilation Rate Procedure), a performance approach (Indoor Air Quality Procedure), and a Natural Ventilation Procedure.
- Provides additional requirements for operations and maintenance practices to reduce indoor pollution sources, such as carbon dioxide, carbon monoxide, or volatile organic compounds (VOCs).

Changes and Improvements from Standard 62.1-2019

- Improved IAQ procedure and modified maximum dew-point temperatures in mechanically cooled buildings and the required exhaust air separation distances.
- Relocated section on outpatient/ambulatory surgery and support care spaces to a new appendix.
- Added normative reference to ASHRAE Standard 170 for healthcare zones.
- Reorganized Section 5, “Systems and Equipment” to better illustrate how buildings, systems, and equipment are related.
- Updated to include air conditioning units within the occupied space.
- Replaced ‘cooling tower’ with ‘evaporative heat-rejection equipment’ to clarify the intent of the requirements with respect to non-evaporative heat rejection equipment.
- Included normative reference to ASHRAE Standard 180 for Legionella control.

Standard 241

ASHRAE Standard 241, *Control of Infectious Aerosols*

Purpose

To establish minimum requirements for control of infectious aerosols to reduce risk of disease transmission in new and existing buildings, and major renovations to existing buildings, including requirements for both outdoor air system and air cleaning system design, installation, commissioning, operation, and maintenance.

Significance

Requirements for airborne infection risk management have been absent from indoor air quality (IAQ) standards for a century, with the exception of those written for health-care facilities and laboratories. In 1895, ASHRAE's predecessor society, the American Society of Heating and Ventilating Engineers (ASHVE), published ventilation recommendations intended to reduce disease transmission that were included in a proposed 1914 model law and adopted in 22 U.S. state codes by 1922. Since the 1930s, however, IAQ standards have focused on perceived air quality and control of chemical and particulate contaminants, reducing minimum ventilation rates by half.

The COVID-19 pandemic, together with the evidence that poorly ventilated buildings can be high risk environments for airborne infection transmission, brought the adequacy of existing IAQ standards under heavy scrutiny. ASHRAE rose to the challenge of creating a comprehensive, consensus-based, code enforceable standard to mitigate the risk from respiratory pathogens by assembling a committee of international experts that spent thousands of hours in development and addressing more than 1,000 comments received.

The U.S. White House COVID019 Response Coordinator, Dr. Ashish Jha, remarked that **Standard 241 *"is one of the most important public health interventions I have seen in years, if not decades.*** *It is really heartening to see this organization take a central role in tackling the biggest challenges facing human health in the U.S. and around the world."*

Scope

Standard 241 defines the amount of equivalent clean airflow met by a combination of of ventilation, filtration, and air cleaning necessary to substantially reduce the risk of disease transmission during infection risk management mode, which is the operating mode when increased protection from infectious aerosol exposure is needed. A prerequisite for meeting Standard 241 is compliance with the applicable version of ANSI/ASHRAE Standards 62.1/62.2, or ANSI/ASHRAE/ASHE Standard 170 (or approved equivalent) at the time of construction or major renovation. The standard focuses on indoor long-range transmission and may not substantially reduce transmission risk in all situations due to the diversity of infectious agents and personal susceptibility.

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Highlights

✓ Equivalent clean airflow requirements are the single most important aspect of Standard 241, which are determined by the space type, number of occupants, and met by a combination of ventilation, filtration, and air cleaning. The standard provides great flexibility to determine how to achieve compliance with the standard through various combinations of these tools.

✓ The standard provides extensive requirements for mechanical filters and air cleaners, including required testing for performance and safety. Mechanical filters must be at least MERV-A 11 or equivalent. Air-cleaner requirements are technology-agnostic.

✓ Safety testing requires measurement of formaldehyde, ozone, and particulate matter emissions to meet target levels.

✓ The standard includes extensive requirements for assessment, planning, commissioning, operation and maintenance of infectious aerosol control systems, which revolve around the development of a Building Readiness Plan.

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INDOOR AIR QUALITY

THE ISSUE

The average adult breathes about 2,000 gallons (7,570 liters) of air each day and most Americans spend around 87% of their time inside buildings – amplifying the importance of indoor air quality. The quality of the air inside our buildings has a significant impact on a person's health, performance and wellbeing. Indoor air is a significant exposure route for airborne contaminants and may contain particles and gases with impacts that range from eye and lung irritation to exposure to infectious pathogens, poisonous compounds, or carcinogens. These contaminants can impact health, comfort, well-being, learning, sleep, and work performance.

The direct connection between health and wellness encourages building designers and operators to prioritize indoor air quality (IAQ) in buildings. Cost-benefit analyses have estimated the health and economic benefits of improved IAQ to be far greater than the costs of implementing strategies that yield IAQ improvements. There are three widely accepted approaches to improving IAQ – source control, ventilation, and air cleaning. Many strategies exist within these approaches that can help achieve good IAQ efficiently and can be implemented to lower energy use and improve occupant satisfaction.

ASHRAE's ROLE

The critical connection between IAQ and building HVAC systems has made IAQ a fundamental issue for ASHRAE and its members for more than 50 years. ASHRAE provides technical resources, coordinates and funds research, organizes conferences, and educates practitioners about IAQ.

ASHRAE developed and continues to support standards, guidelines, and other resources related to efficiently improving IAQ, such as:

- ***ANSI/ASHRAE Standard 62.1, Ventilation and Acceptable Indoor Air Quality*** – This Standard establishes ventilation and other IAQ requirements for buildings other than residential and health care. Its outdoor air ventilation rate requirements have been adopted into the International Mechanical Code and Uniform Mechanical Code, the two most common model building codes in the US. The standard is also referenced by most green commercial building programs including LEED.
- ***ANSI/ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings*** – Residential (multifamily to single family homes) ventilation requirements from this standard have been adopted into codes, including California's Title 24, and into LEED for Homes and the U.S. Environmental Protection Agency's (EPA) Indoor airPlus program.
- ***ANSI/ASHRAE/ASHE Standard 170, Ventilation of Health Care Facilities*** – Standard 170 brought together several documents used throughout North America into a single standard. It is now widely used in building codes for ventilation requirements in hospitals and other health care facilities.
- ***ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1, Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings*** – This

Standard was developed in conjunction with U.S. Green Building Council, the International Code Council and Illuminating Engineering Society, this standard provides IAQ requirements beyond those in Standard 62.1.

- **ASHRAE Standard 241*, Control of Infectious Aerosols*** – This Standard defines the amount of equivalent clean airflow necessary to substantially reduce the risk of disease transmission during infection risk management mode.
- **ASHRAE Guideline 42, *Enhanced Indoor Air Quality in Commercial and Institutional Buildings*** – This Guideline recommends measures that exceed the minimum requirements in Standard 62.1 to provide enhanced indoor air quality through the management of indoor contaminant sources, and through enhanced ventilation and air-cleaning-system design, installation, commissioning, and operation and maintenance.
- **ASHRAE Indoor Air Quality Guide: *Best Practices for Design, Construction, and Commissioning* and *ASHRAE Residential Indoor Air Quality Guide***: **Best Practices for Acquisition, Design, Construction, Maintenance and Operation** – These guides present best practices that have proven successful in building projects to achieve good IAQ.
- ***Damp Buildings, Human Health and HVAC Design*** – This report provides a summary of what is understood about dampness-related health risks in buildings as well as suggestions for HVAC system designers that can help avoid such risks.

ASHRAE'S VIEW

ASHRAE's view is that the provision of acceptable IAQ is an essential building service. Improved IAQ brings substantial health and economic benefits from a broad public health perspective, as well as to individual building owners and occupants.

Therefore, ASHRAE recommends that:

- Achieving and maintaining good IAQ should be included in all decisions (including policy decisions) that affect the design and operation of buildings and HVAC systems, including efforts to improve building energy efficiency, sustainability, resiliency, and the management of infectious diseases.
- The importance of IAQ and the fundamentals of achieving good IAQ through building design and operation should be included in education programs for all stakeholders in built environment – from developers, owners, and operators to designers, technicians, and consultants.
- The latest versions of ASHRAE's IAQ standards should be adopted by building codes and regulations when they are updated every three years, specifically:
    - Standard 62.1-2022 for commercial buildings
    - Standard 62.2-2022 for residential buildings
    - Standard 170-2021 for healthcare buildings
    - Standard 241-2023 for pathogen mitigation
- Research and standards development should be supported by the government, including consideration for a national model standard, improvement of indoor contaminant monitoring and measurement technologies, approaches to improving IAQ beyond ventilation and filtration (e.g., air cleaning), development of tools to assess the economic valuation of IAQ benefits, and improved understanding of new contaminants of concern and techniques for adding them.

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INDOOR CARBON DIOXIDE, VENTILATION AND INDOOR AIR QUALITY

THE ISSUE

Indoor CO_2 has been considered in the context of building ventilation and indoor air quality (IAQ) for centuries. Most of these discussions have focused on how CO_2 concentrations relate to occupant perceptions of IAQ, and the use of CO_2 to evaluate ventilation performance and to control of outdoor air intake rates (demand control ventilation). While these topics have been studied for decades, misinterpretation of CO_2 concentration as an indicator of IAQ and ventilation is common in the HVAC industry, IAQ research community, and the public.

In addition, recent research has studied the impact of CO_2 on human performance at commonly observed indoor concentrations. Indoor CO_2 monitoring has also been promoted as a ventilation indicator in the context of managing the risks of airborne disease transmission. Concerns have long existed regarding the accuracy of indoor CO_2 concentration measurements, which are now more common due to the availability and more widespread application of less expensive sensors. Given all of these factors, as well as increasing calls to monitor CO_2 in buildings, ASHRAE is working to clarify the use of indoor CO_2 measurements as a tool to help improve IAQ and building ventilation.

ASHRAE's ROLE

ASHRAE has long been active in providing engineering technology, standards and design guidance to support the goal of providing healthy and comfortable indoor environments in an energy-efficient manner. For decades, these efforts have focused on providing effective ventilation in buildings, designing and operating ventilation systems and managing the wide range of air pollutants within buildings. For example, ANSI/ASHRAE Standards 62.1 and 62.2 are standards that specify minimum ventilation rates and other measures to support the health, comfort and productivity of building occupants; these standards do not contain CO_2 limits based on human health and comfort .

ASHRAE Standard 62.1. contains CO_2 concentration setpoints for the application of demand control ventilation, but they are not intended to be and should not be used as indicators of IAQ.

ASHRAE's VIEW

Monitoring indoor CO_2 can be a useful tool for understanding building ventilation and IAQ, supporting efforts to provide high quality indoor environments and manage the energy needed to do so. Critically, indoor CO_2 measurements should be understood in the context of the built environment, to ensure that they are measured and interpreted in a meaningful way. Claims that ASHRAE Standard 62.1 requires indoor CO_2 concentrations below a certain threshold (typically 1000 ppm) for acceptable indoor air quality are *incorrect.*[1] ASHRAE's IAQ Standards do not use indoor CO_2 values to determine acceptable indoor air quality, as IAQ is impacted by multiple factors (such as temperature, humidity, particulate matter, gas pollutants, etc.).

[1] Persily, A. 2022. *Development and application of an indoor carbon dioxide metric*. Indoor Air. Volume 32, Issue 7.

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Because of ASHRAE's mission to act for the benefit of the public, it encourages building designers, lawmakers, policymakers and others to craft informed recommendations for the measurement of indoor CO_2 concentrations. To that end, ASHRAE stresses that:

- Indoor CO_2 concentrations do not provide an overall indication of IAQ, but they can be a useful tool in IAQ assessments if users understand the limitations in these applications (e.g., number and activity level of occupants compared to the design capacity, length of time a space has been occupied, no combustion or other sources of CO_2 that could impact readings). While CO_2 readings below a threshold value do not assure overall acceptable IAQ, CO_2 readings far above expected ranges[2] may indicate the ventilation system is not functioning properly.
- Existing evidence for the impacts of CO2 on health, well-being, learning outcomes and work performance is inconsistent and does not currently justify changes to ventilation and IAQ standards, regulations, and guidelines.[3] However, CO_2 can be used to verify if ventilation system performance meets existing IAQ standards, regulations, and guidelines.
- The use of indoor CO2 measurements to evaluate the risk of airborne disease transmission must account for the type of space and its occupancy and the differences in CO2 and infectious aerosols. For example, CO_2 concentration is unaffected by filtration and most other air-cleaning methods that reduce infectious aerosol concentration, so it should not be used as a direct indicator of infection risk.
- Sensor accuracy, location and calibration are all critical for drawing meaningful inferences from measured indoor CO2 concentrations.
- Programs or requirements to monitor CO_2 in buildings, when conducted with an understanding of their technical basis, can be helpful, but monitoring CO_2 without such understanding can lead to confusion on the part of building occupants and the public.

[2] *Ibid*.

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WILDFIRE SMOKE FROM WILDFIRES AND PRESCRIBED BURNS: IMPLICATIONS FOR INDOOR ENVIRONMENTAL HEALTH

THE ISSUE

Wildfires are large-scale, uncontrolled fires that occur in forests, grasslands, and other landscapes. In recent years, the frequency and severity of wildfires have increased due to climate change. The smoke from these fires, along with that from prescribed burns, can cause significant air quality issues both outdoors and indoors. Wildfire smoke poses a risk to indoor air quality (IAQ) by introducing hazardous particles and gases into the air. These contaminants can enter buildings through open doors and windows, ventilation systems, or general air leakage. Once inside, they can remain airborne for long periods of time and lead to health symptoms such as eye irritation, coughing, difficulty breathing, headaches, nausea, and dizziness, as well as more severe health risks such as heart attacks and strokes, especially among vulnerable populations. The health impacts caused by wildfire smoke make it essential for building owners/operators to take proactive steps towards reducing exposure among occupants wherever possible. While wildfires and prescribed burns are the driving issue, many of the concerns and much of the available knowledge and guidance have wider applicability to other smoke events.

ASHRAE's ROLE

ASHRAE develops consensus standards and guidelines, and offers technical resources on both commercial and residential considerations for managing the effects of wildfires. These resources include:

- ASHRAE Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events – provides recommended heating, ventilating, and air conditioning (HVAC) and building measures to minimize occupants' exposures and health impacts from smoke during wildfire and prescribed burns.
- ASHRAE Residential Issue Brief, "Wildfire Smoke Hazards for Dwelling Occupants," 2021 – provides evidence-based information and guidance to protect residential building occupants from smoke exposure and to help designers create residential buildings and systems to limit smoke entry.
- Proposed ASHRAE Guideline 44P, *Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events*– is expected to provide guidance on how to protect building occupants from smoke during wildfire and prescribed burn events. The aim of the guideline will be to provide a series of actions to be taken to reduce the risk of smoke infiltration into a building, protect its occupants from smoke, and reduce the need for evacuation. The guideline is anticipated to address risk reduction, guidance on selecting appropriate smoke management strategies, and information on air filtration and air-conditioning systems for smoke control. The guideline is expected to address building envelope design and construction, and testing and commissioning of smoke management systems.

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ASHRAE's VIEW

ASHRAE's view is that building owners/operators should take proactive measures to reduce exposure to wildfire smoke in order to have improved IAQ. These include reducing outdoor air intake during high levels of wildfire smoke; installing effective filtration systems; sealing cracks or gaps where outdoor air smoke can enter the building; monitoring IAQ conditions with reliable instruments; raising awareness among occupants about potential health effects of wildfire smoke exposure; using portable HEPA filtration devices when necessary; ensuring proper maintenance of HVAC systems; providing greater access to equipment such as respirators or masks when needed; consulting with local public health officials when necessary; and, offering support services for those affected by poor IAQ conditions caused by wildfire smoke.