In-office Air Quality Contamination: What you don’t know WILL harm you

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This is an article to alert you to a silent but insidious problem in the dental profession, one that IS harmful to you, your entire team, your patients, and your family members. Can you recall if you or one of your dental team members has called in sick within the last three months? Have you ever brought a cough or cold home from work and shared it with your family members? The problem is that the indoor air within our dental offices contains unhealthy and often infectious airborne particulate which results from our practices. The dental office is a high traffic, publicly accessible, commercial space, and the multiple daily interactions with our patients can introduce bacterial, viral and fungal infections into the air. All of the furniture, dental equipment, and flooring can produce harmful airborne volatile organic compounds (VOCs). The ultrasonic instruments we use, along with the constant cleaning and disinfection of contact surfaces can create bio-aerosols which contaminate the indoor air and increase the unhealthiness of the dental office.

The Evidence
The Occupational Information Network, a US Department of Labor database, conducted a study to rank the ‘Most Unhealthy Jobs’ in America. They analyzed the health risks in each of the 974 occupations in the database using criteria such as exposure to radiation, disease, contaminants, infections; and time spent sitting, with scores of these factors on a scale from 0-100, with a higher score indicating an increased health risk. Can you guess where the dental profession ranked in this study?

We ranked Number 1 as the Unhealthiest Job of all 974 occupations in this study (Fig. 1). The dental professional is especially vulnerable to exposures to contaminants, disease and infections, and time spent sitting. Most noticeably, fine and ultra-fine particulate matter, which includes harmful bio-aerosol particles, are capable of reaching the deepest part of our lungs, being absorbed into the blood stream and having systemic effects to our health. Studies such as these have elevated indoor air quality and pollution control as a focus of a number of government agencies and organizations to determine correlations to human health.

Indoor air quality contamination has been evident for many years, especially within hospital and the dental manufacturer’s environments. If you have ever worked in the operating room (O.R.) of any hospital, you will have noticed a cooler and filtered positive air flow within each surgical suite. Additionally, all manufacturers of dental implants have source capture devices on their equipment and “Clean Rooms” as part of the final sterilization process to preserve the surfaces of the implants before packaging. These manufacturers pay particular attention to the design of air quality controls to ensure they meet industry, regulatory and governmental standards to protect their staff and their final product.

Many industries and companies have begun installing Air Purification Systems (APS). Some of the early adopters were
Professional sports teams across the NBA (Toronto Raptors, Milwaukee Bucks) (Fig. 2), the NHL (Toronto Maple Leafs, Montreal Canadiens, Vancouver Canucks), MLB (Toronto Blue Jays, Oakland Athletics, Baltimore Orioles) and the NCAA (Northeastern University) (Fig. 2.) They are also being used in Hospitals, Surgery Centers, Bank Headquarters, Security Companies, Law Firms, Universities, Retail Stores and Day Cares. One Canadian based APS manufacturer has already sold systems to over 1,000 dental offices and dental labs in Canada.

Unfortunately, most dental offices have not yet taken the proactive step of purifying their indoor air due to a lack of awareness of both the issue and best practices in managing the risk. In this article, I aim to tackle this head on.

The Dental Office Environment
Understandably, most patients arrive at the dental office with some level of fear and trepidation. With the advent of most modern dental office designs, specific attention and details are addressed to foster a beautiful, clean and relaxing environment that puts patients at ease. These visually streamlined designs correlate to a comfortable environment. However, it is normal human nature to utilize all our senses to interpret an opinion or judgement of an environment. As a result, the indoor environmental conditions are often one of the first things a patient notices when they enter a dental office. But how often do we as dental professionals evaluate the smells and air quality of our dental offices? We are often ‘nose-blind’ to the smells. However, indoor air quality plays an integral role in patient impressions, and in the overall well-being of not only the patients, but of the staff and the dentists as well.

During a regular dental visit, patients and providers are exposed to bio-aerosols which can originate from contaminated patient care items. The oral cavity constitutes the highest reservoir of infectious organisms with over 350 different types of bacteria. During dental treatments, the use of high and low speed instruments drilling into teeth, bones and tissues create hazardous bio-aerosols. Aerosols containing microbes from the saliva, blood, sub gingival fluids are dispersed in the air. The dispersal of fine droplets, which may contain pathogens, can stay airborne for hours! These pathogens are easily inhaled and become a potential source of infection for everyone within the dental office. The amount of time these droplets remain suspended in the air, how far they travel, and their level of contamination should be a concern for everyone, and especially when treating highly vulnerable patients (children, pregnant women and older people).

Typically, a dental office can see 40-50 patients in a day. These patients are another source of air pollution from the squamae that are continually exfoliated from the skin. Researchers believe that the majority of Staphylococcus aureus, one of the leading causes of infection, is transported mainly on these squamae – readily disturbed from floors and other surfaces as microscopic specks of dust which thousands of
pathogens use as a transmission vehicle. Despite the SARS (Severe Acute Respiratory Syndrome) and MRSA (Multi-Resistant Staphylococcus Aureus) epidemics, our awareness and concern regarding the importance of managing indoor air quality to prevent the spread of aerobiological viral and bacterial infections is no higher than before.

Air pollutants from various chemical compounds used in a dental office further decrease the air quality in the office. One of the most harmful chemicals, Mercury vapors, can be dispersed in the air during the removal of old amalgam fillings. Harsh chemical disinfectants used for surface cleaning can also decrease the indoor air quality. The use of chemical compounds and their harmful airborne characteristics increases the exposure levels not only for patients, but even more so for dental providers and the staff who are exposed daily to the pollutants.

No matter where people work, including dental offices, there are times when sick employees show up for work, and sick clients come for visits. These people can spread their highly infectious illnesses throughout the office environment, significantly increasing the risk of disease transmission working within the office. This airborne contamination occurs as the fine droplets containing pathogens remain suspended in air for an extended period of time. The longer these pathogens are suspended, the greater the likelihood they will be inhaled by a susceptible individual, spreading the infection.

Poor indoor air quality can have a dramatic effect on human performance. Symptoms linked to poor air quality include headaches, dryness and irritation of the eyes, nose and throat; coughing and sneezing; shortness of breath; dizziness and nausea. Cognitive functions can also be adversely affected in poor indoor air environments. Studies also show that better indoor air quality leads to higher worker productivity and significantly lower absences due to health issues, specifically respiratory illnesses.

The HVAC Systems (Heating, Ventilation, Air Conditioning) within dental offices further exacerbate the poor indoor air quality conditions as they redistribute and recirculate these harmful airborne contaminants. These systems can also affect indoor air humidity. Research shows that relative humidity of indoor air affects microbial growth. Low indoor humidity increases droplet nuclei levels, allows viruses to evaporate faster, and allows the micro droplets to stay airborne longer.

Our Responsibility
As dental professionals, we are mandated to use universal precaution protocols, sterilize our instruments, and disinfect surface contaminants, but indoor air quality controls have been IGNORED. Indoor air quality control should clearly be a part of infection control protocol to protect patients, staff members and professionals.

The Occupational Health and Safety Act (OHSA) stipulates that every employer, including dentists, has a general duty to protect his or her employees. As employers, we should take every precaution reasonable in these circumstances for the protection of a worker. Under the OHSA industrial hygiene Regulation 851, it specifically addresses the concerns with ventilation and replacement air for the protection of the workers. There should be adequate ventilation by either natural or mechanical means so the atmosphere does not endanger the health and safety of workers. The replacement air shall be free from contamination with any hazardous dust, vapor, smoke, fumes, mist or gas. The discharge of air from any exhaust system shall be in such a manner so as to prevent the return of contaminants into any workplace.

I sincerely hope that I have alerted your attention to the importance of managing your indoor air environment, and convinced you of the vital importance to do something to improve the indoor air quality within your practices. A reliable quality air filter that eliminates the airborne pathogens that can be passed on through droplet or airborne transmission is essential to meet our legal requirements. It can also translate to better work efficiency in the office, reduced employee sick days, improved productivity, and profitability.

The Solution
Microbial air pollution is a health hazard and this is where Air Purifiers Systems (APS) can play a role in significantly reducing the transmittable bio-aerosols. In the dental office environment, the most practical and convenient solution is to have stand-alone air filter systems which clean by constantly drawing out polluted indoor air and exhausting clean filtered air into the room.

There are many different options that are available to the dental industry to clean the indoor air (Fig. 3). When

![Comparison of Air Volume Flow of various Air Purifier Systems available on the market place.](image)
choosing a solution, it is important to consider these selection criteria:

1. Filtration System – First and most obvious is the ability to effectively and efficiently remove all the air pollutants created in the dental office environment. An effective system must be capable of removing dust, volatile organic compounds (VOCs), mold, bacteria, odors, as well as killing germs and viruses using UV-C light.

2. Air Flow Capacity – You need to consider the cubic feet per minute (CFM) that the system can handle and ensure that it will turn-over your dental office air at least once every 30 minutes to provide the required efficacy (Fig. 3.)

3. Sound Level – The movement of air through an APS will generate sound. An APS that creates too much sound will have a negative effect on those working near it, which usually results in the APS being turned down, which reduces the Air Flow Capacity and efficacy. A good APS should be capable of delivering a large air flow capacity at a comfortable sound level of 50 dB (decibels). For reference, a quiet dishwasher is approximately 50 dB, and human speech is 60 dB (Fig. 4.)

4. Operational Cost – When choosing the right APS make sure you consider the long term operational cost and not just the initial purchase price. All APS have components that need replacing over time including filters and in better models, UV light bulbs. Not all systems are the same, some are quite inexpensive to purchase but require very frequent replacement of expensive consumables. Other systems are more expensive to purchase but have permanent components and cheaper consumables and are, therefore, less expensive to operate over time.

Conclusion

In my case, after researching APS options, I purchased purifiers for my dental office, the dental lab and home. The units I selected have Medical Grade Six (6) Stage filtration system capable of removing all forms of contaminates, including Dust, VOCs, Mercury, Odors, Molds, Bacteria, Fungus, and tests that show it removes 99% of airborne virus in less than 15 minutes. My APS moves more air than any other APS at a comfortable 50dB sound level which makes it perfect for my locations (Fig. 5). While it was a bit more expensive to
purchase initially, (removable/washable electronic cell and long duration carbon filters and UV-C light bulbs), over time its low operational cost made it the right financial decision for me. As a bonus, it also has a Negative Ion generator that refreshes the indoor air to help combat afternoon fatigue, making the air as healthy and energetic as fresh mountain air (Fig. 6.)