In CONTROL Fact Sheet

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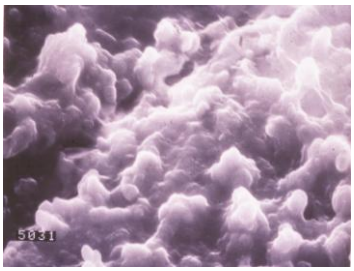
Dental Unit Water Quality

What is biofilm?



Biofilms consist primarily of naturally occurring slime-producing water bacteria and fungi that form thin layers on virtually all surfaces (including dental water delivery systems) that remain in contact with water. They form a protective slime layer known as a "glycocalyx". Dental plaque is perhaps the most well known biofilm. Once formed, these biofilms serve as a reservoir, significantly amplifying the numbers of free-floating microorganisms in the water exiting the waterlines. To date, scientific evidence indicates there is little risk of significant adverse health effects due to contact with water from a dental unit. Despite the lack of documented adverse health effects, exposing patients or dental personnel to water of uncertain microbiological quality is inconsistent with generally accepted infection control principles.

Why are dental unit waterlines susceptible to biofilm formation?

The presence of biofilms in dental unit waterlines has been well established. Dental unit waterlines provide a favorable environment for microbial colonization. Not only do the materials used in dental unit construction support the formation of biofilms, but also the small diameter of the tubing creates a high surface to volume ratio for enhanced biofilm growth. Furthermore, the low water pressure and flow rates used in dentistry, and frequent periods of stagnation encourage accumulation of bacteria introduced from the public water supply. As a result of biofilm formation, relatively high numbers of common water bacteria can be found in some dental water systems.

Do standards exist for dental unit water quality?

In 1995, the American Dental Association (ADA) addressed the dental water concern by asking manufacturers to provide equipment with the ability to deliver treatment water with ≤200 CFU/mL of unfiltered output from waterlines. This threshold was based on the quality assurance standard established for fluids used in hemodialysis units.

Standards also exist for safe drinking water quality as established by the Environmental Protection Agency (EPA), the American Public Health Association (APHA), and the American Water Works Association (AWWA); they have set limits for heterotrophic bacteria of ≤500 CFU/mL of drinking water. Thus, the number of bacteria in water used as a coolant/irrigant for nonsurgical dental procedures should be as low as reasonably achievable and, at a minimum no more than 500 CFU/mL. During oral surgical procedures, sterile water must be delivered to patients.

Can flushing dental unit waterlines reduce biofilm formation?

In 1993, the Centers for Disease Control and Prevention (CDC) recommended that dental waterlines be flushed at the beginning of the clinic day to reduce the microbial load. However, studies have demonstrated this practice does not affect biofilm in the waterlines or reliably improve the quality of water used during dental treatment. Because the recommended value of ≤500 CFU/mL cannot be achieved by using this method, other strategies should be employed (see *"What can be done to improve dental unit water quality?"* question).

Patient material (e.g., oral microorganisms, blood, and saliva) can enter the dental water system during patient treatment. Dental devices that are connected to the dental water system and that enter the patient's mouth (e.g., handpieces, ultrasonic scalers, or air/water syringes) should be operated to

discharge water and air for a minimum of 20–30 seconds after each patient. This procedure is intended to physically flush out patient material that might have entered the turbine, air, or waterlines. The majority of recently manufactured dental units are engineered to prevent retraction of oral fluids, but some older dental units are equipped with antiretraction valves that require periodic maintenance. Users should consult the owner's manual or contact the manufacturer to determine whether testing or maintenance of antiretraction valves or other devices is required. Even with antiretraction valves, flushing devices for a minimum of 20–30 seconds after each patient is recommended.

What can be done to improve dental unit water quality?

Recommendations for flushing waterlines (either at the beginning of the day or between patients) are designed to help reduce the number of microorganisms present in the treatment water, but do not appear to reduce biofilm formation in the waterlines. Commercial devices and procedures designed to improve the quality of water used in dental treatment have been developed because regardless of the source water used, untreated or unfiltered dental unit waterlines are unlikely to meet drinking water standards. Common approaches to improve water quality include:

- self-contained water systems combined with chemical treatment (e.g., periodic or continuous chemical treatment protocols);
- systems designed for single chair or entire practice waterlines that purify or treat incoming water to remove or inactivate microorganisms;
- in-line microfilters on each separate waterline that remove bacteria immediately before dental unit water enters instrument attachments;
- combinations of these treatments.

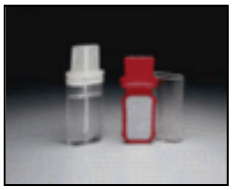
Self-contained water systems or independent water reservoirs, when used with a chemical treatment protocol, have demonstrated safety and efficacy. This type of system isolates the unit from the municipal water supply and allows better control of the quality of source water (e.g., distilled, deionized) introduced into the system. These systems are available as original equipment on dental units or can be retrofitted to most dental units. However use of independent reservoirs without use of a chemical germicidal treatment will have no effect on waterline biofilms. Therefore the primary advantage of independent reservoir systems is that cleaning agents (either periodically or continuously) can be easily introduced into the system. Also, this type of system helps avoid interruptions in dental care when local health authorities issue a boil-water advisory.

Centralized systems designed for single chair or entire practice waterlines are becoming more popular. These systems can purify or treat incoming water to remove or inactivate microorganisms by using various methods such as nano-filtration, reverse osmosis, or ultraviolet light irradiation. It is common for these systems to use a combination of these methods as well as introducing a chemical agent to help control biofilms.

In-line microfilters on each separate waterline that remove bacteria immediately before dental unit water enters instrument attachments are simple to install, however the filters usually require frequent changes to maintain water quality. Also, it's important to note that these filters have no direct effect on biofilms within the dental unit, therefore chemical treatments may be necessary in addition to using the filters.

Regardless of which method is used to maintain dental unit water quality, adherence to maintenance protocols is essential. As always, consultation with the manufacturer of the dental unit to determine the best method for maintaining good water quality is indicated. Please visit the product evaluation section of the DECS Web site for a list of dental unit waterline treatment products evaluated by DECS or click here for a synopsis.

Should I test or monitor my dental unit water?



Clinical monitoring of water quality can ensure that procedures are properly performed and that devices are working in accordance with the manufacturer's previously validated protocol. Monitoring dental unit water quality can assist in identifying problems in performance or compliance and also provides documentation. There is no need to identify specific organisms unless investigating a waterborne illness or a unit refractory to treatment. Testing should accurately detect a wide concentration range and type of aerobic, mesophilic, heterotrophic, waterborne bacteria within a reasonable incubation time at room temperature. Dentists should consult with the manufacturer of their dental unit or water treatment product to determine the best method for maintaining acceptable water quality (i.e., $\leq$ 500 CFU/mL) and the recommended frequency of monitoring. Generally, there are two options:

1) Water samples can be submitted to the microbiology lab or Bioenvironmental Engineering and cultured using method 9215 (heterotrophic plate count) as described in Standard Methods for the Evaluation of Water and Wastewater (American Public Health Association, American Waterworks Association, Water Environment Foundation);1999:9-1–9-41, or

2) Use of an in-office self-contained system that is equivalent to method 9215.

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