



AIRBORNE INFECTION IN THE DENTAL FIELD STUDY ON MONITORING, CHARACTERISATION AND RISK REDUCTION

INTRODUCTION

“Most postoperative surgical infections on site are contracted at the time of the operation, when there is a possibility that microorganisms will reach the open wound [...] The routes of infection are by contact or aerial”*

Prolonged aerosolizations produced by the clinical use of dynamic instruments cause small infected and infecting particles to spread in the air surrounding the operating field, significantly more than any other medical activity.

The result is a real biological air pollution of the dental practice, resulting in the risk of airborne infection.

Hence the importance of reducing airborne particles - which act as a vector for microbiological substances - to achieve a substantial reduction in microbiological contamination.

*Source: UNI EN 13795-1 - Appendix C

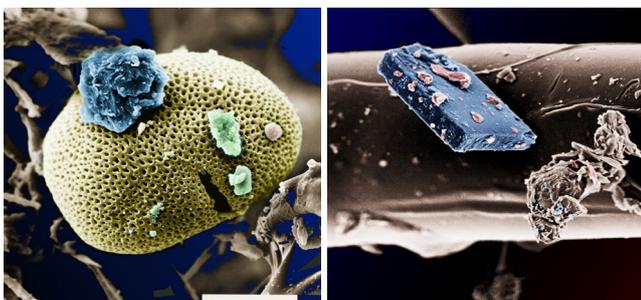
PARTICLE SIZE AND MPPS

The smallest particles including viruses and bacteria adhere to the larger particles and are carried by them. Their sedimentation speed, that is their average travel time, increases according to the diameter of the particle to which they are adhered, consequently increasing the risk of coming into contact with the staff present in the same room.

The efficiency of HEPA filters is measured in MPPS (Most Penetrating Particle Size, that is the particles that, due to their size, are more likely to cross the barrier of a filter) which represents the lowest efficiency of the filter. MPPS is generally between 0.1 and 0.25 microns (a size that coincides with the diameter of the viruses). This means that a H13 filter class retains 99.95% of particles between 0.1 and 0.2 microns. For smaller or larger particles the performance of that filter is even better.

For these reasons, particulate filtration with plug and play recirculation systems equipped with HEPA filters can be considered an effective and simple system for reducing the microbiological risk due to airborne infection in dental practices: viruses are in fact retained by HEPA filters to the extent of 99.95%, and even more if they adhere to larger particles, against which HEPA filter has an even higher filtration efficiency.

Below: Images at SEM (Electronic Scanning Microscope) of particulate matter that conveys smaller particles



METHOD

A characterisation of the level of airborne infection was performed in the environments of dental clinic "Studio Medico Dentistico Associato GBR" owned by Doctors Alberto and Maurizio Giacomello, in Caponago (MB), by monitoring the airborne and microbiological contamination transported near the dental unit and in the waiting room.

The clinic has an area of 15.2 m² and height of 3 meters, it is equipped with a french window and an access door, while the waiting room is a semi-open environment adjacent to the entrance and transit areas with an area of 18 m², height 3 meters, equipped with a french window.

Particulate and microbiological measurement took place over two days: initial particle surveys in both environments were carried out in non-activity on the premises.

Subsequent particle and microbiological surveys were carried out after 5 hours of outpatient activity.

At the end of this period, two **City M** air purifiers were installed, one in the clinic and one in the waiting room, at an average airflow. About an hour after the installation, both measurements were taken again. The purifiers remained in operation until the following day.

On the second day, particulate and microbiological surveys were carried out in the clinic at the opening of the study and after 5 hours of activity, and in the waiting room only particle surveys were carried out at the opening and after 5 hours of activity.

INSTRUMENTATION

Particle surveys were carried out at a specific point in both the study and the waiting room using laser **particle counter Aerotrak** model TSI 9306 s/n 93061119001.

The same points were also used as a reference for microbiological measurements via **SAS (Surface Air System)** for counting airborne forming colony units using a PBI DUO SAS SUPER 360 single-stage sampler and bacterial culture plates.

Company Almata Consulenze Ambientali has been commissioned as guarantor and expert in the field for all microbiological environmental investigation using the IDROGEOLAB certified laboratory (test report 3903530-002).



TSI Aerotrak



SAS

City M is an efficient and quiet plug & play air purifier.

City M is equipped with the most efficient air filters on the market: HEPA absolute particle filters and molecular filters. They ensure a healthier indoor environment through the effective removal of microbiological contaminants, particles, dust and odours.

In less than half an hour City M is able to capture millions of harmful particles.



RESULTS

The results enabled the assessment of the reference contamination class against the indications given by the European Collaborative Action (1993) and the assessment of the improvement achieved through the CITY M air purification system with recirculation system and H13 molecular filters.

The results show several interesting and useful aspects in order to improve indoor air quality levels but above all to reduce the possible risk of airborne infection. In particular, the study allows to make considerations about:

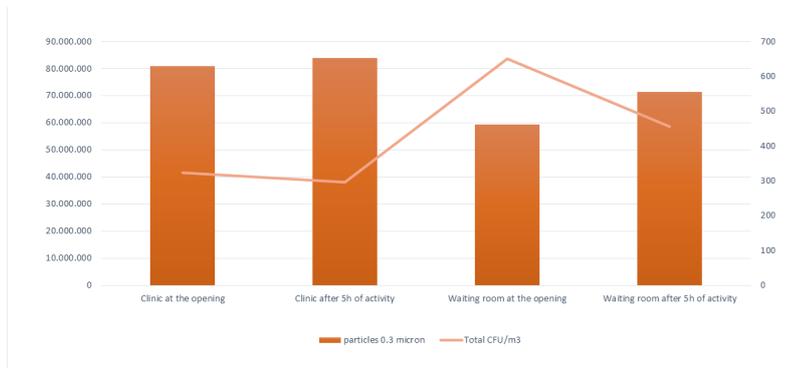
- Level of contamination in the studio and in the waiting room
- Impact of air purification with CITY M
- Impact of normal activities in the studio as sources of internal contamination and the expected level of IAQ compared to the reference guidelines

ECA VALUES 1993: Levels set out in air quality assessment guidelines

High class	Intermediate class	Low class	Surgery	Class A
CFU > 500	100 < CFU < 500	50 < CFU < 100	< 10 CFU	< 1 CFU

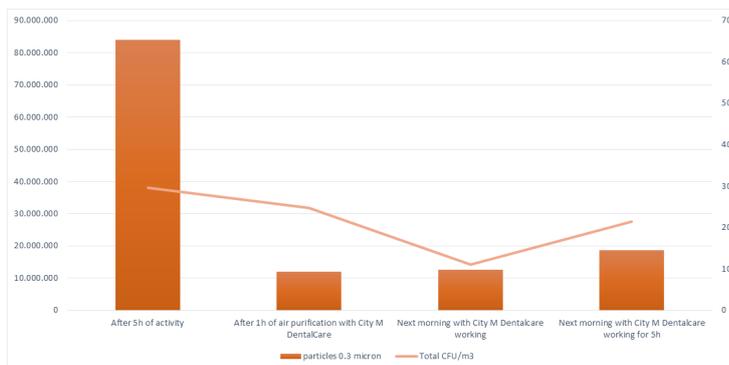
*CFU: Colony Forming Units

1. CLINIC AND WAITING ROOM: CONTAMINATION LEVEL WITHOUT CITY M



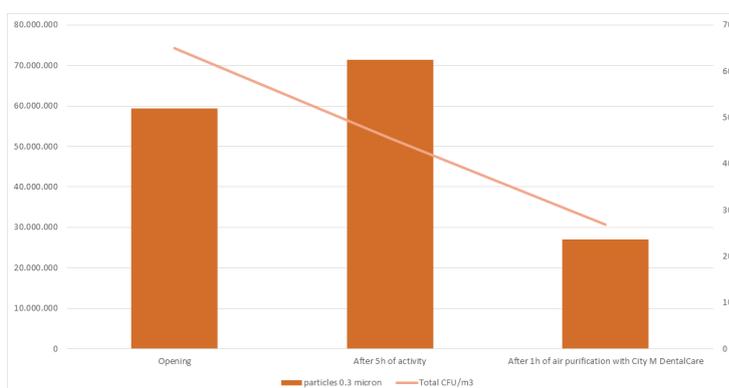
The graph highlights the level of particle contamination (diam. 0.3 microns) and microbiological contamination at the opening of the clinic and after 5 hours of activity both in the clinic and in the waiting room.

2. CLINIC: IMPACT OF AIR PURIFICATION WITH CITY M



The air purification treatment using CITY M unit has proven effective already after the first hour and even more after about 20 hours of continuous operation. In this way, in fact, the purification of the air in the studio during the night, that is without the presence of internal sources, has allowed a considerable reduction of the microbiological fraction reaching the Lower Class according to the European reference guidelines.

3. WAITING ROOM: IMPACT OF AIR PURIFICATION WITH CITY M



Even in the waiting room, although the microbiological situation probably has a different nature and the environment benefits from a natural dilution factor with the entry / exit of patients, CITY M contributes to a net reduction of both particulate and microbiological fraction.

IMPACT OF NORMAL ACTIVITIES IN AMBULATORY AS INTERNAL CONTAMINATION SOURCES

To better understand the impact of human sources of internal contamination, the fraction of particulate taken into consideration was the one with **diameter equal to 10 microns**, that is the fraction mostly correspondent to the particles coming from human activities.

Furthermore, since these particles are aggregators of particulates and bacteria of smaller diameter, this fraction proves to be a key reference parameter for the environmental purification effect obtained with City M.



Important to notice:

- the reduction of 10 micron particles reduces the families of bacteria examined
- after 5 hours of performed activities, although the air purifier is working, this isn't enough to guarantee the maintenance of the cleaning level obtained during the night
- increasing at a later time the fan flow rate of City M, 10 microns particulate level is reduced after just 1 hour, reaching the minimum measured value

FINAL CONSIDERATIONS

Air quality in dental clinics is an important factor in reducing the risk due to airborne infection for both patients and operators.

Camfil **City M** air purifier turned out to be of simple installation and use, and above all it has proved effective for the reduction of both particle and microbiological parameters also at medium recirculation flow rates, both near the dental unit and in the waiting room.

A correct dimensioning of the purified air changes with respect to the volume of the clinic and to the impact of the internal sources may lead to a stable Low Class level in relation to European reference guidelines.



Air purifier
City M



For further information visit our page dedicated to dental practices:
www.camfil.com/en/insights/air-quality/air-quality-recommendations-for-dental-surgeries

FINAL SITUATION

In light of the results obtained, to prevent the risk of airborne infection and guarantee good air quality to their patients and staff, Drs. Maurizio and Alberto Giacomello have purchased and installed two City M units in two ambulatories, and a City M unit in the waiting room.

THE EVOLUTION FOR THE DENTAL SECTOR

City M air purifier has proved to be very effective in the reduction of airborne contaminants; today, its filtration capacity is further improved thanks to H14 class filters, able to capture 99.995% of MPPS.

Besides, Camfil enriches today its proposal with a solution specifically designed for the dental clinic: **City H** is the new air purifier with H14 class filters equipped with a suction arm with adjustable joints and a handle that can more easily reach the source of potential contamination; City H can be perfectly integrated into any type of dental unit.

