



## Quantitative microbial monitoring in a dental office

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The aim of this study was to evaluate the environmental pollution before and after dental procedures (during one year) in a dental office in which a system of air filtration was effective and suitable procedures of microbial controls were routinely applied for instruments and small surfaces. The air contamination was evaluated during one year by the 'plate' method (Air Microbial Index, AMI) in each room of the dental office following a bimonthly monitoring program. Nutrient agar plates were exposed, in monitored areas for 1 h for each control time and incubated at 37°C for 2 days. The number of viable cells was expressed as colony forming units per plate per hour (CFU/plate/h).

During the observation year, the quantitative analysis of the microbiological levels in the operative areas was always within acceptable values. In fact, a range from 4–18 CFU/plate/h was found as the mean of AMI in each controlled room. In particular, the aerosol pollution following dental procedures did not significantly modify AMI values compared with AMI values recorded before dental procedures.

Data presented here demonstrate that the combined use of effective infection control procedures and a system of air filtration can be efficacious in reducing airborne environmental contamination in a dental office and emphasise the use of an inexpensive method such as AMI to verify the environmental bacterial pollution. *Public Health* (2001) **115**, 301–305.

**Keywords:** air microbial index; microbial contamination; colony forming units

### Introduction

Infection control has been considered one of the main concerns of the dental community and the importance of airborne transmission has been widely documented.<sup>1–4</sup> Moreover, dental offices are usually small rooms where both patients and dental health care workers carry away microorganisms through their body and clothes, and the use of dental drills and ultrasonic scalers, both combined with water spray, can give off the most number of aerosol particles containing saliva, blood, dental plaque and germs.<sup>5–7</sup>

Therefore, the indoor pollution is related to a large number of vectors and complex causes such as the correct areas, the crowding index, the rooms volume, the type of ventilation and effective control procedures that can modify the microbial quality in the environment.<sup>8–10</sup>

Several studies emphasise the high risk of transmission and/or contraction of hepatitis B, pneumonitis and other serious infections,<sup>11–13</sup> even though simple preventive measures, such as the wearing of gloves, masks and protective eyewear can easily reduce the risk of disease.<sup>14</sup>

The evaluation of the bacterial charge provides a very

significant parameter to define the airborne environmental contamination level and can be used as a basic control for a prophylaxis program aimed at the control and reduction of microbes in a large number of hazardous environments such as hospitals, outpatient departments and dental surgeries.

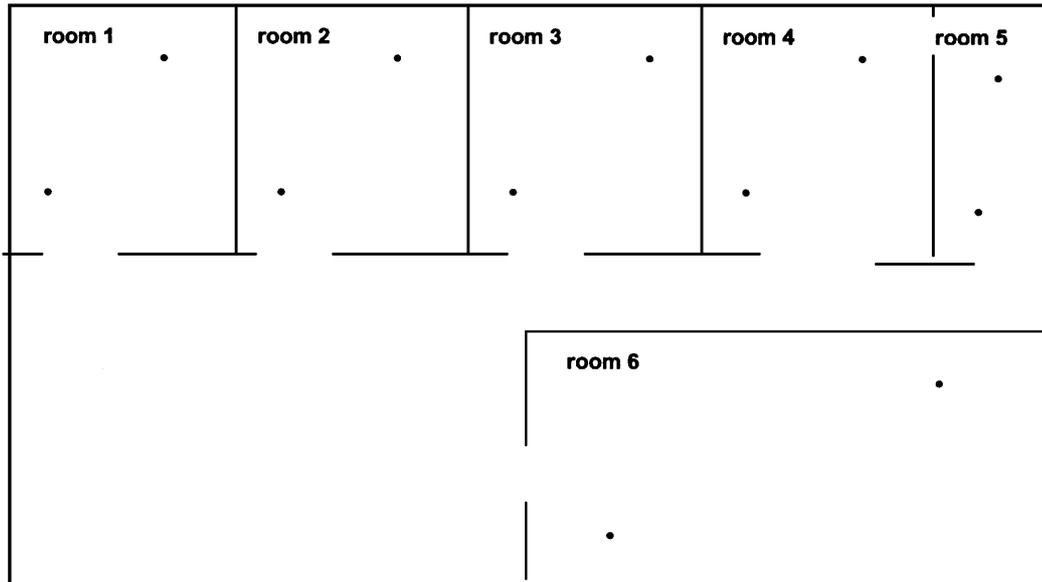
So the use in dental offices of effective infection control procedures and precautions prevents contamination that could involve patients and dental staff. The airborne environmental contamination should be studied to define an autochthonous microbial map and, in particular, to monitor possible quantitative variations of the controls. Laminar unidirectional airflow, air ventilation and air filtration could also be considered to control and reduce the microbial diffusion during ultrasonic scaling.

The aim of the present study is to evaluate environmental pollution using the Air Microbial Index (AMI) during 1 year before and after dental procedures in a dental office in which a system of air filtration is effective and suitable procedures for microbial control were routinely applied to instruments and surfaces.

### Methods

Air contamination was detected during one year in a dental office following a bimonthly monitoring program by using the 'plate' method, Air Microbial Index, AMI.<sup>2,15</sup> Four rooms of active dental treatment, 1 room of instrument

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**Figure 1** Planimetry of dental office with localisation of control points (●) for each room. 1–4: operative areas; 5: sterilisation room; 6: waiting room.

sterilization and 1 waiting room (Figure 1) were controlled. For each room, 2 control points were defined and, for each point, 2 plates of nutrient agar (OXOID Ltd, Basingstoke, UK) of 10 cm diameter were exposed. Plates, prepared immediately prior to exposure, were open for 1 h at 1 m from the floor and 1 m from the wall, twice for each control day, at 8 am, before dental treatment, and at 5 pm, after dental treatment. Plates were incubated at 37°C for 48 h. The numbers of viable cells were counted with a cell count (G Terzano & Co SpA Milano, Italy). The viable cell count was recorded as total colony forming units per plate per hour (CFU/plate/h).

The mean number of CFU/plate/h was defined for each control point and, for each examined room, the mean  $\pm$  standard deviation (s.d.) was calculated.

The dental office was considered as a middle risk ward in which 50 CFU/plate/h identified an acceptable microbiological quality in the operative areas.

### Results

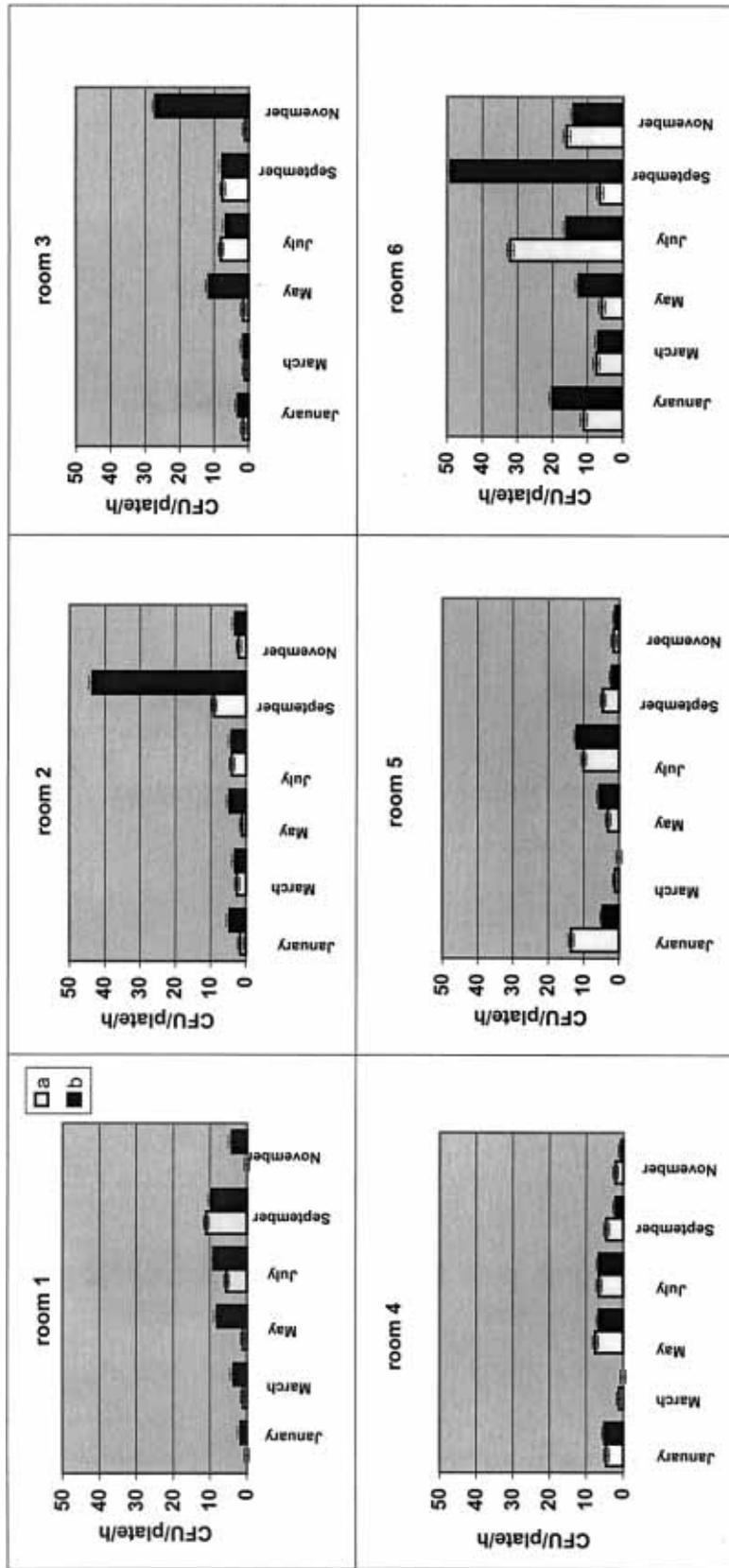
Microbial air contamination data for controlled areas before and after dental procedures during 1 year are shown in Figure 2. From the general view of the figure the bacterial counts at 8 am and 5 pm were low and always within the limit values defined for these environments. In particular, significant variations before and after treatment were not recorded. Only in 3 cases was a substantial increase of AMI value detected between the two daily controls, in particular in rooms 2 and 6 (from  $8 \pm 0.5$  to  $43.5 \pm 4$  and from  $6.5 \pm 1$  to  $50 \pm 2$ , respectively) in September and in room 3 (from

$2 \pm 0.5$  to  $27 \pm 1$ ) in November. The viable cells counted in room 6 (that is, the waiting room) were significantly higher than those found in other areas because of a greater number of patients present at the same time in this area. However, in each of these cases, the recorded values were always within the acceptable levels of microbial charge.

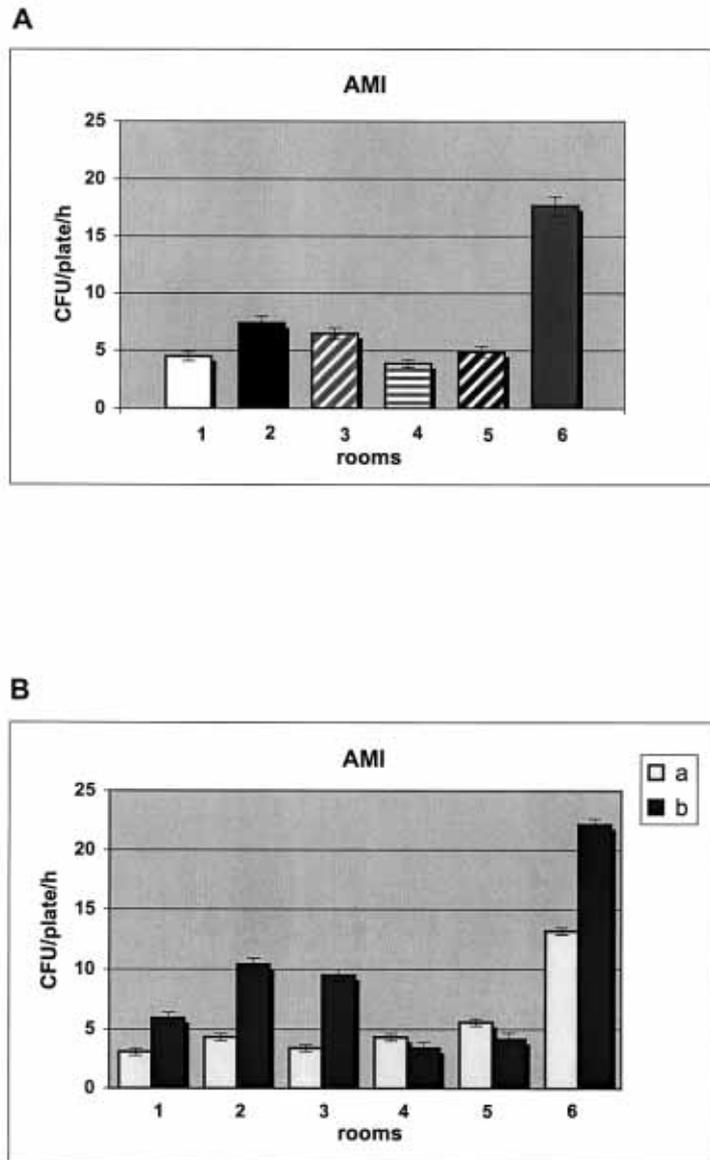
In Figure 3 the mean values obtained over time for each room were shown. The range of these data was from 4–18 CFU/plate/h (A) and the effect of the dental procedures increased the environmental contamination but which, however, was always within the acceptable levels of microbial count (B). Moreover, all observed values were not modified by the season climate variations.

### Discussion

Control of airborne transmission of infection diseases associated with indoor environments is especially important in medical environments. In dental offices, several infectious agents could be acquired by dental staff and patients by airborne transmission. Moreover, dental aerosols containing opportunistic pathogens should also be considered hazardous for immunosuppressed patients, who can develop serious infections. Because of the high risk of cross-contamination in dental areas, researchs should be directed toward developing effective means for controlling and removing aerosols.<sup>12,16,17</sup> Moreover, in view of the increasing number of medically compromised and immunocompromised subjects receiving regular dental treatment it is also important to control the contamination within the dental unit water system.<sup>18</sup>



**Figure 2** Mean values ( $\pm$  s.d.) of Air Microbial Index (AMI) in a dental office before (a) and after (b) dental procedures in operative areas (rooms 1–4), sterilisation room (5) and waiting room (6) during 1 year.



**Figure 3** Mean values ( $\pm$  s.d.) of Air Microbial Index (AMI) during 1 year of bimonthly controls. (A) Mean of values in each room. (B) Mean of values in each room before (a) and after (b) dental procedures.

The application of infection-control procedures and the careful use of protection barriers are closely linked to a low incidence of communicable diseases such as tuberculosis, hepatitis B and C viruses and human immunodeficiency virus (HIV).<sup>12</sup>

In this study, we detect low levels of microbial contamination also after dental procedures when, generally, the microbial status became significantly higher and potentially hazardous for disease transmission.

During the observation year, in the areas of the dental office examined with AMI, a valid control system for instru-

ments and an adequate air filtration system were able to warrant an infection control regimen. In fact, all values obtained at 8 am and 5 pm in each room and at every control time were always lower than 50 CFU/plate/h.

These interesting values support the importance in using an adequate system of microbial control. In particular, to reduce the risk of infection in this dental office specific protocols for small surfaces and instruments were routinely applied: each instrument was treated following 5 steps: preventive decontamination, cleansing, parcelling up, sterilisation and storage.

Moreover, to provide suitable control of the air environment, with the aim of obtaining microclimate with a low level of organic and inorganic contaminants, a system of controlled air (airflow, Forclima, Alliguasego, Padova, Italy), at 'outdoor air' to avoid the airflow among the areas of the dental office, was used. In practice, the air in each room came entirely from the outside and was introduced into areas through a spreader (1 or 2 per room) prefiltered or filtered, humidified or dehumidified, heated or cooled. The amount of outdoor ventilation air is 240 mc/h/person.

These preventive measures show a great reduction of the risk of transmission and/or contraction of disease.

We can conclude that suitable methods to prevent contamination, such as air filtration and routine microbial controls for instruments and surfaces, are effective in a surveillance plan of infection control in a dental office. Moreover, the evaluation of AMI provides a continuous control of the generation of probably hazardous situations and it is important to know the bacterial charge in the environment over time.

### References

- 1 Burge HA *et al.* Dynamic of airborne fungal populations in a large office building. *Curr Microbiol* 2000; **40**: 10–16.
- 2 Pitzurra M, Pasquarella C, Pitzurra O, Savino A. The measurement of microbial contamination of the air. *Ann Igiene* 1996; **8**: 349–359.
- 3 Muzzin KB, King TB, Berry CW. Assessing the clinical effectiveness of an aerosol reduction device for the air polisher. *J Am Dent Assoc* 1999; **130**: 1354–1359.
- 4 Burge HA. Risks associated with indoor infectious aerosols. *Toxicol Ind Health* 1990; **6**: 263–274.
- 5 Legnani P, Checchi L, Pelliccioni GA, D'Achille C. Atmospheric contamination during dental procedures. *Quintessence Int* 1994; **25**: 435–439.
- 6 Osorio R *et al.* Environmental microbial contamination. Pilot study in a dental surgery. *Int Dent J* 1995; **45**: 352–357.
- 7 Grenier D. Quantitative analysis of bacterial aerosols in two different dental clinic environments. *Appl Environ Microbiol* 1995; **61**: 3165–3168.
- 8 Haley RW *et al.* The efficacy of infections surveillance and control programs in preventing nosocomial infections in US hospital. *Am J Epidemiol* 1985; **121**: 182–205.
- 9 Damiani G, Capelli C, Vanini GC. The air quality in indoor hospital environments. *Ann Igiene* 1994; **6**: 251–261.
- 10 Orpianesi C *et al.* Evaluation of microbial contamination in a hospital environment. Comparison between the Surface Air System and the traditional method. *Nuovi Ann Igiene Microbiol* 1983; **34**: 171–185.
- 11 Withers JA. Hepatitis. A review of the disease and its significance to dentistry. *J Periodontol* 1980; **51**: 162–166.
- 12 Porter SR. Infection control in dentistry. *Curr Opin Dent* 1991; **1**: 429–435.
- 13 Francisci D *et al.* Risk factor for acute parenterally transmitted viral hepatitis: a 20-year study. *Eur J Epidemiol* 1993; **9**: 625–628.
- 14 Council on Dental Materials, Instruments and Equipment, Council on Dental Practice, and Council on Dental Therapeutics. Infection control recommendations for the dental office and the dental laboratory. *J Am Dent Assoc* 1988; **116**: 241–248.
- 15 Rulli A, Taraborelli T, Cellini L. Quantitative microbial monitoring in a medium-risk hospital environment. *L'Igiene Moderna* 1997; **107**: 533–541.
- 16 Osorio R *et al.* Environmental microbial contamination. Pilot study in a dental surgery. *Int Dent J* 1995; **45**: 352–357.
- 17 Fine DH *et al.* Efficacy of procedural rinsing with an antiseptic in reducing viable bacteria in dental aerosols. *J Periodontol* 1992; **63**: 821–824.
- 18 Walker JT *et al.* Microbial biofilm formation and contamination of dental-unit water system in general dental practice. *Appl Environ Microbiol* 2000; **66**: 3363–3367.