Air Quality 101
The Importance of Indoor Air Quality
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Air Quality

This guide serves as an informative text on the importance of air quality by supplying the definition of air quality, and research that proves the impact it has on the health and well-being of all people.

What is Air Quality?
Air quality refers to the “purity” of the air we breathe, whether indoors or outdoors. We often hear about the impact of outdoor air pollution on our overall health and most of us have seen images of large or industrialized cities with smokestacks and dark clouds of toxic chemicals being released into the atmosphere. They are alarming images. But what about the toxic chemicals that we cannot see in the air we breathe indoors? Recent research has shown that our indoor environments can be more detrimental to our health than outdoor environments.

While the 20th century did in fact see improvements in our land, air, and water quality, due to EPA laws, the Clean Air Act, and cleaner water standards (the introduction of fluoride, wastewater treatment plants etc.), the quality of the environments we live in largely have an effect on our health. According to the CDC, the top five leading causes of death in the U.S. are: Heart Disease, Cancer, Accidents (unintentional deaths), Chronic Lower Respiratory Diseases, and Stroke. Research has shown that Heart Disease, Cancer, Respiratory Disease and even Stroke can be caused from the chemicals and toxins in our environments introduced into our bodies through the air we breathe.
Pollutants
Chemicals & Viruses

Impact on Health
According to the EPA, “Americans, on average, spend approximately 90 percent of their time indoors, where the concentrations of some pollutants are often 2 to 5 times higher than typical outdoor concentrations.” The impact of Indoor Air Quality (IAQ) on our health and well-being is directly linked to the air we breathe. We do not always associate symptoms we are feeling with air quality, but research shows that indoor air quality is related to common ailments like headaches, chronic fatigue, and reduced cognitive functions.

The EPA also notes that immediate effects to being exposed to poor indoor air quality can cause shortness of breath, dizziness, fatigue, and irritation of the eyes, nose, and throat. Long term effects can show up within an hour of exposure, or years later, and include “some respiratory diseases, heart disease, and cancer, [and] can be severely debilitating or fatal.

Furthermore, daily exposure to poor indoor air quality is known to trigger asthma, respiratory related health issues, allergies, tiredness, and cognitive disruptions. In fact, NEEF the National Environmental Education Foundation reports that “Poor indoor air quality costs the US economy more than $10 billion a year by worsening illnesses and allergenic symptoms and reducing productivity.” The staggering amount of illness caused by poor IAQ leaves businesses and employers searching for ways to improve the cleanliness and air purity of indoor environments to keep people safe and healthy.

Who Is Most Impacted?
According to NEEF, children are amongst those most impacted by poor indoor air quality due to the time they spend in schools. School buildings are often old, and funding is not always available to address structural issues that lead to poor indoor air quality. NEEF also points out that since children’s bodies are still developing, they are not able to process toxins as well as adults thus causing them greater risk for illness.

Individuals with allergies or asthma are also more severely affected by poor indoor air quality because asthma is triggered by the most common pollutants in air such as mold, dust mites, plant matter, and pet dander. Children are significantly affected by this and are one of the highest populations with asthma with “nearly 1 of every 13 school-aged children having asthma,” according to the CDC.

In addition to the young, the elderly population is also negatively affected by poor IAQ due to the time they spend indoors in conjunction with dealing with declining health and often compromised immune systems.
Indoor Irritants
Naturally occurring compounds, such as radon—which is created below the earth’s surface and can leech in through cracks in foundations or other openings in homes, can be very damaging and are directly linked to poor IAQ. Other naturally occurring particulate matter such as mold, pet dander and hair, dust mites, and insect parts (specifically cockroach parts) can all negatively affect indoor air quality as well.

Additional harmful sources consist of tobacco smoke, chimney smoke that can get pushed back inside a building, carbon monoxide, asbestos, lead, pesticides, combustion by-products from wood and coal cooking devices, cleaning supplies, paint, and degrading building materials, not to mention the particulates that can be released from furnaces, space heaters and water heaters.

Whether naturally occurring or man-made, these pollutants and chemicals have all been linked to nose, throat, and eye irritation along with headaches, dizziness and fatigue—all common ailments that can lead to larger issues such as severe allergies, asthma, and life-threatening disease like cancer and respiratory illness, if not diagnosed and treated.

Volatile Organic Compounds (VOCs)
On top of that, the products we use for personal care, cleaning, and even the furniture and fabrics we surround ourselves with daily have harmful toxins and chemicals. These chemicals are known as “Volatile Organic Compounds” (VOCs) and are found in paint, cosmetics, cleaning substances and more. The toxic chemicals in these items evaporate at room temperature and end up polluting indoor air.

When we dig deeper, we realize that many of the products we surround ourselves with are no longer made from natural fibers but are in fact mixtures of plastics and synthetics—meaning they have been treated with chemicals. The materials in furniture and bedding, to glues and adhesives for projects, include VOCs that when released in the air can worsen health problems and contribute to poor air quality.

Everyday use of these products causes fibers to be released indoors mixing into the air. Without proper ventilation, and the use of greener technology and products, air becomes compromised and potentially dangerous to health, especially for those who spend more time indoors or have poor health.

Climate Change
Adding to the problem is the increase in heat and humidity across the globe due to climate change. Weather directly affects our indoor air quality as increased humidity and rain lead to more mold and dust mites in indoor environments.

Viruses and Germs
Other research has shown that viruses and germs are carried on clothing and shoes. The CDC conducted a study on the Aerosol and Surface Distribution of Severe Acute Respiratory Syndrome 2 in Hospital Wards in Wuhan, China, showing that the virus was carried between hospital rooms on the soles of shoes. The study traced medical staff as they moved between sick patients’ rooms to other rooms on the same floor of the hospital.

The virus was found on the floor of the pharmacy where medical staff worked, but there had been no patients and “... half of the samples from the soles of the ICU medical staff shoes tested positive.” While tracking viruses from hospitals into homes and workspaces may not be a reality for most people, it can be deduced that what is tracked in on shoes is concerning, especially to IAQ, as debris from floors can be stirred into air.
How to Improve Air Quality

Considering the amount of time most people spend indoors, it is necessary to address how to improve indoor air quality. The CDC estimates that from asthma alone, there are “14 million school days lost each year” due to chronic illness. Not only is our physical health affected but there is new research showing that our mental health can be affected as well. For schools and the business sector this can cause frustration and loss of productivity.

How to Address the Issue:
Keeping indoor spaces cleaned and well ventilated are key to improving IAQ. Three key steps to clean indoor air include:

- Proper ventilation
- Green buildings
- Clean environments and advanced technology

Proper Ventilation
Keeping indoor spaces properly ventilated is key to improving indoor air quality. Proper ventilation can come from allowing outdoor air into indoor spaces. This can happen by opening doors and windows (providing that the outdoor air quality around the space is good), running window unit air conditioners (that vent to the outdoors), and running bathroom and kitchen fans that also vent to the outdoors. Additionally, many new HVAC units are designed to vent using outdoor air, helping to keep indoor air clean. However, this technology is not installed in all HVAC units. Understanding the type of ventilations systems in buildings is important information to know to positively affect IAQ.
Green Buildings

Green buildings have increased in popularity over the last twenty-five years and for good reason. Green building is structurally engineered to be more environmentally friendly to both the planet and humans. The goal of a green building is to use materials that are friendly to the environment, reduce energy consumption, and supply a better indoor living quality.

A recent study done by researchers from Harvard’s Center for Health and the Global Environment suggests that green buildings can have a positive effect on health and cognitive function. The study was designed to determine indoor air quality effects on cognitive function. Participants were divided into three groups and assigned a different type of building to work in for the duration of the study.

The building types consisted of: conventional (built using standard or common building materials and practices), Green (uses less water, environmentally safe materials, and construction practices that do less harm to the environment), and Green with Advanced Ventilation (uses passive, or non-mechanical, systems to vent outdoor air into spaces in addition to the use of green building materials)—all three spaces simulated real-world scenarios.

At the end of each day, participants were given a cognitive skills test, using the Strategic Management Software Executive Decision tool. Test results showed that overall “cognitive function scores were better in green building conditions compared to conventional building conditions across nine functional domains, including crisis response, strategy, and focused activity level.” Thus, showing the importance of using green technologies to help improve IAQ, as these materials are designed with environmental and human health in mind.
Having a clean indoor environment is another important way to improve IAQ, as what is tracked indoors on our shoes and feet can be a leading contributor to dirt and toxins in the air.

Research shows that carpet covers 70% of flooring in the United States and that carpet can hold more than its weight in dirt and debris. Carpeting can work as a first line of defense in filtering what is tracked indoors—however, this means that carpet must be cleaned regularly and thoroughly. Without consistent cleaning, dirt and debris can settle into carpeting fibers and be tracked back into air.

While hard flooring holds less dirt and debris, dust mops and brooms can be inefficient methods of cleaning as they tend to push dirt and debris around versus proper dust collection and disposal—thus dust is pushed back into the air and then resettles.

**Dust Filtration**

Technological advancements in cleaning equipment and autonomous cleaning equipment are leading the way in terms of making an impact on overall health and IAQ. Much of today’s cleaning equipment comes with HEPA Filters or dust and debris collection systems that pick-up dirt and debris in a more efficient and detailed manner than vacuums and floor sweepers of the past.

**Autonomous Floor Sweepers**

Case in point, leaders in the floor cleaning equipment industry, SoftBank Robotics, sponsored a study that was conducted by PA Consulting Firm at their Cambridge office in the U.K. to test the efficiency of dust collection by Whiz, an autonomous floor sweeper made in conjunction with ICE Robotics. The study utilized an ATP test (a process that measures rapidly growing microorganisms).

According to the study, Whiz was able to cover 98.5% of the set area compared to the other selected participants (which were three of the top choice vacuums in the industry under manual operation).

Other participants in the study showed only a 52.4% efficiency in covering the same area. Robot’s like Whiz are programmed to follow a set route; because of this they are less likely to miss spots that human operators often do miss—thus the robotics vacuum sweeper is more efficient and thorough.

It should also be noted that Whiz was able to complete the job in the same amount of time as the manual participants, which can be deduced as a better more detailed clean as more area was efficiently cleaned during the timeframe. Therefore, deploying autonomous technology can increase the area of floors cleaned in a space each day.
In order to have a positive impact on IAQ, daily cleaning of floors is recommended over the typical once a week routine. Daily floor cleaning has been shown to have a more positive impact on IAQ and overall cleanliness of spaces and for business owners and BSC’s, this is important information to consider when working with clients.

Additionally, due to the amount of area cleaned without human presence, less dust and debris are stirred up and put back into the air. Another study done in Japan noted that due to autonomous technology, the dust that is stirred up from a person that would normally be walking behind a vacuum is significantly reduced, and the air is “8x cleaner” than when traditional vacuuming occurs, thus less debris and pollutants are pushed into the air.

In yet another study, conducted by SoftBank Robotics, testing was done also using ATP testing in office buildings to determine the effectiveness of deploying an AI vacuum sweeper. The research showed that due to the robot’s ability to routinely clean floors, making sure to collect dust particles and airborne fungi, there was a direct correlation between floor cleanliness and air cleanliness. The research showed the “amount of airborne microbes in indoor environments decreases by about 1/5 when the area is cleaned by AI vacuum cleaning robot, Whiz.”

**Autonomous Floor Scrubbers**

Floor scrubbers take this a step further for hard floor surfaces due to the use of EPA approved disinfecting solutions. The EPA website lists approved disinfecting products that also fight serious viruses, like Coronavirus. Registration numbers can be checked through a database on the website to ensure safe products are being used.

Floor cleaning industry standards suggest that floors should be scrubbed with the disinfection solution as normal but without the vacuum pull turned on—as the solution will need to sit on the surface for at least 10 minutes or a minimum time suggested by the manufacturer or the EPA. Once the allotted time is up, collect the disinfection solution with the scrubber and dispose of appropriately, again, according to EPA or local guidelines.

This process allows for a full disinfection of flooring surfaces, helping to reduce the amount of toxins that can be stirred up into the air. The disinfection process kills germs, while the scrubbing process cleans the dirt and debris, resulting in clean floors and cleaner air.

Autonomous floor scrubbers, like EMMA, by ICE Robotics, can take on these types of cleaning routes without the need for manual operation which means daily floor cleaning can be done in large commercial and industrial settings, contributing to better overall IAQ.
Sources:


- CDC: "Aerosol and Surface Distribution of Severe Acute Respiratory Syndrome Coronavirus 2 in Hospital Wards, Wuhan, China, 2020 - Volume 26, Number 7-July 2020 - Emerging Infectious Diseases Journal - CDC." Centers for Disease Control and Prevention, 10 Apr. 2020, wwwnc.cdc.gov/eid/article/26/7/20-0885_article.


