Legionella — Control Methods and Dental Chair Risks

a report by

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Legionella Control Methods

The problems with waterborne micro-organisms have been well documented but are highlighted when outbreaks of infection, accompanied by fatalities, occur. There are various methods advocated for disinfecting water and their effectiveness depends on numerous factors that must be considered prior to deciding which method is most applicable for the particular application. These factors are: condition of the water prior to treatment, pH value, hardness, debris, rust, turbidity, minerals and metals in solution and any treatment methods that may conflict with the proposed process.

Ultraviolet (UV) can be impaired by shadows caused by turbidity and bubbles, restricting the radiation, but its advantage is that it does not introduce chemicals. The disadvantage is that no residual is introduced to treat established sites where bacteria proliferate downstream from the treatment area and, therefore, bacteria harbouring biofilm is not attacked. Therefore, its main uses are at point of entry or at point of use. Ozone (O₃) systems generally operate by drawing air into the apparatus where it is dried and passed to a chamber containing a high-voltage discharge system, generates O₃, which is then drawn into the water by a venturi action. This solution forms an efficient oxidiser and, like UV, kills organisms passing through the system but again, like UV, it does not produce a residual that will circulate throughout a water system, as O₃ is highly unstable and corrosive.

Water supplies are generally treated with chlorine and, by the time the chlorine enters buildings, it is at a low level and not capable of killing bacteria that thrive in manufactured water systems (where temperature and stagnation encourage rapid multiplication from the low levels of bacteria that seed the system from the incoming water). Injecting chlorine is one of several accepted processes. Many organisms are resistant to levels that are acceptable for drinking water and the limited corrosion.

Recently, chlorine derivatives have been introduced, such as chlorine dioxide and monochloromine. These have a longer residual life, whereas chlorine is more volatile and decays more rapidly within pipework, therefore demanding higher levels to be injected. Chlorine dioxide and monochloromine are in turn longer-lived and less corrosive.

Another method is ionisation. This method is thought of as non-chemical and works by introducing a minute stream of positively charged silver and copper ions into the water by a process of electrolysis. This minute stream of ions forms a stable residual that is both non-corrosive and non-volatile. Being long-lived it will circulate throughout water systems, attacking biofilm (slime) that harbours bacteria, particularly Legionella, which multiplies readily within biofilm and is released in bursts as the biofilm becomes saturated.

Ionisation has no effect on water balance, does not produce any odour and complies with international drinking-water standards. The equipment consists of a power source that can be controlled from a water meter to ensure exact proportional dosing and is equally applicable to both hot and cold water being unaffected by temperature. In the past, guidance has recommended raising the hot-water temperature to a minimum of 60°C to inhibit bacterial growth in hot-water systems. Unfortunately, many water systems have a tortuous and lengthy distribution system, where the temperature drops even with extensive lagging and, thus, it is extremely difficult to maintain this temperature. Even when the temperature of the water on return to the heating system is 55°C, bacteria, including Legionella, frequently remain within the system. The disadvantage of raising the hot-water temperature is the possibility of scalding and, therefore, it has been recommended that thermostat mixing valves be fitted at outlets to prevent this. Unfortunately, it has been found that the secondary and outlet side of thermostat mixing valves, which do not receive the raised-temperature hot water, becomes a site for the proliferation of bacteria, seeded from the cold-water blend.

It is the author’s suggestion that, generally, ionisation offers a viable and attractive alternative to other methods, particularly where the incoming water main is treated and thus the whole building is protected.
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Applications include cooling towers where chemicals readily dissipate, whereas ions will remain in the circulated water and in the aerosol rendering it inert, rather than transporting pathogenic organisms such as Legionella. Ionisation has recently been approved for the washing of fruit and vegetables, replacing the previous 100 parts per million of chlorine frequently employed. The residual effect on processed foods dramatically extends the transit and shelf-life, keeping residual moisture inert. Similar to the other methods described, ionisation has a broad spectrum of kill, including Escherichia coli, Salmonella, Pseudomonas and Legionella, and has shown to be highly effective for swimming pools, hospital therapy pools and jacuzzis.

When considering what form of disinfection should be used, the author recommends that only systems approved by the European Community, the UK Health & Safety Executive (HSE) and the soon-to-be released National Health Service (NHS) HTM 2027 and US standards be included. Most important of all is to obtain recommendations from existing users, as many companies make exaggerated and unproven claims.

Disinfection is vitally important, as people’s lives are at risk. It should be ensured that the size of equipment purchased is adequate for the amount of water usage. It should be ensured that the supplying company trains and explains those responsible for maintenance and, preferably, choose a company that is a member of the Code of Conduct Association (CCA), which requires that suppliers take responsibility in assessing each proposed installation individually and maintain a long-term relationship with the client.

Dental Chair Legionella Risks

Although the number of cases of infection reported from dental surgeries are relatively few, there is some argument regarding the safety and potential dangers associated with the water supply for cooling dental drills, rinsing jets and ultrasonic descaling probes fitted to dental pedestals.

High-speed drills and ultrasonic descaling devices generate fine aerosol within the patient’s mouth and organisms within the water droplets may be inhaled or pass into the bloodstream when tissue around the gums and mouth is broken during dental treatment.

The water supply to the dental pedestal may be derived from a number of sources: a small individual water tank; a dedicated piped supply; or from the normal cold-water supply within the building. Each of these may pose a hazard.

Probably the safest and most manageable method is a small water tank or bottle that may be replaced daily by a fresh bottle filled with sterile water. Alternatively, but carrying more risk, the bottle may be refilled daily either with sterile water, filtered water or with tap water, which in some cases includes the addition of a disinfectant.

A dedicated piped network found in some hospitals designed to distribute water to the dental pedestals, may be filtered or treated with a disinfection process to reduce the distribution of micro-organisms and the formation of biofilm within the pipework.

Water fed from the normal cold-water supply is certainly the least recommended as there is a high likelihood of bacteria being transported into the dental equipment with the risk of colonisation.

The water system in modern dental equipment, which supplies water to the dental pedestal feeding the drill head, contains valves, pressure pumps and a morass of capillary pipework where biofilm may become established and support the proliferation of bacteria.

Discussion

The generation of aerosol within the patient’s mouth and surrounding area may well distribute bacteria that will inevitably be inhaled by the patient, the dentist and nursing staff. The normal hospital masks offer only limited protection from aerosol within the surgery.

The amount of water used at each dental station is relatively low, typically one to two litres per day. The regular flushing of dental equipment is most important, particularly when water is stored at the normal room temperature in dental surgeries. Flushing should certainly take place on a daily basis, particularly where equipment has stood idle over a weekend or holiday period. Owing to the small amount of water used, the flow rate through the capillary pipework is relatively low and the water temperature will be no lower than ambient in most cases, allowing bacteria to multiply if they are present.

Surprisingly, there are not a high number of infections reported either for patients or dental workers despite the proximity to the generation of aerosol, coupled with the high levels of bacteria frequently found at the water outlets of the equipment.

Scientists at the Centre for Applied Microbiology and Research (CAMR) at Porton Down, England, examined water samples from 21 dental surgeries in south-west England. They reported that 52 out of 55 samples failed EU drinking-water safety standards.
Legionella and were a potential health risk. It was also reported that scientists found that water lines (in dental pedestals) contained a wide range of bacteria including Legionella. They also found oral streptococci, a natural bacteria found in the mouth in about 10% of water samples. Most of the bacteria occur naturally and pose little threat; however, they can cause problems to vulnerable people, particularly those with a weakened immune system as a result of cancer or HIV infection.

During dental work, gums and surrounding tissue may be vulnerable to invasion and infection from localised bacteria, including methicillin-resistant Staphylococcus aureus and lung infections such as Legionella.

Rinsing water jets has been shown to draw bacteria into their outlets due to a small back-pressure pulse as they are turned off, which would indicate the possibility of the next patient receiving bacteria from the previous patient’s mouth. The suction pipework that drains water collecting in the patient’s mouth may also become contaminated.

Where opportunistic organisms are present, it would seem sensible that a strict regime of disinfection and flushing is advisable. Proprietary disinfectants are available and should be introduced into the water supply to limit the establishment of biofilm and the proliferation of bacteria.

A low level of disinfectant may be added to individual water bottles and tanks. When dental surgeries are connected to a water distribution system, a method of disinfection that introduces a residual that will circulate throughout the tortuous pipework should be employed. This may be a chemical at a level of sufficient efficacy without leaving an unpleasant taste in the patient’s mouth. Alternatively, ionisation can be employed, which does not create any taste or odour. Whichever method is used it should not be corrosive to dental equipment.

Contrary to what one might think, considering the complexity of equipment and the amount of aerosol generated, there are not a high number of reported cases of infection although some do occur both in patients and dentists. A US study examined antibody levels for student dentists and this was followed by a count after several years in practice. It seemed that around 15% showed positive when they were students and 90% of the same group showed positive after being in practice for some time.

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