



Field Research Study - Dental Facilities

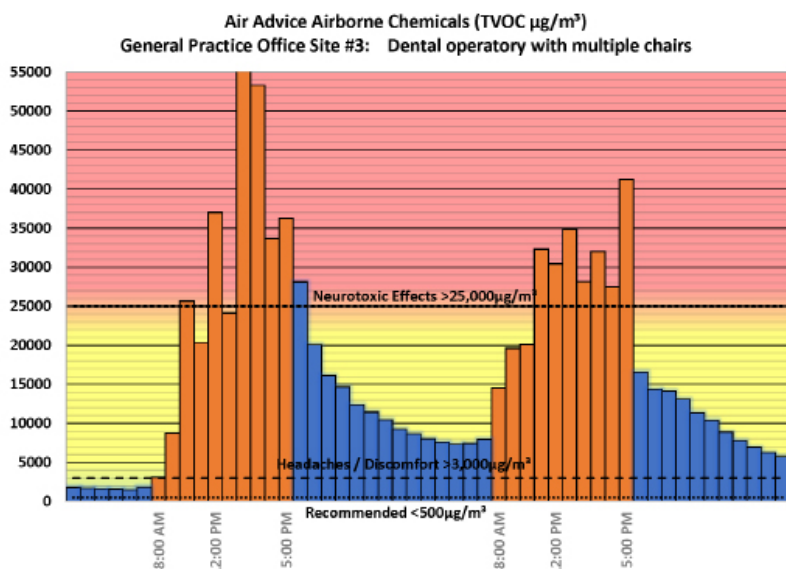
HEPAiRx® Ventilating Room Air Purifier



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Is your practice's air quality on par with a medical environment?

Our baseline data suggests dental practices are seeing air contamination 58X higher than recommended levels.



HEPAiRx System Field Trial Study for Dental Offices Applications

Introduction:

The dental industry, generally, has never adopted the same level of air purification technologies seen in other specialties in the medical industry where patients are being operated on, such as Airborne Infection Isolation Rooms (AIIRs) and operating rooms.¹

The COVID -19 pandemic truly shined a light on this gap in proper environmental sanitation like nothing else before it. Dental facilities found themselves on the front lines of an unprecedented airborne pandemic overnight and were scrambling to find solutions, namely portable air filters. While research into the effectiveness of these products is beginning to surface, our study suggests there is a much broader, hidden problem with air quality in dental facilities which practitioners should take action to mitigate. Addressing these concerns can both help prevent the future spreading of common airborne illnesses (flu, colds, etc.) and the next airborne pandemic as well as reduce the exceptionally high levels of Volatile Organic Compounds (VOCs) - which have been linked to significant health risks - present in dental offices. Our findings suggest it is time for the dental industry to come into line with other medical specialties and significantly improve the air quality and sanitation of environments to which patients and healthcare workers are exposed.

¹ The CDC recommends aerosol generating procedures should take place in an AIIR. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html#section-2>

Scientific Background:

We investigated three dental care facilities in different geographies and specialties. We focused the study on two areas of concern regarding air quality: aerosols and other gases.

1. Aerosols are mixtures of fine particles suspended in the air. Many dental procedures produce high levels of aerosols, both large and small. These particles may contain pathogens, viruses, and metals. Studies have shown the coronavirus is often transmitted through droplets larger than 5µm in size (Linsey C. Marr, Ph.D., 2021). Additional studies have suggested transmission can occur through airborne particulates or smaller aerosols.
2. Dental procedures also produce gases or Volatile Organic Compounds (VOCs). Some common VOCs are nitrous oxide, cleaning agents, and poly-methyl methacrylate (PMMA), also known as monomers. Monomers are commonly used for making dentures and dental prostheses. Research has shown high levels of exposure or long-term exposure to VOCs can have severe health effects including cancer, liver damage, kidney damage and neurotoxic effects.²

Goals & Objectives of the Study:

There are several ways to reduce negative aspects of dental procedures and harmful byproducts they produce. This study examined using filtration and ventilation, while addressing inactivation by implementing UV-C light. The goal was to observe the air quality in terms of particle count and VOC levels in a typical dental office and to determine the HEPAiRx[®] system's ability to bring those measures in line with cleanroom-like standards, which can reduce the potential transmission of airborne illness and exposure to harmful levels of VOCs. Another goal was to determine equivalent air changes (ACH) using ASHRAE's building readiness guide.

Procedure:

The HEPAiRx system is a window-mounted room HVAC system capable of providing heating, cooling, fresh-air ventilation, UV-C light, and 99.97% medical-grade HEPA filtration for both fresh-air and room-air recirculation. The first test performed focused on particle count. Using a laser particle counter, we established a baseline reading, then measured particles after one hour of run time. This data was then compared with data from adjacent rooms that had HEPAiRx systems installed.

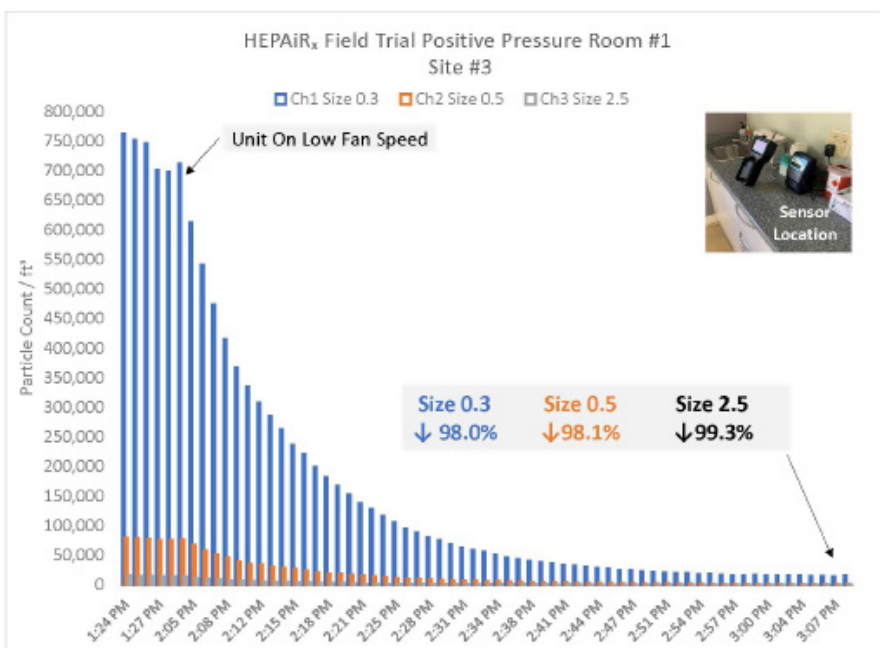
² Science Direct. Indoor air quality in a dentistry clinic. C.G. Helmis, J. Tzoutzas, H.A. Flocas, C.H. Halios, O.I. Stathopoulou, V.D. Assimakopoulos, V. Panis, M. Apostolatou, G. Sgouros, E. Adam

The second test utilized a metal oxide semi conductor (MOS) sensor in each room to monitor Total VOCs (TVOCs) over a three-week time frame. TVOC data was also collected at two additional general-practice dental sites for comparison purposes.



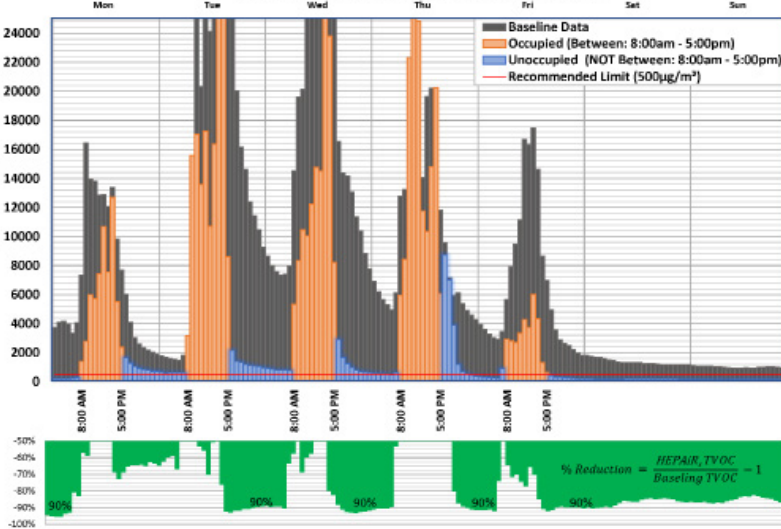
Data & Results:

Our recorded baseline particle levels, without the HEPAiRx[®] system ventilating or filtering the air, were as high as 750,000 particles for size 0.3µm, and our baseline TVOC levels exceeded 25,000µg/m³ — both exceptionally high, posing potential health risks. The HEPAiRx system's positive-pressure room configuration resulted in the most favorable results. Data showed up to a 98% reduction in particles at sizes of 0.3µm and 0.5µm after one hour of operation. TVOC data showed a 90% reduction after three weeks of operation. For reference, the **HEPAiRx system brought the air quality level in line with those expected in hospital AIIR rooms** where patients with infectious diseases are treated. The rate of TVOC reduction also showed significant improvement compared to baseline data. The data suggests the HEPAiRx system significantly reduces potential virus carrying particles and aerosols as well as significantly reducing health risks associated with TVOCs.



Data showed a **98% reduction** in particles at sizes of 0.3µm and 0.5µm **after one hour** of operation.

Airborn Chemicals (TVOC $\mu\text{g}/\text{m}^3$) Site #3
HEPAiRx Closed Room Positive Pressure -vs- Baseline



TVOC data showed a **90% reduction** compared to the baseline data.

Average TVOCs Measured in Work Places & Industrial Settings³

- Washing Solvent Waste Containers
56,000 $\mu\text{g}/\text{m}^3$
- Rubber Tire Manufacturer Gluing Components
28,300 $\mu\text{g}/\text{m}^3$
- Nail & Hair Salon
17,000 $\mu\text{g}/\text{m}^3$
- Paint Factory
15,890 $\mu\text{g}/\text{m}^3$
- Standard Office Environment
55 $\mu\text{g}/\text{m}^3$

Occupied Dental Operatory 28,900 TVOCs

The volatile organic compound levels that were measured in the HEPAiRx dental office field trial were similar to the air quality of a rubber tire manufacturing setting.

The recommended levels for TVOCs is below 500 $\mu\text{g}/\text{m}^3$. Levels from 500 $\mu\text{g}/\text{m}^3$ to 3,000 $\mu\text{g}/\text{m}^3$ may cause irritation and discomfort. 3,000 $\mu\text{g}/\text{m}^3$ to 25,000 $\mu\text{g}/\text{m}^3$ have been reported to cause headaches and severe discomfort. Anything above this value has been linked to Neurotoxic effects and exposure time at these levels can have severe health effects.⁴

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³ Tuomi, T., and S. Yliskola. The Guideline and Target Values for Total Volatile Organic Compound Concentrations in Industrial Indoor Environments in Finland, 7 Oct. 2014.

⁴ Science Direct. Indoor air quality in a dentistry clinic. C.G. Halimís, J. Tzoutzas, H.A. Flocas, C.R. Hallas, O.I. Stathopoulos, V.D. Asimakopoulos, V. Ponió, M. Apostolaki, G. Sgouras, E. Adam

Conclusion:

The COVID -19 pandemic helped to highlight the need for significant improvements in indoor air quality in dental practices which lag behind other medical industries where patients are exposed. Addressing these concerns can help prevent the future spreading of common airborne illnesses (flu, colds, etc.) and the next airborne pandemic and can reduce the exceptionally high levels of Volatile Organic Compounds (VOCs) present in dental offices which have been linked to significant health risks. Our study found the HEPAiRx® system capable of addressing all of these concerns with a window mounted device, helping to assure both patients and practitioners have a safe and healthy environment.

For More Information:

If you would like to learn more about HEPAiRx (including how to purchase) or would like to see the full white paper, please contact Rich Bailey at Air Innovations at rbailey@airinnovations.com.

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Cleanliness

Fresh Air

Pressure

Dedicated HVAC