

A Case for COVID-19 Virus Filtration Solutions For Close Contact Medical & Dental Facilities

Dental Office Shutdown

Dentistry is a close-contact procedure that negates the ability for patients to wear masks during an examination or procedure. As a result, many dental offices in British Columbia had to close their doors to regular patient visits.



Finding a Solution

Dr. Wilson Kwong of Inspired Dental Group, approached us to design a source capture purification system that would work in the face of the COVID-19 pandemic. There were some options available on the market through the dental-industry supply-chains, but the effectiveness of the hood capture, or more importantly the filtration, was in question and did not foster client confidence.

The Challenges With Aerosol Generating Medical Procedures (ABMPs)

Aerosol Generating Procedures (AGPs)

As defined in the Vancouver Coastal Health Infection Prevention and Control Best Practice Guidelines, "Aerosol generating medical procedure (AGMP) are any procedure carried out on a patient/resident/client that can induce the production of aerosols of various sizes, including droplet nuclei. Medical procedures that generate aerosols or droplet nuclei in high concentration present a risk for opportunistic airborne transmission of pathogens not otherwise spread by the airborne route (e.g., SARS, influenza) and increase the risk for transmission of organisms known to spread by the airborne route (e.g. TB)."

Problems Identified, Solutions not Offered

The issue with many of the Best Practices Guidelines that have been circulated by various Authorities offer only partial solutions to issues such as ventilation. Increasing air changes per hour is only part of the solution. The **1973 NIOSH** article that has defined Air Settle / Clearance Times has been adopted throughout the heath and dental industry. Increasing Air Changes (ACH) only offers a partial solution, without addressing accompanying problems, such as:

- There is no guarantee that the increased ACH air will then be filtered and purified down to a medical grade, meaning potential airborne pathogens can then be recirculated back to the same space as it was originally drawn from.
- Increasing ACH through building central HVAC systems is invasive, and very limited. Our client was concerned about the quality of the air and a solution wasn't easy. There are no guidelines to address air quality or source capture.



Source Capture

The first challenge was coming up with a way of providing source capture at the patient level. Our experience in the industrial ventilation realm, specifically working with welders, provided us with a starting point, relevant data we needed and components to provide a source capture technology that would protect the dentist and hygienist from any harmful bioaerosols that result from Aerosol Generating Procedures (AGPs). The patient may breathe out during a procedure.

We determined the hood would need to have:

- **1.** A large enough area to encapsulate the patient's breathing zone.
- 2. An adequate hood velocity and air volume to draw the bioaerosols into the filter from up to 12 inches away.
- **3.** Manoeuvrability, able to allow the dentist and hygienist access to the patient's mouth on three sides.
- 4. Transparency to allow full visibility and light.
- **5.** More than a single configuration. What works for one may not work for another. Dentists will view these hoods as another tool, and they will have different preferences.



The Solution

In selecting the source capture arms, we selected a 4" diameter arm, which is counterintuitive for a dental clinic. Our primary concern was to be able to address all the hood requirements, and a big part of that is ensuring we can provide the hood velocity and volume required. In Industrial Ventilation, size matters. Bigger is generally better in terms of airflow. In a dental workplace, a big, cumbersome source capture arm would not be well received. We chose to use the 4" diameter ME Series in a Ceiling Mount configuration, and provide four styles of hoods for the dental team to choose from. We chose this to try and capture a happy medium of having an arm with a greater airflow capacity, and a small enough diameter so as to fit into an already-busy operatory.

The results show through industrial hygiene testing that we are able to capture 100% of the bioaerosols with this engineered approach.









The Filtration System

The second challenge was coming up with a filtration system that could be trusted to capture as much of the sub-micron particulate as possible while returning the air to the clinic. Most clinics use a building central HVAC system. Installing a capture system that exhausts the air outside would cause a system imbalance with building HVAC. In all cases, exhausting air directly outside will increase energy costs. Our client was concerned about the quality of the air and a solution wasn't easy. There are no guidelines to address air quality or source capture. Recirculating the air without filtration would exasperate exacerbate the problem of spreading viruses. HEPA Filtration alone would not solve the problem of moving sub-micron viruses. We also had to find a way to kill viruses.

Solutions to Air Cleaning

We enlisted **Zlatko Puljic**, **P.Eng.**, **Principle of AME Group** who oversees the firm's Medical HVAC work out of Vancouver. His suggestions included the following:

Increasing Air Turnover

Firstly, he suggested increasing the changes in the clinic to an additional 8 - 12 Air Changes / Hour, in addition to the air changes the current make-up-air systems provide.

Addition of a UV Sterilization Chamber

Secondly, he suggested the use of a UVC Sterilization Chamber.

This meant finding a filtration system that:

- is central to the clinic and would return the air to the clinic
- would sterilize down to Influenza A, and filter 99.99% @ 0.3 microns
- has enough power to achieve the hood face velocity at air volumes desired in each operatory

It quickly became apparent no products existed on the market to fulfil these requirements, **so we built one!**

Pura Air Purification

AIRPLUS Industrial is a founding partner in **Pura Air Purification**, <u>www.puraairpurification.com</u>. The early prototype built for Dr. Kwong, is now operational in his clinic. Pura Air worked with the Applications team at **Signify** <u>www.signify.com</u>, to implement Philips UVC lighting to the design

of the sterilization chamber in order to maximize UVC Exposure to the airstream. We believe the Pura Air TC 1200 has the highest UVC light exposure per CFM than any other competitor offering anything in this industry.

Two systems have been installed, one dedicated to source cap-

ture, and another dedicated to ambient air circulation. The air change-overs, in the clinic, was increased to over 12 ACH, and the source capture inside of a 10' x 10' x 8' operatory, resulted in air change-overs greater than 19 times/hour in that operatory area.

Since installing the initial prototypes at Dr. Kwong's clinic, Airplus has installed Pura Air TC 1200 units at four more dental clinics located throughout the British Columbia Lower Mainland, with very positive initial feedback.

Validating the Design

To validate our source capture systems, we hired Pinchin- <u>www.pinchin.com</u> – a firm of Professional Engineers, Scientists, Industrial Hygienists, Geologists, Technologists, Project Managers & Support Staff across Canada – who specialize in Occupational Health and Safety.

"Based on the site conditions, qualitative irritant smoke tube visual observations and ultrafine particulate measurements the bio-aerosol capture extraction system in place at

Operatory Rooms #1 through 4 was effective at capturing aerosolized particulate. Therefore, with the system in operation, the bio-aerosol capture extraction system should be considered effective at reducing the spread of contaminants (i.e. virus, bacteria, odours etc) within aerosolized droplets from a patient's mouth at the extraction arm hood during dental procedures if properly utilized."

We are excited to be able to provide a real solution to problems dentists and hygienists face in getting back to work.









Testimonials

"The PURA Air containment system has allowed me to stay open and continue working to help my patients. In fact, I have been receiving more new patients now than ever because patients want this for their safety. Because of Pura Air's scientific foundations to capture aerosols at source, UV light virus killing properties, and high grade commercial HEPA filtration, my staff and I are safe from AGP (aerosol generating procedures) which is a real danger to dental personnel. My staff love it. My patients love it and with the cleanest air in the city, I'm breathing fresh 99.99% pure air."

-Dr. Wilson Kwong (full disclosure, now a shareholder in Pura)

"My receptionist said that we had a family contact us from Aldergrove and driving out to see us since I advertised the Pura Air on my website. A new family of 4 will pay for the Pura Air if they are lifelong patients. Super happy to be using the Pura Air today and I find my ergonomics better since I place the shield between the patient and I as a reminder to sit straighter." -**Dr. Stephen Chow**

"My first patient this morning is an engineer who inspects these machines at hospitals. He was super impressed that we have one and I took way too long bragging all about it. Thank you both for your visionary insight into making dentistry safe and for letting Ray and I be the first to show it off. Please feel free if any of your potential clients want to see this wonder. And it is very quiet, as my op is right beside the 'brains' on the other side."

- Dr. Angelique Leung

"It's late, so maybe you're asleep. I just wanted to say thanks for pulling it all together today. It was the first day with this unit and we're super impressed! We all commented on the improved air quality. It felt fresher and not stagnant like it used to be. The motor unit is so quiet. We barely could hear it inside the office. The unit ran flawlessly for the day and we shut her down at 5:30 pm. All the patients commented on how quiet it was, and the bowl is not at all intimidating. We are very pleased with the result!" -Dr. Ray Fong

