

# Adapting Ventilation and Filtration Systems in the Workplace: A Case Study on Mitigating COVID-19 Spread and Future Considerations

## Introduction

The COVID-19 pandemic has brought unprecedented challenges to workplaces worldwide, fundamentally altering how businesses operate and prioritize worker health and safety. Among the various measures adopted to mitigate the spread of the virus, optimizing indoor air quality has emerged as a critical area of focus. Ventilation and filtration systems play a pivotal role in reducing the concentration of airborne pathogens, including the SARS-CoV-2 virus responsible for COVID-19 transmission.

This case study describes the responses of businesses to the challenges posed by the COVID-19 pandemic regarding their ventilation and filtration systems and explores their implications for future workplace health and safety strategies.

## Background

The COVID-19 pandemic has underscored the importance of indoor air quality (IAQ) management in mitigating the transmission of airborne pathogens within enclosed spaces. Ventilation systems play a crucial role in diluting and removing indoor air contaminants, including respiratory droplets containing infectious agents such as the SARS-CoV-2 virus. Increasing ventilation rates, either through natural ventilation or mechanical ventilation systems, can reduce the concentration of airborne particles and mitigate the risk of transmission in indoor environments.<sup>1</sup> The [American Society of Heating,](#)

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<sup>1</sup> [Transmission of COVID-19 virus by droplets and aerosols: A critical review on the unresolved dichotomy](#)

**Refrigerating and Air-Conditioning Engineers** (ASHRAE) recommends maximizing outdoor air intake and ensuring proper ventilation rates to minimize the accumulation of respiratory aerosols.

In addition to ventilation, filtration systems provide an effective means of capturing and removing airborne particles, including viruses, from indoor air. High-efficiency particulate air (HEPA) filters, with their ability to capture particles as small as 0.3 microns with high efficiency, have been widely recommended for use in HVAC systems to enhance filtration effectiveness. The installation of portable air cleaners with HEPA filters in high-risk areas can further supplement existing filtration systems and improve IAQ.<sup>2</sup>

Guidelines issued by public health authorities and professional organizations emphasize the importance of implementing a multi-layered approach to IAQ management, combining ventilation, filtration and other control measures to reduce the risk of COVID-19 transmission in indoor settings.<sup>3</sup> Strategies such as maintaining relative humidity levels within the optimal range (40-60%), implementing air cleaning technologies, and adopting appropriate ventilation strategies tailored to specific building types and occupancy patterns are recommended to enhance IAQ and mitigate the spread of airborne pathogens.

Despite the growing recognition of the importance of ventilation and filtration systems in mitigating COVID-19 transmission, challenges remain in implementing these measures effectively in various workplace settings. Factors such as building design, HVAC system capabilities and budget constraints can influence the feasibility and effectiveness of IAQ management strategies. Addressing these challenges requires a holistic approach that integrates engineering controls and administrative measures to optimize IAQ and protect the safety and health of workers in indoor environments.

## Method

This report summarizes information and insights collected from experts at an industrial hygiene professional organization, a research university and a large safety consulting firm. Through semi-structured interviews with professionals at Capital Technology University and a multi-national health and safety consulting firm, key themes emerged regarding modifications made to ventilation and filtration systems across major industries and operations of many sizes, as well as considerations for the post-pandemic era. Input and external review were provided by volunteers recruited from the American Industrial Hygiene Association (AIHA).

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<sup>2</sup> [A critical review of heating, ventilation, and air conditioning \(HVAC\) systems within the context of a global SARS-CoV-2 epidemic](#)

<sup>3</sup> [CDC: Improving Ventilation in Buildings](#)

## Findings

### Modifications Made in Response to the Pandemic

In response to the COVID-19 pandemic, businesses implemented various modifications to their ventilation and filtration systems to reduce the risk of virus transmission. Common modifications included:

- Increasing ventilation rates by adjusting air exchange rates and maximizing outdoor air intake
- Upgrading the building's air filter to one rated at MERV 13 level or higher – in more at-risk industries, such as health care, filtration systems incorporating high-efficiency particulate air (HEPA) filters are more common due to their effectiveness at trapping viruses and bacteria
- Installing portable air cleaners with HEPA filters in high-traffic areas or spaces with limited ventilation
- Sampling and testing indoor air quality at regular intervals and/or installing continuous monitoring technology

### Challenges Encountered and Strategies for Overcoming Them

Despite the implementation of ventilation system modifications, participants reported encountering challenges, including:

- **Technical limitations of existing HVAC systems and infrastructure:** A main strategy to overcoming these obstacles was collaborating with HVAC contractors and engineering consultants to assess system capabilities and identify feasible solutions. Depending on the layout of indoor spaces and proximity of workers, in some cases physical barriers were put in place to reduce the movement of unclean air between workspaces. In older buildings, or in cases where major overhauls were not feasible, a greater reliance on portable HEPA air cleaners was common.
- **Budget constraints and competing priorities amid the economic downturn, coupled with supply chain disruptions and delays in sourcing equipment and materials:** Some businesses overcame this by implementing a sequence of upgrades and modifications in order of importance and effectiveness, as well as securing additional funding or reallocating resources to prioritize ventilation system upgrades.

- **Navigating unverified claims:** Amid the urgency to secure safer equipment, the problem emerged of manufacturers claiming to bring new technologies to market to prevent transmission, often with unverified claims and aggressive sales tactics. This is one area in which guidance from organizations such as AIHA and ASHRAE were particularly helpful to participants.

## Impact on Indoor Air Quality and Worker Wellbeing

Besides reducing risk of disease transmission, IAQ improvements can have significant positive impacts on worker wellbeing. In addition to helping reduce the concentration of airborne pathogens, cleaner indoor air can reduce physical and cognitive symptoms such as headaches, fatigue and respiratory problems among building occupants.<sup>4</sup> Additionally, studies have shown strong associations between clean indoor air and improved work performance.<sup>4</sup>

“Numerous studies have shown improved indoor air quality successfully increases cognitive function and working productivity, which can benefit both employees and businesses.”

- Kang Chen, PhD, CIE, CEOP, CHMM, EngTech, Capitol Technology University

## Retention of Modifications

One of the key considerations emerging from the findings of this case study is the decision regarding the retention or reversal of modifications made to ventilation and filtration systems as the COVID-19 pandemic recedes. Our participants noted that a majority of businesses are choosing to keep modifications in place, in part because they are a selling point to prospective employees or buyers of commercial real estate. Challenging factors that may be considered are maintenance costs and energy efficiency – the decision may rely on an assessment of return on investment. However, participants noted the major upfront investment had already been made, and there was rarely a compelling case for reverting to pre-pandemic air quality management practices.

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<sup>4</sup> Personal communication with Kang Chen at Capitol Technology University, 2024-05-01

<sup>5</sup> [Healthy Workplaces: The Impact of Building Design on Health, Productivity, and Social Well-being of an Occupant](#)

Participants recognized the lasting importance of indoor air quality in promoting occupant health, productivity and wellbeing, irrespective of the COVID-19 pandemic. Retaining enhanced ventilation and filtration measures aligns with broader efforts to create healthier indoor environments and mitigate the risk of airborne pathogens.

Businesses also view the retention of modifications as a proactive measure to mitigate future health risks and enhance pandemic preparedness. By maintaining elevated standards for IAQ management, businesses can better respond to emerging infectious diseases and adapt to evolving regulatory requirements and public health guidelines.

Some businesses are considering hybrid approaches combining elements of pre-pandemic systems with select modifications tailored to specific operational needs and risk profiles. This flexible approach allows businesses to strike a balance between maintaining optimal indoor air quality and managing costs effectively. By conducting regular assessments and monitoring IAQ metrics, businesses can adapt their ventilation and filtration strategies dynamically in response to changing circumstances.

### Considerations for the Future

As businesses navigate the transition to a post-pandemic workplace environment, several considerations emerge regarding the future management of ventilation and filtration systems, such as:

- **Integration of health and sustainability goals:** Organizations are increasingly recognizing the interconnectedness of health, sustainability and productivity in the built environment. Going beyond compliance with minimum regulatory requirements, businesses can leverage ventilation and filtration system upgrades as opportunities to advance broader health and sustainability goals. Strategies such as investing in energy-efficient HVAC technologies and incorporating natural ventilation strategies can yield benefits for both occupant health and environmental sustainability.
- **Adoption of adaptive and resilient strategies:** The pandemic has underscored the importance of adaptability and resilience in navigating uncertain and evolving risk landscapes. Moving forward, businesses should adopt flexible and adaptive strategies for managing indoor air quality, incorporating dynamic monitoring and control systems that can respond to changing occupancy patterns, environmental conditions and emerging health threats in real-time. By embracing a culture of continuous improvement and innovation, businesses can enhance their capacity to anticipate and mitigate future health risks effectively.

- **Emphasis on worker engagement and empowerment:** Engaging workers as active participants in indoor air quality management can enhance organizational resilience and foster a culture of health and safety. Businesses should prioritize education and empowerment initiatives, providing training on IAQ fundamentals, promoting awareness of ventilation and filtration system features and maintenance protocols, and soliciting feedback and suggestions from workers regarding IAQ concerns and preferences. By involving workers in decision-making processes and fostering open communication channels, businesses can cultivate a shared sense of ownership and responsibility for maintaining a healthy indoor environment.
- **Collaboration and knowledge sharing:** Collaboration across sectors and disciplines is essential for advancing the science and practice of indoor air quality management. Businesses can benefit from collaborating with industry peers, academic institutions, research organizations and government agencies to exchange best practices, share lessons learned and co-develop innovative solutions to common challenges. Participation in industry associations, working groups and professional networks can facilitate knowledge sharing and collective problem-solving, enabling businesses to stay abreast of emerging trends and developments in IAQ management.
- **Embrace of emerging technologies and strategies:** The rapid pace of technological innovation offers new opportunities for enhancing indoor air quality and occupant comfort. Businesses should remain vigilant in evaluating emerging technologies and strategies for ventilation and filtration system optimization, such as advanced sensor technologies, predictive analytics and smart building automation systems. Pilot testing and validation of novel approaches in controlled environments can help businesses assess feasibility, performance and cost-effectiveness before scaling up implementation.

The future of ventilation and filtration system management in the workplace hinges on proactive planning, collaboration and innovation. By integrating health and sustainability goals, adopting adaptive strategies, engaging workers, fostering collaboration and embracing emerging technologies, businesses can create healthier, more resilient indoor environments that support worker wellbeing, productivity and organizational success in the post-pandemic era.

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